Inter-comparison of suspended sediment and phosphorus fluxes and concentrations on two agricultural headwater catchments

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The temporal variability of suspended sediment (SS), particulate phosphorus (PP) and soluble reactive phosphorus (SRP) concentrations and fluxes is high in headwater streams, which highlights variability of availability and transport of phosphorus sources. This paper compares two small agricultural headwater catchments of northwestern France, the Moulinet and the Kervidy-Naizin catchments which present similar physical environments but contrasted landscape infrastructures and landuses. On the Moulinet catchment, agriculture is moderately intensive, with mostly dairy farming. The land use is dominated by pasture grassland (more than 50% of agricultural surface area), mostly in the riparian area, and the landscape is structured by dense hedgerows (7.8 km hedgerows per km²). On the Kervidy catchment, agriculture is more intensive, consisting of dairy, cattle, and pig farming. The surface area of maize and cereal fields exceeds that of grassland fields, and the hedgerows are few (2.7 km hedgerows per km²) but located along the stream.
Annual and monthly SS fluxes are highly contrasted in both streams. Annual SS, PP and SRP fluxes are 64 10^3 kg km^{-2}, 60 kg km^{-2}, 10 kg km^{-2} respectively, on the Moulinet stream, and 12 10^3 kg km^{-2}, 20 kg km^{-2}, 10 kg km^{-2} respectively on the Kervidy stream. The ratio between SRP and PP is therefore different. We show that high SS and PP fluxes in Moulinet are mainly due to the mobilization of deposited sediment or bank particles. SS and PP fluxes in Kervidy are due to slope erosion caused by intensive farming, but limited in amount because of vegetated banks. In contrast SRP fluxes are similar in the two streams.P concentrations of bank and sediment are lower than P concentrations of crop surface soil, indicating two signatures in the Moulinet catchment. At the opposite, the concentrations of all the potential sources are similar and high in the Kervidy catchment. Moreover P concentrations of the SS in this stream are much higher than the P concentrations of the sources. We think that high SRP background in the Kervidy catchment can have polluted all the areas even those usually considered as natural. If in Moulinet SRP is controlled by surface runoff, it is probably controlled in Kervidy by a high availability from PP and subsurface processes. At the flood scale, phosphorus concentration or specific turbidity are used as fingerprint to precise the mobilization of the source along the flood. SS, PP and SRP origins were different on both catchments studied. Very contrasted fluxes were explained by the riparian area management that is a key domain, being a SS, PP and SRP source in one catchment, a SS sink and a SRP source in the other one. Such inter-comparison would be developed to increase our understanding of the phosphorus transfer in agricultural catchments in a large range of situations.

Lefrancois, J., Grimaldi, C., Gascuel-Odoux, C. & Gilliet, N. (2007). Suspended sediment and discharge relationships to identify bank degradation as a main sediment source on small agricultural catchments. *Hydrological Processes* **21**, 2923-2933.

Vongvixay A., Grimaldi C., Gascuel-Odoux C., Laguionie P., Faucheux M., Gilliet N., Mayet M. (2010). Analysis of suspended sediment concentration and discharge relations to identify particle origins in small agricultural watersheds. *IAHS*, in press.