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Numerical simulation of atmospheric transport of radionuclides in Meteorological Research Institute

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Meteorological Research Institute have been conducted numerical simulation of atmospheric transport of radioactive materials with observation, such as the Chernobyl accident in 1986, ^{85}Kr from nuclear fuel reprocessing plants, ^{222}Rn and its progeny released from ground soil. We are currently conducting the radioactive materials released from the accident of Fukushima Daiichi nuclear power plant after the Tohoku great earthquake. To improve our understanding of the temporal and spatial distributions of transport and depositions quantitatively, we are developing both global and regional scale atmospheric transport models. For the global transport of radioactive materials, we used our global aerosol model named MASINGAR (Model of Aerosol Species IN the Global AtmospheRe). In the setting of the experiment, the horizontal grid is about 0.56^o (TL319) and 40 vertical layers (from surface to 0.4hPa). The horizontal wind components are nudged using global analysis of Japan Meteorological Agency (GANAL). For emission flux, we used estimates by Chino et al. (2011) for ^{137}Cs and ^{131}I and estimates of Stohl et al. (2011) for ^{133}Xe. The model treats ^{137}Cs, ^{133}Xe, and ^{131}I as released radionuclides. The model include advective transport, eddy diffusion, convective transport, dry and wet depositions, and radioactive decay. For more detailed distribution and processes of radionuclides, we are developing our regional atmospheric transport model named MRI-PM/r (Passive-tracers Model for Radioactivity). The model incorporates advanced dry deposition parameterization, processes of the mixed-phase cloud microphysical dynamics, the activation of cloud condensation nuclei and ice nuclei, physical and chemical processes of radionuclides, and the interaction with the environment aerosol. This model classifies the aerosol particles into radionuclide primary (PRI), Aitken particle (ATK), particle accumulation mode (ACM), sea salt particles (SS), soil particles (DU), pollen (POL) by category method the aerosol, and considers the elementary processes that include condensation, evaporation, cohesion, activation of cloud condensation nuclei and ice nuclei, dissolution, collision (washout), cloud microphysical processes (conversion processes among following categories; rainout, cloud water, ice clouds, raindrops, snow, hail) and dry deposition. We will show the overview of the current status and challenges of our simulation studies.

Keywords: Numerical simulation, Atmospheric trace substances, Environmental radioactivity