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Detailed intercomparison of atmospheric transport models using newly obtained concentration data of Cs-137 from the Fukushima Daiichi Nuclear Power Plant Accident

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It has been pointed out in our recent intercomparison study in which 12 models are participating (Sato et al. 2018) that the performance of atmospheric transport models applied to the Fukushima Daiichi Nuclear Power Plant (FDNPP) accident substantially differs from plume to plume depending on the physical processes characterizing each plume. Plume 2, which traveled southward in the morning of 15 March, 2011 has been identified as one of the plumes for which the models generally show good performance because of a rather simple meteorological field without significant precipitation. Even though the input meteorological data and the source term are common to all the models, variability in the model results is still large. The present study focuses on differences in the model results of atmospheric Cs-137 concentration of Plume 2 in the area 100 to 200 km downwind from FDNPP by using as reference data the concentration data recently evaluated by our group from gamma radiation spectral data at monitoring stations (MS data; Terasaka et al., 2016) and those measured from the suspended particulate matter filters (SMP data; Oura et al. 2015, Tsuruta et al. 2018).
Comparison was made from the following aspects: 1) plume arrival time, 2) concentration level, 3)cross-wind surface concentration profile, 4) vertical concentration profile and 5) mass balance of Cs-137 activity including deposition processes. Additional analyses were made also for Plume 4, which traveled over the same area on 16 March under rainy condition. It was found that there was no significant systematic difference between Lagrangian and Eulerian models. According to the surface concentration profile along a cross-wind line (CWL) at about 120 km downwind of FDNPP, Plume 2 was simulated by most models to have width of 12 to 16 km with a few exceptional models. The maximum concentration on the CWL was simulated within a factor of 2 (FA2) by five models and additional three models within FA3. The geometrical mean of all the 12 models is 1.41 times the mean of the MS data with a geometrical standard deviation of 2.87. More than half of the models showed similar vertical concentration profiles which was consistent with the potential temperature profile measured at a nearby aerological observatory. The budget analysis for Plume 4 revealed that there were significant discrepancies among models in dry, in-cloud and below-cloud deposition amounts.