Long-term assessment of airborne radio-cesium after the Fukushima nuclear accident: re-suspension from soil and vegetation

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Long-term assessment of ^{137}Cs re-suspension from contaminated soil and vegetation due to the Fukushima nuclear accident in March 2011 and the on-going emission from the premises of the power plant has been conducted using a numerical simulation, a field experiment on the dust deflation at Namie in the restricted habitation area, and air concentration measurements in and out of the area, Namie and Tsukuba, respectively. The analysis period is one year from December 2012, about one and a half years from the accident, up to December 2013. The surface concentration of Cs-137 at Namie was high in the summer (~1 mBq/m^3) and low in the winter (0.1-1 mBq/m^3). The $_{137}$Cs concentration was about one order smaller in Tsukuba (0.01-0.1 mBq/m^3). The differences in the two sites are consistent between the observation and the simulation. Ishizuka et al. (2016) developed a numerical module of ^{137}Cs re-suspension associated with dust deflation based on the flux measurement in Namie. Using the module, the simulated ^{137}Cs from soil had a potential to account for the observed surface concentration in Namie in the winter, but underestimated by 1-2 orders of magnitude in the summer. The Tokyo Electric Power Company assessed the ^{137}Cs emission from the reactor buildings in 2013 as approximately 10^6 Bq/h. By using the emission rate, the simulation substantially underestimated the observation by 2-3 orders of magnitude in Namie. We simulated the re-suspension from vegetation applying a seasonal variation as a function of the green fraction map. With the constant re-suspension rate of 10^{-7} [/h], the simulated vegetation re-suspension quantitatively accounted for the observed surface concentration together with its seasonal variation. Still, so far, the re-suspension mechanism has not been fully understood and thus further investigations for the understanding of the mechanisms and its long-term effects on the environment are needed.

Keywords: Dust deflation module, Three dimensional numerical model, Atmospheric measurement, Budget analysis

