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Comparison of 137Cs activity between an ocean general circulation model and the global database

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We investigate the oceanic dispersion of ^{137}Cs (half-life of 30.1 years) and its impact on the environment. ^{137}Cs has been released into the ocean due to the atmospheric weapons tests, discharge from nuclear reprocessing plants, the Chernobyl accident, and most recently due to Fukushima Daiichi Nuclear Power Plant (1F NPP) accident. ^{137}Cs activities measured for scientific purposes as well as environmental health and safety monitoring have been summarized in a historical database by IAEA. The spatio-temporal density of the observations varies widely, therefore simulation by an ocean general circulation model (OGCM) can be helpful in the interpretation of these observations. Although simulations of ^{137}Cs activity by OGCMs have been carried out previously, the input condition of ^{137}Cs still has large uncertainties due to a lack of observations of global fallout. The horizontal resolution of the previously available estimated global fallout of ^{137}Cs was 10 degree longitude x latitude. We have produced a new estimate of the global fallout of ^{137}Cs with 2.5-degree resolution using the Global Precipitation Climatology Project (GPCP) data, and investigated the impact of the revised input condition on the simulation of distribution of ^{137}Cs in the ocean. In addition, discharges of ^{137}Cs from the reprocessing plants (Sellafield and La Hague) were also considered. We used the Parallel Ocean Program version 2 (POP2) of the Community Earth System Model version 2 (CESM2). The horizontal resolution is 1.125 degree of longitude, and from 0.28 degree to 0.54 degree of latitude. There are 60 vertical levels with a minimum spacing of 10 m near the ocean surface, and increased spacing with depth to a maximum of 250 m. The simulated period was from 1945 to 2010 with the circulation forced by repeating ("Normal Year") atmospheric conditions. We estimated the global distribution of ^{137}Cs deposition from 1945 to 2010 by using these geographical distribution data, the observed time-series data of annual ^{137}Cs deposition at the MRI from 1958 to 2010, and time-series data of ^{137}Cs deposition from 1945 to 1958 estimated from ice-core data. Simulated ^{137}Cs activities derived from the 2.5-degree deposition data were in good agreement with observations, particularly in the Pacific Ocean. Simulated ^{137}Cs activities were strongly influenced by the discharge of ^{137}Cs from the reprocessing plants. Transport processes were also investigated in the simulated results.