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Effects of rain events on transport of radiocesium in the Abukuma River during 2011-2012

Seiya Nagao[1*], KANAMORI, Masaki[2], OCHIAI, Shinya[1], KIRISHIMA, Akira[3], YAMAMOTO, Masayoshi[1]

[1]LLRL, INET, Kanazawa University, [2]Grad. School of NST, Kanazawa University, [3]IMRAM, Tohoku University

About 15 PBq of both Cs-134 and Cs-137 was released from the Fukushima Daiichi Nuclear Power Plant (NPP) after the 2011 Tohoku earthquake and tsunami. Surface deposition pattern of Cs-134 and Cs-137 occurred at Fukushima, Tochigi and Gunma Prefecture by combination with wind direction and precipitation. Therefore, it is important to elucidate the short-term to long-term impacts of the Fukushima Daiichi NPP accident on ecosystems of river watershed environments. This study was conducted to investigate the effects of rain events on transport of Cs-134 and Cs-137 in the Abukuma River running through Fukushima and Miyagi Prefecture in Japan, 15 months after the Fukushima Daiichi NPP accident.

Field experiments were carried out at Shirakawa (upper), Motomiya, Date (middle) and Iwanuma (lower) in the Abukuma River during June 19-21, 2012. Typhoon Guchol struck Japan on June 20. Fukushima Prefecture had rainfall of 77-136 mm during June 19-21. The suspended particles were separated using centrifugation and filtration with No. 5A filters and a pore size of 450 nm membrane filters. The radioactivity of Cs-134 and Cs-137 in the filtered river waters was measured as dissolved forms of radiocesium with gamma-ray spectrometry using ammonium molybdophosphate (AMP)/Cs compound method. The Cs-134 and Cs-137 were measured using gamma-ray spectrometry with a low BKG Ge detector for 1-3 days. The suspended solids were also measured using gamma-ray spectrometry after drying them at room temperature.

Total radioactivity of Cs-134 and Cs-137 in river waters was 0.016-0.27 Bq/l at normal flow conditions on April 18 and June 19 in 2012, but it increased to 3.83 Bq/l in high flow conditions by heavy rains occurring with the typhoon. The particulate fractions of Cs-134 and Cs-137 were 77-89% at the normal flow condition, but were close to 100% after the typhoon. The variations of radiocesium concentration may correlate with the water level at each site. These results indicate that the pulse input of radiocesium associated with suspended particles from land to coastal ocean occurred by the heavy rain event.

Keywords: river water, radiocesium, dissolved forms, particulate forms, migration behavior, raine events