The VERSEAU – TRACKSED -DRASTIC Project: Quantification of sediment fluxes in the Loire hydrographic basin

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Introduction: In France, since the beginning of 20th century, rural landscapes have been completely modified by human activities. These practices have resulted in profound sedimentary and morphological alterations (channel bed incision, deposition of fine sediment, bank erosion, etc.), detrimental to the achievement of good water status [1].
Several research efforts have already investigated either global budgets at the river basin or continental scale or local detailed budget at the plot to the field scale. However, very few studies have tried to analyse the connectivity between fluxes and storages and to draw the links between temporal and spatial scales. In this broad context, the purpose of this study is to examine source-to-sink dynamic of the sediment cycle for the Loire River Basin. This project is broken down into two steps: the first step's aim is to understand poorly studied processes such as sediment production by agricultural drainage or bank erosion by catchment monitoring. The second step is to elaborate a distributed model of sediment connectivity from hillslopes to basin outlet.

Methods:.for the first step, two catchment sites are studied, using historical data or monitoring: the linear (21 km) of two small streams ("La Ligoire") and the Louroux lake catchment. Most of those two catchments are intensively cultivated and have been extensively submitted to subsurface drainage using drain tiles. The objectives of this part are threefold: 1) quantify incision and deposition processes since the channelization of the streams (1970), (2) quantify in-channel deposition rates of fine sediments, and, (3) explain the spatial distribution of these deposits.
For the second step, the modeling approach is based on the use of indicators to describe hillslope processes, potential downstream retention, attempting to link river basin characteristics to a prediction of sediment exports in rivers. It provides insight in the identification of the most influent sediment redistribution processes on the total sediment fluxes and on the differences between various basin typologies [2] [3].

Results and discussion: The Ligoire study shows an important stream incision (around 30 cm in 40 years) and the influence of water obstacles on sediment distribution. The Louroux monitoring permits to differentiate between the different sources of sediment and highlight the importance of surface erosion during flood events and of bank erosion during low flows within small intensively cultivated plain catchments. The increased export of the sediment is primarily due to the very high human-made connectivity of these landscapes that was originally created to evacuate the excess water during the humid seasons.
For the second step, the analysis of particulate sediment and dissolved fluxes datasets at different spatial and temporal scales permits to identify some of the dominant processes, and also to distinguish natural from anthropogenic influences. Concerning upland physical soil surface erosion rates, we find that the average travel distance of eroded particles may be limited, implying a strong decrease in physical erosion rates when moving from the local scale (m²) to the river basin scale (> 103 km²). Chemical erosion rates are less sensitive to scale and can either decrease or increase with increasing area in function of lithology, land management and topography. The results also highlight the predominant role of surface connectivity to characterize the fraction of sediment exported out of river drainage areas by physical soil surface erosion. For the export of dissolved sediment originating from weathering processes, the catchment physiography and connectivity does no longer play the dominant role.

References: [1] Aarts et al., (2004) *Food ans ChemicalToxicology* **42**:45-49; [2] Cerdan et al. (2012) *Comptes Rendus Geoscience* **344:**636-645; [3] Delmas et al. (2012) *Journal of Hydrology* **420-421**:255-263