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Trans Pacific Ocean in surface layer and subduction and re-circulation in the ocean interior of radiocaesium released from TEPCO FNPP1 accident through the end of 2015

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134Cs and 137Cs, hereafter radiocaesium, were released to the North Pacific Ocean by two major likely pathways, direct discharge from the Fukushima NPP1 accident site and atmospheric deposition off Honshu Islands of Japan, east and northeast of the site.

Activities of radiocaesium released by the Fukushima Dai-ichi Nuclear Power Plant (FNPP1) accident were measured by surface sampling at 408 stations in 2011-2013 and in vertical profiles at 24 stations in 2011 and 2012, at 13 station in 2015 in the North Pacific Ocean, and time-series samples were collected at two coastal stations. TEPCO and Japanese government also continue to monitor radiocaesium in seawaters close to the site.

In this presentation, we present long term behavior of TEPCO FNPP1 released radiocaesium in the coastal region and the North Pacific Ocean based on the observations and model simulations during the period from just after the accident to 2016.

After July 2012, 137Cs activity in the surface water near FNPP1 remained around 1000 Bq m−3 until the end of 2014, which corresponds to a discharge rate of about 10 GBq day^{-1}. In 2015 137Cs activity in the surface water near FNPP1 tended to decrease around 100 Bq m−3. 137Cs activity at southern coastal stations at Tomioka became less than 100 Bq m−3 in 2014 and those at Hasaki became less than 10 Bq m−3 which are same level or less than those of 137Cs activity in surface water observed in 1960s in this region.

FNPP1-derived radiocaesium spread eastward in surface water across the mid-latitude North Pacific with a speed of 7 km day^{-1} (8 cm s^{-1}) until March 2012, and of 3 km day^{-1} (3.5 cm s^{-1}) from March 2012 through August 2014. And Fukushima derived radiocaesium had detected trace amount at western coast of Canada in February 2015. Our model simulation results shows good agreement with the observed radiocaesium activities at western coast of Canada, while in the Mexican coast our model projection shows that it will reach in 2016 not in 2015.

In June 2012, 134Cs activity reached a maximum of 6.12 ± 0.50 Bq m−3 at a 151-m depth (potential density, 25.3 kg m−3) at 29°N, 165°E. This subsurface maximum, which was also observed along 149°E, might reflect the southward transport of FNPP1-derived radiocaesium in association with the formation and subduction of subtropical mode water (STMW). In June 2012 at 34°N–39°N along 165°E, 134Cs activity showed a maximum at around potential density= 26.3 kg m−3, which corresponds to central mode water (CMW). 134Cs activity was higher in CMW than in any of the surrounding waters, including STMW. These observations also indicate that the most effective pathway by which FNPP1-derived radiocaesium is introduced into the ocean interior on a 1-year time scale is CMW formation and subduction. In June-July 2015 at 36°N–44°N along 165°E, there are only very week signal of subduction of Fukushima derived radiocaesium which mean subducted radiocaesium might move eastward from this region.