Geophysical Research Abstracts
Vol. 15, EGU2013-3193, 2013
EGU General Assembly 2013

Transport and deposition of radionuclides after the Fukushima nuclear accident: international model inter-comparison in the framework of a WMO Task Team

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In the framework of a Task Team set up after the Fukushima accident sponsored by WMO, the atmospheric transport and deposition models (ATDMs) FLEXPART (Austria), HYSPLIT (U.S.), MLDP0 (Canada), NAME (UK) and RATM (Japan) were inter-compared. These models are well-known and widely used for emergency response activities. As alternative model input data, JMA made available a Meso-Analysis with 5 km/ 3 hour resolution, and a radar/rain gauge precipitation analysis with 1 km and 30 minutes resolution. To allow maximum flexibility regarding the release rates of key nuclides, the computations were based on the concept of source-receptor matrices, in this connection also called transfer coefficient matrices (TCM). The matrices are calculated every 3 hours after 11 March 2011 00 UTC, based on unit emissions, and thus can be overlaid with any present and future release scenario that becomes established. As computational species, the model considered tracers, depositing gases and depositing aerosols, allowing accounting for the range of substances emitted during a nuclear accident. The model comparison was based on observed deposition patterns of Cesium-137 in the Fukushima province as collected by MEXT/USDOE shortly after the accident, and a few available in situ stations measuring radioactive isotopes. To perform a statistical comparison, established parameters like correlation coefficient (r), fractional bias (FB) and figure of merit in space (FMS) were used. A further ensemble analysis was performed to determine what subset of model results out of all available would provide non-redundant information and thus is optimal to describe the transport and deposition during the accident. The investigation showed (i) that a TCM-based calculation approach has a lot of merits due to its flexibility, (ii) that models tended to perform better if they were run in improved resolution or directly with the Japanese Meso-analysis, (iii) that the model results depend on the selection of the source term with the term provided by JAAE ranking best in terms of reproducing local deposition patterns, and (iv) that the ensemble analysis is a very useful approach to select optimized subsets of models in case that measurement data are already available.