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Seasonal and spatial changes in sediment origin, indicated by the isotopic fatty acid fingerprint of suspended river sediments from South Korea and Switzerland.

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Soil erosion and associated sediment transfer are among the major causes of aquatic ecosystem and surface water quality impairment. Through land-use and agricultural practices, human activities modify the soil erosive risk and catchment connectivity, becoming a key factor of sediment dynamics. Hence, restoration and management plans of water bodies can only be efficient if the sediment sources and the proportion attributable to different land-uses are identified.

To achieve this, we conducted two studies: (1) in Central Switzerland and (2) in South Korea, to investigate the seasonal and spatial dynamics in catchment erosion processes. We applied a compound-specific stable isotope (CSSI) approach using the isotopic (d13C) signature of plant-wax derived long-chain fatty acids (C24:0-C30:0) in source soils, suspended sediments and a lake sediment core to apportion the sources of the suspended sediments in the catchments of Lake Baldegg (Switzerland) and Lake Soyang (South Korea). With the R software package MixSiar (version 3.1.10) we calculated the contribution of the different land-uses to the sediments.

Event-based suspended sediment sampling from the five main contributing rivers to Lake Baldegg (up to 10 high flow events over the course of one year) and subsequent compound-specific stable isotope analysis of long-chain fatty acids indicated a strong seasonal variation of the sediment origin in the rivers. In spring, forests are the main contributor to the sediments, rapidly changing to grassland as the main source in early summer. Then, during July and August, the CSSIs are indicating arable lands as the main contributor. Averaged over all events in all rivers, forests are dominating the sediment origin over agricultural land and grasslands.

In Korea, we focused on the suspended sediment apportionment in a mountainous catchment, Haean Basin, which experienced rapid agricultural expansion and intensification during the last decades. Large areas of hill slope forests were transformed to paddies and vegetable fields. The intensive agriculture and easily erodible soils are a major reason for increased soil erosion resulting in high suspended sediment loads in the river systems. Our second aim in Korea was to investigate the spatial variation in sediment contribution along Soyang river from the Haean catchment to the hydro-electric reservoir Lake Soyang. In the Haean catchment and as well at four suspended sediment sampling sites along Soyang river we applied the same CSSI approach as in Switzerland, mentioned above. Source soils were identified and differentiated in the Haean catchment and used to apportion the sediment sources within the catchment and along the river. Our results show a clear shift from almost exclusive contribution of vegetable fields and forest soils to the suspended sediments in the headwater catchment to an increased contribution of maize fields downstream towards Lake Soyang. Since the areal proportion of maize in the Lake Soyang catchment is not increasing significantly downstream compared to vegetables, rice fields or forests, our findings are giving strong indication for a higher vulnerability of the agricultural soils where maize is grown.