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Inventory and actual half-life of ^{137}Cs activity in the North Pacific Ocean Water from 1945 to 2020 by eddy-resolving ROMS

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We hindcasted and forecasted ^{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. Using the Regional Ocean Model System (ROMS) of which domain was the NPO with high resolution (1/12°-1/4° in horizontal, 45 levels in vertical), we simulated the ^{137}Cs activity increased by the atmospheric deposition due to the atmospheric nuclear weapon test from 1945 to 2010 and then the activity by the atmospheric deposition and the direct release from 1F NPP from 2011 to 2020. The calculations almost comparable to the observations from 2011 to 2014 suggested that this model represented the observed ^{137}Cs activities reasonably from 1945 to 2014. The largest inventory of the ^{137}Cs activity in the NPO was recorded to be 290PBq in 1966, because the major fallout occurred around 1963. The inventory has gradually decreased to about 60PBq before the accident in January 2011 because of the half-life and the outflow through the boundaries of the NPO. The Inventory increased to 76PBq, which was composed of 34PBq 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, which was composed of 19PBq in the surface layer and 27PBq in the central layer. 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 the actual half-life of about 20years before and after the accident, the half-life of the total amount in the surface changed from 14 years before the accident to 12 years after the accident and that in the central layer from 19 years to 33years. This suggests 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.