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NPE 2010 results - Independent performance assessment by simulated CTBT violation scenarios

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For verification of compliance to the Comprehensive Nuclear-Test-Ban Treaty (CTBT) the global International Monitoring System (IMS) is currently being built up. The IMS is designed to detect nuclear explosions through their seismic, hydroacoustic, infrasound, and radionuclide signature. The IMS data are collected, processed to analysis products, and distributed to the state signatories by the International Data Centre (IDC) in Vienna. The state signatories themselves may operate National Data Centers (NDC) giving technical advice concerning CTBT verification to the government.
NDC Preparedness Exercises (NPE) are regularly performed to practice the verification procedures for the detection of nuclear explosions in the framework of CTBT monitoring. The initial focus of the NPE 2010 was on the component of radionuclide detections and the application of Atmospheric Transport Modeling (ATM) for defining the source region of a radionuclide event. The exercise was triggered by fictitious radioactive noble gas detections which were calculated beforehand secretly by forward ATM for a hypothetical xenon release scenario starting at location and time of a real seismic event. The task for the exercise participants was to find potential source events by atmospheric backtracking and to analyze in the following promising candidate events concerning their waveform signals.
The study shows one possible way of solution for NPE 2010 as it was performed at German NDC by a team without precedent knowledge of the selected event and release scenario. The ATM Source Receptor Sensitivity (SRS) fields as provided by the IDC were evaluated in a logical approach in order to define probable source regions for several days before the first reported fictitious radioactive xenon finding. Additional information on likely event times was derived from xenon isotopic ratios where applicable. Of the considered seismic events in the potential source region all except one could be identified as earthquakes by seismological analysis. The remaining event at Black Thunder Mine, Wyoming, on 23 Oct at 21:15 UTC showed clear explosion characteristics. It caused also Infrasound detections at one station in Canada. An infrasonic one station localization algorithm led to event localization results comparable in precision to the teleseismic localization. However, the analysis of regional seismological stations gave the most accurate result giving an error ellipse of about 60 square kilometer. Finally a forward ATM simulation was performed with the candidate event as source in order to reproduce the original detection scenario. The ATM results showed a simulated station fingerprint in the IMS very similar to the fictitious detections given in the NPE 2010 scenario which is an additional confirmation that the event was correctly identified. The shown event analysis of the NPE 2010 serves as successful example for Data Fusion between the technology of radionuclide detection supported by ATM and seismological methodology as well as infrasound signal processing.