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Source Estimation and Atmospheric Modelling Uncertainties Quantification

The source estimation of man-made radionuclides by using inverse modeling of atmospheric motion plays a vital role in CTBTO's activities. This work studies the effect of the atmospheric modeling uncertainties on source estimation through a synthetic numerical experiment, which consists of four types of modeling (Eulerian meso-scale atmospheric modeling, forward atmospheric transport modeling (ATM), adjoint ATM, and inverse modeling). Weather Research and Forecast model (WRF) has been used with different configurations of planetary boundary layer and microphysics schemes (17 ensemble members) in order to estimate the uncertainties of atmospheric flow related to these schemes. The output simulations are used as driven meteorological fields for ATM and adjoint ATM. A number of well-known sources of Xe-133 are assumed, then the dispersion of their releases are made by using regional ATM (FLEXPART-WRF), in the forward mode, in order to create synthetic concentrations at CTBTO's IMS radionuclide stations. The next step included the usage of these concentrations in adjoint modeling to produce the SRS fields. The final step is the inverse modeling by using Bayesian approach in order to estimate the sources. This experiment illustrates the importance of the combination of ensemble technique with Bayesian approach in sources estimation and uncertainties quantification.

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