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Impacts of riverine input on distribution of oceanic ^{137}Cs released 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. River discharge rates of ^{137}Cs were calculated by multiplication between river flow rate and ^{137}Cs activity in river water. 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 2 years and 1 year, 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 about 2 years in the coastal zone away from 1F NPP. River discharge affected on temporal change of ^{137}Cs activity in the coastal zone away from 1F NPP. The fresh water flux from river enhanced the south ward current along the Fukushima coast when the river flow rate was large. The change of current also affected on the distribution of ^{137}Cs.