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A spatio-temporal variation of atmospheric concentrations of Cs-137 in the Fukushima area in an early phase after the Fukushima Daiichi Nuclear Power Plant accident

Haruo Tsuruta (1), Yasuji Oura (2), Mitsuru Ebihara (2), Toshimasa Ohara (3), and Teruyuki Nakajima (1)

(1) Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan (haru2004@aori.u-tokyo.ac.jp), (2) Tokyo Metropolitan University, Tokyo, Japan, (3) National Institute for Environmental Studies, Tsukuba, Japan

The current estimates for the internal radiation doses from inhalation by the Fukushima Daiichi Nuclear Power Plant (FD1NPP) accident on March 11, 2011 have large uncertainty, because no observed data has been found of continuous monitoring of radioactive materials in the atmosphere in the Fukushima prefecture (FP) just after the accident, compared with the many observed dataset of deposition rates of radionuclides on the grounds in east Japan. As presented at the previous EGU 2013 Meeting, we successfully retrieved the hourly atmospheric concentration of radionuclides just after the accident, collecting the used filter tapes installed in Suspended Particulate Matter (SPM) monitors with beta ray attenuation method operated in the air pollution monitoring network of east Japan, and measuring Cs-134 and Cs-137 in SPM at a few SPM monitoring sites even after more than one year. In this paper, a comprehensive study will be reported for the first time on a spatio-temporal variation of atmospheric Cs-137 concentrations in the FP. We measured the radionuclides in SPM at ten sites in Nakadori located in the central and lowland area of the FP, at 3 sites in Hamadori located along the east coast of the FP, and at 3 sites in the west FP during March 15-16 and 20-21, 2011 when atmospheric, aquatic, and terrestrial environments were seriously suffered in most of east Japan by a large amount of radioactive materials released from the FD1NPP. On March 15, radioactive materials were firstly transported to south Nakadori, and then to north Nakadori, as the wind direction shifted clockwise. The atmospheric Cs-137 concentration was highest in south Nakadori in the early afternoon, while it was lower in north Nakadori where the polluted air masses were transported in the evening by southeasterly wind and a large amount of radionuclides was deposited on the grounds due to precipitation. On March 20 when the FP had no precipitation, however, high concentration of Cs-137 was firstly observed in north Nakadori by strong southeasterly wind from the FD1NPP, and time to the maximum became later toward south, after the wind direction shifted from south to north in the nighttime. Furthermore, the highest concentration in the FP was found in north Hamadori in the late evening due to the direct transport of the polluted air masses from the FD1NPP by southerly wind. As a result, the time-integrated Cs-137 concentration for 4 days was also highest at the site of north Hamadori, and which might have not been recognized until now. Thus, this new dataset clearly revealed the atmospheric transport of the radionuclides in time and space, and is expected to contribute to reconstruction of the time series of released radionuclides, and to validation of the simulated results by atmospheric transport and deposition models, in addition to re-evaluation of internal radiation doses from inhalation.