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

Olivier Evrard (1), Marion Le Gall (1), Tales Tiecher (2), Jean Paolo Gomes Minella (3), J. Patrick Laceyby (1), Sophie Ayrault (1)

(1) LSCE, Gif-sur-Yvette (France); (2) UFRGS, Porto Alegre (Brazil); (3) UFSM, Santa Maria (Brazil)

Contact: olivier.evrard@lsce.ipsl.fr

Results

- Sediment samples were modelled to mainly originate from downstream Acrisols (mean 41%, standard deviation (SD) 2%), Leptosols (mean 34%, SD 4%) and Luvisols (mean 17%, SD 4%).
- In contrast, contributions of upstream Ferralsols (mean 4%, SD 2%) and Nitisols (mean 4%, SD 6%) were low.

Context

- 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 including direct sowing were progressively implemented in the 1990s.
- However, there remains a lack of observational data to investigate the impact of these conservation practices on soil erosion and sediment supply.

Materials and Methods

- Sediment sources were investigated in the Guaporé catchment (2032 km²) representative of the cultivated environments of Southern Brazil.
- Sediment samples (n=7) were collected at the outlet between 2012 and 2014 using in situ time-integrated suspended sediment samplers.

Sediment fingerprinting

1. Measurement of a panel of potential tracers by ICP-MS and MC-ICP-MS.
2. Examination of the conservative behavior of the elements
   - Only Na was not conservative
3. Kruskal Wallis test (KW)
   - $^{87}\text{Sr}/^{86}\text{Sr}$, Mg, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Sr, Mo, Ag, Sb, Ba, Tl, Pb (discriminant)
4. Stepwise Discriminant Function Analysis (DFA)
   - $^{87}\text{Sr}/^{86}\text{Sr}$, K, Ti, Co, As, Ba, Pb provide the best discrimination
5. Running an un-mixing model to calculate the source contributions
   - Details are provided in the associated publication

Conclusions and perspectives

- These results suggest that soils found in lower parts of the catchment, cultivated with conventional agriculture on steep slopes, were the main source of sediment to the river network.
- In contrast, soils found in upper parts of the catchment, cultivated with soybean under direct sowing, were less eroded or deposited before reaching the sediment sampling location at the outlet.
- These findings demonstrate that the management of local and degraded soil sources is important for reducing sediment loads.

Reference