Modelling the dilution of radioactive contamination in sediment transiting Fukushima coastal rivers (2011-2015)

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The accident that occurred at Fukushima Dai-ichi nuclear power plant in March 2011 led to the formation of a 3000-km^2 radioactive contamination plume with cesium (^{137}Cs) levels exceeding 1000 kBq m^{-2}. Cesium is preferentially bound to fine particles that are preferentially eroded and supplied to river systems. As decontamination operations have started in theis region, it is crucial to investigate whether these remediation works have an impact on the contamination levels measured in sediment transiting rivers of the region.

Distribution models were used to quantify the relative contributions from two end-members, i.e. initial cesium contamination and soils depleted in cesium, to contaminated sediment in two catchments (Mano and Niida Rivers) characterised by different timing of decontamination operations. Models were applied to 41 locations surveyed every 6 months in these two catchments (327 sediment samples) in the five years that followed the accident, from November 2011 to November 2015.

The results show that there has been a sharp decrease of cesium levels in sediment transiting the coastal plains between 2012 (μ 94%, σ 3% of initial levels) and 2015 (μ 10%, σ 9%). The occurrence of typhoons and the progress of remediation works along the tributaries of the Niida River resulted in temporary increases of local contamination levels. However, the mean contamination levels recorded in coastal plain sediment in November 2015 (μ 14%, σ 6% of initial contamination) show that the much of easily erodible contaminated material has already been removed by decontamination or eroded, and transported to the Pacific Ocean. In future, the relative contributions of remediation works and heavy floods to the dilution of cesium contaminated sediment should be investigated through the use of spatially-distributed soil erosion models.