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How phosphorus limitation can control climatic gas emission

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Anthropogenic activities severely increased river nutrient [nitrogen (N) and phosphorus (P)] loads to European coastal areas. However, specific nutrient reduction policies implemented since the late 1990's have considerably reduced P loads, while N is maintained. In the Southern North Sea, the resulting N: P: Si imbalance (compared to phytoplankton requirements) stimulated the growth of Phaeocystis colonies modifying the functioning of the ecosystem and, therefore, the carbon cycle but also the biogenic sulphur cycle, Phaeocystis being a significant producer of DMSP (dimethylsulphide propionate), the precursor of dimethylsulfide (DMS). In this application, the mechanistic MIRO-BIOGAS model is used to investigate the effects of changing N and P loads on ecosystem structure and their impact on DMS and CO_2 emissions. In particular, competition for P between phytoplankton groups (diatoms vs Phaeocystis colonies) but also between phytoplankton and bacteria is explored. The ability of autotroph and heterotroph organism to use dissolved organic phosphorus (DOP) as P nutrient source is also explored and its effect on climatic gas emission estimated. Simulations were done from 1950 to 2010 and different nutrient limiting conditions are analyzed.