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Evaluation of High-Resolution Atmospheric Transport Modelling within the framework of the CTBT with Xe-133 observations in Germany and stack emission data from medical isotope production

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For every atmospheric radionuclide sample taken by the International Monitoring System (IMS) of the Comprehensive Nuclear-Test-Ban Treaty Organisation (CTBTO), the CTBTO makes use of operational Atmospheric Transport Modelling (ATM) to assist States Signatories in localization of possible source regions of any measured substance. Currently, ATM is accomplished by using the Lagrangian particle dispersion model (LPDM) FLEXPART driven by global meteorological fields with a spatial resolution of 0.5 degrees and 1 hourly temporal resolution. Meteorological fields are provided by the European Centre for Medium-Range Weather Forecasts (ECMWF) and the National Centers for Environmental Prediction (NCEP).

Recent studies to increase the accuracy in the CTBTO's localization process to be applied for specific detection events, utilizes High-Resolution Atmospheric Transport Modelling (HRATM) by using the Weather Research and Forecasting model (WRF) to generate high-resolution meteorological input data for the LPDM version Flexpart-WRF.

This presentation uses measurements from the International Monitoring System (IMS) station DEX33 in Germany of seven episodes of elevated Xe-133 concentrations in 2014 in combination with with the stack emission data of the medical isotope production facility IRE in Fleurus, Belgium. Each episode consists of 6 to 11 subsequent 24-hour samples. Backward simulations for each sample are conducted and the sensitivity to the stack emission data are analysed. All samples determined to represent a detection of IRE releases are selected to be used for an evaluation study.

Evaluating the CTBTO's utilization of HRATM requires to investigate the ability to localize the source region as well as the accuracy of the match and the computational performance to accomplish these results. The evaluation of HRATM results is done by using statistical metrics established during former ATM challenges. Concerning the computational performance and to account for uncertainties, sensitivity studies with varying spatial resolutions, physical parameterization variations and different regional domain setups for WRF were accomplished. This comprises a reference comparison to the operational ATM FLEXPART model with an increased spatial resolution to 0.1 degrees.