Radiocaesium activities in the North Pacific Ocean Water from 1945 to 2020 Calculated by eddy-resolving ROMS

*Tsubono Takaki[1], Kazuhiro Misumi[1], Daisuke Tsumune[1], Michio Aoyama[2], katsumi hirose[3]

1. Central Research Institute of Electric Power Industry, 2. Fukushima University, 3. Sophia University

We conducted the ensemble simulation of ^{137}Cs activity in the North Pacific Ocean (NPO) water from 1945 to 2020, before and after the Fukushima Dai-ichi Nuclear Power Plant (1F NPP) accident, because we used the estimations of ^{137}Cs activity flux, but climatology as physical forcing . Using the Regional Ocean Model System (ROMS) with high resolution (1/12º-1/4º in horizontal, 45 levels in vertical), of which domain was the NPO, we preliminarily estimated a factor multiplying the total of ^{134}Cs fluxes, which have been estimated for the atmospheric deposition and the direct discharge from the accident. The direct comparison of the observed and calculated ^{134}Cs showed that the total ^{134}Cs Flux was 1.6 times greater than the previous estimate. We re-calculated the ^{134}Cs activities in the NPO water using the flux multiplied by 1.6 and confirmed the improvement of the simulation by the multiplied flux, which suggested that each the ^{134}Cs and ^{137}Cs inventories in the NPO increase by about 16PBq due to the accident. For the hindcast and forecast of the ^{137}Cs activity in the NPO water, we calculated the ^{137}Cs activity in the NPO water from 1945 to 2020 by using the global fallout flux due to atmospheric nuclear weapons' tests and the Chernobyl accident and the estimated fluxes of the 1F NPP accident. For the calculation, five ensemble calculations of ^{137}Cs activity were conducted by moving the start period of the input flux for one year. The ^{137}Cs activity in the surface water showed that the plume due to the 1F NPP accident with relatively higher activity than 5 Bq m^{-3}was transported to the western area of 135˚W in 2015, while the activity of the plume was rather lower than that in 1985. The peak year of the ^{137}Cs activity can be estimated from the hindcast and forecast. The ^{137}Cs activity in the surface water north of 30˚N shows that the peak activity of ^{137}Cs reached 180˚ in 2011, but in 2012 it moved near 180˚ and in 2017 moved around 90˚W. The total inventory of ^{137}Cs in the NPO increased up to 77 PBq in 2011 and gradually decreased to 61PBq in 2018 by transport outside of the domain, which is almost the same as that in Dec. 2010. The whole amount of ^{137}Cs in the subsurface layer (200-600m depth) is larger than that in the surface layer (0-200m depth) since the 1F NPP accident except 2011.

Keywords: 137Cs, North Pacific ocean, eddy-resolving model