Geophysical Research Abstracts
Vol. 12, EGU2010-13215-2, 2010
EGU General Assembly 2010

On the impact of a doubled sampling frequency on the detection capability and accuracy of a xenon station at the example of the German IMS RN station Schauinsland

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In order to detect any kind of nuclear explosion world-wide the Provisional Technical Secretariat to the Comprehensive Nuclear-Test-Ban Treaty (CTBT) is building up a verification regime that performs global monitoring for typical signals expected from such an event. Backbone of this regime is the 321 facilities International Monitoring System (IMS) comprising also 80 stations to monitor for airborne radionuclides known to be fission or activation products of a nuclear explosion. Whereas particulate radionuclides are very likely fully contained in the cavity of an underground nuclear test explosion, radioactive noble gases bear a good chance to be still vented or seeped through the lithosphere into the atmosphere. As the corresponding relevant isotopes Xe-131m, Xe-133, Xe-133m, and Xe-135, which have the highest fission yields among the noble gases, are also not subdued to wet deposition in the atmosphere, they were regarded as important enough to add a xenon detection capability to 50% of the aforementioned 80 radionuclide stations. This, however, requires measurement methods being completely different to the one utilized for particulate monitoring. Despite tremendous progress that has been made with regard to the detection capability of radio-xenon systems in the past 10 years, gaining one order of magnitude in this metric, certain challenges still occur with regard to noble gas monitoring:

• Only four xenon isotopes instead of more than 90 different particulate radio-isotopes are characteristic for the detection of a nuclear explosion with the IMS.

• These four nuclides feature very different - abundances (background concentrations) that are strongly related to their different half-life times and the site.

• There are known but CTBT irrelevant sources of radioxenon surrounding noble-gas stations at partly short distances (at least much shorter than the average station to station distance of the noble gas network).

• Mountainous IMS stations and their associated higher variable wind fields impose a higher demand on the temporal resolution of the monitoring and the associated source region attribution provided by inversion modelling based on sample specific backtracking results.

This study deals with the impact on the regional xenon detection and source location and attribution capability of the IMS radionuclide station No.33 (Schauinsland, Germany) encountered and analysed for a year 2009 period where the acquisition time of a xenon sampling system was halved yielding two 12h samples instead of one 24h sample per day. It is investigated whether the positive impact of the higher frequency of sampling that allows for the first time to roughly resolve diurnal variations of the meteorological fields is over-compensated by the adverse effects to the detection limit due to an enlarged minimum detectable concentration of the noble gas system SPALAX in use.

Higher temporal resolution at worsened detection limit potentially leads to a different measured composi-

tion of known radioxenon emitters that can be attributed to the xenon detections encountered, as the detections from local sources possibly resolved the first time due to the higher sampling frequency might be compensated by loss of signals from weak or persistent emitters due to the higher detection limit. Therefore, the potentially different monitoring fingerprints of the station operated at 12 and 24h acquisition times are discussed. The result of this case study could have influence on further improvements of the detection capability of equipment and requirements for the Atmospheric Transport Modelling to generally increase the detection capability of the noble gas network.