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Spatial and temporal variations of loads and sources of total and dissolved Phosphorus in a set of rivers (Western France).

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In intensive agricultural regions with important livestock farming, long-term land application of Phosphorus (P) both as chemical fertilizer and animal wastes, have resulted in elevated P contents in soils. Since we know that high P concentrations in rivers is of major concern, few studies have been done at to assess the spatiotemporal variability of P loads in rivers and apportionment of point and nonpoint source in total loads. Here we focus on Brittany (Western France) where even though P is a great issue in terms of human and drinking water safety (cyano-toxins), environmental protection and economic costs for Brittany with regards to the periodic proliferations of cyanobacteria that occur every year in this region, no regional-scale systematic study has been carried out so far.

We selected a set of small rivers (stream order 3-5) with homogeneous agriculture and granitic catchment. By gathering data from three water quality monitoring networks, covering more than 100 measurements stations, we provide a regional-scale quantification of the spatiotemporal variability of dissolved P (DP) and total P (TP) interannual loads from 1992 to 2012. Build on mean P load in low flows and statistical significance tests, we developed a new indicator, called “low flow P load” (LFP-load), which allows us to determine the importance of domestic and industrial P sources in total P load and to assess their spatiotemporal variability compared to agricultural sources.

The calculation and the map representation of DP and TP interannual load variations allow identification of the greatest and lowest P contributory catchments over the study period and the way P loads of Brittany rivers have evolved through time. Both mean DP and TP loads have been divided by more than two over the last 20 years. Mean LFDP-load decreased by more than 60% and mean LFTP-load by more than 45% on average over the same period showing that this marked temporal decrease in total load is largely due to the decrease of domestic and industrial P effluents. A global shift in P inputs apportionment to freshwaters thus occurred in Brittany since 20 years as agricultural nonpoint sources now contribute a greater portion of inputs showing the efficiency of the recent control of point sources by enhancement of water treatment plant and removal of phosphates in detergents. The spatialized P loads provided by this study could give a basis for a better understanding of the factors that drives the P transfers in Brittany soils and hotspots of P emissions while the LFP-load indicator can be a tool to assess effects of point-source P mitigation plans.