SnT 2025
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

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ONLINE DAY
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AT HOFBURG PALACE, VIENNA & ONLINE

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The challenging multi-technology scenario of the NPE 2024

J. Ole Ross, Andreas Steinberg, Christoph Pilger, Peter Gaebler, Patrick Hupe, Nicolai Gestermann, Stefanie Donner, Lars Ceranna

Federal Institute for Geosciences and Natural Resources (BGR),
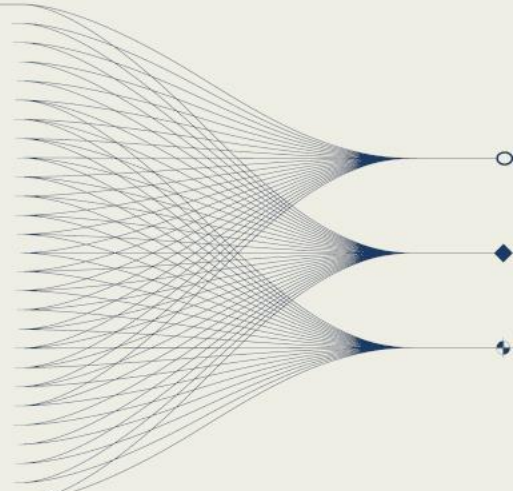Hannover, Germany

INTRODUCTION AND MAIN RESULTS

NDC preparedness exercises (NPE) are potential CTBT violation scenarios organised by the German NDC.
In NPE 2024, the fictional state of Andlantis indirectly accused its southern neighbour, Bezores, of non-compliance with the CTBT by submitting observation data to other NDCs that seemed to indicate a nuclear test explosion.
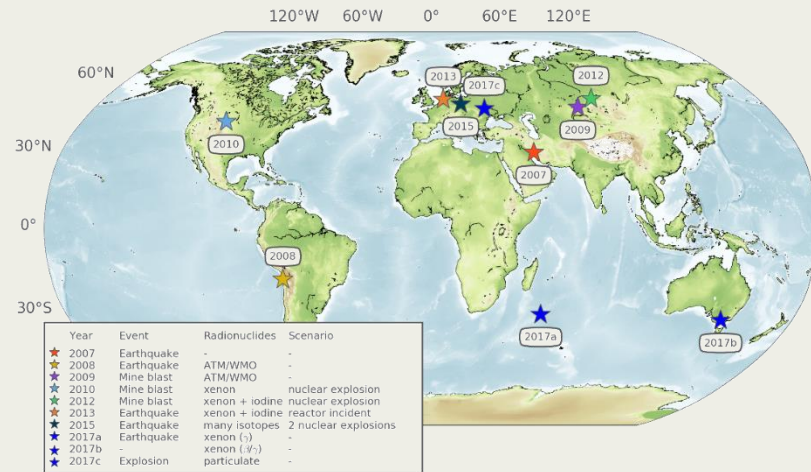The participants had to determine the true nature of the seismic event in question.

The scenario covered all IMS technologies, which were complemented by national technical means, and introduced some innovative gameplay elements.

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About NDC Preparedness Exercises (NPE)

| Year	Event	Radionuclides	Scenario
2007	Earthquake	-	-
2008	Earthquake	ATM/WMO	-
2009	Mine blast	ATM/WMO	-
2010	Mine blast	xenon	nuclear explosion
2012	Mine blast	xenon + iodine	nuclear explosion
2013	Earthquake	xenon + iodine	reactor incident
2015	Earthquake	many isotopes	2 nuclear explosions
2017a	Earthquake	xenon (γ)	-
2017b	-	xenon (β/γ)	-
2017c	Explosion	particulate	-

Since 2007, BGR has organized the National Data Centre Preparedness Exercises (NPEs). The NPE involves partially simulated scenarios of events and cases that are potentially relevant to the CTBT, and gives all NDCs the opportunity to practise and test their procedures. NPEs also facilitate exchange between the IDC and NDCs. Real waveform events are often used for the scenarios, and radionuclide evidence is simulated. NPEs from 2007 to 2017 are shown on the map. For NPE 2019, in collaboration with ENEA, Italy, the data from a shallow earthquake at Lake Constance was altered to resemble an explosive signature. The state of Raetia intentionally released particulate radionuclides at a reactor site and reported the incident in an attempt to divert attention from the radioxenon released by the nuclear explosion.

The puzzle of NPE 2024

Following a hiatus in the NPE series due to the absence of connected in-person NDC workshops, the NPE 2024 was announced in March 2024.

The starting point was that the fictive NDC Andlantis introduced itself on the NDC Forum and asked all other NDC for assistance as they need help in analysis and interpretation of their ocean bottom seismic data.

The data were given at a low frequency sampling rate which caused some confusion for classical picking, localization and magnitude determination.
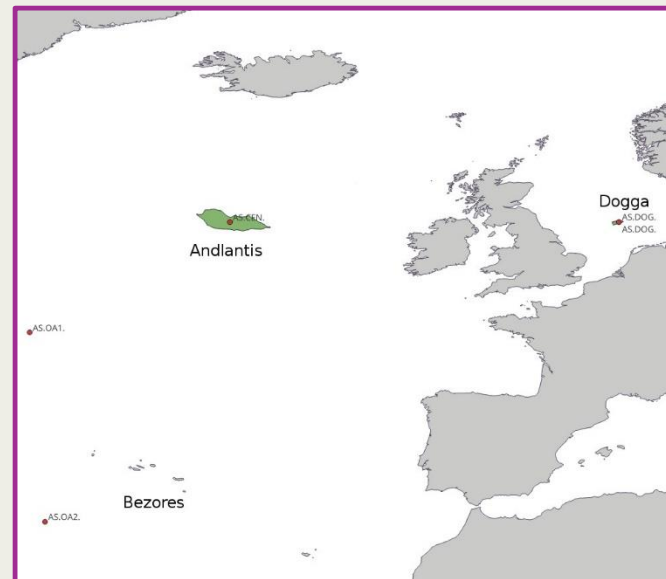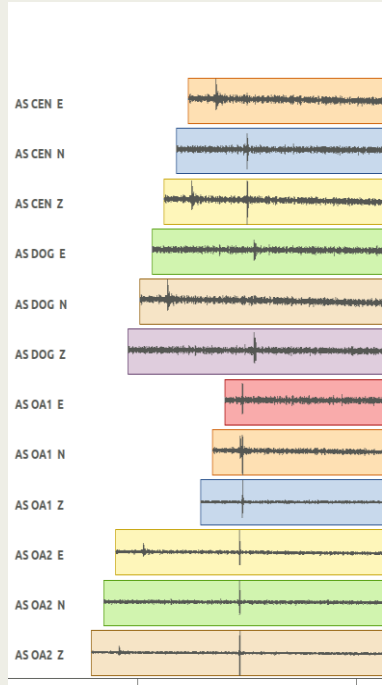

Information received by the participants

- Seismic low frequency data of the national stations of Andlantis
- Suggestion that elevated xenon concentrations at ISM station RN 33 may originate from the event
- Infrasound data of two mobile arrays without the location of the measurements
- A geo-riddle to find the coordinates of the mobile infrasound measurements on "leaked" satellite imagery by matching island shapes
- Hint that hydroacoustic arrivals at IMS station H10 are from the event, revealing that the time in waveform data from Andlantis was shifted by 2h ("ATC")
- Late national radioxenon measurements containing Xe-131m and Xe-133 released by Andlantis taken at one of the mobile infrasound arrays

Key aspects addressed by NPE 2024

- Promotion of the NDC Forum
- Multi-technology analysis and data fusion
- National technical means and their integrity
- Elements of Expert Technical Analysis
- Importance of noble gas background characterization
- Featuring use of NDC-in-a-box software

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Seismic Analysis


```
Geofon solution of real
event:
name = gfz2024ayka
time = 2024-01-14
08:19:57.460
latitude = 38.72
longitude = -27.21
Magnitude = 4.9
depth = 10000


Andlandis reported event:
time = 2024-01-14
06:19:57.460
latitude = 38.798228
longitude = -27.863522
Magnitude = 4.9
Depth = 1000
```

Moment Tensor (MT) Inversion of provided data:
Bayesian surface wave inversion at 20-50s with only four national station's RTZ components at and a Crust2.0 based velocity model. R-components show the most energy and have the best fits, resulting in an isotropic MT.
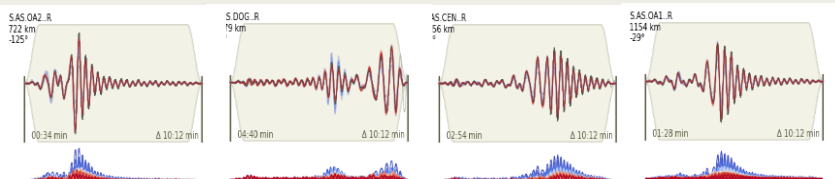
Infrasound Geo-Guess

The NDC Andlantis provided data from two mobile infrasound array IA1 and IA2 with 3 elements each and pretended security concerns to publish the locations of the national measurements. A third party "leaked" satellite images that allowed for identification of the position by matching the shape of the island on Google Earth or other maps.
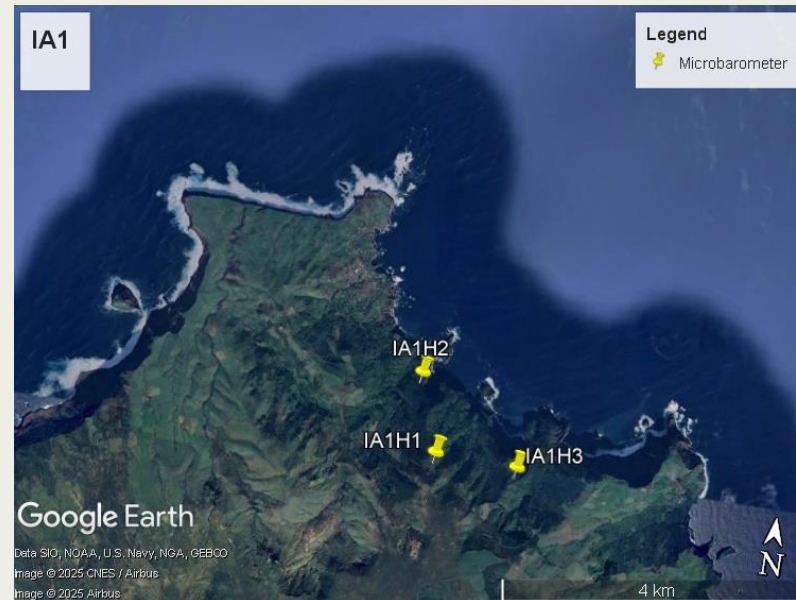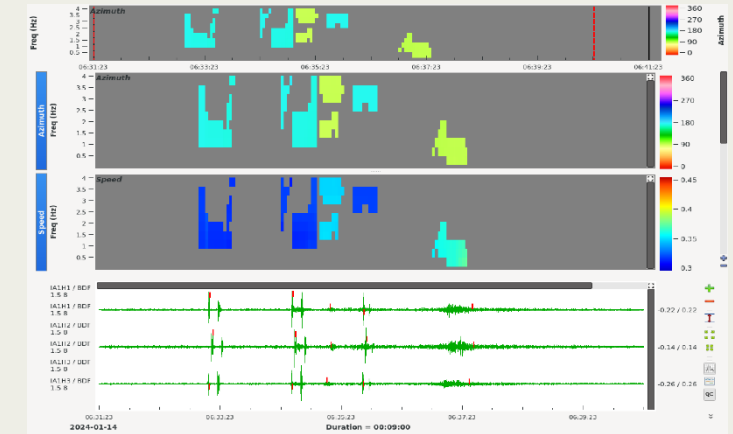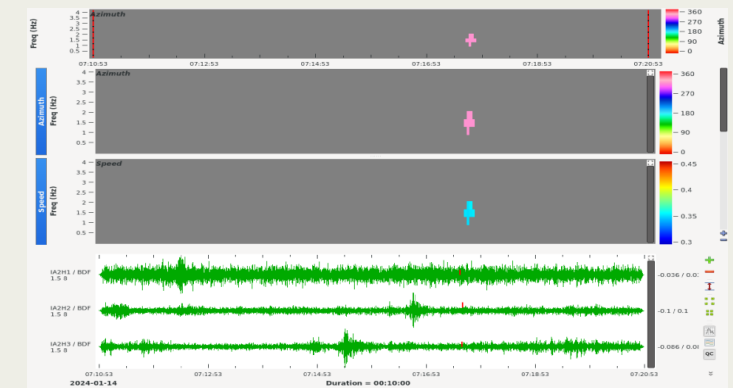

Image Source: GoogleEarth, ©Google/CNES/Airbus, 2025

Using the estimated coordinates of the microbarometer sites the participants were able to adjust the station XML files for the data and to read the infrasound data in the DTK-PMCC component of the NDC-in-a-Box software package for analysis.

Infrasonic Data Signature

PMCC analysis of IA1 revealed coherent phase arrivals which looked familiar to those who remember infrasonic signals after the North Korean test in 2013.

PMCC analysis of signals at IA2 was quite inconclusive in respect to azimuth and coherent content.

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Hydroacoustic Hint

The NDC Andlantis pointed to associated phase arrivals at IMS hydroacoustic station HA10 at about 5500 km distance. The purpose of the IMS detection in the exercise framework was to set the connection to the real REB event and to finally reveal the time shift between the Andlantis Time Zone and UTC (ATZ = UTC-2).
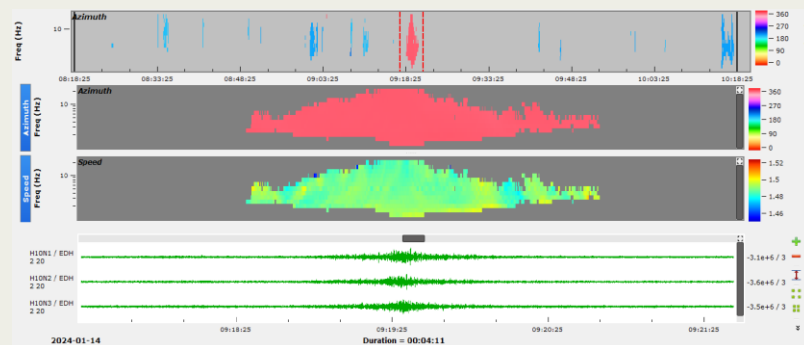
IMS xenon detections

In a further announcement on the NDC Forum the NDC Andlantis stated that they consider radioactive xenon-133 measured in real IMS samples end of January 2024 at RN 33 (Germany) as well as RN 63 (Sweden) categorized as Level C as potentially connected with the location of the SHI event. They asked for supporting Atmospheric Transport Modelling (ATM) analysis. Those real IMS detections on their own gave no clear indication of a release not typical for industrial radioxenon background sources.

Ambiguous ATM for IMS xenon detections
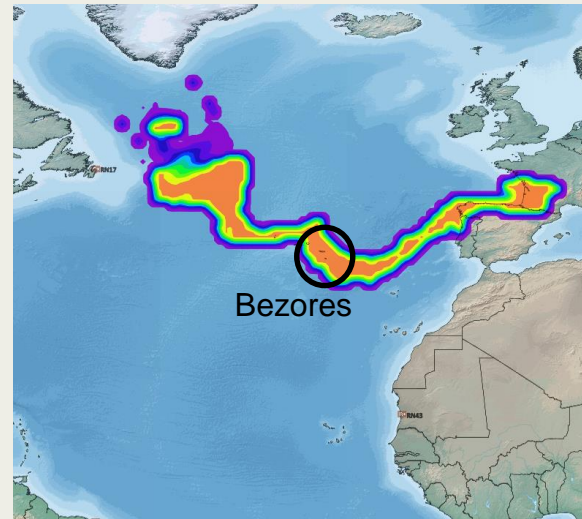
Bezores

The Field Of Regard from operational IDC ATM for the affected RN 33 samples as shown by WebGrape indicated a potential origin at the Bezores islands. The actual higher and in backward view earlier sensitivity to the medical isotope production facility Fleurus was not shown but probably is the real source of the radioxenon.

National xenon data

Later the NDC Andlantis reported national xenon measurements taken at IA2 with activitiy concentrations of 0.63 mBq/m³ ^{131m}Xe and 2.8 mBq/m³ ^{133}Xe. The ATM matched a release at the SHI event location at beginning of March 2024, the isotopic ratio was consistent with delayed nuclear explosion release.

Evidence overview by technology

► **S** eismic:
Synthetic data pretending explosive source charter
► **H** ydroacoustic
Detection of REB event for connection to real world
► **I** nfrasound:
Invented signals at two locations.
► **RN** RadioNuclide (xenon):
1. Real IMS detections with Bezores in source region
2. Fake Xe-131m / Xe-133 detection, ratio similar to delayed signature after North Korean test 2013

Summary and Concluison

- Core of the scenario was a M 4.5 earthquake at the edge of Terceira Island on Jan 14th, 2024.
- Data and hints given by Andlantis suggested an explosive source and xenon releases from that side, the infrasound and the late xenon signatures had similarities to that after North Korean test 2013.
- IMS data and other real data have shown usual earthquake characteristics and normal xenon background concentrations.
- **The solution was that there was no nuclear explosion but Andlantis tried to accuse the Bezores by releasing manipulated data.**