Five-years, regional-scale simulation of ^{137}Cs radioactivity in the ocean following the Fukushima Dai-ichi Nuclear Power Plant accident

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A series of accidents at the Fukushima Dai-ichi Nuclear Power Plant (1F NPP) following the 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.

We reconstructed spatiotemporal variability of ^{137}Cs activity in the regional ocean for five years by a regional scale oceanic dispersion models with inputs of runoff from river and 1F NPP site in addition to direct release and atmospheric deposition.

Direct release rate of ^{137}Cs was estimated for five years after the accident by comparing simulated results and observed activities very close to the site. The estimated total amounts of directly release was 3.7±0.7 PBq. Directly release rate of ^{137}Cs was the order of magnitude of 10^{14} Bq/day and decreased exponentially with time to be the order of magnitude of 10^{9} Bq/day by the end of September 2015. Estimated direct release rate have exponentially reduced with constant rate since November 2011. Simulated ^{137}Cs activities attributable to direct release were in good agreement with observed activities, a result that implies the estimated direct release rate was reasonable, while there is sparse observed data of ^{137}Cs activity in the ocean before start of direct release on 26 March 2011. One of simulated ^{137}Cs activities attributable to atmospheric deposition were underestemated with observed activities. Simulated inputs of ^{137}Cs runoff from river and 1F NPP site were also not effective in a regional ocean in this earlier period. Simulated atmospheric depositions of ^{137}Cs on a reginal ocean by 9 regional atmospheric transport models still have huge uncertainties. It is important to estimate the deposition process ^{137}Cs activity in the earlier periond on a regional ocean to understand contamination process of marine biota.