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Tracking the dispersion of particle-borne radioactive contamination along coastal rivers of Fukushima Prefecture (2011–2014)

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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-km² radioactive pollution plume and resulted in the fallout consisting predominantly of radiocesium (¹³⁷Cs and ¹³⁴Cs) on soils located up to 70 km to the northwest of the damaged site. This mountainous region is drained by several coastal rivers to the Pacific Ocean, and original sediment fingerprinting methods had to be developed to track the dispersion of contaminated sediment across these coastal catchments. Sediment fingerprinting based on the heterogeneous deposition of metastable silver-110 (^{110m}Ag) across the investigated catchments was shown to provide relevant information on the dispersion of contaminated sediment. Based on the measurement of the ^{110m}Ag:¹³⁷Cs activity ratio in soils and river sediment, we demonstrated the occurrence of a seasonal cycle of soil erosion during typhoons followed by sediment export in rivers during the subsequent spring snowmelt in 2011 and 2012. However, due to the rapid decay of ^{110m}Ag (half-life of 250 days), alternative methods had to be developed to continue tracking sediment from 2013 onwards. We therefore used local ground dose rate and ²⁴¹Pu/²³⁹Pu atom ratio measurements to further document this dispersion. We thereby demonstrated that, although overall sediment contamination decreased two years after the accident, decontamination of paddy fields led to the local supply of contamination to the rivers. Ongoing work is focused on the development of a sediment fingerprinting technique based on geochemical properties characterizing the different soil types found in the region. In future, we expect that the contaminated sediment stored in river channels and reservoirs will represent a significant management challenge for local authorities.