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Estimation of radionuclides' deposition over the land and ocean using a regional chemical transport model

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To reveal the transport and deposition processes of radionuclides that have been emitted from the Fukushima Daiichi nuclear power plant after the nuclear accident caused by the Tohoku earthquake and tsunami, we have conducted numerical simulation of radionuclides (131I and 137Cs) using a regional chemical transport model. Data assimilation using nudging for wind field and relative humidity was applied with the 10-minutes' interval ground-based observation, and the model-calculated meteorological fields with the ground-based observations in Fukushima prefecture showed that the model was capable to reproduce the change of wind direction following to the passage of low-pressure systems, and precipitation periods in March 2011. The transport and deposition process of two major discharges on March 15 was estimated using tag-tracer methods. The airmass from the first discharge released during 7-10 JST was transported southward, and 13% of 137Cs was deposited mainly over Kanto area via dry deposition process. In the afternoon, wind direction was changed following to the approach of low-pressure system, and the airmass from the first discharge was transported northward and 13% of 137Cs was deposited mainly over Naka-dori area in Fukushima prefecture via wet deposition process corresponding with the precipitation since 15-16 JST. The model showed that the deposition over Naka-dori area occurred within 3 hours after the beginning of precipitation, although the intensity of precipitation was less than 0.5 mm/hr during that period. The airmass from the second discharge occurred at 13-17 JST was transported northwestward, and 47% of 137Cs in second discharge were estimated to be deposited over the land. The comparison of accumulated deposition of 137Cs at Azuma-yama mountains supposed that the radionuclides from the Fukushima Daiichi nuclear power plant were trapped within the boundary layer, and the highest concentration existed at around 1000-1500 m above the ground level.

Keywords: radionuclides, chemical transport model, atmospheric chemistry, chemical transport