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The sensitivity of the northwest European continental shelf ecosystem to anthropogenic pressures

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Anthropogenic pressure is exerted on ecosystems in several ways, through direct drivers such as eutrophication and levels of fishing effort and by changes in the physical environment brought about by climate change. Changes in water temperature, the timing and duration of seasonal stratification, circulation patterns and ocean-shelf exchange all impact on shelf-sea primary production. We use a coupled hydrodynamics-ecosystem model (POLCOMS-ERSEM) to study ecosystem sensitivity to climate change and the anthropogenic drivers of river nutrient loads, impacting on eutrophication, and trawling effort on the northwest European continental shelf, with an emphasis on changes in the North Sea. To force the model we use data from a coupled ocean-atmosphere global model (IPSL-CM4) representative of conditions in the recent past (1983-2000) and possible conditions in the near future (2030-2040) under a business as usual emissions scenario SRES A1B. To study ecosystem sensitivity to direct anthropogenic forcing, we adopt two scenarios impacting on river nutrient loads and trawling effort – one where there is rapid economic growth and limited environmental policies and a second where economic growth is constrained by environmental objectives. The sensitivity of the system to each single driver: climate change, increase in river nutrient loads, decrease in river nutrient loads and reduction in trawling effort is explored. The response of the ecosystem to the combined effects of changes in multiple drivers under the two scenarios of economic growth is also studied. The results are relevant to the Marine Strategy Framework Directive descriptors on marine food webs, eutrophication and biodiversity.