

CTBT: Science and Technology 2017 Conference

Report of Contributions

ID:

Type: **Poster**

Methods of Network Parametric Selection of Infrasonic Signal Sources

The methods make it possible to get most credible results of the source parameters determination as they are based on the calculation of probability maximum for recorded signal parameters using data bank that contains signal and source parameters and their model theoretical dependence. Theoretical model parameters are optimized on the same principle of maximum credibility of the available data bank. Methods being developed are based on a serial principle. 1. Build up ratio statistics of theoretical and experimental values for each signal parameter using the data bank. 2. Transformation of obtained statistics to the Gauss normalized distribution. 3. Calculation of correlation matrix that contains correlation factors between statistics by averaging the product for all signals from the data bank. 4. Calculation of D matrix determinant and algebraic complement for each element of correlation matrix. 5. Calculation of probability density of multidimensional random normally distributed value with projections for detected signal with parameters from a specified source. 6. Sequentially, with enumerative technique we change parameters of the source and calculate the maximum value of the density possibility.

Primary author: ROGOVOI, Andrei (Ministry of Defence of the Russian Federation)

Presenter: ROGOVOI, Andrei (Ministry of Defence of the Russian Federation)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

and Interpretation of Seismoacoustic Events at German Infrasound Stations

Three infrasound arrays with collocated or nearby installed seismometers are operated by the Federal Institute for Geosciences and Natural Resources (BGR) as the German NDC for the verification of the CTBT. Infrasound generated by seismoacoustic events is routinely detected at these infrasound arrays, but air-to-ground coupled acoustic waves occasionally show up in seismometer recordings as well. Different natural and artificial sources like meteoroids as well as industrial and mining activity generate infrasonic signatures that are simultaneously detected at microbarometers and seismometers. Furthermore, many near-surface sources like earthquakes and explosions generate both seismic and infrasonic waves that can be detected successively with both technologies. The combined interpretation of seismic and acoustic signatures provides additional information about the origin time and location of remote infrasound events or about the characterization of seismic events distinguishing man-made and natural origins. Furthermore, seismoacoustic studies help to improve the modelling of infrasound propagation and ducting in the atmosphere and allow quantifying the portion of energy coupled into ground and into air by seismoacoustic sources. An overview of different seismoacoustic sources and their detection by German infrasound stations as well as some conclusions on the benefit of a combined seismoacoustic analysis are presented within this study.

Primary author: PILGER, Christoph (Federal Institute for Geosciences and Natural Resources (BGR))

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Seismic Waves in Ghesm Area, Southeast Iran

An important parameter which directly affects the propagation of seismic waves either in earthquakes or explosions is attenuation coefficient, quality factor of an area. Quality factor of seismic waves, Q , in the lithosphere at high frequencies (1 to 20 Hz) is one of the most useful parameters to explain attenuation of seismic waves as an important property for the study of earth structure which contains meaningful information even in short distances. Having such a parameter for an area helps us to guess the decreasing of the amplitude of a vibration and could be even useful while monitoring explosions. Many methods have been innovated measuring Q factor using natural and artificial data. In this research we determined Q factor for Ghesm region using Sato method. IIEES broadband network data were used for doing this study. A network comprising 13 seismographs were installed in the area and 112 recorded events over three months after 2005 Ghesm earthquake were used to calculate the parameter. After processing we proposed a relation for Q in Ghesm region as $Q=77f^{0.83}$, where f is frequency and the relation confirms that Q values are frequency dependent (increasing with frequency) in the media through which it propagates.

Primary author: SABOURI, Mania (Engineering Seismology)

Presenter: SABOURI, Mania (Engineering Seismology)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-140 and Ba-140 Background from IMS Particles Stations

This work focus on detections of La-140 and Ba-140 from particles stations of International Monitoring Stations IMS. These two isotopes are part of relevant radionuclides of CTBT and are sometimes detected with abnormal concentrations. The mapping of this background and the analysis of their time series level is a helpful tool than can be used to characterize the activity background of both parent-daughter radionuclides in the world.

Primary author: SANOGO, Oumar (National Center of Scientific and Technological Research (CNRST))

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

for Aircraft Infrasonnd Detections

A number of sources on the earth and in atmosphere can produce the low frequency infrasonnd atmospheric waves. Infrasonnd waves are generated by the regular air traffic subsonic signals. On quiet nights when the measurement conditions are ideal, near infrasonnd arrays airplanes can be detected at high altitudes. Infrasonnd signals from aircrafts are characterized by rapid variation in azimuth and increase in the apparent velocity while the craft approaches the station and the signals are rich in high frequency content. In this study the Algerian aircraft (Trip No.5017) of 24, October, 2014 which fall down in the vicinity of Gao city in Mali is tracked and collocated at the crises site. Another example of such application is the detection of the take-off and landing of aircrafts using infrasonnd array nearby airports which could be utilized to make a signature of infrasonnd aircraft events that could improve the detection of airplanes accidents.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Estimation and Atmospheric Modelling Uncertainties Quantification

The source estimation of man-made radionuclides by using inverse modeling of atmospheric motion plays a vital role in CTBTO's activities. This work studies the effect of the atmospheric modeling uncertainties on source estimation through a synthetic numerical experiment, which consists of four types of modeling (Eulerian meso-scale atmospheric modeling, forward atmospheric transport modeling (ATM), adjoint ATM, and inverse modeling). Weather Research and Forecast model (WRF) has been used with different configurations of planetary boundary layer and microphysics schemes (17 ensemble members) in order to estimate the uncertainties of atmospheric flow related to these schemes. The output simulations are used as driven meteorological fields for ATM and adjoint ATM. A number of well-known sources of Xe-133 are assumed, then the dispersion of their releases are made by using regional ATM (FLEXPART-WRF), in the forward mode, in order to create synthetic concentrations at CTBTO's IMS radionuclide stations. The next step included the usage of these concentrations in adjoint modeling to produce the SRS fields. The final step is the inverse modeling by using Bayesian approach in order to estimate the sources. This experiment illustrates the importance of the combination of ensemble technique with Bayesian approach in sources estimation and uncertainties quantification.

Primary author: MEKHAIMER, Sayed (National Research Institute of Astronomy and Geophysics (NRIAG))

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Eruptions of Volcanoes Around Korean Peninsula: Simulation for Hypothetic Eruptions by Using LADAS-VA Model

A three-dimensional atmospheric dispersion model, Lagrangian Atmospheric Dose Assessment System (LADAS) has been developed by the Korea Atomic Energy Research Institute (KAERI) for the purpose of predicting and assessing atmospheric dispersion of radionuclides released into the air when a nuclear accident occurs elsewhere around the world. It was successfully employed to the environmental impact assessment for the Fukushima Daiichi nuclear disaster. Reflecting recent demand on the response system against potential volcanic risk around Korea, we have been developing LADAS-Volcanic Ash (LADAS-VA) model, a derivative of the LADAS in the form of a Volcanic Ash Transport and Dispersion Model (VATDM). The LADAS-VA model has been constructed based upon the LADAS-regional model so that it utilizes the Unified Model (UM) based Numerical Weather Prediction (NWP) product, which is provided by the Korea Meteorological Administration (KMA), as a primary meteorological data. By using the LADAS-VA model, we performed a series of simulations for (year-round) hypothetic eruptions of several representative volcanoes around Korea, such as Mt. Baekdu (Changbaishan), Asosan, Ulreung, Fujisan, and Shikotsu (Tarumaisan). Here we illustrate the analyzed result of their impacts.

Primary author: PARK, Kihyun (Korea Atomic Energy Research Institute)

Presenter: PARK, Kihyun (Korea Atomic Energy Research Institute)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Acoustic Signature of Underground Chemical Explosions During the Source Physics Experiment

The Source Physics Experiment (SPE) series consisted of six underground non-nuclear chemical explosions in granite. The experiment focused on improving the nuclear monitoring community's understanding of the seismo-acoustic signatures of buried explosions. We discuss the amplitude, impulse, and peak frequency of each shot with respect to explosive yield and depth of burial. The waveforms of each are compared and contrasted, and the influence of ground motion, spall, and gas venting are considered. While the acoustic sensors were relatively close to the source (<5 km), atmospheric perturbations were non-negligible. Thus, the influence of the atmosphere on acoustic waveforms across the network are quantified. Predictions for the last explosion in the series are compared to the recorded time series. Finally, three acoustic source modeling approaches are presented: the Rayleigh integral, explosive source-time function inversion, and a boundary element model.

Primary author: PRESTON, Leiph (Sandia National Laboratories, Albuquerque, NM, USA)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-Dependent Station Magnitude

Magnitude, a concept first presented by Gutenberg and Richter, is the standard measure for the strength of an earthquake. The IDC defines the body wave magnitude for event i at station j as $m(\text{sta}) = \log(AT) + VC(\Delta, h)$, where A is the maximum amplitude, T is the corresponding time period, VC is the Veith-Clawson (VC) correction compensating for the epicentral distance of the station (Δ), and the depth (h) of the source. The network magnitude ($m(\text{net})$) is calculated as the average of the station magnitudes, and should be close in value to the station magnitudes. In reality, it is observed that the residuals range between -1 and 1 μ or $\pm 25\%$ of a given $m(\text{net})$ value. We show that the residual depends linearly on $\log(AT)$, and we propose a method to correct for this using station-specific correction terms. The procedure was used on roughly four million station-event pairs, representing over 400,000 events in the REB bulletin, and we find that it reduces the residuals by roughly a third. We show that this reduction is not an artifact of the averaging process. We also conducted two sets of simulations, which were designed to differentiate between the underlying models for station magnitude.

Primary author: BEN HORIN, Yochai (Soreq Nuclear Research Center)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Local Stresses and Relative Locations of Small Earthquakes in the Sea of Marmara

The goal of this research is to determine earthquake hypocenters and focal mechanism solutions accurately, hence obtain recent states of stresses in the Marmara Region. Accordingly, this research aims to define branches of fault structures and their geometrical orientations. In this study, six clusters of earthquakes are located. Next, they are submitted to the stress tensor inversion procedure and their simultaneous focal mechanism solutions are obtained. Besides, they are relocated once again using HYPODD relative location technique. Consequently, from the comparison of individual and relative relocations, it is found that most of the events have the same orientations due to the usage of a high quality data set. Dipping angles of the segments of the Main Marmara Fault could not be observed; on the other hand, important information is discovered about seismogenic zones. Besides, mostly NE-SW oriented extensional stress structures are found in five regions, while a right lateral strike-slip stress structure is found in the most western Marmara. Further, our sensitive relocation and stress analyses make an important contribution to a better understanding of the movements in the Sea of Marmara, and shed light on earthquake rupture analyses for heterogeneous stress states and other seismological studies.

Primary author: KORKUSUZ ÖZTÜRK, Yasemin (Belbasi Nuclear Test Monitoring Center)

Presenter: KORKUSUZ ÖZTÜRK, Yasemin (Belbasi Nuclear Test Monitoring Center)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Seismic Activity of the Lake Kivu Basin: Need of a Large Seismic Network

Lake Kivu is a collapse ditch lake immediately located in the western branch of the East African Rift. In the lake kivu basin region the seismic activity of the Rift and the volcanic activity constitute the most serious geological risks from which facing the population. Until 2015, there was no seismic sensor installed in the region to monitor the lake Kivu basin. In 2016, three seismic stations were deployed by a belgian project to monitor the seismic activity of Lake Kivu. However a number up to eighteen earthquakes with magnitude between 4.0 and 6.0, all located on the shores of Lake Kivu and which have caused enormous damages to the infrastructures, towns and villages surrounding this lake was identified in this las decade. The problem is due to lack of seismic observation stations, the location of earthquakes and many other seismic analysis are made with many errors, which makes it difficult to define the highly dangerous areas. There is therefore a need for a reliable seismic network to help understand what is taking place in this area and to define seismic risks with possible precision. Key words: Lake Kivu, earthquakes, lack of seismic observations, need of seismic network

Primary author: BIRIMWIRAGI NAMOGO, Didier (Goma Volcano Observatory)

Presenter: BIRIMWIRAGI NAMOGO, Didier (Goma Volcano Observatory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of the Inline WRF-HYSPLIT Model for Mesoscale Atmospheric Transport and Dispersion

A new, inline framework that combines the Weather Research and Forecasting (WRF) model with the Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT) has been developed by the Air Resources Laboratory to improve atmospheric transport and dispersion (ATD) predictions. This inline model, herein referred as WRF-HYSPLIT, has been shown to have some advantages over the traditional off-line implementation of the HYSPLIT model, particularly for meso-gamma-scale, short-range, ATD predictions. Thus, it is of interest to investigate this new inline capability and to assess the potential advantages and limitations of its use. Here, testing of the WRF-HYSPLIT is conducted using field data from a tracer experiment over Colorado Springs, Colorado, USA on 21 October 2010. Two experiments are conducted using WRF, version 3.7, and WRF-HYSPLIT. Comparisons of the morphology of the plumes and computed differences are analyzed. The ability of the models to accurately represent the concentration measurements is also evaluated. Preliminary testing for this case study shows the WRF-HYSPLIT to have some advantages over the traditional implementation of HYSPLIT for mesoscale dispersion. Overall, the WRF-HYSPLIT model provides a unique platform for ATD predictions. Better model performance could be expected as additional parallelization of the code and prognostic fields are implemented and utilized.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-Upper Mantle Structure and Seismic Hazards Studies for National Planning and Development in Nigeria

This work is aimed at assessing critical issues on sites response and earthquakes prediction, improve earthquakes location and better seismic hazards assessment for planning in Nigeria. Firstly, sediment depths in the Lower Benue Trough were collected; resonance frequency (F_0) and shear-wave velocities (V_s) were then computed. Secondly, average velocities were estimated from cross-correlation along stations' paths in Nigeria. Thirdly, the Moho depths beneath Ife, Kaduna and Nsukka stations were estimated, and V_p/V_s ratio beneath Ife station. Finally, Statistical and Probabilistic Seismic Hazard Assessment (PSHA) were used to compute seismic hazard parameters for Nigeria and environs. The results showed Moho depths of 39km, 38km and 28km beneath the stations, and average V_p , V_s and V_p/V_s beneath Ife station to be 5.8, 3.8 and 1.7 respectively. V_s beneath the stations were found to be 288m/s, 1019m/s, 940.6m/s and 255.02m/s respectively. Results from PSHA indicated high probability of yearly occurrence of magnitudes 2.0-3.5 in Nigeria, but low for magnitudes 4.0-6.0. The expected maximum magnitude would likely not exceed 6.5 within the 1-1000 years covered. The computed Peak Ground Accelerations ranged from 0.01-0.08g, and would be useful for engineering design and as baseline parameters for the establishment of seismic building codes for Nigeria.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Dispersion of Radionuclides Originating from Hypothetical Accidents in Turkish Nuclear Power Plants

Although nuclear power is considered to be economically beneficial, it has serious risks for environmental and human health. Turkey plans to build two nuclear power plants in Mediterranean and Black Sea coastlines: Akkuyu and Sinop NPPs. The atmospheric dispersion of Cs-137 to be released from potential accidents in these plants were modeled and total ground deposition of Cs-137 were estimated using a Lagrangian particle dispersion model – FLEXPART. The NCEP dataset used for meteorological input was a 6 hourly dataset with 0.5 x 0.5-degree resolution. A total of 6 scenarios were simulated to assess potential consequences of a nuclear accident under distinct atmospheric conditions. All simulation results were visualized for the dispersion and deposition of radionuclides, and relative comparisons were made between the scenarios. The results were a strong function of regional meteorology. It was found that that the radioactive plume mainly moved towards south and ground level depositions were higher in the southern regions in the simulations conducted for August 2010, while an opposite situation was observed in the simulations conducted for December 2009. Simulated deposition values were ten times lower than the depositions observed after Chernobyl accident due to the differences in the main source term.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

IMS IS13 and IS14 Stations to Analyse Strong Seismic and Volcanic Activity in Chile

Under a collaborative work between the Geophysics Department of Universidad de Chile and the Chilean Nuclear Energy Commission, a long-term project was started based on the infrasound data from stations IS13 (Easter Island) and IS14 (Robinson Crusoe Island) in order to improve the natural phenomena hazard assessment by developing remote monitoring tools with already existing infrastructure in Chile. The first step was to analyze the IMS infrasound data to investigate the spatial and azimuthal resolution of time series that can be associated with seismic and volcanic activity of strong events. The DTK-PMCC tool from the Chilean National Data Center was used with data collected around Maule tsunamigenic earthquake (M8.8) on February 27th, 2010, Puyehue/Cordón Caulle volcano eruption in June, 2011 and Calbuco volcano eruption in April, 2015. It was found that it is possible to use the infrasound stations to parametrize big events in the Chilean territory, providing insights about the infrasound fingerprint of natural phenomena that can complement seismic observations. Although promising results have been obtained, more data analysis is needed to have full knowledge about the physical phenomena that is generating the infrasound signals around strong energy earthquakes and volcano eruptions in Chile.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Infrasound Network: Status and State-of-the-Art Design

The infrasound component of the International Monitoring System (IMS) is composed of sixty stations. Forty-nine of them are already certified and transmit data in near real-time to the International Data Centre, Vienna, Austria. Each infrasound station is composed of an array of infrasound measurement systems capable of measuring micropressure changes produced at ground by infrasonic wave propagation. The Provisional Technical Secretariat (PTS) of the Comprehensive Nuclear-Test-Ban Treaty (CTBTO) is working towards the completion and operation of the IMS infrasound network. The objective of this presentation is to review the history and status of the IMS infrasound network through station constructions, data availability and fulfilment of IMS requirements. State-of-the-art developments for all station components including sensors, wind-noise reduction systems, array geometry, meteorological equipment and data acquisition systems will also be presented.

Primary author: MARTY, Julien (CTBTO)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Microzonation and Site Effect Response of Al Auja District

Al-Aluja is one of the important Palestinian towns. The spatial distribution of the natural periods over a map is presented. It shows the important characteristics of soil deposit that will effect significantly the mitigation of the seismic risk impacts. The microtremors are very important and useful measurements in site response which could compensate the shortage and deficiency of the seismic recorded data, especially when there are missing seismic stations. The aim of this study is to prepare a GIS-based microzonation map of Al-Aluja area for the purposes of urban planning theme. The predominant natural frequency at each site within Al-Aluja area was determined using the Horizontal to Vertical Noise Ratio (HVNR) of the microtremor records. It was applied to about 80 points which covered the whole studied area. The impedance contrast of soil deposit of sediments shows distribution of frequencies and by using the outputs of these results, Al Aluja area is classified into four frequencies zones from 0.8 - 1.4, 1.4 - 2, 2 - 2.5 and 2.5 - 3.8 Hz. The results shows that the lower bound estimate of amplification factor for a soil site is from 2 up to 18 times using microtremor peak values.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Site Effect Estimation Using Microtremor Studies in the Archaeological City Jerash in Jordan

Abstract This study is aimed to determine the local site effect by means of the horizontal-to-vertical (H/V) spectral ratios. The Nakamura's concept (Nakamura Y. 1989) is applied in JERASH city in order to determine the resonance frequencies and amplification factors for, finding the dynamic characteristics for structural engineering purposes. Results obtained in this study show that; dominant frequencies F varies between 2.35 Hz and 3.19 Hz in the archeological JARASH area, while, the amplification factor A varies between 0.87 and 23.47, which gives an indication that the structural culture in most localities of the study area might be seriously affected by any of eventually major short periodic earthquakes released by the nearby seismologic active sources westward, except of localities characterized by long periodic dominant frequencies of the study areas, considering that most structures of the study area are characterized by one to three story profiles.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of IMS Infrasound Stations for Tsunami Warning in the Antarctic Peninsula

Since the geophysical fields are interconnected with each other, it is possible to expect a response to earthquakes in all geospheres. Tsunamis occur only after those earthquakes that are associated with the rapid formation on the bottom of the ocean discharges, avalanches, landslides. This shift acts on the principle of the piston and pushes the water, causing the formation of a tsunami. In addition, this “piston” pushing not only water, but also air, which leads to the generation of infrasound. Infrasound propagation velocity exceeds the speed of propagation of tsunamis, which can be used for its early warning. This fact has been used in the Ukrainian Antarctic Station “Akademik Vernadsky” for developing techniques for early warning of a tsunami in the region of the Antarctic Peninsula (Scotia Sea). For developing of methodology used infrasound, seismic and oceanographic data of Vernadsky stations geophysical complex and infrasound data from IMS stations (Ushuaia, Neumeier). The essence of the procedure was limited to the detection of a strong earthquake in a given region, estimating of travel times and azimuths for infrasound waves and confirmation of the tsunami at tide gauge. A positive result was obtained for earthquakes with a magnitude of more than 7.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

and Validating Path-Dependent Uncertainty Estimates for Use with the Regional Seismic Travel Time (RSTT) Model

The Regional Seismic Travel Time (RSTT) tomography model has been developed to improve travel time predictions for regional phases (Pn, Sn, Pg, Lg) in order to increase seismic location accuracy, especially for explosion monitoring. The RSTT model is specifically designed to exploit regional phases for location, especially when combined with teleseismic arrivals. The latest RSTT model (version 201404um) has been released (<http://www.sandia.gov/rstt>). Travel time uncertainty estimates for RSTT are determined using one-dimensional (1D) distance-dependent error models that have the benefit of being very fast to use in standard location algorithms, but do not account for path-dependent variations in error. Although global in extent, the RSTT tomography model is only defined in areas where data exist. A simple 1D error model does not accurately model areas where RSTT has not been calibrated. We are developing and validating a new error model for RSTT phase arrivals by mathematically deriving this multivariate model directly from a unified model of RSTT embedded into a statistical random effects model. A goal for any RSTT uncertainty method is to be readily useful for the standard RSTT user. We will demonstrate the method and validation of the error model for Pn and other regional phases.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Patterns for Two IMS Infrasound Stations in the Vicinity of the North Korean Test Site

Recently we analyzed infrasound data relevant to the North Korean underground nuclear tests since 2006 at the two IMS infrasound stations closest to the DPRK test site. As has also been found for national infrasound arrays in South Korea at closer distances, most of these tests can be detected acoustically at IMS stations IS45 in Russia and at IS30 in Japan at distances of some 400 km and nearly 1200 km, respectively. Except for the DPRK test in 2013 and the corresponding infrasound signals at IS45, none of these detections can be identified in any of the waveform data. This is further the case for the weak signal detections that can be associated to the seismic event of 12 May 2010 on or very close to the test site. For IS45 and IS30 a continuous detection catalogue is available and we have scanned this catalogue to infer the probability of incidental detections from directions towards the test site. We present the results from this study which indicate that for both IS45 and IS30 the probability of chance detections is very low and that all signals identified for DPRK test site events are highly likely related to these events.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of the Existences of the Mud Volcanoes Beneath East Java-Indonesia Region Using Ambient Noise Tomography Method

Eruption of hot mud volcano in East Java(LUSI) is a disaster that resulted in enormous material loss. This eruption located in areas rich in oil and gas. Eruption is very threatening a lot of people, because there are a lot of pipelines are located in this area. The existence of this eruption is not the first in the research area,there were already 13 times occurred in the different location and times. To generate a the imaging of the subsurface beneath the research area,we use ambient noise tomography method. We used seismic data that were recorded at 80 seismographs spread in East Java. We constructed the inter-station Rayleigh wave Green's functions through cross-correlations of the Z component of seismic noise recordings at 1400 pairs of stations. We used the Neighborhood Algorithm to construct depth profiles of shear wave velocity (V_s). The results of the imaging showed the existences of low V_s anomaly beneath LUSI at a depth of 1.7km. Based on paleontological analyzes, this anomaly is identical to the hot mud volcano. The existence of these anomalies are scattered beneath the surface areas that never experienced a mud volcano eruption, but the lowest anomalies are beneath LUSI area and Madura strait.

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Presenter: ADI MARTHA, Agustya (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

of Seismic Hazard Maps for Georgia

Probabilistic Seismic Hazard Analysis (PSHA) based on standard methodology still remains effective to predict earthquake probabilities particularly in longer time scales. In this work PSHA is performed for Georgia by improved version of the standard methodology developed in the frame of EMME project. A basic aspect of this new approach is to use hybrid empirical ground motion prediction equations developed for PGA and SA at selected periods. Georgia does not have sufficient strong ground motion data to build fully empirical ground motion prediction models. The host-to-target method was applied in two regions in Georgia with different source mechanisms. Two different regions with abundant strong motion data were chosen as host regions. One of them is in Turkey with the dominant strike-slip source mechanism while the other is in Iran with mostly events with reverse mechanism. The hybrid-empirical method developed by Campbell (2003) was used to obtain the host-to-target coefficients. The coefficients were then applied to global and regional ground motion prediction equations, which are consistent with Georgian strong ground motion data, to calculate probabilistic seismic hazard in terms of peak ground (PGA) and spectral acceleration (SA) for 2%, 5%, 10% probability of exceedance rates in 50 years.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Atmospheric Transport Models (ATM) Used in Decision Support in the Framework of the Austrian Radiological Emergency Response Preparedness

The Zentralanstalt für Meteorologie und Geodynamik (ZAMG), the national Austrian Weather Service, is designated by the World Meteorological Organisation (WMO) as Regional Specialized Meteorological Centre (RSMC) Vienna (for backtracking only) and supports the CTBTO verification system with inverse atmospheric modelling activities on a global scale since its entry into operations. Besides, ZAMG supports the federal authorities with meteorological expertise, provides input data for other dispersion models and performs preliminary assessments of radiological dispersion in cases of a disaster event. In such a case, the Austrian Federal Crisis and Disaster Management (SKKM), which subordinates under the Austrian Ministry of the Interior, possesses the results of several atmospheric dispersion models as a profound basis for decision-making. In a recent study, different scenarios have been set-up and evaluated, using identical meteorological forcing for the atmospheric dispersion models, which are available during a radiological incident to the Federal Crisis and Disaster Management. The results of this study will be presented and discussed.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Transport Modelling for the Radionuclides Detection of Northeast Asia in 2010

In May 2010, xenon and its daughter radionuclides were detected at four radionuclide stations in South Korea, Japan, and the Russian Federation. Some scientists estimated that the detected radionuclides had been originated from mountain Mantop where some underground nuclear tests were performed, or Yongbyon site where a small nuclear reactor operated in North Korea. In this study, source regions were estimated using the atmospheric dispersion model LADAS (Lagrangian Atmospheric Dose Assessment System), which has been developed in South Korea. At first, simulations were carried out to estimate the source area by using backward trajectory and atmospheric dispersion models based on measurements of four radionuclide stations. After that, the radionuclides were released from the possible source regions and the calculated concentrations of radionuclides were compared with measurements. From the simulations, possible source regions were estimated in the north east areas of North Korea. Even though there are some uncertainties in estimating unknown source areas due to the lack of measurement stations, the forward and backward atmospheric transport models can be used as good tools for detection of possible release regions from the covert nuclear activities near Northeast Asia.

Primary author: SUH, Kyung-Suk (Korea Atomic Energy Research Institute)

Presenter: SUH, Kyung-Suk (Korea Atomic Energy Research Institute)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Prediction Through Pattern Informatics Applied on Global Seismological Data

Pattern Informatics can be used to predict seismic events. Three forms of patterns can be formed using Global seismological data. Temporal Patterns indicating time relationship between different natural seismic events that took place over the past years at least a two decades depicting their sequence towards forming a pattern. Spatial Patterns indicating the geographic locations of the events and order of their occurrences. Most of the seismic events take place around active fault lines however structured study of the database is likely to reveal additional conclusions. Spectral patterns indicating the frequency characteristics of the events establishing forms of interpretable correlations. A three dimensional matrix comprising all three patterns is likely to yield valuable results. However as estimated complete results strongly depend upon completeness of the acquired data from around the globe used in unison. Variations in sensors and estimation techniques can always be catered for using normalization. A test case based on data collected and structured on the basis of regions, where possible, may also help establishing relationships. However importance of global super set remains prime and is called for. Simulations of available data yielded relevant and usable outcomes indicating possible future events with related scale and depth parameters.

Primary author: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Presenter: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Seismic Travel Times in Central and Northern Costa Rica for Accurate Earthquake Location

Reducing the prediction error of seismic-phase travel times leads directly to improvement in earthquake location accuracy. One-dimensional (1D) velocity models are most commonly used to calculate seismic phase travel times because computer codes are readily available and the computations are inexpensive. Travel time predictions based on 1D models are accurate to within 1 to 2 seconds at teleseismic distance, but complex crust and upper mantle structure can triple prediction errors at regional distance. Increased travel time prediction error at regional distance is particularly prevalent in regions like Central America, where subduction tectonics results in large lateral variations in seismic velocity and crustal thickness. The Regional Seismic Travel Time (RSTT) method (Myers et al., 2010) was specifically developed to improve travel time prediction accuracy by accounting for 3D seismic velocity structure. In this study, we update the RSTT 3D velocity model in northern and central Costa Rica using published studies of velocity structure (DeShon et al., 2006 and Arroyo et al., 2009). Travel times for the updated model are compared to observed travel times for well-constrained earthquakes. We relocate the earthquakes using only regional data to measure the improvement in location that can be achieved with the updated model.

Primary author: AGUIAR MOYA, Ana Cristina (Lawrence Livermore National Laboratory)

Presenter: AGUIAR MOYA, Ana Cristina (Lawrence Livermore National Laboratory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Analysis of Cesium-137 Concentrations Observed in Kuwait Before and After Fukushima Nuclear Disaster

State of Kuwait has a typical dry desert climate which involves deposition and resuspension of atmospheric particulate matter. The International Data Center (IDC) of the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), has been processing radionuclides data received from the RN40 station located in the state of Kuwait. The data include gamma-ray spectrometry, meteorological data, as well as the backward trajectory atmospheric modeling (ATM) results. This paper presents a trend analysis for the measured Cs-137 concentrations for the years 2008 to 2014 collected from RN40, before and after Fukushima nuclear disaster. The aim of this work is to evaluate the potential impact of Fukushima incident on the concentrations of terrestrial deposition of Cs-137 in Kuwait, the activity of this radionuclide were presented in the soil and atmosphere due to the past nuclear testing and/or accidental reactor releases into the atmosphere.

Primary author: AL-RASHIDI, Mufreh (Kuwait Institute for Scientific Research (KISR))

Presenter: AL-RASHIDI, Mufreh (Kuwait Institute for Scientific Research (KISR))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Radionuclides Dispersal in Seawater from Fukushima Disaster to the Coastline of Vietnam

In order to assess the dispersal of radionuclides, e.g., Cs-137 and Cs-134, from the Fukushima disaster towards the coastline of Vietnam, the task of monitoring the radionuclides in the seawater has been conducted in the Institute for Nuclear Science and Technology, VINATOM, Vietnam since 2013. Seawater samples of 200 liters have been collected repeatedly every three months in the Gulf of Tonkin. The sampling locations include the geographical center of the Gulf of Tonkin, close to Bach Long Vi Island, which locates at 108.7269E and 20.11556N, together with three off-shore locations, i.e., Cua Dai-Vinh Thuc, Cua Mo-Van Hoa and Cai Rong-Van Don. After chemical treatments, the radioactivity of Cs-137 and Cs-134 in the seawater samples is measured by a Low-Background-Gamma-Spectrometer with an HPGe detector. After correcting the decreasing radioactivity of the radionuclide Cs-134 in the time period between the Fukushima disaster and the monitoring time in March, 2016, the contributing radioactivity of Cs-137 from Fukushima disaster in the sea area of Bach Long Vi Island, Gulf of Tonkin, is approximately 0.72 Bq/m³. Furthermore, the time when the radionuclides dispersed to the coastline of Vietnam is in the first quarter of 2016, confirming the simulation results from other authors.

Primary author: TRINH VAN, Giap (Institute for Nuclear Science and Technology)

Presenter: TRINH VAN, Giap (Institute for Nuclear Science and Technology)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Preliminary Tidal Analysis Based on the CG-5 AUTOGRAV Gravity Measurements at Lenkaran Station (Azerbaijan)

This research presents an analysis of gravimetric observations at the Lenkaran station (Azerbaijan) with coordinates: 38.733360N, 48.833724E. The station is located on the western seaside of the Caspian Sea. The distance of the site station from the seashore of the Caspian reaches 10 km. The tidal gravity observations were performed during more than two years (from July 2013 to December 2016). This is the first tidal analysis based on the gravity measurements for this location. Relative gravity oscillation observed by Scintrex CG-5 Autograv gravimeter was used for the tidal analysis. Analysis of this data was made using a PreAnalyse and ETERNA Analysis Program. Results give tidal parameters (amplitude and phase factor) for the main diurnal (M1, O1, P1, K1 and etc.) and (M2, S2, N2, K2 and etc.). The favorable concordance was revealed between observed and theoretical amplitudes for the daily waves Q1, O1, P1 and K1. In the observed data, there are also field fluctuations.

Primary author: GADIROV, Fakhraddin (Institute of Geology and Geophysics, Azerbaijan National Academy of Sciences)

Presenter: GADIROV, Fakhraddin (Institute of Geology and Geophysics, Azerbaijan National Academy of Sciences)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Innovated Earthquake Modelling Technique for Near Source Modelling

A hybrid method, with the combination of analytical Modal Summation (MS), numerical Finite Difference (FD) and Green Function (GF) to generate synthetic signals is developed. In this procedure we try to synthetically generate a small magnitude event using the pre-known hybrid technique of MS and FD as green function to simulate and scale target event through GF method. This modeling procedure is suggested since the simulation of small events is more reliable with numerical and analytical methods and it could be more useful while scaling to desired magnitude with GF method because of extended fault evaluation. This is tested using an aftershock recorded following the Bam earthquake. The result of synthetic signals by this method and observed records of Bam are compared both in time and frequency domains and shows good agreement. They show a more precise simulation compare with other methods tested during the study.

Primary author: GHOLAMI, Vahid (Geopersian Company)

Presenter: GHOLAMI, Vahid (Geopersian Company)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

of Future Earthquake Hazard and Risk in Hindukush-Pamir Himalaya Using IMS Network Data

Tuesday, June 27, 2017 5:30 PM (15 minutes)

Seismic threat and related earthquake engineering dedications usually require evaluation of return periods or probabilities of exceedance of specific levels of design load criteria or extremal safety conditions. For the purpose, a comprehensive treatment of earthquake hazard estimation, Gumbel's type-I extremes event probability distribution have been used to estimate designed earthquake recurrence times using annual extreme magnitudes. Hindukush-Pamir Himalaya and their vicinity bounded by 25–40°N and 65–85°E have been selected for quantify future earthquake hazard and risk. The result of analyses have enabled earthquake hazard that exist in the Hindukush-Pamir Himalayan belt to be quantified in terms of recurrence periods and probabilities of occurrence of earthquake of any given magnitude. Seventeen years complete and reliable earthquake data from June 13, 1999 to March 12, 2015 have been taken from International Monitoring System (IMS) Network setup by Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Vienna Austria. Study indicates that the most probable largest annual earthquakes are close to 5.5. The most probable earthquakes that may occur in an interval of 50 years are estimated as 6.6. The results are potentially useful for probabilistic seismic hazard assessment in the region.

Primary author: SHANKER, Daya (Indian Institute of Technology Roorkee)

Presenter: SHANKER, Daya (Indian Institute of Technology Roorkee)

Session Classification: T1.5 Civil, Scientific and Industrial Applications of IMS Data and IDC Products

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Velocity Models and Their Improvement

For the routine procedure to determine the hypocenter of recorded seismic events, explosion and nuclear events, specified crustal 1D seismic velocity models (used in Albania) have been derived and improved over the years. These used 1D velocity models are derived in 1986 (Kocaj S), 1992 (Peci et al), 2001 (Muco et al) years and the new model was developed in 2011 (Ormeni Rr). Comparing of relocate recent seismic events derived by different velocity models, we see that RMS values and location accurate are better to the new 1D velocity model (Ormeni Rr, 2011). The differences between the calculated epicenter of explosion by new model and the real explosion coordinates are very small compared to the explosion epicenter derived by other models. In this context we defined a reference velocity model was designed for Albania to better constrain the hypocentral determination. These high precision hypocenter locations are also required as initial values in 3D local earthquake tomography. Based on 1D velocity models of 2011 was developed 3D P-wave velocity model of Albania (Ormeni Rr, 2013). The interpretation of the 1D and 3D velocity models infers interesting features of the deep structure of Albania.

Primary author: ORMENI, Rrapo (Institute of Geosciences, Energy, Water and Environment (IGEWE))

Presenter: ORMENI, Rrapo (Institute of Geosciences, Energy, Water and Environment (IGEWE))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Portable Infrasound Array in Romania

In the late September 2016, within a collaboration project between National Institute for Earth Physics (NIEP) and Provisional Technical Secretariat (PTS) of the CTBTO, a PTS infrasound portable array (I67RO) has been deployed in Romania (in Cluj County), for one year. PTS assisted NIEP with deployment and with initial training of Romanian staff involved in the operation, maintenance and data acquisition/processing. I67RO array consists of four elements distributed over a 0.9 km aperture and equipped with CEA/DAM MB2005 microbarometers and Reftek RT130 digitizers. The local data are weekly collected and transferred to NIEP, where they are converted from PASSCAL format to CSS3.0 database format. CSS data are processed into detection arrival bulletins using CEA/DASE PMCC algorithm embedded in DTK-GPMCC (extended CTBTO NDC-in-a-box). The infrasound data and detection bulletins are continuously stored at Romanian NDC. We present data processing results, plotted and analyzed using DTK-DIVA software (extended CTBTO NDC-in-a-box), in order to assess the I67RO detection capability, as well as the capacity of fusing the detections into NIEP infrasound monitoring activities. This NIEP-CTBTO joint experiment will improve the understanding of infragenic sources in Central-Europe and will contribute to European ARISE project by expanding the spatial coverage of the European infrasound network.

Primary author: GHICA, Daniela Veronica (Romania National Data Centre)

Presenter: GHICA, Daniela Veronica (Romania National Data Centre)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Resolution on the Performance of FLEXPART with ECMWF Data in the ATM Challenge 2016

In the context of the Atmospheric Transport Modelling (ATM) Challenge 2016, we simulated the Xe-133 concentrations resulting from emissions by the ANSTO facility in Eastern Australia at various IMS noble gas stations. The stations are located at a wide range of geographical areas, from Australia over the Pacific to South America. All simulations were based on ECMWF 0.125 degree meteorological input data and carried out with FLEXPART in backward mode. Due to the highly different transport distances, suitable sampling grid sizes vary accordingly. We study the impact of the sampling grid resolution in the horizontal and vertical on the quality of results. Standard skill scores usually favour smoother low resolution, smoother model fields, which does not necessarily indicate better simulations. This problem will be addressed as well.

Primary author: SEIBERT, Petra (University of Natural Resources and Applied Life Sciences (BOKU))

Presenter: SEIBERT, Petra (University of Natural Resources and Applied Life Sciences (BOKU))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

wave attenuation in the Baikal Rift System

The Baikal rift system is undergoing an active tectonic deformation expressed by a high level of seismic activity. This deformation leads to physical and mechanical changes of crustal properties which can be investigated by the seismic quality factor and its frequency dependence. Using a single backscattering model, a seismic quality-factor (QC), a frequency parameter (n) and an attenuation coefficient (δ) have been estimated by analyzing coda waves of 274 local earthquakes of the Baikal rift system. The values of QC(f) and δ were estimated for the whole Baikal rift system and for separate tectonic blocks: the stable Siberian Platform, main rift basins, spurs and uplifts. Along the rift system, the Q_0 -value (QC-factor at the frequency $f=1$ Hz) varies within 72–109 and the frequency parameter n ranges from 0.87 to 1.22, whereas Q_0 is 134 and n is 0.48 for the stable Siberian Platform. The comparison of lateral variations of seismic wave attenuation and geological and geophysical characteristics of the Baikal rift system shows that attenuation is correlated with both seismic activity and heat flow and in a lesser degree with the surface fault density and the age of the crust.

Primary author: DOBRYNINA, Anna (Institute of the Earth's Crust, Siberian Branch, Russian Academy of Sciences; Geological Institute, Siberian Branch, Russian Academy of Sciences)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Site Effect of Zarqa City and Hashemite University Campus Based on Microtremors Field Measurements: A Microzonation Study

Abstract Zarqa governorate is one of the important governorates in Jordan. It is the second populated after Amman, the location of Zarqa gives the city a great importance because it lies on the main high ways leading to Syria, Iraq and Saudi Arabia and power plants which gives this city a special importance. The Nakamura's technique is applied in this study for both areas; Zarqa city and Hashemite University Campus in order to determine the resonance frequencies (RF) and amplification factors (AF) for each site then draw there maps which will be of a great use in the field of civil and structural engineering by enriching the building codes. The results of our study show that; values of (RF) are not affected by the time of recording. While values of (AF) can vary accordingly. Results also show that the (AF) varies from 0.8 to 8.55 in Zarqa city and varies from 0.4 to 9.36 in Hashemite University Campus, (RF) also varies between 0.37 Hz and 2.98 Hz in Zarqa city and varies from 0.59 Hz to 1.77 Hz in Hashemite Campus, that means some constructions in the study area, in case of a major earthquake, may experience minor damages respectively.

Primary author: OLIMAT, Waleed (Jordan Seismological Observatory)

Presenter: OLIMAT, Waleed (Jordan Seismological Observatory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Calculations on the Production of Ar-37 in Nuclear Power Plants in Regard to the Verification of the Nuclear-Test-Ban Treaty

Context. The verification regime of the CTBT focuses highly on radionuclides. Currently four xenon isotopes are used to distinguish between civil source emissions and those of suspected nuclear tests. Although the use of xenon isotopes is theoretically well understood and established, its applicability may be limited by anthropogenic background and detection of only some of the four isotopes required. Another radionuclide, that is currently an important instrument for on site inspections, is Ar37. It is unknown, whether there is an anthropogenic background of Ar37 that might affect on site measurements. **Aims.** We set out to determine the production of Ar37 in nuclear reactors for assessing potential anthropogenic concentrations in the atmosphere. A potentially important process of Ar37 production inside a power reactor is via neutron capture of Ar36 in the moderator of water cooled reactors, since some air including stable Ar36 inevitably is dissolved in the water. **Methods.** We performed first calculations on the amount of Ar37 that will be produced due to neutron capture reactions in the reactor core. We will also highlight other possible production pathways that might lead to Ar37 in a nuclear power plant.

Primary author: HEISE, Anna Christina (University of Hamburg)

Presenter: HEISE, Anna Christina (University of Hamburg)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

2nd ATM Challenge 2016

After successfully performing an ATM challenge in 2015 the idea of having another and more complex one emerged. The new challenge met with big response from the respective community. 17 organizations from 10 different countries took part. One purpose of the 2nd ATM Challenge 2016 was once again to ascertain the level of agreement one can achieve between real IMS measurements and those simulated using only stack release data and ATM. Another purpose was to compare results of the current challenge in terms of model performances with those from the previous one. Whereas the distance between the source (IRE) and the selected IMS station (DEX33) added up to around 380 km in the 2015 exercise, distances between the source (ANSTO) and the selected IMS stations (six on the Southern hemisphere) varies between around 690 km (AUX04) and around 13500 km (BRX11) for the 2016 exercise. In addition, the locations of the two challenges (~50°N versus ~34°S) are completely almost on the opposite sides of the globe and, consequently, very different atmospheric circulation patterns have to be expected. Final results will be presented, including a discussion about the main driving factors of model performance.

Primary author: MAURER, Christian (Central Institution for Meteorology and Geodynamics (ZAMG))

Presenter: MAURER, Christian (Central Institution for Meteorology and Geodynamics (ZAMG))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Realistic Terrain Boundary Conditions into Numerical Infrasound Propagation Modelling

To accurately interpret infrasound arrivals at International Monitoring System (IMS) arrays requires understanding of low-frequency acoustic propagation in the atmosphere. This is often achieved using numerical acoustic propagation modeling. The Parabolic Wave Equation (PWE) uses an approximated Helmholtz equation, obtained for paraxial (i.e. near-horizontal) propagation, and has been extensively used for modeling wave propagation through ocean and atmospheric waveguides. The suitability of the PWE method for the accurate modeling of infrasound relies on its ability to satisfactorily account for the dominant atmospheric propagation effects: geometric spreading, refraction, reflection, diffraction, and scattering. Although the influence of the terrain topography has slowly gained importance among the atmospheric acoustics community, resulting in new PWE models, current global infrasound propagation studies neglect this effect. Here we derive Finite Difference and Split-Step Fourier PWE, in narrow- and wide-angle forms, and compare against Finite Element Simulations for 2D propagation over simple and realistic topographies. We apply the method to study wind turbine noise recorded at the Ascension Island IMS array. Results show that terrain when combined with refracting atmosphere conditions influences recorded infrasonic amplitudes, and that the PE is valid for slopes up to 20 degrees in narrow angle and 30 degrees in wide angle.

Primary author: KHODR, Codor (Faculty of Engineering, University of Bristol)

Presenter: KHODR, Codor (Faculty of Engineering, University of Bristol)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Signals and Their Source Location Inferred from Array Deployment in the Lützow-Holm Bay, East Antarctica: 2015

Characteristic features of infrasound waves observed in the Antarctic represent a physical interaction relating surface environment in the continental margin and surrounding Southern Ocean. Source location of several infrasound events are demonstrated by using combination of two array deployments along a coast of the Lützow-Holm Bay (LHB), East Antarctica, for data retrieving period in January - June 2015. These infrasound arrays being established in January 2013 clearly detected temporal variations in frequency content and propagation direction of the identified 7 large events. Many of these sources are assumed to have cryoseismic origins by comparison with the MODIS satellite data; the ice-quakes associated with calving of glaciers, discharge of sea-ice, collision between sea-ice and icebergs around the LHB. Moreover, several notable infrasound waves are recorded by local originated signals contaminated with high-frequency contents which may include regional earthquakes. Detail and continuous measurements of infrasound waves in the Antarctic is a proxy for monitoring regional surface environmental variation as well as temporal climate change in high southern latitude.

Primary author: KANAOK, Masaki (National Institute of Polar Research)

Presenter: KANAOK, Masaki (National Institute of Polar Research)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Seismic Velocity Changes Using Ambient Seismic Noise

Seismic ambient seismic noise cross-correlations are now being used to detect temporal (seasonal and prior to strong earthquake etc.) variations of seismic velocity. The purpose of our work is to monitor velocity changes based on cross-correlation technique. Second purpose is to improve our seismic data quality. It is based on three years data archive of seismic real-time telemetered network of Ulaanbaatar. This network has been built in 2013 and data set consists of 16 broadband seismometers placed on Ulaanbaatar area at interdistances ranging from 30 to 50 km. Several studies using Impulse response or Green's function from cross correlation of seismic ambient noise to monitor temporal velocity changes that the small perturbations within a volcanic edifice prior to eruptions. This method has been providing good results in Earth's interior. In this work, We prepared the data archive removed instrument response, whitening spectra and bandpass filtering from 0.1 to 8 Hz. The reason why we have chosen filtering band is due to which frequency band is the highest noise level. We have been using complete software package for computing and monitoring relative velocity variations using ambient seismic noise (MSNoise). Finally we have been improving quality control of seismic data.

Primary author: DALAIJARGAL, Lkhagvadorj (Mongolian National Data Center (MNDC))

Presenter: DALAIJARGAL, Lkhagvadorj (Mongolian National Data Center (MNDC))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

First Infrasound Array in Hungary

The Geodetic and Geophysical Institute of the Hungarian Academy of Sciences joined to the Atmospheric dynamics Research InfraStructure in Europe (ARISE2) project in 2016. This year we have deployed an infrasound array in Piszkesteto, Hungary. The array is the first infrasound station in Hungary and it consists of 4 elements, equipped with SeismoWave MB3d microbarometers and wind noise filtering system. The aperture of the array is approximately 200 m which is optimal for the detection of local events. The central element of the array is co-located with the broadband seismological station, PSZ. In the surroundings of the array there are several mines from where we regularly detect seismic signal of explosions, and we expect also infrasonic detections. The infrasound array began its operation this spring, and shall make the infrasound recordings available to the ARISE community. We present data from the first months of operations, noise spectra and preliminary results of event discrimination using both seismic and infrasound data.

Primary author: CZANIK, Csenge (Research Center for Astronomy and Earth Sciences, Geodetic and Geophysical Institute,)

Presenter: CZANIK, Csenge (Research Center for Astronomy and Earth Sciences, Geodetic and Geophysical Institute,)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-Stratigraphic and Structural Controls on the Groundwater Flow Dynamics and Hydrogeochemical Setting of the Mekelle Outlier and Surroundings, Northern Ethiopia

The isotopic signatures ($\delta^{18}\text{O}$, $\delta^2\text{H}$ and tritium) and patterns of dissolved-ion concentrations in the groundwater, coupled with understanding of the three-dimensional geological framework, are used to conceptualize the groundwater flow model and recharge-discharge mechanisms in this complex hydrogeological environment. Most groundwater samples lay close to the Addis Ababa LMWL indicating meteoric origin. Slight shifts of some samples from this line are attributed to the altitude effect and the isotopic exchanges of rain droplets with the local air mass that have different isotopic composition (more depleted and higher d-excess) from that of Addis Ababa. This effect also results to a smaller slope of the LMWL of the study area ($\delta^2\text{H} = 6.8\delta^{18}\text{O} + 9.8$; $R^2 = 0.8$). The equation for the evaporation line for the area is $\delta^2\text{H} = 4.47\delta^{18}\text{O} + 6.42$; $R^2 = 0.8$. The $\delta^{18}\text{O}$ of shallow groundwater at different altitudes indicates a depletion rate of $-0.51 \text{‰}/100\text{m}$ towards highlands. Isotopic signatures indicate groundwater-surface water interaction. Isotopic measurement of groundwater samples in different seasons indicates a significant amount interflow (throughflow) that is pumped in wells during the summer season and disappears shortly after the rainy season passed. Three groundwater flow systems are identified. Tritium data indicate modern groundwater recharge.

Primary author: GIRMA, Ermias (Addis Ababa Science and Technology University)

Presenter: GIRMA, Ermias (Addis Ababa Science and Technology University)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Use of Argon-37 Measurements as a Coincident Signature with Radioxenon and in High Background Environments in the International Monitoring System

Argon-37 is a nuclear explosion signature that is currently adopted for use in on-site inspections (OSI). Because of the OSI application, new automated equipment is now available to measure this isotope in a sensitive manner from subsurface samples. While use of the Argon-37 signature as a key indicator of a nuclear explosion is widely accepted for OSI applications, the use of this isotope for remote detection has not been explored in great detail. There are a few primary reasons for previous lack of interest in the use of Argon-37 for the International Monitoring System (IMS): 1) the background of the isotope is not well known globally, 2) the equipment that has existed in the past was complex and operator intensive, and 3) the detection sensitivity of previous systems was not high enough to enable detection distant from a source. In this work, the case for Argon-37 as a viable and robust signature for IMS applications is made, including figures-of-merit for the isotope and future work that would be needed.

Primary author: BOWYER, Theodore (Pacific Northwest National Laboratory)

Presenter: BOWYER, Theodore (Pacific Northwest National Laboratory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Study Between Different Types of Models for the Dry Deposition of I-131

FLEXPART is a Lagrangian particle dispersion transport model which is originally designed for calculating the long-range and mesoscale dispersion of air pollutants from point sources. RODOS is also a Lagrangian particle dispersion model which has been specially designed to be used in the emergency planning. The main advantage of the RODOS model is that it can work on a very high resolution and at the local scale. Besides these models, we can also use other tools to calculate deposition in the vicinity of the release, e.g. Rules of thumb (Olyslaegers and Sohler, 2007). This presentation will show results of an intercomparison study between these designs and evaluate the effect of scale on the dry deposition values of modelled I131. As such it will contribute to the uncertainty quantification of dispersion modelling. Geert Olyslaegers and Alain Sohler, Rules of Thumb : Excel software calculation sheet to perform fast radiological impact assessment for atmospheric releases - Microsoft Excel 2007.

Primary author: DELCLOO, Andy (Royal Meteorological Institute)

Presenter: DELCLOO, Andy (Royal Meteorological Institute)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Seasonal Variation of Be-7 Related to Large-Scale Atmospheric Circulation Dynamics

Atmosphere dynamics can be studied using radioisotopes long-term data series. Such tracers, like ^7Be are recorded by the CTBTO through the radionuclide network of the International Monitoring System (IMS). The worldwide collection of activity concentration provided by the network built up unique data sets for scientific research. IMS data have being previously used to correlate beryllium trends to atmospheric patterns on local or regional study but not at a global scale. In this work, we demonstrate how for the first time a worldwide beryllium concentration map is reconstructed using 15 years of data from 63 IMS radionuclide stations. The scope was to interpolate beryllium data into global concentration maps as an expression of atmospheric cell migration such as Hadley, Ferrel and Polar cells. ^7Be data sets might possibly serve as an early warning indicator and complement other methodologies for determining global atmospheric phenomena such as atmospheric cells, ITCZ, sunspots, tropopause height, Walker circulation, ENSO, SSW, SEP, Indian Monsoon and QBO. Resulting correlation can be presented, raising once more the importance of use and potential of IMS data for the scientific community.

Primary author: TERZI, Lucrezia (Belgian Nuclear Research Center (SCK-CEN))

Presenter: TERZI, Lucrezia (Belgian Nuclear Research Center (SCK-CEN))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Use of CTBTO IMS data on Atmospheric Radioactivity Monitoring Following the Fukushima Dai-ichi Nuclear Power Plant Accident

There have been around 100 scientific publications making direct use of or quoting results of CTBTO IMS data on atmospheric radioactivity monitoring following the 2011 Fukushima Dai-ichi nuclear power plant accident. These are focusing on many areas of interest such as plotting the events of the explosion, analysing the environmental and biological impact of the release, and perhaps most importantly, estimating the total release (source term) of certain isotopes. In particular, trends are noted in the data sources used worldwide for radionuclide data, and the importance, impact and main applications of CTBTO's own radionuclide data in relation to the Fukushima accident is assessed. Several source term estimates and their data sources are compared, as well as experts' use and validation of said release estimates in other publications.

Primary author: WATT, Rosie (University of Glasgow, Glasgow, United Kingdom)

Presenter: WATT, Rosie (University of Glasgow, Glasgow, United Kingdom)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

3D Shear Velocity Model of the Eastern and Southern Alps from Ambient Noise Tomography

In this study, we show results from ambient noise correlations. We used two year of continuous data recorded at 59 permanent stations and 19 stations of the AlpArray-EASI profile during 2014 and 2015. Cross correlations of ambient noise are computed in order to estimate the Green's functions of surface waves propagating between the station pairs. Dispersion curves of Rayleigh and Love waves are constructed between 2 and 40 seconds and are then inverted to obtain group velocity maps at different frequency. The Rayleigh and Love wave group velocity measurements are inverted for shear-wave velocities. We present here a 3-D shear-wave velocity model for the Eastern and Southern Alps. Our results show that velocity variations at short periods (up to 10 km depth) correlate well with the surface geology, e.g. tectonic features and faults. The results clearly show low velocity zones associated with the Po-Plain and the Molasse Basin. Under the Molasse basin the low velocity anomaly extends down to 10 km depth. We also observe a high-velocity anomaly surrounded by Northern Calcareous Alps and Dolomites (Southern Limestone Alps), where its southern edge is well-marked by the Periadriatic and Giudicarie lines.

Primary author: QORBANI, Ehsan (CTBTO Preparatory Commission)

Presenter: QORBANI, Ehsan (CTBTO Preparatory Commission)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Seismic Hazard Potentials in Zimbabwe

A probabilistic seismic hazard assessment for Zimbabwe is analysed according to the data and statistics of the seismicity of Zimbabwe and sources of earthquakes around the country. Data from different sources were merged and duplicate earthquakes were removed. Data from IMS stations in Southern Africa ,Zimbabwe included contributed to the catalogue from 2003.The catalogue was unified with all magnitude types converted to Mw. The “deductive” PSHA approach which integrates geological and geophysical information together with seismic event catalogs in the assessment of seismic hazards was used. In this study, seismic hazards maps are presented as maps showing peak ground acceleration (PGA) for Zimbabwe. The maps have a 10% probability of exceedance in 50 year period, and are prepared using a homogenized catalogue compiled for seismic moment magnitude. The highest levels of seismic hazards in Zimbabwe are in eastern border of the country with Mozambique, the Lake Kariba area and the mid Zambezi basin in the vicinity of the Save-Limpopo mobile belt.

Primary author: MARIMIRA, Kwangwari (Goetz Observatory)

Presenter: MARIMIRA, Kwangwari (Goetz Observatory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-Magma Interactions in Nuclear Cavities and Their Effects on the Xenon Isotope Ratios

Underground nuclear explosions lead to the formation of cavities partly filled with magma contributed by the surrounding rocks during cooling, where nuclear reactions take place under the form of multiparent-multidaughter decay chains with half-lives covering many orders of magnitude. In the framework of the International Monitoring System, xenon isotopes decayed from their parent iodine, particularly in the 131, 133 and 135 chains, are central for the discrimination of underground nuclear explosions based on the ratios of four xenon isotopes. However, as a function of time and distance following an underground nuclear explosion, the isotope ratios of xenon vary depending on when and where the fission products are fractionated. Because xenon and their parent iodine isotopes have contrasted solubility and diffusion capabilities in magmas, we consider here a new model for fractionation of iodine and xenon isotopes. For each of the 131, 133 and 135 chains, trapping of cavity gaseous iodine and xenon into the magma as well as their back-diffusion from the magma toward the cavity gas phase are incorporated into modified radioactive decay and ingrowth equations. The consequences on the xenon isotope ratios are computed and compared to scenarios where these effects are neglected.

Primary author: PILI, Eric (Commissariat à l'énergie atomique et aux énergies alternatives (CEA))

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

/GeoAc: An Open Source Infrasonic Ray Tracing Tool

Modeling infrasonic propagation in the atmosphere can be a computationally intensive exercise due to the dynamic and non-stationary nature of the propagation medium. Propagation simulation tools often utilize mathematical approximations to the acoustic wave equation to make obtaining a prediction for propagation effects more feasible. Scientists at Los Alamos National Laboratory (LANL) have developed a robust ray tracing tool kit, InfraGA/GeoAc, that models the propagation of infrasonic signals through the atmosphere in the limit of geometric acoustics. Such ray tracing methods provide highly efficient means to estimate infrasonic arrival characteristics for a given atmospheric state. The methods in InfraGA/GeoAc utilize an inhomogeneous, moving propagation medium model and Cartesian (2D or 3D) or spherical coordinate propagation schemes to model propagation at local to global scales. The software utilizes a set of auxiliary parameters that define geometric spreading effects along individual ray paths. Eigenray methods leveraging the auxiliary parameters are included and provide a means to efficiently identify propagation paths for specific source-receiver geometry even in the case that propagation is not contained within an azimuthal plane.

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Presenter: WHITAKER, Rodney (U.S. Department of Energy, National Nuclear Security Administration)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Study of Ecuador Earthquake Using IMS Stations in Africa

The African region is covered by 22 (primary and auxiliary) IMS seismic stations and 8 infrasound stations. The ability of these stations to be deployed for scientific purposes was assessed using two earthquakes that occurred in Ecuador on 12 August, 2010 and 16 April, 2016. The data from these stations were used to locate both events. Some of the stations recorded data that were used to locate the two events while some did not. This study presents a performance analysis of these stations on the date of the events and an analysis of both events.

Primary author: MADU, Uchenna Onwuhaka (Nigeria Atomic Energy Commission)

Presenter: MADU, Uchenna Onwuhaka (Nigeria Atomic Energy Commission)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Future Landslide Hazards: 12 March Earthquake, West, and 29 March 2014 Landslide, East of Anjouan-Island, Comoros.

The Comoro-Islands, formed along the process of a mantle plume moving eastward within the Somali plate (e.g. Emmerick & Ducan, 1982), are four volcanic Islands, Grand Comore (1148km²), hosting the active “Karthala volcano” (rising up to 2361 m .al), Moheli (211km²; 790m al.), Anjouan (424km²; 1595m al.), and Mayotte (374 km²; 660m al.), which respective eruptions are estimated generally 10 million years ago westwards with time. They are composed of basalts and associated volcanic, plutonic rocks (e.g. Thompson & Flower, 1971; Ludden, 1977). In past 3 years, Anjouan Island recorded moderate earthquakes, and in 2014, a motion from Magnitude 4.8 ML (IDC-REB record) of March 12 has been felt partly in the western side of the Island about 7- 8s tremor duration (villager testimony). Seventeen days separated the earthquake and a Landslide with displacement commenced on March 29 in the Eastern side of the Island (with respect of local oral interviews) after strong rainfall in the area and in many regions of the Islands. The objective of this study is to comprehend the triggering geological causes as well as understanding the possible seismic activities effects on such cases of landslide in the future within the Islands.

Primary author: MADI, Mariama (CNDRS (Centre National de Documentation et de Recherche Scientifique))

Presenter: MADI, Mariama (CNDRS (Centre National de Documentation et de Recherche Scientifique))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

to Glacial Infrasond in Northwestern Greenland

Inaudible sound, i.e., infrasond, is generated by glaciers while moving and cracking and during calving events. Such sounds can be continuously monitored with microbarometer arrays. Changes in the rate of events can be retrieved with a resolution of a few seconds. Applying array processing techniques enables the identification of individual sources over ranges of tens, in this case, to hundreds of kilometers. Here we show, that passively monitoring infrasond enables new insights in regional changes in the cryosphere under global warming. We concentrated on the region around Quanaq in northwestern Greenland and found coherent infrasond of at least five sources over a period of 12 years. It appeared that some glaciers show a reduction in activity, while others show a strong increase in infrasonic events over time. Diurnal variations in the activity of the glaciers is also retrieved through a spectral analysis, indicative for surface-meltwater induced basal sliding. Our results demonstrate the capacity of infrasonic monitoring as an independent proxy for changes in the cryosphere. We anticipate that monitoring glacial infrasond can contribute to a better understanding of the behavior of glaciers in the future, as phenomena can be passively resolved on a fine temporal scale.

Primary author: EVERS, Láslo (KNMI - Royal Netherlands Meteorological Institute)

Presenter: EVERS, Láslo (KNMI - Royal Netherlands Meteorological Institute)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Seismograms of Explosive Sources Calculated by the Earth Simulator

We calculate broadband synthetic seismograms using the spectral-element method (Komatitsch & Tromp, 2001) for Jan. 6 2016 DPRK event (Mw(USGS) 5.1). We use Earth Simulator system in JAMSTEC to compute synthetic seismograms using the spectral-element method. The simulations are performed on 8,100 processors, which require 2,025 nodes of the Earth Simulator. We use one chunk with the angular distance 40 degrees to compute synthetic seismograms. On this number of nodes, a simulation of 10 minutes of wave propagation accurate at periods of 3.0 seconds and longer requires about 2 hours of CPU time. We use CMT solution of Rozhkov et al (2016) as a source model for this event. This source model has 43% CLVD component, 19% double couple component and 38% isotropic component. The hypocenter depth of this solution is 1.4 km but we put the hypocenter at the surface for this computation. Comparisons of the synthetic waveforms with the observation show that the arrival time of Pn and Pg waves matches well with the observation. The surface waves observed are also modeled well in the synthetics, which shows that the CMT solution we have used for this computation correctly grasps the source characteristics of this event.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Analysis of Seismic Bulletin in Egypt

The Egyptian Seismological Network has more than 75 seismic stations distributed all over the country. The analysis of NRIAG bulletin could identify 15769 artificial seismic events recorded in the period from 1997 to 2015. The spatial distribution of events is used to identify localities where there may be explosion contamination. We present a statistics and mapping to identify mining and quarry blasts from seismic catalog. We could detect the location of 26 major potential quarries and one gold mine active from the screening of the catalog. By mapping these events we able to divide Egypt in to Five seismic-artificial zones: North Egypt,middle Egypt,South Egypt,Mersa Alam and Sinai zones; each zone include blasting activity recorded from Quarry-mining areas. We applied Statistical and mapping analysis to recognize the active artificial and natural seismic sources of events,as this represents a challenge for seismic Discrimination between quarry-mining blasts and earthquakes for each zone which can include both natural-artificial event. we applied statistical analysis to evaluate the particular difficulties in identifying of this common type of seismic source from other sources for both earthquakes and artificial explosions with magnitudes ($ML \geq 3.5$). There are 15769 events evaluated in the study should statistically represent possible blasts.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Transport Model Applied to the Design of Medical Isotope Production Facilities

In this work, Atmospheric Transport Models (ATM) are presented as a strategic design tool for the mitigation of radionuclide release to the atmosphere and to evaluate the impact of other radionuclide emissions, like: I-131, I-133, Kr-85, Kr-85M, Kr-87 and Kr-88, among other nuclides. The design of Medical Isotope Production Facilities (MIPF), includes safety and security protection radiological analysis, either inside and outside the installations, and studies of gaseous effluent release monitoring. Related to effluent release to the atmosphere, INVAP has relevant experience on ATM applications to MIPF's, using Gaussian models, on different stages of the design on nuclear facilities, in normal operation and accidental scenarios.

Primary author: ALESSI, Mariana (INVAP S.E.)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Process of the Mw = 5.1, Phalla (Islamabad) Earthquake and Its Tectonic Perspective

The 2015 Phalla earthquake occurred near Islamabad, Pakistan with strong shaking but no damage report. We estimated the focal parameters and slip model of this earthquake by waveform modeling of the local data using moment tensor inversion. We analysis 25 station waveform data retrieved from MSSP (Micro seismic studies Programme). We found strike slip mechanism within thrusting tectonic environment. This right lateral strike slip fault compensates the movement of the left lateral strike slip Jhelum fault present in East. This ineterplate earthquake was largest strike slip event to occur in HKS (Hazara Kashmir Syntax). The spectral parameters were computed using Brune's model fitting of the data. The moment magnitude, fault length, static stress drop and radiated seismic energy were computed as 5.1, 1.5 km, 90 bar, and 9E11 J respectively. The same spectral analysis was applied to the aftershocks waveform data from near local stations. We tested the scaling of seismic spectrum, and the scale invariance of the apparent stress drop with the earthquake size. The existence of this strike slip mechanism within the subduction zone may play vital role in the segmentation of large thrust faults of the HKS zone which will in turn affect the seismic hazard estimation.

Primary author: TAHIR, Mohammad (ISTerre Grenoble France, Yonsei University South Korea)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

European Infrasound Bulletin

The European Infrasound Bulletin highlights infrasound activity produced by mostly anthropogenic sources, recorded all over Europe and collected in the course of the ARISE project (Atmospheric dynamics Research InfraStructure in Europe). Data includes high frequency (>0.7 Hz) infrasound detections of 24 European infrasound arrays from 9 different national institutions complemented with CTBT IMS infrasound stations. Data was acquired during 16 years of operation (from 2000 to 2015), and processed to identify and localize about 48.000 infrasound events within Europe. The source location of these events was derived by combining at least two corresponding station detections per event. Comparisons to ground-truth sources, as e.g. Scandinavian mining activity, are provided. Relocation is performed using ray-tracing methods to estimate celerity and back-azimuth corrections based on either HWM-07/MSISE-00 climatologies or actual ECMWF wind and temperature values for each event. This study focuses on repeating infrasound events (e.g. mining blasts and supersonic flights) and on the seasonal, weekly and diurnal variation of the infrasonic activity of sources in Europe. Estimations of the detection and location capability and accuracy will be given in the course of this study to achieve a comprehensive picture of the activity of infrasound sources and capability of infrasound station in Europe.

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Presenter: PILGER, Christoph (Federal Institute for Geosciences and Natural Resources (BGR))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Structure of West Africa from Surface Wave Tomography Using Regional Earthquakes and Ambient Seismic Noise

Most models of seismic structure of the West African craton come from global-scale studies. With a higher-resolution regional velocity model, we could locate seismic events and calculate regional Green's functions more accurately, thereby improving discrimination between natural earthquakes and man-made events. We aim to produce a 3D regional shear wave velocity model for West Africa, using surface wave tomography, with both regional earthquakes and seismic ambient noise cross-correlation. By using these two types of data we improve azimuthal coverage of the region and therefore hope to produce higher resolution models than possible using earthquakes alone. We presented our preliminary Rayleigh wave group velocity maps obtained from earthquake recordings at the last SnT conference. They imaged the large geological structures of the region (craton, shields, sedimentary basins and mobile belts zone). We now present the results from ambient noise correlation between 26 regional stations and the results from the joint dataset.

Primary author: OUATTARA, Yacouba (Station Geophysique de Lamto)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

for the Popularization of the Virtual Data Exploitation Centre (vDEC) in West Africa

The enormous resources committed by the EU and other relevant partners in the design and development of the Virtual Data Exploitation Centre (vDEC) can only be justified if there is a greater use of this resources by Academics, Researchers and Scientists across the globe, particularly from the developing countries. The focus of this work is to determine the extent of the involvement of the academics, researchers and Scientists from West Africa with the vDEC and to determine how the utilization of the resources can be expanded to benefit Academics, Researchers and Scientists in the region engaged in research and development activities relevant to the CTBT. Engaging other relevant stakeholders in the use of the IMS data and IDC products of the CTBTO has the immense potential to speed up the universalization of the CTBT and its eventual entry-into-force.

Primary author: BISALLAH, Awwal (Nigeria Atomic Energy Commission)

Presenter: BISALLAH, Awwal (Nigeria Atomic Energy Commission)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Noble Gases in Porous Media and the Impact on Nuclear Explosion Signatures

Radioactive isotopes of the noble gases xenon and argon are the “smoking gun” of an underground nuclear explosion in that detection of these isotopes is nearly unequivocal proof that a nuclear explosion occurred, especially if they are detected in the predicted ratios. Traditionally in the context of large-scale environmental transport, such as in the aftermath of a nuclear explosion, the noble gases are largely assumed to be non-reactive. However, results of past tracer experiments have illuminated the possibility that small pore-scale noble gas interactions in geologic media can have a significant aggregate effect on migration behavior over large distances. Presented here are ongoing efforts to understand the potential impact of noble gas sorption in porous geologic media on underground nuclear explosion signatures.

Primary author: LOWREY, Justin (Pacific Northwest National Laboratory)

Presenter: LOWREY, Justin (Pacific Northwest National Laboratory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

-Range Transport of Xe-133 Emissions Under Convective and Non-Convective Conditions

To investigate the transport of xenon emissions, the Provisional Technical Secretariat (PTS) operates an Atmospheric Transport Modelling (ATM) system based on the Lagrangian Particle Dispersion Model FLEXPART. The air mass trajectory provides a “link” between a radionuclide release and a detection confirmed by radionuclide measurements. The aim of this study is to investigate the long-range transport of Xe-133 emissions under convective and non-convective conditions, with special emphasis on evaluating the changes in the simulated activity concentration values due to the inclusion of the convective transport in the ATM simulations. For that purpose a series of 14 day forward simulations, with and without convective transport, released daily in the period from 1 January 2011 to 30 June 2013, were analysed. The release point was at the ANSTO facility in Australia. The simulated activity concentrations for the period January 2011 to February 2012 were calculated using the daily emission values provided by the ANSTO facility; outside the aforementioned period, the median daily emission value was used. In the simulations were used the analysed wind data provided by ECMWF. Availability of both daily emission values and measured Xe-133 activity concentration values was an opportunity to validate the simulations.

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Presenter: KUSMIERCZYK-MICHULEC, Jolanta (CTBTO Preparatory Commission)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of HYSPLIT Dispersion Model in Fukushima Disaster

Atmospheric transport modeling (ATM) is prerequisite for on-site inspection and source location estimation, so it is the critical point of the treaty. The Fukushima Daiichi nuclear disaster was an energy accident at the Fukushima I Nuclear Power Plant in Fukushima, initiated primarily by the tsunami following 9.0 magnitude on 11 March 2011. Literature of Fukushima accident source term estimation for ^{137}Cs , ^{131}I and ^{133}Xe radionuclides was studied that used backward ATM, dose rates in and around Fukushima, seawater contamination and soil contamination methods. The nearest one to reality was used to simulation with HYPPLIT model. The results peruse in some IMS stations and indicated that in majority cases this model has acceptable outcome, also it showed by get away from the point source disagreement with measurements is increase.

Primary author: ABDOLLAHNEJAD, Hamed (Amir-Kabir University of Technology)

Presenter: ABDOLLAHNEJAD, Hamed (Amir-Kabir University of Technology)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

-wave Attenuation Structure of Central Anatolia Using Full Seismogram Envelope

A study of regional and local attenuation of earthquake seismic waves could contribute to the prediction of earthquake ground motion which contributes to the verification system by improving signal interpretation. Here we present the results of a PhD thesis. In this study, we have applied the Multiple Lapse Time Window Analysis (MLTWA) method to the local earthquake data from BRTR (PS-43) and Kandilli Observatory Regional Earthquake-Tsunami Monitoring Center (RETMC) stations in Central Anatolia to estimate the Shear-wave attenuation parameters. Carefully selected 177 events with SNR > 3 used in the process. Seismic Albedo(B_0), Scattering attenuation ($1/Q_s$) and Intrinsic absorption ($1/Q_i$) are measured separately for each station using a uniform and depth dependent velocity model using numerical simulations (Monte Carlo) based on multiple isotropic scattering. Results show us that scattering attenuation is effective at frequencies 3 Hz and lower, whereas intrinsic absorption becomes dominant at higher frequencies. We have compared our results to other regions that were studied previously using the similar methods. The total attenuation is lower in Central Anatolia when compared to western and Eastern Turkey.

Primary author: ŞEMİN, Korhan Umut (Belbasi Nuclear Test Monitoring Center)

Presenter: ŞEMİN, Korhan Umut (Belbasi Nuclear Test Monitoring Center)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

of the Lithospheric Structure in the Northwest South America from Receiver Functions Analysis

We have combined seismological data of the National Seismological Network of Colombia and the CTBTO program for estimating the P-to-S and S-to-P receiver functions beneath Colombia and adjacent regions to make a first-order approximation of the thickness of the Lithosphere-Asthenosphere Boundary (LAB) in the NW South America. An iterative time-domain deconvolution process was carried out and then a move-out correction with a time-depth conversion using seismograms of distant earthquakes recorded at broadband stations. P-to-S receiver functions reveal a relatively thin crust in northern Colombia, with a thickness that roughly varies between 25 and 39 km, with an increase from NW to SE. S-to-P receiver functions were used to estimate lithospheric thickness, yielding values between 65 and 110 km, also increasing from NW to SE. Lithospheric thickness beneath an oceanic island in the Caribbean is ~80 km, whereas for the Ecuador-Colombia Trench it is ~65 km and around 100 km for the Panama Arc. The transition to the continent is associated with an increase in LAB depth, where it can reach ~110 km, with no significant differences among terranes and/or tectonic blocks.

Primary author: VARGAS, Carlos A. (Universidad Nacional de Colombia)

Presenter: VARGAS, Carlos A. (Universidad Nacional de Colombia)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Submarine Volcanic Activity Using IMS Hydrophone Data: Detection and Implications for Ocean Noise

Little is known about active volcanism in the ocean. As eruptions are attenuated by seawater and fallout does not regularly reach the sea surface, timing and exact location of volcanic processes remain poorly constrained. This problem can be overcome by the study of long-range underwater acoustics: It has recently been shown that eruptions at Monowai, a submarine volcano in the Kermadec Arc, can be remotely detected by IMS hydrophone arrays at Ascension Island, and over a geodesic distance of ~15,800 km. In this study, we analysed 11 years of continuous measurements at station H10N to construct a long-term record of hydroacoustic activity at Monowai. Preliminary results from direction-of-arrival calculations and density-based spatial clustering suggest that more than 200 discrete episodes of volcanic activity may have occurred between March 2005 and June 2016, ranging from a few hours to weeks in length and amounting to more than 120 days in total. Hence, Monowai represents one of the predominant sources of persistent low-frequency noise in the southern Equatorial Atlantic Ocean, despite its almost antipodal location. Our findings highlight the exceptional capabilities of the IMS hydroacoustic waveform component for the scientific study of active volcanism in the global ocean.

Primary author: METZ, Dirk (University of Oxford)

Presenter: METZ, Dirk (University of Oxford)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Geological Fault Information Using the Last Shallow Seismic Events

Shallow seismicity at Occidental side in Bolivia is not usual particularly if it was felt at the capital cities, the impact is big enough to stop all activities from two to seven days, obviously this kind of seismicity is related to geological faults which are plotted but not all of them are described, by described we mean that there are not a moment tensor solution. On 1st October 2014 and 13th December 2016 there were two shallow seismic event on La Paz and Oruro City, until now there were not a serious study involving the geologic framework, the seismic event location by our seismic network plus the IMS stations (LPAZ and SIV), the seismic wave correlation and finally the focal mechanic solution. Once we ensemble all data a classical seismic location was applied using the new velocity model 1D, he correlatoin was applied to get some family events, FOCMEC software was used to get the focal mechanics solution, finally a field trip confirmed the focal mechanics solution upgrading the information about the geological fault.

Primary author: FERNANDEZ, Gonzalo Antonio (Observatorio San Calixto)

Presenter: FERNANDEZ, Gonzalo Antonio (Observatorio San Calixto)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of a Coherent Signal in the High-Frequency Range of IMS Hydrophones (105-108Hz) at Station HA08, Diego Garcia, Indian Ocean

Observations are made of signals with frequency peaks around 105 to 110 Hz in the spectra of the Diego Garcia IMS hydroacoustic monitoring station. The data were acquired on 1st January 2003 at two hydrophone triads that belong to CTBTO's IMS hydroacoustic network. These are situated at North-West (H08N) and South-East (H08S) of the Diego Garcia atoll in the Indian Ocean. The IMS hydroacoustic stations are ideal to passively monitor the oceans because the hydrophones are moored in the deep sound fixing and ranging (SOFAR) channel. Sound travels over large distances in the SOFAR channel, which acts as a natural duct that prevents the sound from scattering off the seafloor and also from scattering at the sea surface in most cases. Methods are presented to study the peaks, their coherence within each of the two hydrophone triads of the station and the direction from which they likely originate. The signals were assessed by analysis of the signal itself (shape, frequency, duration), statistical methods and geographical constraints. Their possible origin is explored and is inferred to likely be biological, such as marine mammals.

Primary author: LE BRAS, Ronan (CTBTO Preparatory Commission)

Presenter: LE BRAS, Ronan (CTBTO Preparatory Commission)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

and seismo-tectonic environment at regions of nuclear energetics critical facilities location in Kazakhstan

The regions of 3 research reactors location in Kazakhstan (VVR-K, IGR, IVG-1) were investigated as well as the suggested site for construction of low-enriched uranium bank to develop methodical issues for successful estimation of seismic conditions of places for designed, constructed and exploited facilities of atomic field and atomic industry. To characterize seismic activity of the earth crust at the considered facilities location, the currently effective Map of general seismic zoning (GSZ) of Kazakhstan territory was used. For the investigated facilities, the geological and tectonic, geophysical and seismological data (from ancient time to 2015) were collected and analyzed, earthquake catalogues containing 35 thousand earthquakes and 7.4 thousands earthquake focal mechanisms were compiled. The characteristics of background seismicity and seismic and tectonic conditions for the whole observation period and current period by monitoring data are provided. Periodic variations of seismic and tectonic parameters and its relation to seismic mode of the Northern Tien Shan region where VVR-K reactor is located were determined. Specific features of the strain-stress state parameters before a large earthquake realization were revealed.

Primary author: POLESHKO, Natalya (Institute of Geophysical Researches)

Presenter: POLESHKO, Natalya (Institute of Geophysical Researches)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Variations in the Earthquakes Effects Based on the Bouguer Anomaly Map

Information magnitude of the earthquake effect on the affected area is a very important thing for the rescue. Besides magnitude earthquake parameters, geological information and the rock density determine the earthquake effects. The smaller density of the area, the effects of the earthquake were felt also getting bigger. The simple information on the structural conditions of a region can be obtained from Bouguer anomaly map. To generate Bouguer anomaly map which reflects the structure, we process FAA and elevation data is obtained from the web <http://topex.ucsd.edu/>. we have analyzed Some of the earthquake events using Bouguer anomaly information. The results show the same pattern of shake maps that sourced from accelerograph data. Bouguer Anomaly region associated with the lower anomaly than the epicenter area can feel the effects in spite of having a relatively farther distance, this is because the amplification effect experienced in rocks with low density (sediment). Higher Bouguer Anomaly region than the epicenter allow will not feel the effects of the earthquake were great despite having relatively close distance, this is because large damping effect on high density rock (igneous).

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Presenter: ADI MARTHA, Agustya (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Semipalatinsk Test Site Territory by Data of Kazakhstan Monitoring Network

According to the map of general seismic zoning of the Republic of Kazakhstan (2006) the territory of the Semipalatinsk Test Site is considered as aseismic. Starting from 1950 analogue seismograms of earthquakes were collected, source parameters were précised. Contemporary instrumental seismic data of Kazakhstan monitoring network from 1994, and data from temporary networks of seismic stations installed on the territory of the Test Site in 2005 – 2010 at testing sites Sary-Uzen, Balapan and Degelen (where UNE were conducted) were processed. The works resulted in creating of a unified earthquake catalogue for the STS territory and its vicinity from 1783 till present. The location of tectonic lineaments was précised using Landsat software for space images decoding, and materials of geologic and topographic surveys. The calculations show that the Test Site territory can actually experience the events with intensity 6 by MSK-64 scale. The works on revising the active map of seismic zoning for this territory are conducted. Field seismic stations have recorded small events at the regions where nuclear explosions were conducted; these events are considered as induced events caused by cavities collapses. It is recommended to create a permanent network of seismic monitoring stations to investigate different geodynamic processes.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Botswana for the Period 1950-2016

An earthquake catalogue spanning more than six decades of instrumental observations has been assembled for Botswana and adjacent regions. Whilst the level of local seismicity in Botswana is generally low, moderate to large earthquakes have been recorded in the Okavango delta region (ODR), the largest event of which was observed on 1952 and had a local magnitude of 6.7. The motivation in creating a national seismicity database is not solely for academic research but also of further paramount practical significance in providing a wealth of information that enables seismologists and engineers to better assess the distribution, frequency, and severity of seismic hazards throughout the country for contribution in the establishment of seismic source zones and, social and economic disruption associated with the occurrence of earthquakes. The Botswana Seismological Network (BSN) was established by the Botswana Government through the Department of Geological Survey (DGS) as a national earthquake surveillance facility to undertake a long-term earthquake monitoring across the country. The seismic network data will be used in developing a comprehensive probabilistic assessment of the seismic hazard in the country to enable comprehensive ranking of earthquake-related threats and disaster risk reduction to provide input in the risk management decisions.

Primary author: NTIBINYANE, Onkgopotse (Botswana Geoscience Institute)

Presenter: NTIBINYANE, Onkgopotse (Botswana Geoscience Institute)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

and Seismotectonics of the Sudan and South Sudan

Earthquake data collected from regional and international seismological stations was compiled in order to produce a seismicity map for the Sudan and South Sudan. The seismicity and tectonic information were used to identify the relationship between the distribution of earthquakes and active geological structures and to create seismic source zones. The results showed that the study area lies within seismically-active region which can be divided into three major seismic source zones, namely the Southern Seismic Source Zone (SSSZ; $M_s=7.2$), the Northeastern Seismic Source Zone (NSSZ; $m_b=5.9$), the Central Seismic Source Zone (CSSZ; $M_s=5.5$). The SSSZ is bounded by latitudes $3^{\circ} 00'$ and $10^{\circ}00'$ N and longitudes $22^{\circ} 00'$ and $36^{\circ}00'$ E. The seismic activity with this zone is attributed to the extension of the western branch of the East African Rift System into South Sudan, or possibly related to rejuvenation of movement in the fault-bounded basins of South Sudan. The NSSZ is located to the west of the presently active seismicity along the Red Sea trough. The third zone seismicity is possibly related to rejuvenation of movement along the Central African Shear Zone (CASZ). Additional minor seismic activity is probably related to Cenozoicvolcanicity in Jebel Merra and Bayuda volcanics .

Primary author: BABIKER, Naila Mohamed Osman (Sudan National Data Center, National Center For Research)

Presenter: BABIKER, Naila Mohamed Osman (Sudan National Data Center, National Center For Research)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Information from Signals Undergoing Hydroacoustic Blockage

When the direct line of sight from a hydro-acoustic sensor to a source of an underwater sound is obstructed by land, the blocked signal may still be detected. Acoustic propagation around an island acts as a transfer function, changing the direction and duration of the sound source. Recordings made on CTBT hydro-acoustic stations in the Indian Ocean demonstrate acoustic redirection caused by islands. The transfer function of blocked signals received on the South Station of Diego Garcia is characterized by inspection of T-phases generated by sub-aqueous seismic events cataloged from 2000-2014. These signals, originating primarily along the Carlsburg Ridge, are used to build a filter to detect blocked signals. The filter identifies additional events not recorded in the catalog, providing a useful tool for study of this seismologically active area. Furthermore, the filter allows for detection of events while the north station is inoperative. The directional information and timing of features within the blocked arrival allows for an estimate of the event epicenter. This work benefits the CTBT by salvaging event detection from the blind side of an island while costly retrofits of inoperative stations are underway.

Primary author: DALL'OSTO, David (University of Washington, Applied Physics Laboratory)

Presenter: DALL'OSTO, David (University of Washington, Applied Physics Laboratory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

in the Studies on the Next Generation Cabled IMS Hydroacoustic Stations

In 2016, a study on the design of the next generation cabled hydroacoustic stations was conducted with the objective of evaluating viable architectures for the sensor package of the underwater system. The goals of this project were to: i) improve sustainability by reducing the impact of events that may negatively affect data availability, ii) facilitate reparability through modular designs and iii) develop options for non-interfering instrumentation able to improve the scientific value of IMS hydroacoustic data. The overriding requirements for all proposed concepts were the minimum 20-year design life and the fulfilment of all other CTBT operational manual specifications. Wet- and dry-mateable connector technologies, which have a proven track record in ocean engineering, make it possible to introduce different levels of modularity in order to achieve the above goals. The range of technical solution options that emerged from the study are presented together with the trade-offs vis-à-vis technical /operational complexity and related risks. The successive steps envisaged for this effort are the down-selection of options to fully meet IMS hydroacoustic network requirements and extensive prototype testing.

Primary author: ZAMPOLLI, Mario (CTBTO)

Presenter: ZAMPOLLI, Mario (CTBTO)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Tsunami Potency Determination Using Calculation of Rupture Duration (Tdur), Dominant Period (Td) and T50Ex

ABSTRACT Earthquake with magnitude ≥ 7 , epicenter in the sea, and depth <100 km, is not always able to generate a significant tsunami. It's need other parameters that can be used as an indicator of a potential tsunami, namely the duration rupture, dominant period, and T50Ex. In 2013, we develop determination of potential tsunami application with real time waveform from InaTEWS network, and then do validation for the occurrence of earthquakes in 2014. T 624 earthquake events are calculated by the system and the result is 99.19% (619 events) match with the actual events, it means the system declared no potential tsunami and no tsunami events are also in the field. Meanwhile 0.81% (5 events) are not appropriate, it means the system is expressed earthquake tsunami potential, but the reality is not a tsunami. Offline test for 28 tsunami events that occurred in Indonesia and abroad between 1994-2012, for the tsunami with wave height <1 m obtained 72.7% accuracy and for the tsunami with wave height > 1 meter accuracy of 58.82% was obtained. Determination tsunami potency using calculation of rupture duration, dominant period, T50Ex, $Td * Tdur$, $Td * T50Ex$ consistent enough to determine real time tsunami potency.

Primary author: ROHADI, Supriyanto (Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG))

Presenter: ROHADI, Supriyanto (Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Variability of Infrasound Propagation and Detectability in the European Arctic

Infrasound is a technology for verifying compliance with the Comprehensive Nuclear-Test-Ban Treaty. To quantify the capability of infrasound to detect and classify potential treaty violations, we need to assess both the detection threshold of the global network and the statistical properties of atmospheric signal propagation. Unlike seismic waves in the solid earth, infrasound propagates through an anisotropic medium in continuous motion. Different atmospheric conditions can result in qualitatively different infrasonic observations with significant differences in propagation times and the combination of phases detected. In the European Arctic, we have numerous infrasound arrays and many repeating sources of infrasound. We have compiled an extensive database of repeating, seismically constrained, Ground Truth explosions including many thousands of events and spanning almost 30 years. For each explosion, we include parametric descriptions of the infrasonic wavetrain observed at each available station. Non-detection is also a key observation for an event-station combination. Paths cover distance ranges from a few tens of kilometers to many hundreds of kilometers, an exceptional range of azimuthal directions, and observations exist for all times of year. We display and discuss changes in infrasound propagation for tropospheric, stratospheric and thermospheric phases over time-scales from days to seasons and from year-to-year.

Primary author: GIBBONS, Steven John (NORSAR)

Presenter: GIBBONS, Steven John (NORSAR)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of the IMS Hydroacoustic Station HA04, Crozet Islands, France

In December 2016, a multi-year IMS project culminated in the successful establishment of hydroacoustic station HA04 in the Crozet Islands (France). The installation of HA04 marked an important milestone for CTBTO, as it was the final (eleventh) hydroacoustic station to be installed as part of the International Monitoring System (IMS). While still in its initial testing phase, HA04 sends continuously quality data to the International Data Centre (IDC), pending official certification and promotion to mainstream operational status. An outline of the main phases of this project, highlights and lessons learned from overcoming challenges associated the remote station installation and examples of received HA04 hydroacoustic signals associated with recent underwater seismic activity and marine mammals are presented here. HA04 is scheduled to be fully integrated into the operational platform of IDC in 2017, which will enable registered researchers to access archived monitoring data either via the Virtual Data Exploitation Centre (vDEC), or via the National Data Centres (NDCs).

Primary author: HARALABUS, Georgios (CTBTO)

Presenter: HARALABUS, Georgios (CTBTO)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Hazard Assessment of the Caucasus

Modern seismic hazard assessment is one of the major concepts for sustainable development of the Caucasus region in general. Safety of the civilian population in the region as well as safe implementation of large economic projects must be protected. Prosperity in the Caucasus region, and its successful development, unconditionally depends on international projects aiming to integrate the region into leading economical structure. Earthquake hazard analysis is especially important for economically undeveloped countries, since the recovery period after strong earthquakes is very long. The main objective of this project is to improve the database for hazard calculations and develop modern and new common hazard maps for the region. The primary tasks to obtain our objective are defined as follows:
• Improvement of the shared regional database, with quality control, to include seismological, geological, geophysical, geodetic, geotechnical and other information, as well as data on critical infrastructure.
• Seismic hazard assessment based upon the newly improved database and using new methodologies. The improved database will facilitate tectonic studies, including the development of physical/mathematical models for regional seismotectonic processes. These models will incorporate active tectonic structures throughout the area, including transborder regions.

Primary author: GODOLADZE, Tea (Ilia State University)

Presenter: GODOLADZE, Tea (Ilia State University)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Characteristics of the Fram Strait

The Fram Strait is of great importance in ocean climate monitoring, as it is the only deep-water connection between the Arctic and Atlantic Oceans. An extensive array of oceanographic moorings has been operated in Fram Strait since 1996 to monitor the transports through the Strait. The small spatial scales of the flow are poorly resolved, and lead to large uncertainties. In the 2005–2010 underwater acoustic methods were introduced to improve the monitoring of Fram Strait as part of the DAMOCLES project. The 2008–2009 single acoustic path experiment was followed by the implementation of a multipurpose acoustic network (2010–2012) with a triangle of acoustic transceivers for ocean acoustic tomography, ambient noise, and glider navigation (ACOBAR project). The measurements were continued during 2014–2016 in UNDER-ICE, with eight acoustic paths crisscrossing the Fram Strait. The complex ocean environment makes acoustic tomography in Fram Strait demanding. The sound-speed field has a weak sound channel with little geometric dispersion, making it difficult to resolve and identify individual arrivals. The strong oceanographic variability in space and time reduces the coherence of the received signal and the stability of the arrival pattern. Focus will be on capabilities and challenges using acoustic observing methods.

Primary author: SAGEN, Hanne (Nansen Environmental and Remote Sensing Center)

Presenter: SAGEN, Hanne (Nansen Environmental and Remote Sensing Center)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Aimed at Enhancing the Effectiveness of Seismic Monitoring in West Kazakhstan

At the region of the west Kazakhstan there were no constant seismic observations for a long period of time. In 1994, seismic station AKTK was put into operation at the region of Mugodzhar Range; in 2005, at the same place, the auxiliary station of the IMS AS059 was installed. In 2003, a small aperture seismic array ABKAR was run. Absence of suitable velocity model for this territory, finally, led to significant events location errors. The report shows the estimation of seismic monitoring efficiency by stations AS059 and ABKAR: recording range depending on magnitude, estimation of dynamic parameters of seismic noise. Seismic sources of different nature in western Kazakhstan were analyzed; among them, the following ground-truth events were noted: records of peaceful nuclear explosions conducted in Soviet time, quarry blasts with known parameters and earthquakes recorded by a local seismic network. The travel-time curve for the western part of Kazakhstan was constructed; it was compared with the travel-time curves constructed using data of deep seismic sounding for the southern Ural and Mugodzhar, and region of Caspian depression, as well as with ak135 travel-time curve. For AS059 and ABKAR the station azimuthal and velocity corrections for separate seismically active regions were calculated.

Primary author: SOKOLOVA, Inna (Institute of Geophysical Researches)

Presenter: SOKOLOVA, Inna (Institute of Geophysical Researches)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

of NetVisa Association and Location Performance Using Ground Truth Events and RSTT Model Based SSSCs

The CTBTO's International Data Centre is in the process of implementing NetVISA to perform the automatic association and location steps in the next generation IDC software. NetVISA (Arora et al., 2013) applies a Bayesian approach with a forward physical model using probabilistic representations of the propagation, station capabilities, background seismicity and noise statistics to obtain the maximum a posteriori solution to the highly nonlinear problems of phase association and event location. By default NetVisa uses the iasp91 travel time tables to calculate the forward problem, but it will also be capable of using Source-Station Specific Corrections (SSSCs) to account for the 3D structure of the upper mantle and crust. In this study, we compare Ground Truth (GT0-5) events locations as established by the International Seismological Centre (ISC) for 2013 to the NetVisa locations, IDC's automatic Standard Event Bulletin (SEL3) and Reviewed Event Bulletin (REB), and locations obtained with the iLoc (Bondár and Storchak, 2011) software. iLoc is enabled to use travel times computed from the global 3D upper mantle model Regional Seismic Travel Times (RSTT; Myers et al., 2010), while the REB locations use empirical correction tables.

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Presenter: BONDAR, Istvan (ELKH Research Centre for Astronomy and Earth Sciences)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Measurements of Infrasonic Signal Duration Useful in the Context of Nuclear Explosion Monitoring?

Robust infrasound signal detection and association remains a challenge. False automatically generated infrasound bulletin events impact upon analyst workload at the International Data Centre, and therefore there is interest in improving association algorithms. One signal characteristic that is currently not utilized in the association process is signal duration. Results from a suite of over 40 ground truth signals, recorded on International Monitoring System infrasound arrays, show that signals that propagate along longer paths tend to have longer durations. Although the range-duration relationship is weak, the duration measurements can help identify signal associations that are non-physical given the hypothesis of a single transient source; long signals cannot have been generated at short ranges. We identify propagation conditions that result in longer, or shorter, signal durations due to the fraction of energy ducted in particular waveguides. We also examine the effects of signal-to-noise ratio on signal duration determination, a factor that is likely to limit the usefulness of a duration measurement in high noise conditions.

Primary author: GREEN, David (AWE Blacknest)

Presenter: GREEN, David (AWE Blacknest)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

'Seismic Cycle' and Occurrence of Large Earthquakes

Cyclicality in seismic activity is important for earthquake hazard studies, because these patterns may lead to the prediction of large earthquakes. The observations of temporal variation of seismic activity in Northeast India as well as Gujarat and adjoining region indicate that a periodic seismicity probably exists. In the present study, data from 1819 to 2006 of shallow earthquakes distributed over Gujarat and vicinity have been analyzed on the basis of stationary model of seismicity rates and seismic energy released in 11-years' time window, for future earthquake occurrences. Harmonic variation of seismic energy release shows a system of periodicities with predominant period in low seismicity rate intervals followed by in high seismicity rate intervals with a period of 105 years. However, the time interval of low seismicity rates is slightly larger than high seismicity rates. The frequency distribution of small magnitude (M 4.0-5.9) earthquakes follow the Poisson distribution while large earthquakes (M 6.0-7.8) follows the nonrandom distribution (exponential distribution). The non-randomness characteristics indicate that the prediction of magnitude and time of occurrences of forthcoming large earthquakes may be possible. The occurrence of large earthquakes lies on the maxima of the harmonic curve.

Primary author: SHANKER, Daya (Indian Institute of Technology Roorkee)

Presenter: SHANKER, Daya (Indian Institute of Technology Roorkee)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Detection and Cataloging of Global Explosive Volcanism Using the IMS Infrasound Network

Explosive volcanic eruptions are among the most powerful sources of infrasound observed on Earth, with recordings routinely made at ranges of hundreds to thousands of kilometers. These eruptions can also inject large volumes of ash into heavily travelled aviation routes, thus posing a significant societal and economic hazard. Detecting and counting the global occurrence of explosive volcanism helps with progress toward several goals in Earth sciences and has direct applications in volcanic hazard mitigation. We experiment with a new method to search systematically through multi-year data from the International Monitoring System (IMS) infrasound network to identify explosive volcanic eruption signals originating anywhere on Earth. We combine infrasound signal association across multiple stations with source location using a brute-force, grid-search, cross-bearings approach. We apply the method to global IMS infrasound data from 2005–2010 to construct a preliminary acoustic catalog that emphasizes sustained explosive volcanic activity (long-duration signals or sequences of impulsive transients lasting hours to days). This work represents a step toward the goal of integrating IMS infrasound data products into global volcanic eruption early warning and notification systems.

Primary author: MATOZA, Robin Samuel (University of California, Santa Barbara, CA, United States)

Presenter: MATOZA, Robin Samuel (University of California, Santa Barbara, CA, United States)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Microbaroms Detected by I17CI and I11CV in IMS Data

By using IMS data from 2009 to 2015 of I17CI and I11CV infrasound stations, we study in 0.1Hz to 0.3Hz frequency band, with GPMCC software of NDC-in-Box, the microbaroms in summer et winter periods. We find that the microbaroms detected in winter period by both station comes from the north Atlantic (upper to 30°N). In summer (Jun, July and August), the microbaroms detected are located on equatorial Atlantic band (around 15°N) near the west side of West Africa. Note that, in this zone, the ocean circulation in the upper equatorial Atlantic is composed of vigorous zonal currents. At the surface, there are branches of the North Equatorial Countercurrent (NECC) and South Equatorial Current (SEC) flowing respectively eastward and westward.

Primary author: KOUASSI, Komenan Benjamin (Station Geophysique de Lamto)

Presenter: KOUASSI, Komenan Benjamin (Station Geophysique de Lamto)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Monitoring: Finding New Populations of the Endangered Blue Whale

The blue whale remains endangered, the species has not recovered post whaling. A difficulty has been that this species is extremely hard to survey in the Southern Hemisphere. There are different blue whale subspecies, but although the subspecies look identical they are easily distinguishable by their distinctly different acoustic signals. We have been using the differences in acoustic signals to investigate the ecology of the blue whale complex. We build algorithms to detect blue whale vocalizations in the continuous multi-year (over 16-years at some sites) underwater acoustic data of the UN General Assembly CTBT Nuclear Test Ban Treaty system along with other underwater passive acoustic data collected at sites across the Southern Ocean. To date we have found two previously unknown blue whale populations around the coast of Australia, and we have found that not all Antarctic blue whales return to the Antarctic to feed in the austral summer. We have detected Antarctic blue whale vocalizations year-round in mid and low latitude northern waters and as far north as the Lau Basin. This has rewritten our understanding of this species. This information is being used by the International Whaling Commission, the international body managing the return of these endangered animals.

Primary author: ROGERS, Tracey (University of NSW, Australia)

Presenter: ROGERS, Tracey (University of NSW, Australia)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Effect in Archaeological City Jerash in Jordan

Abstract In this study we determined the local site effect by means of the horizontal-to-vertical (H/V) spectral ratios. The Nakamura's concept (Nakamura Y. 1989) is applied in JERASH city in order to determine the resonance frequencies and amplification factors for, finding the dynamic characteristics for structural engineering purposes. Results obtained in this study shows that; dominant frequencies F varies between 2.35 Hz and 3.19 Hz in the city area, while, the amplification factor A varies "between" 0.87 to 23.47. This means that structural culture in most localities of the study area might be seriously affected by any of eventually major short periodic earthquakes released by the nearby seismologic active sources westward, except of localities characterized by long periodic dominant frequencies of the study areas, considering that most structures of the study area are characterized by one to three story profiles

Primary author: OLIMAT, Waleed (Jordan Seismological Observatory)

Presenter: OLIMAT, Waleed (Jordan Seismological Observatory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Lineaments Mapping Within Karonga Area

The Karonga area is located at the top most part of Northern Malawi and Southern part of Tanzania of Rungwe volcanic region within the EARS. Structurally, the area is defined by almost N-S and NW-SE trending faults. Topographically, the area is mostly hilly and highly faulted as evident from hill shaded SRTM DEM. These faults form part of the extracted lineaments. Automatic extraction of lineaments from satellite data or images (shaded STRM DEM with different solar azimuth) was derived using the LINE Module in PCI Geomatica. LINE Module parameter adjustment for lineament extraction in PCI Geomatica was done in reference to the geology and structural setting of the area. Active lineaments were mapped by integration with seismic data for the area; this process involved defining the buffer zones around earthquake epicenters and hypocenters which were obtained by applying mathematical calculations. Analysis of active lineaments / faults within Karonga area has shown that the central-southern part of Karonga is more active than the rest of the areas; this implies that the rift in this area is opening up fast. Hence further research should consider using geophysical methods. KEY WORDS: Automatic lineaments extraction, Active Lineaments, Satellite Data, Seismic data.

Primary author: MPHEPO, Felix Cuthbert Dulla (Geological Survey Department)

Presenter: MPHEPO, Felix Cuthbert Dulla (Geological Survey Department)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Application of the Infrasound IMS Data: Study of the Temperature and Wind Velocity Vertical Profiles in the Atmosphere

The problem of using infrasound monitoring data for sounding of the vertical profiles of wind velocity and temperature in the atmosphere is discussed. The sounding altitudes are in the range from 20 to 150 km. The surface explosions and volcano eruptions are suggested as the sources of acoustic pulses. The IMS data were analyzed for the following different events: the vapor cloud explosion occurred at an oil depot near Buncefield in the UK on 2005, December 11; the volcano Tungurahua eruptions in Ecuador; the explosions occurred on June 2, 2011, at the artillery weapon storages in Udmurtia, and the Chelyabinsk meteoroid explosion. The effective sound speed profiles were obtained. For the first time the parameters of the fine-scale layered structure of wind velocity and temperature have been estimated in the stratosphere. It is important to note that the estimates of the vertical gradients of the effective sound speed in the upper stratosphere and lower thermosphere are not available from other remote sensing methods (radars, lidars). The future prospective for using the infrasound monitoring system data is outlined.

Primary author: KULICHKOV, Sergey (A.M. Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)

Presenter: KULICHKOV, Sergey (A.M. Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

the Analysis Method of ULF Geomagnetic Data for Earthquake Precursor Monitoring in the Sumatera Region

Although the earthquake prediction is still in controversial for the seismologists, there are significant progress in the detection of earthquake precursor using geomagnetic data. We developed the Earthquake Precursor Monitoring System (EPMS) based on the geomagnetic data recorded in the Geomagnetic Stations located in the Sumatera. The seismomagnetic anomaly is calculated and analyzed weekly by using the power spectral ratio method of the Ultra Low Frequency (ULF) signal. The Anomaly is used to estimate the Magnitude and leadtime of coming potential earthquake. While the azimuthal coverage of the anomaly sources are used to determine the direction and distance of the earthquake. By running EPMS for about 03 years, we found that the system are able to predict earthquake with Magnitude > 5 from 2014 has occurred at Sumatera region. The occurrence of the predicted earthquakes are in the range of 3-24 days after the geomagnetic precursor detected and the location of the earthquakes are within the cross-section area of the azimuthal coverage between two or more stations. By using the result of 20 predicted earthquake we find an empirical formula to estimate the magnitude as the following $M=0.088Amp+0.002distance+4.334$. This results have a possibility improving monitoring the precursor of large earthquake.

Primary author: SYIROJUDIN, Muhamad Syirojudin (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Presenter: SYIROJUDIN, Muhamad Syirojudin (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Processing Technique for T-phase and Tsunami Signals Recorded by IMS Hydrophone Triplets

The IMS hydroacoustic (HA) hydrophone network monitors the world's oceans for signs of nuclear explosions since the early 2000's. The wealth of data acquired by the IMS hydroacoustic stations is also used in civil and scientific applications. The present study focuses: i) on hydrophone data recorded during the tsunamigenic 2011 Tohoku earthquake with the purpose of estimating the directivity of T-phase signals, and ii) on identifying tsunami-induced low frequency recordings from the 2015 Chile earthquake. In the first part of the study, data not including contributions from the tsunami stages are analyzed with the objective of detecting the T-phase and determining its direction of arrival. For this purpose, a new three-step process is examined to obtain a signal envelope associated with the T-phase, which makes it possible to apply F-K analysis without spatial aliasing. It is shown that using the three-step envelope processing technique, the direction of the T-phase signals acquired at the IMS hydrophone triplets can be accurately estimated. The second part of the study addresses the detectability of pressure variations associated with the tsunami itself. For the analysis of tsunami detectability, it is shown that short-period dispersive tsunami signals can be identified by the IMS hydrophone triplets.

Primary author: MATSUMOTO, Hiroyuki (Japan Agency for Marine-Earth Science and Technology (JAMSTEC))

Presenter: MATSUMOTO, Hiroyuki (Japan Agency for Marine-Earth Science and Technology (JAMSTEC))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

3D: A Global 3D Velocity Model for Improved Seismic Event Location in Nuclear Explosion Monitoring

The SALSA3D global 3D velocity model of the Earth's mantle has been developed to improve the accuracy and precision of seismic travel time predictions for a wide suite of regional and teleseismic phases. Improved travel time predictions lead directly to significant improvements in the accuracy and precision of seismic event locations as compared to locations computed using standard 1D velocity models like ak135, or 2½D models like RSTT. A key feature of SALSA3D is that path-specific model uncertainty of travel time predictions are calculated using the full 3D model covariance matrix computed during tomography, which results in more realistic uncertainty ellipses that directly reflect tomographic data coverage. The latest version of the model was constructed using data for many body-wave phases including mantle phases, core phases, reflections off the core-mantle boundary and underside reflections off the surface of the Earth. For use in routine operations, travel time predictions and prediction uncertainties are precomputed and stored in station-phase-specific 3D lookup tables, which allows fast, reliable retrieval of information needed by locators. The lookup capabilities are implemented using the open-source GeoTess software package available at <http://www.sandia.gov/geotess>.

Primary author: BALLARD, Sanford (U.S. Department of Energy, National Nuclear Security Administration)

Presenter: BALLARD, Sanford (U.S. Department of Energy, National Nuclear Security Administration)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

V4R4: Acoustic Surveillance of Hazardous Volcanic Eruptions in Asia

Tuesday, June 27, 2017 5:00 PM (15 minutes)

The ASHE Asia project is an international collaboration between National Data Centers, operational agencies, and research organizations to improve early notification of potentially hazardous eruptions in Asia and the Western Pacific. The increased availability of open seismo-acoustic data in the ASEAN region and recent advances in mobile distributed sensors networks can reduce notification latency of hazardous volcanic eruptions. We use the IMS network in combination with established technologies and next-generation smartphone sensing systems to detect and characterize eruptions in the Asia-Pacific region that can inject volcanic ash at aircraft cruising altitudes. The Volcano Explosivity Index (VEI) is an operational metric traditionally used in the monitoring community, where a VEI 4 eruption injects ash above 10 km. The initial ASHE Asia V4R4 technical objective is to automatically detect and report eruptions with a VEI 4 and above within a maximum notification latency of 4 hours (~4,000 km range). We will implement standardized metrics to provide actionable reports with the eruption location, time, duration and VEI-equivalent energy. These reports would provide relevant eruption characteristics that can be used to trigger ash dispersion models by Volcanic Ash Advisory Centres or individual meteorological services for ash and aviation safety.

Primary author: GARCES, Milton (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Presenter: GARCES, Milton (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Session Classification: T1.5 Civil, Scientific and Industrial Applications of IMS Data and IDC Products

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Deformation Revealed by GPS in Greater Caucasus, Azerbaijan

Shen et. al., 1996 method has been applied to the GPS measurements results in order to investigate crustal deformation of the Azerbaijan and surrounding areas. Compression observed along the Greater Caucasus, Gobustan, Kura depression, Nakhchivan and the border areas with Iran. Compression axis show that reduction of the Earth's crust in the Greater Caucasus happens towards N-NE direction. The maximum value of the strain rate of about 200×10^{-9} per year was observed in the area between GPS points KHID and SHIK and here compression axis sharply changes direction to the SW-NE. Extension zones are observed in the small Caucasus: in Gedebey, Shusha areas and in the area located between the GPS measurement points DAMO and the PIRM in Iran, where the dilatation rate reaches 100×10^{-9} per year. The zone of the epicenters of strong earthquakes is correlated to the gradient zone in the crustal strain rates. The analysis of GPS data for the territory of Azerbaijan and neighboring countries reveals the heterogeneous patterns of strain field in the region. The increase in the number of continuous GPS stations would promote increasing the degree of detail in the reconstructions of the deformation field and identifying the microplate boundaries.

Primary author: SAFAROV, Rafiq (Institute of Geology and Geophysics, Azerbaijan National Academy of Sciences)

Presenter: SAFAROV, Rafiq (Institute of Geology and Geophysics, Azerbaijan National Academy of Sciences)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

- and S-Wave Receiver Function Study of the Crust and Mantle Structure Beneath the Transbaikalia

In this study we present preliminary results on the structure of the crust and upper mantle in Transbaikalia. The research area lies within the Baikal Rift Zone. We present research based on data collected by seismic stations of the Selenginskaya local network during 2-5 years. We use the receiver function (RF) technique in the LQT ray-oriented coordinate system (Vinnik, 1977). The seismic records from distant earthquakes are uniformly filtered, deconvolved and stacked using appropriate moveout corrections. We used events with a magnitude ≥ 5.5 Mw and epicentral distances range from 35 to 90 degrees. This technique allows us to constrain crustal and mantle structures and determine the Moho depth around stations by analyzing the Ps and Sp converted phases generated at discontinuities in the earth interior. The converted phases of P410s and P660s arrived later than predicted by global model which may indicate lower velocities in the upper mantle. We present preliminary interpretation of 1D P- and S-wave velocity models up to a depth of 350 km in terms of the complex tectonic and geodynamic evolution of the Baikal Rift Zone. Further studies will include joint P and S receiver function analysis of this area along the profile.

Primary author: TCYDYPOVA, Larisa (Geological Institute of Siberian Branch of Russian Academy of Sciences (GIN SB RAS))

Presenter: TCYDYPOVA, Larisa (Geological Institute of Siberian Branch of Russian Academy of Sciences (GIN SB RAS))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Results of Recording Infrasound and Internal Gravity Waves from Atmospheric Fronts

The infrasound data from atmospheric storms obtained at the I43 IMS station were analyzed. The corresponding data of infrasound and internal gravity waves at the group of microbarographs in Moscow region were analyzed. The infrasound at a frequency of about 0.3 Hz from convective storms during August 12, 2016 was observed. The corresponding results of recording internal gravity waves from atmospheric storms are presented. The recordings are carried out by four microbarographs of Obukhov Institute of Atmospheric Physics RAS in Moscow. The distance between four microbarographs is from 7 to 54 kilometers. It was detected fluctuations of atmospheric pressure during the approach of atmospheric storm to the registration network and then its passing. The regularity of changes in the parameters of internal gravity waves (coherence, azimuth arrival, amplitude and horizontal velocity of propagation waves) is obtained. The high coherence of internal gravity waves between points registration separated by 60 kilometers in the periods of more than 30 minutes is obtained.

Primary author: GOLIKOVA, Elena (A.M. Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)

Presenter: GOLIKOVA, Elena (A.M. Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Results Obtained from Data of Kazakhstan Seismic Arrays

The first decade of XXI was noted by running of five new seismic arrays on the territory of Kazakhstan. Its construction and operation is the result of the international cooperation of the IGR with the CTBTO and AFTAC. The arrays contribution into global and regional monitoring is very significant. In the system of international monitoring, Kazakhstan seismic arrays are among the most efficient in the world. These arrays have recorded five nuclear tests, detect and process events all over the world, its operative data are used by different International Data Centers. For the regional seismology there are three main fields of effective application of the array data: 1- seismic monitoring of earthquakes and industrial blasts at the whole territory of Kazakhstan including the regions that were earlier considered as aseismic; 2 – identification of new types of seismic sources (natural and technogenous) and its parametrization; 3 – scientific investigations on detailed analysis of the wave structure of earthquake records to obtain new data on forming of “distant” coda of Lg-waves. In all fields the important scientific results were obtained in cooperation with colleagues from other countries (Norway, USA, France).

Primary author: MIKHAILOVA, Natalya (Institute of Geophysical Researches)

Presenter: MIKHAILOVA, Natalya (Institute of Geophysical Researches)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Stress State of Caucasus (Azerbaijan) Based on the Maximum Horizontal Stress Orientations and "World Stress Map" Technique

Caucasus is prone to stress-related geohazards because of its tectonic setting and the high overpressures. Here we analyze and model the effect of local topography anomaly on the stress-strain formation of the Caucasus lithosphere (Azerbaijan). Technique is based on numerical analysis with finite element modeling. The model results show that the stress orientations are influenced by the combination of topography and crust thickness distribution even at very large depth. Western Caucasus shows a N-S to NNE-SSW stress orientation. The results also suggest that the Lesser Caucasus and Kur depression are rotating coherently, with little or no internal deformation in a counter-clockwise rotation located near the north-eastern corner of the Black Sea. The comparative analysis of the stress orientations was performed with the focal mechanism solution map of the earthquakes occurred in Azerbaijan during 1998-2016 period using the CASMO technique ("World stress map"). Orientation of stress axes well consistent with earthquake focal mechanisms revealed that within Upper and Lower Crusts earthquakes are predominantly thrust-faulting with a number of normal-faulting and a few of strike-slip faulting.

Primary author: BABAYEV, Gulam (Institute of Geology and Geophysics, Azerbaijan National Academy of Sciences)

Presenter: BABAYEV, Gulam (Institute of Geology and Geophysics, Azerbaijan National Academy of Sciences)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-Scale Joint Body and Surface Wave Tomography with Vertical Transverse Isotropy for Seismic Monitoring Applications

We continue to develop more advanced models of Earth's global seismic structure with specific focus on improving predictive capabilities for future seismic events. Our most recent version of the model combines high-quality P and S wave body-wave travel times and surface-wave group and phase velocities into a joint (simultaneous) inversion process to tomographically image Earth's crust and mantle. The new model adds anisotropy (in the form of vertical transverse isotropy) to the model, which is necessitated by the addition of surface waves to the tomographic data set. The explicit Earth model design allows for accurate travel time computation using our unique 3D ray tracing algorithms, capable of ray tracing more than 20 distinct seismic phases including crustal, regional, teleseismic, and core phases. Thus, we can now incorporate certain secondary (and sometimes exotic) phases into source location determination and other analyses. New work on model uncertainty quantification assesses the error covariance of the model, which when completed will enable calculation of path-specific estimates of uncertainty for travel times computed using our previous model (LLNL-G3D-JPS), which is available to the monitoring and broader research community and for which we encourage external evaluation and validation.

Primary author: MYERS, Stephen (Lawrence Livermore National Laboratory)

Presenter: MYERS, Stephen (Lawrence Livermore National Laboratory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Atmospheric Transport Modelling: Determining the Source Location, Source Term and Its Uncertainty Quantification

Atmospheric transport modelling allows to determine the possible source regions of airborne radionuclides measured by for instance the International Monitoring System. This makes it a valuable tool for the verification of the CTBT. However, the output from such models contain uncertainties that are difficult to quantify. Given the importance of a correct interpretation of the ATM output, an uncertainty quantification is desired. We have used the atmospheric transport model Flexpart to backtrack observed and fictitious radioxenon concentrations from the International Monitoring System. A method for determining the source location and source term will be described, together with its uncertainty quantification. The latter is achieved by applying the ensemble method: use has been made of the ensemble data assimilation product of the European Centre for Medium-range Weather Forecasts (ECMWF). The ensemble consists of 51 equally likely meteorological scenarios and allows to quantify uncertainty on the simulations.

Primary author: DE MEUTTER, Pieter (Belgian Nuclear Research Centre)

Presenter: DE MEUTTER, Pieter (Belgian Nuclear Research Centre)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

on Earthquake Relocation Using Modified Joint Hypocenter Determination (MJHD) and Double Difference (DD) (Case Study of Kebumen Earthquake 25 January 2014 in Mw: 6.2)

In order to obtain earthquake locations of high fidelity it is important to perform hypocenter relocation accurately with an appropriate methodology. This is because errors due to the velocity structure model cannot be minimized when determining the hypocenter. In this study, the Kebumen earthquake of January 25, 2014 and its aftershocks were relocated using both MJHD and Double Difference methods. The data used were the arrival time readings taken from the earthquake catalog of the Meteorology, Climatology and Geophysics Agency (BMKG) from 25 January 2014 to 10 February 2014 in a region bounded by 6.23 – 10.23 south latitude and 107.2 – 111.2 east longitude. The BMKG catalogue location was then relocated using MJHD and Double Difference methods. The end result of this relocation showed a major earthquake hypocenter position using the MJHD method at -8.416 south latitude – 109.219 east longitude at a depth of 58.03 km, whereas the Double Difference method yielded location at -8.23 south latitude – 109.19 east longitude at a depth of 86.6 km. The results also indicated that the Kebumen earthquake of January 25, 2014 was an intraslab event that occurred in the Wadati Benioff zone.

Primary author: GINTING, Mira (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Presenter: GINTING, Mira (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Relationship Between Deformation Area and Moment Magnitude (M_w) of Earthquake in Subduction Zone of Indo-Australian Plate

Indonesia is known as a region that has a unique structure and complex geology. This because Indonesia is a located at triple junction plate convergence: Indo-Australian plate relative moves to north, Euarasian Plate to south and Pasific plate to west. As a result of these condition, in this junction between plate and the area of the active faults frequently earthquakes. In this study, the data used from USGS 1977-2009. From the data sources can be collected the earthquakes with magnitude $M \geq 5.0$ that occurred along the Indo-Australian plate. From the calculations, the constants a and b in this equation either use the moment magnitude and surface magnitude is equal to 5.67, 0.573682673. So the equation be: $\text{Log } A = 5.87 - 0.573682673 M$.

Primary author: GINTING, Mira (NDC Meteorology Climatology and Geophysics Agency (BMKG))

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Social Media to Aid in the Refinement and Understanding of Seismic and Acoustic Ground Truth Information

Tuesday, June 27, 2017 6:15 PM (15 minutes)

Anthropogenic events of interest to the nuclear treaty monitoring community are typically observed seismically and in some instances acoustically. The number of these events seem to be ever increasing as additional sensors continue to be installed and existing stations are tuned to improve detection capability. The use of non-traditional data sources, such as social media, can corroborate geophysical detection network data. For example, the U.S. Geological Survey's use of Twitter to track earthquakes in populated areas as an alternative data source can aid in situational awareness of ground shaking intensity. The USGS can use social media such as Twitter to alert them before the earthquake is detected by their sensors. These types of alerts help aid the timeliness of first responders to the scene. We incorporate social media into the analysis of events to better characterize sources observed in waveform data sets. This could potentially assist in identifying previously unknown sources and may enhance the scientific community's ground truth data collections.

Primary author: HERTZOG, Justin (ENSCO)

Presenter: HERTZOG, Justin (ENSCO)

Session Classification: T1.5 Civil, Scientific and Industrial Applications of IMS Data and IDC Products

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Naturally Occurring Radionuclides in Paleobeach Groundwater Aquifers in Cox's Bazar, Bangladesh, For Up To 3 Years: Insight into Formation Mechanism

Monitoring of geochemical groundwater parameters was carried out in twenty tubewells with depths ranging from 3 to 103m located in and around the Cox's Bazar paleobeach areas during the period of June 2012, June 2013 and May 2016. Results showed that radionuclides i.e., U and Th concentrations over the period of three years varied with fluctuation in pH and Eh. Concentrations of U (0.09-9.57 $\mu\text{g/l}$) and Th (0.02-127.09 $\mu\text{g/l}$) in 2013 were much greater than in 2012 (0.01-3.40 $\mu\text{g/l}$ for U and 0.002-1.59 $\mu\text{g/l}$ for Th). Likewise, slightly high values of Eh and pH were observed in 2013 (0.11-0.61V and 7.52-8.47) than in 2012 (0.26-0.47V and 6.56-8.30) respectively. Thereafter, samples in 2016 have lower concentrations of U (0.11-5.93 $\mu\text{g/l}$) and Th (0.01-8.33 $\mu\text{g/l}$) than in 2013; the values still slightly higher than those in 2012. Eh of 2016 samples was high (0.46-0.68V) and pH ranged from 6.40 to 7.67. A significant correlation of radionuclides contents with groundwater level, electrical conductivity and concentrations of Ca, Mg, Na, K, and Cl indicates influence of seawater. The trends and behavior of radionuclides contamination will assist in finding suitable methods and techniques for radionuclides remediation. Further study is required to evaluate the health consequences of radionuclides exposure to the groundwater-dependent communities.

Primary author: SEDDIQUE, Ashraf Ali (Dept. of Environmental Science and Engineering, Jatiya Kabi Kazi Nazrul Islam University, Mymensingh 2204, Bangladesh)

Presenter: SEDDIQUE, Ashraf Ali (Dept. of Environmental Science and Engineering, Jatiya Kabi Kazi Nazrul Islam University, Mymensingh 2204, Bangladesh)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Processing of Pressure Pulsations and Wind Velocity Data at Infrasound Stations

Results have been obtained that make it possible to detect infrasound signals based on minimization of false alarm probability using data from pressure and wind velocity measurement channels. An algorithm for creating a multichannel selector performance characteristic has been developed using likelihood ratio as per results of background measurements at the pressure and wind velocity channels as well as modeling acoustic signals in infrasound frequency range. Joint processing is based on methods presented at the SnT2015 in Vienna. It uses the principle of maximization of likelihood ratio Λ with joint recording of pressure pulsations and wind velocity. This method uses the product of conditional probabilities for independent functionals Φ_1, Φ_2 of joint recording of functional $\Phi_{\text{дет}}$ calculated on the basis of data from pressure pulsations measurement channel as an assessment criterion Λ . The Λ numerator consists of the product of probabilities $P(\Phi_i)$ calculated subject to signal S_k availability. The Λ denominator consists of the product of probabilities $P(\Phi_i)$ calculated subject to signal S_k absence.

Primary author: RYBIN, Igor (Ministry of Defence)

Presenter: RYBIN, Igor (Ministry of Defence)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Assessment of Infrasound Events in the REBs Produced in the Year 2016

Assessment of Infrasound technology event contribution towards the REB production for the year 2016 at the IDC is performed. During that year 37,090 REB events were produced using the three technologies (Infrasound, Seismic, and Hydroacoustic). To accomplish the assessment task geographical, seasonal and daily occurrence distributions are considered. Seismic only events contribution to the number of events in REB is over 90% and follows the active seismic zones. The geographical distributions show that most of the Infrasound only events are located around man-made activities. The mixed technology events (Infrasound and Seismic) are few in number and are located in few geographical locations. Seasonal occurrence distribution of Infrasound events shows that relatively less number of events occurs during the summer time. This could be due to the seasonal variation of winds. The weekly and daily distribution of these events shows that they are mainly observed during the weekdays and between 06:00-20:00 hours (UTC). These investigations indicate that most of the Infrasound events in the REB are related to man-made activities and their location and time of occurrence are fairly known. In this respect the results obtained here can be used to categorize these events and thus help allocate resources accordingly.

Primary author: ALAMNEH, Fekadu Kebede (CTBTO Preparatory Commission)

Presenter: ALAMNEH, Fekadu Kebede (CTBTO Preparatory Commission)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Evaluation of Atmospheric Flow and Transport over Complex Terrain at Multiple-Scales with Uncertainty

The simulation of atmospheric plumes requires a holistic multi-scale modeling approach accounting for uncertainty. Such an approach is needed for close-range monitoring and for simulating time-varying releases over complex topography. Our approach will accommodate variable source terms and the resolution of surface meteorological complexities through the development of advanced large-eddy simulation and immersed boundary methods for the Weather Research and Forecasting model. Predicted plume trajectories over complex terrain can diverge as temporal and spatial details are unresolved, particularly in the near-field. Our improved model facilitates better numerical representations of flow over complex terrain, capable of capturing diurnal up-slope and down-slope flow and representing a quantifiable improvement to predictions of plumes from a time-varying source in complex terrain. Uncertainty is quantified using an ensemble-based Bayesian methodology incorporating data and model perturbation. The utility of the Bayesian approach is described in detail for one multi-scale approach through a numerical weather and transport study of a tracer release experiment at a nuclear power plant in California. Here we describe our technique and how it quantifies the contribution of individual source and meteorological parameters to overall model-data variance. This work was performed under the auspices of the US DOE by LLNL under contract DE-AC52-07NA27344.

Primary author: GLASCOE, Lee (Lawrence Livermore National Laboratory)

Presenter: GLASCOE, Lee (Lawrence Livermore National Laboratory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Infrasound Records of Announced Rocket Launches

Infrasound technology as part of the verification regime plays a significant role in monitoring compliance with the CTBT. Low frequency acoustic waves under certain conditions can propagate thousands of kilometres until they arrive at infrasound arrays of the International Monitoring System (IMS). Recorded data are transmitted to the International Data Centre (IDC) and used for detection and characterization atmospheric events. Underground events like large magnitude earthquakes or surface explosions like quarry blasts may also generate infrasound signals. The aim of this study is to present a summary of infrasound records starting from the end of 2016 related to announced spaceflight activity that took place at the different space ports, i.e. Baikonur Cosmodrome, Vandenberg Air Force Base, Guiana Space Centre, Xichang Satellite Launch Centre etc. Signals detected by the IDC were recorded not only at regional distances but also at several thousands of kilometres from the source. An overview of records from certain families of launch vehicles, i.e. Long March and Soyuz provides information helping to identify and locate events occurring along the trajectory. Results of this study may facilitate analysis of signals generated by these complex infrasound sources.

Primary author: MEDINSKAYA, Tatiana (CTBTO)

Presenter: MEDINSKAYA, Tatiana (CTBTO)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Truth Procedure to Improve the Seismic Locations, Velocity Model and Focal Mechanics Bulletin for Bolivia

The seismic Ground Truth procedure proposed by Bondar et al. was applied at San Calixto Observatory not only to improve seismic location also the velocity model and focal mechanics bulleting were improved, furthermore, the deployment of temporally seismic station in our country has allowed us to have a better azimuthal coverage for seismic events. Taking advantage of IMS station LPAZ deployed at Occidental side and SIV installed at Oriental side plus the La Paz short period seismic network have let us to perform the Inversion Procedure (Kissling, 1994) to get a new velocity model which allowed us to have new focal mechanics solutions. Inside of all the process the seismic GT procedure has given us a quality control tool to enhance the daily routine and the future seismic installation to fill the gap. As results we have improved the seismic locations of at least 35 shallow seismic events which have been felt on principal cities, inside the list there are some events that can be candidates to be a GT five event.

Primary author: FERNANDEZ, Gonzalo Antonio (Observatorio San Calixto)

Presenter: FERNANDEZ, Gonzalo Antonio (Observatorio San Calixto)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of the Kathmandu Valley Sediments During the 2015 Gorkha Earthquake Sequence

The Kathmandu Valley was strongly rocked at 11:56 local time by an Mw 7.8 earthquake on 25th of April 2015. This earthquake was followed by a large number of aftershocks including the 12th May 2015 (Mw 7.3) Dolakha Earthquake. So far, the Mw 7.8 earthquake sequence has claimed more than 8500 lives and have made a large population homeless. The largest peak ground acceleration (PGA) was observed at a rock site during the M 7.8 earthquake, however velocity was smaller. On the other hand, the soil sites have recorded smaller acceleration but the velocity was comparatively large during the M 7.8 earthquake. The large velocity at the soil sites is the reason for strong shaking of the multi storey apartment buildings and the damage they sustained and comparatively smaller accelerations are responsible for the small damage of engineered low rise buildings. During other ($M > 6.0$) earthquakes the PGA at rock site are smaller and are large at soil sites. Fourier amplitude spectrum of the acceleration data reveals the predominant frequency at soil sites ranges between 0.2 to 0.3 Hz for the Mw 7.8 earthquake. Fourier amplitude spectrum reveals that, on horizontals, the high frequencies are damped rapidly above 1 Hz.

Primary author: RAJAURE, Sudhir (Department of Mines and Geology)

Presenter: RAJAURE, Sudhir (Department of Mines and Geology)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Inverse Modeling: Investigation Using Cross Appalachian Tracer Experiment (CAPTEX) Data and Ensemble Dispersion Simulations

A HYSPLIT inverse system based on 4D-Var data assimilation and a Lagrangian dispersion transfer coefficient matrix (TCM) has been developed and successfully applied to several implementations. For instance, Chai et al. (2015) recovered cesium-137 release rates from the 2011 Fukushima nuclear accident using air concentration measurements around the globe finding consistent temporal variations with the Katata et al. (2015) estimates. However, it is difficult to quantitatively evaluate the source strength estimates without knowing the exact emission rates. The Cross Appalachian Tracer Experiment (CAPTEX), consisting of perfluoro-monomethylcyclohexane (PMCH) observation data at 84 measurement sites collected from several controlled releases, provides a unique opportunity to evaluate the estimated emission sources. In this study, the HYSPLIT inverse system is tested using the CAPTEX data. In addition, ensemble HYSPLIT runs are used to provide uncertainty analyses for the source estimation. The capabilities of the HYSPLIT inverse system, such as recovering the source strength and temporal variations are evaluated. This investigation is also aimed at improving the HYSPLIT inverse system algorithm and providing insights for the source estimation results in similar applications. Chai, T., R. Draxler, and A. Stein, *Atmos. Environ.*, 106, 241-251, doi:10.1016/j.atmosenv.2015.01.070, 2015 Katata, G., et al., *Chem. Phys.*, 15, 1029-1070, doi:10.5194/acp-15-1029-2015, 2015.

Primary author: CHAI, Tianfeng (University of Maryland)

Presenter: CHAI, Tianfeng (University of Maryland)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Small-Scale Radioxenon Sources on the Background Levels at CTBT IMS Monitoring Stations

In the past, the impact of a major regional radioxenon emitter on the detections at International Monitoring System (IMS) noble gas systems were examined in two atmospheric transport (ATM) challenges. These two International challenges defined the task to predict the impact of known radioxenon releases from a strong regional source on radionuclide stations of the CTBT International Monitoring System (IMS). It has been shown that the availability of stack emission data greatly increases the capability to emulate major peaks in the detected time series. However, detections of low concentrations cannot always be explained with emissions from the major regional emitter, but rather with low emissions from numerous sources. Data from the ATM challenges of 2015 and 2016 are used to assess the overall improvement from considering not only one major emitter, but also numerous small-scale sources.

Primary author: SCHOEPPNER, Michael (University of Natural Resources and Applied Life Sciences (BOKU))

Presenter: SCHOEPPNER, Michael (University of Natural Resources and Applied Life Sciences (BOKU))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Safety: An Important Contribution of CTBT Seismic Monitoring Data

The CTBT provides a robust monitoring and verification regime for the ban on nuclear test explosions established by the United Nations member states. The Treaty employs four global monitoring technologies namely seismic, hydroacoustic, infrasound and radionuclide to monitor and detect any signs of nuclear explosions anywhere on the planet. Provisional Technical Secretariat (PTS) data and products generated from the monitoring system have additional non-verification-related applications in civil, scientific and industrial uses. Seismic monitoring data is one of such beneficial service the CTBT offers to it State Signatories for public good application in the area of earthquake hazard assessment for Ghana. NDC-Ghana regularly accesses and compiles seismic events data registered on the seismo-acoustic networks of IMS for the country, since earthquakes are one of the natural seismic signals regularly detected. This data in addition to the national earthquake monitoring means will be used to update and identify seismically prone areas of the country. Creating public knowledge about earthquake prone areas and the level of vulnerability to lives and properties in an earthquake event is key in earthquake safety planning.

Primary author: AMARTEY, Edmund Okoe (Ghana Atomic Energy Commission)

Presenter: AMARTEY, Edmund Okoe (Ghana Atomic Energy Commission)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Recent Plentiful Detections at H03 and H11

Throughout November 2016, and in January 2017, the IMS H03 (Juan Fernandez, Chile) hydroacoustic station detected prolonged series of short-duration high-frequency signals at an approximate 1 minute interval, consistent with an off-coast ship-based survey. The signals could also be observed, at much attenuated level, at the H11 (Wake Island, US) station. The quantity of signals and their SNR at H03 are exceptional. The SNR at H11 was high enough to record many events at both H03 and H11. This allows for various venues of analysis and means of verifying station performance not normally available. We will present these analyses and explore apparent artifacts (temporally correlated detections at very different azimuth ranges and azimuth quantization) and their causation.

Primary author: BROUWER, Albert (International Institute for Applied Systems Analysis)

Presenter: BROUWER, Albert (International Institute for Applied Systems Analysis)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Analysis and Forecast Uncertainty

Depending on the prevailing weather conditions, the future weather can be anything from very predictable to very unpredictable. “Ensemble forecasts” (essentially many forecasts started from slightly different initial conditions) aim to represent this varying level of uncertainty (arising from the effects of Chaos). Because ensemble forecasts give us a range of possible outcomes, they cannot in general be “wrong” or “right” in the conventional sense. My talk will try to address three questions: How do we evaluate ensemble (or probabilistic) forecasts? What are the key aspects we need to get right? How well have we improved over the years? I will suggest that a focus on very short forecast ranges provides the best method to diagnose how well we represent flow-dependent uncertainty in analyses and forecasts.

Primary author: RODWELL, Mark (European Centre for Medium-Range Weather Forecasts (ECMWF), Reading, United Kingdom)

Presenter: RODWELL, Mark (European Centre for Medium-Range Weather Forecasts (ECMWF), Reading, United Kingdom)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Implications of the 20 May 1990 South Sudan Earthquake

The south Sudan earthquake of May 20, 1990 is so far among the three strongest ($M_w \geq 7.0$) earthquakes to occur in the eastern part of Africa since 1910 and was accompanied by two aftershocks on May 24, 1990 ($M_w = 6.5$ and 7.1). Results of teleseismic body-waves inversion show that the best solution for the May 20, 1990 south Sudan earthquake consists of only one event on a fault having strike, dip and rake of $315^\circ/84^\circ/-30^\circ$, and the fault plane is characterized by left-lateral strike-slip fault mechanism. The left-lateral strike-slip fault mechanism which is consistent with that of the January 6, 1928 Subukia earthquake in central Kenya ($M_s = 6.9$), as well as the distribution of historical earthquakes from south Sudan through central Kenya shows NW-SE alignment of epicenters. The NW-SE alignment of epicenters is characterized by earthquakes of local magnitude $M_l \geq 4.0$, except the January 6, 1928 Subukia earthquake, consistent with the trend of Aswa-Nyangia transform fault zone. From these results, it is evident that these two earthquakes are not necessarily due to the normal faulting of the East African Rift System but rather due to the strike-slip fault motion of the NW-SE trending fault zones.

Primary author: MULWA, Josphat Kyalo (University of Nairobi, Department of Geology)

Presenter: MULWA, Josphat Kyalo (University of Nairobi, Department of Geology)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of the IMS Seismic Stations and Products in Localization of the 28 March 2016 Okavango Delta Event

The event in the Okavango Delta region of Botswana was the largest of the year 2016. The shaking was felt and reported by people living in the surrounding areas. Although the tremor was relatively small (3.7 ML Magnitude), the event prompt for study of the Kunyere and Thamalakane faults which together represent a southwestern extension of the East Africa Rift System (Modisi et al., 2000). The focal region was localized using seismographs from the IMS stations located in Southern Africa, supplemented by recordings from the South African National Digital Seismic System. The combined datasets from the different seismic networks provided improved observational and azimuthal coverage, and improved event location, showing the usefulness of data sharing, collaborative problem solving and regional cooperation in promoting preparedness. Moreover, the present work demonstrates the potential of IMS data for civil and scientific applications and its contribution to the global promotion of benefits from the CTBTO.

Primary author: NTIBINYANE, Onkgopotse (Botswana Geoscience Institute)

Presenter: NTIBINYANE, Onkgopotse (Botswana Geoscience Institute)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Seismic Wave Amplification Based on Comparison Between Surface and Bedrock Peak Ground Acceleration (PGA) (Case Study: Java Island)

The amplification of seismic wave is different from one location to another. This occurs because of differences in the thickness of sediment on top of bedrock. The aims of this researchs are to find an amplification value at each station and to determine areas which soft or hard soil. Area of this research is in Java with the coordinates of 5° S - 12° S and 105° E - 115° E. Using a simple method to obtain amplification value that is based on comparison of the PGA value at the surface with the Young empirical formula for bedrock. The results are amplification value of each point sensor stations ranged from 0.23 to 11.14. The largest value of amplification (thick sediment layer) is 11.14 located at JCJI station in the Jatiwangi, Cirebon, West Java and the smallest value of amplification (thin sediment layer) is 0.23 located at CTJI station in Tegal, Central Java.

Primary author: GINTING, Mira (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Presenter: GINTING, Mira (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Control on Noble Gas Migration

An important component of monitoring underground nuclear explosions is a realistic understanding of the non-prompt post-detonation processes and changes in the environment that produce observable physical and radio-chemical signatures. As such, the material and fracture properties that are brought to bear on noble gas migration within various lithologies is essential. Here we present an empirical methodology to measure noble gas breakthrough on tuffs and rhyolitic lavas. Gas concentration curves are compared with microfracture networks analyzed by microscopy and computed tomography (CT). After release upstream from the sample, a quadrupole mass spectrometer is used to measure nitrogen, argon, xenon, and sulfur-hexafluoride downstream of the sample in real time, allowing the time-series arrival curves for each gas to be determined for each sample. Along with comprehensive material and fracture property analyses, the parameters derived from noble gas experiments will provide invaluable insight into the three-dimensional structure of damage zones, the production of temporally variable signatures and the methods to best detect underground nuclear explosion signatures. Finally, this work provides critical information for predictive modeling capabilities.

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Presenter: BROOME, Scott (U.S. Department of Energy, National Nuclear Security Administration)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Design Architecture of DONET Sea-Floor Observatory Network

DONET, i.e. the Dense Ocean-floor Network system for Earthquakes and Tsunamis is the first real-time seafloor observatory network monitoring earthquake and tsunami with high-accuracy, high-density, and large-scale in the seismogenic zone. It consists of various geophysical sensors such as seismometers and pressure sensors connected with submarine cable. DONET uses the state-of-the-art technologies in the system in order to achieve sustainable seafloor observatory network, for which three functional components are employed; “high reliable backbone cable system”, “maintainable science node”, and “expandable observatory”. To assemble these components in the system, modular architecture has been designed in contrast to the conventional in-lined linear seafloor network. Hybrid wet-mate connectors are used between each component, which allows us to do easy maintenance of the observatory by ROV. Science node which plays an important role as a hub-to-spoke function can also make it possible to increase/separate observatory flexibly. The first DONET has been deployed in 2010 followed by the second DONET in 2016. 51 observatories are now in operation in DONET, and their data availability rate keeps more than 90 % since the deployment. Success of DONET development can contribute to new generation’s seafloor observatory to be deployed in the future in the world’s oceans.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Calibration of Ground-Truth Events from Stochastic Models

In infrasound propagation modelling, we face a large number of models with only a limited number of recorded signals to conduct statistical inference. Typically, standard practice consists of selecting atmospheric and propagation models from a class of models and then proceeding as if the selected models (or slightly perturbed versions of them) had generated the recorded signal. Such an approach ignores the uncertainties in model selection. While prediction of acoustic signals is a complex issue due to the random nature of atmospheric conditions, it turns out that sound propagates through a particular atmospheric state that can be somehow different than the retained atmospheric specification. In this work, we resort on atmospheric and propagation reduced models provided by platform FLOWS and use a bayesian approach as a basis for inference. This approach offers a systematic method for checking the robustness of energy estimates to alternative atmospheric and propagation models. The overall performance of this method is demonstrated using several ground truth events of specific concern for the verification regime. In addition, our results show that the use of stochastic reduced models in combination with a bayesian approach provides posterior distributions of event characteristics at low cost.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Structure of the Amazon Craton, Brazil

The study of crustal thickness provides valuable information about the geology of a certain region, such as crustal composition, formation dynamics and tectonic evolution. Furthermore, it serves as an initial reference for velocity models. In order to fill out crustal information gaps in the Brazilian North and Central-West regions, Receiver Function and the H-k stacking techniques were applied to seismological data of 47 broadband stations to estimate crustal thickness and VP/VS ratio. The results indicate a predominantly felsic crust, with VP/VS around 1.72, and a mean thickness of 38,7 km, ranging from 27.4 to 55.3 km. The interpolation of our data with other crustal thickness 100 points obtained in the literature made possible the delimitation of the Amazon Craton, with a thickness generally exceeding 37 km and the identification of its possible nuclei, as well as that of the Paraná Basin, known as the Paranapanema Block. The craton geometry are in accordance with the natural seismicity, which accompanies its boundaries. The sedimentary basins that undergo some stretching process have a thinner crust, usually less than 37 km. Due to the great variability of the results, it was not possible to stipulate a characteristic value for each structural province.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Tsunami Modelling of the 2 March 2016 Southwest of Sumatra Earthquake (M = 7.8)

The M 7.8 Southwest of Sumatra earthquake occurred in Indian ocean was around 682 km from Mentawai Island. The USGS reported the earthquake occurred at 12:49 UTC, 4.908°S – 94.275°E, with a depth of 24 km. The earthquake felt by people in Padang city and surroundings area. This intraplate earthquake had a strike-slip faulting mechanism and generate the small tsunami. To investigate tsunami in detail, we make numerical tsunami modeling. We estimates the fault length was 200 km and the width was 80 km. We used focal mechanism parameter from W-Phase inversion with strike, dip, rake = 274°, 84°, 169°. To validate our result, we used tsunami wave that was recorded on Indian Ocean coastal sea level gauges, they are Cocos, Christmas Islands, Tanahbala, Gan, Male, and Hanimadhoo.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

on the Volcanic Parameter System with Infrasonic Data

Powerful volcanic eruptions, such as those of Calbuco in 2015, or Eyjafjallajökull in 2010, may cause disturbances in the different atmospheric layers. These eruptions are measured by infrasonic stations and analyzed in order to extract parametric data best characterize the volcanic source. The remote monitoring of volcanic activity with infrasound is of interest to Volcanic Ash Advisory Centres (VAACs) that are responsible for monitoring, modelling and disseminating information on volcanic ash clouds that may endanger aviation. The synergy between the CTBTO and ARISE (Atmospheric dynamics Research Infrastructure in Europe) partners offers a unique opportunity for the establishment of a Volcanic Parameter System (VPS) using infrasound data from a global station network. The VPS makes best use of the infrasound component of the IMS together with the operational capabilities of the IDC. ARISE advanced products provides valuable parametric inputs on the atmosphere dynamics driving infrasound wave propagation. These results may serve as quality indicators increasing VAACs confidence when receiving notification messages. The proposed approach is tested on CTBTO vDEC (virtual Data Exploitation Centre) with VAAC Toulouse, designated by the International Civil Aviation Organization (ICAO), and demonstrates on a specific dataset the usefulness of infrasonic data to International Airways Volcano Watch.

Primary author: MIALLE, Pierrick (CTBTO Preparatory Commission)

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-Range Infrasound Detections of Volcanic Activity by IS42 Station, Azores, Portugal

IS42 is located in the Azores islands, in the middle of the North Atlantic and is one of International Monitoring System (IMS) infrasound stations, able to detect reliably 1-kiloton explosions at ranges of up to 3000 km or more. On the behalf of the ARISE2 project, collaborative research between UNIFI and the University of the Azores, towards the characterization of extreme atmospheric events, allow to analyze detections on the station records attributed to the eruptive activity of Grímsvötn and Mt. Etna volcanoes, in Iceland and Italy respectively.

Grímsvötn volcano is the most active Icelandic volcano, located under the Vatnajökull glacier on the center of the active NE rift zone of Iceland. Its last eruption, on May 2011, caused severe impact in the aviation traffic in Northwestern Europe and the North Atlantic. The eruption broke the ice cover and became subaerial explosive, ejecting volcanic ash into the atmosphere. A network of 4 infrasound arrays is installed in Iceland to monitor volcanic activity on the behalf of the collaboration between the Icelandic Meteorological Office (IMO) and the University of Florence (UNIFI) (Kristin, et al., 2015). We present the long-range detections of the May 2011 eruptive activity recorded at IS42.

Mt. Etna is the largest and most active volcano of Europe, located in NE region of Sicily Island, Southern Italy. Its recent volcanic activity is typically effusive with explosive episodes and lava fountaining, with often-large ash ejection in the atmosphere which generate weak (<20 Pa at 6 km) infrasound (Ulivieri, et al. 2013). In the period between December 2015 and May 2016, two large explosive phases occurred. We show how the second episode

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Cables Sensing the Pulse of the Planet

A Joint Task Force sponsored by three UN agencies—International Telecommunication Union, the World Meteorological Organization and the Intergovernmental Oceanographic Commission of UNESCO—is leading an effort for integrating environmental monitoring sensors into transoceanic commercial submarine telecommunication cables, extending their capabilities beyond transoceanic telemetry. These are called SMART Cables – Science Monitoring And Reliable Communications. The initiative addresses two issues of importance to science and society: a) the need for sustained climate-quality data from the oceans; and b) the need to increase the reliability, integrity, and scope of the global tsunami warning network. To ‘keep it simple’, the initial focus is upon integrating sensors for temperature, pressure, and acceleration; additional sensing and infrastructure capabilities are considered for the future. Several science workshops have reviewed and endorsed the SMART cable concept and modeling studies are underway; several paths are being pursued for pilot systems. The initiative, currently at the concept stage, has the potential of providing a first order addition to the ocean and earth observing system, with unique contributions that will strengthen and complement existing systems. See <http://www.itu.int/en/ITU-T/climatechange/task-force-sc>.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

and Concentrations of Cs-137 in Kuwait

Abstract The RN40 is located on the Southern shore of the Kuwaiti Bay. The station maintains a data sharing relationship with the International Data Center (IDC). It upholds its own share of the bargain, by gathering data on radionuclides and its correlates, and as well, sharing this data with the IDC. The Comprehensive Nuclear-Test-Ban Treaty (CTBT), alongside its function of gathering data, also monitors a lot of fission products. Chief amongst these products is the Cs-137. This fission product has been found to have a half-life of 30.17 years. There are few studies that investigated the existence and concentration of Cs-137 in Kuwait. However, the most recent study that looked at this issue is 17 years old. This makes it important to look at the recent available data from the RN40, so as to lay it side by side, with previous data as have been collected over the years. In view of this, the study here-in, studies the concentration of Cs-137 in Kuwait, and in due course, comparing the recent available data with the data as made available from previous studies, over the years.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Radionuclide Particulate Monitoring in Indonesia

Natural radionuclides essentially a lot of in the environment and along with the use of nuclear technology in various fields would increase the concentration of radionuclides in nature that can causing environmental contamination and it is necessary for monitoring radionuclides in the environment. radionuclides particulate monitoring in Indonesia is aimed determining the ambient concentrations of radionuclides and monitoring of radioactive substances in case of contamination either in Indonesia or coming from outside Indonesia such as the impact of Fukushima accident or nuclear experiments from other countries. In Indonesia has installed radionuclides stations in Jakarta 25 Km from G.A Siwabessy Research Nuclear Reactor. Radionuclide particulate stations is complemented by Snow White JL-900 High volume sampler, Ultra Low background HPGe detector with 60% efficiency from ORTEC that follow the standards CTBTO and sampling was conducted two times a week for 24 hours of measurement. for monitoring particulate air radioactivity in other areas such as Bali, pekanbaru and Bogor used SIBATA High volume sampler. the results obtained some radionuclides such as Pb-210, Be-7, Ra-226, Th-232, Cs-137, K-40 with various concentrations.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

More of the Earth Via Sensors on Transoceanic Telecommunications Cables

Our work is motivated by a partnership between the International Telecommunication Union (ITU), the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (UNESCO/IOC), and the World Meteorological Organization (WMO) that is working towards integration of seismic sensors into the next generation of transoceanic telecommunication cables. These Sensor Enabled Scientific Monitoring And Reliable Telecommunications (SMART) cable systems offer the potential to improve global geophysical models as well as reduce event detection thresholds and location uncertainties. We present a preliminary picture of the improvement to global seismic sampling through SMART cables and their sensors. We present results for forward ray tracing through AK135 for first-arriving P-waves for paths between 0 and 90 degree distances. We have selected earthquakes of magnitude 6 and larger, recorded by current and former seismic receivers around the globe. To reduce raypath redundancy and computational burden we have used only one source and one receiver per 1-degree by 100 km depth cell. Results are presented as a function of ray density, saturating at 100 rays per cell. We compare ray density obtained for current global seismic station distribution to that afforded by the addition of seismic sensors along the first generation of SMART cables.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

for Characterizing Meteors from Infrasound Signals

Within the last few years recent theoretical models have enabled better estimates of meteor-generated infrasounds, thus enabling enhanced descriptions of past events such as the Carancas and Chelyabinsk meteor falls. These models are often derived by employing weakly-nonlinear Whitham's approximations to Burgers equation. Even though it is known how to incorporate the effect of strongly-nonlinear waves that emanate from meteor sources, the use of such theory has been restricted to cases in which the underlying atmosphere is deterministic and in cases in which dispersion is ignored. In the pursuit of the most suitable model for application of CTBT validation, it has been deemed necessary to include random small-scale perturbations (gravity waves, turbulence) within the available atmospheric specifications. Moreover, addition of dispersion phenomena in nonlinear models becomes important when considering long-range infrasound propagation problems and has not been thoroughly studied. In this work, we introduce and comparatively analyze results developed from nonlinear models that include dispersion and atmospheric randomness and discuss how such an analysis can benefit future characterization of meteor sources. Theoretical trends are compared to numerical results obtained by solving a generalized Burgers equation with a Fourier-Galerkin spectral numerical scheme.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Focal Mechanisms in Poorly Known Velocity Models: Inverting Waveform Envelopes

Source characterization of low-magnitude seismic events (M 4-5) is very important for intraplate seismicity studies, like in Brazil. The events are often recorded just in a few regional seismic stations (>300 km), and, velocity models are highly uncertain. We propose determination of moment tensors with the application of a new technique – the waveform envelopes inversion, pre-constrained by polarities. As demonstrated by synthetic tests, the proposed technique is robust with respect to inaccuracies of existing velocity models. We study the event of Vargem Grande ~ 4.7 (mb) (Jan 3, 2017), northern Brazil. This widely felt earthquake occurred in an aseismic area with so far only 4 small events cataloged in the Brasilia Seismograph Bulletin since 1690. With the envelope inversion, we managed to fit polarities at 6 stations, and simultaneously match gross waveform features at 4 stations (one at 40 km and 3 above 500 km), using a simple generic velocity model. The strike-slip focal mechanism is in agreement with an independent study from Fábio Dias (2017), based on ad-hoc, path-specific velocity models.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

-37, Be-7 and Xe-133 in the Atmosphere

Natural Ar-37 in the atmosphere is produced by spallation of argon through $40\text{Ar}(n,4n)^{37}\text{Ar}$ and by neutron capture, $^{36}\text{Ar}(n,\gamma)^{37}\text{Ar}$. The resulting equilibrium concentrations of Ar-37 in the stratosphere and troposphere are about 10 mBq/m³air and 0.5-1 mBq/m³air, respectively as deduced from direct measurements and theoretical calculations. Activity concentrations in atmospheric air measured in Bern over the past three decades range between 1- 10 mBq/m³air. In order to investigate long term activity levels of Ar-37 and potential fluctuations above background at other geographical locations samples were collected at the CTBTO IMS Radionuclide station located in Takasaki, Japan. Sampling at this particular location also allows for time correlated measurements of Ar-37, Be-7 and Xe-133 activity concentrations, for comparison and an identification of any potential common sources. For example, the correlation of elevated levels of Ar-37 with Be-7 may indicate a stratospheric influx of air masses to the ground, whereas correlation with Xe-133 may indicate the source is a civilian nuclear facility. The potential geographical source location of the air masses sampled in Japan, are determined by atmospheric transport modelling

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Framework of Ground Truth Event Locations Across Iran from a Two Tiered Multi-Event Relocation Approach

Uncertainties in standardized earthquake locations, which run into tens-of kilometers in many regions of the world, are a serious limitation to seismotectonic studies. We have developed a new two-tiered multiple-event relocation approach that seeks to improve upon these catalog locations, and have applied it to Iran, a country with abundant seismicity (> 40,000 ISC Bulletin events since 1960), a recent surge in station coverage, but with known shortcomings in location accuracy. In the first stage, locations of small clusters of well-recorded earthquakes at local spatial scales are calibrated either with near-source arrival times or with independent location constraints such as from InSAR or short-duration aftershock deployments. This stage uses MLOC, an implementation of the Hypocentroidal Decomposition relocation technique, that specifically minimizes systematic bias and fully calibrates the location uncertainty, usually to better than 5 km (GT5%). Secondly, these calibrated locations with their uncertainties are used as a backbone of “ground truth” events in BayesLoc, a Bayesian relocation algorithm that can handle larger datasets, to yield region-wide earthquake catalogs that are less vulnerable to systematic bias and have realistic estimates of the location uncertainty. We illustrate the improved locations by re-interpreting a selection of early instrumental and modern mainshock-aftershock sequences.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

-Equilibrium Model of Multi-Phase Radionuclide Transport in Lake Water-Sediment System

The advanced implementation of the multi-phase model, which uses radioactive material as a contaminant, and the evaluation of parameter values are discussed in the work. A semi-analytical solution of the simulation of the contaminant transport dynamics in the lake water and one-dimensional sediment solute transport including non-equilibrium processes is presented. The model includes a concept of contaminant sorption dynamics in the lake water and sediment compartments, considering the specific porous structure of sediments, the contaminant material exchange between the liquid and solid phases of sediments. The key processes included in the model are sedimentation, resuspension, diffusive exchange of solute at the lake water-sediment interface and advection-diffusion in sediment solute. Special attention was paid to the contamination balance between the two spheres in the interface area. The ranges of boundary and initial conditions were extended and the final results were obtained using an accurate and robust numerical inversion calculation based on the De Hoog algorithm. Therefore, the model can be used in experimental measurements interpreting the contaminant profile in lake sediments as well as a part associated with the comprehensive determination of the volumetric activity in the estimation of irradiation doses due to radionuclides released into the lake water.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Infrasound Association at the IDC: Advances and Performances

Global Infrasound Association algorithms are an important area of active development at the IDC. These algorithms are incorporated into the automatic processing system for verification technologies, with a focus on enhancing association and signal characterization. The overall objective is to reduce the number of associated infrasound arrivals that are rejected from automatic bulletins when generating the Reviewed Event Bulletins (REB), and hence reduce IDC analyst workload. The proposed model is a fusion of seismic, hydroacoustic and infrasound processing built on a unified probabilistic framework incorporated into NETVISA, a Bayesian approach to network processing. In this work, the focus is on infrasound specific efforts aimed at optimizing association criteria based on knowledge acquired by IDC over 7 years, and on seismo-acoustic events specificity. The performances of the association algorithms are discussed in comparison with IDC bulletin production at automatic stage and after review process. IDC results for the European region are also compared with the European Infrasound Bulletin (EIB) [Pilger et al, SnT2017]. The EIB focuses on infrasound activity recorded over Europe and collected during the ARISE project (Atmospheric dynamics Research InfraStructure in Europe). Data from the EIB were recorded since 2000 by 24 European infrasound arrays including IMS stations.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

in Atmospheric Dynamics and Infrasound Monitoring

The atmosphere is a complex system submitted to a large set of disturbances including i) high frequency waves from volcanoes, thunderstorms, tornadoes, explosions, ii) gravity and planetary waves at lower frequencies iii) stratospheric warming events which can impact the troposphere during weeks. The infrasound network of the International Monitoring System (IMS) developed for the verification of the CTBT (Comprehensive nuclear-Test-Ban Treaty) showed a high capacity to detect, localize and identify most of these atmospheric disturbances. However, these disturbances are at the origin of uncertainties in atmospheric models and infrasound monitoring analysis. They are determined using complementary observations, including the infrasound IMS, the lidar Network for the Detection of Atmospheric Composition Changes, radars and satellites, in the framework of the ARISE (Atmospheric dynamics research InfraStructure in Europe) project. Differences in the temperature and wind between models and observations can reach 30K and 20 m/s respectively in the stratosphere. The integration of the atmospheric variability in the stratosphere constitutes a challenge for the development of future models of atmosphere and climate. It could lead to improvements of medium range weather predictions and operational infrasound monitoring. The ARISE objective is to provide new data sets in the middle atmosphere for assimilation in models.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

and Uppermost Mantle Structure Beneath Southern Africa Based on First P-Wave Travel Times from Seismograms Generated by Local, Regional and Mining-Induced Earthquakes

Three-dimensional seismic wavespeed structure of the crust and uppermost mantle in southern Africa was determined by tomographic inversion of absolute arrivaltimes of first P-waves picked from seismograms generated by tectonic earthquakes and mining-induced tremors recorded at local and regional distances by 82 broadband stations of the 1997–1999 Southern Africa Broadband Seismic Experiment, supplemented by 3 IMS stations located in the study area. The data used in the inversion comprised 496 well-located seismic events and more than 1500 P-wave times. The geotomograms were determined by applying a tomography method in which traveltimes and raypaths are calculated rapidly and accurately by a 3-D raytracer, and the linearized iterative inversion utilizes the conjugate gradient-type LSQR algorithm. The assumed seed model is a regional average 1-D velocity model taken from previous seismic studies of lithosphere beneath southern Africa. Checkerboard resolution test was performed to confirm the reliability of the main features in the tomographic images. The tomographic images show patterns of heterogeneity in the wavespeed structure below the study area. The velocity anomalies reflect a superposition of various effects including changes in composition and thermal structure as well as other perturbations imprinted during the complex evolution history of the southern Africa region.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Local and Regional Phase Amplitudes

In the late 90s, using waveforms from IMS seismic stations, we showed that cross-validated, empirical amplitude corrections reduce scatter in the high frequency P/S ratios used for event discrimination. Since then, we have explored ways to model local and regional phase amplitudes, and codas, using tomography methods that solve for attenuation, source and site terms. Such models will be important for event magnitude and screening, and should aid in detection and association procedures. Current models are global in extent, but provide greater coverage of continental regions. We find that great circle paths in a 2-D Q grid along with frequency and phase dependent site terms fit Pg, Sn, and Lg amplitudes well (log₁₀ amplitude misfit 0.1). Pn amplitudes fit less well (misfit 0.3) and likely show effects of upper mantle focusing, and perhaps source radiation effects. To raise the models to absolute levels we constrain source terms for a subset of events for which moments have been derived independently, and for a smaller subset for which corner frequencies are available from coda spectral ratio studies. This procedure provides direct constraint across all bands, opportunities for model validation, and reduces tradeoffs between attenuation and event corner frequency.

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Presenter: PHILLIPS, William Scott (Los Alamos National Laboratory)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Near-Field and Far-Field Studies Using IMS Infrasound Data

Infrasound technology gained in the course of the last two decades a key role in monitoring several natural and man-made events, highlighting how much information about the source, as well as about the source-to-station propagation can be embedded in an infrasound signal. This concept applies in particular, but not exclusively, to volcano monitoring, where the understanding of all the source phenomena proceeding an eruption might play a special role in the issuance of early warnings, which would help mitigate the impact on population, aviation and goods and increase resilience. How much the source information is preserved in an infrasound signal when moving apart from the source? Is the source information retrieved in near-field still embedded and retrievable also from signals recorded in far-field? How much a far-field monitoring can support the issuance of early warnings, in particular for volcano monitoring? The Department of Earth Sciences, University of Florence, Italy, is currently developing a comparison between near-field and far-field records in the framework of a vDEC Project: the first results of this study will be presented.

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Track Classification: 1. The Earth as a complex system

ID:

Type: **Oral**

Time Monitoring Data Application and Simulation Researches for Earthquake and Tsunami Disaster Mitigation

Real time monitoring systems around seismogenic zone are very important for early detection of earthquake and Tsunamis. Furthermore, these system are also indispensable to understand crustal activities and phenomena as precursor. In Japan, Ocean floor network systems as DONET and S-NET already deployed for early warning and prediction researches. In DONET system, DONET1 and DONET2 are focusing on the Nankai Trough seismogenic zone southwestern Japan, S-NET is focusing on off east Japan based on lessons learned from 2011 East Japan earthquake. For disaster mitigation, not only real time data but also advanced simulation are indispensable. For example of simulation, we developed the recurrence simulation of mega thrust earthquakes, data assimilation and real time inundation simulation using real time data. Otherwise, real time monitoring system detect micro seismicity for the estimation of seismic stage such as inter seismic stage and pre seismic stage. Finally, we have to integrate advanced simulation and real time information for disaster mitigation.

In this presentation, we explain Japanese ocean floor networks and advanced simulation researches.

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Presenter: KANEDA, Yoshiyuki (Kagawa University)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Management and Program Execution

L-3 MariPro manages program risk using a structured and formalized process. The purpose of this Poster is to describe the risk management highlights used throughout the design, build, and install of HA04 at the Crozet Islands. The Poster will summarize the defined roles and responsibilities, required activities, unique processes and review requirements. The Risk management process described was applied to all program risks including those associated with subcontractors. The Program Risk items are updated monthly and reviewed with the Commission. It is noted that Commission is involved during the course of the project in helping to identify and mitigate risks. The contributions of the team assist in maximizing the likelihood of delivering a system that satisfies all specification, cost and schedule requirements. L-3 MariPro's Risk Management Team is comprised of the Program Manager, Project or Systems Engineer and the program Task Managers. Task Managers provide key expertise in the assessment and mitigation definition efforts for identified issues. The risk management process highlights during the following phases of the HA04 program will be presented: • Land Survey • Route Working Group (RWG) • System design • System Integration Testing • Installation Readiness Review • System Installation

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Presenter: CEKADA, Guy (L-3 MariPro Inc.)

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Waves Generated by Earthquakes and Landslides: Computed by Means of Numerical Simulations in the Western Black Sea

In this work we present numerical simulations of tsunami waves generated by earthquakes and landslides in the region of the western Black Sea. We take into account three main seismic sources (two of them placed near the northern coast of Bulgaria and one near the northwestern Turkish Black Sea coast), and two hypothetical landslides (one subaerial and one underwater). The motion of the sliding body is computed by means of the code UBO-BLOCK1 based on a Lagrangian approach while the propagation of the tsunami waves is simulated through the numerical code UBO-TSUF. The tsunami is computed on three different grids – one for the whole area of the Black Sea (resolution 500 m), and two smaller grids (resolution 100 m) placed near the northern Bulgarian coast (Cape Kaliakra-Kavarna) and near the Turkish Black Sea coast (Zonguldak-Amasra).

Primary author: DIMOVA, Lyuba (Sofia University "St. Kliment Ohridski")

Presenter: DIMOVA, Lyuba (Sofia University "St. Kliment Ohridski")

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

Assessment of the High-Resolution Atmospheric Transport Model at the IDC of the CTBTO

The International Data Centre (IDC) of the CTBTO is developing a capability to do high-resolution atmospheric transport modelling (HRATM) using Flexpart-WRF. Compared to conventional atmospheric transport modelling, HRATM is folding the available meteorological data in coarse resolution with a static, high-resolution topography of the Earth to create new meteorological data with a resolution down to a few kilometers. The performance of Flexpart-WRF at the IDC is assessed by comparing its output to the results of the 1st and 2nd ATM (atmospheric transport modeling) Challenge. The challenge of both international exercises was to predict the impact of known radionuclide releases from a strong regional source on radionuclide stations of the CTBT International Monitoring System (IMS). For both scenarios, the IDC's HRATM installation of Flexpart-WRF is used to simulate the time series of noble gas detections that stem from the major regional emitter and to compare the results with the modelling results of all participants in those challenges.

Primary author: SCHOEPPNER, Michael (University of Natural Resources and Applied Life Sciences (BOKU))

Presenter: SCHOEPPNER, Michael (University of Natural Resources and Applied Life Sciences (BOKU))

Track Classification: 1. The Earth as a complex system

ID:

Type: **Poster**

of Radioargon and Radioxenon in Soil Gas

The most important indicators for a UNE during an OSI are the radioactive xenon isotopes Xe-131m, Xe-133 and Xe-133m and the radioactive argon isotope Ar-37. In the assessment of a detection of these nuclides it is important to have knowledge about the levels that can be expected due to the natural background. Therefore, it is interesting to simultaneously measure the background levels of radioxenon and radioargon in soil gas for a better understanding of the relationship between them. Sub soil sampling has been carried out on the oil shale ash waste pile in Kvarntorp, Sweden, a location with known elevated uranium content. The results from analyzing these samples will be presented along with a discussion of production rates of radionuclides in the subsurface including Rn-222. Correlations between them and the gas composition (i.e. CO₂, O₂) indicate the relative importance of fission reactions, cosmogenic production and mixing.

Primary author: KASTLANDER, Johan Lars (Swedish Defence Research Agency (FOI))

Presenter: KASTLANDER, Johan Lars (Swedish Defence Research Agency (FOI))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

a Better Noble Gas Characterization Scheme Based on 10 Years of National Data Centers (NDC) Analysis

Releases from industrial facilities, due to mainly Medical Isotopes Production facilities (MIPs) and in a lesser extend to Nuclear Power Plants (NPPs), are at the origin of the worldwide radioxenon background and lead to specific activity concentration levels at the most noble gas stations of the IMS network. In parallel, owing to the tremendous atmospheric dilution, signature of an underground nuclear test in case of a prompt or/and delayed release into the atmosphere is likely to be detected at the IMS station at the background level. NDCs follow up over years of detection time series at each IMS noble gas station and the assessment of the worldwide radioxenon background from the atmospheric transport modelling calculations can be of a great help to screen out numerous events but only a radioxenon isotopic ratio will give a clear event discrimination. Analysis and validation by NDCs of isotopic ratios involving three radioxenons (^{135}Xe , $^{133\text{m}}\text{Xe}$ and ^{133}Xe), measured by the IMS noble gas stations over the last decade, allows today to efficiently enhance the current IDC event characterization scheme.

Primary author: LE PETIT, Gilbert, Maurice, Emile (CEA/CENTRE Ile-de-France)

Presenter: LE PETIT, Gilbert, Maurice, Emile (CEA/CENTRE Ile-de-France)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Mechanisms in Egypt

The focal mechanisms for earthquakes in and around Egypt is calculated during (2004 -2016) using the waveform data recorded by the Egyptian National Seismological Network (ENSN) and the International Data Center (IDC) of the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO). These solutions are computed by joining P, S_H, S_V polarities and S_V/P, S_H/P and S_V/S_H amplitude ratios where the quality of each solution is evaluated. This set of solutions is considered as a completion of the Egyptian focal mechanism catalogue. It will be helpful in understanding the temporal changes in the stress field and one of methods for discrimination between Explosion and Natural Events.

Primary author: METWALLY, Mona Abdelazim Abdalla (National Research Institute of Astronomy and Geophysics (NRIAG))

Presenter: METWALLY, Mona Abdelazim Abdalla (National Research Institute of Astronomy and Geophysics (NRIAG))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

the Explosive Nature of the DPRK Nuclear Events at Regional Scale Using Moment Tensor Inversions and MSVMAX

Between 2006 and September 2016, five confirmed nuclear tests occurred in The Democratic People's Republic of Korea (DPRK). The regional and teleseismic seismic waveforms show great similarities suggesting the spatial closeness of the sources and their similar source radiation patterns. Using the available regional data, we perform the source moment tensor inversions of the five events, and we explore the relative differences among the five events, especially in terms of seismic moment and source decomposition. We confirm the explosive nature of the sources. The inversion of the M5.4 earthquake in September 2016 in South Korea using a similar scheme allows us to verify the stability of the inversions and the resulting source decompositions. We extend the characterization of the explosive behavior of the seismic sources by using additional techniques such as the MSVMAX approach implemented at the French National Data Center. The study of the differential surface wave magnitudes recorded at the regional stations provides useful information regarding the source complexities. Discussion regarding complexities in the amplitude ratio is provided with regards to non-isotropic radiation at the source in regional scale and potential path effects.

Primary author: GUILHEM TRILLA, Aurélie (CEA/CENTRE Ile-de-France)

Presenter: GUILHEM TRILLA, Aurélie (CEA/CENTRE Ile-de-France)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

7th Earthquake

Destructive earthquake that occurred on December 7th 2016, in the western part of Aceh, caused damage to buildings and loss of life. We estimated this earthquake source parameters using regional broadband waveform data with the Cut and Paste (CAP) inversion method to better understand this earthquake and the seismic hazard in the region. Our results indicate that the best solution of this event is strike 240°, dip 53° and rake 9° for the first nodal plane and strike 144.6°, dip 82.8° and rake 142.7° for the second nodal plane with 16 km for the centroid depth. Our focal mechanism solution is consistent from other agencies' result, i.e. USGS and Global CMT and also in the agreement to the aftershocks distribution that have been relocated with the teleto-moDD method. The aftershocks distribution showed that the earthquake triggered by the second nodal plane. Moreover, we do coloumb stress analyzed, our result show that more than 80% of the aftershocks are distributed in the positive Coulomb stress increased zones. Our focal mechanism solutions and spatial distribution of the relocated aftershocks concluded that the earthquake is classified as a typical unidentified reverse-fault earthquake.

Primary author: KHAIRINA, Fadiyah (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Presenter: KHAIRINA, Fadiyah (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Assessment of Determination of the Place of the Underground Nuclear Tests by Means of Artificial Radionuclides Presence in Groundwater with STS Example

Results of the study of groundwater in areas of underground nuclear explosions (UNE) on Semipalatinsk test site (STS) have shown that the presence of high concentrations of ^{137}Cs and ^{90}Sr (hundreds of Bq/kg), which can be found only near the venue of the UNE. At a distance from the epicenter of the explosion up to 200 m radionuclide concentration is reduced to a fraction of Bq/kg. At the same time, tritium concentration remains sufficiently high, with value, which depends on the characteristics of the geological structure and hydrogeological conditions. Quantitative values of tritium more than 7 Bq/kg is observed at distances up to 20 km from the epicenter of UNE. Tritium is part of tritiated water and is not adsorbed by rocks at migration. So, tritium can significantly move in short period from UNE place with ground waters. At on-site inspection in regions like STS measurement of tritium concentration in ground water allows to do the general conclusion of UNE presence in 20 km radius. The presence of ^{137}Cs and ^{90}Sr in ground water shows more precise place of UNE epicenter.

Primary author: SUBBOTIN, Sergey (Institute of Radiation Safety and Ecology, National Nuclear Centre of the Republic of Kazakhstan)

Presenter: SUBBOTIN, Sergey (Institute of Radiation Safety and Ecology, National Nuclear Centre of the Republic of Kazakhstan)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Our Understanding of Explosion Seismic Waves from the Nevada Source Physics Experiments

The Source Physics Experiments (SPE) are a series of well-instrumented chemical non-nuclear explosions at the Nevada National Security Site (NNSS) designed to improve the understanding of seismic wave generation and propagation from explosions. The 5-ton SPE-5 on April 26, 2016, and 2.2 ton SPE-6 on October 12th, 2016, were the last of the Phase I series of six underground chemical non-nuclear explosions conducted in the same granite borehole. By varying the size and depth of the shots, while recording them on a common sensor network, ranging from near- to far-field, we are able to improve our understanding of the effects of yield, scale depth, scattering and emplacement properties on explosion seismic wave generation. This has resulted in refinements to previous models for explosion P-wave spectra, S-wave generation, P/S discrimination, correlation behavior and more. As part of the SPE, a temporary deployment of 1000 geophones was installed from April 20 to May 20, 2016, to record the SPE-5 explosion and background signals and noise before and afterwards. A set of large weight drops at 53 locations both inside and outside the array were also recorded, as were several local, regional and teleseismic events.

Primary author: WALTER, William R. (U.S. Department of Energy, National Nuclear Security Administration)

Presenter: WALTER, William R. (U.S. Department of Energy, National Nuclear Security Administration)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

of NK09 and NK13 Source Time Functions and Yields Directly from Seismograms

I estimate the source time functions and yields of the North Korean 2009 and 2013 events (NK09 and NK13) directly from seismograms recorded at Mudanjiang (MDJ) seismological observatory. The path effect between source and receiver is eliminated by finding a ratio filter that shapes the NK09 seismogram to the NK13 seismogram. Neglecting noise, convolution of this filter with the source time function of NK09 yields the source time function of NK13. The two source time functions are also related by the well-known scaling law in which the injected volume is proportional to the yield and the time constant is proportional to the cube-root of the yield. These two independent equations are solved for the two source time functions, which are characteristic of explosions, not earthquakes, by a method that gives the yield ratio: $NK13/NK09 = 2.35$. Using measurements from underground nuclear tests at Nevada Test Site (NTS) for calibration, NK09 and NK13 are estimated to have yields of about 5 kt, and 12 kt. This method has applications in seismic exploration on land with explosives and may also be used to find earthquake source time functions using pairs of events from the same location with the same source mechanism.

Primary author: ZIOLKOWSKI, Antoni (University of Edinburgh)

Presenter: ZIOLKOWSKI, Antoni (University of Edinburgh)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Infrasound Ground-Truth Database Using Seismic Data

Infrasound arrays IS31, Kurchatov and Makanchy form Kazakhstani infrasound network. Kazakh National Data Center also process data of IS46, Russia in addition to data of three above mentioned stations. Signal detection technique at KNDC is PMCC. The detection bulletins are input information for the automatic event location. Network processing started on June 2014. Simultaneously systematic seismic network data processing takes place at the same region using data of numerous stations including 4 Kazakh seismic arrays. The processing includes discrimination of the event nature. Fusion of the infrasound and seismic bulletins allows not only to select unambiguously seismoacoustic events but also to locate them very accurately. Correlation technique is a very efficient instrument for selecting the events occurred at the same place, e. g. D. Schaff and P. Richards, 2016. This method is not applicable for infrasound records but works well with seismic data. The location accuracy after fusion is dramatically higher than the result of processing using infrasound technology only. KNDC is compiling ground truth data base using the concept. The events at the database are the quarry blasts. Association of the seismic and acoustic event is made in accordance with the technique used at IDC, N. Brachet, et al.2010.

Primary author: SMIRNOV, Alexandr (Kazakhstan National Data Centre)

Presenter: SMIRNOV, Alexandr (Kazakhstan National Data Centre)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Reservoir Induced Seismicity in Aswan, Egypt

The river Nile is the longest river in the world. Many dams are located along it. The high dam is largest one and the longest monitored in terms of seismicity, water levels and crustal deformation. Seismicity recorded in the Aswan area between 1986 and 2015 was deeply investigated by applying different statistical techniques. The study of the seismic catalogue allowed us to distinguish between two different depth clusters. The time dynamics and spatial distribution of the two earthquakes clusters in correlation with the loading/unloading process of Nasser Lake were furtherly examined. The study revealed strong correlation between the shallow earthquakes cluster and the water loading/unloading process, whereas deeper earthquakes can be attributed to tectonic process, which is in good agreement with the active faults identified from geological studies.

Primary author: ELGABRY, Mohamed Nabil Mohamed (National Research Institute of Astronomy and Geophysics (NRIAG))

Presenter: ELGABRY, Mohamed Nabil Mohamed (National Research Institute of Astronomy and Geophysics (NRIAG))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Shallow Subsurface Noble Gas Transport Using Subsurface Transport over Multiple Phases (STOMP)

Gas dynamics in the shallow underground environment are a critical component dictating how delayed noble gas indicators of underground nuclear explosions eventually arrive at the surface. Understanding how these gases behave in response to rapid pressure changes, how natural gas backgrounds evolve, and the nature of the atmosphere-surface interface are essential to optimizing monitoring and verification efforts. The Pacific Northwest National Laboratory (PNNL) transport simulator STOMP (Subsurface Transport over Multiple Phases) has been used for decades to understand radionuclide evolution in the environment with respect to waste repository and cleanup efforts. The new application of STOMP to understanding post-nuclear explosion noble gas transport, specifically in the shallow subsurface, is presented here.

Primary author: LOWREY, Justin (Pacific Northwest National Laboratory)

Presenter: LOWREY, Justin (Pacific Northwest National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Depth Determination and Source Characteristics of the DPRK Nuclear Tests (2006, 2009, 2013, 2016J (01/06/2016) and 2016S (09/09/2016)) Using Regional and Teleseismic Arrays

North Korea conducted underground nuclear explosions on October 9, 2006 (M 4.3), May 25, 2009 (M 4.7), February 12, 2013 (M 5.1), January 6, 2016 (M 5.1) and September 9, 2016 (M5.3). We used spectral nulls of body waves and Rayleigh waves from regional and teleseismic arrays. We minimized noise signals and nonlinear tectonic effects using well-azimuthal coverage arrays and common depth point stacks enhancing a S/N ratio. The burial depths of the 2006, 2009 and 2013 nuclear tests were estimated at 2.16, 2.08, 2.08, 2.10 and 2.15 km for the 2006, 2009, 2013, 2016J and 2016S tests respectively. It should be noted that these depths are significantly greater than expected from the standard experiment practice and the source characterization of the 2006 test is quite different from rest of other nuclear tests. We infer that the 2006 test might have been conducted as a vertically distributed source in a vertically contained shaft whereas the rest of other nuclear tests as horizontally distributed sources in mutually connected drifts from source mechanisms as well as absence of radioisotopes after those nuclear explosions. The possibility that these events were over-buried would affect the interpretation of MS-mb discriminants and estimation of the yield.

Primary author: KIM, So Gu (Korea Seismological Institute)

Presenter: KIM, So Gu (Korea Seismological Institute)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Ar-37 Backgrounds at the Nevada National Security Site

A series of measurements have been undertaken at a test bed site on the Nevada National Security Site as part of a large scale subsurface gas migration experiment. Samples have been collected and analyzed for Ar-37. The Ar-37 is expected to be present in shallow soil gas as a result of natural production and at much deeper depths as part of the gas migration experiment. Radiotracers (Ar-37 and Xe-127) were injected into the underground test cavity, and measurements are being made to track the migration of the injected gases. The initial Ar-37 results have been obscured by an interfering radiometric signature and this signature is present at both shallow and deep sampling depths. This talk will discuss the test bed, the sampling methods and the results of samples collected to date. Additional discussion will detail the methods used to determine that the radiometric signature interfering with the Ar-37 analysis results from the presence of Ar-39 at the site.

Primary author: MCINTYRE, Justin John (Pacific Northwest National Laboratory)

Presenter: MCINTYRE, Justin John (Pacific Northwest National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

and Discrimination of Small Earthquakes and Explosions around North Korean Nuclear Test Site

Recently, the detection of two small seismic events which have occurred close to sites where North Korea carried out underground nuclear weapons tests were reported in literature. A seismic event – considered to be a small earthquake of magnitude 1.5, occurred on 12 May 2010 close to the site of 25 May 2009 underground nuclear test (UNT) in North Korea. Another seismic event of magnitude 2.1 occurred on 11 September 2016 that is correlated to 9 September 2016 UNT and reported as an aftershock of the UNT. We examine additional possible small seismic events around the North Korean test site by using seismic data from stations in southern Korea and northeastern China including IMS seismic arrays, GSN stations, and regional network stations in the region. We assess the best method to classify small explosions from earthquakes in the region based on time, location, source depth, spectral amplitude ratios of regional P and S wave from those seismic events. This presentation will discuss several issues raised by the capability of various networks to detect such tiny explosions and earthquakes, and the best discriminant to classify various source types for the region.

Primary author: KIM, Won-Young (Lamont-Doherty Earth Observatory of Columbia University)

Presenter: KIM, Won-Young (Lamont-Doherty Earth Observatory of Columbia University)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Standardized and Accurate Sampling Device for On-Site Inspection and Verification Purposes after a Nuclear Incident

On-site inspections are an integral part of the characterisation and verification of potential nuclear testing events; these involve environmental sampling for off-site analytical determination which may provide evidences of atypical presence and/or amount of radionuclides. As fresh radioactive fallouts are concentrated in the first millimetres of the soil, any anomaly of the topsoil depth distribution and content of radionuclides can provide information about potential past events which could have been unnoticed. The Fine Increment Soil Collector (FISC), created by the SWMCN Laboratory of the Joint FAO/IAEA Division, was originally developed to facilitate the precise determination of soil depth distribution of anthropogenic and naturally occurring radionuclides for use in soil degradation investigations. Because of its characteristics and modus operandi, the FISC facilitates standardized on-site sampling and collection of high resolution (millimetres precision) topsoil samples. The FISC straightforward setup and operation makes it a practical on-site sampling device which may be helpful during on-site inspections. One of the main benefits includes the accurate determination of radionuclide depth distribution which could highlight potential unnoticeable past events that may not have been recorded or covered by the International Monitoring System.

Primary author: LEE ZHI YI, Amelia (IAEA)

Presenter: LEE ZHI YI, Amelia (IAEA)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Nuclear Tests in Ukraine (the Ukrainian SSR) in the Period of 1972-1979 Years

In the USSR, since 1965, has implemented program for nuclear explosions in commercial and industrial applications. All nuclear explosions for industrial and commercial purposes carried out under the ground, so the classification they belong to underground nuclear explosions. Each of these experiments and experiments had their secret name. "Torch" - the first industrial nuclear explosion on the territory of the Ukrainian SSR, Manufactured July 9, 1972 at 10:00 am local time at a distance of 3 km from the village Krestische Krasnograd district, Kharkiv region to close the emergency gas emissions. The explosion did not reach its goal. "Cleavage" - which was carried out on the territory of the Ukrainian SSR on the east wing of the mine "Yunkom" at a September 16, 1979 at 12 o'clock local time. The purpose of the explosion - reduction of stress in the rock mass. Conclusion Ukraine experienced the two "peaceful" nuclear explosion. The nuclear tests carried out in almost the center of Europe. But as you can see, the results of these activities are rather doubtful, and the damage is enormous. In conclusion, we can say one thing: nuclear explosions for peaceful purposes does not exist.

Primary author: DOVBYSH, Serhii (Main Centre of Special Monitoring)

Presenter: DOVBYSH, Serhii (Main Centre of Special Monitoring)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Events from DPRK Test Site in 2016 by Facilities of Main Center of Special Monitoring

Both events in 2016 from DPRK test site were confidently registered by all national stations including primary IMS station PS45. The information about event was processed very quick and forwarded to superior authorities. To identification of the seismic signal from DPRK the cross-correlation analysis between the first arrivals of registered seismic signal and a previously registered signal from UNE, selected as the reference was applied. As reference signal, we used signal from DPRK UNE 09.10.2006. The average cross-correlation coefficients for our stations between the signals from the DPRK UNE and the reference signal were about 0,96. Also for identification of event nature used method, which is based on differences in the change of amplitudes of the envelope signals from earthquakes and explosions, depending on the frequency. The method is based on linear filtration of input signal by set of narrowband filters and calculating of the amplitudes of the envelopes of the seismic signals. Simultaneous use of several methods increases the reliability of identification and facilitates decision-making in complex analysis of seismic signals.

Primary author: KOLESNYKOV, Leonid (Main Centre of Special Monitoring, State Space Agency of Ukraine)

Presenter: KOLESNYKOV, Leonid (Main Centre of Special Monitoring, State Space Agency of Ukraine)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Seismic Signals from Underground Nuclear Explosion Produced at DPRK Test Site

The most effective element of MCSM seismic network is seismic station PS45. Identification of the seismic signal from UNE carried out by determining the cross-correlation between the first arrivals of registered seismic signal and a previously registered signal from UNE, selected as the reference. Determination of duration of seismic signal record for the implementation of the correlation schema of signal detection from UNE is done by finding the minimum of function of the ratio of the cross-correlation coefficients for the signal from UNE and earthquakes (estimated value of 5 seconds). As reference signal, used signal from explosion 09.10.2006. The average cross-correlation coefficients between the signals from the DPRK UNE and the reference signal are 0.91, 0.96, 0.98 for 2009, 2013, 2016 accordingly. Also for the identification of seismic signals from the events with explosive nature used method, which is based on differences in the change of amplitudes of the envelope signals from earthquakes and explosions, depending on the frequency. The method is based on linear filtration of input signal by set of narrowband filters and calculating of the amplitudes of the envelopes of the seismic signals, which avoids the need to define the basic parameters of the seismic signal.

Primary author: LIASHCHUK, Oleksandr (Main Centre of Special Monitoring)

Presenter: LIASHCHUK, Oleksandr (Main Centre of Special Monitoring)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Can We Use Atmospheric Radioxenon Observations Related to the Daiichi Nuclear Power Plant Accident at Fukushima to Better Understand IMS Observations?

One of the principal considerations in nuclear explosion monitoring is to consider the radioxenon isotopic ratios from each possible source and how the sources of individual radioxenon observations might be discriminated from each other. The past observations of atmospheric radioxenon made by the CTBT IMS noble gas network, specifically those from the Fukushima accident in 2011, provides the chance for deeply understanding the source characterization. Based on these observations at IMS stations and analysis at the IDC, this study tries to differentiate individual sources from the Fukushima accident, and some aspects, such as the theoretical developments in time of certain scenarios are investigated in-depth in comparison with observations. This is of particular importance for the identification of signatures from a late release of an underground nuclear test.

Primary author: WANG, Jun (CTBTO)

Presenter: WANG, Jun (CTBTO)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

and Hydroacoustic Observations from Underwater Explosions off the East Coast of Florida

To test the ability of new classes of ship to withstand explosions, the United States Navy periodically detonates underwater 10000lb chemical explosions close to the hull of the vessel undergoing testing. In terms of monitoring compliance with the Comprehensive Nuclear-Test-Ban Treaty, as some ground-truth information exists, these explosions provide an opportunity to assess the capability of the International Monitoring System (IMS) to detect, locate and characterise small yield underwater explosions (body-wave magnitudes around 3.5). In this study, seismic and hydroacoustic signals from a series of test explosions in 2001, 2008 and 2016 near Florida are analysed. As the locations of many of these explosions are known, arrival times of seismic and hydroacoustic signals can be used to assess the reliability of epicentres estimated using the IMS. Seismic and hydroacoustic signals are also used to characterise the underwater explosion sources. Bubble pulses characteristic of underwater explosions are identified at seismic stations in the United States and the estimated explosion depths are shown to be consistent with published ground-truth information. The absence of a clear bubble pulse at the IMS hydrophone station at Ascension Island demonstrates the importance of combining seismic and hydroacoustic observations.

Primary author: HEYBURN, Ross (AWE Blacknest)

Presenter: HEYBURN, Ross (AWE Blacknest)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Importance of Visual Observation to Guide the Application of Other OSI Techniques

- The hi skills of the inspection technique that we need in OSI team, after my experience in the IFE14 , and Visiting Nevada Nuclear Test site : enhancement skills of the inspectors in the Visual observation is very important for all because some of observable signature well be removed by the state or disappear directly and others are not easier to detect after the UNE is happened , also I found some UNE without collapse (how can we observe the signature of this UNE) , what the comfortable technique we will use in this site (with some examples and pictures for this cases) . - Some of technique is not Applicable to conduct in the filed because the ISP , weather or the area in the field this is one of the mane challenges in the OSI ??? . - It is important to study all detections from the event and putting the plan for OSI and the techniques regarding to assessment this details. I will explain and discuss this point above with many details regarding to my OSI experience in IFE14 & observable in Nevada .

Primary author: AL-ALI, Mohammed Fawzi Jumaah (Iraqi National Monitoring Authority)

Presenter: AL-ALI, Mohammed Fawzi Jumaah (Iraqi National Monitoring Authority)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Seismic Event in North Korea 9 September 2016

September 9, 2016 at 9:30 am local time on the territory of North Korea recorded a magnitude 5.3 seismic event. The epicenter was located near the settlements located in 20 kilometers from the nuclear test site Pangiri. Give a high probability that North Korea had conducted a nuclear test on the occasion of the anniversary of the proclamation of the Republic. The US Geological Survey classified the tremors as "explosion". Later, North Korea officially announced the fifth nuclear test. Assessment of the explosion of power - from 10 to 30 kilotons. Chinese seismological center reported that the source of seismic vibrations lies at a depth of zero kilometers, and it could be a blast. This source of seismic events recorded by seismic stations of the Ukrainian National Information Center. Interactive PS45 data processing, and data from other national stations using Geotool software that was provided by the National Centre of the International Data Centre, also points to the location of the source of the events in North Korea, in an area where previously carried out an underground nuclear test.

Primary author: DOVBYSH, Serhii (Main Centre of Special Monitoring)

Presenter: DOVBYSH, Serhii (Main Centre of Special Monitoring)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

-Acoustic Analyses of the DPRK Underground Nuclear Tests for the Estimation of Source Depth

Tuesday, June 27, 2017 6:15 PM (15 minutes)

The nuclear tests by the Democratic People's Republic of Korea (DPRK) have generated both seismic and infrasonic signals. This presentation will address seismo-acoustic analyses of these tests. Special focus will be given to the 2013 and January 2016 tests, that were estimated to have a similar yield. Clear detections were made in the Russian Federation (I45RU) and Japan (I30JP) in 2013 at stations from the International Monitoring System. Both tropospheric and stratospheric refractions arrived at the stations. In 2016, only a weak return was potentially observed at I45RU. Data analysis and propagation modeling show that the noise level at the stations and the stratospheric circumpolar vortex were different in 2016 compared to 2013. A relative analysis of the 2013 and 2016 DPRK tests, in combination with atmospheric infrasound propagation modeling, motivates the hypothesis that the 2016 test was at a greater depth than the 2013 test. In such a case, less seismic energy would couple through the lithosphere-atmosphere interface, leading to less observable infrasound. A preliminary analysis suggests that the 2016 test occurred at least 1.5 times deeper. Since explosion depth is difficult to estimate from seismic data alone, this motivates a synergy between seismics and infrasonics.

Primary author: ASSINK, Jelle D. (KNMI - Royal Netherlands Meteorological Institute)

Presenter: ASSINK, Jelle D. (KNMI - Royal Netherlands Meteorological Institute)

Session Classification: T2.1 Treaty-Relevant Events

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

of Events Through On-Site Inspection

Monday, June 26, 2017 11:30 AM (15 minutes)

Signatures that are anticipated to be observed of a nuclear explosion is adequately known to the scientific community via accumulated knowledge of previous events. On-Site Inspectors are fully equipped to pick site-specific observables through their thorough training. However, it would be rather peculiar to anticipate conventional observables in a clandestine nuclear explosion, as signatures would be concealed to a great extent. Pertaining the verification ease on events of the atmosphere and oceans, a clandestine test will be confined to the subsurface, which detection is a tedious affair. Considered the Treaty-accepted technologies, fixed and partially outdated, along with a degree of concealment that violator may apply, a conclusive OSI would be a great challenge on a clandestine event. OSI is partially denied for luxury of advancing technology, while a possible violator hardly obstructed for the same, keeping the OSI verification in par with would-be Inspected State Parties needs to be critically analyzed. Emphasizing the necessity of lifting technological barriers, synergy of Treaty-accepted technologies via a versatile set of Inspectors who are trained to think out-of-box manner, probably enable to unearth possible cause of an event which a request has been triggered. Where tools and technologies are inadequate, human intuition prevails.

Primary author: DE SILVA, Nalin (Geological Survey and Mines Bureau (GSMB))

Presenter: DE SILVA, Nalin (Geological Survey and Mines Bureau (GSMB))

Session Classification: T2.2 Characterization of Events Through On-Site Inspection

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

features of wave forms of seismic events from the areas of nuclear Asia Test Sites according to the data of AS60 seismic station (AAK, Ala-Archa, Kyrgyzstan)

Three-component seismic station «Ala-Archa» (AAK) was installed in Kyrgyzstan in May, 1983. Location of this one in specially constructed granite tunnel away from the seismic noise sources has made the station an effective site for monitoring both regional, teleseismic events, and nuclear explosions. In October 1990, a digital broadband network station IRIS / IDA AAK was opened here, which was included in the IMS CTBTO network as an 3-C auxiliary seismic station AS060, certified in 2007. AAK station is located on regional distances from the Asia Nuclear Test Sites (Lop Nor, Semipalatinsk, Chagay and Poharan). A comparative analysis of the scanned and digitized historical records of underground nuclear explosions conducted at the Lop Nor Test Site in 1983-1996, at the STS in 1983-1989, as well as at the Poharan and Chagay in 1998 was fulfilled. The wave forms of nuclear explosions were compared with the records of tectonic earthquakes occurred in the areas of test sites and the surrounding territories. The spectral relations of major regional seismic phases both of the nuclear explosions and earthquakes were analyzed. Besides, the comparative analysis of five North Korean nuclear explosions (2006-2016) recorded by the AS60 station was made.

Primary author: BEREZINA, Anna (Institute of Seismology (IS))

Presenter: BEREZINA, Anna (Institute of Seismology (IS))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Korea's Nuclear Tests 2016

This abstract is meant to study the North Korea's nuclear tests that were conducted in January and October 2016. North Korea set off two explosions at the test site in the northeast of the country. Later, it was discovered that these two explosions were nuclear and nuclear device were used in them. The comparison of the two tests result, obtained from Comprehensive Nuclear Test Ban Treaty (CTBTO), showed that the explosions were nuclear with the appearance of Xenon. The CTBTO focused on the main three isotopes which are (Xe-131m, Xe-133m and Xe-133) for North Korea's test as it is considered a significant detection of radioisotopes of xenon, these isotopes are produced in fission reaction and exhibit suitable half-lives and radiation emission to be detected in the atmosphere at low levels at great distances from the release site.

Primary author: KHEKAN, Ahlam Rashid Kharbat (University of Information Technology and Communication)

Presenter: KHEKAN, Ahlam Rashid Kharbat (University of Information Technology and Communication)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Explosions in the Eastern Siberia (the Former USSR) in 1976-1987

During 1976-1987 in the territory of the Eastern Siberia (the Siberian platform, Chitinskaya area and Yakutia) ten peaceful nuclear explosions (PNE) have been produced. PNE's magnitudes vary within 4.8-5.3. Explosions were registered by regional analog seismic station network located in the Baikal rift system (FDSN code is BY) at the epicentral distances from 246 to 1407 km. The regional travel times curves for the regional seismic phases (Pn, Pg, Sn, Sg and Rg) were constructed using data of arrival time of 9 PNE. Relocation of PNE epicenters was carried out using the HYPOCENTER software. In future, these data maybe used for clarification of deep structure of the region.

Primary author: DOBRYNINA, Anna (Institute of the Earth's Crust, Siberian Branch, Russian Academy of Sciences; Geological Institute, Siberian Branch, Russian Academy of Sciences)

Presenter: DOBRYNINA, Anna (Institute of the Earth's Crust, Siberian Branch, Russian Academy of Sciences; Geological Institute, Siberian Branch, Russian Academy of Sciences)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Procedures Developed by the IAEA's ALMERA Network Applicable to the Characterization of Legacy Nuclear Test Sites

The IAEA's network of Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA), consisting early 2017 of 160 laboratories in 87 countries, has for aim to provide timely and reliable measurement results of environmental radioactivity in routine monitoring and emergency situations. The IAEA supports the ALMERA laboratories in their environmental monitoring activities by organizing proficiency tests exercises, collaborative development and validation of analytical procedures for environmental radioactivity measurement, and training courses. The characterization of legacy nuclear test sites in terms of radionuclide levels and distributions is important for obtaining information on the respective nuclear tests and their impacts, as well as for environmental rehabilitation purposes. ALMERA tested and validated analytical procedures are essential tools for the production of reliable and comparable environmental radioactivity measurements in such cases. In addition to routine sequential procedures, rapid procedures were developed for the determination of Pu isotopes and ²⁴¹Am in soil and sediment samples, and for the simultaneous determination of ⁸⁹Sr and ⁹⁰Sr in milk, soil and seawater samples. Rapid procedures allow high sample throughput for large-scale or high resolution site characterization. This contribution will describe the current status of the ALMERA analytical procedures applicable to the characterization of legacy nuclear test sites. (https://nucleus.iaea.org/rpst/ReferenceProducts/ALMERA/Validated_analytical_methods/)

Primary author: PITOIS, Aurelien (IAEA)

Presenter: PITOIS, Aurelien (IAEA)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of IMS Data and Its Potential for Research Through Global Noble Gas Concentration Maps

CTBTO is establishing a global monitoring system for atmospheric xenon radioactivity as part of the International Monitoring System (IMS). Daily activity concentrations have been collected worldwide for over 15 years, of which the past 5 years with reviewed results in IDC Operations, providing unique data sets with long term time series that can be used for the identification of regional sinks and sources and to analyse atmospheric circulation dynamics on the time-scale of the radioxenon isotope half-life (between 9 hours and 11 days). In this study, we use the worldwide noble gas observations at IMS stations for reconstructing global Xe-133 concentration maps. This reconstruction is compared with ATM simulations based on known sources. By creating a residual plot, we can optimize the rendering process of the reconstruction map and improve the understanding of the source estimation on a regional basis. The motivation of this work results from the need to get a better understanding of the global distribution of the activity releases from radioxenon background sources to enhance the Treaty monitoring capabilities. Moreover, this study highlights the unique value for civil and scientific applications that is accrued in more than 15 years of worldwide IMS data on atmospheric radioactivity concentrations.

Primary author: TERZI, Lucrezia (Belgian Nuclear Research Center (SCK-CEN))

Presenter: TERZI, Lucrezia (Belgian Nuclear Research Center (SCK-CEN))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Energy and Aperture Estimation of the Five Explosions in North Korea

According to the calculation, the latest nuclear explosion occurred in North Korea had the largest energy at the frequency of 0.1-3 Hz, and in the frequency higher than 3 Hz, the latest event had the same energy with the ones in Jan. 2016, the one in 2013 and even the one in 2009. At 2 Hz, the ratio of the event occurred on Sep. in 2016 to other four events are 40.1, 4.7, 2.0, 1.8 respectively, which have little difference with the results of Wen Lianxing's 2016 group, who gave the 17.8 kt, 11.3 kt, 12.2 kt, 7 kt, 0.48 kt for the five events, and the ratios are 37.1, 2.5, 1.5, 1.6 respectively. According to the calculation, the maximum coefficients of E1609 and E0609, E1316 is 0.88, 0.98, 0.94, 0.98 in vertical direction. According to Fuqing array, Zhangzhou array analysis in China and the research results of Ingate (1985) and Rindal (1982), we concluded that the aperture of the five events is no larger than 3 km, the distance of the latest two events is no longer than 1 km.

Primary author: ZHENG, Zhong (Institute of Geophysics, China Seismology Bureau)

Presenter: ZHENG, Zhong (Institute of Geophysics, China Seismology Bureau)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

-Ray Imaging for Assessing Radiation Source Distributions in On-Site Inspection

The Lawrence Livermore National Laboratory has developed and commercialized many advanced radiation detection technologies that have become widely adopted and are used around the world. One of our most recent developments is the Germanium-Gamma-Imager (GeGI) System. This novel system combines a mechanically-cooled segmented planar HPGe detector with an optical camera. The GeGI identifies the radionuclides through traditional gamma-ray spectroscopy, computationally determines the spatial distribution and places that distribution atop an optical image of the same area. This enables the user “to see” otherwise invisible radioactivity and its distribution. We computed the performance of the GeGI against the IFE2014 scenario (10x60Co sources, 10 MBq each, distributed over a few hundred m² and slightly buried in soil at about 10-15 cm). We assessed several different distances from the perimeter of the source plane of polygon 29 and also the cliff side. For some of the distances examined, the GeGI would have both detected the presence of the sources, and identified a number of hot spots. This presentation will describe the hardware and the results of the model-based assessment of the expected performance against the IFE14 scenario. Work performed under the auspices of the U.S. DOE by LLNL under Contract DE-AC52-07NA27344, LLNL-ABS-716590.

Primary author: KREEK, Steven (Lawrence Livermore National Laboratory (LLNL))

Presenter: KREEK, Steven (Lawrence Livermore National Laboratory (LLNL))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

-2: On-Site Inspection Capabilities – Examination of Laboratory Detector Response

Choosing detection sensitivities or data quality objectives (DQO) for on-site inspections (OSI) requires selecting a threshold that must be met or exceeded during in-field analysis. However, this threshold may be difficult to meet in every scenario. A modeling utility built using the GEANT4 C++ framework has been developed to simulate acquired gamma spectra from any user-defined source. Using this resource, the detector response to a sample containing a mixture representative of a fast fissioned sample of ^{239}Pu one month after irradiation of only the OSI relevant radionuclides from several detectors was modeled. The detectors modeled include the six HPGe detectors deployed during the Integrated Field Exercise 2014 held in Jordan, one International Monitoring System detector from Radionuclide Laboratory 16, and one detector from the advanced portal monitoring systems developed in the United States. The performance of the detectors was compared, using a non-isotope-specific minimum detectable activity (MDA). Based on these simulations, HPGe detectors with a moderate thickness (~30 mm or greater) and a wide diameter (>80 mm) provide the best MDAs in the 0-750 keV range at the expense of increased cascade summing at close counting geometries.

Primary author: FRIESE, Judah (Pacific Northwest National Laboratory)

Presenter: FRIESE, Judah (Pacific Northwest National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

the On-site Inspection (OSI) Concept of Operations in Light of Integrated Field Exercise 2014 (IFE14) and Inspection Team Functionality

At the end of March 1999 work on the OSI Concept of Operations was transitioned to work on the OSI Operational Manual. The Concept of Operations document was compiled in CTBT/PTS/INF.136, "Compilation of Work on the Draft Concept of Operations for a CTBT OSI." The ideas expressed in the Concept of Operations have continued to guide the PTS OSI Program and Operational Manual. IFE14 successfully demonstrated the current state of the OSI regime, as it utilized the Inspection Team Functionality process for the decisions concerning activities as factually and data driven as possible. We will examine the progress made in light of the OSI vision of OSI conduct proposed by the State Signatories from 1998-1999 while formulating the OSI Concept of Operations, highlighting the differences and the similarities between vision and achievement.

Primary author: MACLEOD, Gordon Avery (Los Alamos National Laboratory)

Presenter: MACLEOD, Gordon Avery (Los Alamos National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Source Parameters and Their Uncertainties of Explosion Sources Using Equalization Technique: Application to the SPE Chemical Explosions at NNSS

In this paper, we use equalization of seismograms from nearby explosions recorded at common stations to estimate source parameters. Expressing waveforms $O_1(t)$ and $O_2(t)$ from two explosions of yield W_1 and W_2 with corresponding DOB of H_1 and H_2 as $S_1(t, W_1, H_1)G_1(t, W_1, H_1)$ and $S_2(t, W_2, H_2)G_2(t, W_2, H_2)$, respectively where S and G represent the source and Green's functions, we can argue that seismograms constructed by convolving the first event seismogram O_1 with S_2 and the second event seismogram O_2 with S_1 are nearly identical provided the DOB and distance differences between events are small. Green's functions in this algorithm are empirical and can include the effect of lateral structure, complex geology, and attenuation along the wave-propagation paths. When source parameters W and DOB of one explosion are known, this equalization algorithm will allow to solve for the yield and DOB of the other event, employing a grid-search technique. One can further use a specified tolerance to equalize seismograms and estimate the uncertainties in the source parameters. Results will be presented from our on-going study in which we have successfully examined the validity of the algorithm using waveforms from five chemical explosions of the PHASE I Source Physics Experiment with known yields and DOBs.

Primary author: SAIKIA, Chandan (U.S. Air Force Technical Applications Center)

Presenter: SAIKIA, Chandan (U.S. Air Force Technical Applications Center)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Seismic Sources of North Korean Nuclear Tests and Its Meaning for Event Identification

Wednesday, June 28, 2017 11:15 AM (15 minutes)

Amplitude ratios between the first 2016 and 2013 North Korean nuclear tests for different kinds of seismic waves are compared. The observations show the first 2016 test had generated stronger Rayleigh waves with weaker short period P and Love waves in comparison with the 2013 test. Based on the observations, secondary seismic sources including the DC components caused by tectonic releases and the CLVD components caused by induced rock damages of the explosions are determined. It is shown the DC sources of the two tests should have an identical thrust faulting mechanism with DC moment MDC of the first 2016 test smaller than that of the 2013 test, and the ratio between the CLVD moment MCLVD and the isotropic moment Miso is between 17~27% for the 2013 test, 0.7~11% for the first 2016 test, both much lower than that for underground nuclear explosions detonated by standard yield-scaled burial depth and of similar mb. The above mentioned results suggest the tectonic releases have significant effect on Ms for DPRK nuclear tests, which is of important implications for understanding the mb:Ms criteria and Ms-yield scaling.

Primary author: JIN, Ping (Northwest Institute of Nuclear Technology)

Presenter: JIN, Ping (Northwest Institute of Nuclear Technology)

Session Classification: T2.1 Treaty-Relevant Events (cont.)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Radioxenon Monitoring after the Announced Nuclear Tests of the DPRK on 6 January and 9 September 2016

For the purpose of monitoring for compliance with the Comprehensive Nuclear-Test-Ban Treaty (CTBT), the International Monitoring System (IMS) is being established that includes 40 sensor systems for atmospheric xenon radioactivity, 28 respectively 27 of which were in operation at least for part of the first two months following the two nuclear tests in 2016. Five underground nuclear tests were announced by the Democratic People's Republic of Korea (DPRK) at the Punggye-ri Nuclear Test Site. In the aftermath of the first test in 2006 and the third one in 2013, radioxenon observations were made that were consistent to be associated with the time and location of the relevant seismic events. The fourth and fifth tests were announced on 6 January and 9 September 2016. This paper describes analytical methods and results of the relevant data from neighbouring IMS stations with emphasis on episodes of elevated levels of radioxenon that could be consistent with a late release from the location of the seismic event. Several standard and additional exploratory methods were applied to test the hypothesis whether the observed radioxenon can be correlated to the seismic event. The final judgement is the responsibility of the State Signatories.

Primary author: KALINOWSKI, Martin B. (CTBTO Preparatory Commission)

Presenter: KALINOWSKI, Martin B. (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

of Regional Seismic and Infrasonic Data from Five North Korean Nuclear Explosions

Wednesday, June 28, 2017 12:00 PM (15 minutes)

We analyze seismic and infrasonic signals generated by five underground nuclear tests in North Korea in 2006, 2009, 2013, and 2016 (January and September). Regional data from six seismo-acoustic arrays, cooperatively operated by Southern Methodist University (SMU) and Korea Institute of Geosciences and Mineral Resources (KIGAM) in the Korean peninsula, were used with two additional infrasonic arrays operated by KIGAM and an additional seismic station in China. We explore the relative seismic source scaling of Pn, Pg, Sn, and Lg phases, using the Mueller and Murphy (1971) and Denny and Johnson (1991) source models. This analysis constrains a range of relative source strengths and depths. We analyzed infrasonic signals detected from all the explosions using an automatic detector and compared these with the model predictions using time dependent atmospheric specifications. These results suggest that infrasonic detections from the five explosions are strongly dependent on atmospheric condition at the time of each explosion (best detectability in January 2016 case) with infrasonic event locations improved using this information. Future work is needed to integrate both seismic and infrasonic analyses to provide combined constraints on source depth as well as free surface interactions near the source.

Primary author: STUMP, Brian (Southern Methodist University)

Presenter: STUMP, Brian (Southern Methodist University)

Session Classification: T2.1 Treaty-Relevant Events (cont.)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Dangerous Technogenic Objects at Semipalatinsk Test Site

During underground nuclear explosion (UNE) significant rocks volume turns gaseous forming UNE cavity. The most part of “warfare” borehole (WB) has no signs of day surface disturbance, and remains to our time in quasi-stable state. At the same time in a number of epicentral areas of WB the failing is observed, formed at different times - a part during UNE, others – much later. The presence of technogenic effects, intense fracturing zone, collapse pillar and other tectonic destruction make UNE-cavity air passable. Increased gas emission in these areas is expected effect because of large number of cracks. It is obvious that the increased gas emission means the presence of technogenic effects of the UNE in rocks. One of the signs of long-term processes of rocks destruction in the epicentral area – gas emission, which allows identifying potentially dangerous in terms of the collapse of WB day surface. WB at the site “Balapan”, which go to the category of dangerous objects: 1010, 1086, 1053, 1223, 1201, 1234, 1236, 1309, 1315, 1316, 1318, 1322, 1323, 1325, 1326, 1328, 1331 1340, 1355, 1421 “Deep”. WB at the site “Sary-Uzen”, which go to the category of dangerous objects: 102, 104 and 111.

Primary author: SUPRUNOV, Vladislav (Institute of Radiation Safety and Ecology, Branch of National Nuclear Center of Republic of Kazakhstan)

Presenter: SUPRUNOV, Vladislav (Institute of Radiation Safety and Ecology, Branch of National Nuclear Center of Republic of Kazakhstan)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Discrimination and Source Parameters Using Moment Tensor Inversion

Seismic moment tensors are summation of force couples that are scale invariants, symmetric and independent on the coordinate system used to describe the source. The seismic moment tensors for certain types of sources, such as volcanic earthquakes and nuclear explosions are expected to contain an isotropic component and have volume change. Whereas in case double couple deviatoric tensor is maximum and no volumetric changes occurred. In recent analysis we explore new methodology of regional moment tensor inversion to improve earthquake-explosion discrimination. Source parameters of India, Pakistan and North Korea nuclear explosions are determined and compared with the earthquakes occurred in the vicinity of the explosion. We observed maximum isotropic components (> 50%) during explosion as compare to double component. Minor impression of double couple mechanism in the nuclear explosion may be due to the interactions of tectonic activities and multiple scatterings. Moment magnitude of India (Mw 4.63) and Pakistan (Mw 4.57) explosions are comparable. Whereas North Korean explosion moment magnitude for 2006 (Mw 4.03), 2009 (Mw 4.29), 2013 (Mw 4.47), 2016 (4.59, 5.65) were different and relatively 2016 North Korea are large as compare to previous one. Moment tensor inversions could be vital tool for nuclear monitoring and events discrimination.

Primary author: TAHIR, Mohammad (ISTerre Grenoble France, Yonsei University South Korea)

Presenter: TAHIR, Mohammad (ISTerre Grenoble France, Yonsei University South Korea)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Cs-137 Background of Global Fallout at OSI Site as the Signature to Search for Radiation Anomaly or the Artefact

• In the late 80-ies of the last century, it was noted that Cs-137 contamination of the ground has been significantly diminished after the nuclear explosion in the shaft (vertical hole) at Semipalatinsk test Site (STS). Sites around 3 old tested nuclear shafts 1350, 1365 and 1412, have been surveyed on 1997-1998. Global fallout level of Cs-137 in the region of STS was on 1997-98 about 2.0-2.5 kBq/m². • During survey have been obtained gamma-spectra with Ge-detectors at 6-8 points and also mobile gamma-spectrometer "Niva" has NaI(Tl)-spectrometer along eight radial profiles. Cs-137 background in 50-100 m radius around tested shafts was significantly lower than fallouts level (approximately 2 – 10 times). The gamma spectrometric measurements conducted by two various techniques, has shown almost an identical picture on all surveyed sites. Variations of Cs-137 global fallouts occur as a consequence of large volume of constructive assembly operations during of shafts preparation activity for nuclear explosion. Change and shifting of surface top soil takes place at the site as a result of preparatory engineering works, and this can be complementary evidence of clandestine nuclear weapon test. These effects are suggested to be used as the search characteristic during the on-site inspection.

Primary author: DUBASOV, Yurii (Khlopin Radium Institute)

Presenter: DUBASOV, Yurii (Khlopin Radium Institute)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

-85 Monitoring in North-Western Region of Russian Federation

Kr-85 monitoring in USSR-Russia ended in 1993, at that time its concentration activity was 0.9 - 0.92 Bq/m³. The monitoring of Xe and Kr-85 radionuclides was renewed in August 2006, and was arranged at the sampling station in Cherepovets city, located 220 km north of the Kalinin NPP. A balloon was filled with the Kr-Xe gas mixture with charcoal and analysed on the Radium Institute. For the period of monitoring on 2006-2008 in Cherepovets city the concentration of Kr-85 varied from 1.3 to 1.8 Bq/m³ and amounted to 1.55 ± 0.12 Bq/m³ in average. The mean Kr-85 concentration activity in atmospheric air in St.-Petersburg made up 2.11 ± 0.66 Bq/m³, which is 37% higher than that in Cherepovets. Air masses with increased Kr-85 content are mainly transferred from the West and the South-west directions, i.e. from NPPs location regions. Air masses with a lowered Kr-85 concentration moved from the North (Greenland Sea, Northern and Norwegian Seas), where there are no NPPs located. Kr-85 concentration activity in old gas balloon (1995) was measured. The data Kr-85 monitoring in 2012-2016 are presented.

Primary author: DUBASOV, Yuri (Khlopin Radium Institute)

Presenter: DUBASOV, Yuri (Khlopin Radium Institute)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Study by a Physical Model of the Ahar-Varzaghan Doublet Earthquakes (6.5, 6.3) 2012 at the Northwest of Iran

Local earthquake coda wave decay parameter, called Q coda, studying is a worldwide motivation. Geometrical spreading, scattering attenuation due to heterogeneities and intrinsic absorption due to inelastic properties of the media are some reasons to decay of wave amplitude or energy during its propagation. Numerous papers have been published reporting changes in coda Q associated with the occurrence of major earthquakes in time and space showing a correlation with seismicity. In order to develop a physical model to account for the above observations, we shall look at the phenomena from dilatancy-diffusion model viewpoints. Seismic coda waves of short-period S waves were estimated from local earthquakes for 4-8 Hz frequencies of the coda before doublet Ahar-Varzaghan (Mw 6.5, Mw 6.3 2012). The inherent large error of every single measurement can only be reduced by averaging over many events. So, coda measured both 7 and 11 consecutive earthquakes, respectively each set sharing three and five common earthquakes with their neighbours. Due to our results, coda variation before Ahar-Varzaghan is compatible with dilatancy-diffusion model. Based on available model, we can model the time and magnitude estimation of the major shock; however, we believe additional data can improve the model for the whole region.

Primary author: REZAEI, Reza (Institute of Geophysics, University of Tehran)

Presenter: REZAEI, Reza (Institute of Geophysics, University of Tehran)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Stress and Fault Orientation in Double Subduction Zone of Maluku Sea Region by Using Iterative Joint Inversion Method

Iterative Joint Inversion is one of the methods which used to determine stress orientation based on earthquake focal mechanism data. Stress orientation determination of the earthquake events is very useful for disaster mitigation field. This research used Iterative Joint Inversion method to determine stress orientation in double subduction zone of Maluku Sea region. The earthquake focal mechanism data was retrieved from The Global CMT (Centroid Moment Tensor) with range of time from January 1, 2011 till December 31, 2015, and range of magnitude from Mw 4 till Mw 7. The results of this research are values of Friction, Shape Ratio and azimuth/plunge of each axis, respectively. The values of Friction are 0.6 and Shape Ratio is 0.67, respectively. While the values of azimuth/plunge are as follow: the T-axis is $302.24^{\circ}/6.52^{\circ}$, the B-axis is $32.81^{\circ}/4.94^{\circ}$, and the P-axis is $159.68^{\circ}/81.80^{\circ}$, respectively. Based on this result, it can be concluded that stress orientation in double subduction zone of Maluku Sea Region is categorized as the Normal Fault.

Primary author: KAMARUDDIN, Basri (Geophysical Station of Ternate, Meteorological, Climatological, and Geophysical Agency of Indonesia)

Presenter: KAMARUDDIN, Basri (Geophysical Station of Ternate, Meteorological, Climatological, and Geophysical Agency of Indonesia)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

New Experimental Field Study of the Effects of Explosive Detonation Products on Seismic Radiation

Understanding explosion source processes is of great importance for seismic event characterization and explosive yield estimate. Weston Geophysical conducted a series of chemical explosions using various explosives with different properties in order to investigate their effect on seismic signatures. Previous experimental data (NEDE, e.g. Martin et al, 2012) suggest that low-frequency P-wave amplitudes are affected by the explosive velocity of detonation (VOD) and by the thermodynamic characteristics of gaseous explosive products (Stroujkova, 2015). The new experiment conducted in New Hampshire in 2016 was designed to isolate the effects of the amount of the explosive gases by using aluminized and non-aluminized explosive pairs. Our new results confirm NEDE findings and indicate that seismic amplitudes and source signatures are affected not only by the explosive yield and VOD, but also by the volume of gaseous products and by the presence of fluids in the emplacement medium.

Primary author: STROUJKOVA, Anastasia (Weston Geophysical Corp)

Presenter: STROUJKOVA, Anastasia (Weston Geophysical Corp)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of a Relative Depth and Yield of DPRK's Third and Fourth UNE

Democratic People's Republic of Korea(DPRK) has carried out five underground nuclear tests since 2006 at P'unggyeri test site. For DPRK's UNEs, the explosions have been performed almost at closely located test sites. In this case, with an assumption of well coupled explosions, estimates on the relative depth and yield of UNE can be attained by a spectral division of the two seismograms recorded at the same station because the source area's geological contribution to yield and attenuation effect along the seismic propagation path can be canceled out. We tried to estimate relative depth and yield between DPRK's 3rd and 4th UNE using spectral division of Pn and Pg phases. The yield ratio, as a function of amplitude ratio at low frequency and depth ratio, is estimated along with another expression with corner frequency ratio and depth ratio. These two relationships give a solution of relative depth and yield between two events with 95 % confidence intervals.

Primary author: KIM, Tae Sung (Korea Institute of Geoscience and Mineral Resources (KIGAM))

Presenter: KIM, Tae Sung (Korea Institute of Geoscience and Mineral Resources (KIGAM))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Tritium as an Indicator of Underground Nuclear Explosion Venues at the STS

During the last 5 years a complex research of the main environmental components of testing sites of the STS have been carried out. It was found that biological components of the environment either at the territories with high tritium concentrations in channel water. It can be assumed that all well-mouth sites of underground tests at the «Balapan» site can be potential sources of tritium uptake into environmental objects. At the «Balapan» site in venues of UNEs presence of tritium was revealed in snow cover. Maximum concentrations of tritium in snow were found at the well heads up to 400 Bq/kg. To study the mechanism of tritium entry into snow cover boreholes were dilled and tritium content determined in soil. Tritium in soil was found in all boreholes drilled, its content is not uniformly distributed, maximum tritium concentrations up to 20 kBq/kg were found at the depth of 1 - 3 m. A conclusion was made that in the UNEs epicenters tritium contained in the snow cover enters from the soil cover naturally by means of capillary elevation. This method for determining tritium content in snow cover can be successfully used to identify venues of underground nuclear explosions.

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Presenter: TURCHENKO, Denis (Institute of Radiation Safety and Ecology, National Nuclear Centre of the Republic of Kazakhstan)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Event Fallout Inhomogeneity on Small- and Medium-Scale in Meadows and Forests

Due to peculiarities of radionuclides dispersion in the atmosphere the fallout, especially if radionuclides are not emitted into the stratosphere through an obvious atmospheric nuclear test conducted, creates a significant inhomogeneous pattern while air mass travel-path models show definite backward trajectories pointed out to the possible emission source. In order to understand nuclear fallout inhomogeneity reasons up to one hundred soil samples were collected in certain places where the Chernobyl accident plume travelled over. For a reasonably comprehensive sample analysis different techniques were used: HPGe gamma, alpha spectrometry, inductively coupled plasma mass spectrometry combined with a high sensitivity APEX sample introduction system. Although the mixture of global nuclear tests fallout and the negligible Chernobyl plume emissions prevailed, the results showed a substantial concentration increase (up to one hundred times) of ^{137}Cs and Pu and considerable atomic and isotopic ratios differences of $^{137}\text{Cs}/^{239,240}\text{Pu}$, $^{238}\text{Pu}/^{239,240}\text{Pu}$, $^{240}\text{Pu}/^{239}\text{Pu}$ in sampling locations nearby and in medium-scale, sometimes revealing Chernobyl contribution up to 43% in certain places. Places to perform sampling under air mass trajectories of the possible radionuclide emission for the best its detection sensitivity are discussed. The numerical model to explain inhomogeneous fallout depending on various surface and near-ground troposphere parameters is contemplated, too.

Primary author: PUZAS, Andrius (Center for Physical Sciences and Technology (FTMC))

Presenter: PUZAS, Andrius (Center for Physical Sciences and Technology (FTMC))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Background Gamma Radiation in the Northern Marshall Islands

Sixty-seven nuclear tests were conducted on two atolls in the northern Marshall Islands between 1946 and 1958. These tests produced radioactive fallout, which even today gives rise to radiation measurable above naturally occurring background levels. Rather than obtain new data, recent estimates of contamination levels in the northern Marshall Islands use measurements made decades ago to calculate present radiation levels. In contrast, this study reports on timely measurements on three different atolls, and also provide detailed fits and simulated maps across several islands, including the islands of Bikini and Rongelap. Bikini and Rongelap Islands are of particular interest as they are relevant to the discussion of human resettlement; indeed, the study measured radiation values for Bikini Island are higher than those previously reported. See the related paper here: <http://www.pnas.org/content/113/25/6833.abstract>

Primary author: BORDNER, Autumn (Stanford University)

Presenter: BORDNER, Autumn (Stanford University)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Years on Since the Upgrade of the Eskdalemuir, UK, Seismic Array: Network Advances and New Observations

The seismic array station located near Eskdalemuir in the UK is part of the auxiliary seismic network of the International Monitoring System (IMS). The station was originally installed in 1962 and has been in operation since then. In 2009, the station was significantly upgraded to modern IMS standards. The upgraded 20 pits of the array house a new broadband sensor (30 s to 50 Hz 3V seismometer, replacing standalone Wilmore Mk2 short-period sensors), a 24-bit digitiser with integrated authentication module, tamper detection switches, UPS, and fibre optic interface. Compared to the existing analogue infrastructure, the new digital fibre network (with buried cables) increases timing accuracy and reduces interference from electrical storms. Eskdalemuir is now one of the most reliable seismic arrays in the world in terms of its data availability due to its robust sensor, power and data infrastructure. Since the upgrade, the array typically functions with close to 100% reliability, with data availability to CTBTO reported as ~99.88%. We show examples of recorded waveforms from the recent nuclear tests in the DPRK recorded at Eskdalemuir. We also present new observations from air-gun signals during regional active-source seismic surveys in the North and Irish Seas.

Primary author: PETERS, Hannah (Guralp Systems)

Presenter: PETERS, Hannah (Guralp Systems)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Telltale Signature of an Underground Nuclear Explosion

Prompt release of gases at the ground surface resulting from existing or explosively propagated vents has typically been considered the only mode of transport of detonation gases from an underground nuclear explosion (UNE) capable of giving rise to measurable levels of radioxenon gases in downwind atmospheric samples. With a model for thermally and barometrically driven post-detonation transport across the permeable ground surface of a simulated UNE site, we show, using the results of simulations and an atmospheric tracer-release experiment, that even UNEs without significant prompt vents or leaks are potentially detectable many kilometers downwind with current technology. The bulk permeability of the UNE site and the depth of detonation appear to be primary source-term parameters controlling the distance of detection from the detonation point. Computer simulations of subsurface transport generally resulted in larger atmospheric signals for shallower, lower-yield explosions.

Primary author: CARRIGAN, Charles (Lawrence Livermore National Laboratory)

Presenter: CARRIGAN, Charles (Lawrence Livermore National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Array Analysis for Accurate Relative Event Location at the North Korea Nuclear Test Site

Between October 2006 and September 2016, 5 declared underground nuclear explosions carried out at the Punggye-ri test-site in North Korea were detected both at regional and teleseismic distances. Double-difference relative location estimates are quite network-sensitive with inter-event distance estimates from regional Pn phases consistently longer than estimates from teleseismic P-phases. The seismic wavefield leaving the test-site is more complicated than predicted by a 1D velocity model. Slowness corrections for each of the rays leaving the source region can be found which reduce the double-difference time residuals and provide relative location estimates which are consistent for all seismic measurements. Source-array analysis provides a different approach to modelling the seismic wavefield leaving the DPRK test-site and supports the hypothesis that the slownesses for regional Pn waves are frequently underestimated. Given the number of events now recorded at the test-site, source-array analysis provides an important tool for analyzing subsequent events which may be problematic for classical double-difference methods. One such scenario is a low magnitude event recorded only regionally, with limitations in azimuthal coverage. Another is a test in a different part of the site for which the waveform similarity is significantly diminished at some stations.

Primary author: GIBBONS, Steven John (NORSAR)

Presenter: GIBBONS, Steven John (NORSAR)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

and Relative Location at the IDC: Five DPRK Events

The International Data Centre (IDC) estimates absolute location of seismic events in routine processing. The final solution is obtained in interactive analysis and includes geographical coordinates of the epicenter and depth estimate. All estimated values are characterized by uncertainties, which correspond to measurement and modelling errors of arrival times at associated seismic stations of the International Monitoring System (IMS). In the IDC, the final position of an event hypothesis depends on modelling errors and is less sensitive to measurement errors. Both errors can be significantly decreased for relative estimation of arrival and travel time. Waveform cross correlation can improve the accuracy of arrival time estimate to a fraction time step. Spatial closeness of several events allows replacement of theoretical travel times with empirical ones. Therefore, one can accurately estimate their relative location. The procedure of relative location has been applied to five DPRK tests. Using various combinations of stations (e.g. all associated IMS stations, only regional, only teleseismic stations) we have studied the change in relative locations and selected best station subsets for pairwise and joint determination of relative coordinates. The IDC absolute solutions with their confidence ellipses are compared with relative location.

Primary author: KITOV, Ivan (CTBTO)

Presenter: KITOV, Ivan (CTBTO)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Spectral and Focal Mechanism of Likely Nuclear Explosion in North Korea January 2016

Characters from the initial impulse wave signals coming from the explosion is compression or trending upward in the early phase of the earthquake is recorded while the earthquake wave signal has an initial impulse can vary the compression or dilation (trending down) depending position relative to the source of the earthquake station. In the case of North Korea's nuclear test in 2016. When viewed from this characteristic, it is clear that the recording of seismic waves on January 6, 2016 at 01:30:01 UTC about coming from the explosion. However unique seismograph recordings of a nuclear test in 2016 have recorded a large surface waves. It can be seen visually on the waveform, the spectral waveform and spectrogram. It is quite interesting because it is contrary to the opinion that the explosion would not result if surface waves or surface waves will not be too big. Especially Rayleigh surface waves (ground roll) can be formed by the explosion of dynamite on reflection seismic for exploration. Shift or slip allowed formed as a consequence of North Korea's nuclear test in 2016, the static displacement is the key why surface waves are formed by quite big.

Primary author: ROHADI, Supriyanto (Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG))

Presenter: ROHADI, Supriyanto (Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

National Data Centre Contribution to Nuclear Test Monitoring

Five nuclear tests (in 2006, 2009, 2013 and two in 2016) have been conducted by the Democratic People's Republic of Korea (DPRK). The explosions were detected by International Monitoring System (IMS) and located at International Data Centre (IDC), event magnitude estimates (mb from 4.1 to 5.1) indicating the increasing of energy chronologically released. Seismic signals generated by the DPRK events detected by Romanian Seismic Network (RSN) and by other regional monitoring stations were used to compute event locations at Romania National Data Centre (ROM_NDC). A comparison between solutions obtained at ROM_NDC and IDC is presented. However all the IDC locations are better constrained as a consequence of IMS global coverage, a significant enhancement of accuracy in ROM_NDC estimates is observed for the latter events, due to RSN stations continuous multiplying, as well as to the increasing of events' magnitude. The shapes, amplitudes and spectral features of RSN signals were examined. A remarkably shape resemblance was observed for the signals generated by all five events, suggesting very similar explosive source type. Array processing techniques were applied for signal detection at Romanian seismic array, BURAR, in order to estimate the slowness information and to specifically characterize signals from nuclear explosions.

Primary author: GHICA, Daniela Veronica (Romania National Data Centre)

Presenter: GHICA, Daniela Veronica (Romania National Data Centre)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Seismicity on the Territory of Kazakhstan

Starting from 1994, the monitoring network of the RSE IGR mainly consisting of sensitive seismic arrays of different configuration has been operating on the territory of Kazakhstan. Seismicity monitoring of Kazakhstan has revealed a significant number of earthquakes at regions that were traditionally considered as aseismic. A range of earthquakes is related to places of active induced effect. The report shows the information on events of induced and man-made nature on the territory of Kazakhstan using contemporary instrumental data from regional monitoring network and data of the International data centers. The man-made earthquakes occurred at solid mineral deposits (Zhezkazgan deposit in Central Kazakhstan, gold ore quarried of Northern Kazakhstan), at raw hydrocarbon deposits (oil and gas Tengiz deposit, gas condensate Zhanazhol deposit), at former Semipalatinsk Test Site, and natural-induced (induced) earthquakes (in Central and Western Kazakhstan) were studied. Possible reasons of its occurrence are considered. The waves pattern of records from sources of different nature from the same region are analyzed for its reliable discrimination.

Primary author: SOKOLOVA, Inna (Institute of Geophysical Researches)

Presenter: SOKOLOVA, Inna (Institute of Geophysical Researches)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of the Wave Pattern of Nuclear Explosions Records from Lop Nor Test Site by Central Asia Stations

The report shows the investigation results of the wave pattern of underground and air nuclear explosions conducted at Lop Nor Test Site (China), and tectonic earthquakes with epicenters close to the Test Site region. For the analysis, the digitized analogue and digital seismograms from Central Asia seismic stations at distances of ~700–2000 km for the period of 1965–2016 were used. For seismic discrimination, the structure of short-period seismic fields from UNEs and earthquakes was studied. Threshold values for each parameter were determined, and discrimination quality was estimated. To investigate the geodynamic processes at the Test Site, the characteristics of short-period S-wave attenuation field at this area were considered by data of Kazakhstan station BRVK. The methods based on analysis of relative level of Sn and Pn waves (Sn/Pn parameter), and slope of P-coda envelopes were used. The UNE records show considerable diminishing Sn/Pn mean values and increasing P-coda envelopes slope from the end of 1960-s to 1990-s. The earthquake records from Lop Nor Test Site area showed decrease of Sn/Pn values with time even after the UNEs series ceasing. We suppose that the effects revealed are related to migration of deep-seated fluids as a result of long intensive induced influence.

Primary author: SOKOLOVA, Inna (Institute of Geophysical Researches)

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Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Method for Applying Measurement Restrictions to a High-Purity Germanium Detector Within the Framework of On-Site Inspections

The purpose of high-resolution gamma-ray spectrometry during an on-site inspection (OSI) is to determine the presence or absence of radionuclides which indicate the occurrence of a nuclear explosion. High resolution gamma-ray measurements are usually performed using a high-purity germanium detector in the field (in-situ) or in the laboratory to samples taken in the inspected area. The comprehensive test ban treaty allows for measurement restrictions for high resolution gamma spectrometry within the framework of managed access (par. 89, Part II, CTBT protocol). The term “measurement restrictions” refers to technological methods which filter out any radionuclide data which is not treaty-relevant (CTBT/WGB/TL-4/42, 2012). We propose a method for measurement restriction based on hardware and software which can be applied to any high resolution germanium detector (stationary and mobile based systems). The basic principle of the proposed method includes deletion of parts of the measured spectrum, which in turn, can be analyzed by the inspectors in standard gamma-ray methods. In recent years, a feasibility study for the proposed method was carried out, including external tests by gamma analysts. We will present the method and the results of the feasibility study, as well as an initial model system for measurement restriction.

Primary author: AVIV, Ofer (Soreq Nuclear Research Center)

Presenter: AVIV, Ofer (Soreq Nuclear Research Center)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Explosive Yield Estimation

Yield estimation of explosions using seismic ways is always a difficult problem in seismology. There are many factors that can affect the result of yield estimation such as source characteristics, depth of burial, propagation path, attenuation, variation of the crustal structure and so on. Accurate yield estimation need a suitable relationship which is always empirical and must solve the problems mentioned above. Yield is directly related to the power released by the events that somewhat can be expressed with magnitude. So, magnitude-yield estimation relationship is common used in yield estimation including body-wave magnitude, surface-wave magnitude and coda wave magnitude, each has its advantages and disadvantages. The main purpose of the paper is to summarize the existing yield estimation relationships and make a simple analysis on interference factors. We focus on the description of underground nuclear explosions's yield and summarize the information of North Korea underground nuclear explosions.

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Presenter: KONG, Handong (Institute of Geophysics, China Seismology Bureau)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Response to an Underwater or Surface Test in International Waters

The hydroacoustic array system and national technical means of member states, coupled with the seismic system, radionuclide detection system, and even the infrasound system may give indications that a clandestine test has been carried out in international waters. The paper proposes that the CTBT use for analysis a previously conducted US test in international waters to determine the procedures and practices that might lead to a post-facto determination of a test and attribution to identify the testing state. In addition, consideration will be given to whether the methods involved developed could be used to determine whether the Vela event in 1979 could still be detected using the methodology necessary for analysis of underwater/surface testing.

Primary author: MOORE, George (Middlebury Institute of International Studies)

Presenter: MOORE, George (Middlebury Institute of International Studies)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Effects of the Khubsugul Earthquake of 5 December 2014, $M_w = 4.9$, Mongolia

Seismoacoustic effects of the Khubsugul earthquake of December 5, 2014 (51.37N, 100.63E, $MW=4.9$) were studied. Earthquake occurred in the Khubsugul basin at the depth 3 km. Acoustic signal was registered by the infrasound station "Tory" located at the distance 175 km from the epicenter. Travel time of acoustic waves is about 280 s. Apparent velocity of infrasound signal propagation is ~625 m/s. We assumed that the epicentral area may not be acoustic wave radiation source and modeled the signal partly as a seismic and partly as an acoustic. For the calculations velocity of acoustic waves was assumed to be 300 m/s and surface waves – 3.2 km/s. According to the calculations, the emergence of acoustic waves in the atmosphere are expected to 80-85 km radius from the receiver. On the trace "source-receiver" these distances correspond to the northern slope of the Khamar-Daban ridge (southern board of the Turan depression). The difference in height here is 1700 meters. It can be concluded that infrasound signal was radiated by the slope of the mountain ridge, and the high apparent velocity of acoustic waves is explained by the fact that the signal is propagated in the crust as seismic.

Primary author: DOBRYNINA, Anna (Institute of the Earth's Crust, Siberian Branch, Russian Academy of Sciences; Geological Institute, Siberian Branch, Russian Academy of Sciences)

Presenter: DOBRYNINA, Anna (Institute of the Earth's Crust, Siberian Branch, Russian Academy of Sciences; Geological Institute, Siberian Branch, Russian Academy of Sciences)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Variability of Xe-133 Atmospheric Background: Characterization and Implications for the International Monitoring System of the Comprehensive Nuclear-Test-Ban Treaty

Global maps of atmospheric Xe-133 from simulations of the atmospheric dispersion of industrial releases (radiopharmaceutical facilities and nuclear power plants) have revealed a large spatial variability. On annual average, simulated activity concentrations near the surface vary from 0.01 mBq/m³ to more than 5 mBq/m³. At most stations of the International Monitoring Network (IMS) of the Comprehensive Nuclear-test-Ban treaty, simulated levels of Xe-133 are explained by a complex combination of multiple sources. The signature of industrial radioxenon can thus interfere with that of nuclear tests. Therefore, a better characterization of this radioxenon atmospheric background is needed. In this study, the simulations of the Xe-133 atmospheric background are analyzed to characterize the temporal variability of its distributions. The dataset is based on two-year simulations, using 2013 and 2014 meteorological data, and the most comprehensive emission inventory of facilities as possible. Seasonal and monthly means at each of the 39 IMS stations (operational and planned) are calculated. Time series are compared to measurements when available (a total of 6000 detections at the 29 operational stations in 2013/2014 have been used). The seasonal effect is also assessed in terms of variations of the simulated spatial extent of the distributions in the northern/southern hemispheres.

Primary author: GENEROSO, Sylvia (CEA/CENTRE Ile-de-France)

Presenter: GENEROSO, Sylvia (CEA/CENTRE Ile-de-France)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Technique for Estimation of Global Isotopes Releases Affecting Test Detection

A fairly good estimate of net global (or regional) release of isotopes from man made processes can be formed by a system based on estimates of total isotopes production across the world by all known (and to be known) facilities. These quantities can both be estimated, acquired or reported by the producers. Same can be used to determine release of CTBT related isotopes (Radio Xenon) by using different known techniques. Variations in results, from different techniques can be normalized by using mean values. A mid line of possible releases can therefore be formed. This mid line accordingly can be added to with upper and lower limit curves using both types of estimates while excluding outliers initially for inclusion post successful testing(s). A set of curves comprising different corresponding levels to which probabilities can be assigned can be formed. Accordingly, these curves can be validated over a specified time by comparing values with physically found results from sensors beside gradual perfection using validated data from various other means. This system can therefore help in validation of all test related detection(s) to a fairly accurate levels. Life span of the process can also be shortened using various related expedients.

Primary author: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Presenter: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

6: Harvesting Results from Intensified Cooperation Between the Nuclear Explosion Monitoring and Isotope Production Communities

The sixth workshop on the signatures of man-made isotope production (WOSMIP) was held November 28 through December 2nd in Bariloche, Argentina. CTBTO, PNNL and INVAP jointly organized the event, where 81 participants representing 27 countries took part. More than 60 contributions, among oral presentations and posters were submitted. This workshop continued the tradition of bringing together the nuclear explosion monitoring and the isotope production communities, respectively. Over the years, these communities have developed common understanding and intensive cooperation and gathered again to discuss latest developments of technical solutions to minimizing the effect radionuclide emissions from fission based ^{99}Mo production has on the IMS. This workshop had sessions on alternative radionuclide sources, current and future ^{99}Mo production overviews, R&D on emission reduction, stack data availability and atmospheric transport modeling. This presentation will highlight the outcomes of this workshop, and focus on some novel solutions discussed during the WOSMIP workshop. It provides a thorough overview over the scientific and technical aspects needed to facilitate methods for calculating event characterization parameters and screening criteria for radionuclide detections based on thorough understanding of the radionuclide background in the atmosphere taking account of all known sources and regional variations. Oral/poster: preferring oral presentation.

Primary author: NASSIF, Eduardo Luis (INVAP S.E.)

Presenter: NASSIF, Eduardo Luis (INVAP S.E.)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

-Domain Source Function (TDSF) for Nuclear and Chemical Explosions: Analysis Around Nevada National Security Site (NNSS)

Displacement spectra from explosion accelerograms within a few kilometers (<3.5 km) of shot points indicate that the spectral level increases gradually from the f_c towards the zero frequency. In this paper, we present a time-domain expression (TDSF) which has two deformation terms: "static" and "dynamic", supporting this observation. For $f < f_c$, the static contribution dominates the dynamic contribution and leads to the gradual increase. For low-yield explosions, f_c is high; this effect is more pronounced. For $f > f_c$, the "dynamic" term contributions dominate and decay approximately as f^{-2} . For seismic waves propagating from the elastic boundary R_{el} to large distances, these two wavefields are affected identically by attenuation and spreading. Hence, the corrected spectra should exhibit these spectral features. P-wave explosion seismogram analysis indicates a likely presence of this effect and provides evidence of a yield equivalence by a factor of 2 between the nuclear and chemical explosions. By convolving the proposed TDSF with $[\exp(-C/R_{el}) H(t)]$, where C is the material velocity at the shot point, one can calculate the RDP at R_{el} of the source. We use this proposed RDP to investigate the influence of yield and depth of burial (DOB) on the spectral overshoot and f_c of explosion sources.

Primary author: SAIKIA, Chandan (U.S. Air Force Technical Applications Center)

Presenter: SAIKIA, Chandan (U.S. Air Force Technical Applications Center)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

and Analysis of CTBT-Relevant Xe Isotopes Global Background Between 2010 and 2016

Reliable measurements of radioxenon isotopes are essential for the International Monitoring System (IMS) as required for the Comprehensive Nuclear-Test-Ban Treaty (CTBT). IMS measures continuously the four Xenon isotopes of interest for CTBT verification: ^{131m}Xe , ^{133m}Xe , ^{133}Xe and ^{135}Xe . The characterization of the global Xe isotopes background is very important for the accuracy of IMS measurements and hence for the CTBT verification. In this work, we thoroughly analyze the global distribution of the four Xe isotopes depending on data measured by the IMS noble gas stations from 2010 to 2016. The ratios between different Xe isotopes were calculated for all the available stations. The ratios between different Xe isotopes were drawn and compared to the separation line between the nuclear explosion regime and civil regime according to Kalinowski graph. Then, we focused on studying stations with the highest Xe concentrations.

Primary author: ELBAHRAWY, Mohammed Yehia Taha Ahmed (National Research Institute of Astronomy and Geophysics (NRIAG))

Presenter: ELBAHRAWY, Mohammed Yehia Taha Ahmed (National Research Institute of Astronomy and Geophysics (NRIAG))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Xenon-133 to Iodine-131 Ratios for Discriminating Signatures of Nuclear Test Explosions Against Normal Operational Releases from Nuclear Facilities

Isotopic ratios of xenon emissions as well as of iodine emissions can be used to discriminate between releases from nuclear test explosions and normal operational releases from nuclear facilities. Radioisotopes of both elements can be detected by International Monitoring System (IMS) set up by the CTBTO. The scope of this study is to consider whether the ratio between the most frequently observed radioisotopes of these two elements, xenon-133 and iodine-131, can be applied to discriminate between a nuclear test explosion and emissions from nuclear facilities. This was done by comparing calculated and measured data. For nuclear explosions, calculations were performed using the Bateman equation and measured emissions were taken from publicly available data of the continental tests in the United States. For reactor emissions, Monte Carlo simulations of a light water reactor (LWR) burn-up and radioactive effluents records publicized by the European Commission were used. By comparing the calculations and measured emissions, a significant difference cannot be noticed. Without a more comprehensive understanding of diffusion processes from underground cavities and reactors to the atmosphere, it is concluded that the ratio of Xe-133 and I-131 cannot be routinely used to discriminate nuclear test explosions against effluents from nuclear facilities.

Primary author: KALINOWSKI, Martin B. (CTBTO Preparatory Commission)

Presenter: KALINOWSKI, Martin B. (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

-4: Source Term Analysis of Xenon (STAX) – Exploring Methods for Understanding Radioxenon Civilian Source Terms

The radioxenon background in the atmosphere is dominated by civilian sources, most noticeably from the production of ^{99}Mo from fission of uranium. Radioxenon from these sources are detected every day in the International Monitoring System (IMS). In an effort to minimize the impact of these radioxenon emissions on the IMS, the STAX project has been conceived to measure the emissions at the civilian sources using standard stack detectors, and send this emission data to the nuclear explosion monitoring (NEM) community. We describe the data needed by the NEM community and how it will be provided by the STAX project, the detector systems needed to collect the radioxenon emission data, and the data security mechanism to ensure propriety information from commercial production facilities is appropriately protected.

Primary author: FRIESE, Judah (Pacific Northwest National Laboratory)

Presenter: FRIESE, Judah (Pacific Northwest National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Experiment and Numerical Modelling to Understand Response Near Chemical Explosions

The Source Physics Experiment (SPE) is a series of buried chemical explosions in granite and includes a comprehensive set of measurements. Among these are near-source accelerometers and unmanned aerial system (UAS)-borne photogrammetry. Data analysis is supported by numerical modeling with the goal of better understanding wave propagation phenomenology, particularly generation of shear. Inspection of near-source velocity traces reveals that non-radial components are initially quiescent as expected for quasi-spherical sources. However, immediately following the peak radial motion, the non-radial components display a sudden surge to significant amplitude, providing a candidate for shear generation. We propose that this response reflects a build-up of strain on the fractures during initial loading. After peak stress, unloading results in an extensional state, allowing release of the stored shear strain. We support this hypothesis with high-fidelity, explicitly-jointed finite element simulations. Moreover, the data indicate release occurs in the direction of least regional horizontal stress and aligns with local geologic structure. This is consistent with analysis of pre- and post-test photogrammetry data where the horizontal component of displacement aligns with the direction implied by the velocity data. Further, we illustrate quantitative agreement between surface displacements computed in our numerical model and those determined in the photogrammetry survey.

Primary author: STEEDMAN, David (U.S. Department of Energy, National Nuclear Security Administration)

Presenter: STEEDMAN, David (U.S. Department of Energy, National Nuclear Security Administration)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Detection of Low-Level Aerosol Isotopes from New Civilian Nuclear Processes

As the world faces a challenging future in maintaining the commercial availability of radioactive isotopes for medical use, new methods of medical isotope production are being pursued. Many of these are small in size and could effectively operate continuously. With the potential for much shorter retention times, a new suite of isotopes may soon be found in the environment. An effort to evaluate possible release scenarios from such processes and the relevance to nuclear explosion monitoring technologies is presented here. It is estimated that many more aerosols containing low-level isotopes of gas/volatile origin could be detectable at short ranges and times, and a few at longer ranges and times as compared to those released in more common nuclear reactor operations.

Primary author: MILEY, Harry (Pacific Northwest National Laboratory)

Presenter: MILEY, Harry (Pacific Northwest National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

-Up and Calibration of INVAP Stack Air Effluent Monitor

The new Air Effluent Monitor (AEM) that INVAP has developed for nuclear facilities stacks, with the combination of a NaI scintillator and a CdTe semiconductor detector, has been assembled, started-up at factory, and will be installed in a new facility in the next months. Calibration of the monitor has been performed with tailored radioactive sources, to cover the needs of the detection of specific radioisotopes (^{133}Xe , $^{133\text{m}}\text{Xe}$, ^{135}Xe , $^{135\text{m}}\text{Xe}$, ^{131}Xe , ^{85}Kr). Tests of the monitor performance have been carried out in conditions similar to real stack environment. Data corresponding to the calibration of the two detectors and preliminary results of response of detectors to real emission conditions are presented. Full information on all process variables and spectrometric data is available through a local communication interface. This data is also available in a format suitable to be shared with IMS. As a means to enlarge the range of radioxenon isotopes that can be measured by the AEM, approaches to the use of high resolution spectrometry detectors (HPGe) are discussed.

Primary author: DI TADA, Mariana Lidia (INVAP S.E.)

Presenter: DI TADA, Mariana Lidia (INVAP S.E.)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Source of Moderate Earthquakes in Colombia

The National Seismological Network of Colombia operated by Colombian Geological Survey receive in real time seismic data from 48 broad band stations and 47 strong motion stations installed along the Colombian territory and data from stations of neighbor countries. This high density of the data allows to retrieve source parameters of moderate earthquakes. Moment tensor solutions from earthquakes with $M_w > 4.0$ recorded between 2012 and 2017 in Colombia and offshore areas were obtained. Moment tensor inversions were calculated with the inversion of complete regional waveforms in the range of 0.01–0.1Hz using the ISOLA code. The epicenters, depths and magnitudes estimated by national network were used as input, centroid position and depth were refined by spacial and time grids-searching around the starting parameters and the quality of the solutions was assessed taking advantage of the ISOLA tools. This new catalog with a considerable increase of the total number of available solutions has great potential to improve our understanding of the regional seismicity and of the ongoing tectonics.

Primary author: PEDRAZA GARCÍA, Patricia (Servicio Geológico Colombiano (SGC))

Presenter: PEDRAZA GARCÍA, Patricia (Servicio Geológico Colombiano (SGC))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Radionuclide Observables from the Platte Underground Nuclear Explosive Test

The Platte underground nuclear explosive test occurred in a tunnel at the U.S. Nevada Test Site on 14 April 1962. The test vented quickly (1.5 seconds) and radiation was detected at locations up to 200 km away. Using radioisotope measurements at the Queen City Summit location and HYbrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT) modeling of dispersion and deposition, a release fraction of approximately 0.36% can be determined. Using this, we have calculated deposition concentrations for the particulate on-site inspection (OSI)-relevant radionuclides, assuming no fractionation. Then, applying the minimum detectable activities (MDA) obtained by the Base of Operations laboratory at the Integrated Field Exercise 2014 (IFE14), we have calculated the maximum times an OSI could be expected to detect the various particulate OSI-relevant radionuclides for a vent of this magnitude. Such information can be used to determine sensitivity requirements for OSI equipment and procedures.

Primary author: MILBRATH, Brian (Pacific Northwest National Laboratory)

Presenter: MILBRATH, Brian (Pacific Northwest National Laboratory)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Gas Fluxes in the Subsurface and Sampling: From Science to Technology

Following underground nuclear explosions, migration of radioactive gases to the atmosphere takes many forms depending on the pressure and temperature evolution in the cavity and the properties of the geological media. This results in a diversity of gas fluxes at the geosphere-atmosphere interface that must be understood for proper detection of nuclear events both through the IMS and from OSI. In addition, numerous gaseous species are naturally present in the subsurface and their distributions in space and time are highly variable, due to biogeochemical reactions and water movements. Naturally occurring gaseous species are shown to be a good proxy of the migration capability of the radioactive gases of interest in a given environment, the major species O₂ and CO₂ locally controlling advection. Therefore, it is important to monitor many gas species either by on-line analysis or through bag sampling. Improvements of the conventional devices (tarps and boreholes) for subsurface gas sampling and analysis will be presented before considering optimization by means of numerical simulations. The new Controlled and Reliable SubSurface Air (CoRSSAir) sampler recently developed by CEA will be presented. It allows reliable sampling and guarantees sample integrity even under the harshest conditions in the field.

Primary author: PILI, Eric (Commissariat à l'énergie atomique et aux énergies alternatives (CEA))

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Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

as a Significant Tool for the Design of Gaseous Effluents Stack Monitors

The accurate measurement of the noble gases released by a Radioisotope Production Facilities (RPF) requires the design of an optimized monitoring system. The design process must take into account the characteristics of the radiation detectors and the engineering variables involved in the measurement. In addition, the field start-up experience is a key feature for the evolution and optimization of the new monitoring system. INVAP has a 25 year experience in the design, construction and start-up of stack gaseous effluent monitoring systems. The hands-on knowledge acquired during these years has allowed to reach a modular, versatile and multipurpose product, that can be installed either in RPF, Nuclear Research Reactors or any other nuclear facility. The stack gaseous effluent monitor has been optimized for the real-time measurement the radioxenon releases to the atmosphere. Characterization of emissions from RPFs is of great interest for CTBT, given its need to know the atmospheric background because the fact that RPFs are the responsible of most of the produced background. This poster presents the evolution of the INVAP stack monitor. The main features taken into account in the optimization of the design are described following the historical evolution of the monitoring system.

Primary author: SCARINCI, Ignacio (IFEG - CONICET - Universidad Nacional de Córdoba - Argentina)

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Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Production in Argentina: Change of HEU to LEU and Improvements to Reduce the Emissions of Radioxenon

Argentina was the first country in the world to change the Molybdenum 99 production process from HEU (high enrichment Uranium) to LEU (low enrichment Uranium) bearing in mind commitment towards the Treaty on Non-Proliferation of Nuclear Weapons (NPT) and world initiatives for stricter control of nuclear material. In 1985 the Radioisotope Production Plant from Fission (PPRF) began to produce commercially Molybdenum-99 with HEU targets and in 2002 it was changed to LEU. The production process start with the dissolution of the uranium / aluminum alloy targets in an alkaline medium and continues with 4 purification steps. In this type of process three main ways of emission of radioxenon to the environment can be distinguished. These ways are air, hydrogen and production process, they are analyzed and quantified. The PPRF taking into account the recommendations of CTBTO and IAEA is developing and implementing actions to reduce emissions of radioxenon. For this purpose, the volume of the decaying tanks will be increased, the separation of the hydrogen from the noble gases will be carried out and improve have been made during the production process. The details of these changes will be presented in the Poster.

Primary author: CARRANZA, Eduardo Carlos (Comision Nacional de Energía Atómica)

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Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Mechanisms of Ground and Surface Waters at "Balapan" Site of Semipalatinsk Test Site

The present work provides results of determining mechanisms of origin of water objects, including revealing of water exchange between different types of underground waters (fracture and ground waters), and their interrelation with surface waters. It was found that fracture waters (-121.6 ‰ for $\delta^2\text{H}$ and -16.6 ‰ for $\delta^{18}\text{O}$) are formed by means of feeding by local atmospheric precipitation of winter period. Ground waters, (-110.4 ‰ for $\delta^2\text{H}$ and -14.9 ‰ for $\delta^{18}\text{O}$) are fed from both fracture waters, and surface water bodies. The "Atomic" lake is characterized by the heavies isotopes, as related to global line of meteoric water [Craig H., 1961]. Dex values – excessive deuterium content [Dansgaard, 1964] in the lake are negative (-2.4 to -10.6 ‰). This means that fractionation of the water body isotopes is attributed to evaporation process, where ^2H and ^{18}O heavy isotopes are condensing in remaining water. So it was found that the reservoir is not fed from entry of ground waters of any kind. In Shagan river sites (5 km, 28 and 50 km) corresponding to ratio values of stable isotopes of contaminated fracture waters of "Balapan" site (see above) were found and localized.

Primary author: AKTAYEV, Medet (ORSMOS)

Presenter: AKTAYEV, Medet (ORSMOS)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Radioisotope Signatures from NPP Power Variations and Their Impact on the CTBTO Verification Regime

Xenon radioisotopes may be a clear signature of nuclear explosions, so that their detection, by the International Monitoring System (IMS) of the CTBTO, is of paramount importance. However, the emission of Xenon radioisotopes also from other sources, challenges the capability of the IMS to identify significant events out of this background, the isotopic composition of the Xenon trace becoming the actual discriminant for detection. Among the main background sources, there are Nuclear Power Plants (NPPs), which may release Xenon radioisotopes during normal operation cycles. Whilst the typical isotopic signatures of NPPs differ from those of a nuclear explosion, some peculiar conditions - for example, a rapid decrease of power - may impact the composition of radioxenon. In such cases, the power variation velocity has a crucial role in determining the amplitude of ^{135}Xe overshooting, in turn implying variations in the isotopic ratios used to discriminate the released sources. In this work, the variation in ^{135}Xe overshooting as a function of the NPP power ramping-down rate, is investigated through a parametric analysis using the SCALE 6.1 ORIGEN-S code, as well as its impact on the discrimination of the related isotopic ratios with respect to the threshold of the corresponding screening flags.

Primary author: OTTAVIANO, Giuseppe (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Presenter: OTTAVIANO, Giuseppe (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

: A Prototype Software Application Simulating the Impact of Radioxenon Emissions from Civil Sources on IMS Stations

The Comprehensive Nuclear-Test-Ban Treaty (CTBT) established a global monitoring system for atmospheric xenon radioactivity as part of the International Monitoring System (IMS).

During the International Noble Gas Experiment (INGE), a significant correlation between radio-xenon background and geographical region was observed. Investigations on the radio-xenon background have highlighted that different nuclear civil applications were contributing to this background. The major contributors to this background are a few Medical Isotope Production Facilities dispersed all around the world; other smaller contributors are Nuclear Power Plants and Hospitals.

The radio-xenon background makes the discrimination between radio-xenon detections from civil nuclear applications and from nuclear testing a very complex task. The scientific challenge is to develop algorithms and tools that facilitate the understanding of the background. The longer-term vision is to eventually predict the impact of civil sources on the radio-xenon detections at the IMS stations. With the goal of gaining first experience and scientific insight, a prototype software application is developed at the International Data Centre (IDC) to calculate hypothetical radio-xenon concentrations at IMS stations, based on a combination of source-receptor sensitivity (SRS) fields and estimated civil radio-xenon releases. The software tool is baptized SIMPAX – Prototype (Simulated IMPAct of Xenon).

The contribution aims at presenting the key features of SIMPAX prototype in terms of simulation model, input definition and output format.

Primary author: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Presenter: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

Civil Xe-Emissions: From Source to Receptor

Xenon emissions from medical isotope production facilities (MIPFs) and other nuclear installations affect verification capability of the International Monitoring System (IMS) of the Comprehensive Nuclear Test Ban Treaty Organisation (CTBTO). While the best way to address the issue is mitigating emissions at the source, retro-fitting mitigation systems in existing MIPFs can be very costly. Consequently, it is currently being explored as part of an IAEA Coordinated Research Project (CRP F23031) how stack monitoring data from MIPFs and other nuclear facilities, together with Atmospheric Transport Modelling (ATM) can be used to model the civil xenon-background at monitoring stations away from a source, and so reliably discriminate against Xe-detections resulting from clandestine nuclear activities. In this paper we report on the advancement of a compact stack monitoring system, based on a CZT (cadmium-zinc-telluride) 1 cm³ semi-conductor detector. We will present results from environmental monitoring of atmospheric Xe-133 activity concentrations throughout Germany. Monitoring data from 2014 are compared with results from Atmospheric Transport Modelling (ATM). The ATM used emission data from a large MIPF and other nuclear facilities in Europe (at time resolutions ranging from <1h to 1 y) and weather data from the ECMWF (European Centre for Medium-Range Weather Forecasts) as inputs and the atmospheric transport model Flexpart. Inconsistencies are discussed and knowledge needs identified to strengthen the ability to reliably discriminate civil from clandestine sources of Xe in the atmosphere for verification purposes.

Primary author: BOLLHÖFER, Andreas (Federal Office for Radiation Protection, Institution for Atmospheric Radiation/Support)

Presenter: BOLLHÖFER, Andreas (Federal Office for Radiation Protection, Institution for Atmospheric Radiation/Support)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Infrasound Signals from the 1920s

In the years 1912 and 1917, during the first world war two explosions took place in the eastern part of Austria in an ammunition depot. Observations of infrasound signals were made in the close vicinity of the depots as well at distances between 250 to 300 km. Old documents and reports describing both incidents are kept in the archive of the Zentralanstalt für Meteorologie und Geophysik (ZAMG). A compilation of the historic data will be shown in the presentation.

Primary author: MITTERBAUER, Ulrike Helene (Central Institute for Meteorology and Geodynamics)

Presenter: MITTERBAUER, Ulrike Helene (Central Institute for Meteorology and Geodynamics)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Full Moment Tensors, Including Uncertainties, For Earthquakes, Volcanic Events and Nuclear Explosions

A seismic moment tensor is a 3x3 symmetric matrix that provides a compact representation of seismic events within Earth's crust. We develop an algorithm to estimate moment tensors and their uncertainties from observed seismic data. The moment tensor uncertainties allow us to better discriminate among source types and to discuss physical processes for the events. For a given event, the algorithm performs a grid search over the six-dimensional space of moment tensors by generating synthetic waveforms at each grid point and then evaluating a misfit function between the observed and synthetic waveforms. 'The' moment tensor M for the event is then the moment tensor with minimum misfit. To describe the uncertainty associated with M , we first convert the misfit function to a probability function. The uncertainty is estimated from a probability that the true moment tensor for the event lies within the neighborhood of M . We apply the method to data from events in different regions and tectonic settings: small ($M_w < 2.5$) events at Uturuncu volcano in Bolivia, moderate ($M_w > 4$) earthquakes in the southern Alaska subduction zone, and nuclear explosions at the Nevada Test Site.

Primary author: ALVIZURI, Celso (NORSAR)

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Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Worldwide Background of CTBT-Relevant Xenon Isotopes

One of the CTBTO achievements over the recent years was the concretization of the project Noble Gas (NG) into Operations. The main milestones included the certification of 25 NG systems of the International Monitoring System (IMS) and the installation of NG processing software pipeline in the International Data Centre (IDC). Data from certified NG systems are reviewed by IDC Analysts on a daily basis. Automated and reviewed products are generated and made available to Member States via the IDC secure web site and through the new message system. A 3-level based categorization scheme was implemented as a first screening layer of CTBT relevant xenon isotopes. In addition, different radio-xenon measurement campaigns have been carried out by CTBTO at several locations of interest over the world, using mobile NG systems. IDC reviewed results over a long term period at various locations further contributed to a reliable characterization for better understanding the worldwide background of xenon isotopes. The presentation aims at compiling updated results on radio-xenon observations at IMS NG systems. Results from background measurement campaigns will also be included.

Primary author: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Presenter: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Precise Location of the Fifth Nuclear Test in North Korea

The accuracy of earthquake location is controlled by several factors, including the network geometry, available phases, arrival-time reading accuracy, and knowledge of the crustal structure. At 00:30 (UTC) on 09 September 2016, the North Korea conducted its fifth nuclear test. Because lack of near station and poor network geometry, it's difficult to determine the location of the fifth nuclear test in DPRK with routine earthquake location method. In this study, we developed a relative location method to locate the position of the fifth nuclear test. We extract the travel time differences of Pg/Pn between the new event and reference event at the same station using waveform cross correlation method. We then find the minimum of travel time residual by searching potential location near the reference event with grid search method. Synthetic tests indicate that the method has little effect on velocity model and the location error is less than 100 m. We determined the location of the fifth nuclear test with the new method. The fifth nuclear test is located to the northeastern of the fourth test. The distance between the two tests is about 500 m.

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Presenter: FANG, Lihua (Institute of Geophysics, China Seismology Bureau)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Detected by the Indian Ocean Network of Hydroacoustic IMS Stations

The International Monitoring System (IMS) is based on four technologies: seismic, hydroacoustic, infrasound and radionuclide. The hydroacoustic network, which consists of underwater hydrophone stations and T-stations (on-land seismometers), is essential for detection and location of underwater sources. Hydrophone stations are more sensitive than T-stations and provide azimuth information therefore they are more capable of detecting events and estimating event location. The Indian Ocean is the only area covered by three hydrophone stations, thanks to the recently installed HA04 at Crozet Island. During routine analysis of seismo-acoustic events analysts focus on either associating hydroacoustic signals (T phases) to seismic events or on verifying automatically formed hydroacoustic events from H phase detections. The installation of HA04 gave analysts an opportunity to examine underwater events missed by the automatic processing. This study will provide an overview of events recorded by hydroacoustic stations located in the Indian Ocean Basin (HA01, HA04 and HA08) since the recent deployment of the new HA04 station.

Primary author: BITTNER, Paulina (CTBTO Preparatory Commission)

Presenter: BITTNER, Paulina (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

and Outcomes in Xenon Mitigation under the EU Council Decision V

The monitoring capabilities of the IMS noble gas systems may benefit from reductions of radioactive noble gas emissions. If these are achieved at nuclear facilities that have high radioxenon releases in normal operation, this could significantly enhance the CTBT verification capability. In this framework, the SCK•CEN was contracted by the CTBTO under the EU Council Decision V to design a mobile system for the reduction of radioxenon emissions from radiopharmaceutical production facilities. The project was subdivided in three phases: i) exploration and selection of appropriate xenon adsorption materials, ii) study of operational conditions and trap design and iii) construction and testing of a mobile xenon trap. The project was performed in close collaboration with the Institute of RadioElements and was successfully completed by the end of 2015. The major results and outcomes of the project will be shown.

Primary author: GUEIBE, Christophe (Belgian Nuclear Research Centre)

Presenter: GUEIBE, Christophe (Belgian Nuclear Research Centre)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

the 2014 Baseline for Simulated Activity Concentrations of Four Radioxenon Isotopes at IMS Sites Based on Estimated Annual Releases of Known Sources

Worldwide monitoring of noble gases is an essential part of the verification system of the Comprehensive Nuclear-Test-Ban Treaty as it can provide a direct evidence of the nuclear nature of an underground or underwater explosion. The detection capability of the noble gas network is weakened due to the presence of a worldwide civilian radioxenon background. Improving the understanding of civilian radioxenon sources and their effects on the noble gas systems is crucial. In this study, a baseline radioxenon emission inventory is proposed for all four CTBT relevant radioxenon isotopes for the year 2014. This is based on a literature review for the Medical Isotopes Productions Facilities and Nuclear Power Plants, for which peer-reviewed information on their location and radioxenon emission exists. The radioxenon emission inventory is used together with Atmospheric Transport Modelling to estimate the radioxenon activity concentrations at IMS noble gas systems. The estimations are compared and discussed with regard to the observations of noble gas systems that were operational in 2014. This study is to our knowledge the first attempt to propose an emission inventory for all four CTBT relevant radioxenon isotopes and to compare the resulting estimated activity concentrations with all observations at IMS noble gas systems.

Primary author: GUEIBE, Christophe (Belgian Nuclear Research Centre)

Presenter: GUEIBE, Christophe (Belgian Nuclear Research Centre)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Simulations Characterizing Xenon Isotopic Ratios in Nuclear Power Plants

The principle of discrimination between xenon from civil reactor sources and xenon released from a nuclear explosion by analysing xenon isotopic ratios is well established. Xenon isotopic ratios similar to those from explosive sources are of particular relevance for CTBT monitoring. This study investigated which parameters influence the isotopic composition of radioactive xenon in nuclear power plants in a way that they could be more easily mistaken as explosion-like. In order to achieve this we calculated different isotopic vectors of xenon produced in nuclear power plants with neutronic simulations under typical operating conditions in the plant and compared them with older models. Different production mechanisms in nuclear power reactors will be discussed including a sensitivity analysis of the isotopic vector to fuel element geometry, burnup, fuel composition, reactor type, power level and others. Finally we will present estimates about the release of xenon to the atmosphere from a power plant under different operation conditions such as shut-down, start of operation and potential accidental releases.

Primary author: ROSS, Jens Ole (Federal Institute for Geosciences and Natural Resources (BGR))

Presenter: ROSS, Jens Ole (Federal Institute for Geosciences and Natural Resources (BGR))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Oral**

-Method for Identification of Underground Nuclear Explosion-Induced Radionuclide Seepage Area During On-Site Inspection

This paper addresses issues of related to atmospheric transport with account of deposition of dispersed and gaseous radionuclides originated by underground nuclear explosion (UNE). UNE-originated radionuclides may be released in the atmosphere either completely just after immediate accidental penetration of soil, or partially within several hours after UNE. And even if UNE is contained and its cavity is almost pressurized radioactive noble gases (RNG) and volatile agents slowly migrate to ground surface and release into the atmosphere for a long time. This paper presents interpolation technique of express-analysis of radionuclides distribution in the environment and at the ground surface. During on-site inspection (OSI) this technique will facilitate prompt search of UNE-originated radionuclide release area. Radionuclide distribution parameters (Gaussian plume) were specified using the computations made with dedicated CFD code, developed by RFNC-VNIITF for assessment of emergency situations at industrial nuclear sites. Based on simulated atmospheric transport of radionuclides this paper demonstrates the operation of express-method for identification of their release area.

Primary author: USTSELEMOV, Andrey (RFNC-VNIITF, Rosatom Corp.)

Presenter: USTSELEMOV, Andrey (RFNC-VNIITF, Rosatom Corp.)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Transport Modelling Assessing Chances to Detect Radionuclides Released from the Known DPRK Test Site

Forward simulations of the atmospheric dispersion from sites of particular interest are regularly performed at BGR, the German NDC. Since 2012 four forecasts per day are performed with the Lagrangian Particle Dispersion Model HYSPLIT (NOAA) and GFS (NCEP) meteorological data for potential releases from the known DPRK test site. The forecasts are used to assess the plume propagation patterns and to predict which IMS RN stations could become sensitive in case of an event. The simulated concentrations at IMS radionuclide stations in the region are analysed for the whole set of more than 5000 simulations. Seasonal variations of the detection chances are investigated. The results are compared with the operational SRS fields provided by the International Data Center in backward mode. In addition, for RN 38, Takasaki (Japan) backtracking simulations with ECMWF analysis data in 0.2° horizontal resolution are performed for selected samples in order to determine the source regions of the most dominant background detections. Furthermore a special focus lies on the time periods following the announced nuclear test explosions in January and September 2016.

Primary author: ROSS, Jens Ole (Federal Institute for Geosciences and Natural Resources (BGR))

Presenter: ROSS, Jens Ole (Federal Institute for Geosciences and Natural Resources (BGR))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Release Data Analysis: Progress and Expected Outcomes

The International Monitoring System (IMS) of the CTBTO comprises 80 radionuclide monitoring stations worldwide, of which 40 will be capable of measuring radioxenon. Radioxenon monitoring is a key component of the IMS as it provides forensic evidence of underground nuclear explosions. Radioxenon may however be emitted by civilian nuclear facilities, such as medical isotope production facilities, in routine operating conditions or accidental situations. A deep understanding of emissions originating from nuclear facilities is then of fundamental importance to discriminate signals potentially originating from a nuclear explosion, from the normal background. The CTBTO is currently developing a scientific project to analyse stack release data provided by nuclear facilities on a voluntary basis to characterize the radioxenon background. The current progress and the expected outcomes of the project will be presented.

Primary author: BARÉ, Jonathan (CTBTO Preparatory Commission)

Presenter: BARÉ, Jonathan (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

and Relative Body Wave Magnitudes of Five DPRK Events as Measured by the IDC

The International Data Centre (IDC) determines various types of seismic magnitudes. Estimation of body wave magnitude m_b is based on P-waves measured at stations of the International Monitoring System (IMS). Because of the CTBT-related monitoring requirements signal amplitude and corresponding period are measured within a 6 s window, including 5.5 s after arrival time. This is approximately the same time window as used in the waveform cross-correlation (WCC) method, which is under development at the IDC. The WCC method is applicable only to spatially close events generating similar signals as observed at IMS stations. We proposed to use the ratio of RMS amplitudes in cross-correlation windows for relative magnitude estimation of two close events. Five DPRK tests were conducted within a few km from each other and represent an important case for relative magnitude estimation and comparison with the network m_b estimates. Stations of the IMS seismic network are well distributed over azimuth and take-off angles for the DPRK test site. Thus, the ratios of RMS amplitudes are tested for the use in the relative moment tensor inversion.

Primary author: KITOV, Ivan (CTBTO)

Presenter: KITOV, Ivan (CTBTO)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Test Site: Underground Nuclear Explosions Signatures in the Velocity Field on P- And S- Waves (for the OSI Purposes)

At the location of explosive nuclear boreholes at Semipalatinsk Test Site area an active seismic investigations have been conducted along 8 parallel profiles with 6 km length and distance of 500 m between them. During these works 3-component signal registration was carried out, which allowed us to make analyses of the P- and S-waves first arrivals. Using forward ray tracing method, velocity structure of the section has been determined up to the depth of 300 m. In the vicinity of UNE boreholes location, a technogenically changed layer with the thickness of 40-80 m and velocity that is reduced with regards to undisturbed rocks by the value of up to 1.5 km/sec for P-waves and 1.35 km/sec for S-waves has been detected. This layer underlays the low velocity zone at the depth of 20-70 m, it's thickness changes proportionally to the yield of the nuclear charge. The obtained information can be used to update the UNEs phenomenology database and for the development of active seismic techniques for the On-site inspection purposes.

Primary author: BELYASHOV, Andrey (Trofimuk Institute of Petroleum Geology and Geophysics of Siberian Branch Russian Academy of Sciences)

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Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Site Carbon Dioxide and Stable Isotopologues Measurement to Support OSI Subsurface Gas Sampling

Sampling of subsurface soil gases represents one of the main On Site Inspection (OSI) activities for the verification of the Treaty. According to the scenario in which the OSI has been launched, the search logic framework could give to this activity an high priority. Generally, gas compositions are entirely different in air and deep-crust derived components and the usually higher concentration of helium, radon, methane and carbon dioxide in the subsurface gases drives the diffusion of these gases upward to the surface and the mixture with the air components; thus soil gas composition results from the mixing of these two components. In the OSI scenario the presence of buried structures and the production of high quantity of gases could influence the gas mixture migration and change its the final composition. Deep faults or fractures below the surface may provide pathways for the gases and carbon dioxide could act as carrier gas facilitating the migration upward from the deep crust or mantle. Portable isotopic analysers allow the measurement of CO₂ and its stable isotopologues concentration can be used to understand infiltration from atmospheric gases or the degree of permeation of atmospheric gases in the soil gases.

Primary author: RIZZO, Antonietta (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

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Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

of Data from an Intercomparison Between a SAUNA II and a SAUNA III System

A prototype of the SAUNA III system has been running in parallel with the SEX63 SAUNA II IMS station in Stockholm since December 2016. The SAUNA II system at SEX63 measures samples with 12 hour time resolution, while the SAUNA III system measures 6-hour air samples, each containing at least twice the amount of stable xenon compared to the SAUNA II. This results in a considerable improvement in measurement precision and plume time resolution. Analysis results from a comparison of the two data sets will be presented, including a comparison of detection capability, ratio uncertainties and source location capabilities.

Primary author: RINGBOM, Anders (Swedish Defence Research Agency (FOI))

Presenter: RINGBOM, Anders (Swedish Defence Research Agency (FOI))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Test Explosions Recorded by Seismic Stations of the Slovak Academy of Sciences

Archiving, retrieval and digitization of the historical seismographic data from nuclear test monitoring is an inevitable step before the data can be further investigated. Since the very first nuclear weapon test in 1945, several nuclear explosions took place around the world during the 20th century. It is a naturally arising task to investigate the corresponding seismic recordings obtained by the Slovak National Network of Seismic Stations operated by the Slovak Academy of Sciences. So far, a complex processing of the relevant data has not been performed, unless the standard reporting in the yearly bulletins and reports. In order to accomplish this goal, the historical data from the Slovak National Network of Seismic Stations have been investigated and checked for the presence of data corresponding to nuclear test explosions. The main sources of data have been the bulletins of both the Czechoslovak and Slovak seismographic stations published on the early basis. Besides this, the analog recordings from the Slovak seismic stations have been checked for the presence of data from nuclear explosions. We present the summary of the historical seismic data for the nuclear explosions, recorded by the seismic stations on the territory of Slovakia.

Primary author: KYSEL, Robert (Earth Science Institute, Slovak Academy of Sciences)

Presenter: KYSEL, Robert (Earth Science Institute, Slovak Academy of Sciences)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

10 New Research Reactor for Medical Isotope Production in Argentina

Argentina started the construction of a new 30 MW research reactor (RA-10), located at the Ezeiza Atomic Center (CAE), 40 km from Buenos Aires city. The RA-10 is conceived as a multipurpose facility suitable for radioisotopes production, materials and fuel irradiation, neutron techniques applications and silicon doping. The operation cycle is a 26 continuous days. The design is based on low enrichment uranium (LEU) Material Testing Reactor (MTR) fuel. The RA10 will replace the old 10 MW RA3 reactor, both operated by National Atomic Energy Commission (CNEA). The weekly production of Mo-99 from fission will be increased from 900 6 days-Ci to 2500 6 days-Ci. Such expansion will put the CNEA in the ranks of large-scale producers of the global market. To reach this goal a construction license for a new radioisotopes production plant from fission by RA10 reactor is under consideration at Argentine Nuclear Regulatory Authority (ARN). During the purification process of the Mo-99, fission gases containing xenon are released into the atmosphere. The design of the production plant includes the improvement in engineering and devices necessary to minimize the noble gases emission. ARN use optimized discharges to calculate discharge values following the philosophy of ALARA concept.

Primary author: QUINTANA, Eduardo Edmundo (Autoridad Regulatoria Nuclear (ARN))

Presenter: QUINTANA, Eduardo Edmundo (Autoridad Regulatoria Nuclear (ARN))

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Imaging of an Uncollapsed Nuclear Explosive Test

We present data and analysis of a seismic data collect at the HADDOCK underground nuclear explosive test in Yucca Flat, a sedimentary basin on the Nevada National Security Site, USA. HADDOCK was conducted in 1964 with an announced yield of less than 20 kt and depth-of-burial of 364 meters. The test is unusual in that the collapse of the test cavity did not reach the ground surface. As such, HADDOCK represents an opportunity to test advanced geophysical methods for detection and characterization of nuclear explosions that result in little-to-no surface expression. As part of the experiment (called Frey-Chimney), new high-resolution seismic and gravity data were acquired. The seismic experiment consisted of a hybrid 2D/3D array of approximately 1,000 2-Hz, 3-component geophones recording over 250 source points with two different seismic sources. The two seismic sources were the Seismic Hammer™ (SH, a prototype 13,000 kg weight-drop) and a much smaller accelerated weight-drop (AWD) used to supplement the SH-derived data with higher frequencies. In addition to the active-source data collection, pre-experiment ambient noise was collected on the array. Planned data analyses include processing for seismic reflections, body-wave and surface-wave velocity tomography, body-wave attenuation tomography, ambient noise tomography, and seismic cavity resonance detection.

Primary author: ABBOTT, Robert (Sandia National Laboratories)

Presenter: ABBOTT, Robert (Sandia National Laboratories)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Prototype Trap Validation and Controlled Source Experiments Under the EU Council Decision VI Project

The monitoring capabilities of the IMS noble gas systems may benefit from reductions of radioactive noble gas emissions. If these are achieved at nuclear facilities that have high radioxenon releases in normal operation, this could significantly enhance the CTBT verification capability. In this framework, the SCK•CEN was contracted by the CTBTO under EU Council Decision V to design a mobile system for the reduction of radioxenon emissions from civil production facilities. A follow-up of this project was necessary to carry on the work already performed on emission reduction and to utilize it for controlled source experiments with field measurements, supported by the high resolution atmospheric transport modelling (HRATM). In this regard, the SCK•CEN and the IRE were contracted in 2016 by the CTBTO under EU Council Decision VI to: i) analyze the scale-up and the long term behavior of the prototype developed under EU Council Decision V, ii) perform design studies at additional facilities and iii) investigate further the stack releases at IRE, through observations at various distances and comparison with ATM results. The current progress and the expected outcomes of the project will be presented.

Primary author: BARÉ, Jonathan (CTBTO Preparatory Commission)

Presenter: BARÉ, Jonathan (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Transport Modelling for Radionuclide Monitoring after the Nuclear Tests of the DPRK on 6 January and 9 September 2016

The International Monitoring System (IMS) developed by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) is a global system of monitoring stations, using four complementary technologies: seismic, hydroacoustic, infrasound and radionuclide. The radionuclide network comprises 80 stations, of which more than 60 are certified. The aim of radionuclide stations is a global monitoring of radioactive aerosols, radioactive noble gases and atmospheric transport modelling (ATM). To investigate the transport of radionuclide emissions, the Provisional Technical Secretariat (PTS) operates an Atmospheric Transport Modelling (ATM) system based on the Lagrangian Particle Dispersion Model FLEXPART. The air mass trajectory provides a “link” between a radionuclide release and a detection confirmed by radionuclide measurements. The aim of this study is to demonstrate the application of ATM to investigate the episodes of elevated levels of radioxenon observed by IMS stations after the fourth and fifth nuclear tests, announced by the Democratic People’s Republic of Korea (DPRK) at the Punggye-ri Nuclear Test Site on 6 January and 9 September 2016.

Primary author: KUSMIERCZYK-MICHULEC, Jolanta (CTBTO Preparatory Commission)

Presenter: KUSMIERCZYK-MICHULEC, Jolanta (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Determination of Radioxenon by the Study of Rotationally Inelastic Dynamics

The theoretical study of collisional excitation of LiH with rare gas shows the presence of Argon (Ar) and Xenon (Xe) in the atmosphere. The determination of ab initio potential energy surface (PES) allows the description of the interaction between the rare gas Ar or Xe and the rotating LiH molecule. The close coupling (CC) approach is used to determine the cross sections of collision. The rate coefficients are determined by averaging these cross sections over a Maxwell-Boltzmann distribution of kinetic energies. In our previous work [Niane et al. SpringerPlus 2014, 3:188 – Niane et al. Computational and Theoretical Chemistry 993 (2012) 20-25], the 11 first rotational levels of rate coefficients of rotational collision of LiH with Argon (Ar) are evaluated for temperatures ranging from 10 to 300K. The determination of rate coefficients by collisional study of LiH with radioxenon will allow us to determine its behavior in the fields of atmospherically molecules.

Primary author: NIANE, Aliou (Department of Physics UCAD)

Presenter: NIANE, Aliou (Department of Physics UCAD)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

Particulates and Noble Gas Spectra to Improve Detection Sensitivity and Reduce Statistical Uncertainty

An opportunity for improved detection sensitivity and reduced statistical uncertainty in analysis results from the CTBTO International Monitoring System (IMS) radionuclide stations might get of particular importance when dealing with special CTBT monitoring situations.

The radionuclide monitoring in the aftermath of the DPRK announced nuclear test in January 2016 triggered the development by the CTBTO International Data Centre (IDC) of a new approach based on summation of daily spectra for which the assumption can be made that they sample the same plume from a single release event. The combined spectrum is analysed using standard IDC software.

The method is implemented in a software tool prototype and handles both HPGe and beta-gamma coincidence based detection technologies.

The technique was successfully applied to improve detection sensitivity of Xe-131m in spectra from the IMS Noble Gas system RN38, Japan, following an episode of Xe-133 observations in February 2016.

The technique was then extended to data of collocated IMS particulates station for improving detection sensitivity of iodine isotopes over the time frame of interest.

The presentation emphasizes on methodological aspects of the spectral summation approach with examples on application cases. The added value of Atmospheric Transport Modelling to the new approach is also demonstrated.

Primary author: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Presenter: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Track Classification: 2. Events and Nuclear Test Sites

ID:

Type: **Poster**

-Based Mobile Gamma Spectrometry

Following the accident at the Fukushima-Daiichi power plant, the IAEA Nuclear Science and Instrumentation Laboratory has developed an unmanned aerial vehicle based mobile gamma spectrometry system for environmental monitoring and mapping. The system is based on a commercial hexacopter and includes a variety of detector options, including cameras, Geiger-Mueller spectrometer and LaBr spectrometer, a laser altimeter and a high resolution GNSS. A prototype system has been delivered to Fukushima Prefecture in July 2016. This talk will present the system and its applications.

Primary author: KAISER, Ralf (IAEA)

Presenter: KAISER, Ralf (IAEA)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Reflection Arrivals from Shallow Small Magnitude Explosions Using the Cepstrum Technique: A Numerical Analysis

The Cepstrum technique is often applied to estimate arrival times of the depth phases which is an increasingly difficult task, as the event depth becomes small. For the shallow events, the delay time of the depth phase from the first onset can be small (<1s). Influence of path attenuation, low Q values within the weathering layers near the surface, topography and ever present noise make the task even more problematic. Here, we attempt to determine the extent to which the cepstrum algorithm can be used. We constructed suites of frequency-wavenumber P seismograms for both up-going and down-going wavefields at regional and teleseismic distances for depths up to 1000m. Two wavefields allow to incorporate an accurate surface reflection coefficient for the pP phase and precisely predict the delay time. The up-going and down-going wavefields were added together to generate the full P-wave seismograms, which were then analyzed using the cepstrum technique to recover the delay time of the up-going relative to the down-going wavefield. Our preliminary studies on noise-free synthetic waveforms suggest that the cepstral method may produce reliable estimates for events deeper than 250m. Additional results will be presented from investigations with noise-contaminated synthetic waveforms, using complex digital signal processing techniques.

Primary author: SAIKIA, Chandan (U.S. Air Force Technical Applications Center)

Presenter: SAIKIA, Chandan (U.S. Air Force Technical Applications Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

and High-Order Master Event Design for CTBT Monitoring

We consider a hypercomplex and high-order (tensorial) representation of multichannel seismic data as they are recorded by the International Monitoring System of the CTBTO with processing within the context of the corresponding multidimensional model. In particular, we discuss an approach to construct multidimensional master-event waveform templates for cross-correlation-based detection and relative location with the data recorded at multichannel seismic installations, such as 3-C seismic stations and arrays. Hypercomplex number systems are natural cases of representing a 3-C digital seismogram samples requiring however special attention to the underlying axiomatics. Dealing with the composite observations (3-C arrays) may demand higher than 4-dimensional algebras, or some specific grouping of them, so tensor representation of seismic wavefield seems natural in this case. Data processing then would be conducted not on separate waveform projections, but on relatively full multidimensional objects, so tensor operations on the data from the 3C arrays would utilize volumetric spatial wavefield information. Dimensionality reduction of tensor data produces lower order principal components, a basis for the multidimensional waveform templates. Highly effective master events built with the hypercomplex and multilinear SVD provide a good example of introducing multidimensional data models into CTBTO practice. The approach is tested on sets of quarry blasts.

Primary author: ROZHKOV, Mikhail (CTBTO)

Presenter: ROZHKOV, Mikhail (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Application of Local Seismic and Infrasound Networks as National Technical Mean

In this study, some local networks of Iran are presented and their activity compare with regional network. Seismic networks are and will be probably forever the only tool that enables study of the detailed structure and physical properties of the Earth. Local seismic networks could effectively use checking seismic activity of any area with highest resolution and precision. Lots of small events couldn't record on global networks and the magnitude of completeness of local network catalogs are always less than regional or global ones which is a great advantage of these kind of networks as national technical mean. The detecting ability simply changes with instrumental coverage which plays an effective role for professional and applied usages in seismology. Many local networks are operating for various goals of seismology in Iran and this definitely will increase the quality of studies and can prepare lots of informative data that directly relates to seismic hazard assessment. Infrasound networks are one of the other local networks that we could have. We could use infrasound networks in south-east of Iran, Makran subduction zone. We could detect interfering oceanic waves if we have Infrasound network in this region.

Primary author: NAJAFIPOUR, Nooshin (Parsian Seismograph Company)

Presenter: NAJAFIPOUR, Nooshin (Parsian Seismograph Company)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

and Experimental Analyses of Infrasound-Electromagnetic Data Fusion

Electromagnetic pulse has been excluded from the IMS technologies because its high false alarm rate due to lightning discharges. Here we examine a possible method of overcoming this obstacle by merging infrasound data with electromagnetic measurements. Theoretical estimations predict a detection rate of one lightning per second for a typical electromagnetic receiver which is capable of detecting nuclear explosion from a distance of 2500 km. However, it is shown that once an infrasound event is detected, the time window determined by the IS system location accuracy and the sector determined by the directional accuracy of the two crossed loop antennas leave us with only few lightning signals requiring further discrimination. An antenna was located adjacent to the Mt. Meron infrasound array, and the measured EM fields have been recorded for three days. Initiation time and location of selected infrasound events have been calculated. Then, the EM data was searched for possible signal arriving from respective time and location. We present here examples and statistical analysis of the results. These results give hope that the proposed data fusion method can implemented to enhance both detection and discrimination capabilities of the IMS.

Primary author: LIPSHTAT, Eliezer (Soreq Nuclear Research Center)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Navy's "Full Ship Shock Trials" as Opportunities for USGS and CTBTO Seismic System Evaluation and Calibration

The Navy conducts "full ship shock trials" (FSST) on new warships to assess the combatant's ability to withstand the effects of nearby underwater explosions. On June 10, June 23, and July 16, 2016, three FSSTs were carried out on a Littoral Combat Ship off the Florida coast. The three events, with magnitudes in the range of 3.7-3.8, were well recorded in the eastern United States by the U.S. Geological Survey (USGS), resulting in 78, 82, and 114 associated phases, respectively. The hypocenters (based on standard single-event method) computed by USGS and CTBTO fall inside a small hexagon separately defined by the Navy. The CTBTO's seismic bulletin has the first and third FSSTs reported, but not the second. The CTBTO/IMS seismic stations in the United States, Canada, Turkey, Finland, and Australia saw some of these events. In addition, five hydrophone channels at IMS Ascension Island hydroacoustic array detected two events. The CTBTO/IDC did not "screen out" the FSST events as earthquakes. The best calibration data for seismic monitoring are from those controlled active-source experiments for which the Ground Truth are known. The Navy's FSSTs have the potential for evaluation and calibration of the seismic systems operated by the USGS and CTBTO.

Primary author: JIH, Rong Song (U.S. Department of State)

Presenter: JIH, Rong Song (U.S. Department of State)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Isolation Chamber for Improved Sensor Calibration

Infrasound isolation chambers are used to isolate sensors from ambient conditions in order to perform calibrations of the sensors being evaluated. Calibrations are typically performed on sensors to be deployed within a monitoring station. Calibrations identifying that a sensor meets performance requirements are necessary before a station can be certified for inclusion within the International Monitoring System (IMS) of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Infrasound isolation chambers are able to attenuate variations in ambient pressure and temperature that may otherwise affect the outcome of a sensor calibration. Recent advances in infrasound chamber design have improved the isolation through the use of sturdier materials and provided a large volume for evaluating more sensors simultaneously. Infrasound sensor designs have been observed to have performance that is variable at different elevations. In response to this, researchers at Sandia National Laboratories have been developing improvements that will allow a chamber to be pressurized or evacuated in order to replicate the static pressure observed at different elevations. In addition, developments are underway to control the temperature within the chamber to improve traceability and to generate higher dynamic pressures so as to evaluate sensors over a greater amplitude range.

Primary author: MERCHANT, Bion John (Sandia National Laboratories)

Presenter: MERCHANT, Bion John (Sandia National Laboratories)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

and Xenon Time Series Analysis: A New Methodological Approach for Atmospheric Transport Modelling at Small, Synoptic and Global Scales

A new methodological approach based on time series analysis for event screening categorization of beryllium and xenon background and outliers was tested. After the time series was detrended, the Lomb-Scargle spectrum can be computed for frequency domain analysis. Then, all frequencies were characterized in by a notch filter for $P(\omega)$ higher than a threshold, and reducing the time series to noise residuals. The autocorrelation of the residuals was first computed, in order to test if they can be considered random or not. The Detrended Fluctuations Analysis was applied to noise residuals, and then for characterizing the statistical distributions, two goodness of fit tests were considered: Kolmogorov-Smirnov and Anderson-Darling. The mean and variance of noise residuals were computed for the normalisation and outliers detection. Finally, was performed a noise analysis for testing that such outliers were not likely due to the particular noise configuration (white, pink, red). This new methodological approach was tested on beryllium, xenon, and meteorological data of CTBTO, and for a period longer than 11-year solar cycle. Finally, was possible to characterize by ATM the source-receptor relationship, and for beryllium to define the patterns at small, synoptic and global scales for testing the possible associated tropopause folding.

Primary author: PLASTINO, Wolfango (Roma Tre University)

Presenter: PLASTINO, Wolfango (Roma Tre University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

-Wave Cross Correlation Applied to Detection and Location of Events in High-Seismicity Regions of Mainland East Asia

Cross-correlation methods have been demonstrated by several groups to improve detection capability (~ tenfold) and location precision (~ hundredfold), when applied on local and near-regional scales. We are finding practical ways to achieve comparable results in application to broad areas, and have succeeded with fixed-window-length three-component Lg-waves in the 0.5 to 5 Hz pass-band recorded on sparse networks over far-regional distances. Examples include an epicentral relocation study for events in and near China during 1985 to 2005, for which we obtain high-quality locations for about 20% of the events in the Annual Bulletin of Chinese Earthquakes. These well-located events are organized into more than a hundred clusters containing at least five events (the largest, with more than 700). Average semi-major axes of 95% confidence ellipses are only 420 m, and are only a few tens of meters for some event clusters. Slinkard et al (Bull. Seism. Soc. Amer., 2016) report the use of template Lg waveforms from 1426 aftershocks of the Wenchuan earthquake to detect about five times as many additional aftershocks, which also turn out to be relocated mainly in clusters. Such results are of potential significance to both the explosion-monitoring and earthquake-monitoring communities.

Primary author: RICHARDS, Paul Granston (Lamont-Doherty Earth Observatory, Columbia University)

Presenter: RICHARDS, Paul Granston (Lamont-Doherty Earth Observatory, Columbia University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Characteristics of Soil Using Geophysical Techniques in Atbara Area, Sudan

In Atbara area, many industrial factories, roads and bridges have been constructed. Geophysical techniques are mainly used in planning for these strategic projects and to study and determine the soil characteristics to avoid the associated problems during and after construction. In the present study shallow seismic refraction technique was carried out to determine the lateral extension and dynamics properties of the layers. A set of profiles with a 24 channel for vertical geophones were used to generate P-waves. Travel-time versus distance graphs were constructed, velocities and the thickness of the three subsurface layers in the study area were determined. The final results show that P- wave velocities ranges from 248 m/s to 498m/s , 596m/s - 1005m/s and 908 m/s - 1896 m/s for the first, second and third layer, respectively. The subsurface layers stratigraphy was delineate using the geological cross sections which were obtained from boreholes data. The comparison between the geological cross sections and the H/V spectral ratio which was obtained from the previous study was performed. Finally, it will conclude that the shallow seismic refraction technique is one of the most effective methods which are very useful for building and other civil engineering purposes.

Primary author: KHALDA YASSIN IBRAHIM ALI, . (Seismological Research Institute)

Presenter: KHALDA YASSIN IBRAHIM ALI, . (Seismological Research Institute)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Fission Radionuclides Sr-90 and Pu-242 in Water Samples

Radionuclides have been conducted to determine the fission products Sr-90 and Pu-242 in water samples. Radionuclides are very much in nature, one of which is -90 strontium (Sr-90) and Plutonium - 242 (Pu-242) which is a specific radionuclide fission product. Sr-90 and Pu-242 from environmental samples is determined using the method of chemical separation. There are three steps to determine Sr-90 and Pu 242 in water samples are preparation, isolation of radionuclides and determination of radionuclides by using nuclear spectroscopy. For Sr-90 were analyzed by Liquid Scintillation Counter (LSC) and for Pu-242 is measured using alpha spectroscopy detector.

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Presenter: ROSIANNA, Ilsa (BATAN Indonesia's National Nuclear Energy Agency)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of U.S. NDC Performance Metrics Through Large Scale Analysis of System Log Files With Hadoop Distributed File System Based Tools

Optimizing the performance of the United States National Data Center (U.S. NDC) geophysical data processing system is critical for efficiently monitoring international compliance to nuclear test ban treaties. The U.S. NDC software stores system performance information for each data processing interval in a collection of semi-structured alphanumeric log files. On average, the system generates 140,000 log files per day which are stored in different directories. Currently, acquisition of process specific performance information or isolation of error messages must be parsed from each log-file individually. This manual parsing process is time consuming and often leads to incomplete collections of system performance information. The U.S. NDC system has been modified to output log files in JavaScript Object Notation (JSON), which is a highly structured data format that can be easily parsed. Here, we show how U.S. NDC system performance information can be parsed from JSON files and analyzed using a collection of Hadoop Distributed File System (HDFS) based tools such as Hive, Zeppelin, and PySpark. The HDFS system architecture is designed to store and process large alphanumeric datasets, which can be easily scaled to accommodate our continuously growing collection of performance information extracted from U.S. NDC log files.

Primary author: JUNEK, W. N. (United States National Data Center)

Presenter: JUNEK, W. N. (United States National Data Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Seismic Event Detection Analytics at the Edge

Over two decades ago, the Earthworm regional seismic processing system was introduced as a state-of-the-art analytical system for regional seismic event detection and analysis. Today it is still in wide spread use worldwide, despite amazing advances in distributed processing, cloud-based computing, data storage and edge-based analytics. The xQuake system, designed and built by the original architect of Earthworm, incorporates these advances into a plexus of microanalytics with interconnecting streaming hubs (e.g. Apache Kafka brokers), a modern version of Earthworm's rings and things, with a GPU accelerated browser interface. A centerpiece of xQuake is xGlass, an extension of the GLASS 3.0 global associator developed for the USGS/NEIC providing fusion of multiple sensor types within a 3D GIS context, locally adaptable global travel-time models, and seamless application across teleseismic, regional, and local domains. The foundation for xQuake is the open source xGraph (eXecutable Graph) framework with analytics and database functions designed for the integration of extremely large and complex systems using algorithms drawn from the biomimetic concept of a computational ecosystem, artificial intelligence and complexity theory. The ultimate goal is to migrate analytics to the sensors themselves (the edge) in a truly distributed and adaptive System of Sensor Systems (SoSS) framework.

Primary author: JOHNSON, Caryl Erin (Introspective Systems LLC)

Presenter: JOHNSON, Caryl Erin (Introspective Systems LLC)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

for Volcanic Monitoring Using the Processing and Analysis of Geospatial Data and Its Implementation in the "Concepción" Volcano of Nicaragua

According to documents of the Nicaraguan Institute of Territorial Studies (INETER), the Concepción volcano, which emerges from Lake Cocibolca, is one of the most dangerous volcanoes in Nicaragua, Concepción volcano is one of two volcanoes that make up the island of Ometepe in the great lake of Nicaragua where more than 40,000 inhabitants live. At the beginning of 2010, a scientific project was created between the University of Cádiz (UCA), the Higher Council for Scientific Research (CSIC), both institutions from Spain and the INETER of Nicaragua, for the design and creation of a permanent geodetic network (Conceptepe Network) that allows the monitoring of the volcano this with the purpose of establishing a system to analyze the parameter of surface deformation and so obtain models of geodynamic deformation to help in the reduction and prevention of risks. As a result of this collaboration, a GNSS-GPS geodynamic network has been developed comprising seven continuous stations (MAGN, RIVA, JAPO, CONC, ESPE, MORR, OMAJ) actually used to monitor the volcanic activity in quasi real time.

Primary author: RAMIREZ, Javier (INETER - Instituto Nicaragüense de Estudios Territoriales)

Presenter: RAMIREZ, Javier (INETER - Instituto Nicaragüense de Estudios Territoriales)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

3D Visualization of Different OSI Data Types with More Standard 2D Representation

During an OSI, inspectors should expect to have access to certain types of data for an inspection area prior to deployment, irrespective of where on Earth the OSI occurs. Satellite and aerial imagery, cartographic maps, digital elevation models, geological maps are all data types that can be found for almost any part of the planet prior to OSI deployment. We explore how to visualise such baseline datasets in 3D to support of the Inspection, from pre-deployment through to entry into country. In an OSI, there are four main scenarios where this type of data visualisation is important: 1. Planning prior to Point of Entry procedures, 2. Mission planning and logistics during the OSI, 3. Visualisation of treaty-relevant data, 4. Producing briefing materials for all stakeholders. In this poster, we present a detailed exploration of how best to represent these data in both 2D and 3D environments. We contrast the power of visualising such data in a 3D environment to standard 2D representation of the same data, using the commercial software GeoVisionary, developed by the British Geological Survey and Virtalis Ltd. Ultimately, we discuss the potential benefits of adopting GeoVisionary, or a similar tool, into the inspector toolkit.

Primary author: STEVANOVIC, Jennifer (AWE Blacknest)

Presenter: STEVANOVIC, Jennifer (AWE Blacknest)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Benefit of Using Higher Sampled Regional Seismic Data for Determining Cepstral Depths of Shallow Events

During the GSETT-3 experiment and early days of the CTBT, discussions were held regarding the appropriate specifications for the primary and auxiliary seismic stations. Communications cost and digital storage availability were two of the reasons for specifying the relatively low rate of 40 samples per second (sps) for the collection and storage of seismic data. In fact several of the legacy array stations were allowed to remain at 20 sps. Since that time a number of non International Monitoring Stations (IMS) have increased sampling rates to as high as 100 sps, and even 200 sps. One example is the open Chinese station MDJ which has witnessed a number of recent events. In this paper, we present results from the processing of synthetic data, and MDJ data at two sample rates, 40 sps, and 100 sps for two recent events. In this processing, we compute the spectra, together with the Power and Complex Cepstrums for the two sample rates, and study the results obtained from the processing of the Complex Cepstrums. Our results indicate that better depth and yield information can be obtained from the higher sampled data. The metrics used in this evaluation are also discussed in this paper.

Primary author: KEMERAIT, Robert (U.S. Air Force Technical Applications Center)

Presenter: KEMERAIT, Robert (U.S. Air Force Technical Applications Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

the Usability of Event Zero Time Determinations Using Xenon Isotopic Activity Ratios Given the Real Atmospheric Background Observations

One key parameter when IMS facilities of CTBTO detect radionuclides is the time origin of release. The activities of different isotopes reported in IMS measurements are usable for event time calculation. In theory, event dating works well under the assumption of a nuclear explosion scenario. For the radioxenon isotopes, the operational challenge is to understand results of event dating applied to the normal background. The routine IMS atmospheric background observations result from normal operational releases of nuclear facilities. The goal of this study is to estimate the usefulness of the timing equations in light of the real observations. It aims at characterizing conditions under which reasonable origin times can be determined and under which discrimination between nuclear test signatures and normal atmospheric background could work. The following two questions will be studied. (1) Can determination of the origin time for episodes of abnormal radioxenon background be utilized as a new way of background characterization? This will assume a range of realistic nuclear reactor sources. (2) Can event zero time determination be used for screening between nuclear tests and nuclear reactor sources? This will apply both reactor and explosion source scenarios and compare the results.

Primary author: YAMBA, Kassoum (Centre National de la Recherche Scientifique et Technologique (CNRST))

Presenter: YAMBA, Kassoum (Centre National de la Recherche Scientifique et Technologique (CNRST))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Sensing and Sparsity Based Method for Time-Frequency Distribution Optimization

Nonstationary signals are optimally represented in the joint time-frequency domain using time-frequency distributions (TFDs). The unwanted artefacts, which are by-products of TFDs quadratic nature, make TFD interpretation a challenging task. Recently proposed methods address the problem of artefact removal by employing compressive sensing (CS) techniques, with the unavoidable resolution loss being reduced by using reconstruction algorithms based on sparsity constraints. In this work, we study the effects of the CS area size and shape selection on the resulting sparse TFD performance. We also propose a method for automatic data-driven CS area selection. The method performance is tested on synthetic signals, and examples of geophysical signals and their models.

Primary author: SUCIC, Victor (University of Rijeka)

Presenter: SUCIC, Victor (University of Rijeka)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Surface Geophysical Observations on the Great Cavern, Felsőpetény Testing Area, near Budapest, Hungary

The Great Cavern, Felsőpetény testing area, near Budapest, Hungary, had a great interest for On-Site Inspection (OSI) as an old nuclear explosion site. The area was subjected for near surface geophysical investigations in the form of microgravity and seismic investigations along two crossing profiles. The main objective of these observations in Felsőpetény area was to outline the subsurface void of Great Cavern which are accompany with mass discontinuity. A sensitive gravity sensor (Scintrex CG-5 AutoGrav of 1 μ Gal resolution) are used for gravity data acquiring. The gravity data were modeled (2.5 D modeling). The results showed that the low gravity signals can be observed on the W-E profile and this location is considered to be the center of the subsurface target. Correlation between the resulted gravity signals along both profiles and the theoretical gravity values of the target at spot locations reveals that, the lowest gravity values exceeding the value of the theoretical gravity at the same spot locations. This could be due to the value of the negative anomaly is represented the void (target) and the overburden of less dense rocks than the surroundings. The results showed that, there is a great coincidence between the seismic and gravity data output.

Primary author: ISSAWY, Elsayed Abdelazim Mohamed (National Research Institute of Astronomy and Geophysics (NRIAG))

Presenter: ISSAWY, Elsayed Abdelazim Mohamed (National Research Institute of Astronomy and Geophysics (NRIAG))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Use of Waveform Cross-Correlation for Detection, Relative Location and Magnitude Estimation of Repeated Mining Blasts: The Jordan Phosphate Mine Eshidiya

We analyze signals measured by stations HRFI, PRNI, EIL, ASF, and MMAI from a long series of repeated blasts at the Eshidiya phosphate mine in Jordan. We estimate the dependence of the cross-correlation coefficient on signal length and frequency band using all pairs of events detected at a given station. A small set of signals having the highest similarity with all other signals are used as waveform templates for detection based on waveform cross-correlation. Three stations lie west of the phosphate quarry and have the same sampling rate. We cross-correlated signals from different events measured at HRFI, PRNI and EIL and found a high level of similarity, which is close to the level of similarity between signals at any one of these stations. For each event detected by three and more stations, we calculated the location and magnitude relative to the selected master events. To characterize the similarity between signals, we applied Principal Component Analysis to waveforms at each station and found that the level of normalized eigenvalues falls to 0.2 and below for the first five to ten components. The PCA eigenvectors corresponding to the highest eigenvalues are successfully used as waveform templates since they can find all signals.

Primary author: YEDLIN, Matthew (University of British Columbia)

Presenter: YEDLIN, Matthew (University of British Columbia)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Problem of the Precise Second on Earthquake Recorders

There are lots of challenges producing earthquake recorders and matching of second length of various instruments where they produce separately but use together in a networks. Second in electronic systems has a specific definition and it is the number of clock oscillation of an oscillator that producer declare in a specific temperature. As an example a 16MHz oscillator means that this oscillator oscillate around 16million times in a second. But the design doesn't finish as simple as this. This second has not enough precision and this is the main reason that seismologist use GPS to sync their data. But does GPS could simply resolve all the problems? This study most important challenges in this regard are considered. We try to describe how GPS losing errors can be resolved and minimized. Many applicable details are described to brighten the all sides of the time problem in data recording.

Primary author: SEIF POUR ABOLHASSANI, Ali (GeoPersian Company)

Presenter: SEIF POUR ABOLHASSANI, Ali (GeoPersian Company)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

the Challenges of Displaying Geotechnical Information in 3D Environments

During the course of an On Site Inspection (OSI), many different types of data and data products are generated, including cartographic, logistical and technical data. Representing them so the information they contain is easily understood by the Inspection Team is important but extremely challenging whether they are displayed in 2D or 3D additionally, any one result can be displayed in several ways depending on its purpose. This poster presents options for displaying a range of OSI relevant data products with the goal of finding optimal ways to present them within integrated 3D environments: using data from OSI exercise IFE14. The results can support future OSI work, including planning, training and exercises. We also report on new ways to generate 3D data products and will display an additive manufacture (3D printed) colour model and a digital model of the principle location for IFE14. We explore how raw data may be adapted for integration into 3D environments. Some relatively complex data must be abstracted into simpler products so it can be represented in a meaningful way e.g seismic data, in contrast, the complexity of some data products may have to increase, e.g converting standard photographs into detailed 3D models by using photogrammetry.

Primary author: PALMER, James (AWE Aldermaston)

Presenter: PALMER, James (AWE Aldermaston)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Correction of Coincidence Summing Effect in Filter Sample Measurement with HPGe Spectrometer

The coincidence summing effect influence the accuracy of the measured activity in IMS filter sample measurement. This article describes the correction of coincidence summing effect in Filter sample measurement with HPGe spectrometer, including the mechanism of coincidence summing effect, the influence to the measurement, the method of correction and, the result of correction. The conclusion is that the accuracy of measured activity in IMS filter sample is improved after the correction of coincidence summing effect.

Primary author: FAN, Yuanqing (CTBT Beijing National Data Center and Beijing Radionuclide Laboratory)

Presenter: FAN, Yuanqing (CTBT Beijing National Data Center and Beijing Radionuclide Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Novel Three Component Optical Seismometer Based on the Moiré Technique

We have built a new three components optical seismometer. The oscillation systems consist of a spring-suspended mass which its position is monitored by moiré technique. We use a pair of similar gratings that one of them is fixed to the suspended mass and another is fixed to the seismometer frame. The gratings are installed close to each other with no physical contact, which the planes of the gratings are parallel to each other and their lines making a small angle with one another; thus, moiré pattern is formed. A narrow beam of a laser diode passes through the moiré patterns and the beam power is detected by a light detector. Due to a typical impulse, the second grating is displaced with respect to the first grating, and as a result the moiré fringes are moved with a magnification of more than ten times. So, the detector output is a time series of the mass displacements. The response of the optical seismometer was validated through comparison of recorded waveforms with those obtained by CMG-6TD seismometer. Comparisons show that, in terms of both noise and signal fidelity, the optical approach is quite reliable.

Primary author: ANSARI, Anooshiravan (International Institute of Earthquake Engineering and Seismology (IIEES))

Presenter: ANSARI, Anooshiravan (International Institute of Earthquake Engineering and Seismology (IIEES))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Identification of Repeated Industrial Seismicity in the Reviewed Event Bulletin

The Reviewed Event Bulletin (REB) produced by the IDC (International Data Center) of the CTBTO includes thousands of industrial explosions detected by the primary seismic network of the International monitoring system every year. According to the CTBTO's monitoring mandate, these events represent background noise, which demands human and computer resources for interactive and automatic processing, possibly increasing the overall detection threshold. Most of these blasts are repeated events generating similar signals. Using an extended set of signals from the Aitik and Kiruna mines in Sweden measured at the closest IMS array stations ARCES, FINES, NOA, and HFS, we develop a method of automatic event formation and identification based on waveform cross-correlation (WCC). Real-time automatic processing includes signal detection and characterization, local association of the detected arrivals with seismic events, relative location and magnitude estimation. A prototype pipeline is currently being tested at the IDC. We present select results of detection, relative location and mine identification obtained since January 1, 2017. Worldwide, there are tens of mines with hundreds of events per year, which are present in the REB. The developed method can reduce the overall IDC analysts' workload by several percentage points, saving time and resources for comprehensive monitoring.

Primary author: YEDLIN, Matthew (University of British Columbia)

Presenter: YEDLIN, Matthew (University of British Columbia)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

ENIAB in Cloud Platform

In 2016 last release of Extended NDC-in-a-box was installed and tuned for the purposes of UANDC. As VM with ENIAB is limited by size we made clear installation from source code to separate server. During the operational duty and routine data processing, at least 3 persons are using ENIAB software contemporaneously and in this connection the question of remote use of the same software in same time is very actual. One of solution is to deploy software at the cloud platform. Such private cloud was deployed by Unigeocloud at UANDC server and it is working in testing mode now. Software installed into environments, tuned there, data connected and ready for processing. Database and waveform data located on separate environment and always available for all software. Such system allows to use one environment with a set of software (for training or control of on-duty personnel by experts) or clone prepared environment and work directly with it. The advantages of such virtualization are flexibility, remote/local installation and tuning, absence of specific requirements to workstation for data processing, you can operate and use it from anywhere, just need web browser and internet.

Primary author: KOLESNYKOV, Leonid (Main Centre of Special Monitoring, State Space Agency of Ukraine)

Presenter: KOLESNYKOV, Leonid (Main Centre of Special Monitoring, State Space Agency of Ukraine)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

: A Proposed Platform for Analysis of International Monitoring System Radionuclide Data Sets

Pacific Northwest National Laboratory (PNNL) has developed a software platform to analyze the radioxenon and particulate radionuclide datasets from the International Monitoring System (IMS). This development platform, called Watchmen, allows the testing of software modules to provide additional analysis methods and to combine the radionuclide data sets for more complete evaluation. PNNL proposes to develop an international version, called Sentry, of the software platform for the National Data Center (NDC)-in-a-box software currently available to National Data Centers of States Parties. The Sentry platform would allow the inclusion of other analysis techniques that may be of interest to National Data Centers. This would facilitate subject matter experts within the International Data Centre, the IMS, and National Data Centers to collaborate on new data analysis techniques and display methods. They can then develop modules which become part of the Sentry platform. This talk will discuss the currently available analysis modules, the software criteria, and potential new modules.

Primary author: MCINTYRE, Justin John (Pacific Northwest National Laboratory)

Presenter: MCINTYRE, Justin John (Pacific Northwest National Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Gamma-Spectrometry Mapping

If you want to perform a quick macroscopic gamma-survey, one of the best ways is to perform an airborne gamma-spectrometry survey. It allows you to investigate a large area in a short time and at a reasonable cost. The airborne gamma mapping has some limitations caused by the atmosphere shielding for the gamma ray. In this manner and to balance between efficiency and precision we have to use an aircraft flying at 60 to 120 meters height. For an accurate measurement we should do several calibration flights, which allows us to calculate the cosmic background correction and intrinsic background correction. In order to save flying time, for differentiation of the industrial, NORM or radionuclides from nuclear testing we need to use spectrometry dose meter with high sensitivity and quick response. It is also important to know the terrain specifics to choose a model that describes it best. Sharing our practical experience can help us find how far we can go using the known methods and technology.

Primary author: ILIEV, Ivan (Theta-Consult Ltd, Sofia University)

Presenter: ILIEV, Ivan (Theta-Consult Ltd, Sofia University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Capability of the IMS Seismic Network in 2013

This study introduces a method of seismic threshold monitoring to assess an upper magnitude limit of a potential seismic event in a certain given geographical region. The method is based on ambient seismic background noise measurements at the individual IMS seismic stations in the year 2013 as well as on global distance correction terms for body wave magnitudes, which are calculated using the seismic reflectivity method. From our investigations we conclude that a global detection threshold of around mb 4.0 can be achieved using only stations from the primary seismic network, a clear latitudinal dependence for the detection threshold can be observed between northern and southern hemisphere. Including the seismic stations of the auxiliary seismic IMS network results in a slight improvement of global detection capability. However, including wave arrivals from distances greater than 120 degrees, mainly PKP-wave arrivals, leads to a significant improvement in average global detection capability. In special this leads to an improvement of the detection threshold on the southern hemisphere. We further investigate the dependence of the detection capability on spatial (latitude and longitude) and temporal parameters, as well as on parameters such as source type and percentage of operational IMS stations.

Primary author: GAEBLER, Peter Jost (Federal Institute for Geosciences and Natural Resources (BGR))

Presenter: GAEBLER, Peter Jost (Federal Institute for Geosciences and Natural Resources (BGR))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Gamma Viewfinder Concept

For gamma radiation fields, current “gamma pictures” are created nowadays by commercially available “gamma cameras”, using either segmented or pin-hole collimators, as well as Compton cameras, thus creating expensive, large and slow detectors, rather unsuitable to be used for verification of undeclared activities. A new concept of “gamma vision”, based on a fully different concept of a position sensitive detector is presented. In this concept, developed by INVAP each detection element measures the gamma rays in a defined solid angle, using a lobular, compact, lightweight and high efficiency collimator (at significantly lower costs). Unlike existing gamma cameras, the presented gamma vision concept don’t use the usual concept of lens + focus. For this reason- and differentiating it from existing gamma cameras-, the system is called Gamma Viewfinder (patent pending). INVAP concept is similar to that of composed fly-eyes, producing a gamma image using a set of adjacent gamma sensors, each sensor including its own high efficiency viewing lobe overlapping neighbor elements, in an assembly that lacks of common focus. A suitable deconvolution of the incident gamma field using math processing provides increased image sharpness, efficiency and speed.

Primary author: FLORIDO, Pablo Carlos (INVAP S.E.)

Presenter: FLORIDO, Pablo Carlos (INVAP S.E.)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Monitoring Evolution and Extensive Seismicity of Egypt

In September 03, 2015, anew earthquake with magnitude $M_B = 4.5$ was occurred in a completely silent area located at 40 km south El Alamein city, north western desert, where there are some 20 million pieces of unexploded ordnance. This study aims to review the widespread seismicity over interval periods of seismic monitoring of Egypt and argue El Alamein event as a new active source. Seismic catalog of Egypt was updating to the January 2017 including the historical and instrumental earthquakes since -2200 BC. Seismicity of Egypt was compared over four periods based on significant evolution in the seismic monitoring system. Seismic source zones were delineated for each period based on the earthquake catalog, geologic structure trends and focal mechanisms. The new local seismic spot was argued entire historical, instrumental and modern observations and interpreted in view of the local and regional tectonic movements.

Primary author: FERGANY, Elsayed (National Research Institute of Astronomy and Geophysics (NRIAG))

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Techniques for Waveform Correlation Applied to Regional Monitoring of Eastern Asia

Waveform correlation techniques have proven effective detecting repeated events from large aftershock sequences; however, application for monitoring a large region over a long time period has yet to be adequately explored. We applied waveform correlation to continuous waveform data for the year 2012 at twelve stations spread through Eastern Asia, using automatically generated templates from historical archives going back to the time of station installation. Our study region includes the countries of China, North Korea, South Korea, Mongolia, Nepal, Bhutan, Bangladesh, and parts of neighboring countries. We used nine China Digital Network (CD/IC) three-component stations and three arrays that had continuous coverage from 2006-2012; this yielded 12 stations which spanned 40 degrees in latitude and 70 degrees in longitude with a mean nearest-neighbor distance between stations of 728 km. To declare a detected event, we required coincident correlations from two or more arrivals. Detection results are compared to the International Seismological Centre (ISC) catalog to analyze the effectiveness and challenges associated with applying waveform correlation on a broad regional and multi-year scale. We include analysis of the impact of network geometry, historical template library span and size, and template phase to provide direction for future regional studies using waveform correlation.

Primary author: SLINKARD, Megan (Sandia National Laboratories, Albuquerque, NM, USA)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

International: A New Capability for Radioxenon Measurements

Xenon International is a new ground-based radioxenon measurement system being developed at the Pacific Northwest National Laboratory (PNNL) built to realize the lessons learned from the International Noble Gas Experiment. Specifically, the Xenon International system provides better sensitivity to radioxenon isotopes, faster throughput of samples, and higher reliability of operation. The goal of the Xenon International project is to develop a xenon collection, purification, and analysis system that will detect evidence of nuclear explosions. Development of two pre-production prototype systems, one built by PNNL, and one built by Teledyne Brown Engineering (TBE), has been completed. Significant testing and evaluation of system operation and operational performance has been performed on both systems. Each prototype has also completed equivalency testing to assure that the Xenon International system can be successfully built and operated by a commercialization partner. The Xenon International system will complete formal verification testing and a field test at Charlottesville, Virginia, USA in 2017 – 2018. This presentation/poster will highlight the tests performed during formal testing, and will present the results. Completion of formal testing is the gateway to passing into formal pre-production.

Primary author: HAYES, James (Pacific Northwest National Laboratory)

Presenter: HAYES, James (Pacific Northwest National Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Event Bulletin Construction for a Global Sparse Network Using Waveform Correlation

Waveform correlation is a very useful technique for identifying repeating seismicity. In this investigation, we seek to determine the ability of waveform correlation to reconstruct a seismic event bulletin for a global, sparse network. Using about 10 years of data from the International Monitoring System (IMS) primary stations, we constructed a template library based on about 2.6 million arrivals in the arrival table of the International Data Centre (IDC) Late Event Bulletin (LEB). Then we cross-correlated several weeks of test arrivals retrieved from the IDCX arrival table against the template library and formed events from the resulting matches using cluster analysis. We applied approximate nearest neighbor (ANN) methods to perform searches 20 to 30 times faster than brute force correlation. We found approximately 30 percent of the origins reported in the LEB origin table, but that number is highly dependent on the chosen tolerance for discovery of false positives. Templates from local and regional phases had much higher probabilities of contributing a match to an origin in our bulletin. However, because there are many more templates of teleseismic arrivals in our template library, most of the matches that contributed to origins in our bulletin came from teleseismic arrivals.

Primary author: BALLARD, Sanford (U.S. Department of Energy, National Nuclear Security Administration)

Presenter: BALLARD, Sanford (U.S. Department of Energy, National Nuclear Security Administration)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

the Practice of Seismology in Iraq

Iraq is located at the leading northeastern edge of the Arabian plate. Its seismotectonic framework is a product of the NE motion of the plate and the continental collision along the Bitlis and Zagros orogenic zones. In late 1970s, the country embarked on the establishment of Iraq Seismographic network (ISN) consisting of 5 autonomous observatories equipped with a mix of seismic sensors. In early 1990s, the effort came to an ill-fated end, and the first 3 established stations were vandalized. In late 2005, we collaborated on the establishment of the 10 stations North Iraq Seismographic Network (NISN). In 2008, NISN's capability was further enhanced by adding the 5 stations circular seismoacoustic array KSIRS. In early 2009, the central government resurrected ISN by establishing a new network of 6 stations. All of the stations established since 2005 are equipped with advanced three components broadband sensors, and some are also equipped with radio and satellite telemetry. The establishment of the networked observatories in the cities of Sulaimaniyah and Erbil, NISN and KSIRS have brought unprecedented advancements to the practice of seismology in Iraq, for example, the ongoing daily updated database of over 11000 seismic events located in Iraq and the surrounding regions.

Primary author: GHALIB, Hafidh (Array Information Technology)

Presenter: GHALIB, Hafidh (Array Information Technology)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

West Eurasian Clusters of Infrasound Arrivals in Analyst-Reviewed Bulletins of the International Data Centre

Five years (2010-2015) of infrasound arrivals, included in International Data Centre (IDC) analyst-reviewed bulletins, detected across the International Monitoring System (IMS) show clusters in West Eurasia of up to 268 infrasound only events (no associated seismic phases). Ground truth information is unavailable for these clusters, although one large cluster (North Sea region) is associated with sonic booms from supersonic aircraft activity. A comparison of IMS data with infrasound waveforms from the Netherlands supports the existence of these North Sea events and allows the determination of common characteristics. Subsets of 20 randomly selected events from each of three other large clusters in West Eurasia are studied, with every reported infrasound array arrival re-analysed using an F-detector to objectively assess the REB arrivals. Approximately 60% of events studied fulfil the event definition criteria of ≥ 3 station detections, suggesting that caution should be exercised when using the Reviewed Event Bulletin (REB) published by the IDC as a benchmark for studies aimed at improving IDC products. The IMS infrasound network is shown to be particularly sensitive to sonic booms because the elevated source height reduces the anisotropy of infrasonic propagation within a stratospheric duct and allows for episodic upwind propagation.

Primary author: GREEN, David (AWE Blacknest)

Presenter: GREEN, David (AWE Blacknest)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of New Technologies at the IMS Radionuclide Particulate Stations

Sixty-nine of the 80 CTBT IMS particulate stations are already installed and 64 stations are also certified. Some of these stations are situated in very remote locations, and operational conditions often include very harsh climate conditions and austere infrastructures. In order to improve data availability and quality for these stations and also to sustain long term operations, the IMS division is developing and implementing state of art solutions which decrease the stations susceptibility to these harsh external conditions. This paper describes the latest technological solutions, some already implemented or soon to be implemented at IMS radionuclide particulate stations, to provide improved reliability, redundancy, and data quality.

Primary author: NADALUT, Barbara (CTBTO)

Presenter: NADALUT, Barbara (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

OSI Data into an Interactive 3D Environment to Aid Inspection Activities

The visualisation of large, disparate geospatial datasets is extremely important during an On Site Inspection (OSI). There is a requirement for inspectors to be able to integrate data gathered from many different techniques and to represent them, in their geographic context, within an appropriate cartographic framework. AWE has begun testing of a commercial software package called GeoVisionary to assess the benefits and challenges of viewing such data in full interactive 3D. This talk presents our results of applying GeoVisionary to OSI activities such as: planning prior to Point of Entry procedures; mission planning and logistics during the OSI; visualisation of treaty-relevant data; and producing briefing materials for all stakeholders. We will show results by using data from the Integrated Field Exercise 2014 in the form of animations produced within the software. We find this type of data integration within an interactive 3D environment to be an excellent tool for inspections and it has a number of other advantages which will be discussed. We suggest that the capabilities of the type and quality provided by GeoVisionary would be of great value for inspectors during an OSI, and recommend that such capabilities be available for future OSI activities.

Primary author: PALMER, James (AWE Aldermaston)

Presenter: PALMER, James (AWE Aldermaston)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Cavities: Understanding the Seismic Wave Propagation Inside and Around an Underground Cavity

In the past years major advances have been done concerning the development of the techniques used within an OSI. A critical task is the verification of the presence of a cavity caused by the underground nuclear explosion. One method to investigate the geophysical properties of a cavity allowed by the Comprehensive Nuclear-Test Ban Treaty is referred to as resonance seismometry - using passive or active seismic techniques and relying on seismic cavity vibrations. This method however is still under development and has not been successfully tested in the field yet. This motivates to investigate this problem on a purely numerical level. We study the full elastic wave field in three dimensions and consider the effects from an incoming plane wave as well as point source located in the surrounding of the cavity at the surface. Further we want to demonstrate the specific characteristics of the scattered wave field from a P-waves and S-wave separately. For our computations we use the discontinuous Galerkin Spectral Element Code SPEED. The computations are carried out on the Vienna Scientific Cluster. The accurate numerical modeling will help to set a proper scientific base of OSI and contribute to bringing the treaty into force.

Primary author: ESTERHAZY, Sofi (University of Vienna, Austria)

Presenter: ESTERHAZY, Sofi (University of Vienna, Austria)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Corrections to Improve Detection, Location and Measurement of Seismic Discriminants at IMS Arrays

The analysis of seismic data for test-ban verification relies on the detection of and discrimination between underground nuclear explosions and natural earthquakes. Data with high signal-to-noise ratio (SNR) is needed to make measurements of such seismic discriminants as source depth and mb/Ms. Seismic arrays can be used to improve the SNR of waveform data for a suspicious event using various stacking methods. The linear delay-and-sum stack is computationally simple and preserves the waveforms such that accurate magnitude ratios can be calculated. However, optimal SNR improvement requires that delay times be accurately estimated at each station within the array. We therefore seek static corrections to the arrival times and amplitudes of seismic phases to account for local velocity structure beneath IMS arrays. We have developed a semi-automated procedure that uses vespagrams to make slowness-azimuth station corrections as a function of slowness and backazimuth. The corrected slownesses are then used to calculate static corrections. The improvement in detection, location and SNR achieved using these corrections is demonstrated for example IMS arrays using the F-statistic. The enhanced data is then used to measure seismic discriminants for the nuclear tests conducted in the DPRK from 2006-2016, and compared with previously reported values.

Primary author: WILKINS, Neil (University of Bristol)

Presenter: WILKINS, Neil (University of Bristol)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Model of Seymareh Region: Southwest of Iran Using Local Seismic Network Data

The velocity structural model of Seymareh dam, central Zagros region, is computed using recorded data from local seismic network of Seymareh dam and Velest one-dimensional inversion technique. The study has performed after creating the catalog by phase picking of all data recorded during the network operation from 2010 to 2015. 3000 events were processed, at radii of 50 km and filtered down to 474 events for Velest run considering conditions of azimuthal gap less than 180, residual RMS less than 0.5, and uncertainties in epicenter less than 6 km. V_p/V_s ratio was computed to be about 1.74 and a four layer velocity model is resolved where the top layers are 3, 4, 6 and 12 km respectively. Using hypoDD, the resulted velocity model was used relocating the seismic events. The relocated map of distribution and depth cross section for the area are prepared and presented. Keywords: velocity model, inversion, local seismic network, Seymareh dam, relocation

Primary author: NAJAFIPOUR, Nooshin (Parsian Seismograph Company)

Presenter: NAJAFIPOUR, Nooshin (Parsian Seismograph Company)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Seismic Noise Survey of Western Kazakhstan

Kazakhstan is strongly committed to and ideally suited geographically for monitoring of nuclear explosions. Kazakhstan contributes key seismic stations and arrays to global and other cooperative efforts, though most monitoring activities are concentrated at sites in Central and Eastern Kazakhstan. Western Kazakhstan contains very few seismic stations and had not been adequately surveyed to identify quiet locations that could improve global monitoring capability. We deployed a temporary network of ten Guralp CMG-3T broadband seismometers in the Mangystau Region of western Kazakhstan, between the Caspian and Aral Seas, in August and September 2016, to identify noise characteristics and quiet sites suitable for monitoring. We found that at frequencies above 1 Hz, noise levels at some stations approach the New Low Noise Model and detection thresholds are similar to permanent borehole stations elsewhere in Kazakhstan. At frequencies below 1 Hz, noise levels are elevated due to microseism generated by the Caspian Sea. The quietest sites were those furthest from the Caspian Sea. On 9 September, 2017, four stations were operating and recorded the DPRK-declared nuclear test with good signal to noise ratios. Overall, stations were quieter and locations better than anticipated and we feel that efforts to install permanent stations are warranted.

Primary author: MACKEY, Kevin (Michigan State University)

Presenter: MACKEY, Kevin (Michigan State University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Seismic Recording in Frequency Domain at Nuclear Bomb Explosion: Case Study North Korea's Nuclear Test

A research has been done to compare frequency response, its dominant frequency and its correlation between North Korea's Nuclear Test Explosions. We used recent North Korea's Nuclear Test Explosions that recorded in the CTBTO's Seismic Stations nearby Korean Peninsula. We used seismic recording data in MiniSEED dataset format of the events from each station and its dataless SEED format. Dataless SEED is used to remove the instrument responses that existed inside the MiniSEED dataset to make the true seismic waveform recording without instrument interferences. The seismic waveform data from each station are processed using Trend Frequency Analysis and Analysis of Spectral Ratio Method to see the frequency response and its dominant frequency. After acquiring its frequency responses, we made correlation of the frequency response between nuclear explosion to determine the frequency similarities between those events. Determining the seismic frequency occurrence of nuclear explosions in Korean Peninsula will help seismologist to identify and separate which one is the nuclear activities and the earthquake activities

Primary author: WIBOWO, Bagus Adi (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Presenter: WIBOWO, Bagus Adi (NDC Meteorology Climatology and Geophysics Agency (BMKG))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Signal Before Indonesia's Large Earthquakes 2011 Detected by Superconducting Gravimeter

Superconducting Gravimeter are the most sensitive instrument to measure gravity change's continuously in low frequencies. In Indonesia, there is one Superconducting Gravimeter that installed in Cibinong. Using this SG, we studied gravity changes during Indonesia's large earthquakes event. Global CMT recorded 17 earthquakes in Indonesia that had magnitude moment (M_w) > 6 since January until December 2011. We investigate possible applications of Superconducting Gravimeter to detecting anomalous signal before this earthquakes happened. Using Spectrogram Analysis, we found anomalous signal few hours before earthquakes event. Frequencies of anomalous are between 0.03 Hz up to 0.20 Hz. This frequencies are correlated with stress accumulation of nucleation mainshock. We concluded Superconducting Gravimeter can be use for supporting earthquake early warning system. Keywords : Superconducting Gravimeter, Earthquake, Precursor

Primary author: PRIYAMBADA, Fajar Rachmadi (1. Regional Seismic Center 3 of BMKG Indonesia)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Atmospheric Monitoring Networks Using Bayesian Methods and Genetic Algorithms for Multiple Objectives

The monitoring of atmospheric plumes using a network of sensors is complicated by many constraints such as interfering plumes, and sensor placement, cost and performance. The presence of interfering plumes can confound efforts to discriminate a specific source, while network optimization is rarely independent of cost or placement constraints. The use of Bayesian methods and Genetic Algorithms offer a way to optimize monitoring networks with multiple objectives in mind and accounting for the presence of background interference. An example considering overall network performance and cost is discussed. The use of a multiple objective approach, considering both sensor cost and performance for a network of six sensors, is determined from a computationally determined Pareto frontier of optimized network options. The example demonstrates how such methods can help analyze the discrepancy between models and observations and thus provide an economic and scientific rationale to include additional sources, exclude certain sensors, or to explore specific sensors and their surrounding environment at higher fidelity. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344.

Primary author: GLASCOE, Lee (Lawrence Livermore National Laboratory)

Presenter: GLASCOE, Lee (Lawrence Livermore National Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Metadata Accuracy Within Seismic Networks

Seismic station metadata includes such parameters as location, digitizer parameters and sensor calibrations. Accurate metadata are essential for effective nuclear explosion monitoring, allowing researchers to analyze vast amounts of seismic data throughout the world. Yet, our research demonstrates problems with the accuracy of seismic station metadata, particularly calibration metadata. Observed errors in calibration metadata include unknown, outdated, and incorrect parameters, as well as inappropriate calibration applications. Incorrect station parameters often propagate within a network. For example, a review of metadata from Geotech S-13 stations archived at the Incorporated Research Institutions for Seismology Data Management Center reveal that many calibration tables list erroneous sensitivities arising from misapplication of the factory calibration sheet. This error propagates by routine copying of the assumed standardized response. Additionally, our work across networks of the Former Soviet Union shows that calibrations are often unknown following conversion from analog to digital recording, and sensor orientations and coordinates are sometimes incorrect. We have developed a field-portable system to calibrate electromechanical sensors, thus improving station calibration metadata accuracy. This technique is available to assist networks with calibrations and vetting of station metadata to help produce high quality scientific data for accurate seismic hazard and Comprehensive Nuclear-Test-Ban Treaty (CTBT) monitoring.

Primary author: BURK, Daniel (Michigan State University)

Presenter: BURK, Daniel (Michigan State University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Noise Field Characteristics of a Small Aperture Seismic Array on the Southeast Coast of China

In order to obtain the differences of characteristics of the noise field between the seismic arrays along the coast and the seismic arrays in the mainland, we use the data from Fuqing array and LZDM array in this research. Cross-correlation method was used in this research to tell us the truth that the noise cross-correlation between site pairs along the coast present a linear relation with the increasing of the separation between two sites in 0.1-1 Hz and 0.5-1.5 Hz, while the noise cross-correlation in the mainland show different type. The noise cross-correlation values for the array located along the coast are very high, and dropped to 0.5 in 2000 m, 1200 m, 750 m, 500 m and 200 m for the frequency bands of 0.1-1, 0.5-1.5, 0.8-2.5, 1-2 and 2-4 respectively, while the noise cross-correlation values for the array in the mainland are very low, and dropped to 0.5 in 200 m for the frequency bands of 0.5-1.5, which show us the array along the coast was effected by the low frequency sea wave severely. We also find obvious minus cross-correlation values in Fuqing array, and the LZDM array show blurred minus cross-correlation values.

Primary author: HAO, Chunyue (Institute of Geophysics, China Seismology Bureau)

Presenter: HAO, Chunyue (Institute of Geophysics, China Seismology Bureau)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Monitoring Using Arrays in the Middle East

As part of capacity building and joint research under the U.S. Department of Energy's Seismic Cooperation Program (SCP), Lawrence Livermore National Laboratory (LLNL) collaboratively installed 9-element seismic arrays QWAR (Saudi Arabia, 2012) and HOQAR (Oman, 2015). All elements are equipped with 3-component short-period sensors. HOQAR array data is received in real-time at the Earthquake Monitoring Center (EMC) of Sultan Qaboos University (SQU) using Antelope software. The aperture of both arrays is approximately 3.5 kilometers, and minimum element spacing is about 500 meters. We test the array capabilities with a time-domain beampacking scheme which searches for the optimal slowness vector of a signal by measuring the power of beams formed over a grid of slowness points. The slowness vector provides information on both the apparent velocity and direction of the signal. We extend this analysis to examine the coherent noise recorded over time at the array. Coherent noise is generated globally at a range of frequencies and is useful due to its ability to impact an array's detection performance, and its ability to be used in a variety of seismic imaging studies. We also test waveform correlation detection performance using both arrays and Global Seismic Network data in the Middle East.

Primary author: GOK, Rengin (Lawrence Livermore National Laboratory)

Presenter: GOK, Rengin (Lawrence Livermore National Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Use Seismoacoustic Complex of MCSM for Monitoring of Natural and Man-Made Events

To date, the main center of special monitoring (MCSM) is the only one structure in Ukraine, which is able to perform the tasks of nuclear tests control and this is a priority in the activities of the center. On the basis of MCSM deployed National Data Centre. The existing distributed system of collection, processing and analysis of information allowed to detect and identify all known nuclear explosions since 1995. Features of MCSM hardware enable monitoring events that generate seismic and acoustic activity, magnetic storms, and radiation. To perform the tasks assigned to MCSM used complex methods of observation: seismic, infrasound, radionuclide, magnetic and radio. Each detection method is unique and is designed to monitor the situation in certain geophysical shell of the Earth. The use of the detection methods in combination allows you to effectively use the information for other purposes, such as monitoring of natural hazards. A seismoacoustic complex got special development. Complex of seismic and infrasound devices installed on the four observation points of MCSM, one of which is located in Antarctica. The data are used to identify explosions and earthquakes, bolides blasts, research anomalies in the preparation of earthquake, tsunami warning.

Primary author: KARYAGIN, Yevgeniy (Main Centre of Special Monitoring)

Presenter: KARYAGIN, Yevgeniy (Main Centre of Special Monitoring)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Metrics Developed for Our Complex Cepstrum Depth Program

We present research, which has recently been undertaken, to develop metrics for a semi-automated program to estimate the depth of a very shallow seismic event (depth less than 2 km) in near-real time, by using the Complex Cepstrum algorithm. This sophisticated program has been shown to provide a unique method for identifying, and separating multiple events. This method is particularly suitable for shallow event analysis because it provides information on the phase of the signal periodicity, and allows processing within a very narrow time window at the start of the signal onset. As part of this research, we have developed several metrics to evaluate statistical confidence limits which are described in detail. The metrics include correlations between the de-convolved and the original seismogram, and estimated and observed echo lag-time comparisons. Two other relevant parameters are investigated and reported in this paper: 1) the optimum windowing of the original seismogram that starts the process, and 2) the liftering of the Complex Cepstrum, used to remove the depth phase from the original seismogram. After the above two processes are completed, the total procedure is evaluated by applying the metrics, to the results achieved from the application of the windowing and liftering processes.

Primary author: TIBULEAC, Ileana (U.S. Air Force Technical Applications Center)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Gamma Spectroscopy for On-Site Inspections in Winter Environments

The On Site Inspection (OSI) Action Plan (AP) for 2016-19 identifies improvements in aerial operations, particularly in different environmental settings, as two of its goals (A.P. 1.5: Operationalization of OSI's in Different Environments, and AP 1.10: Application of OSI Techniques). In February 2017 a study and field exercise of aerial gamma spectroscopy techniques was performed at a test site in Ottawa, Canada, including specific operations support required under adverse climatic conditions. Temperatures at this time of year are typically in the range of 0 C to -20 C with snow depths on the order of 50cm. This repeated aspects of a study conducted with similar equipment (a 20 litre NaI (Tl) detector) in the summer of 2013 at the same location. The system is of the same type as used in IFE 2014, though with a smaller crystal volume. The study included measurements of the response of the detectors to point sources of Cs-137 and Co-60. This allowed the comparison of equipment performance and the effects of winter-dependent changed natural radiological backgrounds in an otherwise similar location. This presentation will provide results of this comparison as well as details of operational experience.

Primary author: SEYWERD, Henry (Natural Resources Canada)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

the Chances for Detecting Nuclear Test Signatures of Prompt and Early Releases Using Radioxenon Isotopic Ratios

In the context of CTBT verification, isotopic ratios of xenon are used to distinguish civilian sources of radioactivity from nuclear test events using a threshold value that separates the reactor and nuclear test domains. Two methods exist to calculate the confidence range of the ratios: Bayesian decision method, and Fieller's Theorem. The purpose of this project is to select the best method tuned to provide the optimized screening results. This is accomplished by comparing the effectiveness and robustness of each method for source discrimination. First each method is applied to data from IMS radionuclide stations twice, once using a one standard deviation confidence interval, and once using a two standard deviation confidence interval. A threshold isotopic ratio for screening is then defined by setting the rate of false positives (type II error) to 5%. Next, the results of each method and choice of confidence interval were "scored" using hypothetical data from simulated nuclear tests added to real atmospheric background in selected IMS samples. The best method is the one with the highest detection rate.

Primary author: GORDON, Emily (University of Illinois at Urbana-Champaign, IL, USA)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

a New Paradigm for the Interactive Analysis of Waveform Data

Motivation for a radical change in approach to interactive analysis suffers from the QWERTY syndrome, which shuns the retraining burden associated with redesigning repetitive manual actions of high acuity. Perhaps for this reason, the IDC waveform software re-engineering project does not envisage such change. All software for the interactive analysis of individual seismic events (as opposed to the repeating events characteristic of exploration seismology) presents data in a similar way to the paper seismograms of a hundred years ago, and in some ways is inferior (for example in the absence of a hand lens equivalent). A major part of the analyst's work is correcting misassociated arrivals, yet multiple events and their resulting signals are never presented in a composite visual. The geometric context of multiple seismograms distributed over the earth's surface and their relation to the supposed hypocentre is also missing. Indeed, the role of maps is rudimentary, despite the use of stereographic projections for earthquake focal mechanisms dating back to the 1950s. Proposals for redressing such shortcomings are presented, with the aim of increasing analyst throughput and reducing analyst dependence upon a vast body of personally acquired anecdotal experience, much of which could be displayed automatically as needed.

Primary author: PEARCE, Robert Graham (CTBTO)

Presenter: PEARCE, Robert Graham (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Seismicity in Northern East of Egypt: Contribution of Different Regional Seismic Networks

The North East of Egypt is considered the most active seismotectonic region in Egypt, having geologically and seimotectonically complicated structures with moderate seismic activity. The seismic activity was not located properly due to the lack of observations. Even with re-picking all earthquakes above 2.5 and increasing the total number of phases involved in location by (24.1%), using only the data of the Egyptian National Seismic Network (ENSN) will still drives large azimuth gap. As the data of Egyptian National Seismological Network (ENSN) is not enough, Adding data recorded by the Seismic networks of the surrounding countries and International Seismological Center (ISC) was accomplished. Additionally, the Wadati diagram (Novotny, 2016) and the least square methods were applied to enhance the phase picking reliability and reduce its time residuals by minimizing the horizontal and the vertical errors. In comparison with the previous studies conducted on the same area our results give clear image of the tectonic setting of the study area. The obtained new locations will be used for computing the three dimension velocity model Sinai Peninsula, and a direct contribution for further seismic hazard assessment study in the study area also can be provided.

Primary author: FARIED, Ahmad (National Research Institute of Astronomy and Geophysics (NRIAG))

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Results of Low-Magnitude Seismicity Recording in Belarus

The modern seismological monitoring system in the Republic of Belarus provides continuous round-the-clock observations and recording both natural and man-made seismic events in a wide energy and distance range, real-time data transmission, processing and analysis, as well as the seismic conditions assessment. It comprises 2 broadband seismic stations and 2 local Soligorsk (8 observation points) and Ostrovets (7 points) networks. The territory of Belarus situated in the East European Platform west shows a rather low-magnitude seismic activity. The Earthquake Catalogue of Belarus 1883-2016 includes more than 1,500 events of $M \leq 4.5$. The contemporary seismicity is confined to a zone where the Pripyat Trough northwestern part joins the Belarusian Antecline, notably to the Soligorsk mining region. The Soligorsk network was created to record the seismicity in the Starobin potassium salt deposit region. About 1,500 local events with $M = 0.3 - 3.1$ were instrumentally recorded there. The data obtained suggest that the local seismic process is not only induced, but also due to the old rifting zone fault activation as a consequence of the stress redistribution under both man-made and natural impacts. The Ostrovets network deployed within the Belarusian NPP construction site provides monitoring of the nearest earthquake source zones.

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of the Evaluated Radioxenon Nuclear Decay Data

Precise and high-quality decay data of radioxenon nuclei are fundamental for the CTBT. Radioactive decay quantities, such as half-life, gamma-ray emissions (intensities and energies), internal conversion coefficients, X-ray energies, conversion electron and Auger electron emissions, branching ratios of the decay modes, are used in the analysis of spectral data from the noble gas monitoring systems, or in detector's calibration, or in isotope ratios calculations carried out to distinguish if detected radioxenons are generated during a nuclear explosion or a nuclear reactor operation. Therefore, precise and well evaluated nuclear decay data are crucial to be provided by the CTBTO radionuclide library. This work presents the last updated evaluations of the nuclear and decay data of some radioxenons. This includes the most recent measured values of the half-life and internal conversion coefficients. The evaluation procedure has been made within the Decay Data Evaluation Project framework and using the ultimate available versions of different nuclear and atomic data evaluation software tools.

Primary author: GALAN, Monica (CTBTO)

Presenter: GALAN, Monica (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Noise Level at CTBTO Facilities

The seismometers can detect not only the seismic events but also other natural vibrations such as cultural activities, wind and ocean waves which referred to seismic noise. Seismic noise exists everywhere on the Earth surface so it can mask seismic signals completely. In this study, we analyzed seismic background noise of BRTR array (PS-43) which is one of International Monitoring System primary seismic station under Belbasi Nuclear Monitoring Center for the verification of compliance with the Comprehensive Nuclear-Test-Ban Treaty since February 2000. PS-43 is composed of two sub arrays which deliver data online to the International Data Center. The advantage of a seismic array is to provide high quality data for earthquake-monitoring and detection purposes but noise levels affect the quality of data, thus it is needed to know the seismic noise levels of a seismic station. Background noise levels of BRTR array for the period of 2005 -2011 have been analyzed and the results indicate a little change in noise conditions in terms of time and location. Noise level changes were observed at 3-5 Hz in diurnal variations at Keskin array, and noise levels of medium period array are high in 1-2 Hz frequency range. The seasonal background noise variation at both sites also shows very similar properties to each other.

Primary author: ERKAN, Mahmure Ezgi (Kocaeli University)

Presenter: ERKAN, Mahmure Ezgi (Kocaeli University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Evidence: The Non-Use of Non-Detections in IDC Seismic Data Processing

The location of a seismic event using globally recorded P-wave signals presupposes that the signals have been correctly associated to each event in a multi-event environment. Incorrect association of signals is a major cause of mislocated events and of 'invalid' event hypotheses comprising a mixture of signals from different real events. In this context negative evidence includes the non-observation of a signal where one is expected according to the event location hypothesis. Although IDC network processing utilizes the probability of detection at each station as one criterion for acceptance or rejection of an event hypothesis, negative evidence is not used optimally. Reliable differentiation between the absence of a signal, the absence of data, or a malfunctioning acquisition system at the onset time of interest is one problem, although developments in the continuous measurement of data quality provide a way to address this. It is argued that negative evidence could and should be used to greater effect, and possibilities are presented. One approach, not currently envisaged in the IDC re-engineering project, is to use non-detections (identified either automatically or by an analyst) as additional 'signals' in the event building process. Another is to assign 'expected stations' based on historical data.

Primary author: PEARCE, Robert Graham (CTBTO)

Presenter: PEARCE, Robert Graham (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Model of Portative Field In-Situ Spectrometer-Identifier of Gamma Isotopes

In Ukraine for on-field monitoring of the radionuclides uses the Radiometric and spectrometric instrument PRS-01 which is created according to IAEA recommendations stated in the IAEA TECDOC-1312, (2002) "Detection of Radioactive Material at Borders", and UNECE document "Recommendations on Monitoring and Response Procedures for Radioactive Scrap Metal". Modern rules of ecological and radiation safety is requiring the equipment with highest functionality and comfortable usage. Old PRS-01 not fully qualify to modernity and as future improvement proposed new spectrometer based on PRS-01 with increased functionality. The scope of use of modified spectrometer-identifier of gamma radionuclides: monitoring of the natural radionuclides in deposits; monitoring of the medical isotopes in medical radiological centres; monitoring of radionuclides in industrial production; monitoring of accident and anthropogenic radionuclides in emergency case.

Primary author: KACHALIN, Igor (, RPE "ATOM KOMPLEX PRYLAD")

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

a Low Cost Shout Down MEMS Base Accelerometer Suitable for Rapid Response and Structural Applications

Mega-cities, specially when located in a high potential seismic region, are always threaten by huge damage because of earthquake. Decreasing the earthquake side effects is the main target of our developed low cost MEMS base accelerometer unit. There are more than 300 CGS gas stations distributed all over the Tehran city which can act like a bomb when an earthquake happens. There are lots of hospitals which needs to switch on emergency electricity state before by an earthquake the system crashed. Lots of general structural applications are defined on the software and various relay switch are considered for the system such as elevator stop at the nearest floor, industrial machinery switch off, schools and organizations alarm, CGS controlling and auto shout down, power lines switching off, metro stop alarm, toy city alarms and stops, trains speed control and etc. the system exactly monitor the noise level of the installed place and based on CAV algorithm discard the transient peaks and shocks to reach the minimum level of false detection.

Primary author: GHOLAMI, Vahid (Geopersian Company)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of a Field Portable Ar-37 Monitoring Capability

Since ^{37}Ar is produced in significant quantities when neutrons from a nuclear explosion activate calcium in the ground, measurements of ^{37}Ar are among the most important made for nuclear explosion monitoring applications, including on-site inspections (OSI) under the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Measurement of ^{37}Ar is also among the more difficult measurements to make in field conditions for a number of reasons, such as the need for portability and ease of operation, the difficulty in the separation of bulk argon from air, and the difficulty in measuring the low energy decay Auger electron. In addition, the throughput and detection sensitivity of an effective field portable ^{37}Ar collection and measurement system must meet the needs of the nuclear explosion monitoring community. After decades of experience with the sensitive collection and measurement of noble gases for nuclear explosion monitoring, and more recently the sensitive measurement of ^{37}Ar in a laboratory environment, PNNL is developing an ^{37}Ar field system that could be used for applications such as CTBT OSI. This presentation will explain the basic operating principles of the U.S. system, as well

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Presenter: HAYES, James (Pacific Northwest National Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

MDC in the Radionuclide Particulate RASA System

The monitoring community expressed desires to improve the RASA particulate radionuclide system MDC to increase network sensitivity. Before investing and developing new sampling technology, GDMS investigated minor configuration changes to improve the RASA MDC. MDC may be improved by enhancing the detector signal-to-noise ratio or increasing air flow. Focusing on detector signal-to-noise, GDMS investigated shielding improvements, alternate materials, reduction in detector chamber dead space and mechanical/electrical noise reduction to quantify MDC effects. GDMS conducted several different experiments to determine whether the addition of lead shielding and/or modification of the internal lead cave reduced the MDC. GDMS performed experiments to determine if material inside the lead cave adversely affected the MDC by elevating the Gross Background Count Rate (GBCR). By testing the absence of the component, GDMS quantified the potential benefit of changing material or eliminating the component altogether. GDMS investigated and found no measureable benefit to adjusting the current radon decay protocol. The results showed additional lead shielding provides a simple and cost effective method to reduce the MDC. This small shielding improvement was simple to manufacture, install and maintain. In 2017, GDMS began implementing this shielding improvement into the IMS to reduce the RASA MDC.

Primary author: WRIGHT, Matthew S. (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Presenter: WRIGHT, Matthew S. (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Testing and Our RASA Software Development Environment

The GDMS Nuclear Monitoring program requires software and hardware testing to support operations, maintenance, upgrades and sustainment of the RASA particulate radionuclide monitoring system. The software is under active development to repair bugs, add enhancements, and support obsolescence of individual hardware components. Prior to this automation effort, GDMS engineers manually tested the RASA software and hardware encompassing three man-days to complete the labor intensive test plan. The test plan also required an additional two-week "hands off" verification period consuming additional scarce hardware and personnel resources. The goal of this project was to provide the necessary tools and tests to improve the quality and reliability of the delivered RASA software and to provide a level of quality assurance of the RASA and its component hardware. GDMS accomplished this by developing the following: 1) software simulators for the RASA and its component hardware, 2) hardware test stands to isolate individual hardware components to reduce the reliance on a fully functional RASA system, and 3) an automated testing framework that is tied into our software build process allowing us to detect errors earlier in the software development cycle and which can easily test the various RASA system permutations.

Primary author: WRIGHT, Matthew S. (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Presenter: WRIGHT, Matthew S. (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Evaluations of Signal-Based Bayesian Seismic Monitoring (SIGVISA)

We present SIG-VISA (SIGnal-based Vertically Integrated Seismic Analysis), a next-generation approach to Bayesian seismic monitoring. This work builds upon the success of NET-VISA, recently recommended for production deployment at the IDC. SIG-VISA extends the detection-based NET-VISA approach by modeling full continuous seismic waveforms. Bayesian inference in this model yields a new algorithm for simultaneous detection and location of seismic events, unifying signal-based techniques such as waveform matching and double-differencing with traditional detection-based monitoring in a single framework with principled handling of uncertainty. We report an evaluation of SIGVISA monitoring the western United States. Over a two-week period, SIGVISA detects more than twice as many events as NETVISA, and three times as many as SEL3 while operating at the same precision. At the same time, signal-based monitoring reduces mean location errors by a factor of four relative to detection-based systems. We provide evidence that, given only IMS data, SIGVISA detects events that are missed by regional monitoring networks, indicating that our evaluations may even underestimate its performance. Finally, SIGVISA matches or exceeds the detection rates of existing systems for de novo events – events with no nearby historical seismicity – and detects a number of such events missed in the LEB.

Primary author: MOORE, David (University of California, Berkeley)

Presenter: MOORE, David (University of California, Berkeley)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Detection of Uncertain Seismic Signals

Correlation detectors have become integral components of seismic monitoring pipelines, offering sensitive detection and simultaneous event classification and location in situations where the relevant signals are known accurately. Often, however, the target signals are not known with certainty, but may be known only to be members of a particular class of signals. For example, the signals may derive from events that occur not at a single source location, but rather over a slightly broader geographic region. In such instances, subspace detectors may improve detection by allowing a degree of variation in the signals. But subspace detectors raise the false alarm rate requiring a corresponding increase in the detection threshold relative to correlation detectors. In this study we examine a related detector, which we call the tangent space detector, which has some of the desirable attributes of the subspace detector, but may have reduced false alarm rates relative to subspace detectors. We contrast the performance of correlation, subspace and tangent space detectors in the context of detecting events at the North Korean test site.

Primary author: HARRIS, David B. (Deschutes Signal Processing LLC)

Presenter: HARRIS, David B. (Deschutes Signal Processing LLC)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Technical Analysis Improvements at the International Data Center, CTBTO

Expert Technical Analysis (ETA) is a role that the IDC plays to provide higher-level research products on data from the IMS and other relevant data to improve the estimated values for standard event parameters and assist State Parties in identifying the source of specific event. As depth is one of these values, we focus on its improving using modern advances in seismic modeling. First part of our ETA work used cross-correlation between observed and theoretical seismograms with adjustable t^* teleseismic attenuation model to provide a depth estimate. The extended method is based on estimating a full moment tensor solution for body and surface waves recordings because it provides a further constraint on depth. A wide set of nuclear explosions including PNE was studied with presumably known depths, and recent DPRK nuclear tests. In both methods, a set of analysis tools was developed. The tools allow an expert to easily operate the various open source modules available for synthetics generation and fitting against observed waveforms, drive the workflow, and show results and uncertainties in a coherent fashion. These tools will allow the IDC experts generating products for the IDC to provide to member states for events demanding ETA and special studies.

Primary author: ROZHKOV, Mikhail (CTBTO)

Presenter: ROZHKOV, Mikhail (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Laboratory for Noble Gases Analysis in Atmospheric Air

• Mobile Russian Installation for Noble Gas Analysis –Field (RINGA-F) has the productivity 20m³/h and Xe-133 MDC=0.35 mBq/m³. • Main process for sampling and processing of Xe and Kr from atmospheric air is cryogenic sorption on the charcoal. The turbo - expander used for cooling of the air. The minimum temperature -105 C was achieved after 6 hours, after 1.5 hours, T=-80 C. Extraction efficiency is $\geq 50\%$, Xe stable was extracted up to 6 - 9 cm³. Scintillation NaI (TI) - spectrometer β - γ coincidences is used; and NaI (TI) + Si-PIN diodes spectrometer is now made. RINGA-F Noble gas system allows to sampling of air during 1.5-3 hours, MDC on Xe-133 be 0.3 mBq / m³. This installation can be used to atmospheric air analysis at On-site inspection . RINGA-F was used to monitor of air on areas of Leningrad, Kalinin and Kola NPPs , as well as in the Vologda region far away from the NPP. Almost all components and installation units, despite the great distances traveled 1200 km, were intact and functioning. This installation can be transported, for example, by a minivan VW Crafter 30-35 •

Primary author: DUBASOV, Yuri (Khlopin Radium Institute)

Presenter: DUBASOV, Yuri (Khlopin Radium Institute)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

earthquakes in Colombia since 1993

Seismic events that have had a significant impact on the Colombian population (Sismo-Tsunami Tumaco 1979, M 7.9, Sismo Maizales 1979 M 7.9, Sismo Popayán 1983 M 5.5, Nevado del Ruiz Eruption 1985), along with other natural disasters, The Government Colombian government to assign to INGEOMINAS (now SGC) the functions of study and prevention of all types of geological risks in the Colombian territory. In 1987 INGEOMINAS created the project of monitoring seismic activity that includes the National Seismological Network of Colombia and the National Accelerometer Network of Colombia (RSNC and RNAC), which began its activities in June 1993. The RSNC has been operating continuously 24/7, providing information to disaster prevention agencies and the general public during crises and deploying specialized personnel and portable monitoring equipment for the complete analysis of the seismic source. The RSNC and RNAC have national coverage and have the best and most modern seismic monitoring equipment, with a total of 170 permanent monitoring stations, between acceleration sensors and speed sensors (short period, strong motion and broad band, includin ROSC station from the CTBTO), 94 of them real time transmission to the headquarters in Bogotá.

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

@zeolite: Toward the Miniaturization of the NG Process

The IMS noble gas station requires to purify and to concentrate Xe by using compact and cost-effective process. CEA has worked for few years on the development of a new adsorbent material to purify and concentrate Xe: silver exchanged zeolite (MFI), Ag@ZSM5. This adsorbent exhibits about two order higher retention capacities than the classical active carbons. In addition, more recent experiments show that this adsorbent can be used directly to purify atmospheric air with high efficiency. Indeed, about 100 g of Ag@ZSM5 is able to recover all the xenon from 3 m³ of atmospheric air. These performances enable to explore new NG system design with very high compacity and energy-effectiveness. This adsorbent is tested directly on atmospheric air in the CEA laboratory and in the Health Canada laboratory (CEA-HC collaboration).

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

and Simulation of a Leaser-Interferometer Broadband Seismometer

In this study, we propose a design of a broad band seismometer for monitoring the vertical component of the ground velocity in the frequency band from 50 sec (25 mHz) up to 50 Hz with a sensitivity of 1500 V/m/sec. Our proposed seismometer uses a mass-leaf-spring suspension as a mechanical receiver to convert the variations in ground acceleration into displacements of the seismic mass relative to the seismometer body (ground). A Michelson laser interferometer is then used to convert these displacements into an analog signal representing the ground acceleration. A PID feedback loop is designed to shape the seismometer response to ground velocity. Both amplitude and phase responses as well as the frequency band of the proposed seismometer are compared to those of the Nanometrics seismometer Trillium-40 (the same sensitivity and bandwidth). As a final evaluation of the proposed seismometer, we tested its simulated response to both a local and a regional real earthquake which have different magnitudes and frequency contents, and recorded by Trillium-40. The simulated waveforms output from our simulated seismometer are almost identical to those recorded by Trillium-40.

Primary author: HABBAK, Eman Lotfy Zakaria (National Research Institute of Astronomy and Geophysics (NRIAG))

Presenter: HABBAK, Eman Lotfy Zakaria (National Research Institute of Astronomy and Geophysics (NRIAG))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Monitoring Technology of Weak Earthquakes and Explosions on the Based of Solution the Seismic Moment Tensor Inverse Problem

The new computational technology for weak seismic activity monitoring has been developed based on the data of local networks and seismic data processing. The coordinates of the epicenters and six independent components of the seismic moment tensor equivalent sources were determined. The components of the seismic moment tensor depend on the time. This allows us to do a complete analysis of dynamic, spatial and spectral properties of the seismic source, evaluate his main stresses as a functions of time or frequency. The proposed approach requires the solution of so-called unstable dynamic inverse problem of determining the seismic moment tensor. The proposed approach has been tested for some small earthquakes and chemical explosions with the equivalent energies.

Primary author: EROKHIN, Gennady (Immanuel Kant Baltic Federal University)

Presenter: EROKHIN, Gennady (Immanuel Kant Baltic Federal University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Explosion Identification Using Seismic and Infrasonic Station Data

There are hundreds of mines and quarries within the Mongolia territories using blasts with varying yields and firing schemes. This mining-related explosion occupies a big part of the seismic catalogue issued by the IAG. To discriminate the earthquake and explosion is more difficult because the size and distances are different for all events. This study is designed to quantify Baganuur mining explosion using seismic and infrasonic station data. The study uses ground truth coal mining explosion data in year 2016 which is obtained from Baganuur mine company. In total 167 explosion data were used for this analysis. Using infrasonic station data, we estimated minimum explosive level that detected infrasonic stations. We also include seasonal variation in detectable level of explosive. For seismic acoustic data, we estimated relationship between mining explosions total explosive yields with peak amplitude, magnitude and Arias intensity. Waveform cross correlation technique used in order to find detection threshold level using master event of this Baganuur mining area.

Primary author: LKHAGVA, Tungalag (Institute of Astronomy and Geophysics, Mongolian Academy of Science (MAS))

Presenter: LKHAGVA, Tungalag (Institute of Astronomy and Geophysics, Mongolian Academy of Science (MAS))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Data from Seismic Measurements in the Kylylahti Region, Finland, in 2016 for Further Development of Geophysical Seismic Techniques for CTBT On-Site Inspections

The Integrated Field Exercise of 2014 (IFE14) was a field event held in the Hashemite Kingdom of Jordan (with concurrent activities in Austria) that tested the operational and technical capabilities of an On-Site Inspection (OSI) according to the Comprehensive Test Ban Treaty (CTBT). The IFE14 tested in integrated manner already developed OSI techniques, including geophysical seismic techniques. However, one of permitted techniques not yet developed is resonance seismometry. During August and September 2016, field measurements have been conducted in the Kylylahti region in Finland. 45 seismic stations were used to acquire continuously seismic signals in parallel to active seismic surveys conducted at the site. During that time, in addition to the man-made seismic events associated with the surveys, local, regional and teleseismic natural events were acquired, including a damaging earthquake in Italy and a nuclear test explosion conducted by the DPRK on 9 September 2016. This presentation will show examples from the data set and will also discuss the use of the data set for the development of resonance seismometry capabilities for OSIs.

Primary author: LABAK, Peter (CTBTO)

Presenter: LABAK, Peter (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of the On-site Inspection Geophysical Techniques for the Detection and Identification of Subsurface Features

A significant portion of CTBT permitted techniques for use during an on-site inspection are the geophysical techniques. While passive seismological monitoring for aftershocks can be utilized during all periods of an on-site inspection, other techniques like resonance seismometry, active seismic surveys, magnetic and gravitational field mapping, ground penetrating radar and electrical conductivity measurements can be applied only during the continuation and extension periods. The purpose of use of the geophysical techniques varies. Passive seismological monitoring allows to monitor aftershocks down to magnitude -2 and thus contributes to narrowing down the search area. Other techniques can contribute to the site characterization. Depth penetration of the techniques varies as well. Shallow techniques can help to identify man made artifacts. Deeper techniques can contribute to the identification and characterization of the potential place of treaty violation including through the detection of cavities. Examples of the application of the geophysical techniques will be presented. Selected results of the use of passive seismic monitoring during field tests and exercises will be shown. This includes data from use of geophysical techniques for shallow and deep targets applied during the Integrated Field Exercise 2014 in Jordan. The use of such techniques for other applications will be discussed.

Primary author: LABAK, Peter (CTBTO)

Presenter: LABAK, Peter (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of the Results of a New Automatic Association System for Waveform Data Analysis

The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) has been developing and testing NET-VISA (Arora et al., 2013), a Bayesian automatic event detection and localization program, and evaluating its performance in a realistic operational mode. In our preliminary testing at the CTBTO, NET-VISA shows better performance than its currently operating automatic localization program. However, given CTBTO's role and its international context, a new technology should be introduced cautiously when it replaces a key piece of the automatic processing. We integrated the results of NET-VISA into the Analyst Review Station, extensively used by the analysts so that they can check the accuracy and robustness of the Bayesian approach. We expect the work load of the analysts to be reduced because of the better performance of NET-VISA in finding missed events and getting a more complete set of stations than the current system which has been operating for nearly twenty years. Preliminary results of the introduction in operations are presented. At the conference, the effects in operational environment will be presented.

Primary author: KUSHIDA, Noriyuki (CTBTO)

Presenter: KUSHIDA, Noriyuki (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Aftershocks with Waveform Cross-Correlation

For the International Monitoring System (IMS) it is difficult to find low-magnitude aftershocks of small underground nuclear tests using only standard detection and phase association methods. At the same time, signals from thousands of aftershocks per day following Mw8+ earthquakes are difficult to separate, and thus, to recover the whole sequence. Both tasks are important for the International Data Centre (IDC) of the Comprehensive Nuclear-Test-Ban Organization. The underlying problems can be better solved with waveform cross correlation (WCC), which is most suitable for repeating events. The WCC method can reduce detection threshold and enhance phase association fully utilizing the similarity of waveforms generated spatially close seismic events. In addition, the use of WCC at seismic arrays of the IMS can reduce station-specific detection thresholds, allow accurate estimate of signal attributes, including relative magnitude, and effectively suppress irrelevant arrivals. Here, we test an aftershock tool matching IDC requirements for seismic events. It includes creation of waveform templates for master-events, cross correlation (CC) of real-time waveforms with these templates, association of arrivals detected at CC-traces in event hypotheses; building events matching the IDC event definition criteria; and resolution of conflicts between events hypotheses created by neighboring master-events.

Primary author: KITOV, Ivan (CTBTO)

Presenter: KITOV, Ivan (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Software Functionality Enhancement

The responsibility for SAMS software development has been switched from the Institute for Geophysics, University of Stuttgart, Germany to the software developing company Sonicon, Tübingen, Germany. In the contractual context Sonicon will develop and implement new features and enhancements to the present SAMS software version. The key features include improvements of the data management and OSI-specific verification requirements: (1) software tool for designing the layout of the SAMS network taking into account topography, access and security concerns, (2) software tool for displaying the state of health of SAMS stations as a part of OSI SAMS software, (3) software tool to show in a graphical form data availability, (4) improved software tool for editing SAMS mini-array meta-data, (5) software tool to record, manage and display results of data processing and analysis in graphical form. The current status of the development of the listed software improvements as well as possible future aspects will be presented and discussed.

Primary author: WALTER, Marco (Seismic Solutions / Sonicon)

Presenter: WALTER, Marco (Seismic Solutions / Sonicon)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Revolution in Gamma Acquisition Systems: Costs and Benefits

For decades, gamma spectrometry data acquisition systems were based on analogue electronic modules. Developed at the beginning of the 1990s, digital data acquisition system democratized in the past 10 years. Since 2012 the R&D team in low level gamma spectrometry at CEA center of Bruyères-le-Châtel has started to use these systems. Digital electronics presents several advantages. First, all the required operations to record an event (filtering, amplification, time management, anti/coincidence ...) are performed in one single module whereas at least half a dozen of analogue NIM modules were needed previously. Then logical operations between channels are decided a posteriori where only a priori operations where possible before. And furthermore, a great improvement is the possibility to save the waveform of each incoming signal. Digital pulse shape analysis is a rather young but very promising discipline, which could allow automatic Compton background reduction, neutron/gamma discrimination, etc. In counterpart, this technology is rather young and several bugs or issues remain that do not exist with analogue electronics. Benefits and disadvantages of using both electronics for gamma-ray analysis will be presented.

Primary author: DELAUNE, Olivier (CEA/CENTRE Ile-de-France)

Presenter: DELAUNE, Olivier (CEA/CENTRE Ile-de-France)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Radiation Measurements

The unmanned UAV platform allows make gamma spectrometry in severe nuclear release situation where manned aerial radiation measurements are not acceptable. The system consist of solid state Kromek GR1 Cadmium Zink Telluride (CZT, active volume 1 cm³) or Canberra Osprey Lanthanum Bromide (LaBr₃, active volume 43.5 cm³) gamma-ray spectrometer, Intel 32/64 architecture PC Stick computer and Threod Systems KX-4 LE or KY-6 mini helicopter. We have implemented manned aerial radiation measurements more than twenty years using Unisampo measurements program with online extension to control measurements, combine GPS coordinates with radiation data to produce modeled radiation map layer to be presented on geographical map. The measurement, analysis and modeler programs run on Linux operating system. Kromek spectrometer and computer weight 700 grams. With Osprey LaBr₃ detector the weight is 2000 grams. Measurement system works autonomously and can be controlled from ground station. The UAV radiation measurements will be used to:

- Measure heavily contaminated areas
- Find lost radiation sources
- Identify nuclear power plant release
- The system can be implemented on jet powered UAV to measure radiation levels from wider areas what is possible with mini helicopter or from upper atmosphere where military and commercial aero plane fly.

Primary author: KETTUNEN, Markku Juhani

Presenter: KETTUNEN, Markku Juhani

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Wireless Capabilities to an IMS Portable Infrasonic Array

A Portable IMS Infrasonic Array was installed in Romania, in late September 2016, in a remote mountain area. The array is composed of four elements arranged in a stellar shape. Each element includes: equipment box with digitizer and microbarometer and power supply (charge controller and batteries); wind noise reducing system, connected to the microbarometer in the equipment box; temperature sensor and GPS antenna; external solar panels with mounting frame. In order to improve the collection of sampled data we proposed equipping this array with a wireless sensor network (WSN) operating in the sub 1GHz band. The sub 1GHz band (868 MHz for Europe) is an unlicensed ISM band and was selected for the right balance between distance and data throughput. The communication protocol selected was ISA100.11a (IEC62734) due to its industrial characteristics such as determinism, reliability, security and the possibility of star and mesh topologies. The WSN technology allows the retrieving of the data which is stored by each digitizer at any time of day or night and regardless of weather conditions or the future locations of sensors, bringing a significant improvement to the activity of data collection.

Primary author: RATIU, Ovidiu (Control Data Systems SRL)

Presenter: RATIU, Ovidiu (Control Data Systems SRL)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

and Efficient Viscoelastic Finite-difference Modelling for Analysis of Seismic Wavefields Applied to On-Site Inspection

Monday, June 26, 2017 4:00 PM (15 minutes)

Numerical modelling of seismic wave propagation and seismic motion in realistic models of local small-scale near-surface structures requires realistic physical models and sufficiently accurate numerical-modelling method. Realistic models may include non-planar material interfaces, smooth heterogeneities inside layers/blocks and frequency-dependent attenuation. We present an optimized FD scheme with a. reduced grid dispersion in sediments, b. more accurate discrete representation of an interface, c. more accurate representation of realistic attenuation. The reduced grid dispersion in sediments is due to an optimized FD approximation of spatial derivatives. The approximation combines the Taylor-expansion and dispersion-relation-preserving approaches. The resulting scheme differs from the standard (2,4) staggered-grid scheme only by values of two approximation coefficients. A new discrete representation of heterogeneous viscoelastic medium with material discontinuities is based on the assumption that an interface of two viscoelastic media with the generalized Maxwell body (GMB-EK) rheologies can be approximated by an averaged orthorhombic medium with the GMB-EK rheology and the optimal procedure for a joint determination of the anelastic coefficients and distribution of the relaxation frequencies for an arbitrary $Q(\omega)$ law. The improved numerical modelling will be applied to the set of structural models of an underground cavity after a nuclear test explosion in the vertical emplacement.

Primary author: MOCZO, Peter (Comenius University Bratislava)

Presenter: MOCZO, Peter (Comenius University Bratislava)

Session Classification: T3.4 Geophysical Methods Applied to On-Site Inspection

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Quantitative Investigation of the Performance of Three-Component Optical Seismometer

This experimental study demonstrates the performance of a three-component optical seismometer. The seismometer components consist of a novel spring-suspended mass whose position is monitored by moiré technique. In this seismometer, two gratings are used, one attached to the suspended mass, and the other one fixed to the frame of the seismometer. Also, a laser diode, a light detector and a narrow slit have been used and fixed to the seismometer frame to illuminate fringes displacement due to the suspended mass movement. Due to a typical impulse, the moiré fringes oscillate in front of the light detector and the output voltage of detector can be used to measure the mass movement. So, the precise displacement can be determined by moiré detecting procedure. Also, the mechanical system of our instrument is modeled. As well as, we derive the mathematical formulation for the simulation of the response of the seismometer to an excitation function. The experimental result and theoretical simulation are compared. The results show close similarity between simulation and experiment. We also compared the performance of our optical seismometer and a common seismometer (CMG-6TD) in equal conditions. Quantitative investigations and Comparisons show that, our seismometer is quite reliable.

Primary author: ESMAEILI, Shamseddin (International Institute of Earthquake Engineering and Seismology (IIIES))

Presenter: ESMAEILI, Shamseddin (International Institute of Earthquake Engineering and Seismology (IIIES))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Series Classification Using Covariance Descriptors

This presentation presents a novel framework for time series classification that leverages the geometric structure of covariance matrices when labeling signals. Our method maps each signal to a new multivariate localized feature signal (MLFS) representation, from which we compute a covariance descriptor. This robust MLFS covariance representation handles classification tasks when the sample rates of the signals vary within a class and between classes. We demonstrate that the k-nearest neighbor (k-NN) method performs well in classifying the data. This is important because in the machine learning community the k-NN method of classification is one of the simplest classification algorithms. When we switch to more complicated classifiers, we expect to see an even better performance.

Primary author: CLAUTER, Dean (U.S. Air Force Technical Applications Center)

Presenter: CLAUTER, Dean (U.S. Air Force Technical Applications Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Waves Associated of Earthquakes and Nuclear Explosions Using Total Electron Content (TEC)

Atmospheric gravity and infrasonic waves can be excited seismic activities such as earthquake and tsunami. If the tsunami and earthquake are strong enough, the waves can propagate to a height of the ionosphere so that fluctuations in the ionosphere in the period order of atmospheric gravity and infrasonic waves can appear in the ionosphere. Monitoring system of ionosphere waves associated with the earthquake from GPS data has been developed from a network of GPS observation stations. Using sliding Fast Fourier Transform (SFFT) on differential TEC data estimated from the carrier phase data of the GPS signal, ionospheric irregular fluctuations in period order from seconds to tens of minutes can be detected in the ionosphere with an average amplitude which varies in the order of less than 0,01 TECU. At a certain moment the ionospheric fluctuations becomes more regular and have greater amplitude more than 0,01 TECU. The methodology examining using the GPS data during the occurrence of some earthquakes shown that the ionosphere waves can be detected a few minutes to a few hours after the earthquake and tsunami. The Nuclear explosions also examined using this method, the result show that indicate little TEC anomaly after the explosion.

Primary author: ROHADI, Supriyanto (Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG))

Presenter: ROHADI, Supriyanto (Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

a Joint Array and Polarization Processing from IMS 3-Component Stations and Arrays: Seismic Wavefield Polarization and Its Spatial Coherency

Seismic waves are characterized not only by their propagation properties (i.e. velocity and direction of propagation) but also by the local particle motion trajectories they generate. These particle motion trajectories are the polarization properties of the waves and play a large part in identifying and extracting the seismic phases. To study the polarization, 3-component data are required. Most of the IMS seismic arrays contain one station co-located with a 3-C station, which offer the possibility to combine both propagation and polarization analysis. This work focuses on polarization analysis which remains underused on seismic waves study. A review of the existing 3-components array processing methods reveals that these methods are complex and limited in their use. Therefore, two alternative methods that associate array processing and polarization are suggested. In order to best exploit the polarization analyses, a standardized parametrization system describing the polarization is developed and associated with a visualization solution regrouping all the parameters necessary for the interpretation on one figure. In addition, a polarization analysis performed on data from the fully 3-component seismic broadband array of the Low Noise Underground Laboratory (LSBB), France, demonstrates the possibility to use spatial coherency to assist with the interpretation of seismograms.

Primary author: SÈBE, Olivier (CEA/CENTRE Ile-de-France)

Presenter: SÈBE, Olivier (CEA/CENTRE Ile-de-France)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Equipment Challenges for Waveform Technologies

The presentation is focused on equipment challenges for IMS seismic and infrasound networks. As per Operational Manuals, stations of both networks have to meet requirements for data authentication, data buffering, data availability with less than five min delay when transmitted to IDC and accurate control of absolute and relative timing for data samples. Developed Standard Station Interface (SSI) solution provides the compliance with these requirements. It is known that verification seismology is concerned with searching of reliable methods of signal detections at high frequencies whilst IDC MS/mb screening criteria relies on reliable surface waves detection at low frequencies. To achieve that the requirements for instrumental noises are defined as certain dBs below minimum background within the whole required frequency band. Therefore the compliance with them introduces challenging task when close to NLNM conditions are recorded at the site. The experience has shown that hybrid response seismometers provide optimal solution for utilization of system dynamic range and assuring the compliance with instrumental noise requirements. Results were achieved in infrasound technology to optimize the response of the WNRS within the required infrasound passband. To obey the requirement for infrasound system calibration the reference sensor technique was developed and validated at several stations.

Primary author: STAROVOYT, Yuri (Comprehensive Nuclear-Test-Ban Treaty Organization/IMS Division)

Presenter: STAROVOYT, Yuri (Comprehensive Nuclear-Test-Ban Treaty Organization/IMS Division)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of OSI-Relevant Features Using Time-Series Radar Imagery

The availability of data and the ability to efficiently interpret those data in the context of an alleged Treaty violation are critical to the preparation of the Initial Inspection Plan during the launch phase of an On-Site Inspection. Data provided as national technical means can support authenticated data products from the CTBT International Data Centre. In this context, remotely sensed data and derived products acquired from sensors on satellites could feature prominently. To test the value of radar data in this context, a time series of radar imagery encompassing the period of site engineering modifications prior to the Integrated Field Exercise in Jordan in 2014 were analysed. The imagery, in the form of RADARSAT-2 SLA Beam Mode images at spatial resolution of approximately 1m, covering an area of 100km² were acquired between August and November 2014. Each acquisition was compared with its predecessor for OSI-relevant changes. The paper reports on the automated processing methods employed and the findings of the analyses. In this respect, the ability of the radar imagery to positively detect simulated features is addressed.

Primary author: ROWLANDS, Aled (CTBTO Preparatory Commission)

Presenter: ROWLANDS, Aled (CTBTO Preparatory Commission)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Review of the Most Frequently Applied Seismic P-Wave Picking Algorithms

Seismic phase arrival picking has been firstly carried out manually by qualified analysts. However, the introduction of digital seismic monitoring systems and the increasing volume of data collected by large seismic networks, as well as the need for providing fast earthquake location led to the necessity of developing automatic-picking schemes. A reliable automatic picking task considerably reduces the effort required and makes picking faster and more objective with consistency in error estimation. A literature review shows that many automatic methods have been investigated, ranging from simple to sophisticated procedures. Each procedure has advantages and disadvantages. The choice of an appropriate algorithm depends on the performance required of the picker and the type of signal expected (low/high SNR, emergent, impulsive). Furthermore, many algorithms have been developed for a specific data type or for a particular application. In this study, we are interested in discussing the most popular and frequently applied automatic picking algorithm, particularly for P-wave identification.

Primary author: ATMANI, Abderrahman (ENSA, Ibn Zohr University)

Presenter: ATMANI, Abderrahman (ENSA, Ibn Zohr University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Attenuation and Applied in Earthquake and Explosion Identification

In our study, we analyzed the identification ability of first motion amplitude P_i maximum amplitude P_m to S maximum amplitude S_m ratios based on the small magnitude earthquakes and explosions occurred in Huailai, Beijing. Considering the variations of amplitude attenuation influenced by propagation paths, we selected reasonable formula to study attenuation characteristics of P, S amplitudes with epicenter distance, and obtained that amplitudes of explosion attenuated faster than earthquakes. After attenuation correction, we calculated the amplitude ratios again and found that the correct recognition rate of P_i/S_m amplitude ratios was improved from 84% to 98% and the P_m/S_m amplitude ratios was improved from 92% to 100%. This method has also been used to recognizing small magnitude event in North Korea. The correct recognition rate of P_i/S_m amplitude ratios was improved from 77% to 93% and the P_m/S_m amplitude ratios was improved from 87% to 92%. In conclusion, the results show that as an additional criterion to maximum amplitude ratio, the initial amplitude ratio has a better effect on recognition. After attenuation correction, the amplitude ratio criterion can be better applied to small magnitude earthquakes and explosions identification.

Primary author: WANG, Tingting (Institute of Geophysics, China Seismology Bureau)

Presenter: WANG, Tingting (Institute of Geophysics, China Seismology Bureau)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Options to Visualize the Technical Data Generated During an OSI

A large quantity of multi-variate, technical data will be collected during an OSI, and the IT members must be able to see all of that data in its geographic context. Without an integrated and intuitive platform to display such data, important information could be over-looked. Deciding how to display technical data is not a trivial task and will vary extensively from technique to technique. In this talk, we will discuss the challenges inherent in adapting the following four broad data product types for use in a 3D visualisation platform: 1. Visualisation of 2D cross sectional data 2. Visualisation of 3D volumetric data 3. Abstraction and visualisation of complex data (eg Seismic) 4. Display of electromagnetic imagery The processing requirements for converting each data type into a format which can be visualised will vary, as will the level of abstraction to be applied to the data. We conclude that in all cases, it is possible to present these data in a logical way that adds value by integrating the results into a single representational framework.

Primary author: STEVANOVIC, Jennifer (AWE Blacknest)

Presenter: STEVANOVIC, Jennifer (AWE Blacknest)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Cepstral Methods for the Improved Processing of Seismic Data

In this paper, we discuss research in improving shallow depth estimates by adding enhancements to our Cepstral processing. These enhancements include: 1) the employment of a predictive lifter to the Complex Cepstrum, which should improve the depth phase removal; thereby, giving a better estimate of the P-phase; 2) the effectiveness of the lifter in removing a second explosion from the seismogram; 3) The use of Mel Cepstrum (taken from speech literature) for discriminating events of interest (explosions versus earthquakes); 4) the identification of ripple fire events as a screening tool for reducing the analysts' work load by quickly identifying ripple fire mining explosions. Finally, we investigate Complex Cepstrum methods to improve very shallow event depth estimates, including pre-filtering, use of single station data versus array data, for identifying multiple explosions, and weighting of the time series (seismogram); thereby, taking advantage of minimum/maximum phase sequences.

Primary author: KEMERAIT, Robert (U.S. Air Force Technical Applications Center)

Presenter: KEMERAIT, Robert (U.S. Air Force Technical Applications Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Guide for Tunnels and Voids Detection Using High Resolution Microgravity

Gravity measurements indicate variations in the earth's gravitational field caused by lateral differences in density of the subsurface soil or rock or the presence of natural voids or man-made structures. Microgravity surveys are used for the near-surface geologic investigations, as geotechnical, environmental and archaeological studies. Geologic and geotechnical applications include the locations of buried channels, voids, tunnels, caves, and low-density zones in the foundations materials. The modern Gravity meters such as CG-5 Scintrex Autograve can detect these small relatively low gravity anomalies, which result from the large voids, like tunnels or weapon production facilities. Modeling of the resulted gravity data can indicate the exact locations of the tunnels and weapon facilities. This study acts as a guide that includes the optimum way to deal with microgravity survey for detecting the voids and tunnels. Some theoretical examples for tunnels and their corresponding gravity signals required to detect these tunnels are included. The study created flow chart which summarizes the steps of the high resolution microgravity measurements. This study can be considered as important step to introduce a standard operating procedure for one of the geophysical techniques (Gravity methods) to apply as a continuation period technology for On-Site Inspection (OSI).

Primary author: ISSAWY, Elsayed Abdelazim Mohamed (National Research Institute of Astronomy and Geophysics (NRIAG))

Presenter: ISSAWY, Elsayed Abdelazim Mohamed (National Research Institute of Astronomy and Geophysics (NRIAG))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

S-wave Data Acquisition and Processing Above a Tunnel

S-waves are characterized by lower velocity than the P-waves therefore they provide more detailed images of the subsurface. The geologic and man-made structures can be detected more precisely on the S-wave sections than on the P-wave ones. However, the attenuation for the S-waves is higher than for the P-waves resulting in lower signal-to-noise ratio. That is why the S-wave data acquisition and processing is more challenging than the P-wave procedures. S-wave data collection was performed in the Bakony Mountains near Veszprém city in Hungary. The profile crossed over a railway tunnel and it was implemented along a straight and flat road. The depth of the tunnel arch was 14 m. ELVIS-III type horizontal vibrator was utilized as a seismic source and horizontal geophones were deployed to observe the S-wave arrivals. During the reflection data processing we aimed to get the highest possible signal-to-noise ratio and resolution on the final migrated section; while refraction tomography provided an independent S-wave velocity model. On both sections, slide-like structures were detected; in addition, the tunnel can be recognized as a disturbed zone on the reflection section. The explanation is that the diameter of the tunnel is on the limit of horizontal resolution (7 m).

Primary author: BUJDOSÓ, Éva Ágnes (Geological and Geophysical Institute of Hungary)

Presenter: BUJDOSÓ, Éva Ágnes (Geological and Geophysical Institute of Hungary)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

and performance of Cosmic Guard and Compton Suppression System for Environmental Radiological Analysis

Gamma spectrometry laboratories analyze environmental samples with low radionuclide content. The determination of low level activities is challenged by the problem of high background signals which can mask the events from a sample or increases the uncertainty of peaks that are found. A primary contributor to the background is terrestrial radiation resulting from naturally occurring radiological materials. Another source of background is caused by highly penetrating cosmic rays passing through the shielding and interacting with the detector producing a characteristic continuum response in a spectral histogram. A third source is the result of partial absorption of the full gamma-ray energy due to Compton scatter and escape of an event within the detector. Mirion Technologies (Canberra) Inc. has introduced a Cosmic Veto system allowing users to readily retrofit shielded HPGe systems in order to gain the benefits of cosmic background reduction. Additionally, Compton Suppression system which reduces the effects of Compton escape has been enhanced. Both systems leverage modern digital signal processing allowing users to easily configure and operate these systems. These digital systems acquire not only the vetoed spectra, but also the unsuppressed data, which allows for quality assurance and defensible results. The performance of these systems will be presented.

Primary author: ILIE, Gabriela (Mirion Technologies (Canberra), Inc.)

Presenter: ILIE, Gabriela (Mirion Technologies (Canberra), Inc.)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Scintillators: A Possible Enhancement for Handheld OSI Detectors

Many detection systems detect either gamma or neutron radiation or combine the detection of both nuclear radiation types by integrating two detectors in one system. For hand-held systems a very small ^3He -tube is often combined with a scintillation crystal of e.g. NaI or LaBr₃. The recently developed detector material CLYC promises to detect gammas and neutrons simultaneously with good resolution and efficiency for fast and reliable isotope identification and efficient neutron counting. In the paper we report on tests with a CLYC detector. The scintillation material of CLYC-detectors ($\text{Cs}_2\text{LiYCl}_6:\text{Ce}$) contains enriched ^6Li . Via the nuclear reaction $^6\text{Li}(n,\alpha)t$ alpha particles and high energetic tritons are generated by neutron radiation. The ions generate a light pulse while travelling through the crystal. Gamma radiation excites electrons in the scintillator. Neutron and gamma radiation have a unique pulse shape, enabling the distinct discrimination of induced pulses. New detector materials like CLYC, which are able to detect gammas and neutrons simultaneously, may lead to a new type of small and efficient hand-held devices. These detectors have the potential to improve the detection of nuclear and radioactive material and may be used successfully in OSI.

Primary author: KÖBLE, Theo (Fraunhofer INT)

Presenter: KÖBLE, Theo (Fraunhofer INT)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Laboratory Sample Ganging: Characterization of Multisample Holder Positions to Screen Out the Samples

One main effort in the OSI laboratory field activity is to ensure a high throughput of gamma spectrometry analysis of the samples. Most of the typical analysed samples, such as soils, are supposed to be within environmental range of activity and it is very important to screening out any anomaly in the gamma spectra of the samples. A multisample holder, with two separate layers, has been designed, fabricated and tested for the purpose to analyse simultaneously up to 13 samples with a defined geometry. This approach, allowing the screening of a big number of samples and the ganging of samples according to the OSI search logic strategy, has been tested effectively during IFE14. In this work the procedure for the identification of the sample with anomalous concentration has been further explored. Spiked samples have been measured in different positions of the holder (upper and lower layers) in order to record the response of the detector and to compare the different efficiencies of the positions. The analysis of the data will represent a starting point for the design of a fast and efficient screening procedure for sample ganging measurements.

Primary author: RIZZO, Antonietta (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Presenter: RIZZO, Antonietta (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Analysing for Supporting the CTBTO's Treaty by the National Data Center Suriname

The National Data Center Suriname (NDCSUR) operating since September 2012 is receiving Seismological data from three Seismic stations from Colombia, Bolivia and Brazil. This data is send to us from the International Data Center (IDC) in Vienna Austria on daily bases in near real time. If there is an event of interest in our region, we request for data from more stations and analyze it using the Geotool software. If the event is suspicious we can request for additional data (e.g. Radionuclide) and do further analyzes. A monthly bulletin of these events is prepared and send to the local authorities and environmental- and disaster departments to buildup an understanding that the data is not only used for the CTBTO's verification regime, but it is also for great importance to civil and scientific applications.

Primary author: AMIERALI, Mohamed Firozali (Meteorologische Dienst Suriname)

Presenter: AMIERALI, Mohamed Firozali (Meteorologische Dienst Suriname)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Antineutrinos to Verify the Nuclear Nature of a Suspect Nuclear Test Based on Seismic Event Coincidence

The default means of confirming the nuclear nature of an explosion is to detect radioactive noble gases which seep out slowly from underground tests and sometimes escape detection entirely. Detection of antineutrinos coincident with a seismic signal from the International Monitoring System (IMS) or other seismic networks could provide a tool to more rapidly verify the true nature of a suspect nuclear event. Compared to previously explored antineutrino-based techniques, a key advantage to this combined approach is that it requires few antineutrino events to confirm the nuclear nature of the event due to the cueing information provided by the seismic system. The coincidence window is short (~10 seconds) so that the likelihood of false coincidence in a low background detector will be low. This will make detector sizes somewhat more tractable facilitating standoff deployment. This paper presents the findings of an investigation into the feasibility of using antineutrino detectors to confirm the nuclear nature of a suspect nuclear test. We present the sensitivity of detection as a function of standoff distance, bomb yield, for a variety of detector technologies. We include in our analysis neutrino oscillation effects and realistic backgrounds from past neutrino experiments.

Primary author: DALNOKI VERESS, Jacob Rolf Ferenc (James Martin Center for Nonproliferation Studies (CNS))

Presenter: DALNOKI VERESS, Jacob Rolf Ferenc (James Martin Center for Nonproliferation Studies (CNS))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

-Gamma Coincidence Analysis of the 2015 Proficiency Test Exercise (PTE)

As part of regular laboratory operations, GBL15 (the UK CTBTO certified radionuclide laboratory) participates in annual Proficiency Test Exercises (PTEs) organised by the CTBTO. GBL15 consistently achieves the top 'A' grade in these exercises using dedicated HPGe detector systems; to achieve the sensitivity required these are specifically designed to use low-background materials, and are further enclosed within advanced passive and active shielding [1]. GBL15 also has a research system that is based on two high-efficiency HPGe detectors collocated in a single shield, currently capable of measuring and quantifying X-ray-gamma and gamma-gamma signals[2-4]. By measuring cascades of gamma radiation, the background is dramatically lowered, greatly increasing the sensitivity of the system. This poster describes the use of this system to conduct a PTE, and compares the results to a standard analysis. 1. Burnett J, Davies A, (2013) J Radioanal Nucl Chem 298-2, 987-992 2. Britton R, Burnett J, Davies A, Jackson M, (2015) J Environ Radioact 146, 1-5 3. Britton R, Jackson M, Davies A, (2015) J Environ Radioact 149, 158-163 4. Britton R, Jackson M, Davies A, (2016) J App Rad Isot 116, 128-133

Primary author: BRITTON, Richard (CTBTO)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Reflection Green's Functions Extracted from Ambient Seismic Noise and Signal for IMS Seismic Station Site Crustal Reflector Characterization

Seismic interferometry is applied to extract reflection Green's Functions (GFs) at PDAR, Pinedale, Wyoming, USA. The possibility of extracting crustal reflector structure beneath each station of this well-calibrated IMS primary seismic array is assessed, and the resulting GFs are interpreted using existing geophysical information, including borehole data. Here we address two issues identified in previous studies: 1) difficulty in phase identification, and 2) high frequency loss by extracting GFs from stacks of two years of continuous waveform autocorrelations. First, to address challenges related to phase identification, we use synthetic waveform modelling, an F-statistic detector and Cepstral analysis. Second, to address high frequency loss, extraction of reflections with higher frequency content (and thus, improved resolution) was found to be possible when applying the same method to several days of high teleseismic activity, as opposed to two years of continuous data. We investigate these observations using synthetic waveforms.

Primary author: TIBULEAC, Ileana (U.S. Air Force Technical Applications Center)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Intelligent Sensor Systems

Power optimizations beside power sourcing innovations and global coverage by satellite networks supports designing autonomous – intelligent sensor systems. These systems can be deployed in hitherto unreachable geographic locations and can operate without much needed human interface. Such proposed systems have many other related advantages. The architecture of such systems, in brief, may comprise of on sensor low powered microprocessors with flash memory based storage. They have SHF– VHF, wide band antennas or antenna arrays for communication with both available network nodes in the vicinity or the satellites on as available or as required basis towards power optimizations and the signal strength. A separate ad-hoc networking capability like MANETs can also be incorporated using the capabilities of these sensor systems. Implementation of different decision and optimization algorithms at such systems makes related processing and transmission optimized by reducing the data to minimum essential. Terminal benefits of reduced or essential data storage at Data Centers and its expeditious handling will reduce the associated costs against the cost additionally incurring on these sensor systems. These proposed sensors can enjoy at least limited mobility with geographical tagging of data and geo-location awareness of the system itself.

Primary author: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Presenter: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Seismic Noise Introduced by External Infrastructure: Field Data and Transfer Mechanism

Seismic noise generated by wind was analyzed at five co-located seismic and infrasound arrays. The main factors affecting the noise level were identified as (a) external structures as antenna towers and vegetation, (b) borehole casing and (c) local lithology. The wind-induced seismic noise peaks in the spectra can be predicted by combination of inverted pendulum model for antenna towers, free- or clamped-tube resonance of the borehole casing and is dependent on the type of sedimentary upper layer. Observed resonance frequencies are in agreement with calculated resonance modes for towers and borehole casings. Improvement of the seismic data quality can be achieved by minimizing the impact of surrounding structures close to seismic boreholes. The need and the advantage of the borehole installation may vanish and appear to be even not necessary at locations with non-consolidated sediments because the impact of surrounding structures on seismic background may significantly deteriorate the installation quality and therefore the detection capability of the array. Several IMS arrays where the radio telemetry antennas are used for data delivery to the central site may benefit from the redesign of the intrasite communication system by its substitute with the fiber-optic net as less harmful engineering solution.

Primary author: MARTYSEVICH, Pavel (CTBTO)

Presenter: MARTYSEVICH, Pavel (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Explosions and Earthquakes Using Infrasonid and Seismic Data

During the monitoring compliance of the Treaty, a big problem for the Ukrainian seismic networks are mining explosions. Distinguish of industrial explosions is possible by number of criteria (time of the explosion and the day of the week, power, location). But in the same regions periodically there are earthquakes, including those due to induced seismicity. Separately, there are events caused by emergencies and combat operations. Therefore, the separation and identification of the events, determination of danger degree to the public is an important task. One way to solve it is to use a complex of geophysical methods (seismic and infrasonid), which is implemented in the MCSM. For known mines the database was created that includes their location, distance to the observation sites and travel times of seismic and infrasonid waves from the source to the observation sites, azimuth to the source. As a result of the identification process for such places may be carried out in automatic mode after the selection of seismic and infrasonid waves. Presence only of infrasonid waves can talk about an emergency event. Availability in MCSM of three small-aperture infrasonid groups enables location of all local powerful events, which generate an acoustic wave.

Primary author: KOLESNYKOV, Leonid (Main Centre of Special Monitoring, State Space Agency of Ukraine)

Presenter: KOLESNYKOV, Leonid (Main Centre of Special Monitoring, State Space Agency of Ukraine)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

NDC-in-a-Box Implementation for Mongolian NDC

Installation and implementation of the Extended NDC in a Box for Mongolian NDC was completed successfully. Using new features in Extended NDC in a Box we have following benefits (DTK-GPMCC, DTK-DIVA and DTK-Jade) for advanced research for seismic and infrasound network. It also provides new tools (Webgrape(ATM), Norfy and OpenSpectra) are ready for processing, visualizing and analyzing radionuclide data.

Primary author: DORJ, Enkhtulga (Mongolian National Data Center (MNDC))

Presenter: DORJ, Enkhtulga (Mongolian National Data Center (MNDC))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Heat Transfer in a Closed Cavity Ventilated Inside

In this work, we presented a numerical study of the phenomenon of heat transfer through the laminar, incompressible and steady mixed convection in a closed square cavity with the left vertical wall of the cavity is subjected to a warm temperature, while the right wall is considered to be cold. The horizontal are assumed adiabatic. . The numerical simulations were performed for a wide range of Reynolds numbers 1, 10, 100, and 1000 numbers are equal to 0.01,0.1 Richardson, 0.5,1 and 10.The analysis of the results shows a flow bicellular , one is created by the speed of the fan placed in the inner cavity, one on the left is due to the difference between the temperatures right wall and the left wall. Knowledge of the intensity of each of these cells allowed us to get an original result. And the values obtained from each of Nuselt convection which allow to know the rate of heat transfer in the cavity.Finally we find that there is a significant influence on the position of the fan on the heat transfer for values of Reynolds studied and for low values of Richardson handed this influence is negligible for high values of the latter.

Primary author: BENSEGHIR, Omar (USTHB)

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Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

on Recognition Technology for Weak Explosion Signals

The waveforms of 50t explosion occurred on Dec. 11, in 2007 and the nuclear explosion occurred on Oct. 9, in 2006 recorded by HIA (belong to Global Seismic Network) and PS12 (belong to International Monitoring System) had been analyzed. The distances between the two events to HIA and PS12 are over 1000km, and the distance between HIA and PS12 is about 30km, the PS12 is farther than HIA. Analyst results explicated that a borehole station can raised the SNR of P waves 4.7 times compared to the common station (for example, the nuclear explosion occurred in Oct. 9 in 2006), and the PS12 borehole array can depress noise 2.5 times (6 stations work normally) by the using of beamforming technique, and then raised the SNR of a weak signal about 11.4 times compare to common stations. As to some events (50t explosion occurred on Dec.11 in 2007), HIA hasn't any signal, PS12 can recorded and analyzed, which tell us the strong detection capability of a borehole array.

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Presenter: HAO, Chunyue (Institute of Geophysics, China Seismology Bureau)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Calibration of IMS Seismic and Hydroacoustic T-Phase Stations

The purpose of the Seismic and Hydroacoustic T-Phase Stations calibration activity is the verification of the stability of calibration parameters and instrument responses over time against reference values established at the certification/revalidation time. The calibration process implements the workflow and associated reporting of the calibration activity at each particular station. Regardless of the type of equipment, the relative calibration process has to be the same and should rely on the comparison of an on-site measured system response against a reference established at the time when the station has been certified or when revalidation has been completed. However, technical implementation of calibration procedures, parameters of the calibration signals and the methodology used to evaluate the results are different and depend on the equipment characteristics, available calibration software and any other arrangements. We present the results of the calibration activities performed at IMS Seismic and Hydroacoustic T-phase stations in 2016. Calibration activities were initiated at 149 seismic stations of the International Monitoring System (IMS) (42 primary stations and 107 auxiliary stations). Of these 122 stations (39 primary stations and 83 auxiliary stations) were calibrated. The second scheduled calibration of all 5 certified IMS Hydroacoustic T-phase stations was successfully conducted in 2016.

Primary author: OTSUKA, Riyo (CTBTO IDC/OPS/MFO)

Presenter: OTSUKA, Riyo (CTBTO IDC/OPS/MFO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Detection of Earthquakes in Chile

On March 23, 2015 and September 16, 2015 two major earthquakes occurred in Chile that is within the South America continental shelf and territory. This territory is covered by six IMS infrasound stations (IS02AR, IS08BO, IS09BR, IS13CL, IS14CL and IS41PA). Using these infrasound stations coupled by seismic stations the two events were analysed to test the operational readiness of the IMS stations. Some of the infrasound stations recorded data that were used to locate the two events while some did not. The probable causes of insufficient data and the results obtained from the analysis are presented in this study.

Primary author: MADU, Uchenna Onwuhaka (Nigeria Atomic Energy Commission)

Presenter: MADU, Uchenna Onwuhaka (Nigeria Atomic Energy Commission)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Seismometry: A Toolbox for OSI

Besides aftershock monitoring, resonance seismometry is listed in the CTBT as passive seismological method for On Site Inspection (OSI). The objective is nuclear verification through detection of resonances, static structural anomalies and monitoring of temporal changes of subsurface properties caused by an underground nuclear explosion (UNE). During an expert meeting in November 2015 at the CTBTO several techniques have been listed, to be tested for this purpose including those relying on cavity resonances. Besides a cavity, the expected structural anomaly in the subsurface comprises also rubble and spall zones which can be used as targets for seismological exploration. We are aiming at an evaluation of the proposed methods by the investigation of the complex wave field interactions at an UNE test site through forward modeling and analysis of data collected at a natural analogue site. The appearance of the actual cavity-resonances can be predicted from analytical modeling. Origin of the resonance peaks are internal reverberations of waves transmitted to the cavity's interior and causing an echoing signal that couples out to the surrounding rock. The resonance frequencies correlate to the eigenmodes of the acoustic cavity. The frequency range of detectability is thereby restricted by intrinsic attenuation of the acoustic medium.

Primary author: SCHNEIDER, Felix Michael (Helmholtz Centre Potsdam GFZ - German Research Centre for Geosciences)

Presenter: SCHNEIDER, Felix Michael (Helmholtz Centre Potsdam GFZ - German Research Centre for Geosciences)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Next Generation Noble Gas System for the IMS Network

40 out of the 80 radionuclide stations of the International Monitoring System of the CTBTO will be equipped with Noble Gas detection systems. Today 31 of these stations are already installed and 25 certified. Noble Gas detection system technology for the CTBT verification founded its basis with the International Noble Gas Experiment (INGE) more than 15 years ago with the contribution in technology advancement from 4 member states. In continued cooperation with member states and the noble gas system vendors, the IMS Division continues engineering and development efforts on next generation noble gas systems. This paper describes various R&D projects which aim to increase data availability and quality and sustainability of current systems, and further improve performance and modularity of the IMS noble gas network.

Primary author: PLENTEDA, Romano (CTBTO)

Presenter: PLENTEDA, Romano (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Geophysical Data Processing and Research With Multi-Cloud Environments

Currently many geophysical organizations are already using different forms of cloud services and at the same time retaining control over the data processing. Such organizations get highly customized and sophisticated data processing environments with an optimal priceâ€¦performance ratio by combining public and private cloud infrastructure within a hybrid or multi-cloud solution. In addition these organizations improve high availability and disaster recovery by diversifying the choice of cloud providers and using multiple data centers for its critical workloads. At this session we will review the main benefits and the most common challenges of multi-cloud implementation for an advanced geophysical research.

Primary author: SYNYTSKY, Ruslan (Main Centre of Special Monitoring)

Presenter: SYNYTSKY, Ruslan (Main Centre of Special Monitoring)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Genuinely Novel Method to Identifying Gamma Rays in Region of Infrared Spectrum

Abstract As photons enter a mineral, some are reflected from grain surfaces, some pass through the grain, and some are absorbed. Those photons that are reflected from grain surfaces or refracted through a particle are called scattered. Scattered photons may encounter another grain or be scattered away from the surface so they may be detected and measured (a major part of the CTBTO activity). Infrared spectrometry works by analyzing the number of infrared photons and the amount of energy found in infrared photons absorbed by the molecule which depends on the energy of the vibrational molecules. Gamma ray is one type of photon with high energy which changes other molecules' energy. So the changing of energy in molecules would be detected by infrared spectroscopy. It is very useful for detecting a region with radiative activity when the gamma ray affects the surrounded material. Some satellites (Hyperion, Aster) and hyperspectral airborne sensor (aviris) may be use to show the gamma ray affects by changing the spectrum, especially in the region of infrared. This method is very applicable when the gamma rays cannot reach gamma detector or can be used to reduce cost of scanning purpose area.

Primary author: EJTEHADI, M.Mahdi (Shahid Beheshti University of Tehran, Iran)

Presenter: EJTEHADI, M.Mahdi (Shahid Beheshti University of Tehran, Iran)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Event Detection and Separation from Local Noise Using SVM Classifier

One problem with early warning and shutdown systems, is early detection of occurrence of an earthquake in the presence of local and false events. It could be a complicated problem specially when we want to detect an event with a few seconds of received signal. Early warning and automatic shutdown systems, if we discern local noise mistakenly as an earthquake, the least consequences of this decision would be abandoning the system. In other words, early warning and shutdown systems should distinguish earthquakes from local noise and other sources of vibration signals without making mistakes. In the past, various methods have been developed for the job of which SI and CAV methods can be mentioned. Given the high capability and good performance of support vector machine (SVM) methodology as a signal classifier tool, a method has been developed to detect early earthquakes. the results showed that SVM can be used as a powerful tool in early warning and shutdown systems.

Primary author: SEIF POUR ABOLHASSANI, Ali (GeoPersian Company)

Presenter: SEIF POUR ABOLHASSANI, Ali (GeoPersian Company)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of a Remediated Sink Hole with S-Wave Seismic and Geoelectric Methods

Due to subsurface movement along karstic fracture zones a sink hole with a surface diameter of 8 m appeared in the vicinity of a small town in 2001. Later the hole was filled up and the landscape was remediated. In 2016 a geophysical survey was organized in the site in order to monitor the quality of the remediation and observe the possibilities of the investigation of buried sink holes as an analogy of remediated sites of surface and near-surface nuclear explosions. Two dimensional geoelectric profiling was used to build up the image of the subsurface geological structure, while the vicinity of the former collapsing zone was investigated with S-wave seismic and 3D geoelectric methods.

Primary author: POLGÁR, Dorottya Enikő (Geological and Geophysical Institute of Hungary)

Presenter: POLGÁR, Dorottya Enikő (Geological and Geophysical Institute of Hungary)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Interface and Capability of a Carborne Survey Instrument Developed for the PTS Under US CiK

The Lawrence Livermore National Laboratory developed an easy to use software interface for the PTS to use with NaI-based survey instruments that also use the Ortec Digibase. Our interface, now operating on two US-loaned 4-L NaI systems with integrated GPS, enables both the rapid detection of radiation anomalies as well as determination of the relative direction of the source. Combined with GPS and producing standard ANSI-formatted file outputs, the LLNL-developed detectors and interface are being evaluated by the PTS for use in mobile survey training. This poster will describe the technical specifications of the interface and the hardware. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC - LLNL-ABS-716591.

Primary author: KREEK, Steven (Lawrence Livermore National Laboratory (LLNL))

Presenter: KREEK, Steven (Lawrence Livermore National Laboratory (LLNL))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Radiological Field Training Simulator (RaFTS)/Spectroscopic Injection Pulser (SIP) for Radiation Detection Training Without Radiation Sources in On-Site Inspection

LLNL has developed a capability for radiation detection instrument training that enables the use of detection instruments against realistic radiation sources/scenarios of interest to CTBT on site inspection. The sources and scenarios include, for example, short-lived relevant radionuclide radioactivity that is distributed on the surface inside an inspection area or might be contained in sample collected from the same. Our method uses actual operating radiation detection instruments and injects, pulse by pulse, the response into the detectors. Demonstrated on an operational and commercial HPGe detector used for in situ gamma spectroscopy and/or sample measurements in a field laboratory, our approach maintains the full physics fidelity while also maintaining the realities of field operations. The presentation will describe the current capability and results of some recent demonstrations performed at the VIC and also in Washington, DC. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 Lawrence Livermore National Security, LLC., LLNL-ABS-716592.

Primary author: KREEK, Steven (Lawrence Livermore National Laboratory (LLNL))

Presenter: KREEK, Steven (Lawrence Livermore National Laboratory (LLNL))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Approach to Radionuclide Time Series Reconstruction Based on Autoregressive Analysis

Fragmented time series are not unusual in the radionuclide results reported by the International Data Center (IDC), especially those measured with Xe monitors. When the number of valid data (understood as over the decision limit) is high, simple interpolation methods are good enough in most cases. When the number of valid data is low, time series reconstruction offers preliminary results that can be useful for further analysis. Time series reconstruction based on autoregressive models preserves the basic statistical descriptors and allows the use advanced statistical analysis such as the Hilbert transform and cross-correlations. This methodology has been applied on the ^{133}Xe radionuclide data available with CRTOOL for the stations RN38 (Takasaki, Japan) and RN58 (Ussuriysk, Russia) for the period January 1st 2016 to April 15th 2016, which includes the estimated date for the nuclear test performed by the Democratic Popular Republic of North Korea on January 6th, 2016. In both stations, time series based on 12-hours monitoring period provided about 50% of positive ^{133}Xe measurements, with some results over 1 mBq/m³ for RN38 (January 6th, February 21st, March 13th & 15th) and RN58 (February 17-18th). The proposed analysis on the reconstructed time series demonstrates that these events are not correlated.

Primary author: BENITO DIAZ, Gonzalo (CIEMAT)

Presenter: BENITO DIAZ, Gonzalo (CIEMAT)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

at the UK National Data Centre for Radionuclide Analysis

Recent developments at the UK National Data Centre, hosted by UK Radionuclide Laboratory GBL15, have significantly improved the data processing capabilities for IMS radionuclide data. GBL15 utilises the IDC-developed software packages including `nms_client` and `rms_pipeline` in order to receive data downloads and automatically analyse the files. These results are used as a foundation for further investigation using independent, in-house developed analysis software. The GBL15 analysis sequence for gamma and beta-gamma spectral data employs software written using Python, SQL, Bash and ROOT languages to provide a comprehensive, automatically generated interpretation of each sample. The software is able to identify samples of interest, probe the IMS network for preliminary data captured during the sample acquisition, independently verify the identification of nuclides of interest, and flag this to GBL15 Radionuclide Specialists. This poster summarises the work that has gone in to developing a custom automatic analysis pipeline for radionuclide data, its validation against commercial software and the opportunities for further enhancing the capability of automated radionuclide analysis and data fusion in the UK.

Primary author: GOODWIN, Matthew Alan (AWE Aldermaston)

Presenter: GOODWIN, Matthew Alan (AWE Aldermaston)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

and Testing of a Cosmic Veto System at the IMS Station RN67, St Helena

AWE recently developed a Cosmic Veto system for use with CTBTO detectors at UK laboratory GBL15. The technology used for this has subsequently been adapted and optimised so that Cosmic Veto systems can be retrofitted to existing IMS manual station designs. During October 2016, in collaboration with the PTS and Enviroearth, a 'Hot Spare' system was installed at RN67 St Helena in the South Atlantic to field test the Veto system on a CTBTO specification detector. The 'Hot Spare' configuration is of particular importance for remote stations, comprising of a secondary certified detector that can be used if there is a problem with the primary system. Additionally, experience and expertise in the design of low-background systems was utilised to upgrade the shielding of the 'Hot Spare', further improving system sensitivity. This upgrade was also designed specifically to enable easy and cost-effective retrofit of existing IMS stations. RN67 and AWE both utilise a 'Snow White' sampler, allowing testing of the system as a hot spare and as a primary detector. The Veto has been proven to provide a substantial sensitivity improvement in the field, with no adverse effects on the validity and robustness of the CTBTO certified measurement and analysis process.

Primary author: DAVIES, Ashley (CTBTO)

Presenter: DAVIES, Ashley (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Analysis of Radioxenon Samples as a Support of the IMS Network

Certified laboratories are an essential component of the IMS network. One of their duties is to perform in-depth analysis of anomalous radionuclide samples collected in the field. FRL08 laboratory is candidate to noble gas certification. Radioxenon analysis is far more challenging than analysis of particulate filters: samples are gaseous which makes them prone to leaks and memory effect, procedures have to accommodate three significantly different types of archive bottles, preparation of the gas mixture is needed prior to measurement, half-lives of radionuclides are short... The sample measurement procedure developed at FRL08 consists of three main steps. The first one comprises sample purification using cryo-condensation in order to remove the carrier gas from the xenon. Residual gas is then transferred by an automatized syringe into a double-sided cell fitted with carbon epoxy windows. Relevant radioxenons are detected and quantified by a high efficiency/low background double-crystal HPGe gamma/X spectrometer. Finally stable xenon composition (proportional to sample air equivalent volume) is assessed using an automated gas phase chromatograph. These optimized tools allow meeting present certification criteria. In some specific cases, laboratory sensitivity is so high that it can encompass unavoidable decay of the sample during transportation and extend IMS network detection capability.

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Presenter: DOUYSET, Guilhem (CEA/CENTRE Ile-de-France)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Optical Microbarometer

Usually, transducers implemented in infrasound sensor are mainly composed of two associated elements. The first one converts the external pressure variation into a physical linear displacement. The second one converts this motion into an electrical signal. According to this configuration, MB3, MB2000 and MB2005 microbarometers are using an aneroid capsule for the first one, and an electromagnetic transducer (Magnet-coil or LVDT) for the second one. Changing the electromagnetic transducer by an interferometer is a solution to increase the dynamic and the resolution of the sensor. We are exploring this way in order to propose a future optical microbarometer which will enlarge the panel of infrasound sensors. First, we will present the new transducer principles, taking into account the aneroid capsule and the interferometer using integrated optics technology. Secondly, we will present the optical microbarometer in which the interferometer is positioned inside the aneroid capsule under vacuum. The adjustment of the interferometer position is a challenge we solved. The optical measurement is naturally protected from environmental disturbances. Four prototypes were manufactured to compare their performances. Finally, we will present the results we obtained with this sensor (sensitivity, self-noise, effect of environmental disturbance, etc) compared to those of a MB3 microbarometer.

Primary author: OLIVIER, Nathalie (iXblue)

Presenter: OLIVIER, Nathalie (iXblue)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Tests of OSIRIS: A Spectrum-Blind Gamma-Ray Spectrometer for On-Site Inspections under the Comprehensive Nuclear-Test-Ban Treaty

We have conducted extensive system tests of the On-Site Inspection RadioIsotopic Spectroscopy (OSIRIS) system, a spectrum-blind instrument for the acquisition and analysis of high-resolution gamma-ray spectra during on-site inspections under the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Unlike most other spectrometers, the OSIRIS system does not display actual gamma-ray spectra, and its software filter limits the display of spectral information to just seventeen CTBT-relevant fission-product isotopes, for example, ^{131}I . The OSIRIS tests include environmental chamber measurements of energy-calibration accuracy and electronic-gain stability of the mechanically-cooled high-purity germanium gamma-ray spectrometer over the range measured from $-12\text{ }^{\circ}\text{C}$ ($10\text{ }^{\circ}\text{F}$) to $50\text{ }^{\circ}\text{C}$ ($122\text{ }^{\circ}\text{F}$). Other measurements have followed the decay of calibrated uranium fission-product sources for over a year at Idaho National Laboratory (INL) and Pacific Northwest National Laboratory (PNNL). Many of the fission-product measurements at INL and PNNL were conducted outdoors under a broad range of ambient conditions.

Primary author: CAFFREY, Gus (Idaho National Laboratory)

Presenter: CAFFREY, Gus (Idaho National Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

-Linear Kernel Methods for Seismic Event Characterization

Characterization of seismic events is an important component of the CTBT verification regime. Non-linear machine learning techniques are capable of compactly modeling complex datasets by using a local similarity metric. This process results in a low-dimensional representation of the dataset, in which each data item is characterized by a small number of intrinsic parameters. In this work, we apply a machine learning technique called diffusion maps for automatic earthquake-explosion discrimination and explosion classification. Diffusion maps construct a geometric representation of the seismograms that capture the intrinsic structure of the signal at each channel. As a pre-processing step, the seismograms are converted to normalized sonograms. In the obtained low-dimensional representation, seismic events with similar source mechanism from the same region have a similar representation. In addition, the single channel based classification method is extended to a multi-station one by introducing a kernel multiplication technique. This method extends the standard diffusion maps framework by providing a solution to handle multi-views and multi-source inputs. Our approach is demonstrated on several seismic data sets that are embedded and can also be visualized in a low-dimensional space. High accuracy discrimination results are achieved by using simple classification analysis methods in the low-dimensional space.

Primary author: RABIN, Neta (Afeka - Tel Aviv Academic College of Engineering)

Presenter: RABIN, Neta (Afeka - Tel Aviv Academic College of Engineering)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Seismic Monitoring: Developments at the USGS National Earthquake Information Center

The United States Geological Survey's National Earthquake Information Center (NEIC) operates real-time seismic monitoring systems that seamlessly integrate local, regional, national, and global seismic data for routine monitoring of earthquake activity and response to significant seismic events. These systems use real-time seismic data from more than 2,000 stations operated by more than 130 seismic monitoring organizations worldwide. The NEIC has automated the concepts of self-discovery of waveform data and station metadata, processing subsystem self-configuration of pickers, associators, correlators, and quality assurance testing. Implementing these concepts ensures NEIC uses the best available data and information to produce rapid and accurate reporting of earthquake source parameters and impact assessment. NEIC is working toward better integration of seismological source parameters (e.g. calibrated relocations) and seismotectonic constraints (e.g. new velocity models, slab geometry) to further improve location accuracy. We will provide illustrative examples utilizing these concepts.

Primary author: BENZ, Harley (U.S. Department of the Interior, U.S. Geological Survey - Earthquake Hazards Program)

Presenter: BENZ, Harley (U.S. Department of the Interior, U.S. Geological Survey - Earthquake Hazards Program)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Ionospheric Disturbances Using a Large GNSS Network

Traveling Ionospheric Disturbances (TIDs) can be observed following surface or underground nuclear weapons tests. The availability of large, dense networks of GNSS receivers enables the detection of these disturbances and mapping of their speed and direction of propagation over large geographical areas. Our previously published results have shown the detection of disturbances from the 2006 and 2009 DPRK events. Many other types of sources, however, can produce similar disturbances, and consequently TIDs are ubiquitous in the ionosphere, often with a seasonal and directional dependence. We have applied the wavelet transform to isolate individual traveling wave packets and are studying pattern classification methods for distinguishing different sources from their unique signatures in the time series of the Total Electron Content (TEC). In addition, we are applying a high fidelity coupled atmosphere-ionosphere model to study the sensitivity of TEC variations to source strength and environmental variables. We will present results from application of our array processing techniques to assess the detectability of signatures in data collected during the 2013 and 2016 DPRK tests

Primary author: GARRISON, James (Purdue University)

Presenter: GARRISON, James (Purdue University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

the Global Network of Radiation Portal Monitors

Thousands of Radiation Portal Monitors (RPM) are deployed worldwide by various government agencies. They are installed at nuclear facilities, border crossings, airports, seaports, scrap metal processing facilities, etc. The most common implementation includes the use of a primary detection and secondary inspection. The first stage is designed to determine the presence of radiation, while the second stage requires segregation of the alarming entity and subsequent isotopic analysis. In some cases, the data is collected and analyzed offline to estimate system health and diagnose root causes of component failures. The most widely used detector type is Poly Vinyl Toluene (PVT) (as well as the similar Poly Styrene (PS)), based largely on cost and detector-size scalability. These poor-resolution detectors are unable to identify alarming isotopes based on energy spectra – but they are able to identify some isotopes through their decay half-life. This fundamental ability of already-deployed systems can be used to augment the data stream used to detect illicit nuclear events. Many global agencies, such as the Comprehensive Nuclear Test Ban Treaty Organization (CTBTO) whose mission is to passively monitor for isotopes associated with nuclear testing would benefit from the addition of a multitude of detectors to their data stream.

Primary author: LIVESAY, Ronald (IB3 Global Solutions)

Presenter: LIVESAY, Ronald (IB3 Global Solutions)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Classification of Seismic P and S Wave Signals Using Multiple Parameters, Frequency Ranges and Artificial Neural Network

Automatic classification of seismic P and S wave signals is essential in automatic seismic event detection and location systems. The problem is tackled by utilizing multiple signals of different types each in several frequency bands. Artificial Neural Networks (ANN) are a robust and efficient tool in classification using large amount of input parameters. P and S wave signals have fundamentally different polarization properties. The input parameters depending on signal polarization in this study included rectilinearity, principal ellipticity, global polarization parameter, eigenresultants, quadratic resultant and predicted coherency. Several statistical parameters were used also. They included skewness, kurtosis and Jarque-Bera test. Instead of or in addition to several parameters their variances in time were added to the input database. Different amplitude ratios were used also. Many of the parameters were computed separately from vertical and horizontal channels. All parameters were computed at 6 different frequency range and time window combinations resulting 210 input parameters. The parameters were computed from 10634 seismic traces of local events creating 2.2 new time-series. Independent training, testing and validation datasets picked from these time-series consisted ~1.5M inputs each. Using a deep ANN with 4 hidden layers 98% of signals of validation data were classified correctly.

Primary author: TIIRA, Timo (University of Helsinki, Institute of Seismology)

Presenter: TIIRA, Timo (University of Helsinki, Institute of Seismology)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

the Variability of Earth's Microseisms Through Signal Coherency Analysis

For the purpose of a long-term self-noise study of the STS-2 seismometer, four co-aligned sensors were deployed side by side at the Conrad Observatory (Austria) over a four year time span. The analysis of the recorded data shows that self-noise estimates computed using the standard three-sensor coherency method strongly depend on accurate sensor alignment, and that for vertical components misalignment of sensors almost exclusively disturbs self-noise spectra within the frequency band of Earth's secondary microseisms. Insufficient sensor alignment as small as 1/100 of a degree or less can cause incoherencies between the three sensors' recorded signal, which can be detected in the self-noise spectra. In this work we show that this effect can be used to study the variability of secondary microseisms, as the amount of disturbing signal "leaking" into the self-noise estimates depends on microseisms' activity and the angle of misalignment. Intentionally misaligning seismic traces by numerical trace rotation about small angles results in disturbances of the self-noise spectra that primarily depend on microseismic activity. Results show that the technique is able to detect the increased amount of Rayleigh-waves during events as microseismic storms or hurricanes, potentially rendering this method a means to better observe and study Earth's microseisms.

Primary author: GERNER, Andreas (University of Vienna)

Presenter: GERNER, Andreas (University of Vienna)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Time Monitoring Data Application and Simulation Researches for Earthquake and Tsunami Disaster Mitigation

Real time monitoring systems around seismogenic zone are very important for early detection of earthquake and Tsunamis. Furthermore, these system are also indispensable to understand crustal activities and phenomena as precursor. In Japan, Ocean floor network systems as DONET and S-NET already deployed for early warning and prediction researches. In DONET system, DONET1 and DONET2 are focusing on the Nankai Trough seismogenic zone southwestern Japan, S-NET is focusing on off east Japan based on lessons learned from 2011 East Japan earthquake. For disaster mitigation, not only real time data but also advanced simulation are indispensable. For example of simulation, we developed the recurrence simulation of mega thrust earthquakes, data assimilation and real time inundation simulation using real time data. Otherwise, real time monitoring system detect micro seismicity for the estimation of seismic stage such as inter seismic stage and pre seismic stage. Finally, we have to integrate advanced simulation and real time information for disaster mitigation.

In this presentation, we explain Japanese ocean floor networks and advanced simulation researches.

Primary author: KANEDA, Yoshiyuki (Kagawa University)

Presenter: KANEDA, Yoshiyuki (Kagawa University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Radionuclide Laboratory (IRL): Gas Extraction and Volume Measurement Set-Up

The radionuclide monitoring network of comprehensive nuclear-test-ban treaty International Monitoring System (IMS) consists of 80 radionuclide stations and 16 radionuclide laboratories. Forty of these stations shall also be capable of monitoring for the presence of relevant noble gases and radioxenon monitoring became the key component of the verification regime. Four xenon radioisotopes of interest are the following: ^{131m}Xe , ^{133m}Xe , ^{133}Xe and ^{135}Xe . In some cases after analysis of air extracted radioxenon isotopes, the archive bottle of xenon system needs to be re-measured by laboratories to confirm the results. Laboratory system shall include noble gas extraction, precise volume and activity measurement equipment. Islamic Republic of Iran Radionuclide Laboratory (IRL) has been designed and established with radioxenon analysis capability. This Paper is focused on design and implementation of gas extraction and volume measurement parts of the system and presents its performance based on the inter-comparison exercise and standard sample analysis results.

Primary author: SABZIAN, Mohammad (Faculty of Advanced Sciences & Technologies, University of Isfahan)

Presenter: SABZIAN, Mohammad (Faculty of Advanced Sciences & Technologies, University of Isfahan)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

SAUNA CUBE Project: A New Concept in Radioxenon Detection Using Noble Gas System Arrays

By using existing technology for radioxenon detection and making it less complex it would be possible to manufacture very reliable and less costly systems compared to the ones used today. The resulting decreased sensitivity of the individual systems would be more than compensated by increasing the number of measurement nodes, and placing them in an array configuration. Such arrays would have the possibility to substantially increase the verification capability of a noble gas network. A new project at FOI has been launched to develop a prototype system that can be used in such arrays. Project status and plans, including recently performed simulations, will be presented.

Primary author: RINGBOM, Anders (Swedish Defence Research Agency (FOI))

Presenter: RINGBOM, Anders (Swedish Defence Research Agency (FOI))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Series Reconstruction as a Preventive Maintenance Tool for the Radionuclide IMS Data

The Article IV section B the CTBT defines the IMS, which is responsible for verifying compliance with the Treaty. Data generated by the IMS and processed by the IDC are often fragmented because some data is below the detection limit. This implies that they need to be reconstructed using autoregressive models for more advanced statistical analysis. The use of advanced statistic allows monitoring the evolution of activity concentration in a more accurate way before, during and after a radiological event. In addition, the statistical characterization of the time series serves as an indication of a possible malfunction in the measuring station, which allows to anticipate the preventive actions without losing quality in the operation of the network and decrease maintenance costs. This methodology has been carried out for the ^{133}Xe radionuclide registered at the RN38 station (Takasaki, Japan) from the 1st of August to the 31st of October, 2016. Preliminary results on the time evolution of the signal positive allowed to establish the baseline for ^{133}Xe , to detect the significant high concentration events and to obtain time trends that could be related to the data quality and equipment output.

Primary author: BENITO DIAZ, Gonzalo (CIEMAT)

Presenter: BENITO DIAZ, Gonzalo (CIEMAT)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

IDC Re-Engineering Project, Phase 2

The International Data Centre (IDC) is conducting a three-phase, multi-year re-engineering project to improve capabilities and long-term maintainability of their system for acquisition, processing, and analysis of seismic, hydroacoustic, and infrasonic (SHI) data. The primary goal of phase 2 of this project (just completed) was to specify and design a new software architecture that will meet the needs of the IDC and facilitate extensibility to meet anticipated future needs. Work started with eliciting the requirements for the re-engineered system, in the form of specifications, use cases, and storyboards that define the desired features and behaviors of the future system. High-level architectural concepts enable features such as improved configurability, comprehensive capture and use of data provenance to provide insight into processing results, and extensibility to accommodate new processing and analysis components based on innovations emerging from the monitoring research community. An important enhancement that will enable this extensibility is the consideration of a new, object-oriented data model for use by all processing components in the system. Together, the various requirements artifacts and the architecture baseline will enable development of a consistent, reliable system to meet the needs of CTBT member states for decades to come.

Primary author: TOMUTA, Elena (CTBTO)

Presenter: TOMUTA, Elena (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Provided GIS Data Sources for Treaty Verification

The IAEA's Division of Information Management regularly uses geographic information for assessment of correctness and completeness of States' declarations, which is essential to soundly draw safeguards conclusions. The data model guidelines (1) for providing information set forth in the Model Additional Protocol (AP) may also provide for other verification regimes with a proven, real-world example when designing criteria for geographic information provided by States parties. Within the IAEA, a joint Member State Support Programme task on Digital Declaration Site Maps has already demonstrated the viability of submitting declaration site maps digitally in a spatial format. IAEA's new input system for AP declarations, Protocol Reporter 3, supports the integration of digital maps. A next step in this pilot project is to evaluate the technical changes required to implement a new submission process using a secure, web-based Geographic Information System (GIS) for a few selected sites in Germany. Modern GIS portals hold the potential to assist in sharing information and enhancing collaboration within international verification organizations or between organizations and State parties. 1. The IAEA's 2004 Guidelines and Format for Preparation and Submission of Declarations Pursuant to Articles 2 and 3 of the Model Protocol Additional to Safeguards Agreements, Service Series 11

Primary author: RUTKOWSKI, Joshua (Forschungszentrum Jülich)

Presenter: RUTKOWSKI, Joshua (Forschungszentrum Jülich)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Diffusion Maps for Seismic Event Characterization in Israel

In this work, we apply an advanced machine learning technique named diffusion maps for automatic earthquake-explosion discrimination and for explosion classification in Israel. The proposed methods construct a low-dimensional model of the original data. In this new low-dimensional space discrimination and classification analysis is carried out. In addition, the new construction allows visualizing the pair wise distances between all of the events. The method is applied for discrimination and classification of seismic data that was recorded at the Israel Cooperating National Facility (CNF) stations. These stations are defined by the Comprehensive Nuclear-Test Ban Treaty and are built according to the same standard as the IMS stations. The algorithm's performance is demonstrated on several seismic data sets, high accuracy discrimination and classification rates are achieved. For instance, the diffusion-based algorithm provides a correct discrimination rate that is more than 90% for a data set comprising seismic events from the Dead Sea area. These events were taken from the seismic catalog of the Geophysical Institute of Israel for years 2004-2014 with duration magnitudes $M_d \geq 2.5$.

Primary author: BREGMAN, Yuri (Soreq Nuclear Research Center)

Presenter: BREGMAN, Yuri (Soreq Nuclear Research Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

for Coping with Large Aftershock Sequences

Aftershock sequences following major earthquakes present great challenges to seismic bulletin generation. The analyst resources needed to locate events increase with increased event numbers as the quality of underlying, fully automatic, event lists deteriorates. While current pipelines, designed a generation ago, are usually limited to single passes over the raw data, modern systems also allow multiple passes. Processing the raw data from each station currently generates parametric data streams that are later subject to phase-association algorithms which form event hypotheses. We consider a major earthquake scenario and propose to define a region of likely aftershock activity in which we will detect and accurately locate events using a separate, specially targeted, semi-automatic process. This effort may use either pattern detectors or more general algorithms that cover wider source regions without requiring waveform similarity. An iterative procedure to generate automatic bulletins would incorporate all the aftershock event hypotheses generated by the auxiliary process, and filter all phases from these events from the original detection lists prior to a new iteration of the global phase-association algorithm. We demonstrate proof-of-concept using the 2015 Gorkha sequence, Nepal, recorded on IMS stations.

Primary author: KVÆRNA, Tormod (NORSAR)

Presenter: KVÆRNA, Tormod (NORSAR)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

of Multi-Parameter Borehole Instrumentation System (Marsite)

We present two year results obtained from the integrated multiparameter borehole system at Marsite. The very broad band (VBB) system have been operating since installation in November 2014; one year in a water filled borehole and one year in a dry Borehole. from January 2016. The real time data has been available to the community. The two Borehole environments are compared showing the superior performance of dry borehole environment compared to water filled for a very broad band (VBB) seismometer. The practical considerations applied in both borehole installations are compared and the best borehole practical installation techniques are presented and discussed. The data is also compared with a surface 120 second broad band sensor and the seismic arrays with in MarSite region. The very long term performance, (one year data in a dry hole) of the VBB Borehole seismometer and the Dilatometer will be presented. The high frequency performance of the VBB seismometer which extends to 150 Hz and the dilatometer are compared characterising the results from the dilatometer.

Primary author: OZEL, Oguz (Belbasi Nuclear Test Monitoring Center)

Presenter: OZEL, Oguz (Belbasi Nuclear Test Monitoring Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

to the CTBTO IDC Radionuclide Processing Pipeline for Particulate Samples Achieving Significant Improvement of Automatic Products

Software development efforts at the CTBTO International Data Centre (IDC) for particulate data processing over the recent years focused on boosting the consistency of automatic results and reducing the work load on Analysts in interactive mode. The presentation compiles the key enhancements and new features of the software modules for particulate sample data as deployed in IDC Operations and released in NDC-in-a-Box package. Deployed improvements covered various components of the radionuclide pipeline: automatic processing software application, interactive review tools as well as database schema and configuration. IDC products are also enhanced accordingly. The first part of the presentation aims at introducing the key enhancements: (a) a new feature for automatic discrimination between Tc-99m and Ge-75m, (b) a new module for automatically commenting out non-sample peaks, (c) optimizing the key lines of several CTBT relevant radionuclides in the IDC database library, and (d) implementation of a new module for automatic subtraction of background contribution to sample spectra. The second part of the contribution illustrates the way these software solutions have considerably improved the overall picture in terms radionuclide background characterization at particulate stations of the International Monitoring System (IMS) network.

Primary author: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Presenter: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Tropical Cyclones Using Seismic and Infrasonic Stations Surrounding the South-Western Indian Ocean

In the South-West Indian Ocean, tropical cyclones occur from December to April. As they move over the ocean, cyclones generate strong swells that may represent large sources of microseismic noise (secondary peak at 0.1-0.35Hz) and infrasound noise (microbaroms at 0.2Hz). A dominant source of noise in the oceans is indeed generated by standing waves, issued from the interaction of two swells in opposite directions. Such standing wave create Rayleigh waves that propagate in the oceanic crust and recorded by seismic stations (Longuet-Higgins, 1950). In the meantime, these stationary waves generate microbaroms' sources that travel in the atmosphere and well recorded by infrasound stations (Benioff & Butenberg, 1939). We combined these two independent observables of stationary waves for tracking Bingiza tropical storm (February 2011). We used seismic stations from the Volcano Observatory of the Piton de la Fournaise (OVPF) on La Réunion Island and IMS infrasound data from CTBTO. The azimuths of the microseismic source regions are determined by polarization analyses (Schimmel et al., 2012). The microbarom sources are analyzed with WinPMCC4.3 software (CEA/DASE2010) based on Correlation Method (Cansi, 1995). As result, we observed a clear signature in both seismic and infrasound noise sources that show good agreement with the cyclone track.

Primary author: ANDRIANAIVOARISOA, Jean Bernardo (Institute and Observatory of Geophysics of Antananarivo (IOGA))

Presenter: ANDRIANAIVOARISOA, Jean Bernardo (Institute and Observatory of Geophysics of Antananarivo (IOGA))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Investigations of the National Data Centre Preparedness Exercise 2015 (NPE2015)

The National Data Centre Preparedness Exercises (NPE) are regularly performed dealing with fictitious treaty violations to practice the combined analysis of CTBT verification technologies and national technical means. These exercises should help to evaluate the effectiveness of analysis procedures applied at NDCs and the quality, completeness and usefulness of IDC products. The NPE2015 is a combined radionuclide-waveform scenario. Fictitious particulate radionuclide and radioxenon measurements at IMS stations were reported to the international community. The type of isotopes and concentrations could arise from an underground nuclear explosion. The task is to identify the scenario behind the provided data. The source region and time domain of a possible treaty violation was determined from backtracking ATM. A time slot in October and a region around the mining area Lubin could be identified. The seismicity of the determined source region was investigated to identify events which cannot be classified as natural or induced within the relevant time interval. The comparison of spectral characteristics and a cluster analysis was applied to search for non-characteristic events within a number of known induced events in the area. The results reveal that all candidate events are part of cluster with a minimum of seven events with comparable signature.

Primary author: GESTERMANN, Nicolai Johannes (Federal Institute for Geosciences and Natural Resources (BGR))

Presenter: GESTERMANN, Nicolai Johannes (Federal Institute for Geosciences and Natural Resources (BGR))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Analysis Methods to Identify Radioxenon Isotopes

Four isotopes are of interest for radioxenon monitoring, Xe-135, Xe-133, Xe-133m, and Xe-131m. Many of the detectors in the International Monitoring System (IMS) use β - γ coincidence detection: where NaI(Tl) is the gamma detector and the plastic cell is the source container and beta detector. To characterize the source of radioxenon, ratios between the isotopes are used, which require accurate quantification of each isotope. However, the use of low resolution plastic scintillators for beta detection causes significant challenges for quantifying the metastable isotopes, whose emissions overlap with Xe-133 emissions. This overlap makes it difficult to identify metastable isotopes when Xe-133 is present, which happens frequently. An alternative method of quantifying radioxenon is presented. In this method, the Xe-131m and Xe-133m energy spectra are evaluated through β -anti- γ detection, whereby a signal is detected via beta measurement but vetoed if a simultaneous gamma signal is detected. This exploits the nuclear emissions differences between the β - decay of Xe-133, and the internal conversion decay of the metastable isotopes; all three isotopes are still detected; but our method suppresses Xe-133 signal relative to Xe-131m and Xe-133m signals. We show new experimental and simulated data from a NaI(Tl)-plastic scintillator system.

Primary author: SIVELS, Ciara (University of Michigan)

Presenter: SIVELS, Ciara (University of Michigan)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

in IMS Infrason... Array Geometry Tools

A well planned array geometry is fundamental in the construction of state-of-the-art infrason... arrays. The International Monitoring Division (IMS) has made a concerted effort to create new and improved tools to ply, when designing and planning the construction of a new and existing IMS network infrason... station. When using the tool, the following is considered: Number of array elements, array area, minimum distance between elements, irregular placement and omni-directionality. The loss of individual elements is also taken into account, while still minding all initial requirements. The projection of array geometries onto geographical coordinates allows IMS engineers to not only plan ahead, but to also use these tools in the field and make adjustments on the fly. Though designed for initial array planning, these tools can also be used when considering the relocation of elements at existing infrason... arrays. The new planning technique has been recently implemented in the design of IS01, Argentina and tested on site with promising results. Moving forward, the focus of these design tools remains the optimization of relevant infrason... detections at IMS stations, while bringing convenience into station design and/or upgrades.

Primary author: ROBERTSON, James Stuart (CTBTO)

Presenter: ROBERTSON, James Stuart (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Re-Engineering Phase 2: Analysis Interface Improvements

A major focus of Phase 2 of the IDC Re-engineering project has been the establishment of the requirements for the re-engineered system. This process included the development of detailed User Interface Storyboards (UIs) that graphically depict the basic layouts of the new user interfaces and capture key user interactions. Development of these UIs in close collaboration with expert users is crucial to ensure that designers and developers have a complete understanding of the full range of functionality the interfaces must support before coding begins. This poster presents mockups of several of the new data analysis interfaces and describes their use in analysis scenarios.

Primary author: TOMUTA, Elena (CTBTO)

Presenter: TOMUTA, Elena (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Geophysical Network OVSICORI and Seismic Stations of IMS Network CTBTO

The integration of stations of the global network IMS of the CTBTO to the OVSICORI-UNA geophysical monitoring network including auxiliary and primary seismic stations near Costa Rica such as: PCRV, ROSC, BDFB. The integration of IMS stations into the local network is done with the SeisComp3 acquisition system located at the National Data Centre in Costa Rica and integrated into the system of acquisition, automatic localization, processing of seismic events in Antelope, this for events greater magnitude to have a better location with stations far away from the Costa Rican border, examples: Nicoya earthquake (2012) and Cinchona earthquake (2009). A redundant data communication system is provided to the IMS auxiliary seismic station AS025 in order to have greater availability, if CGI telecommunication system of the CTBTO fails, a WIFI-type system can be used to send directly to OVSICORI and to the NDC and then to the IDC. All data from the OVSICORI seismic monitoring stations and the stations included by the CTBTO NDC and the AS025 auxiliary seismic station located in Juntas de Abangares, Costa Rica are data that is shared internationally by IRIS Data Services for the Incorporated Research Institutions for Seismology (IRIS).

Primary author: VILLALOBOS VILLALOBOS, Hairo (Observatorio Vulcanológico y Sismológico de Costa Rica (OVSICORI))

Presenter: VILLALOBOS VILLALOBOS, Hairo (Observatorio Vulcanológico y Sismológico de Costa Rica (OVSICORI))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Selection and Preparation of Waveform Templates for Cross-Correlation Detection of Seismic Events

In this paper we present the process of selection and preparation of waveform templates for the cross-correlation detection of seismic events. Selection of the template based on parametric characteristics of the set of previously received records of seismic events in a given region. Parametric characteristics includes the list of recorded seismic phases, the parameters of the autocorrelation function, the bandwidth-duration product of the signal, the level of anthropogenic noise, amplitude and spectral characteristics of the noise before the begin of the signal, the signal to noise ratio in different frequency bands in the signal. We can prepare the set of the templates based on one single record of the seismic event, differing in length and a set of seismic phases. We introduce the template quality metric is computed by its parametric indicators. The final template selection is made on the results of the quality metrics match. We designed the software by Python programming language for parametric analysis of waveform templates. We considered using of this software for the recordings made by Mikhnevo small aperture seismic array of Institute of Geosphere Dynamics, Russian Academy of Sciences.

Primary author: SERGEEV, Sergei (Institute of Geosphere Dynamics, Russian Academy of Sciences)

Presenter: SERGEEV, Sergei (Institute of Geosphere Dynamics, Russian Academy of Sciences)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Seismological Network and Its Challenges

Due that Colombia has steep topography, the seismological data transport has been a challenge in order to provide it in Bogotá - Colombia, where the Colombian Seismological Network from Colombian Geological Survey (SGC) has its headquarter. In 1993, when it began to deploy infrastructure and seismological equipment, the telecommunications in the country had had an incipient development, so the robustness and strongest way to reach wide country for 24/7 earthquake monitoring was by satellite. However, the technology evolution has made the Colombian telecommunications companies reach far places and become them more reliable. This work has the purpose of test and analyze those technologies, including Internet (LAN, WAN, VPN) and cellular (MESH, VPN) in order to implement them in the earthquake monitoring; Those kind of technologies should have stable latencies, connections, and no data lost specially when an important earthquake occurs. The result of this test and analysis allow to know how those technologies can be used in earthquake monitoring either critical or post processing seismological stations and densify the wide country, improving the magnitude and location accuracy.

Primary author: GOMEZ GOMEZ, Andres Felipe (Servicio Geologico Colombiano - SGC)

Presenter: GOMEZ GOMEZ, Andres Felipe (Servicio Geologico Colombiano - SGC)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Portable High Purity Germanium Detectors for Use in Stand Alone Configuration

A low weight, portable High Purity Germanium detector, n-type, 55% efficiency has been tested and characterised for the purpose to evaluate its use in an OSI field laboratory. This detector has been proved reliable and robust in field conditions but some further tests need to be performed in order to assess its reliability and efficiency in a laboratory like configuration. One main aspect to be considered is the need of a dedicated shielding in order to achieve a lower background signal and to identify small activity in the samples. The shielding structure has been designed and implemented in a horizontal configuration and the performances of the detectors have been measured. Different configurations and set up will be discussed in order to verify the suitability of this type of detectors for the OSI field laboratory.

Primary author: RIZZO, Antonietta (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Presenter: RIZZO, Antonietta (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

'CARD': Characterization of Adjoint Response for Ge Detectors

Gamma ray spectroscopy is an important tool in ensuring treaty verification and compliance. In employing this tool, it has proven useful to completely characterize the detector efficiency that is yielded via deterministic adjoint radiation transport analysis of typically fielded germanium gamma detectors. The adjoint transport methodology can be readily utilized to produce a high fidelity mapping of the precise detector efficiency for any gamma ray striking a detector originating from any location surrounding the detector at any specific gamma energy. This mapping can prove to be very important in understanding the subtle effects of source placement and sample geometry on the detector efficiency, and thus the overall sensitivity of the detector measurement and detectable quantities being measured, etc. In this paper, we computed the detector efficiency using the 3-D deterministic Sn code PENTRAN to solve the adjoint form of the Boltzmann radiation transport equation over a high resolution space-angle-energy grid (the "phase space") used to accurately describe a shielded 2" x 2" coaxial Germanium detector. Overall, we will demonstrate how a complete computational adjoint characterization of a radiation detector's response over the space-angle-energy grid minimizes the uncertainty in counting any sample.

Primary author: SJODEN, Glenn (U.S. Air Force Technical Applications Center)

Presenter: SJODEN, Glenn (U.S. Air Force Technical Applications Center)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Noise Reduction Systems in the International Monitoring System Infrasound Network

The objective of this poster is to present the efforts made by the Provisional Technical Secretariat (PTS) over the last six years to assess and improve the robustness and efficiency of Wind Noise Reduction Systems (WNRS) used within the IMS (International Monitoring System) infrasound network. This work includes modelling of the frequency response of the different types of WNRS. It also includes the investigation and testing of new materials / components to improve the robustness of the WNRS. Efforts were also made to better adapt WNRS to the environment through the design of flexible systems. Finally, WNRS design was also enhanced to reduce manufacturing, installation and maintenance costs, as well as to extend their life cycle.

Primary author: KRAMER, Alfred (CTBTO)

Presenter: KRAMER, Alfred (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

-Calibration of Airborne and Ground Based Gamma Radiation Survey Techniques Under On-Site Inspection Conditions

This study presents the method of work and results obtained during a field campaign deploying various on-site inspection (OSI) equipment techniques in order to cross-calibrate the performance of OSI gamma radiation sensors. Airborne and ground-truth survey techniques are deployed over large areas, whereas in-situ high resolution gamma spectroscopy measurements are conducted at specific locations, and supported by environmental soil and vegetation sampling and analysis at the field laboratory. The deployment region including the calibration line is part of the Allentsteig area, Austria, which has been previously characterised for its sedimentary composition. Results collected and lessons learned will be used to build an improved framework for future field exercises aimed at periodically monitoring performance and cross-calibrating field instruments prepared for an on-site inspection. Such capability also provides opportunities for practicing and training surrogate inspectors under realistic field scenarios.

Primary author: BLANCHARD, Xavier (CTBTO Preparatory Commission)

Presenter: BLANCHARD, Xavier (CTBTO Preparatory Commission)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Xe Radionuclides Measurements on Noble Gas System with a Long Cycle of Sampling

• The model connecting results of measurement of Xe-131m, Xe-133m, Xe-133, and Xe-135 on noble gas system of ARIX type with a long cycle of sampling with average values of concentration activity of these radionuclides in atmospheric air is offered. The model considers: - probable changes of volumetric activity Xe radionuclides in atmospheric air during sampling; -Xe radionuclides decay in an air sample during its fixation in an adsorber; -accumulation Xe-133 at decay Xe-133m in an adsorber; -variation Xe concentration activity during sample processing. The result of these processes in the model is implemented using 5 special coefficients B and allows to improve the accuracy of the results. The numerical values of the coefficients B and the method of their calculation are presented.

Primary author: DUBASOV, Yurii (Khlopin Radium Institute)

Presenter: DUBASOV, Yurii (Khlopin Radium Institute)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Hyperspectral Imaging: Hand-held Image Acquisition for Ground Inspection

Multispectral imaging techniques have been tested in OSI related CTBTO activities. The Treaty permits the use of hand-held multispectral cameras during OSI ground inspections. Spectral scanners have successfully mastered several applications over broad spectral ranges; however hand-held scanning has its limitations in mobility and flexibility. To overcome these limitations, snapshot imaging or a spectral frame camera technique can be used. Such a device captures the entire hyperspectral dataset/image during a single integration (one shot takes about 1 ms). During in-field and close-field applications weight, speed and power uptake are important considerations. In the context of an agricultural research project, a hand-held snapshot spectral camera with more than 100 spectral channels in the visible and near infrared region was tested. Different spectro-phenological parameters were inspected. The usability, data delivery, spectral data quality and spectral documentation potential of the camera were evaluated. It was concluded that it provides a rapid and easy-to-use data set for spectral mobile mapping. It worked as a portable non-invasive and non-destructive sampling method with an extreme short data acquisition time – akin to taking a simple digital photograph. Data processing turnaround times were of the order of minutes enabling rapid phenological and physiological characterisation of vegetation cover.

Primary author: SZALAY, Kornél (Institute of Agricultural Engineering (NAIK))

Presenter: SZALAY, Kornél (Institute of Agricultural Engineering (NAIK))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Re-Engineering Phase 2: Software Architecture and Data Model

The second phase of the IDC Re-engineering project has developed a software architecture to guide development of the next-generation IDC waveform processing system. The architecture describes system-wide principles and features desirable in the new system, including definitions of common system patterns, fundamental mechanisms (e.g. data storage, processing control), and interfaces that abstract algorithm implementations. A new conceptual data model is proposed that represents station reference information, processing configuration, and system results in a way that is consistent with system principles such as extensibility, flexibility, data provenance, and isolation of concerns. This presentation describes architectural elements and data model concepts relevant to the addition of new processing and analysis components to the system.

Primary author: TOMUTA, Elena (CTBTO)

Presenter: TOMUTA, Elena (CTBTO)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Method to Improve Relative Earthquake Locations Using Surface Waves

Current earthquake-location capabilities provide no better than 25-km precision in remote areas, which is insufficient for many investigations. Surface waves, with their slow horizontal propagation speeds and high signal strength even at teleseismic distances, contain information on earthquake location that can improve epicenter determinations. Earlier work by other authors has demonstrated the possibility of precise relative location by cross-correlation of Rayleigh waves for pairs of earthquakes with the same focal mechanism and depth, and Cleveland and Ammon (2013) have recently demonstrated success with this approach for multiple events with similar mechanisms and a double-difference relocation method. For earthquakes with arbitrary focal mechanisms, we extend earlier approaches to improve relative locations for events beneath oceans and in subduction zones (where most seismic activity occurs). We correct inter-event cross-correlation functions of Love and Rayleigh surface-wave signals for differences in focal mechanisms and depths before calculating cross-correlation delay times and relative locations. Experiments on full synthetic seismograms indicate that the algorithm results in improved locations in the presence of realistic uncertainties in earthquake focal depths and mechanisms. We present results from the synthetic experiments and applications to real data, using earthquakes from the Global CMT catalog representing different tectonic environments.

Primary author: HOWE, Michael (Columbia University)

Presenter: HOWE, Michael (Columbia University)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

IMS Seismic Network Used to Support and Mitigate Volcanic Risk with One Single Station Method

It is well known that one of the more accurate methods to predict a possible volcanic eruption is by seismic monitoring. The ideal way to do it is complementing and matching the seismic data with other types of monitoring like infrasound, soil deformation measured by GPS, relevant chemistry and mineral variation in the hydro-thermal system around the volcano, heat measurement of the ash plumes and the volcanic body, etc. But what happens when resources are not enough and there is just a single seismic station in the vicinity of the volcano? Is it possible to record seismic activity with just one sensor and obtain an acceptable location and confident parameters of the events recorded? In this work, it will be discussed how some of the IMS seismic sensors that are close to active volcanoes or the ones that have the potential to be active, can make the role of early warning in case of poor or null monitoring in particular volcanic regions. This will be explained with real cases of study that have happened in some volcanoes around the world.

Primary author: GUTIERREZ JIMENEZ, Aaron Joseph (CTBTO Preparatory Commission)

Presenter: GUTIERREZ JIMENEZ, Aaron Joseph (CTBTO Preparatory Commission)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Gamma Imager for CTBT On-Site Inspection

Gamma-radiation survey is an essential component of an on-site inspection under the Comprehensive Nuclear-Test-Ban Treaty (CTBT - 69.c). The Silicon photomultiplier-based Compton Telescope for Safety and Security (SCoTSS) provides mobile-survey isotope detection, alarming and identification, as well as concentration and dose-rate measurements for contour mapping. In addition, SCoTSS can produce an image of the radiation emitters in the environment, overlaid on an optical photograph. For operators, this is a graphic and intuitive product. The imager is especially useful in situations where restrictions apply to the available airspace. SCoTSS can show a gamma-ray image of an area to which inspectors are restricted from entry (as was experienced during IFE 2014). SCoTSS is a rugged instrument making use of field-proven crystalline scintillator gamma detectors with state-of-the-art miniaturized light collection and custom electronics. Operation and readout are identical to that already in use in CTBT on-site inspection aerial survey so that SCoTSS can function as a drop-in replacement. It is modular, available in a small form suitable for backpack survey and a large form suitable for aerial survey. In this presentation we will provide a review of the performance of the SCoTSS imager with particular attention to scenarios relevant to CTBT on-site inspection.

Primary author: SAULL, Patrick (National Research Council Canada)

Presenter: SAULL, Patrick (National Research Council Canada)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

-New Generation: Deployment, Operation and Performances

CEA developed for many years systems that enable to detect radioactive noble gas from civilian and military nuclear activities. It leads to the patent (1999) and the industrialization (beginning of 2000's) of the « Système de Prélèvement d'Air et de détection en Ligne Automatique des radioXénons atmosphériques » (SPALAX). After several intermediate improvements especially regarding ovens, software and plc, CEA launch in 2013 the SPALAX-New Generation project which consists especially in the use of a new adsorbent material and a new β - γ spectrometer (Si-PIN coupled with a HPGe). The evolution leads to a huge increase of the xenon production (~ factor 4) and overall sensitivity (~ factor 4 to 40 depending the isotopes). These new performances enable to increase the sampling frequency from 24h to 8h by keeping very low detection limits: < 0.3 mBq.m⁻³ for all the four relevant isotopes. Moreover, the high resolution of the new spectrometer enables to easily separate the contribution of each isotope without corrections. The industrialization of the system is achieved by Cegelec Defense and the first prototype will be released in 2017. This presentation aims at given an overview on deployment, operation and performances of the SPALAX-NG system.

Primary author: TOPIN, Sylvain (Commissariat à l'énergie atomique et aux énergies alternatives (CEA))

Presenter: TOPIN, Sylvain (Commissariat à l'énergie atomique et aux énergies alternatives (CEA))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Insights into the Dead Sea Transform Fault Seismicity Gained from the IFE2014 Seismological Recordings

In this study we apply a newly developed automatic detection and location method to a dataset compiled for the period of the IFE14 exercise in 2014 in Jordan. The aim is to compare results of the new techniques to outcomes of the exercise and to discriminate better between natural and artificial weak events in the Dead Sea basin. We complemented the IFE14 dataset by 5 permanent broad band, 8 short period stations and a temporary array of 15 stations. The analysis is based on coherency analysis of traces, stacked using synthetic P and S phase arrivals, calculated for each grid node of a discretized volume covering the region under investigation. In order to further enhance the detection performance, we combine this method with standard array techniques. The onset detections and the crude localizations are refined in a subsequent step employing a different characteristic function based on an STA/LTA window. We compare the detection performance of our method with that of the IFE14 focusing on the magnitude of completeness. We are able to detect and locate several local small events in the study region confirming previous results on the complex transtensional setting of the Dead Sea basin. Acknowledgements: DESERVE Project

Primary author: KRIEGEROWSKI, Marius (GFZ German Research Centre for Geosciences)

Presenter: KRIEGEROWSKI, Marius (GFZ German Research Centre for Geosciences)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

SAUNA III Project

In 2014 a development project – SAUNA III - was started at FOI with the goal to substantially improve performance and capability of the SAUNA II system, which currently is installed at 17 IMS locations. The project plans were presented at the 2015 S&T conference. At the end of 2016, the SAUNA III prototype was ready. Compared to SAUNA II, the SAUNA III prototype operates with increased air sampling capacity, time resolution (6 hours), detection sensitivity and stability, and user friendliness. The presentation will include a description of performed modifications and resulting system capability.

Primary author: RINGBOM, Anders (Swedish Defence Research Agency (FOI))

Presenter: RINGBOM, Anders (Swedish Defence Research Agency (FOI))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Generation of Synthetic Radionuclide Spectra to Support the NDC Preparedness Exercise NPE15

As part of the 2015 NDC Preparedness Exercise (NPE15), the production of a large number of synthetic spectra was required both for Noble Gas and particulates technologies. The NPE15 control team requested the CTBTO to generate the largest portion of the particulate spectra with specified nuclides of interest and activity concentrations. Some spectra contain a very large number of radionuclides (up to 80) and with very high activities. This presentation describes the key methodological aspects and tools used by the CTBTO to meet these high requirements: (a) optimization of the Monte Carlo model of VGSL (Virtual Gamma Spectroscopy Laboratory) tool with detailed simulation parameters (specific IMS detector, shielding and source geometry), (b) simulation of spectra matching the high activities of the CTBT relevant nuclides as provided by the control team and (c) combination with actual sample spectra as sent by IMS stations, which represents the station background conditions (d) creation of SPHD files in IMS 2.0 format (e) test of samples with NDC-in-a-box automatic processing and interactive analysis software. The result is a set of 21 spectra that were used by the participants of the NPE15 and that can in future be used for training and testing purposes.

Primary author: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Presenter: GHEDDOU, Abdelhakim (CTBTO Preparatory Commission)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Search and Fitting Techniques for Analysis of the Radioxenon Beta-Gamma Coincidence Spectra

Beta-gamma coincidence monitoring systems are one of the technologies of the noble gas component of the International Monitoring System (IMS). The coincidence spectra are analysed at the International Data Centre (IDC) using the so called net count calculation method (NCC) based on a number of Regions of Interest (ROI) in the coincidence spectrum. In order to enhance the reliability of analysis results, an alternative method - briefly called 2D-fitting method - has been developed to be used in parallel with the NCC method. This applies peak search and peak fitting techniques on the beta and gamma projections of the coincidence spectrum. The idea is to reduce the rate of false positives in reported results, using the distinct peak structures of the radioxenon isotopes, especially the coincidence beta peaks of the metastable Xe-131m and Xe-133m. As a first step, the fitted peak areas instead of the net counts in each ROI are determined but the same energy and efficiency calibration data of the NCC method is used. This contribution presents the analysis method and results for spike samples as well as for high level noble gas samples from the IMS beta-gamma coincidence based Noble Gas systems.

Primary author: LIU, Boxue (CTBTO Preparatory Commission)

Presenter: LIU, Boxue (CTBTO Preparatory Commission)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

III New Beta Detector Performance

To achieve the design requirements for the SAUNA III radio-xenon measurement system a new beta detector cell has been developed. The new detector was designed to handle the considerably larger sample size and the change in carrier gas from helium to nitrogen, with maintained or improved detector sensitivity and energy resolution. The first detectors of the new design have been produced and installed in the SAUNA III prototype and measurement results can be compared with the Monte-Carlo simulations that were used in the design of the new detector. The detector performance has been studied with respect to gas composition, sample size and cell pressure. The achieved minimum detectable concentration (MDC) for the different xenon isotopes when used in a SAUNA III system will also be presented.

Primary author: FRITIOFF, Tomas (Swedish Defence Research Agency, FOI)

Presenter: FRITIOFF, Tomas (Swedish Defence Research Agency, FOI)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

-borne Video Processing and Reporting Techniques for Imagery Analysis

Monday, June 26, 2017 11:15 AM (15 minutes)

The availability of space-borne high resolution full-motion video such as Urthcast or Google's Terra Bella offer new data sources for imagery analysts. These sensors capture up to 90 seconds of video over an area of interest in high resolution video. The videos are analyzed in industry-standard imagery exploitation software using specialized tools specifically developed for video analysis. Video may complement or enhance existing treaty verification analysis by offering more information for visual interpretation as well as offering additional input data to create digital elevation models. Because video may be used to show activities and motion on the earth's surface, it may offer enhanced reporting methods for analysts. CTBTO's International Monitoring System may use these datasets to cross-reference observations and the On-Site Inspection Division may complement this with their existing use of remote sensing. This presentation will highlight some of the existing processing and interpretation techniques developed for satellite borne video. Preliminary results show that elevation models from SkySat video imagery can recover height information of industrial buildings with a similar quality as satellite-borne sub-meter very high resolution optical stereo pairs.

Primary author: RUTKOWSKI, Joshua (Forschungszentrum Jülich)

Presenter: RUTKOWSKI, Joshua (Forschungszentrum Jülich)

Session Classification: T3.3 Remote Sensing, Satellite Imagery and Data Acquisition Platforms

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Transport Modelling and Radionuclide Analysis for the NPE 2015 Scenario

For practicing verification procedures and interplay between the International Data Centre (IDC) and National Data Centres, NDC preparedness exercises (NPE) are regularly performed with selected events of fictitious CTBT-violation suspicion. The German NDC's expertise for radionuclide analyses and operation of station RN33 is provided by the Federal Office for Radiation Protection (BfS) while Atmospheric Transport Modelling (ATM) for CTBT purposes is performed at the Federal Institute for Geosciences and Natural Resources (BGR) for the combination of radionuclide results with waveform evidence. The radionuclide part of the NPE 2015 scenario is tackled in a joint effort by BfS and BGR. First, the NPE 2015 spectra are analysed, fission products are identified, and respective activity concentrations are derived. Special focus is on isotopic ratios which allow for source characterization and event timing. For atmospheric backtracking the binary coincidence method is applied for the first affected samples to determine the area with high atmospheric release probability. The ATM results together with the radionuclide fingerprint are used for identification of waveform candidate events. Comparative forward simulations of atmospheric dispersion for candidate events are performed. Finally the overall consistency of various source scenarios is assessed and a fictitious government briefing on the findings is given.

Primary author: ROSS, Jens Ole (Federal Institute for Geosciences and Natural Resources (BGR))

Presenter: ROSS, Jens Ole (Federal Institute for Geosciences and Natural Resources (BGR))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Detection in Remote Optical Imagery

Remote optical imagery, including panchromatic, multispectral, and infrared, can be acquired during on-site inspection (OSI) to search for anomalies and artifacts. Imagery acquired during an OSI can provide unique information that may increase an inspection team's efficiency and effectiveness at prioritizing regions of interest within an inspection area. For example, optical imagery can reveal large scale spatial or spectral patterns that may be indicative of activities relevant to the OSI, but are not directly apparent from ground based visual observation or other inspection techniques. Although imagery is a powerful tool, processing and analyzing large volumes of optical imagery that can be produced from surveying an inspection area can be computationally and manually intensive. In the case of OSI, the situation is compounded by Comprehensive Nuclear-Test-Ban Treaty (CTBT)-imposed manpower and time limitations. Automated processing and analysis techniques offer a means to enhance the utility of remote optical imagery for OSI by increasing the throughput of OSI-relevant information while reducing manual processing requirements. This work examines automated statistical techniques for anomaly detection in remote optical imagery. These techniques can be used to generate anomaly maps of areas that differ significantly from background, thereby reducing the regions to be reviewed or inspected manually.

Primary author: ANDERSON, Dylan (Sandia National Laboratories, Albuquerque, NM, USA)

Presenter: ANDERSON, Dylan (Sandia National Laboratories, Albuquerque, NM, USA)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

of Si-PIN Diodes Detection Unit for Noble Gas Systems ARIX

• New detecting unit of conversion electrons was made in new geometry of 10 pieces Si-PIN diodes, disposed in an aluminum cylinder of height 35 mm and diameter 18 mm (~8cm³ volume) . Si-PIN detectors with a thickness of ~0.45 mm and an active area of ~1 cm² were used. The parameters of the created detection unit was tested using gas that contains all four Xe radionuclides. New development of detection unit allowed to obtain the energy resolution for conversion electrons ^{131m}Xe equal 15 keV. The real effectiveness of registration was ~30 %. • NaI (Tl) -Si-PIN detector will be used for Noble gas system ARIX-4 for the IMS radionuclide station RUX-55 in Norilsk, Russia and mobile Noble gas system of high productivity RINGA-F. Estimations expected for the given Si-PIN detector unit of uncertainty measurement and the minimal detected activity of Xe isomers are compared to corresponding parameters of used scintillation beta-gamma coincidence detector

Primary author: DUBASOV, Yuri (Khlopin Radium Institute)

Presenter: DUBASOV, Yuri (Khlopin Radium Institute)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

for Recording the Full Seismic Wavefield

Monday, June 26, 2017 5:15 PM (15 minutes)

A demonstration experiment was recently conducted in the state of Oklahoma in the USA to evaluate strategies for observing the full seismic wavefield, for events at local to teleseismic distances and across a wide range of frequencies. The experiment tested new instrumentation and deployment strategies, producing an open-use dataset for evaluating a range of array processing techniques. The field effort, organized by the Incorporated Research Institutions for Seismology, used a crew of ~50 students and faculty to deploy 363 3-component “nodal” sensors along three seismic lines and in a seven-layer nested gradiometer array. The seismic lines spanned a region ~13x5 km. A broadband, 18 element “Golay 3x6” array was deployed with an aperture of approximately 5 km, encompassing the two nodal arrays. In addition, 9 infrasound stations were deployed to capture and identify acoustic events that might be recorded by the seismic array. We summarize the design considerations for the gradiometer and Golay arrays, along with preliminary analyses of the data. We examine the performance of the various types of instrumentation, including co-located surface and buried nodes, and co-located nodes and broadband stations. We present ground motion visualizations illustrating the wavefield complexity observed by these arrays.

Primary author: WOODWARD, Robert (Incorporated Research Institutions for Seismology)

Presenter: WOODWARD, Robert (Incorporated Research Institutions for Seismology)

Session Classification: T3.1 Design of Sensor Systems and Advanced Sensor Technologies

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

, Surface and Remote Observations of Legacy Nuclear Explosion Sites

Underground nuclear explosions (UNE) result in numerous signatures that manifest on a wide range of temporal and spatial scales. In case studies of legacy nuclear explosion sites, we demonstrate the scalar variability of surface and subsurface observables, briefly discuss current capabilities to locate, detect and analyze potential nuclear explosion locations, and explain how emergent technologies and amalgamation of disparate data sets will facilitate improved monitoring and verification. At the smaller scales, material and fracture analyses on rock collected from legacy UNE sites can be incorporated into predictive modeling efforts. Subsurface data collected includes gravity and magnetics. Spatial analyses of digital elevation models and orthoimagery show subtle surface topographic changes and damage at nearby outcrops. Additionally, it is possible to use the vegetation as a companion signature reflecting geologic conditions and showing subsurface effects. Aerial systems based on Red-Green-Blue (RGB) imagery, light detection and ranging, and hyperspectral imaging can allow for combined remote sensing modalities to perform pattern recognition and classification tasks. Finally, more remote systems such as satellite based synthetic aperture radar and satellite imagery are other techniques in development for UNE site detection, location and analysis. Together, these observations provide critical input for predictive modeling efforts.

Primary author: SUSSMAN, Aviva (Los Alamos National Laboratory)

Presenter: SUSSMAN, Aviva (Los Alamos National Laboratory)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Poster**

Testing Environment for Airborne Optical Sensors

Underground nuclear explosions can have detectable impacts on surface conditions. The nature of the impact can vary based on several factors including geology. Continuous or fragmented vegetation cover as well as exposed soil may reveal detectable changes related to this impact in the optical and thermal infrared region of the electromagnetic spectrum. With an appropriate sensor assembly, these changes may be detected as OSI-relevant anomalies. The use of multispectral imaging equipment at the surface and from the air is permitted during an On-Site Inspection to search for anomalies. In order to develop an optimal sensor array for overflights different hardware configurations have been tested. Airborne tests typically require a lead-in time and are costly while ground-based tests in a laboratory environment provides effective means of testing airborne cameras and sensors. In this paper, a testing environment is presented which comprises a modular sensor platform, adjustable illumination and height as well as a programmable sample tray. The system can be used to vary spatial and spectral resolution and sampling frequencies of different airborne sensors. This testing environment offers an opportunity for precise system calibration, fundamental research, system integration tests and hands-on training of airborne imaging in a time and cost-effective manner.

Primary author: SZALAY, Kornél (Institute of Agricultural Engineering (NAIK))

Presenter: SZALAY, Kornél (Institute of Agricultural Engineering (NAIK))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Sampling and Measuring Complex "SLARS"

Radioactive argon-37 borns in significant quantities when the neutrons of nuclear explosion interacts with the environment elements, its lifetime is optimum for registration on the far distance and during the long period after the explosion. Thereof argon-37 is one of key informative radionuclides who can be "witnesses" of infringements of the Comprehensive Nuclear-Test-Ban Treaty (CTBT). Owing to difficulties of separation, purification and measurement today all over the world there is not enough equipment, capable to register argon-37 at background level in atmosphere (1 mBq/m³), or in subsoil air (<20 mBq/m³), that demands for the on-site inspections (OSIs) applications. In the Khlopin Radium Institute was developed the conception and draft project of Mobile Sampling and Measuring Complex «SLARS» (abbreviation of Subsoil Liquefied ARGon Scintillations). It is intended for measurement of argon-37 in air sample of 2m³ volume on the level better than 20 mBq/m³ at exposition of 12 hours. Equipment complex "SLARS" is portable and easy operated and suitable for work in field conditions at OSI performance.

Primary author: PAKHOMOV, Sergei (Khlopin Radium Institute of the "Rosatom" State Corp.)

Presenter: PAKHOMOV, Sergei (Khlopin Radium Institute of the "Rosatom" State Corp.)

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Sensing Radar Interferometry and Precise Localization of the North Korean Nuclear Explosions

Radar data from remote sensing satellites is being used as additional mean for the verification of underground nuclear explosions. The Differential Interferometry Synthetic Aperture Radar (DInSAR) analysis provide the evidence of a non-recurring surface displacement of up to 10 cm after the January 2016 explosion about 3 km northwest of the tunnel entrance at the North Korean test site. This result is consistently proved for the subsequent nuclear test in September 2016. The strong spatial and temporal coincidence of these observations with the seismic data suggests a correlation with the underground tests. The seismograms of the five events from seismic stations at regional distances from the source, are individually correlated, and display a high coherence between the corresponding signals. This allows to estimate relative travel time differences and to perform the relative localization with a high accuracy. In combination with the results of the radar interferometry, the locations of the explosions are estimated relative to the center of the surface displacement of the January 2016 event. As result, the tests in 2009, 2013, and 2016 are conducted within a radius of 450 m, whereas the 2006 event is about 2700 m to the East from that.

Primary author: HARTMANN, Gernot (Federal Institute for Geosciences and Natural Resources (BGR))

Presenter: HARTMANN, Gernot (Federal Institute for Geosciences and Natural Resources (BGR))

Track Classification: 3. Advances in sensors, networks and processing

ID:

Type: **Oral**

Waveform Data Processing System Establishment Based on the Private Cloud platform

The Cloud computing has been used more and more in many data centers due to the computing and storage resources integration and optimization, the fast deployment of services, the enhancement of services availability and the complication reduction of system management. This paper introduces the new version waveform data processing system of CTBT Beijing National Data Center based on the Private Cloud platform, focusing on the virtualization of computing and storage resources, the migration of waveform data processing software and its function enhancement. And also the main function of the operation maintenance and management system (OMMS), which is the assistant tools to monitoring the whole NDC facilities. By the end, we discussed the analysis result of the DPRK event on September 2016 based on the systems as above mentioned.

Primary author: WANG, Xiaoming (CTBT Beijing National Data Center and Beijing Radionuclide Laboratory)

Presenter: WANG, Xiaoming (CTBT Beijing National Data Center and Beijing Radionuclide Laboratory)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Local Seismic Networks Data to Complete Instrumental Gaps of CTBTO Global Network

Seismic waves attenuate while propagating through the earth from the source to any target site or recording station. Density and the geometry of each seismic network has the main role on the recording and then evaluating the parameters of an earthquake. CTBTO by its responsibility has a key role to make a safe world where it can threaten by nuclear weapons. Monitoring all probable nuclear tests can be more precise if many local seismic networks took into account. CTBTO can develop and define a role to collect all available small local networks to share their data with a specific format or protocol via network. This protocol can simply gather lots of stations and data to strengthen evaluation of all events and effectively extends the number of monitoring equipments all over the world. This paper tries to introduce such a snapshot of this data sharing.

Primary author: GHOLAMI, Vahid (Geopersian Company)

Presenter: GHOLAMI, Vahid (Geopersian Company)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

GPS: Challenges of GPS Signals in High Noise Areas

In the world of seismology there are situations that we need to use a recording system in the place that there is no access to open sky or in a place with lots of electronic noises of cellphones or satellites. The question is what should to do in this situations to have a clean data from time point of view? Available GPS antenna are usually produce with a length of 5meters in the market. There are very few GPS's that support longer cables. High frequency of GPS waves results the high precision of positioning. Most GPS antenna are an amplifier and because they receive their 3.3V power from the source so can't make remarkable amplify and 5 meter cable limit came from this problem. With a small external noise source the GPS can't act normally and GPS can't lock data very soon and easy. This paper presents a GPS system which digitize the data at the source then transfer to the recording media. This protocol gives high performance cables with lengths more than 30-50 meters and theoretically up to 200 meters.

Primary author: SEIF POUR ABOLHASSANI, Ali (GeoPersian Company)

Presenter: SEIF POUR ABOLHASSANI, Ali (GeoPersian Company)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Oral**

Assurance of Ground Motion Data Using the IRIS MUSTANG Analytics System

The Incorporated Research Institutions for Seismology (IRIS) Data Management Center has developed and currently operates the Modular Utility for Statistical Knowledge Gathering (MUSTANG) system. IRIS receives data from approximately 3500 stations in real time and has roughly 30,000 stations covering 5 decades in its holdings. MUSTANG has analyzed all Broadband, High Broadband, and Long period time series data it manages at the present time. The extension to shorter period and higher frequency channels is now underway as well. MUSTANG calculates approximately 50 different metrics on the time series data to assess the data quality and to aid in the identification of data problems. The metrics are stored in a PostgreSQL database and the metrics are made available to anyone through web services. A variety of clients have been developed to aid in using the nearly 7 terabytes of metrics that have been calculated. This talk will discuss how the MUSTANG system works, how it can be extended, and identify some of the problems that it has uncovered. An overview of some of the clients that are available will also be given including, the MUSTANG Databrowser, LASSO, and MUSTANGular, a system that displays values of metrics on a map display.

Primary author: AHERN, Tim (IRIS)

Presenter: AHERN, Tim (IRIS)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Reporting System and Incident Management in Operations Centre

Incident management in Operations Centre encompasses the incident handling and resolution processes. Incidents are, for example an unexpected data outage, may be identified by station operators, or by the Operations Centre through an automated scripts. Any incidents are recorded using the IMS reporting System (IRS). IRS was created as a way to structure and record email correspondence between operators of station or laboratory facilities and IMS staff related to operation and maintenance of the facilities. IRS supports structured emails (with different types of reports like PR, OR, CCR, CCN, MR, LOR, LON). A Web based GUI with integrated Control Panel helps to manage it effectively. The main components of IRS are: Email handling, Database, Web Interface, Alert manager, and Control Panel (Incident management). CTBTO with support of DTRA is moving towards an Integrated Incident Reporting System (IRS2) based on JIRA that positions the organization to manage system wide issues across common platform. The overall goal of the IRS2 implementation is to: Enhance reporting capabilities and data mining; Solidify system sustainability; Efficient, reliable, and friendly use; Design simplicity; Improve inter-operability among CTBTO systems.

Primary author: AKTAS, Kadircan (CTBTO)

Presenter: AKTAS, Kadircan (CTBTO)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

of RN-52 Generated Data in the Establishment of Radioactivity Data Base in the Philippines

One of the modalities of CTBTO verification systems is the operation of radionuclide monitoring station for air particulates. The Philippines through the Philippine Nuclear Research Institute has been operating and maintaining the RN-52 since 2005. This station is co-located at the Weather and Radar Station of the Philippine Atmospheric, Geophysical and Astronomical Services Administration in Tanay, Rizal, Philippines. It is a manual station, whose function is to provide continuous monitoring of radioactivity levels in the air. This involves collection of particulate materials on a filter; performance of gamma spectroscopy to identify radionuclides in the air filter and transmittal of raw spectral data using the Global Communications Infrastructure (GCI) to the International Data Centre (IDC). The designated operator manually change the filter and complete the daily routine. The radionuclide data from the ten-year RN-52 operation, thru the NDC-137 were retrieved, collated and analyzed. The poster presentation will discuss the analysis made on the radionuclide data as to the levels/ types of radioactivity, abundance, half lives, seasonal variation, and other relevant characteristics. These data will be inputted to the radionuclide baseline data being established in the Philippines. This baseline data will be useful for information, research and impact assessments in case of nuclear incidents.

Primary author: DELA CRUZ, Fe (Philippine Nuclear Research Institute (PNRI))

Presenter: DELA CRUZ, Fe (Philippine Nuclear Research Institute (PNRI))

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

from Transport Times and Minimum Detectable Activity on the Analysis of Low-Activity Samples at CTBT Radionuclide Laboratories

If a radioactive air sample taken at an IMS station is of relevance for a possible event, it is split into half and sent to two different CTBT radionuclide laboratories for further analysis. The radionuclide activity of relevant isotopes detected at the station might be lower than the minimum detectable activity (MDA) at the laboratory once the sample arrives. To estimate the detection probability of a low activity sample, the empirical MDAs of the laboratories and the transport times between the stations and the laboratories must be considered. While the CTBT radionuclide laboratories have MDAs significantly lower than the stations, the detectability of CTBT relevant isotopes with very short half-lives may be affected by their radioactive decay. In this study, empirical station MDAs of seven CTBT relevant radionuclides with short half-lives were compared to the respective MDAs of ten certified CTBT radionuclide laboratories during the radioactive decay. The results were linked to a distribution of empirical sample transport times from stations to laboratories. The comparison indicates that for the short-lived isotopes I-131, Te-132, Mo-99, La-140, and I-133 with low sample activity the selection of the radionuclide laboratory should be based on the sample transport time and the empirical laboratory MDAs.

Primary author: BUHMANN, Erik (Student, University of Hamburg)

Presenter: BUHMANN, Erik (Student, University of Hamburg)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Assessment of Meteorological Data from CTBTO/IMS Radionuclide Stations

All radionuclide stations are equipped with meteorological sensors and transmit these data to the IDC. These data help to interpret radionuclide measurements, especially with respect to local influences. Data from selected stations are transmitted real-time to the World Meteorological Organisation (WMO). Meteorological measurements not being the primary mission of the IMS, their quality is not seen as a priority. However data can only be used if they are available and reliable. Therefore, data from DEP33 Schauinsland, a mountain station used in the first ATM Challenge, and JPP38 Takasaki, which is important for monitoring the DPRK test site, were investigated in detail. For the data quality at Schauinsland, several problems were found, most severe with relative humidity which are of no useful value at this station. Data at Takasaki were found to be of better quality. All available data from the network were then screened with respect to availability and climatological limits. They show in general problematic quality, especially for relative humidity and precipitation. Station height data are missing for a majority of stations. In order to achieve satisfactory quality, there is a need for regular inspections and maintenance of the equipment and automatic quality checks within the SOH procedures.

Primary author: SEIBERT, Petra (University of Natural Resources and Applied Life Sciences (BOKU))

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Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

for IMS Waveform Data Requested/Queried from the CTBT Secure Web Portal (SWP) Different from the Time Specified in the Query/Request

In November 2014 during routine access of the IMS waveform data from the secure signatory account at the Kenyan National Data Centre (KE-NDC), it was noted that the times of the IMS waveform data requested/queried was different from that displayed on the actual waveforms. This was rather intriguing since the understanding is that the times for all stations of the CTBT network are in Coordinated Universal Times (UTC). Again this posed a significant challenge to accurate access of the correct waveform data for specific seismic events. This problem was raised to CTBT Support and a Support Ticket ID SHD-29357 created. The problem was finally resolved within a duration of about one year. During the CTBT SnT 2017 conference an excerpt of the communication between myself at KE-NDC and CTBT Support Team will be presented. This excerpt of the communication is intended to demonstrate the challenges in trying to resolve this issue/problem since the error was not being replicated at the IDC but the same was persistent at KE-NDC. A sample of the IMS waveforms showing the time shifts before the problem was resolved will also be presented.

Primary author: MULWA, Josphat Kyalo (University of Nairobi, Department of Geology)

Presenter: MULWA, Josphat Kyalo (University of Nairobi, Department of Geology)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

in State of Health Analysis for International Monitoring Systems

International monitoring system (IMS) stations report state of health (SOH) data at regular intervals. Analysis of this data can provide valuable information about the current performance of the stations as well as help operators diagnose problems. Additionally, the data can provide information about component degradations that could eventually lead to system failure resulting in down-time or loss of data. Pacific Northwest National Laboratory (PNNL) is performing SOH analysis research to aid in the identification of current and potential future failures. The objective is to improve the current SOH monitoring capability to increase system uptime, decrease loss of data, and reduce unscheduled maintenance visits. PNNL has developed a software framework that uses model-based analysis techniques and provides a web-based graphical user interface for interaction. The current version of the tool was designed to analyze data from the Swedish Automated Unattended Noble gas Analyzer (SAUNA). Models of normal operation were implemented using both a basic mean and an alternate, exponential smoothing approach. Deviations from the models are then used to provide alerts and identify trends. The current state of the tool and SOH analysis will be presented.

Primary author: SUAREZ, Reynold (Pacific Northwest National Laboratory)

Presenter: SUAREZ, Reynold (Pacific Northwest National Laboratory)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Oral**

the Consistency, Quality and Completeness of the Reviewed Event Bulletin with Waveform Cross Correlation

The Reviewed Event Bulletin (REB) of the IDC includes more than 500,000 events with associated seismic phases. The quality of these events and its completeness depends on multistage automatic processing followed by interactive analysis. The IDC raw data archive allows to apply the method of waveform cross correlation (WCC) for assessment of the similarity between seismic signals associated with REB events, and thus, the overall bulletin consistency. For cross correlation, we create a global set of master-events (ME) in the areas where reliable seismic events are available in the REB. Using only events within 3 degrees from a given ME, we apply the Principal Component Analysis to signals at each associated station. The major components are used to build synthetic MEs. Using real and synthetic MEs, we process continuous data in a specified region with the aim to find new REB-compatible events, which are missing from the REB. Therefore, the developed method allows to test REB consistency, quality, and completeness in any specified region or globally. It can also be thought as an alternative to the manual spot check during an independent review of the REB in routine IDC event analysis or as an additional tool for the independent reviewer

Primary author: KITOV, Ivan (CTBTO)

Presenter: KITOV, Ivan (CTBTO)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Space Optics (FSO) Systems as Alternative Back-Up Links for NDCs and IMS Stations

Free Space Optics (FSO) systems can provide high data bite rates up to 10 GB/s. They are also easy to install and low cost compared to wired optical fiber. In that regard, FSO can play a key role in link back-up for the infrastructure of the CTBTO in the field and even for the infrastructure at the headquarters in Vienna in terms of rapid deployment for securing links and data rate transmission.

Primary author: DATH, Cheikh Amadou Bamba (Direction des Systèmes Informatique de l'Université cheikh Anta Diop de Dakar (UCAD))

Presenter: DATH, Cheikh Amadou Bamba (Direction des Systèmes Informatique de l'Université cheikh Anta Diop de Dakar (UCAD))

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Detector Calibrations: Field Automation and Potential for Factory Calibrations to Replace Field Calibrations

The process of performing RASA high purity germanium (HPGe) detector calibrations in field systems is a labor-intensive and error-prone task. Mistakes and delays in this process commonly result in additional downtime of RASA systems after a detector replacement. At present, human intervention is required for input of detector certificate data, monitoring acquisitions for the appropriate stop time, retrieval of efficiency calculation results from an external source, and manual editing of configuration files to insert calibration results. GDMS is leveraging experience with automated software testing to modernize the RASA detector calibration workflow. In addition to automating manual tasks, the software in development includes a local processing module for on-site calculation of energy, resolution, and efficiency line pairs. Automation and localization of this process will result in faster restoration of RASA systems to operational status after detector replacement. GDMS is also comparing methods to determine if the field calibration process can be eliminated in favor of factory calibrations. Options include a standard RASA calibration performed shortly before deployment, or a vendor solution such as Canberra LABSOCS/ISOCS technology. If these processes prove to be viable replacements to in-field calibrations, the detector replacement process may be shortened to improve data availability.

Primary author: WRIGHT, Matthew S. (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Presenter: WRIGHT, Matthew S. (Defense Threat Reduction Agency, Nuclear Arms Control Technology Program)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Oral**

Different Approach to Data Availability: It's More Than Just a Performance Metric!

AFTAC has demonstrated a new approach to analyzing data gaps that identifies and helps to understand drivers of our network performance. Every data gap is now assigned unique identifier, characterized and then cataloged for analysis. Previously, we have struggled to link non-associated data gaps with specific system components or maintenance actions. This new methodology shows how data gaps not resulting in unscheduled maintenance can be used as indicators for an upcoming hard failure. Planned scheduled maintenance activity then allows preemptive action to prevent larger outages. The analysis of these cataloged gaps have been crucial in both AFTAC engineering and maintenance planning by development of models projecting future network behavior. The results allow for performance optimization of the CTBTO network we are responsible for while greatly increasing cost effectiveness and reducing risk for AFTAC.

Primary author: POINDEXTER, Stephen (AFTAC)

Presenter: POINDEXTER, Stephen (AFTAC)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Insulation System and Automatic Heating of Air Sampler "SNOW WHITE" for IMS Radionuclide Station (for Example Station RN61 (Dubna)).

Here is the the thermal insulation system and automatic heating of air sampler «SNOW WHITE» for IMS radionuclide station (for example station RN61 (Dubna)). During sustained operation of IMS radionuclide stations CTBTO on Russia we have the problem of air sampler «SNOW WHITE». When the temperatures low than -25 Degrees Celsius (winter period), we will have the next problems of sampler: - the data from Snow White will be stop, because the electronic bloc for transmit data is frozen (for example station RN61 this is LANTRONIX CoBox -FI-01; - sampling will be stop, because the bearings were destroyed and Vacuum Pump and electrical motor were jammed. This is difficult situation - sampling will be stop and need complicated repair of sampler at low outdoor temperatures. My system will provide stability of working «SNOW WHITE», if the temperatures from -25 Degrees Celsius to -50 Degrees Celsius. From December 2016 to February 2017 the system was successfully testing on the radionuclide station RN61. The reports were PR100013 and CCN124720 about it. The system has low costs, a good quality and it install and adjust don't stop «SNOW WHITE». I offer to install this system on all stations working low temperatures.

Primary author: RULEV, Igor (National Data Centre of Russian Federation)

Presenter: RULEV, Igor (National Data Centre of Russian Federation)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Detection Quality of Primary IMS Seismic Stations

Monitoring of underground nuclear tests is based on the Primary Seismic Network of the International Monitoring System (IMS) consisting of 3-C stations and arrays. Detection of signals is the principal task of stations. The capability of finding an event of interest depends on station sensitivity, i.e. detection threshold and reliability of signal attributes such as arrival time, signal-to-noise ratio, amplitude, period, and so on. The current set of parameters used by the International Data Centre for station processing yields a detection list of good quality. There are several problems, however, that call for further improvement. These include, inter alia, a high rate of phases wrongly associated with event hypotheses during automatic processing, a large fraction of manually added arrivals (more than 10%), arrivals renamed from noise (N-) phases (up to 10%) in the Reviewed Event Bulletin, and re-timing of many arrivals by more than 4 s. To investigate the reasons for these and other problems and to find appropriate solutions, the IDC develops a tool for off-line data re-processing and analysis. We present its methods of analysis and parameter optimization.

Primary author: BROUWER, Albert (International Institute for Applied Systems Analysis)

Presenter: BROUWER, Albert (International Institute for Applied Systems Analysis)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Indications of High-Purity Germanium Detector Failure

The CTBTO aims to maximize the data availability and spectral quality from its radionuclide network. The radionuclide network consists of numerous stations of which many are in remote locations. In order to achieve the goal it is important to exploit possibilities to predict failures of the gamma detectors. The high resolution gamma detection requires reliable cooling and good cryostat vacuum. PTS staff are developing ways to monitor these and will present some exemplary cases in this presentation.

The electrical cooling system manufactured by Canberra, CP5 and CP5+, is operated in a mode which keeps the detector temperature at a constant level. When the detector vacuum deteriorates more power is needed to maintain the same crystal temperature. Therefore the cooling power consumption is a very good benchmark for an adequate detector vacuum and should be included in the State of Health parameters. By monitoring the full width at half maximum and observing a steady increase over time one can infer deteriorated detector vacuum.

On the other hand ORTEC X-Cooler II and X-Cooler III are operated by supplying constant power. When the vacuum deteriorates the Cooler cannot absorb the higher load which leads to an increase in crystal temperature and detector resolution.

Primary author: WIENS, Andreas (CTBTO)

Presenter: WIENS, Andreas (CTBTO)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Intelligence Software as a Self-Service Data Analysis Platform for the CTBTO

Business Intelligence (BI), as a collection of software, strategies, processes and services that support decision making in an enterprise has received a lot of attention in recent years. Some BI technologies have been around for more than a decade. They are normally packaged with all larger relational database management systems and include On-line Analytical Processing capabilities as well as data warehouse solutions and supporting tools, such as Extract-Transform-Load capabilities. Newer techniques include Complex Event Processing and advanced data analytics that make machine learning algorithms and tools (clustering, decision trees, neural networks, and others) available for main-stream use. Advanced reporting capabilities, another BI component, are an essential ingredient in self-service capabilities, the ability for end-users to perform relatively sophisticated data analysis operations, using intuitive, interactive tools, without the involvement of IT specialists or data analysts. This poster explores the applicability of BI suites from some of the leaders in the field (e.g. Tableau Software, Qlik, Microsoft), to provide self-service data analysis capabilities to IDC staff for performance monitoring purposes, as well as to external stakeholders who are not familiar with CTBTO database schemas, such as vDEC users and Authorized Users from Member States.

Primary author: TOMUTA, Elena (CTBTO)

Presenter: TOMUTA, Elena (CTBTO)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Oral**

a 'Digital Twin' for Use in System Design and Support

Hardware and electronic systems makers submit their products to testing before they are put into service. Where safety and operational criticality is vital then that testing is very rigorous. Once in service, keeping complex equipment operating requires a support program which can itself be complex and often costs more over time than the original hardware acquisition. Why is it that support systems are seldom subjected to testing before they are brought into operation? This paper examines the use of a Digital Twin - a mathematical model - of a support system whose purpose is to test the support plan's efficacy and to determine its periodic cost. Case studies will be used to illustrate the various ways that a complex equipment support system can be represented in model form and the benefits they provide to operators. The paper will address an obstacle to modelling that is common in peoples' minds, which is the availability and quality of data. The paper will demonstrate how the integration of automatically captured data from environmental and positional sensors can significantly add to the fidelity of a Twin of a support system and enhance its ability to predict increased risk of system operational unavailability.

Primary author: SHARP, John (Ministry of Defence)

Presenter: SHARP, John (Ministry of Defence)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Radionuclide Network Quality Control Programme

During the operations of certified IMS (International Monitoring System) radionuclide particulate stations, a Quality Assurance and Quality Control (QA/QC) system is carried out to ensure that the data produced are of acceptable quality and the stations are working within the requirements. The station QA/QC is carried out by the station operators according to the operation and maintenance procedures, equipment manuals, and daily SOH (State Of Health) data monitoring. At the (P)TS (Provisional Technical Secretariat), in addition to the basic QA/QC functions, a network QC program is run on a periodic and ongoing basis to assess the station performances by independent measurements and analysis: randomly selected samples collected during normal operations are dispatched regularly from stations to the IMS certified radionuclide laboratories for reanalysis to verify system calibrations as part of this program. On the basis of the laboratory results, the (P)TS may initiate a request for corrective actions. The results of the network QC program for the period 2015-2016 will be provided.

Primary author: NAVA, Elisabetta (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Presenter: NAVA, Elisabetta (Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA))

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Oral**

Real Time Data Dissemination and Warehousing Protocol

Thursday, June 29, 2017 11:45 AM (15 minutes)

Globalized Data Dissemination in near real time is a challenge. Data replication as an alternative is cost intensive and delayed. Therefore, one of the possible solutions is to develop a protocol that classifies data at source. This sorting of data is based on spatial, temporal and spectral significances defined at the source. Parametric thresholds, i.e. boundary conditions for classification, are part of the architecture resulting in propagation ready warehousing of data at source. Optimizations are also achieved by propagating only variations to the standard data or most specific conditions. This results in a sizable reduction of data transmitted over the networks. The complete data set or subset, as may be applicable, can be rebuilt at the remote site by adding variations to the standard conditions generating data as recorded by the sensors. This protocol can be implemented at the transport or higher layers of the Open Systems Interconnection model. New fields are required in the existing database designs to accommodate only keeping records of received variations. A furtherance to this optimization can be achieved by only recording variations at sensors even prior to the analogue to digital conversions and transmission can also be investigated with possibly fascinating outcomes.

Primary author: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Presenter: SHAH, Syed Muhammad Ayub (National Defense University (NDU))

Session Classification: T4.1 Performance Optimization and Systems Engineering

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Cycle Modelling Data Required to Sustain the International Monitoring System

The International Monitoring System network consists of hundreds of facilities, composed of four different technologies with a variety of designs, deployed in diverse environments around the globe. The sustainment of this network with a high level of availability is challenging and requires extensive resource planning for its optimization. The PTS has already developed a sparing capability to determine the optimal quantity and location of spare parts. In parallel, a life cycle analysis capability continues to be developed to support PTS decision making on station design, recapitalization, and effective logistics support. An overview of IMS activity-based life cycle modelling, which identifies and optimizes the activities and resources required to support and sustain stations through their whole life, is presented. The data required for life cycle modelling, where it can be found, and how to bring the disparate sources of data together is explored.

Primary author: FOSTER, Daniel (CTBTO)

Presenter: FOSTER, Daniel (CTBTO)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

: A unified Data Distribution Approach for the International Monitoring System

The International Monitoring System (IMS) consists of 337 facilities, 321 monitoring stations and 16 laboratories, built and distributed worldwide. These facilities send different types of raw data in near real time to the International Data Center (IDC) using a dedicated Global Communications Infrastructure (GCI) that provides timely and reliable transmission of IMS data. IDC distributes IMS data, IDC bulletins and reports to member states. Currently, different types of processes and tools are used for information distribution based on type of data or reports generated. Maintaining and monitoring of such processes has flexibility, scalability, efficiency and performance problems, as both data volume and number of recipient states increases. The aim of this poster is to present a unified, flexible, reliable, efficient and distributed framework for data distribution based on Data Distribution Service (DDS) and Complex Event Processing (CEP), in order to overcome these challenging issues. The details of the proposed methodology, implementation, experimental results, advantages, and limitations of this approach are presented. Finally, future directions and recommendations are discussed.

Primary author: LABAN, Shaban (CTBTO)

Presenter: LABAN, Shaban (CTBTO)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

WNRS of IS48TN Infrasound Station: Problems and Solutions

The Infrasound Station IS48, in Kesra, Tunisia is part of the verification regime for the Comprehensive Nuclear-Test-Ban Treaty. IS48 is managed and maintained by the Tunisian NDC. Its good location in the middle of the Mediterranean Sea allows to have various and interesting detections. Several signals with different signatures were recorded and identified, but since 2010, the station has began to be noisy due to a leakage in the pipe array, despite efforts to solve the issue through the pressure test and maintenance . To solve this issue, PTS decided to upgrade the WNRS at IS48TN in April 2017. In this poster, the performance of the IS48TN new design will be highlighted with respect to the older one.

Primary author: FRIHA, Naima (National Data Centre)

Presenter: FRIHA, Naima (National Data Centre)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

of local network in processing discrimination of sources

Based on the IMS statistical assessments done on historically recorded earthquakes in Tunisia and the Mediterranean, it was noticed a certain shortness in locating all events triggered in Tunisia. This issue may result essentially from the geodynamic structure of the country location as well as from the insufficient number of seismic stations in that area. Consequently, a risk that a suspect event conducted in the vicinity of our territory cannot be detected. An overview of this statistic will be highlighted over this poster with a glance to the possible solutions to overcome this issue.

Primary author: SOUAYEH, Saoussen (National Data Centre)

Presenter: SOUAYEH, Saoussen (National Data Centre)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Data Centre at Royal Science and Technology Park, Swaziland

Royal Science and Technology Park (RSTP) is in the process of constructing a Tier-3 National Data Center (NDC) for the country. RSTP National Data Center will be the brain of the establishment; it will accommodate computer systems and a number of mechanisms, such as telecommunications and storage structures. The processors and servers that will be hosted will run 24/7, with an up-time of 99.999%. The Park through its NDC will enable delivery of a number of services. Network equipment and optical fibre will offer the infrastructure that is crucial for running the facility. We are expecting to connect the whole country. Also key about the NDC we will be hosting of data. We will implement this through Cloud Computing Services such as Infrastructure as a Service (IaaS), Platform as a Service (Paas) and Software as a Service (SaaS). We anticipate having a high internet access speed, to ensure our clients receive a stable and are continuously on access. A multi path redundancy in the network infrastructure routing, uninterrupted power supply, cooling and fire prevention & suppression systems and backup protocols is also being considered for fail-over options. This will ensure Uninterrupted Business Continuity for the RSTP clients.

Primary author: DLAMINI, Khanyisile (Systems Developer & Business Analyst)

Presenter: DLAMINI, Khanyisile (Systems Developer & Business Analyst)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Oral**

Reduction in Operation and Maintenance of IMS Stations (IS32 and PS24)

Kenya hosts two IMS primary stations, IS32 and PS24. In previous years, the cost of operation and maintenance was significantly high. In recent years, these costs as well as the risks have greatly reduced due to the involvement (education) of the local community and the involvement of government agencies as stakeholders. As a result of the above, an enabling business environment has been created around these two stations that has greatly enhanced performance to meet the minimum 98% data availability. Trainings at the station have drastically reduced the cost of operation and maintenance, considering that, for instance, infrasound technology was relatively new in the country. Government involvement to improve the road network has turned the place into a tourist attraction, thus eliminating various maintenance costs previously incurred by the CTBTO and hence improving the livelihood of the communities living nearby. Several businesses and people have benefited directly because of the existence of these stations. Station operators have also demonstrated high levels of professionalism in the daily operation and maintenance of the stations.

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Presenter: AKECH, John Opiyo (National Council for Science & Technology)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Data Center Based on Big Data Processing and Collaborative Management and its Application in the CTBT Verification System

The rapid development of the cloud computing and big data processing technology has great potential to improve the data transmission and processing activities in CTBT verification system. The distributed Cloud Data Center, which is based on Openstack platform, with the innovation of open, hardware and software decoupling and software defined network, can realize hardware resource pooling, software architecture distribution and operation automation. It can increase the IT resource utilization and ensure the service continuity. At the same time, based on Convergent Video Conference System, it can support the attendees from different departments and different locations, to share voice, data and video by any type of terminal (conference rooms, tablets, web pages, mobile phones, etc.). The collaboration and management efficiency can be improved significantly. Moreover, the blu-ray based storage system with long-life - 50 years - used in the data centers improves the data reliability greatly. Related technologies and their possible application in the CTBT verification system are discussed in this paper.

Primary author: XUE, Xiaodong (N/A)

Presenter: XUE, Xiaodong (N/A)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

and Evaluation of Resource Constraints: Optimization of AFTAC's Configuration Management Process

Resource constraints impact the cost effective and timely execution of seismic sustainment activities. An analysis of AFTAC configuration management processes identified deficiencies in baseline plan development, monitoring procedures, and resource allocation. Through decomposition of work scope into its lowest manageable level, project engineers and configuration managers were able to assess the time phased labor cost of their efforts supporting Engineering Change Orders (ECOs). The time phased labor budget constituted the performance measurement baseline (PMB) which serves as the basis for monitoring past performance and developing predicative metrics. Resource loaded project schedules modeled critical resource constraints affecting installation schedules with the potential to impact data availability rates. Future resource demand rates were also tracked across project lifecycles to facilitate management efforts to mitigate resource bottlenecks and monitor workflow. Prior performance against the PMB is a basis for more reliable estimate of future project performance. This metric-based process for monitoring and controlling project execution will decrease AFTAC lifecycle costs by helping mitigate inefficient resource allocations, forecast accurate installation and procurement schedules, and optimize engineering processes.

Primary author: POINDEXTER, Stephen (AFTAC)

Presenter: POINDEXTER, Stephen (AFTAC)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Research Activities of Turkish NDC

Boğazici University - Kandilli Observatory and Earthquake Research Institute (KOERI) acts as the Turkish National Data Center (NDC) and is operating International Monitoring System (IMS) Primary Seismic Station BRTR (PS-43) under Belbasi Nuclear Tests Monitoring Center (Belbasi NTMC) for the verification of compliance with the Comprehensive Nuclear-Test-Ban Treaty since February 2000. The NDC is responsible for operating two arrays, which are part of the IMS, as well as for transmitting data from these stations to the International Data Centre (IDC) in Vienna. Selected capacity building activities of the Turkish NDC to be presented at SnT 2017 focus on i) A theoretical study to investigate the array response and gain for different array configurations in order to find the optimal placement of additional sites for a possible enlargement of BRTR from 6 SP-1 BB to 9 SP-1BB elements; ii) Comparison of CTBTO/IDC and KOERI/Regional Earthquake and Tsunami Monitoring Center (RETMC) earthquake bulletins for the first six months period of 2016, iii) Analysis of DPRK events; and iv) Seismic analysis and yield estimation of selected vehicle-installed bomb explosions occurred in 2016 in Turkey.

Primary author: NECMIOGLU, Ocal (European Commission - Joint Research Center)

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Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

of the Quality of the Interactive Analysis and Reviewed Event Bulletin During the September 2016 Experiment

In this work we assess the quality of the regular REB by comparing it with a baseline bulletin REB produced during the 2016 experiment by an independent team of waveform analysts for three reference days. The assessment is done using an external software package based on generic comparison of focal parameters and a set of IDC built-in scripts designed for internal comparison of PTS bulletins. Input data was filtered according to the detectability of the IMS network and very stringent target requirements were established for evaluation purposes: $\geq 98\%$ of matching events, $\leq 4\%$ of false events and $\geq 96\%$ of matching events with overlapping error ellipses. Results indicate that, over a sample of 357 events in the baseline bulletin, 188 are above the detectability of the network ($\text{mag}=3.6$). 92.6% (176/188) of the events match in both REB and baseline bulletins and the percentage of matching events whose ellipses overlap is 92.9%; both values close but not meeting the target requirements. Only 1.1% (2/188) are false events thus meeting in excess the target requirement. Considering the worldwide coverage of the IMS network, additional investigation including zonation is needed to ascertain the reasons of the discrepancies between the REB and the reference bulletin.

Primary author: VILA CODINA, Josep (CTBTO)

Presenter: VILA CODINA, Josep (CTBTO)

Track Classification: 4. Performance Optimization and Systems Engineering

ID:

Type: **Poster**

Benefits of CTBTO to Iraq

The National Data Center (NDC) in Iraq is established at the Iraqi National Monitoring Authority to promote nonproliferation. The center is mandated to collect seismic, hydroacoustic, infrasound (SHI) and radionuclide data to monitor test explosions. In addition, the Iraqi NDC use data it receives from the International Data Center (IDC) and the International Monitoring System (IMS) to promote nonproliferation objectives and scientific applications, such as earthquake disaster mitigation. Likewise, the Iraqi NDC anticipates to use the data for research related to nuclear security. The Iraqi NDC has participated in many CTBTO workshops and capacity building training courses to strengthen the capabilities of our NDC staff and provide us with CBS system to strengthen our scientific capabilities. The proposed paper will focus on the role and comparison between the NDC IN A BOX and the extended NDC in a box, and the advantages of the new version. This paper will explore NDC-IN a box in the Iraqi NDC context and how the extended NDC in a box package improves the NDCs processing capabilities for SHI data. Our detection of the North Korea test by using all available IMS data is an example of scientific applications related to nonproliferation issues.

Primary author: AL-ABBOODI, Rana Hameed Majeed (Iraqi National Monitoring Authority)

Presenter: AL-ABBOODI, Rana Hameed Majeed (Iraqi National Monitoring Authority)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Community: Its Role in Nuclear Disarmament

Scientist across the world played a significant role in nuclear arms control; for example, developing the technologies to detect illicit underground testing of weapons. The scientific community must now collaborate, communicate among themselves to develop the technology to support disarmament. Institutions, or in other words an ordered platform is necessary to initiate the process. A formal institution like a scientific advisory group should be set up to establish cooperation and guide international disarmament research. A scientific laboratory where international participants can share knowledge is also an utmost necessity. Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) has built over 300 stations in 89 countries. These stations monitor for nuclear explosions around the globe round the clock. Of the 44 countries listed as a nuclear technology capable; only India, Pakistan and North Korea are the non-signatories from the list. Nuclear disarmament is a very sensitive issue, yet scientific diplomacy can pave the way for nuclear weapon free world. This study is based on the research question; can model like Triple Helix; academia, industry and government collaboration leading to innovations help in the fulfillment of objective of CTBT? The study will be based on secondary literature from different sources with the qualitative method of exploration.

Primary author: CHAMUAH, Anjan (PhD Scholar)

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

-Ecological Monitoring of the Uranium Mining in the Mountain Areas

Kyrgyzstan was a country producing uranium ore in the USSR from 1940 to 1970. There were remained the huge amount of uranium waste in the country. Many tailings and uranium wastes were located in seismically hazardous mountainous areas along the mountains, rivers, populated areas and areas at risk of landslides. The radiological impact on the environment and the population was not fully known yet. Because there were low standards of living, social and migration issues and it could be influenced to poor socio-psychological situation in these areas, including the threats and risks from radiation, as well as other potential physical risks. The protective structures of the uranium tailings and dumps were destroyed because of weak monitoring and did not timely doing repair works. It was found that the potential dangerous waste was the uranium tailings; Tuyuk-Suu, Taldy-Bulak, Kaji-Sai and Mailu-Suu in the uranium technogenic province near the mountains of the republic, which are included in the register of the Ministry of Emergency Situations of the Kyrgyz Republic.

Primary author: DJENBAEV, Bekmamat (Instiute Biology and Pedology NAS KR)

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

the Use of the CTBT Educational Resources Among the Academics in West Africa

The apparent low utilization of the CTBT Educational Resources (CER) by members of the academics from the West African region motivated this study. This is focussed on determining the level of awareness of the benefits of the CER among the Academics from the West African Region and what can be done to enhance the use of the CER in the region in order to promote CTBT Education and in understanding its the values and benefits. The results obtained from survey, response to questionnaires distributed to some individuals in the sub-region and Focused Group Discussion (FGD) during some specific events in the sub-region and personal contacts confirmed that only about 17% of the respondents, drawn mainly form the academic communities, seemed to be aware of the CTBT and its various learning resources. Concentrations of most of those that are aware came mainly from Universities where there is an NDC. This is considered as a huge gap and a major draw-back in the sub-region. To justify the enormous resources committed by the CTBTO in establishing this educational platform, we have developed strategy for increase awareness on the values and benefits of the CTBTO among members of the academia within the region

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Contributions of CTBTO to the Full Implementation and Complement of the Pelindaba Treaty

The Palindaba Treaty which aims to create a nuclear weapon free zone (NWFZ) in Africa entered into force, since July 2009. The African Commission on Nuclear Energy (AFCONE) was established for the purpose of ensuring compliance with the obligations under the Treaty consisting for the Parties to do not conduct, among others, research and development in nuclear explosions and other allied activities in the region. The AFCONE, is also in charge of developing nuclear sciences and applications in its member states. In that context, the challenge of AFCONE related to checking, preventing and alerting on threats on nuclear material and weapons may be handled within the infrastructure of the CTBTO, like the international monitoring systems (IMS). The CTBTO infrastructure can also serve as data bases and systems for supporting nuclear sciences, seismology, and other scientific fields of interests of the Palindaba Treaty compliances. The IMS networks and the OSI programs of the CTBTO could be useful for providing informations and alerts during nuclear emergency events and in tracking other malicious acts involving nuclear material around the African region, and by the way, putting in place and effective system of verification and scientific supports.

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

CTBT and the Ban Treaty

Wednesday, June 28, 2017 12:15 PM (15 minutes)

The CTBT and the Ban Treaty Edward Ifft The UNGA recently voted to authorize negotiation of a treaty banning nuclear weapons. This negotiation will end July 7, shortly after the conclusion of SnT 2017. It may appear that there would be little relationship between such a treaty and the CTBT, but there may be important technical, legal and political issues between the two. The Ban Treaty (BT) will ban the testing of nuclear weapons, so we may have in force a legally binding document that explicitly prohibits the testing of nuclear devices well before EIF of the CTBT. Efforts for and against the BT may distract from the CTBT. A strong case can be made that efforts to universalize and bring into force the CTBT should have priority. Also will the BT only refer to “testing,” or will it explicitly specify “explosions?” Will operative terms be defined and obligations with respect to what is/is not allowed be exactly the same as in the CTBT? If not, the possibility of ambiguities and contradictions is clear. Will the BT attempt to define a “nuclear explosion,” something that was purposely not done in the CTBT? All these issues bear careful watching.

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Presenter: IFFT, Edward Milton (Stanford University)

Session Classification: T5.4 Capacity Building, Education and Public Awareness

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

the Status Quo

The refusal of the three Middle Eastern Annex II states that have not ratified the (CTBT), namely Egypt, Israel and Iran has held hostage the CTBT entry to force to political bargains based on cost-benefit approaches. All three countries do not have strategic reasons not to ratify the CTBT, but they linkage ratification to issues, outside the CTBT realm. To accurately diagnose the current status quo on the CTBT ratification, the obstruction of the ratification in the region should be best described as a symptom. Tackling the symptoms of any patient could never be considered as a full diagnosis for the patient. The proposed paper seeks to analyze some of the core barriers that led to the current status quo for a more accurate diagnosis. The real challenge that faces the ratification of the CTBT (as well as the establishment of MEWMDFZ) is the absence of minimal favorable conditions. The purpose of this abstract is to go beyond the regional political official reasons giving by these three countries, which are mostly based on security concerns, and offer alternative, such as regional cooperation based on win-win scenarios to consolidate confidence building among the parties as a milestone for a CTBT ratification.

Primary author: EL-BAZ, Karim (Royal Military College of Canada)

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

Developments in QA/QC for IMS Radionuclide Laboratories

A network of 16 IMS radionuclide laboratories support analysis of samples from IMS radionuclide stations using high resolution, high purity germanium (HPGe) gamma ray spectrometry and/or coincidence system (for Noble gas). Thirteen of these 16 CTBT IMS particulate laboratories have been certified. Since 2001, as a part of the QA/QC program for the IMS Laboratories, the PTS organizes and conducts annual Proficiency Test Exercises (PTEs). These Exercises have been a valuable tool for monitoring the quality of analytical results of certified laboratories and assuring data quality of uncertified laboratories during or in preparation of the certification process. The PTE results are used by laboratories to improve their nuclide measurement and analysis capabilities and correct non-conformances. This annual PTE offers unique opportunities for interaction on the evaluation of results between the laboratories and the PTS, and also supports the continuous improvement of the PTS evaluation methods of laboratory data. This paper describes the new developments for Radionuclide Laboratory PTEs including recently developed software tools for increasing quality and efficiency in the evaluation and reporting of PTE results.

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Presenter: INOUE, Naoko (Comprehensive Nuclear-Test-Ban Treaty Organization)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

of the CTBTO at the Country's National Parliament

The chief objective of this essay is to raise awareness towards the Treaty's rapid entry into force in the group of lawmakers or members of the parliament(s) at the national level. Just by knowing the full form of the CTBT does not make any sense. The vision of CTBT is too deep as well as highly important and it must be resonate in hearts. In this capacity, political leaders can extend the primary objective of CTBTO among the citizens/public. To achieve this goal, we need to address the importance of the CTBT and its entry into force to the people's representatives of the respective country as they are the responsible for the national policy making and when they will address their local constituencies about the CTBT and its significance from viewpoints of the global peace and security then our efforts would be multiplied in due course of the time. In order for spreading public awareness, political awareness must be enhanced. In this direction, in the leadership of Executive Secretary of the CTBTO along with the youth member/s of the respective country can represent at the respective national parliament to widen the horizon of the CTBT in hearts of people worldwide.

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Presenter: SHARMA, Saurabh (Chino Corporation)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

's Experience in Operating and Maintaining RN01 and RN03 Towards the Installation of RN02

After adoption of the CTBT, experts from all over the world faced the challenge of having to install a large number of stations in a wide range of places. ARN was designated in 1999 by the MFA as PoC between Argentina and the PREPCOM, being responsible for the RN and IS technology. In this sense, ARN started working towards the installation of the stations under its responsibility, being able in 2002 to certify the first station in America. RN01 was completely designed and built by ARN and it operates 24/365 since 2001. However, despite its high performance, the station is currently being upgraded aiming at its standardization. Additionally, in 2003 ARN installed RN03, which equipment was provided by the PTS. The Treaty's 20th anniversary represented a great opportunity to reflect upon it and Argentina reaffirmed once again its commitment by playing its part. For several years now, big efforts are being made to move forward with the installation of the third RN station, RN02. In this process, and after more than 15 years of performing operation and maintenance activities, it is impossible not to take into consideration ARN's experience towards de installation of RN02 and RN stations in general.

Primary author: FERRO, Natalia Paola (Autoridad Regulatoria Nuclear (ARN))

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

CTBTO Semester-Long Simulation Course in International Relations Curriculum as a Method of Developing the Students' Professional Skills

Simulations are recognized as a valued instrument in teaching practices, both in natural sciences and in social sciences, thanks to developing a large number of skills. In international studies, simulation events of different scale, e. g. Model United Nations (MUN). However, a common feature, characterizing the majority of teaching and training simulations, is the time limit. Ural Federal University (UrFU) International Relations Department was the first in Russia to introduce long-term simulation into curriculum in the framework of the course named "Diplomatic Practice". The aim of this paper is to analyse the impact of using a semester-long simulation course as an innovative teaching method in International Relations curriculum. We regard simulation as a complex of teaching techniques, allowing the students to obtain the necessary competences and to develop extensive expertise in multilateral diplomacy. The semester-long course simulation is formed by lectures and seminars, with the latter organized as simulation. The course is run entirely in English. While lectures provide the necessary theoretical background, seminars are integrated with one topic, depending on the current international situation, e. g., in autumn 2016 the topic was the United Nations discussion on the issue of Comprehensive Nuclear Test Ban Treaty Organization (CTBTO).

Primary author: MIKHAYLENKO, Ekaterina (Lecturer)

Presenter: MIKHAYLENKO, Ekaterina (Lecturer)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Monitoring and its Analysis in Kyrgyzstan

Kyrgyzstan has signed the CTBT in 1996, and in 2003 it had been ratified by the Kyrgyz Parliament. In 2002 on the basis of Data Center of the Institute of seismology of National Academy of sciences of Kyrgyz Republic the National Data Center NDC-093 was established. Creation of the NDC-KG with access to the IDC in Vienna opens for Kyrgyzstan the additional capabilities in solving both scientific and practical problems in the seismic monitoring field, so far as geographically Kyrgyzstan is located in the limits of the Tien-Shan orogen, the modern tectonic activity of which defines a high seismicity of this territory. Very strong earthquakes with magnitude up to 8 and a lot of weaker events occur here. In average we process more than twelve thousand earthquakes per year. That is why a seismic monitoring was and remains one of the most actual problems for our republic. Correct seismic monitoring data and its appropriate analysis have both scientific and practical importance for Kyrgyzstan, as they are the basis for the estimation of seismic risk of this territory and appropriate preventive procedures planning, especially as the most densely populated areas are located in the focal zones of strong earthquakes.

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

National Data Centre

International geophysical year in 1957, very first seismic station from Russia was installed in Ulaanbaatar Mongolia and seismic monitoring started from this year. The Mongolia is situated in seismically active region, seismic activity of Mongolia is associated with the deformation included by the collision between India and Eurasia. Several strong earthquakes took places in Mongolia last century. The Mongolian Seismic Network has been expanding year by year and now seismic station including 6 mini-arrays (one of them belongs to CTBTO) are working online at 15 separate points in Mongolian territory. Also we established earthquake early warning system, Geophysical monitoring system for study of active faults around Ulaanbaatar city with Mongolian government. A seismicity of Mongolia is recorded by The Mongolian Seismic Monitoring Network, sparse network at present and determining and improving of detection capability of the Mongolian Seismic Network is important for seismic event detection and characterization in Mongolia. We will present improvement of technical availability and detection capability, data availability of the Mongolian Seismic Monitoring Network in this poster.

Primary author: JARGALSAIKHAN, Bayaraa (Mongolian National Data Center (MNDC))

Presenter: JARGALSAIKHAN, Bayaraa (Mongolian National Data Center (MNDC))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

for Nuclear Explosions

Abstract The main part of this report is a list of nuclear explosions conducted by the United States, the Soviet Union, the United Kingdom, France, China, India and Pakistan in 1945-98. The list includes all known nuclear test explosions and is compiled from a variety of sources including officially published information from the USA, Russia and France. The details given for each explosion (date, origin time, location, yield, type, etc.) are often compiled from more than one source because the individual sources do not give complete information. The report includes a short background to nuclear testing and provides brief information on the Comprehensive Nuclear-Test-Ban Treaty (CTBT) and the verification regime now being established to verify compliance with the treaty. It also summarizes nuclear testing country by country. The list should be used with some caution because its compilation from a variety of sources means that some of the data could be incorrect. This report is the result of cooperation between the Defence Research Establishment (FOA) and the Stockholm International Peace Research Institute (SIPRI)

Primary author: ALBISS, Bassam (Jordan Seismological Observatory)

Presenter: ALBISS, Bassam (Jordan Seismological Observatory)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Seismicity and Seismic Network from 1900-2016

Malawi lies within the East African Rift System (EARS) that runs through Lake Tanganyika, Lake Malawi to the Ulema graben in Mozambique. It falls within one of the seismically active zones of the world. Malawi has experienced earthquakes ranging from small to moderate with some being so destructive, like the one on 9th March 1989 in Salima, and Karonga on the 19th December 2009, both along the Rift System. Malawi had the first station in the early sixties, at Chileka (CLK) in Blantyre and later in the seventies at Mzuzu (MZM). In 1989, three more analog stations were installed at Zomba (ZOMB), Lilongwe (LLM) and Mzuzu (MZM). Following the Karonga earthquakes in December 2009, another set of broadband stations were installed in 2012 making the local network of eleven (11) stations across the country. These include the two Africaarray broadband seismic stations that are collocated with GPS receivers and automated weather stations. The coming in of broadband stations has improved the network and the earthquakes recorded at local, regional and teleseismic distribution. However, much as the improvements are touted, there is lack of proper training for the personnel managing it. KEY WORDS: Malawi seismicity, seismic network, EARS, broadband.

Primary author: MPHEPO, Felix Cuthbert Dulla (Geological Survey Department)

Presenter: MPHEPO, Felix Cuthbert Dulla (Geological Survey Department)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Awareness and Capacity Building

The surveillance system of the CTBTO remains today, the most powerful and the most imposing surveillance system in the world. It offers opportunities for research in many fields (aviation, health, studies of certain marine features, studies and prevention of volcanoes). The member countries of the CTBTO, in their desire to accompany the organization for the success of its mission, benefit from continuous training on the use of IDC data. My goal is to highlight the importance of capacity building of national data centers through training, online courses, equipment and public awareness necessity. Because in the near future, where we will not again talk about nuclear explosions, the same surveillance system will always be used in the civilian field, such as aviation, natural disaster prevention, the study of the earth's core.

Primary author: OUEDRAOGO, Abdou (National Center of Scientific and Technological Research (CNRST))

Presenter: OUEDRAOGO, Abdou (National Center of Scientific and Technological Research (CNRST))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Seismological Observatory and IMS

Jordan Seismological Observatory (JSO) began its routine operation in September 1983. JSO is observing seismic events around the hour, doing the analysis, assessment and archiving, preparing seismic maps and seismic hazard maps data exchanging with universal observatories periodically and when needed in order to achieve complete set of data for better results providing seismic data to local authorities, coordinating with local authorities for the aim of minimizing seismic hazards. JSO is participating in studies and programs aiming for public awareness of seismic hazards, identifying active faults and their types issuing monthly and annual bulletins of local and regional seismic events and maintaining the networks JSO has relation with IMS in CTBTO. Jordan has signed and ratified the CTBTO treaty and is now having the Tel-ALASFAR, auxiliary seismic station, first station in Jordan. TEL-AL-ASFAR (AS056) is some 90 km northeast of Amman. Jordan hosted in 1999 the regional workshop on magnitude calibration. Jordan hosted in 2003 the regional Workshop on evaluation and quality control. The NDC Development workshop for Middle East and south Asian was conducted during the period, 27- 30 September 2010. Jordan hosted on 2014 and Integrated Field exercise (IFE14) 3November to 9 December 2014.

Primary author: MESAAD, Wajdi Talib Abdelhadi (Jordan Seismological Observatory)

Presenter: MESAAD, Wajdi Talib Abdelhadi (Jordan Seismological Observatory)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Awareness Creation of National Data Centres in Africa

ABSTRACT The National Data Centres (NDCs) are technical organisations that play an important role in providing support to the CTBTO Member States. NDCs accomplish this by advising the CTBTO Member States on verification of the CTBT through the sharing of data and products received from the International Data Centre (IDC) as well as analysis of data received from the International Monitoring System (IMS) stations. The NDCs are established in CTBTO Member States with the support of the CTBTO. Many elements of the current monitoring efforts by CTBTO are also used in other contexts. For instance, data from IMS stations which is normally used for verification purposes with respect to the CTBT has the potential to be used for civil and scientific applications. Enhanced awareness creation of the NDCs in Africa has potential to create wide interest in spin-off applications of CTBTO's data for civil and scientific purposes. The paper discusses how the public awareness creation in CTBTO's African Member States could be raised on the usefulness of the NDCs and the data they provide.

Primary author: MUTURI, Harun Raphael Munyi (National Council for Science & Technology)

Presenter: MUTURI, Harun Raphael Munyi (National Council for Science & Technology)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

a Massive Online Open Course on Nuclear Weapons and Arms Control

Nuclear weapons and arms control education is becoming increasingly important, both in educational environments and in society in general. There is a growing need to improve the capacities of universities, international institutions, and governments to promote evidence and fact-based social dialogue about nuclear weapons and related arms control agreement and treaties. At the University of British Columbia, Dr. Allen Sens (Department of Political Science) and Dr. Matt Yedlin (Department of Electrical and Computer Engineering) teach a unique course on nuclear weapons and arms control. We will describe the features of the course, which include: team-teaching, interdisciplinary content across the arts and sciences, arts and engineering student enrollment, online instructional videos, in class participation, and engagement with CTBTO materials. This course has been very successful but is accessible only to UBC students. Our plan is to create a Massive Open Online Course (MOOC) accessible to the public. We will describe the current design of this proposed course, and the teaching technologies and methods used in its delivery. We will use the occasion of SnT2017 to invite input and possibly solicit potential partners and collaborators in this project.

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Presenter: SENS, Allen (University of British Columbia)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Hidden Potential of Nuclear Research Centres Collaborations

With the advent of the twenty-first century, science and technology development has been becoming increasingly more global. In order to accomplish large-scale agreements, such as the Comprehensive Nuclear-Test-Ban Treaty, it is important to get various stakeholders involved in the technology development and implementation. These stakeholders include university research groups, national laboratories, governments, and individuals themselves. However, even in such critical fields as nuclear weapons testing deterrence, the network of these stakeholders may have gaps of opportunity for collaboration and impact. This work focuses specifically on collaboration among researchers who are at either universities or national laboratories and work on nuclear weapons test ban monitoring and verification technology. The project uses the Thomson Reuters Incites Database to analyze the recent publication trends in the quantity and quality of co-publications among stakeholders. On the fundamental level, the network analysis provides insights into the central stakeholders and cooperation strength among various parties. On a more advanced level, the work identifies the gaps in collaboration that could lead to new, complementary partnerships, both in the various sub-fields and in between new stakeholders. Finally, by correlating various policy measures with the co-publication activity, we glean further insights on the effectiveness of those measures over time.

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Awareness of the Comprehensive Nuclear-Test-Ban Treaty in Nigeria

Nigeria has demonstrated her strong resolve to support the universality of the Comprehensive Nuclear Test Ban Treaty (CTBT) by signing the treaty in 2000 and ratifying in 2001. This is in addition to participation in international workshops and ministerial meetings. While much effort is being made at the international level, it is important to assess the level of awareness of Nigerians on the activities of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) in safeguarding the world from the threat of nuclear weapons and the treaty. Hence, this survey will in part 1, provide a snapshot of public awareness of CTBTO, nuclear weapons, its risks and effects. Part 2 will proffer solution for increasing public awareness of CTBTO in Nigeria.

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

of the International Monitoring System

The IMS (International Monitoring System) is a global network of monitoring facilities using different technologies: waveform (seismic, hydroacoustic and infrasound) and radionuclide (particulate and noble gas). It is designed to detect the waveform produced by nuclear test explosions and the subsequently released radioactive radionuclides. IMS stations transmit their data to the IDC (International Data Centre) in Vienna (Austria) through a private global network known as GCI (Global Communication Infrastructure). The operation of the facilities and the GCI are managed by the IDC Operations Section to ensure proper operation and performances of the stations and GCI and provide network oversight and incident management. Specific software tools are used for monitoring the stations' state of health and data quality, first level troubleshooting of incidents and reporting with internal and external stakeholders. Operations and management of the stations are managed through: support to the station operators to develop and implement tailored Operation and Maintenance plans for their stations; PCA (Post-Certification Activity) contracts; focus on the requirement for data quality (calibration of the seismic stations, QA/QC programme for radionuclide stations); training programme for station operators (joined effort of IDC and IMS Divisions).

Primary author: HAN, Dongmei (CTBTO)

Presenter: HAN, Dongmei (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

m-Science Systems for Engaging Broader Community to the Needs of Nuclear Test Monitoring and Verification

The CTBT serves humanity in both ways through promoting nuclear non-proliferation and disarmament as well as saving lives. Although its central mission is to detecting nuclear explosions, the huge data also provides tsunami warning and better understanding the nature. We propose here to introduce m-Science systems as such, comprising three main subjects of sensing, computing and dissemination of CTBT's scientific knowledge by the use of mobile devices. The usage of m-Science systems promote preparatory remote sensing, data collection, environmental monitoring which raises scientific awareness and promote education for all regarding CTBT's activities. In this paper, we propose how m-Science systems can be integrated with CTBT's IMS. In this way both party gets benefits, CTBT can disseminate its activities engaging broader community for public awareness and local users acting as sensor provides data to CTBT's national data centre. The resultant data analysis increases CTBT's credibility of monitoring and verification, ratification, exchanging knowledge and sharing advances in monitoring and verification technologies with its stakeholders. Local citizen gets CTBT's warning earlier about disaster. Integrating m-Science system to CTBT's activities can be a promising way to increase the better environment for humanity. Finally, we discuss the implications of the findings for research and practice

Primary author: HOSSAIN, Md. Dulal (Bangladesh Atomic Energy Commission)

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Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

of CTBT Academic Curricula in South-South Nigeria

About four years on, introduction of the CTBT Academic curricula in University of Benin, located in South-South Nigeria stimulated its fast spread to other parts of the region; despite the initial hitches. The successes recorded especially in South-South states of Rivers, Bayelsa, Cross Rivers and Delta states, bordering the Atlantic Ocean has been on steady rise. The geometric progression is also reflective of the zeal exhibited in both the teaching staff and students cutting across almost all academic disciplines. Results of structured questionnaires administered to more than 3000 respondents in the six states of the region, revealed that inherent potential research opportunities using IMS products and overall diversification of knowledge-based academic curricula, were central for the renewed acceptability. In spite of the impressive successes however, incorporation of CTBT Curricula in Nigerian higher institutions remains a challenge begging for attention. The CTBT Academic-related research in South-South has also thrown up specific questions on ease of access to CTBT materials, internet, and CTBT course accreditation etc. As integration of its activities gets momentum, strategic steps should be taken by relevant authorities within CTBTO to deliberately establish communication channels with Nigeria's educational authorities for the purpose of CTBT curricula integration.

Primary author: KADIRI, Umar Afegbua (Centre for Geodesy and Geodynamics)

Presenter: KADIRI, Umar Afegbua (Centre for Geodesy and Geodynamics)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

in Ground-Based Nuclear Explosion Monitoring Research and Development

There have been significant technological and scientific revolutions in the fields of seismology, acoustics, and radionuclide sciences with regard to the Comprehensive Nuclear Test-Ban Treaty (CTBT) which opened for signature in 1996. It is valuable to pause now and observe the arcs of progress evident in the body of research results reported in the literature related to improving monitoring capabilities. A recent document entitled “Trends in Ground-Based Nuclear Explosion Monitoring Research & Development – A Physics Perspective” reviews the accessible literature for four research areas: source physics (understanding signal generation), signal propagation (accounting for signal changes with distance), sensors (recording the signals), and signal analysis (processing the signals). The document addresses over 40 trends, such as moving from 1D to 3D earth models, from pick-based methods to full waveform methods, and from separate analysis of sensor data to integrated analysis. Highlighted in the document for each trend are the value and benefit to the monitoring mission, key papers that advanced the science, and promising research and development for the future.

Primary author: MACEIRA, Monica (Oak Ridge National Laboratory)

Presenter: MACEIRA, Monica (Oak Ridge National Laboratory)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

of Nuclear Energy and the Lack of Strategic Governance for the Elimination of the Explosions and the Decrease of Collateral Risks

This research performs an analysis of the flaws in governance systems and public policies concerning the prohibition of nuclear tests in the world, as well as their contradictions and impacts. Since there is a dangerous and contradictory discussion that many governments make of nuclear energy, this discussion does not adequately recognize the negative effects of nuclear energy and its explosions, which produce radioactive wastes with almost null elimination, and which have irreversible consequences for the planet and their ecosystems. Added to the collateral damage of uranium production and uranium enrichment. The lack of global governance and the absence of government policies in this topic involves a risk for world peace and security, and involve a challenge to the Comprehensive Test-Ban-Treaty Organization (CTBTO).

Primary author: SANCHEZ C., Julieta E. (Universidad Juárez del Estado de Durango)

Presenter: SANCHEZ C., Julieta E. (Universidad Juárez del Estado de Durango)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

Monitoring Stations as an Interim Step to Ratifying the CTBT in the Middle East and Southern Asia

Eight Annex 2 countries must ratify CTBT in order for it to enter into force; five of these are located in regions of the world challenged by longstanding interstate conflicts that are intimately tied to nonproliferation and disarmament efforts. The CTBT's ratification by these five countries would lay the groundwork for broader regional peace and stability. In spite of strong rationale for ratification, countries in the Middle East (Egypt, Iran, and Israel) and Southern Asia (China, India and Pakistan) are yet to do so. Nevertheless, Treaty ratification is not the only way to support the objectives of the CTBTO. There is room to lay the groundwork and facilitate its entry into force. Therefore, an international group of CTBTO Youth Group members at CNS is exploring interim measures outside of signature or ratification that would still move momentum for the treaty forward. Specifically, the aim of this paper is to examine how hosting IMS stations in the above mentioned countries could advance CTBTO's objectives. We will use our perspective as scholars from Annex 2 countries to deepen the relevance of our findings. As members of the next generation of nonproliferation experts, we intend to make a unique contribution to this conversation.

Primary author: BIDGOOD, Sarah (Center for Nonproliferation Studies)

Presenter: BIDGOOD, Sarah (Center for Nonproliferation Studies)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

Angle for Promoting Nuclear Test Ban

The end of 2016 became a true political challenge for the arms control community. New US administration with its tough nuclear rhetoric seriously affected the widespread optimism about the potential momentum for the CTBT ratification by one of the most important Annex 2 States and the impetus for others to follow suit. Before November 2016 there was an actual prospect of catalysing the CTBT EIF. Now any political progress in CTBT-related issues is most likely frozen for the next 4 years. Nevertheless, this gives the arms control community the opportunity to take a step back from politics and look at how to promote CTBT EIF from another angle. It's high time we thought of new platforms that can be involved in CTBT discussion. Within the next 4 years our efforts might be focused on the following: - education courses for potential diplomats of the Annex 2 States/summer schools - new international platforms to promote CTBT (f ex Shanghai Cooperation Organisation that has three Annex 2 States as members, one as an observer and one applied for observer status) - involving youth in promoting CTBT by forging partnerships with other youth organisations (f ex the UN Youth) and major youth platforms

Primary author: SHAVROVA, Anastasia (CTBTO)

Presenter: SHAVROVA, Anastasia (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

and Advances in Implementation of CTBTO Facilities and Supports in Senegal

Senegal has adopted the CTBT, fully ratified in 2001 and by the way, a seismic station has been established and a National data Center during the period 2006-2011. Since 2013, the cooperation is strengthened in the field of human resources development, and equipment providing in regard to help the government to fulfill its role and responsibilities on behalf of the treaty, but, in the same time, a new consideration and apprehension are established with university, professional and government in a very benefit manner, for the CTBTO and for Senegal

Primary author: DATH, Cheikh Amadou Bamba (Direction des Systèmes Informatique de l'Université cheikh Anta Diop de Dakar (UCAD))

Presenter: DATH, Cheikh Amadou Bamba (Direction des Systèmes Informatique de l'Université cheikh Anta Diop de Dakar (UCAD))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Policies and Global Strategic Governance for Planetary Sustainability, Control of Nuclear Energy and the Elimination of Nuclear Tests

This research conducts an analysis of the production of nuclear energy, the nuclear tests and its negative impacts on the planet. Currently there is a dangerous and contradictory discussion that many governments make of nuclear energy, showing it as an energy that does not contribute to the generation of CO₂, which reduces dependence on the use and exploitation of hydrocarbons, justifying less damage to the environment. But this discussion tries to cover up and does not mention the negative effects of nuclear power and explosions, which produce radioactive waste with almost no elimination. Nuclear power plants are subject to human accidents and failures that have irreversible consequences, coupled with the collateral damage of the nuclear tests and nuclear energy production. This analysis makes a proposal for better forms of global governance that will influence government policies in favor of strategies to improve global sustainability.

Primary author: SAENZ SANCHEZ, Erasmo Adolfo (Physics student, UNAM)

Presenter: SAENZ SANCHEZ, Erasmo Adolfo (Physics student, UNAM)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

IS35 and AS067 IMS Infrason and Auxiliary Seismic Station in Tsumeb, Namibia

The IMS IS35 infrason station located in Tsumeb, Namibia is managed by the Geophysics Division of the Geological Survey of Namibia. Located at the Geophysical Research Station in the northern part of Namibia 16km east of Tsumeb, an established mining town, the station is locally managed by a Chief Geotechnician assisted by a geotechnician. Conditions are wet in the summer months and extremely dry in the winter months presenting various natural hazards. The station is also 70km from one of Africa's best known wildlife parks known as Etosha National Park. Although the station is primarily an Infrason station, the USGS has an auxiliary seismic station, AS067, also managed by the Geophysics Division with support from the USGS. Additionally, the station is also home to a long term neutron flux experiment and serves as a magnetic reference station. Although the station is in a remote area, it still provides an excellent venue with its infrastructure for regional capacity building programs as well as driving public awareness on the Comprehensive Nuclear Test-Ban Treaty. This poster will illustrate in particular detail the various activities and geophysical experiments located at the Tsumeb Geophysical Research station.

Primary author: TITUS, Nortin Peter-David (Geological Survey of Namibia)

Presenter: TITUS, Nortin Peter-David (Geological Survey of Namibia)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

in Support of International Treaties and Sustainable Development Goals

Though the CTBTO verification regime is not equipped and designed to solve many the issue that accompanied in International Treaties and Sustainable Development Goals of UN, the CTBTO centralized approach confirmed the necessity of similar framework to address the global issues, preferably adding and building required tools around the CTBTO system while maintaining its authentic core function, simultaneously facilitating the global and noble desires. specific International Treaties address concerns on cross-border pollution, ballistic missile testing, air-space violation to migratory species, which physical characters such as thermal and noise components are involved. As CTBTO, over the decades, become masters of waveform analysis, re-configuring the existing facilities via adding necessary components would be very feasible towards facilitating these International Treaties. Fresh water availability, food security and clean energy seem to be the main pillars of the UN Sustainable Development Goals. Well-developed centralized system of CTBTO, with added components, will enables to address many concerns associated with these main basic requirements along with forecast of possible threat to the same via natural disasters. An upgraded centralized CTBTO system enables to cater International Treaties and UN Sustainable Development Goals putting many things in proper order additionally “putting an end to nuclear testing”.

Primary author: DE SILVA, Nalin (Geological Survey and Mines Bureau (GSMB))

Presenter: DE SILVA, Nalin (Geological Survey and Mines Bureau (GSMB))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

Methods: Using Art and Science to Explore the Nuclear Legacy of the Marshall Islands

This talk presents recent projects that combine art and science to assess the impacts of the 67 nuclear weapons tests conducted in the Marshall Islands by the United States. An award-winning documentary on this topic, produced by Columbia University students, will be screened. Also covered will be the adventures and findings of a recent three-week boat journey in the Marshall Islands, undertaken by the same student group, in order to conduct a radiological assessment atolls contaminated during the U.S. nuclear testing program.

Primary author: BORDNER, Autumn (Stanford University)

Presenter: BORDNER, Autumn (Stanford University)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Denuclearization in South Pacific: Failures and Successes after 30 years

On 6th august 1945, when the B29 Enola Gay took off from Tinian in the Northern Mariana Islands to drop nuclear bomb on Hiroshima, it changed the balance of power of the international system, which divided the world into two: nuclear weapon states and non-nuclear weapon states, thereby altering the discourse of the conventional idea of security. In this course of series, worst victim became the small islands states of south Pacific, site of most of nuclear tests and later it turned as prominent destination for dumping of radioactive wastes from all over the world. It hampered the bio-diversity of the region and degraded the environment. The Rarotonga treaty (1986) was a just voice against such oppression. The treaty declares south pacific zone largely as denuclearized. The approach to Regional Denuclearisation is a commitment to ensure no testing, manufacture or possession any sort of nuclear weapon. In this scenario, the paper attempts to review the treaty of Rarotonga by comparing it with other NWFZs in the world, assess its performance and how this model can be emulated globally. Finally, this paper attempts to find out how the great powers, especially U.S., China and Japan, are reacting to this endeavor.

Primary author: BASAK, Sweta (Jawaharlal Nehru University)

Presenter: BASAK, Sweta (Jawaharlal Nehru University)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Public Awareness of the CTBTO/ CTBT Among Youth

For the CTBTO to enhance public awareness of the CTBT among youth, social media must be the primary focus. It's harder than ever to capture people's attention with social media because of its ephemeral nature, so our message will educate young people in a fast, easy and effective nature. The public information campaign would start with a minute long, simple, video informing people about the risks of nuclear weapons, and the role of the CTBTO. Once this video is out, with the help of various mediums, we will organize a global march, similar to the Women's March, or the 1970's global protests against nuclear weapons testing, which will increase the public's knowledge of the influential role of the ratification of the CTBT, causing it to become a trending topic on social media. These two movements would increase their social media base, and once their base is increased, they can continue to educate citizens on a much larger scale through vehicles such as Facebook, Snapchat, Twitter, and a hashtag. In the long-term this would become a driving force in causing the subject of ratifying the CTBT to become a topic of increased political importance encouraging more governments to ratify the treaty.

Primary author: MCCARTER, Bronwyn (University of British Columbia)

Presenter: MCCARTER, Bronwyn (University of British Columbia)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Cycle On-Site Inspection (OSI) Surrogate Inspector Training: Positive Outcomes on the Local Level

The 3rd OSI surrogate inspector training cycle started with a 14 day introductory course during October 2016 in Slovakia followed by a seven day course on Health, Safety and Security in The Hashemite Kingdom of Jordan. The training impact can be a challenge to measure, maybe impossible. Trainers and trainees can develop a feel for this measure using a two-tier concept, namely: 1. Increase the probability of conducting “successful” OSI missions. 2. Methodology, topics and tools that are applicable to trainees to effect positive change in their workplaces. A successful mission can only be declared or defined once a real OSI mission took place and include the training impact. This then remains impossible to measure. To illustrate a measure of impact on point 2, Crustal Geophysics, a newly formed sub-division in the Geophysics Division of the Geological Survey of Namibia is used as an example. This sub-division is tasked with seismology and all CTBTO related matters. Methods, tools and concepts learned in the 3rd training cycle was applied to this sub-division to lay the foundation for a new staff structure as well as promoting a “safety first” culture in the sub-division.

Primary author: TITUS, Nortin Peter-David (Geological Survey of Namibia)

Presenter: TITUS, Nortin Peter-David (Geological Survey of Namibia)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

of Scientific Community in Promoting the CTBT

The objective of the paper is to examine the role of scientific community in promoting the CTBT. The crucial role scientists played as public intellectuals, policy influencers, and community leaders in shifting nuclear weapons policies and helping to build the international nuclear nonproliferation regime—including CTBT—remains understudied in policy scholarship. The CTBT’s historical antecedent—the Partial Test Ban Treaty—is an exemplar of how “policy entrepreneurship” by scientists and advisers (e.g. Bush, Killian, Seaborg) helped to create conditions conducive to a pro-test-ban policy that eventually culminated in the CTBT, against the influence of anti-test-ban advocates (e.g. Strauss, Teller) The paper will address three areas. First, it will examine the role of the scientific community’s “policy entrepreneurship” played in bringing about the CTBT. Secondly, it will draw contrasts between the political and scientific opposition pro-test ban advocates faced in their time and the CTBT regime faces at present. Third, it will identify lessons from history on how CTBT and the scientific community can help build similar synergies in non-ratifying and non-signatory states; particularly focusing on the current state of affairs in the U.S., the geopolitical situation in the Middle East and South Asia, and the climate-change discourse around the Small Island Developing States initiative.

Primary author: SAZAK, Selim Can (Brown University)

Presenter: SAZAK, Selim Can (Brown University)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

of Raising Public Awareness about CTBT

CTBTO has been coping with and developing its educational activities and resources from various aspects so that these can contribute to achieve the treaty to enter into force through raising public awareness. Examples of practical education resources are as follows, Knowledge and Training Portal (KTP) whose various courses help users learn about the CTBT specifically, Global Partnership with institutions and universities all over the world, iTunes U page, symposiums and forums. Furthermore, those who have been involved in the CTBT through its education courses and events are not only scientists, experts, diplomats but also students study many fields respectively. Events such as launching its Youth Group involving the next generation have nurtured and encouraged young people who would play an important role in the future. Overall, these various education courses have been providing deep specialization for a large number of people around the world freely. Since the CTBTO has been proactively corresponding to new methods and ideas of education, these are continuously contributing to raise public awareness and to deepen knowledge about the CTBT in order to further its entry into force.

Primary author: KURAMITSU, Shizuka (CTBTO Youth Group)

Presenter: KURAMITSU, Shizuka (CTBTO Youth Group)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

Refreshment of IMS SHI Stations

The availability of new technologies on the market presents an opportunity to enhance present functionality, resiliency, redundancy, and thus, overall reliability of IMS SHI stations, which are nearing the need of major recapitalization. Redesigned power and communications components introduce new remote monitoring capabilities with improved preventative maintenance measures. In addition, deployment of next generation data acquisition systems and instruments presents strong potential for improved data quality, event detection capability, and processing at the IDC. In order to materialize these opportunities, a series of call-of Contracts were established to facilitate the procurement of the necessary equipment and Engineering services.

Primary author: JUSKO, Marian (Comprehensive Nuclear-Test-Ban Treaty Organization)

Presenter: JUSKO, Marian (Comprehensive Nuclear-Test-Ban Treaty Organization)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Significance of National Data Centres Established in West Africa

The establishment of National Data Centres (NDC's) by member states helps in the monitoring and verification efforts of the Comprehensive Nuclear Test-Ban Treaty Organization (CTBTO). The core mandate of the CTBTO is to ban all nuclear test explosions. Almost all the West African countries have signed and ratified the CTBT. Ghana being a signatory and a ratified member state of the organization established its National Data Centre in February, 2010. To monitor nuclear test explosions, systems built on the principles of seismic, infra-sound, radionuclide and hydro-acoustic technologies are installed worldwide to record and monitor man-made and natural events. Ghana is a beneficiary, as it uses the seismic data obtained from the International Data Centre to monitor earthquake activities in the country complementing the efforts of the Geological Survey Department of Ghana. The West Africa sub-region has experienced some devastating earthquakes in the past though far from the major plate boundaries. The NDC's established in the region are therefore making good use of the data received from the International Monitoring System and products from the International Data Centre to monitor its seismic activities. The infrasound technology has as well been introduced in the sub-region.

Primary author: AMPONSAH, Paulina Ekua (Ghana Atomic Energy Commission)

Presenter: AMPONSAH, Paulina Ekua (Ghana Atomic Energy Commission)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

into the Power: Public Awareness of the CTBT Through Grassroots Coalition Building

How can the CTBT gain public awareness within the information-flooded global media? By tapping into preexisting religious, medical and nonproliferation networks, young CTBT advocates can reach a larger audience without building these networks from scratch. This presentation addresses these communities and proposes steps for coalition-building within each area. First, it examines the religious community's ties to the issue by examining nuclear condemnation expressed by Christian, Islamic, and Buddhist faiths and their religious basis to support the CTBT. By engaging in dialogue with religious leaders and urging them to publicly support the treaty, we can increase exposure through religious networks. Second, it examines the medical community's connection to the issues of radiation and cancer fallout. Young CTBT activists should engage with local medical schools to highlight public support for a test ban within this community to increase public awareness. Finally, it examines the nonproliferation network's role in coalition building by providing recommendations for how to petition preexisting advocacy groups to include the CTBT in their platforms. Specifically, it examines nonproliferation groups with youth outreach (Global Zero student chapters, ICAN Youth Academy, etc.) and explores ways CTBTO Youth Group can connect with these young advocates to share resources and engage in cross-promotion.

Primary author: GAUTAM, Brenna (Georgetown University Law School)

Presenter: GAUTAM, Brenna (Georgetown University Law School)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

Analysis for the SHI Networks

The International Monitoring System (IMS) is one of the four elements of the CTBTO verification regime. A part of the IMS is composed of seismic, infrasound and hydroacoustic stations participating to the underground, air, and underwater explosions monitoring. The minimum requirement in term of data availability (DA) for each of station is 98%. This means that each station should be able to send its data to the International Data Center (IDC) over 98% of the time, regardless of the challenging environment they are facing. When an issue occurs at a station, solutions are discussed through the IMS Report System (IRS). All the information gathered in the IRS are then processed in order to present statistics on the failure causes with the aim of taking actions from the lessons learned. Failure analysis are performed on a six-month basis since Nov. 2011 with the objective of triggering the required engineering activities, verifying that the implemented engineering solutions led to improvements on reliability, initiating further analysis when needed (root cause analysis) and using trends to anticipate future failures. The poster presents the approach of the analysis, the limitations and lessons learned from the past five years, and propose perspectives for complementary actions.

Primary author: SID AHMED, Yacine (CTBTO Preparatory Commission)

Presenter: SID AHMED, Yacine (CTBTO Preparatory Commission)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

VNIIA Activities Related to CTBT Technologies

FSUE "VNIIA" is the leading organization of the State Atomic Energy Corporation "Rosatom" regarding the aspects of the implementation of the CTBT. It currently carries out activities in the following directions: - Repair and modernization of technical equipment at International Monitoring System (IMS) stations located on the territory of the Russian Federation; - Scientific and methodological support of on-site inspection; - Identification of questionable events that might indicate a possible non-compliance with the CTBT. Some results will be discussed: - Upgrading of software for training systems with regard to methods and procedures for on-site inspection (OSI), making use of technologies such as the geographic information system ArcGIS, the WEB management system CartoPac, and interfacing with the CTBTO PrepCom information management systems FIMS and IIMS; - Studies of the trend in the concentration of Xe isotopes measured at IMS stations; - Development and installation of new equipment for monitoring Xe isotopes at the RN58 IMS station ; - Estimating corrections of yields for North Korea tests was made by the method developed at VNIIA to calculate the average magnitude using station's corrections for underground nuclear explosion (UNE).

Primary author: ZASIMOV, Gleb (All-Russia Research Institute of Automatics named after N.L. Dukhov (VNIIA))

Presenter: ZASIMOV, Gleb (All-Russia Research Institute of Automatics named after N.L. Dukhov (VNIIA))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

Similarities and Differences of Signals Measured by IMS Stations from Five DPRK Underground Tests

Primary and auxiliary seismic stations of the International Monitoring System detected seismic signals from five declared underground tests conducted by the DPRK. These data allow thorough quantitative comparison aimed at understanding of the similarities and differences in seismic wave generation by underground explosions. In routine automatic and interactive processing, the International Data Center found all five events, estimated absolute locations and magnitudes together with their uncertainties. The International seismological centre makes these results available for the broader monitoring community. In this study, we extend the estimates of relative characteristics of detected signals to station level using standard methods adapted at the International Data Centre (IDC). In addition, we apply several techniques based on waveforms cross correlation (WCC), which are under development at the IDC. The WCC method allows significant improvement in the accuracy of relative location, magnitude, and seismic moment tensor estimation.

Primary author: KITOV, Ivan (CTBTO)

Presenter: KITOV, Ivan (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

of the IMS Seismic and Hydroacoustic Stations Using Standard Station Interface (SSI) Software

Standard Station Interface (SSI) calibration module is a tool for execution of instrumental calibrations and review of calibration results. SSI supports main digitizers used by the IMS network: Guralp DM24, Nanometrics Europa-T and Quanterra Q330 and MariPro hydroacoustic station. SSI Calibration Command Line Interface (CLI) is a collection of 17 comprehensive programs which allow a user to execute calibrations from the Unix console and via IMS2.0 protocol, compare waveforms and responses from multiple calibrations and channels, update channel calibration value in SSI and digitizers. SSICalibrationGUI is an intuitive front end to CalibrationCLI which allows users execute calibrations locally and remotely, view waveforms and calibration responses, and generate IMS2.0 calibration messages. Calibration Module supports the Station Operator over the whole operational procedure of calibration, including the timely exchange of authenticated Command and Control messages, definition of a calibration scenario, performance of calibration task, and evaluation and publication of calibration results. Main purpose of SSICalibration Module is to support the operationalization / standardization of both scheduled and un-scheduled calibration of IMS Seismic and T-phase stations. Module was deployed at a few pilot stations in 2016, and PTS plans on deploying it at many other stations in 2017/2018. The module undergoes continuous improvements.

Primary author: MILJANOVIC TAMARIT, Vera (CTBTO)

Presenter: MILJANOVIC TAMARIT, Vera (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

Scientific Insights into Disarmament Policy: Science Advice at the Organisation for the Prohibition of Chemical Weapons

Thursday, June 29, 2017 4:00 PM (15 minutes)

From definitions of weapons, to articles governing verification of compliance, inspection, and assistance, science and technology underpin international disarmament treaties. Both treaty negotiation and implementation require sound technical advice to inform policy; requiring scientific advisers. Despite this need for science in disarmament, the two worlds are often at odds. The Chemical and Biological Weapons Conventions serve to illustrate this tension, where to some, scientific developments raise concerns about misuse potential and security risk, while others see opportunities for innovation in treaty implementation and solutions to pressing global issues. Science is only one of many dimensions that policymakers must consider in decision making, yet the world's current security environment shows a need for scientifically literate policymakers and scientist-policymaker engagement that has never been greater. Actionable science advice for policy requires experts capable of clearly communicating with those receiving advice. In this regard, the Chemical Weapons Convention (CWC) serves as a case study on involvement of scientists in treaty negotiation, compliance verification, providing advice to policymakers, and as science communicators to policymakers. We will discuss experiences and lessons learned from the CWC's science advisory mechanism; lessons informative for nurturing the science-policymaker engagement required to meet current and future disarmament challenges.

Primary author: FORMAN, Jonathan (Organisation for the Prohibition of Chemical Weapons)

Presenter: FORMAN, Jonathan (Organisation for the Prohibition of Chemical Weapons)

Session Classification: T5.1 Science in Support of Global Policy Decisions

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

Roles of Global Verification and On-Site Verification

Thursday, June 29, 2017 4:15 PM (15 minutes)

Global Verification extends far beyond the standard tools of International Monitoring System (IMS), and act as the common platform for public interaction; a platform to share knowledge. The tools of Global Verification regime would be a library of knowledge varying from physical earth characters to possible physiological behaviour of a would-be Inspected State Party. Whereas, On-Site Verification is a specialized and robust operation, confined to specific expertise, due to strict code-of-conduct and sensitivity of the outcome. The two entities, marry effectively forming a continuous process towards successful verification via IMS products. On a specific event, IMS products along with Global Verification tools produces an effective framework for OSI initiation. The whole process is a continuous flow zooming into the area of interest, adding layers as progress, towards fruitful On-Site Verification. Considered the developing trends of remote sensing techniques, the challenges on evolving a full-fledged remote Global Verification mechanism hardly a technical aspect, yet political, as constrains will be imposed on usage of the technology under the pretext of “national security”. However, identifying the Global Verification norms in its practical domain and appropriate linkage with the On-Site inspection tools and functionality, enables to overcome many the challenges that Verification demands.

Primary author: DE SILVA, Nalin (Geological Survey and Mines Bureau (GSMB))

Presenter: DE SILVA, Nalin (Geological Survey and Mines Bureau (GSMB))

Session Classification: T5.1 Science in Support of Global Policy Decisions

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

to Basics: Building the Next Generation of Indian Nuclear Experts

The Institute of Peace and Conflict Studies, where this author works, aims to bring clarity to Indian nuclear policy through its Annual Residential Young Scholars' Nuclear Workshop (YSW), which it has conducted since 2008. It is the only workshop of its kind in India, and perhaps in South Asia, that offers an education on nuclear fundamentals through both political and technical instruction. In India, information conveyed to the press on nuclear issues is tightly controlled and quite immune to clarification. This has played into the observation that almost all YSW participants have never been inside a nuclear reactor, or near reprocessing. Consequently, the knowledge of nuclear basics is weak, buttressed by a parochial discourse that seems to reinforce the limited knowledge provided. To address this gap, IPCS seeks to add a new module to the YSW curriculum: virtual reality-based simulations, such as security of installations, on-site CTBT verification, etc. This presentation will explore why this critical for nuclear learning, why it is especially relevant for Southern Asia, and use this as the basis for future collaboration with scientists who use 3D modelling and other interactive nuclear tutorials. The CTBTO's SnT conference would allow the most ideal platform for this cross-pollination.

Primary author: NEOG, Ruhee (Institute of Peace and Conflict Studies (IPCS))

Presenter: NEOG, Ruhee (Institute of Peace and Conflict Studies (IPCS))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

Seismic Travel Time Evaluation, Training and Outreach

The Regional Seismic Travel Time (RSTT) model reduces travel time prediction errors for phases (Pn, Pg, Sn, and Lg) which are commonly used for seismic event location. Reduction of travel time prediction errors leads directly to reduction of epicenter location errors, and accurate event location is critical to Comprehensive Nuclear-Test-Ban Treaty (CTBT) verification. The Provisional Technical Secretariat (PTS) and several CTBT States Signatories have conducted tests of RSTT on the International Data Centre (IDC) system and found that epicenter errors are measurably reduced when the location data set consists of more than approximately 20% regional phases, i.e., events with seismic magnitude equal to and less than approximately 4. Further tests indicate that RSTT does not adversely affect the IDC association algorithm, demonstrating that implementation of RSTT at the IDC would be a net benefit to the system. The PTS has incorporated RSTT into international training since 2012. Twelve PTS training and professional-meeting special sessions have featured RSTT. The presentation will review RSTT international collaborations and detail the effort to establish RSTT as a standard for the calculation of regional seismic travel times.

Primary author: MYERS, Stephen (Lawrence Livermore National Laboratory)

Presenter: MYERS, Stephen (Lawrence Livermore National Laboratory)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

CTBT as a useful tool for Myanmar's students in Nuclear Age

Myanmar is actively enhancing its nuclear science and technological programmes to support the peaceful application of nuclear science and technology for socio-economic development. Myanmar college students, unfamiliar with the intergovernmental organizations and regimes in place to reduce the dangers of nuclear weapons, tend to hold an ethnocentric perspective on nuclear weapon issues. Therefore, the use of CTBT educational materials such as CTBTO's e-learning platform in the teaching of nuclear engineering courses at the Technological University (kyaukse) was introduced in 2016. Graduate students were introduced with the CTBT materials as general reading materials for the introduction of four monitoring technologies used by the CTBTO: seismic, radionuclide, hydro acoustic and infra-sound monitoring. Some of these students went on to register to get access and even attempted some of the quizzes. The CTBT serves as a useful tool with which to learn and/or discuss a variety of topics, including the threat of nuclear proliferation, the use of diplomacy, the art of negotiation, the functioning of international organizations, and the impact of science and technology (SnT) on international relations. And we looked closely at how SnT affected the negotiations of the Treaty over its history, and how it is affecting the Treaty's ratification today.

Primary author: WIN, Thu Zar (Nagasaki University, Japan)

Presenter: WIN, Thu Zar (Nagasaki University, Japan)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

of the Capacity Building System (CBS) in Zambia's NDC

In April, 2016, CTBTO came to Zambia to configure and install the Capacity Building System at our National Data centre (NDC) office. The National Data Centre was commissioned in February 2006, inZambian. With this new Capacity Building system that comes with some analysis programs, it has made our work much easier in analysis, getting data from other surrounding Countries and come up with a precise location of the earthquake. The Importance of setting up the national Data Centre is to enable us to constantly monitor, manage and coordinate both natural and man-made seismic activities in the country and around the globe. Also, uploading data to the international Data Centre (NDC), as well as receiving by using international Monitoring System (IMS) data and also IDC products for the treaty verification. We access and analyze seismic waveforms, relevant to the International Data Centre and also make the data available to its stakeholder institutions for earthquake disaster mitigation and reporting on all aspects of disaster related to government agencies. NDC staff makes recommendations to the government of Zambia on earthquake safety measures to provide information to assist government institutions on appropriate land and building policies and submit data to its agencies.

Primary author: CHAFWA, Gift (MINISTRY OF MINES AND MINERALS DEVELOPMENT)

Presenter: CHAFWA, Gift (MINISTRY OF MINES AND MINERALS DEVELOPMENT)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Between Cameroon, CTBTO and Others Parties: Capacity Building, Education and Public Awareness

Cameroon has adopted the CTBT, fully ratified in February 2006 and by the way, a Radionuclide Station and a National Data Center have been established during the period 2006-2007. Since 2008, the cooperation is strengthened in the field of human resources development, and equipment providing in regard to help the government to fulfill its role and responsibilities on behalf of the treaty. One of the responsibilities of each state signatory is to develop capabilities in order to assist it detect clandestine nuclear explosion tests and to use the IMS data, the IDC products or other CTBT relevant information for research, training, increasing public awareness, application in civil and scientific purposes. For this, the NDC was strengthened with the support of the CTBT capacity building, the e-learning training courses who can be attended at any time and the workshops. Cameroon, like several other African countries has benefited several training capacity building and workshops to enhance the exchange knowledge and ideas between the CTBT and the broader scientific community. The internal training sessions were organized and a new consideration or apprehension are established with university, professional, rural or local organizations and government in a very benefit manner for CTBT and for Cameroon.

Primary author: NADINE YOLANDE, Djuissi Seutchueng (Institute of Geological and Mining Research (IRGM))

Presenter: NADINE YOLANDE, Djuissi Seutchueng (Institute of Geological and Mining Research (IRGM))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

Synergy Between IMS Data and Local Data: Verification, Detection Threshold and Local Applications

Combining IMS seismological data with data from local and regional seismographs can provide many benefits to NDCs. We will provide three different examples from the Danish NDC: a) verification of the DPRK nuclear tests, b) identification of conventional explosions in the Danish territorial waters, and c) using IMS data to determine the depth of small Danish earthquakes. The Danish NDC operates five BB seismographs in Denmark, and jointly with partners in the GLISN project 20 BB seismographs in Greenland. In daily operation data from selected Norwegian and Swedish stations are included. The recent nuclear tests by DPRK were clearly recorded in Greenland as well as in Denmark, and we were able to locate the events quickly using our own data exclusively, thus providing a completely independent validation. The precision was improved when including IMS data. All processing at the Danish NDC is carried out using the SeisAn processing package. Data from IMS is downloaded and imported into SeisAn. This is feasible when including smaller amounts of IMS data. For full integration between local data processing and IMS waveforms as well as bulletin data, it would be desirable to have a direct link between NDC-in-a-box and SeisAn.

Primary author: LARSEN, Tine Birgitte (Geological Survey of Denmark and Greenland (GEUS))

Presenter: LARSEN, Tine Birgitte (Geological Survey of Denmark and Greenland (GEUS))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Educational Materials as a Tool for Sensitization and Internal Training

Globally, one of the foremost multilateral treaties established by the United Nations (UN) to verify nuclear explosion activities around the world is the Comprehensive Nuclear-Test-Ban Treaty (CTBT). The Treaty bans any nuclear explosions anywhere by anyone on the planet. Compliance to the nuclear test ban requires understanding of the Treaty's relevance and contribution to international peace and security. CTBT educational materials as a source of information are available on the CTBTO web-portals, give focus on "building and maintaining the necessary awareness and capacity in the technical, scientific, legal and political aspects of the Treaty and its verification regime" for enriched knowledge. These educational materials are accessible to technical staff and the public through various e-learning courses and programmes that serve as useful tools to provide the requisite knowledge and understanding of the Treaty issues. Regular participation in CTBTO organized courses such as 2013 Diplomacy and Public Policy; 2012 Advanced Science; 2012 Intensive Policy; 2011 Advanced Science; and 2011 CTBT Introductory, help to sensitize and stimulate broader understanding of the Treaty and its verification regime which aided the successful conducts of internal training at NDC-Ghana.

Primary author: AMARTEY, Edmund Okoe (Ghana Atomic Energy Commission)

Presenter: AMARTEY, Edmund Okoe (Ghana Atomic Energy Commission)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Knowledge Generated by CTBT in Teaching Nuclear Science and Engineering

Worcester Polytechnic Institute is committed to the education and training of scientists for the needs of the new century by connecting science content to issues of critical local, national, and global importance. In our recently developed curriculum in the Nuclear Science and Engineering field, we have integrated CTBT as a tool to illustrate and discuss a variety of topics including new advances in sensors networks and processing, case studies of events and characterizations, the threat of nuclear proliferation, and the impact of society and technology on international relations. The integration of the CTBT as a tool in teaching Nuclear Science and Engineering bridges the fundamental nuclear physics and engineering concepts to the global critical needs and better prepares students to successfully contribute to the global partnership.

Primary author: STROE, Izabela (Worcester Polytechnic Institute, USA)

Presenter: STROE, Izabela (Worcester Polytechnic Institute, USA)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Network in Papua New Guinea and the Utilization for the Benefits of the Local and Regional Monitoring Systems

ABSTRACT: Collaboration between CTBTO and Port Moresby Geophysical Observatory (PMGO) has reached extra heights in terms of achievements in IMS operated networks in Papua New Guinea. The regional seismic monitoring stations of IMS, one of which is located in Port Moresby, AS-75PMG including the National Data Centre (NDC) receive processed earthquake data at PMGO via internet from USGS-NEIC. The seismic data and results of analysis are shared freely by PMGO and other regional organization in global collaboration efforts to monitor and map the distribution of seismic activity in PNG region as well as the nuclear verification regime purposes. However, despite milestones reached in establishing other additional International Monitoring Stations (IMS) such as Infrasound Station (IS40), Radionuclide Station (RN51), Auxiliary Seismic Station (AS-76) throughout PNG, the mandated National Data Centre (NDC) remains to be revamped in terms of training and capacity building, Linux-software and hard ware upgrades, password for NDC access to IDC data and products, Tsunami Agreements Signing, and Ratifications Agreement Signing are some of the objectives yet to be achieved.

Primary author: KENTUO, Norris (Geophysical Observatory)

Presenter: KENTUO, Norris (Geophysical Observatory)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Training 2.0: From Training Analysts to Training NDCs

The CTBTO runs a Capacity Building and Training (CBT) Programme focused on providing technical assistance to States Signatories to enable their effective participation in the CTBT verification regime.

One of the major Programme components is training NDC analysts to access and use IMS Data and IDC Products. The ultimate goal is to prepare NDCs to act as technical advisors to their respective governments.

Over the years, the volume of requests for IMS Data, IDC Products, training courses and tools from NDCs has increased. The PTS continuously responds by (i) improving effectiveness of the training programme and (ii) improving existing and developing new software tools for the NDC-in-a-Box Package.

The improved CBT Programme aims to use available time and resources efficiently while promoting interactions among NDC analysts. In addition to focusing on individual analyst's skills, it will provide opportunities for the trainees to cooperate as an NDC in analysing events of interest using the IMS technologies and the different tools provided by the IDC (i.e. using scenarios of NDC Preparedness Exercises). To achieve this, a training programme incorporating progression from introductory to intermediate to advanced level courses with an opportunity for trainees to move through the levels has been introduced.

Primary author: AGREBI, Abdelouaheb (CTBTO)

Presenter: AGREBI, Abdelouaheb (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Pacific: An International Public Inquiry on French Nuclear Weapons Testing in French Polynesia

France conducted atmospheric and underground nuclear weapons tests on and around the atoll of Moruroa and Fangataufa in the Tuamotu Archipelago in French Polynesia between 1966 and 1996. The poster outlines a project for raising public awareness on the history and impact of these 193 tests through the establishment of an alternative commission of inquiry. It explores the legacy of the nuclear testing in French Polynesia through gathering spatial evidence in the form of maps, media and visualizations based on declassified and freely available environmental monitoring data. The historical material is supported by data collected from an expedition to the Tuamotu Archipelago aboard the research vessel of TBA21 Academy in July 2016. While it was not possible to access the former testing sites, the expedition conducted interviews with local veteran organizations, government officials and researchers in several islands. Further research is needed to assess current state of radiological and environmental impacts in French Polynesia as a historical case that can advance the prohibition of nuclear testing.

Primary author: AHMED, Nabil (Forensic Architecture, Goldsmiths University of London)

Presenter: AHMED, Nabil (Forensic Architecture, Goldsmiths University of London)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

Installation of IMS Hydroacoustic Station HA04 Crozet

The CTBTO's International Monitoring System (IMS) includes 6 hydrophone based monitoring stations. During 2016 the Engineering and Development Section within the IMS Division installed the final hydroacoustic station at the Crozet Islands, France. The installation of HA04 was a challenging ocean engineering and logistical undertaking due to the the Crozet Islands' location in the 'roaring forties' and that access to the islands is only possible by ship, with the nearest port nearly 3,000 km distant. The weather at Crozet is such that any marine operations have to be carefully planned and can only be conducted during a short Austral summer weather window, and even during this period hurricane force winds and large swells are encountered. To maximise the chances of a successful installation in these harsh maritime conditions required close attention to be paid to engineering details, underwater system design, risk management and the use of a state of the art cable ship as a deployment platform. The requirement for 20 years of operation without a maintenance interaction was a key driver in the station's design and its qualification testing. The station's design and its installation also had to take into consideration the environmental sensitivity of the Crozet Islands.

Primary author: ZAMPOLLI, Mario (CTBTO)

Presenter: ZAMPOLLI, Mario (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

and Operational Approaches Adopted for the Installation of IMS Hydroacoustic Station HA04 Crozet

The installation of HA04 Crozet took place during December 2016 in exceptionally harsh weather, which added a further challenge on top of the known local scenario that includes a complex bathymetry and strong underwater currents. A number of engineering and operational decisions adopted during the preparatory phases of this installation made it possible to manage the risks and contributed to the success of the mission despite these difficult environmental conditions. The collection of high resolution bathymetric data and currents measurements during the February 2016 preparatory cruise with the French Oceanographic and Supply Vessel Marion Dufresne II (MDII) made it possible to optimize the location of the hydrophone triplets and to confirm that the impact of currents on the hydrophone risers was mitigated by the chosen design. Furthermore, an analysis of 9 years of daily weather data from the local weather station, and the consideration of appropriate thresholds for installation operations, made it possible to identify together with the Contractor design improvements which enabled the safe deployment of the hydrophones in the presence of higher sea states. An overview of the above engineering and operational approaches is presented, together with video footage and photography illustrating the different phases of the work.

Primary author: ZAMPOLLI, Mario (CTBTO)

Presenter: ZAMPOLLI, Mario (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

Data Analysis of Earthquakes Received on the Newly Re-Established HA04 Hydroacoustic Stations of the CTBTO International Monitoring System

During December 2016, the Comprehensive Nuclear-Test-Ban-Treaty Organization (CTBTO) re-established the hydro-acoustic station HA04 close to the Crozet Islands in the Indian Ocean as part of the International Monitoring System's (IMS) world-wide, multi-technology sensor network. The station is composed of two triads of hydrophones located to the north and south of Possession Island. High quality hydro-acoustic data are being received continuously at CTBTO since the deployment of the station where signals from whale calls, earthquakes and radiated noise from transiting ships have been detected. In this presentation, emphasis is given to four earthquake events located on the Indian Ocean Ridge at a range of 850-2500 km to the north of the station and in an azimuthal direction of 145-205 degrees. Preliminary analysis of the propagation paths and received signal levels from the events to the station has been performed considering the complex local bathymetry and spatio-temporal variations in the water column sound speed. An assessment will be performed, to the extent possible, concerning the impact of these environmental factors on the propagation in this particular scenario with the aim of examining potential improvements to the International Data Centre's (IDC) automatic processing algorithms.

Primary author: NIELSEN, Peter Lourcing (CTBTO Preparatory Commission)

Presenter: NIELSEN, Peter Lourcing (CTBTO Preparatory Commission)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

CTBT as a Confidence Building Tool in South Asia

CBM and CTBT are interdependent where CTBT serves as a CBM but for CTBT to be successfully implemented CBMs need to be put in place. CBM is one of the four elements of the CTBT's verification regime and CTBT can provide a forum for exchanging information, data and facilitating cooperation and voluntary unilateral moratorium on testing is a key element of formal and informal CBMs and bilateral and/or multilateral CBMs. However, CTBT will need to adapt to the region and include States relevant to strategic chain of conversation even if not in the region. The basic obligation envisaged in Article I can form the basis of confidence building thereby reducing fears and nuclear war by miscalculation. A phrase describing burden of knowledge goes like this— "I ought never to have taken my lantern to see what was going on. On the other hand, there was no way, once I had picked up the lantern, for me to put it down again." The CTBT reminds us that nuclear tests are steps towards a possible use of nuclear weapons, which is contrary to international humanitarian and customary international law. We have the burden of knowledge and cannot ignore the responsibility knowledge bestows upon us.

Primary author: KUMARI, Deepshikha (UNIVERSITY OF OXFORD, UNITED KINGDOM)

Presenter: KUMARI, Deepshikha (UNIVERSITY OF OXFORD, UNITED KINGDOM)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Exhibition**

of Art Stations Information Management: Enhancing the Sustainment of the International Monitoring System Network

Operations and Maintenance of the facilities at International Monitoring System (IMS) is performed by the Station Operators with the required support at the Provisional Technical Secretariat. This is the sustainment strategy and it requires continuous knowledge of the facilities; the installed equipment and its configuration, the conditions at the sites and operating procedures. The IMS Operational Manuals in their Attachment III define the information items required by Station Operators and PTS to sustain the network. To fulfil this mandate, the PTS launched the Station Specific Documentation (SSD) Project. The project is designed to manage the development of up to date, validated, maintainable, re-usable station documentation, providing accessibility to the documentation simultaneously to all stakeholders. The project uses information management best practices avoiding data silos, with centralized data management where metadata and business rules are well defined. It presents a complete solution, easy to integrate with other applications and easy to use for all user cases. SSD project balances the three key intervention areas in information management; processes, people and technology. The paper presents in detail the current status of the SSD project and the way forward in enhancing the sustainment of the International Monitoring System based on information management.

Primary author: AKRAWY, Michael (CTBTO Prep Com / PTS)

Presenter: AKRAWY, Michael (CTBTO Prep Com / PTS)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Role of Small States in Monitoring Nuclear Explosions: The Case of Kazakhstan

There is no universally established definition of a “small state”, even though so-called small countries form a majority of UN members. In many respects, major powers have decisive impact on issues pertaining to international peace and security, while combined influence of small states on world affairs remains limited. However, as we observe more emphasis on multilateralism and concert-type arrangements, it is not infrequent that small states take responsible actions to promote a nuclear-free world. Being a typical small state, Kazakhstan, nevertheless, makes a major contribution to the treaty’s verification capacity building. Kazakhstan’s role in monitoring nuclear explosions is important as it is home to the five International Monitoring System stations. Moreover, the nation participates actively in CTBTO exercises by making available its nuclear expertise and facilities. Since 2012, Kazakhstan promotes the ATOM project, a campaign to raise public awareness and build global support for nuclear test ban. At Kazakhstan’s suggestion, the UNGA declared 29 August the International Day against Nuclear Tests to commemorate the closure of the Semipalatinsk Nuclear Test site. The case of Kazakhstan clearly demonstrates that a country’s perceived limited political, economic or military weight cannot prevent it from pursuing a bold agenda for achieving a safer world.

Primary author: ABEN, Dauren (Eurasian Research Institute)

Presenter: ABEN, Dauren (Eurasian Research Institute)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

and New Strategies of Youth Outreach

In the fields of diplomacy, politics, and security, there are few individuals who do not understand the importance of the CTBT. However, in order to pressure modern governments and organizations, there must first be public demand and public awareness of the issues that the CTBT works with. Current efforts to raise public awareness are insufficient, they are not targeting, or poorly targeting the youth population of the world. This opinions and priorities of this demographic will only become more important as they enter voting age, and attracting their attention to the CTBT is essential in the long term. This presentation seeks to first identify and explain flaws with current efforts regarding youth outreach. The presentation will then to explain methods and strategies that can be used by governments, universities, and other organizations to better attract and retain the attention of young people to the efforts of The Comprehensive Nuclear-Test-Ban Treaty.

Primary author: BAI, Ziheng (University of California)

Presenter: BAI, Ziheng (University of California)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Education on CTBT in Beijing Language and Culture University

I have two regular courses for more than ten years in school of IR, BLCU, which are “International Security” for undergraduate students, and “Arms Control & International Security” for graduate students. Since 2012, after I attended the CTBTO academic conference for my first time, I have purposely integrated CTBTO online courses into my regular courses. There are three major approaches to teach CTBT. Firstly I used three weeks to introduce the background, history, achievements and obstacles of the CTBT. Meantime, students were required to read broadly about the CTBT review, monitor techniques and procedures mainly from the CTBTO website. Secondly, we discussed and debated on some specific questions in class. Finally, students were encouraged to take part in the CTBTO online courses.

Through diversified teaching, CTBT has attracted more and more young students' attention. Nearly one hundred students, which taking 80% of the total number in the class, have registered the CTBTO online courses since then; most of them obtained the last certificates. One student was honored an opportunity to attend the CTBTO 2016 course in Vienna. Some students chose CTBT related topics to finish their dissertations and some of them continue to study on CTBT after graduation.

Primary author: LIU, Huaping (Beijing language & Culture University)

Presenter: LIU, Huaping (Beijing language & Culture University)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Essay**

Knowledge Sharing Between Young Scientists and Policy Makers

The CTBT, once ratified, would be enormously beneficial for the United States and global security. There are many factors which block ratification, including a lack of communication between scientists and policy makers. The CTBT has languished for so long, that now we must not only revitalize the actors currently responsible for treaty entry-into-force, but also energize the upcoming group of advocates and scientists, many of whom are unaware of the treaty and its benefits. In order to bridge this gap, the CTBTO could facilitate conversation and knowledge sharing among students and young professionals in both science and policy. The CTBTO Youth Group could play a role in this process, although some reform to the group's structure may be necessary in order to most effectively address this issue.

Primary author: TAHERAN, Shervin (Arms Control Association)

Presenter: TAHERAN, Shervin (Arms Control Association)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Oral**

Novel Framework for Expanding NDC Capacity Building

The objective of establishing National Data Centres (NDCs) is to receive, process and analyse International Monitoring System data to afford each member state independent verification on treaty compliance. NDCs vary in resources, capacity and competency dictated by the need of each member state. Capacity building undertaken by the Provisional Technical Secretariat (PTS) is constrained by human and financial resources. Despite these challenges the PTS empowers signatory states with equipment, software and training to build up NDC capacities. To protect and grow the investment by the PTS we propose an expansion of the current capacity building framework. The 3rd On-Site Inspection (OSI) surrogate inspector training brought together three trainees from different signatory states on an informal platform. This opportunity birthed an exchange of ideas about the verification regime beyond the OSI pillar. Reflecting on their own diverse needs, particularly on matters pertaining to the relative competencies of NDCs, led to the development of simple and workable solutions for expanding capacity building. The proposed framework introduces two additional mechanisms, mentorship and partnership, in a cooperative environment, to preserve and expand NDC capabilities. The framework can provide tailored solutions according to each member state needs. This presentation will put forward the framework.

Primary author: MOUTINHO SILVA, MAURICIO (CTBTO)

Presenter: MOUTINHO SILVA, MAURICIO (CTBTO)

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **Poster**

Status of the CTBTO Link to the ISC Database

The Link to the database of the International Seismological Centre (ISC) provides both PTS and National Data Centres a dedicated access to datasets maintained by ISC using specially designed graphical interfaces and database queries. This service gives access to several products: the ISC/ISS bulletins of natural seismicity of the Earth, mining induced events, nuclear and chemical explosions; the ISC-EHB bulletin and the IASPEI Reference Event list (GT) and ISC Event Bibliography.

The database searches are tailored to the needs of the monitoring community and divided into four categories: the Area based spatio-temporal search (based on ISC Bulletin), the REB based spatio-temporal search (based on specific REB events), the GT event based search and the IMS station based search (historical reporting patterns of stations close to IMS sites).

We made improvements to the waveform preview/request tool that deals with non-IMS waveform records of the REB and GT events as well as to the tool that allows on-line ISCloc/RSTT relocation of the REB events using additional station data available at ISC. We now provide references to scientific articles describing CTBT relevant events. The service has been extensively used by the NDCs and PTS and proved useful during a number of CTBTO Exercises.

Primary author: STORCHAK, Dmitry (International Seismological Centre (ISC))

Presenter: STORCHAK, Dmitry (International Seismological Centre (ISC))

Track Classification: 5. Monitoring for Nuclear Explosions in a Global Context

ID:

Type: **not specified**

**Discussion "Advancing the CTBT with Science
Diplomacy: Learning from the Past to Enable
Confidence Building Across Scientific Communities"**

Friday, June 30, 2017 11:00 AM (2 hours)

ID:

Type: **not specified**

BREAK

Wednesday, June 28, 2017 1:00 PM (30 minutes)

ID:

Type: **not specified**

Session: T2.4

Monday, June 26, 2017 6:00 PM (3 hours)

Topic 2.4 Atmospheric Background of Radioxenon

T2.4-P1 Analysis of Data from an Intercomparison Between a SAUNA II and a SAUNA III System

T2.4-P2 Considerations of Xenon-133 to Iodine-131 Ratios for Discriminating Signatures of Nuclear Test Explosions Against Normal Operational Releases from Nuclear Facilities

T2.4-P3 Description and Analysis of CTBT-Relevant Xe Isotopes Global Background Between 2010 and 2016

T2.4-P4 (Y) Experience as a Significant Tool for the Design of Gaseous Effluents Stack Monitors

T2.4-P5 How Can We Use Atmospheric Radioxenon Observations Related to the Daiichi Nuclear Power Plant Accident at Fukushima to Better Understand IMS Observations?

T2.4-P6 RA10 New Research Reactor for Medical Isotope Production in Argentina

T2.4-P7 Radioisotopes Production in Argentina: Change of HEU to LEU and Improvements to Reduce the Emissions of Radioxenon

T2.4-P8 Radioxenon Prototype Trap Validation and Controlled Source Experiments Under the EU Council Decision VI Project

T2.4-P9 Reactor Simulations Characterizing Xenon Isotopic Ratios in Nuclear Power Plants

T2.4-P10 (Y) Results and Outcomes in Xenon Mitigation under the EU Council Decision V

T2.4-P11 (Y) Setting the 2014 Baseline for Simulated Activity Concentrations of Four Radioxenon Isotopes at IMS Sites Based on Estimated Annual Releases of Known Sources

T2.4-P12 SIMPAX: A Prototype Software Application Simulating the Impact of Radioxenon Emissions from Civil Sources on IMS Stations

T2.4-P13 Stack Release Data Analysis: Progress and Expected Outcomes

T2.4-P14 Start-Up and Calibration of INVAP Stack Air Effluent Monitor

T2.4-P15 Statistical Technique for Estimation of Global Isotopes Releases Affecting Test Detection

T2.4-P16 The Determination of Radioxenon by the Study of Rotationally Inelastic Dynamics

T2.4-P17 Towards a Better Noble Gas Characterization Scheme Based on 10 Years of National Data Centers (NDC) Analysis

T2.4-P18 Updated Worldwide Background of CTBT-Relevant Xenon Isotopes

T2.4-P19 Use of IMS Data and Its Potential for Research Through Global Noble Gas Concentration Maps

T2.4-P20 WOSMIP 6: Harvesting Results from Intensified Cooperation Between the Nuclear Explosion Monitoring and Isotope Production Communities

T2.4-P21 Xenon Radioisotope Signatures from NPP Power Variations and Their Impact on the CTBTO Verification Regime

ID:

Type: **not specified**

Session: T1.2, T3.2, T4.1, T5.1

Thursday, June 29, 2017 6:00 PM (4 hours)

Topic 1.2 Solid Earth Structure

T1.2-P1 3D Shear Velocity Model of the Eastern and Southern Alps from Ambient Noise Tomography

T1.2-P2 (Y) A Framework of Ground Truth Event Locations Across Iran from a Two Tiered Multi-Event Relocation Approach

T1.2-P3 Amplitude-Dependent Station Magnitude

T1.2-P4 (Y) An Innovated Earthquake Modelling Technique for Near Source Modelling

T1.2-P5 (Y) Analysis of Relationship Between Deformation Area and Moment Magnitude (Mw) of Earthquake in Subduction Zone of Indo-Australian Plate

T1.2-P6 Analysis of Stress State of Caucasus (Azerbaijan) Based on the Maximum Horizontal Stress Orientations and "World Stress Map" Technique

T1.2-P7 (Y) Analysis of Variations in the Earthquakes Effects Based on the Bouguer Anomaly Map

T1.2-P8 (Y) Analysis on Earthquake Relocation Using Modified Joint Hypocenter Determination (MJHD) and Double Difference (DD) (Case Study of Kebumen Earthquake 25 January 2014 in Mw: 6.2)

T1.2-P9 Attenuation of Seismic Waves in Gheshm Area, Southeast Iran

T1.2-P10 Crust and Uppermost Mantle Structure Beneath Southern Africa Based on First P-Wave Travel Times from Seismograms Generated by Local, Regional and Mining-Induced Earthquakes

T1.2-P11 Crust-Upper Mantle Structure and Seismic Hazards Studies for National Planning and Development in Nigeria

T1.2-P12 (Y) Crustal Deformation Revealed by GPS in Greater Caucasus, Azerbaijan

T1.2-P13 Crustal Structure of the Amazon Craton, Brazil

T1.2-P14 (Y) Determination of Design Spectra with Considering Different Site Classification, in Andisheh Suburb of Bandar Abbas, South of Iran

T1.2-P15 Determination Site Effect of Zarqa City and Hashemite University Campus Based on Microtremors Field Measurements: A Microzonation Study

T1.2-P16 Determining the Kaki Earthquake Properties with Using InSAR Method, 2013, Kaki, South-west Iran

T1.2-P17 (Y) Distribution of Seismic Wave Amplification Based on Comparison Between Surface and Bedrock Peak Ground Acceleration (PGA) (Case Study: Java Island)

T1.2-P18 Global-Scale Joint Body and Surface Wave Tomography with Vertical Transverse Isotropy for Seismic Monitoring Applications

T1.2-P19 (Y) Ground Truth Procedure to Improve the Seismic Locations, Velocity Model and Focal Mechanics Bulletin for Bolivia

T1.2-P20 (Y) Identification of the Existences of the Mud Volcanoes Beneath East Java-Indonesia Region Using Ambient Noise Tomography Method

T1.2-P21 Illuminating More of the Earth Via Sensors on Transoceanic Telecommunications Cables

T1.2-P22 (Y) Improved Seismic Travel Times in Central and Northern Costa Rica for Accurate Earthquake Location

T1.2-P23 (Y) Improving the Analysis Method of ULF Geomagnetic Data for Earthquake Precursor Monitoring in the Sumatera Region

T1.2-P24 Investigations Aimed at Enhancing the Effectiveness of Seismic Monitoring in West Kazakhstan

T1.2-P25 (Y) Monitoring Seismic Velocity Changes Using Ambient Seismic Noise

T1.2-P26 Seismic Site Effect Estimation Using Microtremor Studies in the Archaeological City Jerash in Jordan

T1.2-P27 Seismic Structure of West Africa from Surface Wave Tomography Using Regional Earthquakes and Ambient Seismic Noise

T1.2-P28 Seismic wave attenuation in the Baikal Rift System

- T1.2-P29 Seismicity and Seismotectonics of the Sudan and South Sudan
T1.2-P30 (Y) Seismicity of Botswana for the Period 1950-2016
T1.2-P31 Site Effect in Archaeological City Jerash in Jordan
T1.2-P32 Source Process of the Mw = 5.1, Phalla (Islamabad) Earthquake and Its Tectonic Perspective
T1.2-P33 (Y) States of Local Stresses and Relative Locations of Small Earthquakes in the Sea of Marmara
T1.2-P34 (Y) Statistical Analysis of Seismic Bulletin in Egypt
T1.2-P35 Synthetic Seismograms of Explosive Sources Calculated by the Earth Simulator
T1.2-P36 The Preliminary Tidal Analysis Based on the CG-5 AUTOGRAV Gravity Measurements at Lenkaran Station (Azerbaijan)
T1.2-P37 (Y) The Seismic Activity of the Lake Kivu Basin: Need of a Large Seismic Network

Topic 3.2 Laboratories Including Mobile and Field-Based Facilities

- T3.2-P1 (Y) Determination of Fission Radionuclides Sr-90 and Pu-242 in Water Samples
T3.2-P2 (Y) Gamma-Gamma Coincidence Analysis of the 2015 Proficiency Test Exercise (PTE)
T3.2-P3 Iranian Radionuclide Laboratory (IRL): Gas Extraction and Volume Measurement Set-Up
T3.2-P4 Laboratory Analysis of Radioxenon Samples as a Support of the IMS Network
T3.2-P5 OSI Laboratory Sample Ganging: Characterization of Multisample Holder Positions to Screen Out the Samples
T3.2-P6 Shielding of Portable High Purity Germanium Detectors for Use in Stand Alone Configuration

Topic 4.1 Performance Optimization and Systems Engineering

- T4.1-P1 Advances in State of Health Analysis for International Monitoring Systems
T4.1-P2 Assessment of the Quality of the Interactive Analysis and Reviewed Event Bulletin During the September 2016 Experiment
T4.1-P3 Business Intelligence Software as a Self-Service Data Analysis Platform for the CTBTO
T4.1-P4 (Y) Chilean National Data Center and Station Management Model
T4.1-P5 Cloud Data Center Based on Big Data Processing and Collaborative Management and its Application in the CTBT Verification System
T4.1-P6 (Y) Constraints from Transport Times and Minimum Detectable Activity on the Analysis of Low-Activity Samples at CTBT Radionuclide Laboratories
T4.1-P7 Contribution of RN-52 Generated Data in the Establishment of Radioactivity Data Base in the Philippines
T4.1-P8 Digital GPS: Challenges of GPS Signals in High Noise Areas
T4.1-P9 Establishing Information Management in an Organization: When Structured Information Moves You Forward
T4.1-P10 Free Space Optics (FSO) Systems as Alternative Back-Up Links for NDCs and IMS Stations
T4.1-P11 Identification and Evaluation of Resource Constraints: Optimization of AFTAC's Configuration Management Process
T4.1-P12 Improving Detection Quality of Primary IMS Seismic Stations
T4.1-P13 IMS Reporting System and Incident Management in Operations Centre
T4.1-P14 Life Cycle Modelling Data Required to Sustain the International Monitoring System
T4.1-P15 Monitoring Indications of High-Purity Germanium Detector Failure
T4.1-P16 National Data Centre at Royal Science and Technology Park, Swaziland
T4.1-P17 Quality Assessment of Meteorological Data from CTBTO/IMS Radionuclide Stations
T4.1-P18 RASA Detector Calibrations: Field Automation and Potential for Factory Calibrations to Replace Field Calibrations
T4.1-P19 Selected Research Activities of Turkish NDC
T4.1-P20 (Y) Sharing Local Seismic Networks Data to Complete Instrumental Gaps of CTBTO Global Network
T4.1-P21 The Radionuclide Network Quality Control Programme
T4.1-P22 The WNRS of IS48TN Infrasound Station: Problems and Solutions
T4.1-P23 Thermal Insulation System and Automatic Heating of Air Sampler "SNOW WHITE" for IMS Radionuclide Station (for Example Station RN61 (Dubna)).

T4.1-P24 Times for IMS Waveform Data Requested/Queried from the CTBT Secure Web Portal (SWP) Different from the Time Specified in the Query/Request

T4.1-P25 uniDDS: A unified Data Distribution Approach for the International Monitoring System

T4.1-P26 (Y) Importance of local network in processing discrimination of sources

Topic 5.1 Science in Support of Global Policy Decisions

T5.1-P1 (Y) Government Policies and Global Strategic Governance for Planetary Sustainability, Control of Nuclear Energy and the Elimination of Nuclear Tests

T5.1-P2 Impacts of Nuclear Energy and the Lack of Strategic Governance for the Elimination of the Explosions and the Decrease of Collateral Risks

T5.1-P3 Potential Contributions of CTBTO to the Full Implementation and Complement of the Pelindaba Treaty

T5.1-P4 Radio-Ecological Monitoring of the Uranium Mining in the Mountain Areas

T5.1-P5 Science in Support of International Treaties and Sustainable Development Goals

ID:

Type: **not specified**

Preview Session

Wednesday, June 28, 2017 1:00 PM (15 minutes)

ID:

Type: **not specified**

RECEPTION

Friday, June 30, 2017 6:30 PM (1h 30m)

ID:

Type: **not specified**

Discussion "Uncertainty Measurement in Atmospheric Transport Modelling and Atmospheric Dynamics"

Thursday, June 29, 2017 1:30 PM (1h 30m)

ID:

Type: **not specified**

Discussion "Mobile Devices as Geophysical Sensors: Promising Paths and Blind Alleys"

Monday, June 26, 2017 1:30 PM (1h 30m)

ID:

Type: **not specified**

: "Effective Communication Skills"

Tuesday, June 27, 2017 7:30 PM (2h 30m)

ID:

Type: **not specified**

Youth Group Workshop "CTBT and South Asia: Analyzing and Engaging the Public"

Thursday, June 29, 2017 1:30 PM (1h 30m)

Facilitators: Beenish Pervaiz, Aditi Malhotra, Hamzah Rifaat

ID:

Type: **not specified**

BREAK

Monday, June 26, 2017 1:00 PM (30 minutes)

ID:

Type: **not specified**

Session: T1.3

Thursday, June 29, 2017 6:00 PM (4 hours)

Topic 1.3 Atmospheric and Subsurface Radionuclide Dispersion and Depletion

T1.3-P1 Assessment of Radionuclides Dispersal in Seawater from Fukushima Disaster to the Coastline of Vietnam

T1.3-P2 (Y) Atmospheric Dispersion of Radionuclides Originating from Hypothetical Accidents in Turkish Nuclear Power Plants

T1.3-P3 Atmospheric Transport Modelling for the Radionuclides Detection of Northeast Asia in 2010

T1.3-P4 Atmospheric Transport Model Applied to the Design of Medical Isotope Production Facilities

T1.3-P5 (Y) Capability of HYPPLIT Dispersion Model in Fukushima Disaster

T1.3-P6 Comparison of Atmospheric Transport Models (ATM) Used in Decision Support in the Framework of the Austrian Radiological Emergency Response Preparedness

T1.3-P7 (Y) Evaluation of the Inline WRF-HYSPLIT Model for Mesoscale Atmospheric Transport and Dispersion

T1.3-P8 Gas-Magma Interactions in Nuclear Cavities and Their Effects on the Xenon Isotope Ratios

T1.3-P9 (Y) Generation of EURDEP Exercise Data Using Existing Modelling Tools

T1.3-P10 Geologic Control on Noble Gas Migration

T1.3-P11 Impacts of Eruptions of Volcanoes Around Korean Peninsula: Simulation for Hypothetic Eruptions by Using LADAS-VA Model

T1.3-P12 Improved Evaluation of Atmospheric Flow and Transport over Complex Terrain at Multiple Scales with Uncertainty

T1.3-P13 Influence of Resolution on the Performance of FLEXPART with ECMWF Data in the ATM Challenge 2016

T1.3-P14 Influence of Small-Scale Radioxenon Sources on the Background Levels at CTBT IMS Monitoring Stations

T1.3-P15 Intercomparison Study Between Different Types of Models for the Dry Deposition of I-131

T1.3-P16 La-140 and Ba-140 Background from IMS Particles Stations

T1.3-P17 Monitoring of Naturally Occurring Radionuclides in Paleobeach Groundwater Aquifers in Cox's Bazar, Bangladesh, For Up To 3 Years: Insight into Formation Mechanism

T1.3-P18 (Y) Non-Equilibrium Model of Multi-Phase Radionuclide Transport in Lake Water-Sediment System

T1.3-P19 Performance Assessment of the High-Resolution Atmospheric Transport Model at the IDC of the CTBTO

T1.3-P20 (Y) Sorption of Noble Gases in Porous Media and the Impact on Nuclear Explosion Signatures

T1.3-P21 Sources and Concentrations of Cs-137 in Kuwait

ID:

Type: **not specified**

Discussion "Utilizing Monitoring Technologies for Global Development [...]"

Friday, June 30, 2017 1:30 PM (1h 30m)

"Exploring Potential Applications of IMS data of Support the Sustainable Development Goals, the Paris Climate Agreement, and Disaster Risk Reduction"

Opening Address: José Fidel Santana Núñez, Deputy Minister of Science, Technology and Environment, Cuba

ID:

Type: **not specified**

Stream of High Level Opening from the Zeremoniensaal

Tuesday, June 27, 2017 12:00 PM (2 hours)

ID:

Type: **not specified**

BREAK

Wednesday, June 28, 2017 6:00 PM (30 minutes)

ID:

Type: **not specified**

Wednesday, June 28, 2017 8:30 PM (1h 15m)

ID:

Type: **not specified**

Tuesday, June 27, 2017 10:00 AM (2 hours)

CTBT: Science an ... / Report of Contributions

LUNCH

ID:

Type: **not specified**

Thursday, June 29, 2017 3:00 PM (1 hour)

ID:

Type: **not specified**

Session: T2.1

Tuesday, June 27, 2017 7:00 PM (3 hours)

Topic 2.1 Treaty-Relevant Events

T2.1-P1 (Y) Eight Years on Since the Upgrade of the Eskdalemuir, UK, Seismic Array: Network Advances and New Observations

T2.1-P2 Absolute and Relative Body Wave Magnitudes of Five DPRK Events as Measured by the IDC

T2.1-P3 Absolute and Relative Location at the IDC: Five DPRK Events

T2.1-P4 Analysis Spectral and Focal Mechanism of Likely Nuclear Explosion in North Korea January 2016

T2.1-P5 Atmospheric Transport Modelling Assessing Chances to Detect Radionuclides Released from the Known DPRK Test Site

T2.1-P6 Atmospheric Transport Modelling for Radionuclide Monitoring after the Nuclear Tests of the DPRK on 6 January and 9 September 2016

T2.1-P7 Estimation of a Relative Depth and Yield of DPRK's Third and Fourth UNE

T2.1-P8 Events Discrimination and Source Parameters Using Moment Tensor Inversion

T2.1-P9 Identification of Seismic Signals from Underground Nuclear Explosion Produced at DPRK Test Site

T2.1-P10 Improving Our Understanding of Explosion Seismic Waves from the Nevada Source Physics Experiments

T2.1-P11 IMS Radionuclide Monitoring after the Announced Nuclear Tests of the DPRK on 6 January and 9 September 2016

T2.1-P12 North Korea's Nuclear Tests 2016

T2.1-P13 (Y) Nuclear Event Fallout Inhomogeneity on Small- and Medium-Scale in Meadows and Forests

T2.1-P14 Registration of Events from DPRK Test Site in 2016 by Facilities of Main Center of Special Monitoring

T2.1-P15 (Y) Review of Explosive Yield Estimation

T2.1-P16 Romania National Data Centre Contribution to Nuclear Test Monitoring

T2.1-P17 Summing Particulates and Noble Gas Spectra to Improve Detection Sensitivity and Reduce Statistical Uncertainty

T2.1-P18 The Seismic Event in North Korea 9 September 2016

ID:

Type: **not specified**

BREAK

Friday, June 30, 2017 1:00 PM (30 minutes)

ID:

Type: **not specified**

Session: T1.1

Wednesday, June 28, 2017 6:00 PM (2h 30m)

Topic 1.1 Infrasound and Atmospheric Dynamics

T1.1-P1 Advances on the Volcanic Parameter System with Infrasound Data

T1.1-P2 An Assessment of Infrasound Events in the REBs Produced in the Year 2016

T1.1-P3 (Y) Applications for Aircraft Infrasound Detections

T1.1-P4 Are Measurements of Infrasonic Signal Duration Useful in the Context of Nuclear Explosion Monitoring?

T1.1-P5 (Y) Automated Detection and Cataloging of Global Explosive Volcanism Using the IMS Infrasound Network

T1.1-P6 Comparative Near-Field and Far-Field Studies Using IMS Infrasound Data

T1.1-P7 Detection and Interpretation of Seismoacoustic Events at German Infrasound Stations

T1.1-P8 Detection Patterns for Two IMS Infrasound Stations in the Vicinity of the North Korean Test Site

T1.1-P9 Global Infrasound Association at the IDC: Advances and Performances

T1.1-P10 IMS Infrasound Records of Announced Rocket Launches

T1.1-P11 (Y) Incorporating Realistic Terrain Boundary Conditions into Numerical Infrasound Propagation Modelling

T1.1-P12 InfraGA/GeoAc: An Open Source Infrasonic Ray Tracing Tool

T1.1-P13 Infrasound Signals and Their Source Location Inferred from Array Deployment in the Lützow-Holm Bay, East Antarctica: 2015

T1.1-P14 Joint Processing of Pressure Pulsations and Wind Velocity Data at Infrasound Stations

T1.1-P15 Localization of Microbaroms Detected by I17CI and I11CV in IMS Data

T1.1-P16 Long-Range Infrasound Detections of Volcanic Activity by IS42 Station, Azores, Portugal

T1.1-P17 Optimization Methods of Network Parametric Selection of Infrasound Signal Sources

T1.1-P18 PTS Portable Infrasound Array in Romania

T1.1-P19 Some Results of Recording Infrasound and Internal Gravity Waves from Atmospheric Fronts

T1.1-P20 Temporal Variability of Infrasound Propagation and Detectability in the European Arctic

T1.1-P21 The Acoustic Signature of Underground Chemical Explosions During the Source Physics Experiment

T1.1-P22 The European Infrasound Bulletin

T1.1-P23 (Y) The First Infrasound Array in Hungary

T1.1-P24 (Y) Using IMS IS13 and IS14 Stations to Analyse Strong Seismic and Volcanic Activity in Chile

ID:

Type: **not specified**

Session: T1.5, T3.1

Tuesday, June 27, 2017 7:00 PM (3 hours)

Topic 1.5 Civil, Scientific and Industrial Applications of IMS data and IDC Products

T1.5-P1 'Seismic Cycle' and Occurrence of Large Earthquakes

T1.5-P2 Active Lineaments Mapping Within Karonga Area

T1.5-P3 (Y) Assessment of Seismic Hazard Potentials in Zimbabwe

T1.5-P4 (Y) Contribution of the IMS Seismic Stations and Products in Localization of the 28 March 2016 Okavango Delta Event

T1.5-P5 Disaster Prediction Through Pattern Informatics Applied on Global Seismological Data

T1.5-P6 Earthquake Safety: An Important Contribution of CTBT Seismic Monitoring Data

T1.5-P7 Important Results Obtained from Data of Kazakhstan Seismic Arrays

T1.5-P8 Litho-Stratigraphic and Structural Controls on the Groundwater Flow Dynamics and Hydrogeochemical Setting of the Mekelle Outlier and Surroundings, Northern Ethiopia

T1.5-P9 (Y) Profile of Radionuclide Particulate Monitoring in Indonesia

T1.5-P10 Response of the Kathmandu Valley Sediments During the 2015 Gorkha Earthquake Sequence

T1.5-P11 Seismic Hazard Assessment of the Caucasus

T1.5-P12 Seismic Microzonation and Site Effect Response of Al Auja District

T1.5-P13 Seismic Velocity Models and Their Improvement

T1.5-P14 Seismicity and seismo-tectonic environment at regions of nuclear energetics critical facilities location in Kazakhstan

T1.5-P15 Seismicity of Semipalatinsk Test Site Territory by Data of Kazakhstan Monitoring Network

T1.5-P16 Seismotectonic Implications of the 20 May 1990 South Sudan Earthquake

T1.5-P17 Strategy for the Popularization of the Virtual Data Exploitation Centre (vDEC) in West Africa

T1.5-P18 Teleseismic Study of Ecuador Earthquake Using IMS Stations in Africa

T1.5-P19 (Y) The Use of CTBTO IMS data on Atmospheric Radioactivity Monitoring Following the Fukushima Dai-ichi Nuclear Power Plant Accident

T1.5-P20 Trend Analysis of Cesium-137 Concentrations Observed in Kuwait Before and After Fukushima Nuclear Disaster

T1.5-P21 (Y) Understanding Future Landslide Hazards: 12 March Earthquake, West, and 29 March 2014 Landslide, East of Anjouan-Island, Comoros.

T1.5-P22 (Y) Upgrading Geological Fault Information Using the Last Shallow Seismic Events

T1.5-P23 Using of IMS Infrasound Stations for Tsunami Warning in the Antarctic Peninsula

T1.5-P24 Validation of Tsunami Potency Determination Using Calculation of Rupture Duration (T_{dur}), Dominant Period (T_d) and T50Ex

Topic 3.1 Design of Sensor Systems and Advanced Sensor Technologies

T3.1-P1 'CARD': Characterization of Adjoint Response for Ge Detectors

T3.1-P2 (Y) A Genuinely Novel Method to Identifying Gamma Rays in Region of Infrared Spectrum

T3.1-P3 A Novel Three Component Optical Seismometer Based on the Moiré Technique

T3.1-P4 (Y) A Quantitative Investigation of the Performance of Three-Component Optical Seismometer

T3.1-P5 A Seismic Noise Survey of Western Kazakhstan

T3.1-P6 (Y) A Testing Environment for Airborne Optical Sensors

T3.1-P7 Adding Wireless Capabilities to an IMS Portable Infrasound Array

T3.1-P8 (Y) Ag@zeolite: Toward the Miniaturization of the NG Process

T3.1-P9 Automated Testing and Our RASA Software Development Environment

- T3.1-P10 Autonomous Intelligent Sensor Systems
- T3.1-P11 CLYC Scintillators: A Possible Enhancement for Handheld OSI Detectors
- T3.1-P12 (Y) Colombian Seismological Network and Its Challenges
- T3.1-P13 Cross-Calibration of Airborne and Ground Based Gamma Radiation Survey Techniques Under On-Site Inspection Conditions
- T3.1-P14 (Y) Design and Simulation of a Leaser-Interferometer Broadband Seismometer
- T3.1-P15 Detection Efficiency Calculation and Spectrum Simulation with Geant4 for a BEGe Detector at the Health Canada CTBT Laboratory
- T3.1-P16 (Y) Developing a Low Cost Shout Down MEMS Base Accelerometer Suitable for Rapid Response and Structural Applications
- T3.1-P17 Development and performance of Cosmic Guard and Compton Suppression System for Environmental Radiological Analysis
- T3.1-P18 Development of a Field Portable Ar-37 Monitoring Capability
- T3.1-P19 Development of Si-PIN Diodes Detection Unit for Noble Gas Systems ARIX
- T3.1-P20 Development of U.S. NDC Performance Metrics Through Large Scale Analysis of System Log Files With Hadoop Distributed File System Based Tools
- T3.1-P21 Developments in IMS Infrasound Array Geometry Tools
- T3.1-P22 Implementation of New Technologies at the IMS Radionuclide Particulate Stations
- T3.1-P23 Improving MDC in the Radionuclide Particulate RASA System
- T3.1-P24 Improving Metadata Accuracy Within Seismic Networks
- T3.1-P25 IMS Equipment Challenges for Waveform Technologies
- T3.1-P26 Infrasound Isolation Chamber for Improved Sensor Calibration
- T3.1-P27 Installation and Testing of a Cosmic Veto System at the IMS Station RN67, St Helena
- T3.1-P28 Next Generation Noble Gas System for the IMS Network
- T3.1-P29 Operational Interface and Capability of a Carborne Survey Instrument Developed for the PTS Under US CiK
- T3.1-P30 Perspective Model of Portative Field In-Situ Spectrometer-Identifier of Gamma Isotopes
- T3.1-P31 SAUNA III New Beta Detector Performance
- T3.1-P32 Sensing Ionospheric Disturbances Using a Large GNSS Network
- T3.1-P33 (Y) Snapshot Hyperspectral Imaging: Hand-held Image Acquisition for Ground Inspection
- T3.1-P34 System Tests of OSIRIS: A Spectrum-Blind Gamma-Ray Spectrometer for On-Site Inspections under the Comprehensive Nuclear-Test-Ban Treaty
- T3.1-P35 The Calibration of IMS Seismic and Hydroacoustic T-Phase Stations
- T3.1-P36 The Problem of the Precise Second on Earthquake Recorders
- T3.1-P37 The Radiological Field Training Simulator (RaFTS)/Spectroscopic Injection Pulser (SIP) for Radiation Detection Training Without Radiation Sources in On-Site Inspection
- T3.1-P38 The SAUNA CUBE Project: A New Concept in Radioxenon Detection Using Noble Gas System Arrays
- T3.1-P39 Unmanned Radiation Measurements
- T3.1-P40 Using Antineutrinos to Verify the Nuclear Nature of a Suspect Nuclear Test Based on Seismic Event Coincidence
- T3.1-P41 Wind Noise Reduction Systems in the International Monitoring System Infrasound Network
- T3.1-P42 Xenon International: A New Capability for Radioxenon Measurements

ID:

Type: **not specified**

Session: T1.4, T3.5, T3.7, T5.4

Wednesday, June 28, 2017 6:00 PM (2h 30m)

Topic 1.4 Hydroacoustics and Physical Properties of the Oceans

T1.4-P1 Data Processing Technique for T-phase and Tsunami Signals Recorded by IMS Hydrophone Triplets

T1.4-P2 Establishment of the IMS Hydroacoustic Station HA04, Crozet Islands, France

T1.4-P3 Exploiting Recent Plentiful Detections at H03 and H11

T1.4-P4 (Y) Numerical Tsunami Modelling of the 2 March 2016 Southwest of Sumatra Earthquake (M = 7.8)

T1.4-P5 Observations of a Coherent Signal in the High-Frequency Range of IMS Hydrophones (105-108Hz) at Station HA08, Diego Garcia, Indian Ocean

T1.4-P6 Progress in the Studies on the Next Generation Cabled IMS Hydroacoustic Stations

T1.4-P7 Risk Management and Program Execution

T1.4-P8 (Y) Tsunami Waves Generated by Earthquakes and Landslides: Computed by Means of Numerical Simulations in the Western Black Sea

Topic 3.5 Data Processing and Interpretation

T3.5-P1 Addressing the Challenges of Displaying Geotechnical Information in 3D Environments

T3.5-P2 Advancing the Practice of Seismology in Iraq

T3.5-P3 (Y) Amplitude Attenuation and Applied in Earthquake and Explosion Identification

T3.5-P4 (Y) Analyzing of Seismic Recording in Frequency Domain at Nuclear Bomb Explosion: Case Study North Korea's Nuclear Test

T3.5-P5 (Y) Anomalous Signal Before Indonesia's Large Earthquakes 2011 Detected by Superconducting Gravimeter

T3.5-P6 (Y) Comparison of Analysis Methods to Identify Radionuclide Isotopes

T3.5-P7 Comprehensive Seismic Monitoring: Developments at the USGS National Earthquake Information Center

T3.5-P8 (Y) Contrasting 3D Visualization of Different OSI Data Types with More Standard 2D Representation

T3.5-P9 Correlation Detection of Uncertain Seismic Signals

T3.5-P10 Data Analysing for Supporting the CTBTO's Treaty by the National Data Center Suriname

T3.5-P11 Deploying ENIAB in Cloud Platform

T3.5-P12 Detection Capability of the IMS Seismic Network in 2013

T3.5-P13 (Y) Developments at the UK National Data Centre for Radionuclide Analysis

T3.5-P14 Digital Revolution in Gamma Acquisition Systems: Costs and Benefits

T3.5-P15 Distributed Seismic Event Detection Analytics at the Edge

T3.5-P16 Evaluating West Eurasian Clusters of Infrasound Arrivals in Analyst-Reviewed Bulletins of the International Data Centre

T3.5-P17 Expert Technical Analysis Improvements at the International Data Center, CTBTO

T3.5-P18 (Y) Extended NDC-in-a-Box Implementation for Mongolian NDC

T3.5-P19 Finding Aftershocks with Waveform Cross-Correlation

T3.5-P20 Hypercomplex and High-Order Master Event Design for CTBT Monitoring

T3.5-P21 IDC Re-Engineering Phase 2: Analysis Interface Improvements

T3.5-P22 IDC Re-Engineering Phase 2: Software Architecture and Data Model

T3.5-P23 Identification of Explosions and Earthquakes Using Infrasound and Seismic Data

T3.5-P24 (Y) Importance of Noise Level at CTBTO Facilities

T3.5-P25 Improving Geophysical Data Processing and Research With Multi-Cloud Environments

T3.5-P26 Introduction of the Results of a New Automatic Association System for Waveform Data Analysis

T3.5-P27 (Y) Methodology for Volcanic Monitoring Using the Processing and Analysis of Geospa-

- tial Data and Its Implementation in the “Concepción” Volcano of Nicaragua
- T3.5-P28 (Y) Mining Explosion Identification Using Seismic and Infrasonic Station Data
- T3.5-P29 Monitoring of Tropical Cyclones Using Seismic and Infrasonic Stations Surrounding the South-Western Indian Ocean
- T3.5-P30 Negative Evidence: The Non-Use of Non-Detections in IDC Seismic Data Processing
- T3.5-P31 Observing the Variability of Earth’s Microseisms Through Signal Coherency Analysis
- T3.5-P32 (Y) On the Usability of Event Zero Time Determinations Using Xenon Isotopic Activity Ratios Given the Real Atmospheric Background Observations
- T3.5-P33 Optimizing Atmospheric Monitoring Networks Using Bayesian Methods and Genetic Algorithms for Multiple Objectives
- T3.5-P34 Real Time Monitoring Data Application and Simulation Researches for Earthquake and Tsunami Disaster Mitigation
- T3.5-P35 (Y) Relocation of Seismicity in Northern East of Egypt: Contribution of Different Regional Seismic Networks
- T3.5-P36 Research on Recognition Technology for Weak Explosion Signals
- T3.5-P37 Seismic Monitoring Evolution and Extensive Seismicity of Egypt
- T3.5-P38 Seismic Monitoring Technology of Weak Earthquakes and Explosions on the Based of Solution the Seismic Moment Tensor Inverse Problem
- T3.5-P39 Seismic Monitoring Using Arrays in the Middle East
- T3.5-P40 Some Results of Low-Magnitude Seismicity Recording in Belarus
- T3.5-P41 Special Noise Field Characteristics of a Small Aperture Seismic Array on the Southeast Coast of China
- T3.5-P42 (Y) Static Corrections to Improve Detection, Location and Measurement of Seismic Discriminants at IMS Arrays
- T3.5-P43 Surface Reflection Arrivals from Shallow Small Magnitude Explosions Using the Cepstrum Technique: A Numerical Analysis
- T3.5-P44 The Benefit of Using Higher Sampled Regional Seismic Data for Determining Cepstral Depths of Shallow Events
- T3.5-P45 The Correction of Coincidence Summing Effect in Filter Sample Measurement with HPGe Spectrometer
- T3.5-P46 The IDC Re-Engineering Project, Phase 2
- T3.5-P47 The IMS Seismic Network Used to Support and Mitigate Volcanic Risk with One Single Station Method
- T3.5-P48 Theoretical and Experimental Analyses of Infrasonic-Electromagnetic Data Fusion
- T3.5-P49 Time Series Classification Using Covariance Descriptors
- T3.5-P50 (Y) Time Series Reconstruction as a Preventive Maintenance Tool for the Radionuclide IMS Data
- T3.5-P51 Towards a New Paradigm for the Interactive Analysis of Waveform Data
- T3.5-P52 US Navy’s “Full Ship Shock Trials” as Opportunities for USGS and CTBTO Seismic System Evaluation and Calibration
- T3.5-P53 Update of the Evaluated Radioxenon Nuclear Decay Data
- T3.5-P54 Using Reflection Green’s Functions Extracted from Ambient Seismic Noise and Signal for IMS Seismic Station Site Crustal Reflector Characterization
- T3.5-P55 (Y) Velocity Model of Seymareh Region: Southwest of Iran Using Local Seismic Network Data
- T3.5-P56 Wind Seismic Noise Introduced by External Infrastructure: Field Data and Transfer Mechanism
- T3.5-P57 Model of Xe Radionuclides Measurements on Noble Gas System with a Long Cycle of Sampling
- Topic 3.7 Algorithms
- T3.7-P1 (Y) A Method to Improve Relative Earthquake Locations Using Surface Waves
- T3.7-P2 A Review of the Most Frequently Applied Seismic P-Wave Picking Algorithms
- T3.7-P3 Application of Diffusion Maps for Seismic Event Characterization in Israel
- T3.7-P4 Automated Techniques for Waveform Correlation Applied to Regional Monitoring of Eastern Asia
- T3.7-P5 Automatic Classification of Seismic P and S Wave Signals Using Multiple Parameters, Fre-

quency Ranges and Artificial Neural Network

T3.7-P6 Automatic Identification of Repeated Industrial Seismicity in the Reviewed Event Bulletin

T3.7-P7 Compressive Sensing and Sparsity Based Method for Time-Frequency Distribution Optimization

T3.7-P8 Earthquake Event Detection and Separation from Local Noise Using SVM Classifier

T3.7-P9 Enhancement of Cepstral Methods for the Improved Processing of Seismic Data

T3.7-P10 Non-Linear Kernel Methods for Seismic Event Characterization

T3.7-P11 Peak Search and Fitting Techniques for Analysis of the Radioxenon Beta-Gamma Coincidence Spectra

T3.7-P12 The Use of Waveform Cross-Correlation for Detection, Relative Location and Magnitude Estimation of Repeated Mining Blasts: The Jordan Phosphate Mine Eshidiya

Topic 5.4 Capacity Building, Education and Public Awareness

T5.4-P1 Third Cycle On-Site Inspection (OSI) Surrogate Inspector Training: Positive Outcomes on the Local Level

T5.4-P2 A CTBTO Semester-Long Simulation Course in International Relations Curriculum as a Method of Developing the Students' Professional Skills

T5.4-P3 Advancement of CTBT Academic Curricula in South-South Nigeria

T5.4-P4 (Y) Back to Basics: Building the Next Generation of Indian Nuclear Experts

T5.4-P5 Challenges and Advances in Implementation of CTBTO Facilities and Supports in Senegal

T5.4-P6 (Y) Cooperation Between Cameroon, CTBTO and Others Parties: Capacity Building, Education and Public Awareness

T5.4-P7 CTBT Educational Materials as a Tool for Sensitization and Internal Training

T5.4-P8 Current Awareness of the Comprehensive Nuclear-Test-Ban Treaty in Nigeria

T5.4-P9 Diversified Education on CTBT in Beijing Language and Culture University

T5.4-P10 Expanding the Use of the CTBT Educational Resources Among the Academics in West Africa

T5.4-P11 FSUE VNIA Activities Related to CTBT Technologies

T5.4-P12 IMS Network in Papua New Guinea and the Utilization for the Benefits of the Local and Regional Monitoring Systems

T5.4-P13 Integrating Knowledge Generated by CTBT in Teaching Nuclear Science and Engineering

T5.4-P14 Introducing m-Science Systems for Engaging Broader Community to the Needs of Nuclear Test Monitoring and Verification

T5.4-P15 Jordan Seismological Observatory and IMS

T5.4-P16 Malawi Seismicity and Seismic Network from 1900-2016

T5.4-P17 Mongolian National Data Centre

T5.4-P18 Monitoring for Nuclear Explosions

T5.4-P19 NDC Training 2.0: From Training Analysts to Training NDCs

T5.4-P20 Nuclear Pacific: An International Public Inquiry on French Nuclear Weapons Testing in French Polynesia

T5.4-P21 (Y) Potential Benefits of CTBTO to Iraq

T5.4-P22 Public Awareness and Capacity Building

T5.4-P23 Public Awareness Creation of National Data Centres in Africa

T5.4-P24 (Y) Relevance of the Capacity Building System (CBS) in Zambia's NDC

T5.4-P25 (Y) Scientific Community: Its Role in Nuclear Disarmament

T5.4-P26 Seismic Monitoring and its Analysis in Kyrgyzstan

T5.4-P27 (Y) The CTBT as a useful tool for Myanmar's students in Nuclear Age

T5.4-P28 (Y) The Hidden Potential of Nuclear Research Centres Collaborations

T5.4-P29 The IS35 and AS067 IMS Infrasound and Auxiliary Seismic Station in Tsumeb, Namibia

T5.4-P30 The Role of Small States in Monitoring Nuclear Explosions: The Case of Kazakhstan

T5.4-P31 The Significance of National Data Centres Established in West Africa

T5.4-P32 The Status of the CTBTO Link to the ISC Database

T5.4-P33 (Y) Implementing National Nuclear Safety Knowledge Platform within the GNSSN Framework

T5.4-P34 Enhancing Public Awareness of the CTBTO/ CTBT Among Youth

T5.4-P35 Regional Denuclearization in South Pacific: Failures and Successes after 30 years

ID:

Type: **not specified**

Discussion: "Seizing Opportunities and Overcoming Challenges: The CTBT's Relevance in a Dynamic Global Context"

Tuesday, June 27, 2017 2:00 PM (1 hour)

ID:

Type: **not specified**

BREAK

Thursday, June 29, 2017 6:00 PM (30 minutes)

ID:

Type: **not specified**

Session: NPE

Wednesday, June 28, 2017 7:45 PM (45 minutes)

NDC Preparedness Exercise 2017 NPE2017
Lead by NDC Germany
Discussion and Arrangements

ID:

Type: **not specified**

Session

Friday, June 30, 2017 4:00 PM (2h 30m)

Awards Presentation Ceremony

Technical Summary: Joachim Schulze, Chairperson of Working Group B, CTBTO Preparatory Commission

Remarks: Representative of the City of Vienna

Keynote Address: Des Browne, former Secretary of State for Defence of the United Kingdom

Remarks: Wolfgang Hoffman and Tibor Tóth, Executive Secretaries Emeritus, CTBTO Preparatory Commission

Closing Remarks: Lassina Zerbo, Executive Secretary, CTBTO Preparatory Commission

ID:

Type: **not specified**

Discussion "Global Verification Capability: The Five Announced DPRK Nuclear Tests"

Wednesday, June 28, 2017 1:30 PM (1h 30m)

ID:

Type: **not specified**

Discussion "The International Monitoring System: Challenges from Installation Through Certification to Sustainment of this Unique Global Network"

Monday, June 26, 2017 1:30 PM (1h 30m)

ID:

Type: **not specified**

Level Opening of the CTBT: Science and Technology 2017 Conference

Tuesday, June 27, 2017 12:00 PM (2 hours)

Introduction

Sanam Shantyaiei, SnT2017 Moderator (France 24)

CTBTO Welcome and Opening Remarks

Lassina Zerbo, CTBTO Executive Secretary

Michael Linhart, Secretary-General for Foreign Affairs of the Federal Ministry for Europe,
Integration and Foreign Affairs, Austria

Keynote Addresses

Princess Sumaya of Jordan, President of the Royal Scientific Society of Jordan

Maria Candida Pereira Teixeira, Minister for Science and Technology, Angola

Pascale Ultré Guérard, National Centre for Space Studies, France

Film on the installation of hydroacoustic station HA04, Crozet Islands (France)

ID:

Type: **not specified**

**Discussion: "Training, Education and Public
Advocacy for the CTBT: The Role of Advocacy for the
CTBT: The Role of Academia in Securing the Treaty's
Entry into Force and Universalization"**

Wednesday, June 28, 2017 4:00 PM (2 hours)

CTBT: Science an ... / Report of Contributions

LUNCH

ID:

Type: **not specified**

Monday, June 26, 2017 3:00 PM (1 hour)

ID:

Type: **not specified**

BREAK

Monday, June 26, 2017 6:00 PM (30 minutes)

ID:

Type: **not specified**

AND LUNCH

Tuesday, June 27, 2017 3:00 PM (2 hours)

ID:

Type: **not specified**

: "Best Practices for Social Media Advocacy"

Monday, June 26, 2017 4:00 PM (2 hours)

ID:

Type: **not specified**

Youth Group Orientation Session

Monday, June 26, 2017 11:00 AM (2 hours)

Speakers: Lassina Zerbo, Maria Chepurina, Ryan González

ID:

Type: **not specified**

BREAK

Tuesday, June 27, 2017 7:00 PM (30 minutes)

ID:

Type: **not specified**

Meeting, Including Initial Discussion on Si-PIN Detectors

Thursday, June 29, 2017 7:30 PM (2h 30m)

ID:

Type: **not specified**

Analysis Demonstration

Thursday, June 29, 2017 7:30 PM (2h 30m)

ID:

Type: **not specified**

Analysis Demonstration

Tuesday, June 27, 2017 8:00 PM (2 hours)

ID:

Type: **not specified**

Youth Group Mentoring Session

Monday, June 26, 2017 7:00 PM (2 hours)

ID:

Type: **not specified**

: "Writing for Media Outlets/Op-eds and Letters to the Editor"

Thursday, June 29, 2017 6:00 PM (4 hours)

ID:

Type: **not specified**

Session: Cooperation between NDCs

Wednesday, June 28, 2017 7:00 PM (45 minutes)

1) “Practical example for expanding NDC capacity building” (Cooperation between NDCs from Austria, Brazil and Namibia)

Authors: Mauricio Moutinho (NDC Brazil), Ulrike Mittlebauer (NDC Austria) and Nortin Titus (NDC Namibia)

2) Palau NDC Design (Cooperation between University of Hawaii and the NDC of Palau for infrastructure support; NDC-in-a-cloud)

Authors: Milton Garces (NDC Palau, SO for IS39), M. Ngemaes (Palau NDC and National Weather Service)

3) eNIAB in Cloud Platform (Example of operating the extended NDC-in-a-box in a cloud)

Author: Leonid Kolesnykov (NDC Ukraine)

CTBT: Science an ... / Report of Contributions

LUNCH

ID:

Type: **not specified**

Wednesday, June 28, 2017 3:00 PM (1 hour)

ID:

Type: **not specified**

Youth Group Panel Discussions: "Nuclear Testing and Use"

Wednesday, June 28, 2017 6:00 PM (2h 30m)

"Nuclear Testing and Use"

"The CTBT as a Confidence Building Measure"

"Advocacy and Outreach"

ID:

Type: **not specified**

BREAK

Thursday, June 29, 2017 1:00 PM (30 minutes)

CTBT: Science an ... / Report of Contributions

LUNCH

ID:

Type: **not specified**

Friday, June 30, 2017 3:00 PM (1 hour)

ID:

Type: **not specified**

Discussion "Processing and Analysis of Seismic Aftershock Sequences: Protecting Operational Performance in the IDC"

Thursday, June 29, 2017 1:30 PM (1h 30m)

ID:

Type: **not specified**

Session: T2.2, T2.3, T2.5, T3.3, T3.4, T3.6

Monday, June 26, 2017 6:00 PM (3 hours)

Topic 2.2 Characterization of Events Through On-Site Inspection

T2.2-P1 A Standardized and Accurate Sampling Device for On-Site Inspection and Verification Purposes after a Nuclear Incident

T2.2-P2 Analytical Procedures Developed by the IAEA's ALMERA Network Applicable to the Characterization of Legacy Nuclear Test Sites

T2.2-P3 Delayed Telltale Signature of an Underground Nuclear Explosion

T2.2-P4 (Y) Determining Mechanisms of Ground and Surface Waters at "Balapan" Site of Semipalatinsk Test Site

T2.2-P5 Geophysical Imaging of an Uncollapsed Nuclear Explosive Test

T2.2-P6 Measurement of Radioargon and Radon in Soil Gas

T2.2-P7 Measurements of Ar-37 Backgrounds at the Nevada National Security Site

T2.2-P8 On Site Carbon Dioxide and Stable Isotopologues Measurement to Support OSI Subsurface Gas Sampling

T2.2-P9 PNNL-2: On-Site Inspection Capabilities – Examination of Laboratory Detector Response

T2.2-P10 Revisiting the On-site Inspection (OSI) Concept of Operations in Light of Integrated Field Exercise 2014 (IFE14) and Inspection Team Functionality

T2.2-P11 Semipalatinsk Test Site: Underground Nuclear Explosions Signatures in the Velocity Field on P- And S- Waves (for the OSI Purposes)

T2.2-P12 (Y) Simulation of Shallow Subsurface Noble Gas Transport Using Subsurface Transport over Multiple Phases (STOMP)

T2.2-P13 (Y) Use of Tritium as an Indicator of Underground Nuclear Explosion Venues at the STS

T2.2-P14 Variations of Cs-137 Background of Global Fallout at OSI Site as the Signature to Search for Radiation Anomaly or the Artefact

T2.2-P15 The Importance of Visual Observation to Guide the Application of Other OSI Techniques

Topic 2.3 Seismoacoustic Sources in Theory and Practice

T2.3-P1 A New Experimental Field Study of the Effects of Explosive Detonation Products on Seismic Radiation

T2.3-P2 (Y) Analysis of Stress and Fault Orientation in Double Subduction Zone of Maluku Sea Region by Using Iterative Joint Inversion Method

T2.3-P3 Combined Experiment and Numerical Modelling to Understand Response Near Chemical Explosions

T2.3-P4 Compilation of Infrasound Ground-Truth Database Using Seismic Data

T2.3-P5 (Y) December 7th Earthquake

T2.3-P6 Dynamics of Reservoir Induced Seismicity in Aswan, Egypt

T2.3-P7 (Y) Earthquakes Mechanisms in Egypt

T2.3-P8 Estimation of Full Moment Tensors, Including Uncertainties, For Earthquakes, Volcanic Events and Nuclear Explosions

T2.3-P9 Estimation of Source Parameters and Their Uncertainties of Explosion Sources Using Equalization Technique: Application to the SPE Chemical Explosions at NNSS

T2.3-P10 Events Detected by the Indian Ocean Network of Hydroacoustic IMS Stations

T2.3-P11 Induced Seismicity on the Territory of Kazakhstan

T2.3-P12 Precursor Study by a Physical Model of the Ahar-Varzaghan Doublet Earthquakes (6.5, 6.3) 2012 at the Northwest of Iran

T2.3-P13 Seismic and Hydroacoustic Observations from Underwater Explosions off the East Coast of Florida

T2.3-P14 Seismoacoustic Effects of the Khubsugul Earthquake of 5 December 2014, Mw = 4.9, Mongolia

T2.3-P15 Time-Domain Source Function (TDSF) for Nuclear and Chemical Explosions: Analysis

Around Nevada National Security Site (NNSS)

T2.3-P16 Seismic Source of Moderate Earthquakes in Colombia

Topic 2.5 Historical Data from Nuclear Test Monitoring

T2.5-P1 Kr-85 Monitoring in North-Western Region of Russian Federation

T2.5-P2 Analysis of the Wave Pattern of Nuclear Explosions Records from Lop Nor Test Site by Central Asia Stations

T2.5-P3 (Y) Measurement of Background Gamma Radiation in the Northern Marshall Islands

T2.5-P4 Nuclear Explosions in the Eastern Siberia (the Former USSR) in 1976-1987

T2.5-P5 (Y) Nuclear Test Explosions Recorded by Seismic Stations of the Slovak Academy of Sciences

T2.5-P6 Observation of Infrasound Signals from the 1920s

T2.5-P7 Possibility Assessment of Determination of the Place of the Underground Nuclear Tests by Means of Artificial Radionuclides Presence in Groundwater with STS Example

T2.5-P8 Potentially Dangerous Technogenic Objects at Semipalatinsk Test Site

T2.5-P9 Some features of wave forms of seismic events from the areas of nuclear Asia Test Sites according to the data of AS60 seismic station (AAK, Ala-Archa, Kyrgyzstan)

T2.5-P10 The Nuclear Tests in Ukraine (the Ukrainian SSR) in the Period of 1972-1979 Years

T2.5-P11 (Y) The Precise Location of the Fifth Nuclear Test in North Korea

Topic 3.3 Remote Sensing, Satellite Imagery and Data Acquisition Platforms

T3.3-P1 Aerial Gamma Spectroscopy for On-Site Inspections in Winter Environments

T3.3-P2 (Y) Airborne Gamma-Spectrometry Mapping

T3.3-P3 (Y) Anomaly Detection in Remote Optical Imagery

T3.3-P4 Detection of OSI-Relevant Features Using Time-Series Radar Imagery

T3.3-P5 Ionospheric Waves Associated of Earthquakes and Nuclear Explosions Using Total Electron Content (TEC)

T3.3-P6 Repurposing the Global Network of Radiation Portal Monitors

T3.3-P7 State Provided GIS Data Sources for Treaty Verification

T3.3-P8 Subsurface, Surface and Remote Observations of Legacy Nuclear Explosion Sites

T3.3-P9 UAV-Based Mobile Gamma Spectrometry

Topic 3.4 Geophysical Methods Applied to On-Site Inspection

T3.4-P1 Analysis of Heat Transfer in a Closed Cavity Ventilated Inside

T3.4-P2 Application of Radial and 3D Electrical Resistivity Electrode Profile Configuration for Improved Subsurface Imaging to Detect Anomalies/Artefacts related to Nuclear Testing and Explosion

T3.4-P3 Application of the On-site Inspection Geophysical Techniques for the Detection and Identification of Subsurface Features

T3.4-P4 Dynamic Characteristics of Soil Using Geophysical Techniques in Atbara Area, Sudan

T3.4-P5 (Y) Experimental S-wave Data Acquisition and Processing Above a Tunnel

T3.4-P6 (Y) Investigation of a Remediated Sink Hole with S-Wave Seismic and Geoelectric Methods

T3.4-P7 Near Surface Geophysical Observations on the Great Cavern, Felsőpetény Testing Area, near Budapest, Hungary

T3.4-P8 (Y) Resonance Seismometry: A Toolbox for OSI

T3.4-P9 SAMS Software Functionality Enhancement

T3.4-P10 Seismological Investigations of the National Data Centre Preparedness Exercise 2015 (NPE2015)

T3.4-P11 The Guide for Tunnels and Voids Detection Using High Resolution Microgravity

T3.4-P12 Use of Data from Seismic Measurements in the Kylylahti Region, Finland, in 2016 for Further Development of Geophysical Seismic Techniques for CTBT On-Site Inspections

Topic 3.6 Fusion of Data from Different Monitoring Technologies

T3.6-P1 CTBTO Generation of Synthetic Radionuclide Spectra to Support the NDC Preparedness Exercise NPE15

T3.6-P2 Experience of Use Seismoacoustic Complex of MCSM for Monitoring of Natural and Man-Made Events

T3.6-P3 Infrasound Detection of Earthquakes in Chile

T3.6-P4 (Y) Integration Geophysical Network OVSICORI and Seismic Stations of IMS Network
CTBTO

T3.6-P5 (Y) The Application of Local Seismic and Infrasound Networks as National Technical Mean