



Estimation of future nutrient enrichment in Europe's regional seas

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A variety of human activities lead to an increased flux of nutrients into Europe's regional seas. While most industrial sources have been abated, agricultural activities, wastewater treatment plants, and fossil fuel combustion still emit nitrogen and/or phosphorus to air or water, that ultimately load our seas with nutrients. This paper reports on a study conducted within the EU-sponsored ELME (European Lifestyles and Marine Ecosystems) project. Historical data on sources of nutrients and their impacts on the current and past states of the Adriatic, Baltic, Black (NW shelf) and North Seas were used to construct models based on Bayesian Belief Networks. These models tested a range of scenarios for future socio-economic development. The results highlight that:

- physiographic and hydromorphic characteristics of the regional seas have a strong influence on their response to and the severity of eutrophication;
- in particular, these characteristics foster system memory, with past nutrient fluxes contributing to current eutrophication symptoms;
- economic development and associated nutrient releases have varied across Europe, but luckily the largest fluxes entered the well-flushed North Sea rather

than the more enclosed and more vulnerable Adriatic, Baltic and NW shelf of the Black Sea;

- the most likely course of future economic development will continue to reduce emissions to the Adriatic, Baltic and North Seas, but the Black Sea is likely to experience an increase relative to the past 15 years (following the breakdown of communism and with reduced agricultural sources); and
- an increase in N:P in the future, with likely effects on phytoplankton composition and food webs but the models cannot predict such effects due to limited and conflicting data on ecosystem responses to nutrient ratios far outside the Redfield ratio.