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Long term behavior of radioactive plume of TEPCO FNPP1 released 134Cs and 137Cs in the North Pacific Ocean through the end of 2014

Michio Aoyama (1), Daisuke Tsumune (2), Takaki Tsubono (3), Yasunori Hamajima (4), and Yuichiro Kumamoto (5)

(1) Institute of Environmental Radioactivity, Fukushima Univ., Fukushima, Japan (r706@ipc.fukushima-u.ac.jp), (2) Environmental Science Research Laboratory, Central Research Institute of Electric Power Industry, Tokyo, Japan(tsumune@criepi.denken.or.jp,), (3) Environmental Science Research Laboratory, Central Research Institute of Electric Power Industry, Tokyo, Japan (tsubono@criepi.denken.or.jp), (4) Institute of Nature and Environmental Technology, Kanazawa University, Kanazawa, Japan (hamajima@se.kanazawa-u.ac.jp), (5) Research Institute for Global Change, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Kanagawa, Japan (kumamoto@jamstec.go.jp)

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. High density observations of 134Cs and 137Cs in the surface water were carried out by 17 cruises of cargo ships and several research vessel cruises since March 2011 till March 2012. Thereafter we and our collaborators continue to collect seawater samples in 2013 and 2014 in the North Pacific Ocean. We also conduct to measure radiocaesium in coastal waters at Tomioka and Hasaki, Japan through the end of 2014. 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 summer in 2014.

In the coastal region very close to TEPCO FNPP1 site, the data show peak ocean discharges in early April 2011, one month after the earthquake and a factor of 1000 decrease in the month following. The 137Cs activity through the end of September 2014 remain higher than expected, ca. 1000 Bq m-3, implying continued releases from the reactors. Since directly discharged radiocaesium were transported dominantly southward along the coastline of northeastern Honshu, the 137Cs activities in coastal seawater collected at Tomioka and Hasaki were still one or two order of magnitude higher, several to 100 Bq m-3, rather than pre-Fukushima level in summer 2014.

In the North Pacific Ocean main body of radiocaesium surface plume of which activity exceed 10 Bq m-3 had been travelling along 40 ºN, and reached International Date Line on March 2012 one year after the accident. A feature was that the radiocaesium plume was confined along 40 ºN when the plume reached International Date Line. A zonal speed of the radiocaesium plume was estimated to be about 8 cm s-1 which was consistent with zonal speeds derived by Argo floats and satellite observations at the region. After that, main body of radiocaesium surface plume continued to travel eastward and reached off west coast of US continent in August 2014 which implies the zonal speed of the radiocaesium plume was maintained at similar speed. The activity of 137Cs in the surface plume in August 2014 was a few Bq m-3. Our basin scale model simulation can reproduce these trans-Pacific travel of the surface plume very well for travel time , travel pathway and the activity of 137Cs in the surface plume.

In the ocean interior at mid latitude in the Pacific Ocean, we observed subducted radiocaesium along 165 deg. E in 2012 around 300-400 meters depth at 35 – 40 deg. N. We also observed subducted radiocaesium in south of Kuroshio extension in March- July in 2014. In terms of mass balance of radicaesium released from Fukushima NPP1 accident in the Pacific Ocean, larger portion of released radiocaesium are already in the ocean interior and transported southward.