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Comparing radiation dose rates in soils and riverine sediment to track the dispersion of radioactive contamination in Fukushima coastal rivers

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The Fukushima Dai-ichi nuclear power plant (FDNPP) accident that occurred in March 2011 led to the formation of a 3000-km^2 radioactive pollution plume on soils located up to 70 km to the northwest of the damaged site. Forests and paddy fields are the dominant land uses in this mountainous region drained to the Pacific Ocean by several rivers that flow across densely inhabited coastal plains. It is then crucial to track the dispersion of radioactive material conveyed by those rivers to estimate the continental supply of radionuclides to the Ocean and to assess redistribution of radioactive sediment in those catchments. Radiations emitted by this contaminated material may indeed lead to an external exposure threat for local populations. As river discharge and sediment concentration data were not available during the first two years that followed the accident, alternative methods had to be developed to track this dispersion.

We therefore organized field campaigns every six months and conducted local ground dose rate measurements to estimate whether fresh sediment drape deposits were more or less contaminated compared to local soils. Overall, our results showed that, in those regions exposed to violent typhoons and spring snowmelt, transfers of sediment are massive and episodic, and that they followed a seasonal cycle in 2011-2012. Then, 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. This could have indicated a drying-up of the upstream sources of contamination. However, after the violent typhoons that occurred during summer in 2013, dose rates measured in fresh sediment deposits in November 2013 increased again systematically across the region. We thereby suggest that remobilization of contaminated sediment by typhoons and their storage in reservoirs and in coastal sections of the river channels now represent the most crucial issues to protect the local populations and manage the most contaminated catchments.