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Radioxenon Detections at Regional IMS NG Station and ATM Tracking of Possible Emission Source

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INTRODUCTION AND MAIN RESULTS

This presentation looks at radioxenon detections in 2020 at CMX13 noble gas station in the African sub-region. How essential background monitoring enable good discrimination of potentially abnormal levels of detections (Xe-133) observed at the station. Such monitoring in the global environment is crucial for treaty verification purposes. The use of ATM to identify the possible source(s) contributing to the observed detection.

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Introduction

Airborne radioactivity monitoring (ie. particulates and noble gases) is one of the monitoring technologies deployed for the verification of the CTBT. It is only radionuclide monitoring that can provide unmistakable proof of the nuclear nature of an explosion [1]. The global monitoring of radioxenon is crucial for the CTBT, a discriminating measure under the treaty [2]. Natural sources of radioxenon isotopes is relatively very small compared to anthropogenic sources [3]. Thus, anthropogenic sources (nuclear explosions, isotope production facilities, nuclear power plants, other sources of radioxenon) has significant contribution to any daily sampled measurements [3, 6]. Thus, the significant need to monitor background activity concentrations of radioxenon for any potentially anomalous concentration detections of CTBT relevance to be well discriminated.

IMS Noble Gas Stations and Radioxenon Monitoring

With 26 certified IMS noble gas stations, the network monitors radioxenon isotopes in the global environment. Located in Edea, Cameroon is IMS noble gas station CMX13 (Fig.1) . Radioxenon isotopes (Xe-131m, Xe-133m, Xe-133, X e-135) are noble gases that do not interact with the soil, so possibly can escape from any underground test explosion through normal cracks and fissures or can be vented in an underwater explosion into the atmosphere [4].

Fig. 1 Locations of IMS station CMX13

Methods/Data

Radioxenon Activities Monitoring and IDC Radioxenon Data

The CMX13 station applies a SPALAX technology for monitoring atmospheric radioxenon. Uses high resolution gamma spectroscopy [5]. The sampler collects air in 24 hour cycles while simultaneously concentrating xenon from the air. Completion of concentration and delivery to a gas counting cell occurs 1hour before the xenon product is counted on a gamma spectrometer for 23 hours. The gamma spectra analyzed and reviewed with the CTBTO-developed radionuclide analysis and evaluation software Aatami [5]. In this study the air samples collected during the period of 2020 for radioxenon detection at CMX13 station were considered. The daily activity concentrations for the period were retrieved for CMX13 station from IDC reviewed radionuclide report.

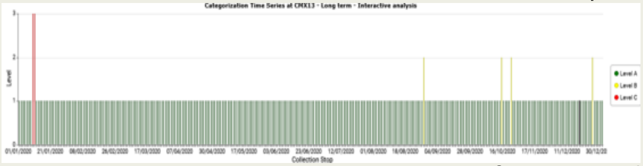

Fig. 2 Categorization time series at CMX13 Station for 2020 samples

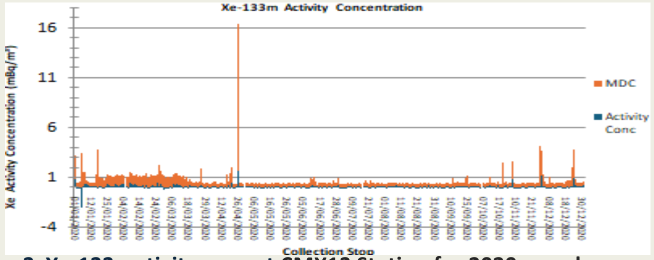

Fig. 3 Xe-133 activity conc at CMX13 Station for 2020 samples

Conclusions

The samples from CMX13 station in 2020 analyzed for the radioxenon generally showed no xenon detection. Radioxenon emissions from natural sources often give relatively very low yield compared to that from anthropogenic sources, resulting in no detections due to its absence or at a concentration below the MDC. Thus, the relatively low radioxenon background levels observed with only (Xe-133) in abnormal concentration levels. ATM was used to identify the possible source(s) contributing to the observed detection.

Results/*Discussions*

Discussions

Radioxenon Detection Levels Observed at CMX13 in 2020

Analyses of daily samples collected at the CMX13 station for 2020 showed that 0.6 % of the 312 samples measured anomalous radioxenon detection (Fig.2). Only xenon-133 showed abnormal detection of concentrations <1.0 mBq/m³ in January 2020 (Fig. 3). For most of the samples analyzed, each of the four radioxenon isotopes (Xe-131m, Xe-133m, Xe-133, X e-135) showed no xenon detection, categorized as level A (Fig. 2), generally below the minimum detectable concentration (MDC) ranges. Those from anthropogenic sources namely medical isotopes production facilities (MIPFs) and nuclear power plants (NPPs), probable emitters are far away from this monitoring station with the nearest facility (~3800 km) being the MIPF located in Pelindaba, South Africa, which is south of the station [6]. Using *b*ackward ATM modeling, the emissions origin indicates that PSR is around industrial Xe emitting facility in South Africa (Fig. 4), the only major emitting source in the region around station CMX13 with significant impact on detections depending on meteorological conditions.

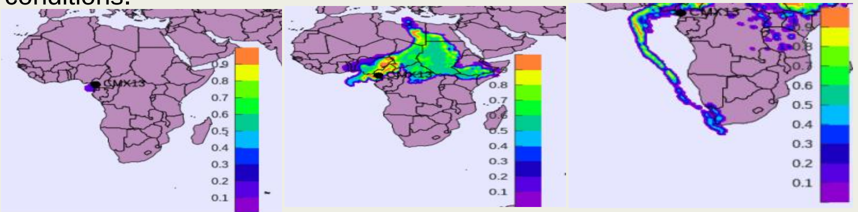

Fig. 4 ATM PSR for 1, 7 and 14 days quantitative [3hd] for CMX13 station detection

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