Impacts of direct release and river discharge on oceanic ^{137}Cs derived from the Fukushima Dai-ichi Nuclear Power Plant accident

*Daisuke Tsumune[1], Tsubono Takaki[1], Kazuhiro Misumi[1], Yutaka Tateda[1], Yuichi Onda[2], Michio Aoyama[2]

1. Central Research Institute of Electric Power Industry, 2. Center for Research in Isotopes and Environmental Dynamics

A series of accidents at the Fukushima Dai-ichi Nuclear Power Plant (1F NPP) following the Great East Japan Earthquake and tsunami of 11 March 2011 resulted in the release of radioactive materials to the ocean. We used the Regional Ocean Model System (ROMS) to simulate the ^{137}Cs activity in the oceanic area off Fukushima, with the sources of radioactivity being direct release, atmospheric deposition, river discharge, and inflow across the domain boundary. The direct release rate of ^{137}Cs after the accident until the end of 2016 was estimated by comparing simulated results with measured ^{137}Cs activities adjacent to the 1F NPP. River discharge rates of ^{137}Cs were estimated by multiplying simulated river flow rates by the dissolved ^{137}Cs activities, which were estimated by an empirical function. Inflow of ^{137}Cs across the domain boundary was set according to the results of a North Pacific Ocean model. Because the spatiotemporal variability of ^{137}Cs activity was large, the simulated results were compared with the annual averaged observed ^{137}Cs activity distribution. Normalized annual averaged ^{137}Cs activity distributions in the regional ocean were similar for each year from 2013 to 2016. This result suggests that the annual averaged distribution is predictable. Simulated ^{137}Cs activity attributable to direct release was in good agreement with measurement data from the coastal zone adjacent to the 1F NPP. Comparison of the simulated results with measured activity in the offshore area indicated that the simulation slightly underestimated the activity attributable to inflow across the domain boundary. This result suggests that recirculation of subducted ^{137}Cs to the surface layer was underestimated by the North Pacific model. During the study period, the effect of river discharge on oceanic ^{137}Cs activity was small compared to the effect of directly released ^{137}Cs.

Keywords: Fukushima Dai-ichi Nuclear Power Plant accident, Radiocaesium, Regional ocean model, Direct release, River discharge

