



## **Past and future trends in nutrient loads into European seas: long term impact of European environmental legislation and relevance of alternatives nutrient mitigation measures**

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Eutrophication has been an acute problem in Europe waters for about two decades, and cases of severe eutrophication are still observed even after implementation of environmental legislations since the beginning of the '90s to control nutrient losses and inputs in the environment. The persistence of these riverine alteration syndromes attests for the difficulty to reverse the increasing human pressures in European watersheds and calls for long term assessment. In order to support the implementation of the Marine Strategy Directive, a long term retrospective and prospective analysis (1985-2020) of land-based nutrient loads in European Seas is performed.

A spatially explicit statistical approach (GREEN model) applied to continental Europe on a sub-catchment basis, is used to link input from anthropogenic activities and nutrient loads into European Seas (namely nitrogen and phosphorous). Effectiveness of environmental legislation is first assessed for the 1985-2005 period, emphasizing the regional differences between European countries as well as the respective contribution of anthropogenic changes and hydrological fluctuation in nutrient exports. The contribution of the different nutrient sources was evaluated. It indicated that recent improvements of connectivity and level of sewage treatment and the ban of P in detergent in some countries have induced an important decrease in P river export; while nutrient management in agriculture was not successful in achieving a significant decrease in nitrogen export.

On this basis, a set of prospective scenarios are implemented at the time line 2020 and compared to a 'business as usual' reference, propagating the current trend of anthropogenic pressures but considering the status-quo in the mitigation of land based nutrient emissions. These mitigation measures aim at (i) assessing the potentialities of a full implementation of on going policy options (in particular the Urban Waste Water Directive), (ii) highlighting the need to rethink the actual mode of agricultural production to limit nutrient emission and transfer to coastal sea (nitrogen) and preserve the availability of nutrient resources (phosphorous). These latter options will consider going beyond the strict framework of the current political agenda, and offer an outlook on the evolution of human needs and the environmental consequences of a change in diet (based on a strong reduction of meat intake).

All prospective analyses are implemented for EU-27 and are discussed in terms of capacities to mitigate land based emissions of nutrient, and also according to their impacts on the loads of nutrient exported to European coastal areas based on the simulations provided by the GREEN model.