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Radiocesium discharge from Niidagawa river basin after the accident of Fukushima Dai-ichi Nuclear Power Plant

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Redistribution of radiocesium through a river system poses potential risks on residents within the river basin. Niidagawa river basin on north eastern part of Fukushima prefecture is indeed a case in point. The river basin includes highly contaminated area on its upstream part and the river goes through residential area of its downstream. Quantitative evaluation of radiocesium redistribution associated with discharged sediment is required for mitigating radiological risk on residents and ocean environment. Previous studies on the environmental monitoring of various contaminants, as well as radiocesium, suggested that large portion of discharge of such contaminants should occur during intensive rainfall events. This study aims to quantify radiocesium discharge within the Niidagawa River Basin and to reveal its discharge processes. For quantifying radiocesium discharge, we installed sets of time-integrative suspended sediment sampler, turbidity sensor and water level sensor on three points in summer 2014. The points are named as Sakegawa-bashi (N37^{o}38'33", E141^{o}00'20"), Notegami-kita (N37^{o}39'16", E140^{o}47'47") and Warabi-daira (N37^{o}36'49", E140^{o}48'04") and specific initial Cs-137 deposition are 752, 810, 1462 kBq/m^2, respectively. We have collected suspended sediments trapped in the samplers approximately every 2 months and served them for radiocesium measurements with HPGe gamma detectors in laboratory. Radiocesium discharge (Bq/hour) were calculated by multiplying radiocesium concentrations of suspended sediment (Bq/kg) with time-series data of turbidity (kg/m^3) and water discharge (m^3/hour). Mean Cs-137 concentration of suspended sediment (n = 3) at Sakegawa-bashi, Notegami-kita and Warabi-daira were 13, 14 and 31 kBq/kg, respectively. Those concentrations appeared to agree with initial Cs-137 deposition for each point basically. No common temporal trend of Cs-137 concentration was found among Cs-137 concentrations of these three points. Estimated total Cs-137 discharges at these points were in magnitude of 10^{11} Bq. Estimated Cs-137 wash-off rates (%), calculated by dividing specific Cs-137 discharge (Bq/m^2) with initial Cs-137 inventory, were in magnitude of 0.1 %. For evaluating Cs-137 discharge during intensive rainfall events, we focused on three large rainfall events during 8-11th August (59 mm), 5-8th October (109 mm) and 13-16th October (69.5 mm). Ratios of Cs-137 discharges during these events to total Cs-137 discharge through all observation period approximately were approximately 0.3 at Sakegawa-bashi and approximately 0.7 at both of Notegami-kita and Warabi-daira. Discharge of Cs-137 from smaller catchment area appeared to be more vulnerable to intensive rainfall events.

Keywords: Radiocesiumu, River, Fukushima Dai-ichi Nuclear Power Plant, Suspended sediment