Using multiple tracers to quantify changes in sediment source contributions to the rivers and lakes draining the main radioactive plume of Fukushima, Japan (2011-2018)

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Large quantities of radionuclides deposited on soils located up to 70 km to the northwest of the Fukushima Dai-ichi Nuclear Power Plant after the multiple disasters that occurred in March 2011. As soil erosion may lead to the redistribution of the initial radioactive deposits across the landscape, information on the sediment source contributions and their potential changes in space and time is required.

To this end, lag deposits (n=400) were collected at ~50 locations along rivers draining the plume during 13 campaigns between 2011–2018. Furthermore, sediment cores were collected in the Mano Dam reservoir. Soil samples (n=100) were also collected to cover the variety of sources. A selection of samples was analysed for the following properties: fallout radionuclides; elemental geochemistry; organic matter; Pu isotopes; colour; environmental DNA.

The results showed that the radiocesium levels in sediment decreased by 90% between 2011–2018. Early after 2011, the majority of sediment was supplied by Fluvisols (corresponding to cropland). However, the contribution of sediment originating from subsoil and forests was also significant (from the lake sediment archives, it was estimated that cropland, subsoil and forests supplied each 1 third of the sediment).

Since the completion of the remediation works, the subsoil contribution to sediment increased, because decontamination consisted in removing the topsoil layer concentrating radionuclides. The main future challenge is therefore to propose low-cost and fast tracing techniques (e.g. spectrocolorimetry) to monitor the impact of the restart of cultivation on the fate of the residual radioactive contamination in this region.