

Time series of Cs-137 activity Inventory in the North Pacific Ocean Water from 1945 to 2020 by using eddy-resolving ROMS

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We conducted the five 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. We applied the Regional Ocean Model System (ROMS) with variable mesh of $1/12^\circ$ - $1/4^\circ$ in horizontal, 45 levels in vertical), of which domain was the NPO, to the activity in NPO by using the estimations of ^{137}Cs activity flux such as the atmospheric deposition due to the atmospheric nuclear weapon test from 1945 to 2020 and the atmospheric deposition and the direct release due to 1F NPP accident from 2011 to 2020, but climatology as physical forcing in the whole time. The calculations show almost comparable to the ^{137}Cs activities from 2011 to 2014 in the area that was increased or not increased by the impact of the accident. That suggested that this model reproduced the observed ^{137}Cs activities reasonably from 1945 to 2014.

The model showed the largest inventory (290 PBq) of the ^{137}Cs activity in the NPO recorded in 1966, because the largest fallout occurred around 1963 due to the atmospheric nuclear weapon test. The inventory has gradually decreased to about 60PBq by January 2011 because of the half-life and the outflow through the boundaries of the NPO, while hardly showing impact of the Chernobyl accident. The Inventory rapidly increased to 76PBq of which 34PBq existed in surface layer (0 - 200m depth) and 31PBq in central layer (200m - 600m depth) after the accident in April 2011 and then decreased to 56PBq of which 19PBq in the surface layer and 27PBq in the central layer in 2020. The actual half-life, including the radioactive half-life, the transport between the layers and the outflow from the domain, of the inventory was calculated before and after the accident. While the inventory showed same the actual half-life of about 20 years before and after the accident, the half-life of the total amount in the surface decreased from 14 years before the accident to 12 years after the accident and that in the central layer increased from 19 years to 33years. This result showed that the decrease in the total amount in surface is mainly because of the transport from the surface to the central layer after the accident.

Keywords: Cs-137, North Pacific ocean, eddy-resolving model, atmospheric nuclear weapon tests , Fukushima Dai-ichi Nuclear Power Plant accident