Impacts of riverine input on oceanic ^{137}Cs derived from the Fukushima Dai-ichi Nuclear Power Plant accident

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A series of accidents at the Fukushima Dai-ichi Nuclear Power Plant following the Great East Japan Earthquake and tsunami of 11 March 2011 resulted in the release of radioactive materials to the ocean by two major pathways: direct release from the accident site and atmospheric deposition. A 6 years, regional-scale simulation of ^{137}Cs activity in the ocean offshore of Fukushima was carried out by the Regional Ocean Model System (ROMS), the sources of radioactivity being direct release, atmospheric deposition, the inflow of ^{137}Cs deposited into the ocean by atmospheric deposition outside the domain of the model, and river discharges.

Direct releases of ^{137}Cs were estimated for 6 years after the accident by comparing simulated results and measured activities adjacent to the accident site. In addition, river discharge rates ^{137}Cs were calculated by multiplication between river flow rate and ^{137}Cs activity. River flow rates were simulated by a water circulation analysis model for each catchment. Temporal change of ^{137}Cs activity both of particle and dissolved forms were measured at 8 rivers and normalized by the inventory of ^{137}Cs in each catchment. ^{137}Cs activity in other 4 rivers were estimated by the normalized ^{137}Cs activity and inventories of catchments. After 2013, direct release and river discharge were dominant for input of ^{137}Cs to the ocean. Apparent half-life of direct release and river discharge of were estimated to be about 1 year and 2 years, respectively.

Apparent half-life of measured ^{137}Cs activity adjacent to 1F NPP was about 1 year, on the other hand, the ones in the coastal zone away from 1F NPP were about 2 years after 2013. Apparent half-life of simulated results with river discharge was in good agreement with the one in the coastal zone away from 1F NPP. River discharge affected on temporal change of ^{137}Cs activity there. On the other hands, simulated ^{137}Cs activities with river input were one order of magnitudes smaller than observations. This underestimation suggests modifications of river input process, such as estuary mixing process, removal from particle form ^{137}Cs and inputs from small rivers around the 1F NPP.

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