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Process-based modelling of phosphorus transformations and retention in global rivers

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Phosphorus (P) plays a major role in the biogeochemical functioning of aquatic systems. It typically acts as the limiting nutrient for primary productivity in freshwater bodies, and thus the increase in anthropogenic P loads during the XXth century has fuelled the eutrophication of these systems. Total P retention in global rivers has also escalated over this timeframe as demonstrated via a global model that implements the spiralling method at a spatial resolution of 0.5° (IMAGE-GNM, Beusen et al., 2015). Here, we refine this coupled hydrological - nutrient model by including mechanistic biogeochemical interactions that govern the P cycle. Special attention is paid to the representation of particle processes (i.e. particle loading, sedimentation and erosion), which play a major role in P transport and accumulation in aquatic systems. Our preliminary results are compared to measurements of suspended sediments, total P and orthophosphates in selected river basins. Initial model results show that P concentrations are particularly sensitive to particulate load distribution in the river network within a grid cell. This novel modelling approach will eventually allow a better assessment of the amounts of different forms of P (organic P, soluble reactive P, and particulate inorganic P), of P transformation rates and retention in inland waters.

References

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