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The Atmospheric Radionuclide Transport Model (ARTM) - Validation of a long-term atmospheric dispersion model

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In the last couple of years, the Atmospheric Radionuclide Transport Model (ARTM) has been developed by the German Federal Office for Radiation Protection (BfS) and the Society for Plant and Reactor Security (GRS). ARTM is an atmospheric dispersion model for continuous long-term releases of radionuclides into the atmosphere, based on the Lagrangian particle model. This model, developed in the first place as a more realistic replacement for the out-dated Gaussian plume models, is currently being optimised for further scientific purposes to study atmospheric dispersion in short-range scenarios. It includes a diagnostic wind field model, allows for the application of building structures and multiple sources (including linear, 2-and 3-dimensional source geometries), and considers orography and surface roughness. As an output it calculates the activity concentration, dry and wet deposition and can model also the radioactive decay of Rn-222. As such, ARTM requires to undergo an intense validation process. While for short-term and short-range models, which were mainly developed for examining nuclear accidents or explosions, a few measurement data-sets are available for validation, data-sets for validating long-term models are very sparse and the existing ones mostly prove to be not applicable for validation.
Here we present a strategy for the validation of long-term Lagrangian particle models based on the work with ARTM. In our validation study, the first part we present is a comprehensive analysis of the model sensitivities on different parameters like e.g. (simulation grid size resolution, starting random number, amount of simulation particles, etc.). This study provides a good estimation for the uncertainties of the simulation results and consequently can be used to generate model outputs comparable to the available measurements data at various distances from the emission source. This comparison between measurement data from selected scenarios and simulation results forms the second part of our validation study.