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Vertical structure of radiocaesium derived from FNPP1 accident and global fallout in subtropical gyre of the North Pacific through 2017

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134Cs and 137Cs, hereafter radiocaesium, were released to the North Pacific by the TEPCO Fukushima Dai-ichi Nuclear Power Plant (FNPP1) accident in March 2011. Total amount of released 137Cs was 15-18 PBq. Before the FNPP1 accident, 137Cs was also injected to the North Pacific due to atmospheric weapon tests fallout and an inventory of 137Cs was 69 PBq in 2011. 134Cs vs. 137Cs activity ratio released from FNPP1 accident was ca. 1 at the time of the accident, we can therefore distinguish and evaluate FNPP1 derived 137Cs and fallout derived 137Cs based on observed 134Cs activity concentration. We observed vertical profiles of radiocaesium at 19 stations in 2002, 10 stations in 2005, 11 stations in 2011, 14 stations in 2012, 13 station in 2015, 6 stations in 2016 and 5 stations in 2017 to study transport processes in the ocean interior of the North Pacific Ocean. The major pathway from surface to ocean interior after injected in the ocean surface can be considered subduction of central mode water (CMW) and subduction of subduction of subtropical mode water (STMW), respectively. The 137Cs profile observed in 2002 along 165 deg. E was characterized by two 137Cs activity concentration maxima at 20 deg. N, 165 deg. E, one at 250 m (sigma $\approx$ 25.5 g kg-1) and one at 400–500 m (sigma $\approx$ 26.0 g kg-1) depths. The shallower maximum was in the density range of North Pacific Subtropical Mode Water (NPSTMW) and the deeper one was in the density range of Lighter Central Mode Water (LCMW) (Aoyama et al., 2008). After FNPP1 accident, maximum of 137Cs activity concentration at 21 deg. N, 165 deg. E in June 2015 and 21 deg. N, 136.5 deg. E in Sept. 2017 located at 300 m (sigma $\approx$ 25.5 g kg-1) and both showed very similar activity concentration as about 3 Bq m-3. Shapes of 137Cs vertical profiles at both stations were also very similar and 137Cs activity concentrations showed systematic decreases to both shallower and deeper directions. In STMW region, 134Cs vs. 137Cs activity ratio at 21N, 165E in 2015 was ca. 0.5 and it at 21 deg. N, 136.5 deg. E in 2017 was also 0.59+-0.11 which indicates that FNPP1 derived 137Cs and fallout derived 137Cs are equivalent here. These might indicate that FNPP1 derived radiocaesium subducted into ocean interior due to STMW formation are already recirculated and becomes homogenous within subtropical gyre after several years after injection to the STMW.
We however see big differences between FNPP1 derived 137Cs and fallout derived 137Cs, in the deeper layer below sigma=26.5 g kg-1. In the deeper layer below 26.5 g kg-1, main contributor of 137Cs activity concentration was fallout derived 137Cs not FNPP1 derived 137Cs. This indicates that FNPP1 derived radiocaesium did not reach below sigma=26.5 g kg-1 in 2017 after 6 years from the accident.