Tracking the early dispersion (2011-2013) of radioactive sediment in coastal catchments draining Fukushima contamination plume

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information

Title	**TRACKING THE EARLY DISPERSION (2011–2013) OF RADIOACTIVE SEDIMENT IN COASTAL CATCHMENTS DRAINING FUKUSHIMA CONTAMINATION PLUME**
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Summary

The accident that occurred at Fukushima Dai-ichi nuclear power plant (FDNPP) in March 2011 led to the formation of a 3000-km² radioactive pollution plume on soils located up to 70 km to the northwest of the damaged site. This mountainous region occupied by a dominance of forests and paddy fields is drained to the Pacific Ocean by several coastal rivers that flow across inhabited areas relatively spared by initial radioactive fallout. It is then crucial to track the dispersion of radioactive material conveyed by those rivers in order to estimate the continental supply of radionuclides to the Ocean and to assess the spatial and temporal patterns of radioactive sediment storage in those catchments as their radiations may lead to an external exposure threat for local populations. In addition, the transfer of contamination to plants and animals may affect human activities in the region. As river discharge and sediment concentration data have not been available during the first two years that followed the accident, alternative methods were developed to track the dispersion of contaminated sediment across coastal catchments.

The first method relied on measurements of the ^{110m}Ag:^{137}Cs ratio in both soils and river sediment. We thereby identified a partial export of contaminated sediment from inland mountain ranges – exposed initially to the highest radionuclide fallout – to the coastal plains as soon as in November 2011, after a series of violent typhoons. This export was then amplified by the spring snowmelt in 2012. However, due to the relatively rapid decay of ^{110m}Ag (half-life of 250 days), an alternative method was developed to continue tracking sediment. We therefore used local ground dose rate measurements to estimate whether fresh sediment drape deposits were more or less contaminated compared to local soils. We supported the interpretation of the dose rate measurements by running a simple connectivity model that evaluates the extent of potential sediment transfers between hillslopes and rivers. This method confirmed the relevance of the first results obtained with the ^{110m}Ag:^{137}Cs ratio, and showed that, in May 2013, contamination levels measured in sediment found in the upper parts of the catchments were almost systematically lower than the ones measured in nearby soils, whereas their contamination was higher in the coastal plains. However, after the violent typhoons that occurred during

summer in 2013, dose rates increased again, which demonstrates the widespread remobilization of contaminated material in catchments where cultivation has been abandoned.

Overall, our results show that, in those regions exposed to violent typhoons and spring snowmelt, transfers of sediment are massive and episodic, and that they follow a seasonal cycle. We thereby suggest that remobilization of contaminated sediment by typhoons and their storage in reservoirs and in coastal sections of the river channels now represents the most crucial issue to protect the local populations and manage the most contaminated catchments.