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Quantifying the main sediment sources in agricultural landscapes of Southern Brazil cultivated with conventional and conservation practices

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Agricultural expansion that occurred in the 1960s in Southern Brazil significantly increased soil erosion and sediment supply to the river networks. To limit the deleterious impacts of soil erosion, conservation practices were progressively implemented in the 1990s, including the direct sowing of crops on a soil densely covered with plant residues, contour farming, the installation of ponds to trap sediment in the landscape and the use of crop rotations. However, there remains a lack of observational data to investigate the impact of these conservation practices on soil erosion and sediment supply. This data is crucial to protect soil resources and maintain the sustainability of food production systems in this region of the world characterized by a rapidly increasing population.

Accordingly, sediment sources were investigated in the Guaporé catchment (2,032 km^2) representative of the cultivated environments found in this part of the world. In the upper catchment, the landscape is characterized by gentle slopes and deep soils (Ferralsols, Nitisols) corresponding to the edge of the basaltic plateau. Soybean, corn and wheat under direct sowing are the main crops in this area. In contrast, steep and shallow soils (Luvisols, Acrisols, Leptosols) highly connected to the rivers are found in the lower catchment, where tobacco and corn fields are cultivated with conventional ploughing.

These soil types were characterized by elemental geochemistry and 87Sr/86Sr ratios. Sediment sources were then modelled using the optimal suite of properties (87Sr/86Sr ratios, K, Ti, Co, As, Ba, and Pb). The results demonstrate that sediment collected at the catchment outlet during two hydrological years (2012–2014) mainly originated from downstream soils (Luvisols, Acrisols, Leptosols; 92±3%), with this proportion remaining stable throughout the monitoring period. This research indicates that conservation practices implemented in the upper catchment are effective and that similar methods should be applied to downstream soils in order to conserve soil resources and limit the degradation of freshwater environments.