Combining river monitoring and sediment fingerprinting to quantify spatial and temporal dynamics of fine sediment in mountainous catchments of the French Alps and the Mexican Central Highlands

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An excess supply of fine sediment to rivers leads to numerous environmental problems, such as an increase in water turbidity and a rapid filling of reservoirs. Fine sediment is also an important conveyor of contaminants and nutrients. Spatial and temporal dynamics of sediment transfer need to be better understood to implement efficient control measures. We determined the spatial origin of sediment between 2007 and 2009 in two mountainous river catchments (600 – 1000 km^2) by combining river flow records and geochemical / radionuclide concentrations as potential input properties to a Monte Carlo mixing model. Results on the main sources of sediment have important management implications in both catchments. In Mexico, we showed a variable sediment supply by historical gully networks and cropland during the rainy season. In the French Alps, we showed that the contribution of black marls that locally produce severe erosion was not systematically dominant at the entire catchment scale. Furthermore, we measured the transfer times of sediment in rivers using a radionuclide two-box balance model and the Be-7/excess-Pb-210 ratio. In Mexico, we outlined the major role played by the flood type on sediment remobilisation and export. In the French Alps, 80% of sediment were exported by low-intensity widespread rainfall and were mainly composed of “old” material that deposited on the riverbed during previous floods and that was subsequently remobilised. In future, we aim to further increase the temporal frequency of sediment sampling to characterize intra-flood variations and to combine ‘conventional’ fingerprinting techniques with low-cost infrared spectroscopy measurements.