Nutrient limitations in French coastal and lake ecosystems: variability, assessment, emerging issues related to bio-availability of particulate P

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Since P limitation of lakes primary production has been fully demonstrated (after the limiting nutrient controversy during the mid 1970 s), the control of lake eutrophication has been based on controlling P concentration to decrease algal biomass, mainly thanks to reducing the external P inputs. This strategy has led to some significant improvement associated with sharp reductions in point sources discharges (large deep alpine lakes). However, in some case diffuse sources and internal P loads (released from lake bottom sediments) slow down and delay rehabilitation or seem to be able to stabilize the lake trophic state. Biological processes and feedback process or N/P interactions, are also involved in this stabilization.

P status is also an important parameter for phytoplankton growth in transitional waters such as estuaries and some coastal waters, and should be included in management programs designed to control coastal eutrophication (Carpenter, 2008). But the studies dealing with nutrient limitations in estuaries, costal waters of the Atlantic Ocean or in oligotrophic parts of the Mediteranean sea, has evidenced either a P or an N deficiency (see, Labry et al, 2002, Cugier et al., 2007). Modeling of phytoplankton and algal growth in coastal waters and estuaries allows to investigate the seasonal and spatial variability of the nutrient limiting factor. Models (Perrot el al, 2007) indicate NO3 as the key controlling factor of the "green tides" (overgrowth of marine macrophytes which ruin some parts of the atlantic cost and for which the level of concern of local people is very high). These findings have been used to established sharp standards and targets for N-NO3 levels in rivers and to reinforce N management on watersheds.

Once point sources of nutrients have been sufficiently reduced, diffuse sources become the main phosphorus provider for aquatic ecosystems. Most of the total-P is transferred as particulate-P from terrestrial sources. The N/P ratio of the inputs changes (Lancelot et al 2007) and new issues related to particulate-P emerge: assessment of both the long-term and short term impacts of particulate-P inputs become an important management concern. Management strategies need especially extensive understanding of spatial and temporal variations of properties of particulate-P (bioavailability, sorption balance….). Since the properties of particulate-P are affected by changes in the distribution of the constituents to which P compounds are incorporated or attached (Poulenard et al., 2008), we would like to proposed a conceptual model to try to establish the links between some bio and physical behaviour of particulate-P and the origins of associated sediments (the P carrier phase) within watersheds, during various hydrological events.

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