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Tracing the dispersion of sediment contaminated with fallout radionuclides along the main rivers draining the contaminated plume in Fukushima Prefecture (Japan)

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Fukushima Dai-ichi nuclear power plant accident led to the release of important quantities of radionuclides into the environment. Several of those substances (e.g., Cs-134; Cs-137) strongly sorb onto soil particles. Resulting radiations lead to an external exposure threat associated with the spatial distribution of radionuclides. This threat, associated with the possibility of transfer of contamination to plants and direct ingestion of contaminated particles, will affect human activities such as agriculture, forest exploitation and fishing for long periods of time, depending on the half life of the radionuclides (e.g., 2 yrs for Cs-134; 30 yrs for Cs-137). Furthermore, sediment can be a preferential vector of contaminants in rivers, and its transfer can lead to the dispersion of radioactive contamination across larger areas over time. We present here preliminary results obtained during a field campaign conducted in November 2011 in a part of Fukushima Prefecture located in the main contamination plume and covering an area of about 5000 km^2. We had the unique opportunity to measure and "trace" the dispersion of sediment contaminated with radionuclides shortly after the catastrophe.

In total, 125 soil and sediment samples were collected along the main rivers of the area (i.e. Abukuma, Nitta, Mano, Kutchibuto and Hirose Rivers). This hydrological network drains the contamination plume located 20 to 80 km northwest of Fukushima Dai-ichi power plant. Furthermore, radiation dose rates were measured all throughout the field survey.

Preliminary results show that, 8 months after the accident, radiation dose rates constitute a good proxy to trace contamination dispersion in the region, especially along rivers. Radiation dose rates varied between 0.5 μSv/h and 200 μSv/h in the field. Transfer of contaminated sediment has already started in rivers, and it was accelerated by the occurrence of violent typhoons in the region between July and October, 2011. Main gamma-emitting radionuclides detected in the area are Cs-134, Cs-137 and Ag-110m. So far, activities of Cs-134+137 measured in river sediment ranged between 3–300 kBq/kg, sometimes far exceeding the expected activity associated with the initial deposits.

This pioneer investigation is crucial and constitutes a scientific prerequisite for the proposal of catchment management measures to control and limit radioactive pollution propagation. Typhoon-triggered flooding leading to subsequent sediment redistribution might generate long-lasting contamination of the food chain in this agricultural region.

Keywords: Fallout radionuclides; sediment tracing; nuclear accident; catchment; river; Fukushima Dai-ichi.