Geophysical Research Abstracts
Vol. 15, EGU2013-11614, 2013
EGU General Assembly 2013

Riverine nutrients fluxes to the North Sea and harmful algal blooms, what changed since 1984 ?

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Nutrients fluxes delivered to the coastal zones reflect human activities taking place within watersheds. Silica (Si) fluxes mainly originate from soils and rocks weathering, so they are few impacted by human activities. On the contrary, nitrogen (N) and phosphorus (P) fluxes are dramatically impacted by human activities. N originates from urban waste water but mainly from agricultural activities. P originates mostly from urban and industrial waste waters. The enrichment of the hydrosystems in N and P leads to an imbalance between N and P in one hand and Si in the other hand. This imbalance leads to harmful algal blooms, which are damaging aquatic ecosystems, fishing activities and touristic activities. In 1992, the OSPAR convention was signed by 15 European States and targets to decrease the N and P fluxes delivered to the European coastal zones by 50 % with respect to the reference year of 1985.

Focusing on the Seine, Somme and Scheldt watersheds (France and Belgium) and the adjacent coastal zone of the North Sea, we developed a retrospective modelling from 1984 to 2007 calculating nutrients fluxes from watersheds and Phaeocystis blooms occurring in the coastal zone. We coupled the biogeochemical deterministic model Seneque/Riverstrahler depicting processes occurring within hydrological networks with the marine model MIRO simulating Phaeocystis blooms in the coastal zone.

The evolution of N and P fluxes were highly dissimilar. Indeed, P mainly originates from point sources. Thereby the banishment of P from the washing powders during the nineties, the development of sewage and the improvement of WWTP in terms of waste water treatment lead to a decrease of P fluxes delivered to the coastal zone. This decrease can be observed for the three watersheds. The P OSPAR objective is achieved since the middle of the 2000's years. On the other side, N, mostly originating from agricultural diffuse sources, did not decrease over the period. The fluxes even increased at the outlet of the Seine River. This slackness or increase can be explained by the inefficiency of the measures taken in order to manage agricultural pollutions. The N OSPAR objective is still not yet achieved and no decreasing trend can be observed. Concerning the coastal zone, Phaeocystis blooms decreased by 50 % in terms of intensity and duration over the period. Our simulations permit us to show that, P availability is the main explaining factor of the Phaeocystis development.

As the main major efforts have been focused on the P abatement over the period and the corresponding OSPAR objective is now achieved, the nowadays challenge is the decrease of N fluxes. Although Phaeocystis are well controlled by P, other toxic algae (as Dinoflagellates) could be driven by N availability. Moreover, high concentration of N within continental hydrological networks is damaging for aquatic ecosystems and is a major threat for producing drinking water.