Geophysical Research Abstracts
Vol. 12, EGU2010-14828, 2010
EGU General Assembly 2010
© Author(s) 2010

An assessment on the PTS global radionuclide monitoring capabilities to detect the atmospheric traces of nuclear explosions

Andreas Becker (1), Gerhard Wotawa (2), Matthias Auer (3), and Monika Krysta (1)

(1) CTBTO Prep Com, International Data Centre Division, Vienna, Austria (andreas.becker@ctbto.org, +43 1 2630 5874), (2) Central Institute for Meteorology and Geodynamics, Data, Methods and Modelling, Vienna, Austria (gerhard.wotawa@zamg.ac.at), (3) CTBTO Prep Com, International Monitoring System Division, Vienna, Austria (matthias.auer@ctbto.org)

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 80 stations to monitor for particulate radionuclides known to be fission or activation products of a nuclear explosion. Every second station is also equipped with a system capable to monitor for the occurrence of the CTBT relevant isotopes Xe-131m, Xe-133, Xe-133m, and Xe-135, which have the highest post-explosion fission yields among the noble gases, and are also not subject to wet deposition in the atmosphere. Moreover, they have a good chance to escape from the cavity of an underground nuclear explosion in contrast to the particulates.

Effective radionuclide monitoring requires an optimum overall probability of a one-station detection of an atmospheric or underground nuclear explosion within 14 days. Consequently, the distribution of this detection probability is crucial for assessing the capacity of the radionuclide IMS to meet this requirement.

The CTBT monitoring capabilities of the RN IMS are quite different in dependence on the environment in which the nuclear test is conducted (underground, underwater or atmospheric) as this determines the first crucial factor for the overall detection probability, the degree of containment. Secondly, the detection probability is subject to the nuclide specific decay and the dilution of any release (containment failure) during its atmospheric dispersion from the release location to one of the IMS stations. Thirdly, the detection limits of the measurement systems in use factor in.

In the study presented here the radionuclide monitoring capabilities for detecting atmospheric and underground explosions, the latter mimicked by a 90% contained atmospheric release (first factor), are assessed. We examine the typical yields of a 1-kt atmospheric explosion for five key nuclides, Barium(Lanthanum)-140, for the 80 stations particulate network, and the four aforementioned gaseous nuclides, Xe-131m, Xe-133, Xe-133m, and Xe-135, for the 40 stations noble-gas network. The second factor (decay & dispersion) is determined by consideration of the half-life time of the respective nuclide and by evaluation of the so called source-receptor-sensitivity (SRS) files generated daily by the CTBTO for each station to diagnose the one-station probability within 5, 10 and 14 days. A one year time period was used (August 2008 to 31 July 2009), which considered samples from the radionuclide particulate and xenon stations, taking into account their detection limits (third factor). It should be noted that the contribution of station No. 35 of the 80 station IMS particulate network, intended for the Indian Subcontinent, was not considered.

Despite the obvious sensitivity to the maximum atmospheric transport time allowed from the source to the first detecting station, there is a general observation of the prevailing impact of the meteorological wind patterns for the global distribution and average of the one-station detection probability. Therefore, certain gaps in the tropical belt can only be ‘filled’ by extending the allowed transport time or supplementing stations. This is in particular true for the noble gas network that comprises only 50% of the stations. Obviously, adding the xenon

monitoring capability at a few of the so far particulate only stations that monitor the ‘gap areas’ is a ‘low hanging fruit’. Moreover, we observe that the shorter the half-life time the more the nuclide specific detection limits become relevant.

These findings will be elaborated in all required detail in the presentation.