Sensitivity of the Northwest European Continental Shelf Sea ecosystem to projected climate change

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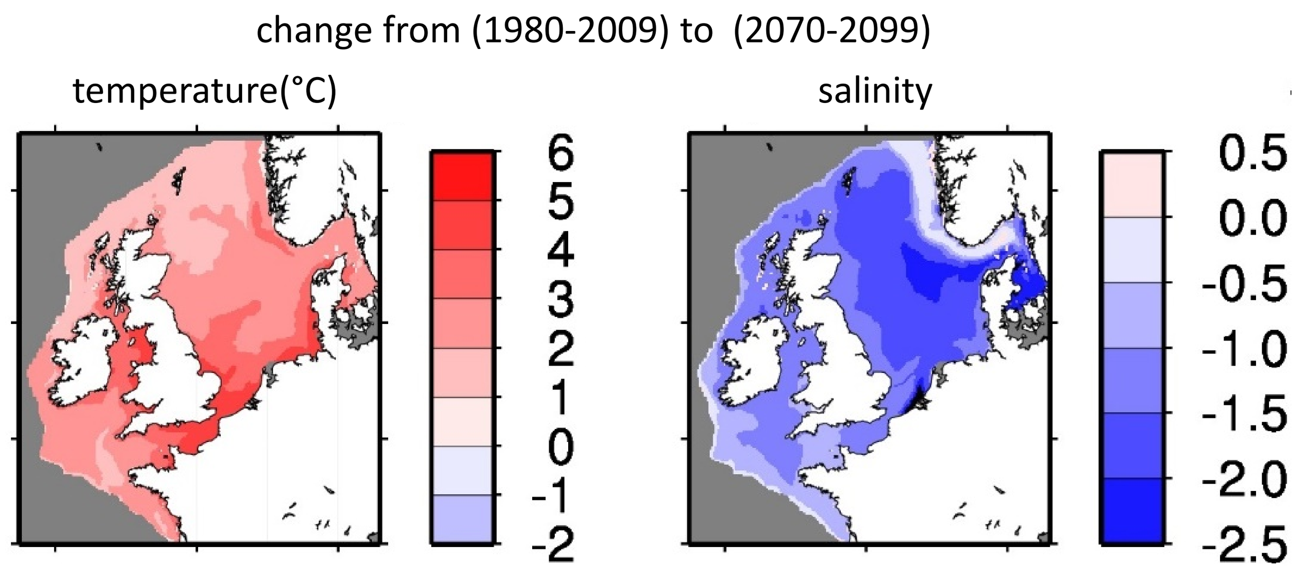
1. INTRODUCTION

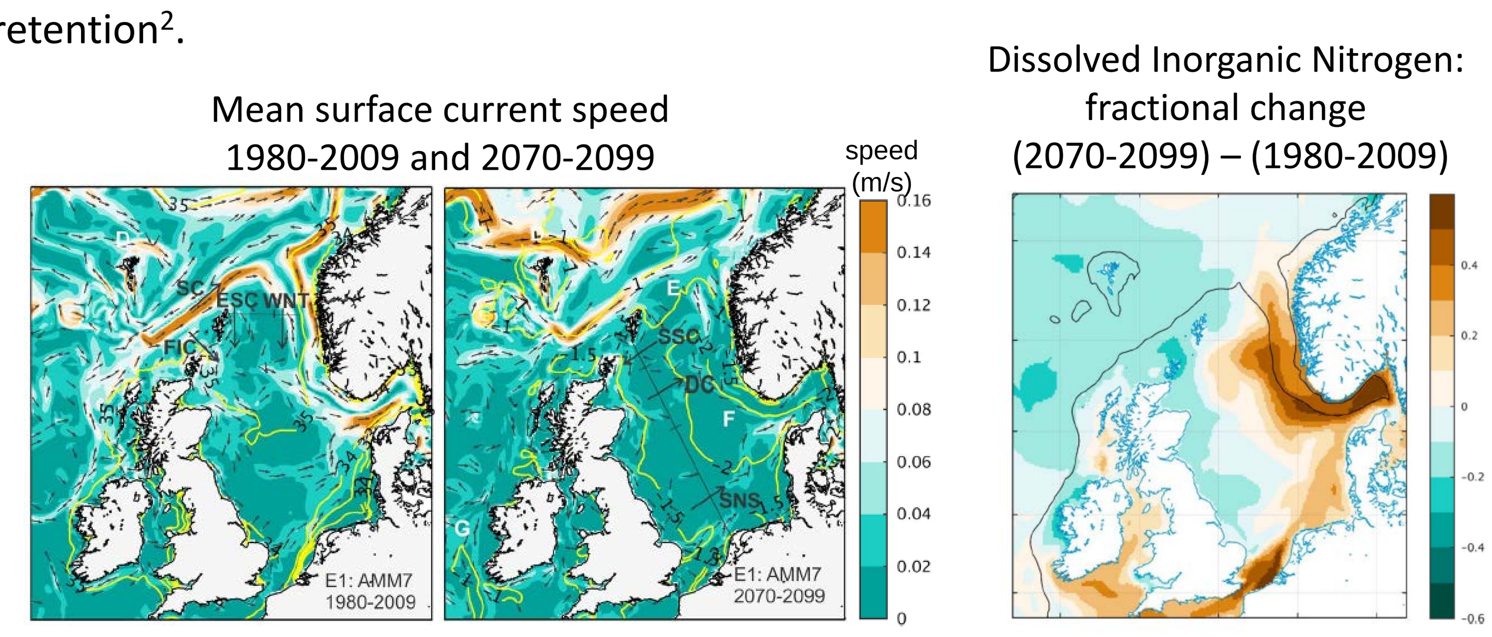
The northwest European shelf is a shallow region (< 200 m deep) in the northeast Atlantic, whose physics and biogeochemistry respond to changes in both regional atmospheric conditions and the physics/biogeochemistry of the neighbouring Atlantic Ocean. Close proximity to industrial regions of northern Europe provides further anthropogenic impact on the ecosystem, such as through the addition of nutrients via atmospheric deposition and runoff from land. In this poster, we summarise results from recent studies[1,2,3] using coupled physics-ecosystem models (POLCOMS-ERSEM and NEMO-ERSEM) forced by Global Climate Models (GCMs) to explore changes under medium (A1b) and high (RCP8.5) emission scenarios during the 21st Century.

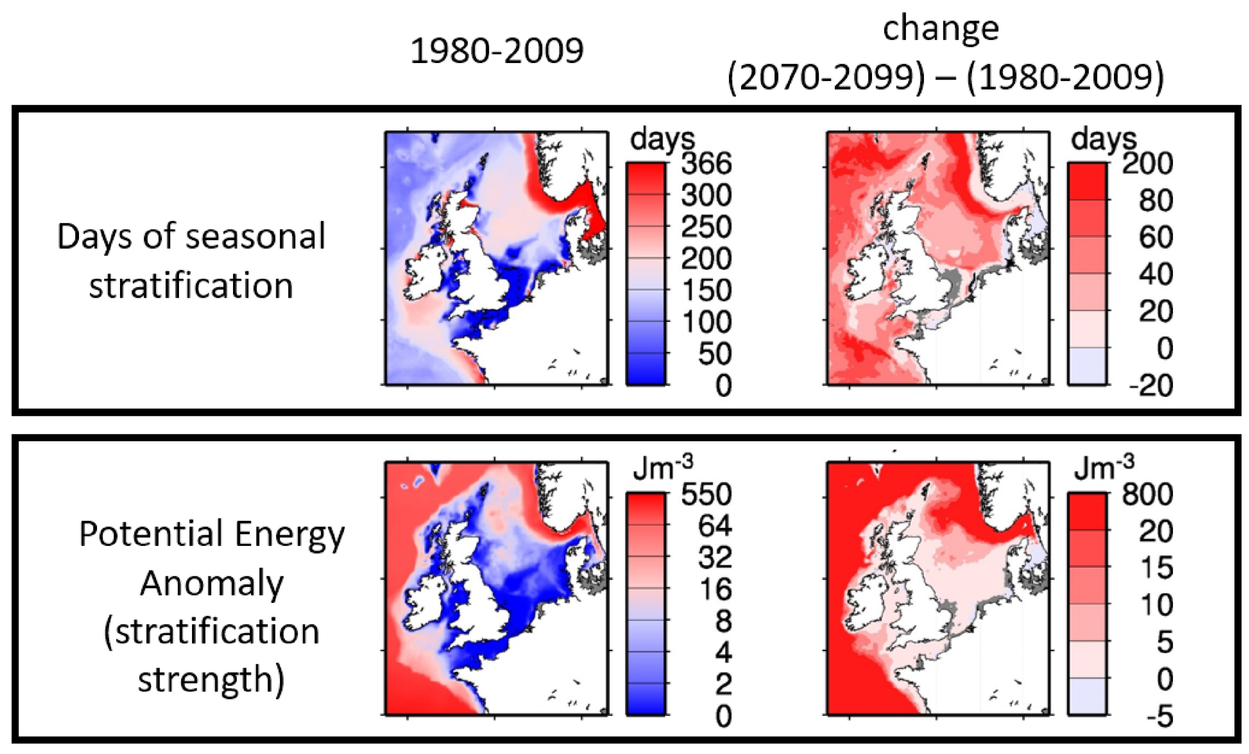
2. ENVIRONMENTAL CHANGES

Under emissions scenario RCP8.5, the northwest shelf is projected to become warmer and fresher[1].



Open ocean changes may reduce circulation in the North Sea, leading to increased upstream nutrient retention[2].



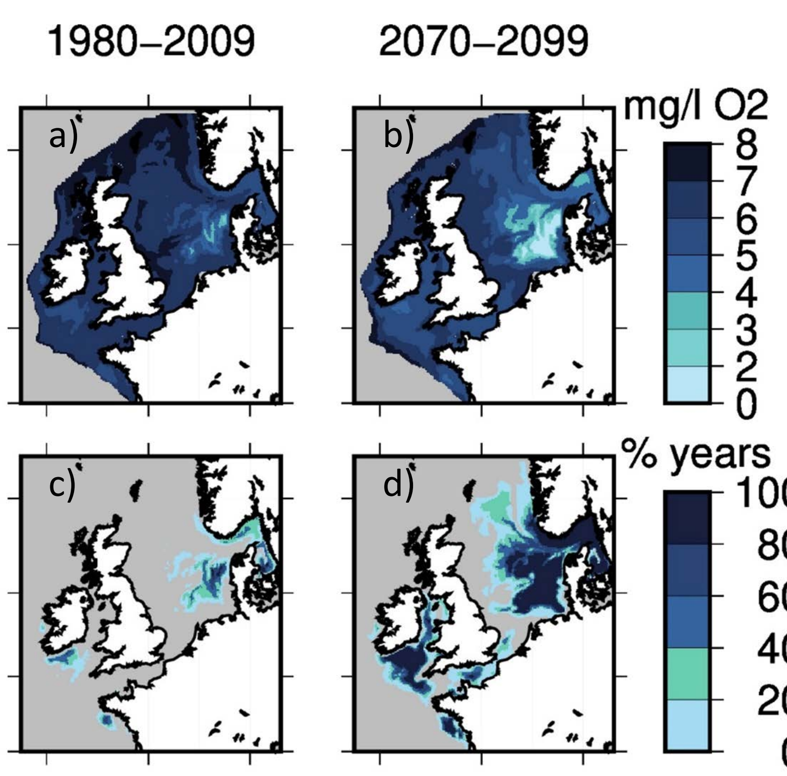


Seasonal stratification is projected to be stronger by the end of the century, and last longer. Changes in the North Atlantic alter the supply of nutrients to the shelf.

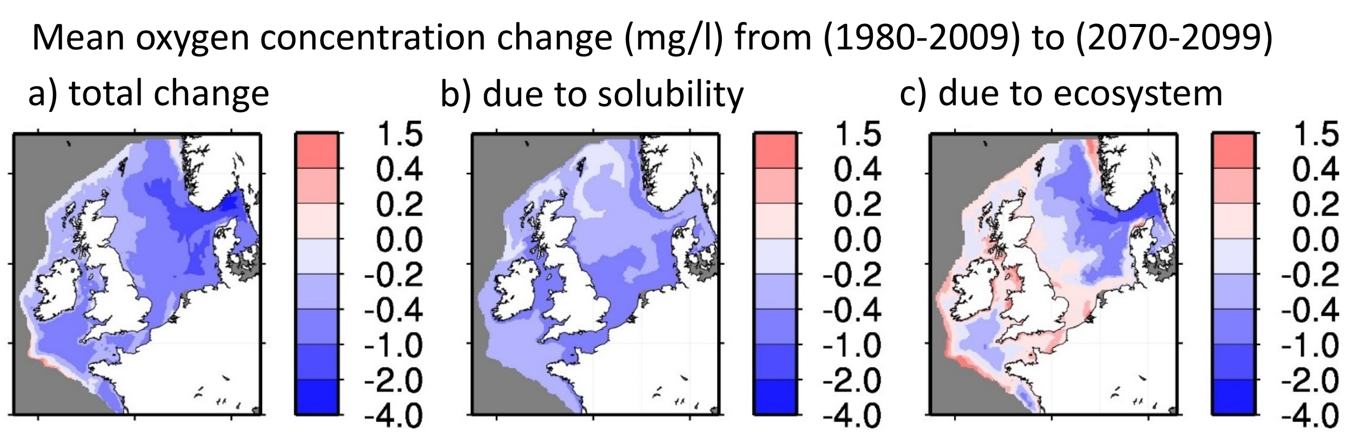
3. OXYGEN CHANGES

Gas solubility in the ocean decreases as water temperature increases leading to a reduction in dissolved oxygen concentrations. Seasonal stratification isolates near-bed water from atmospheric exchange and contributes to oxygen concentrations in some regions falling to levels potentially harmful for ecosystem health. The impact is modulated by changes in ecosystem processes under evolving climatic conditions.

Over the 21st century under scenario RCP8.5, the mean near-bed oxygen concentration on the European shelf is projected to decrease by 6.3%, of which 73% is due to solubility changes and the remainder to changes in the ecosystem processes[1].



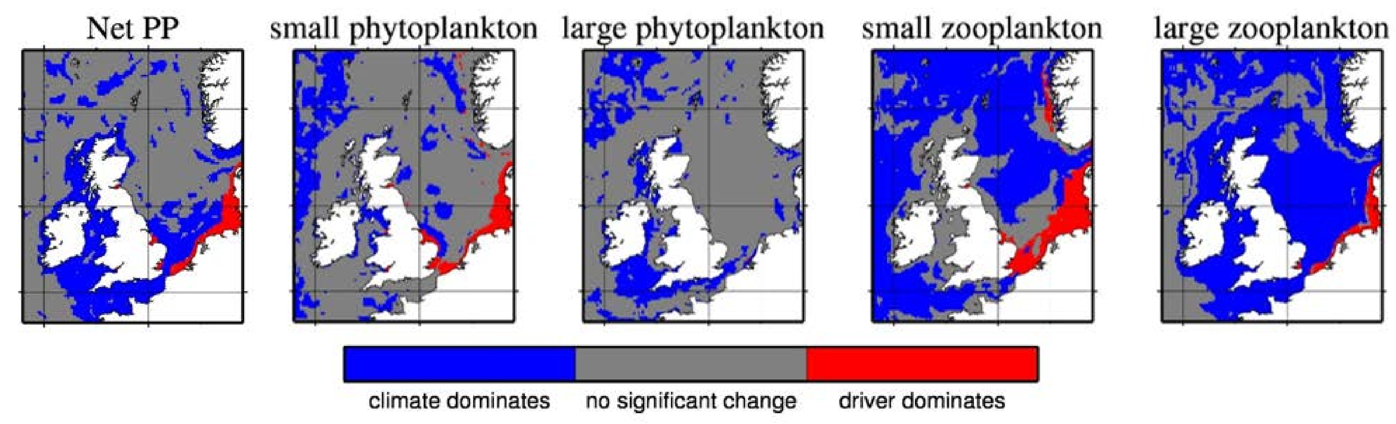
Right: Minimum oxygen concentrations near the sea bed decline from a) 1980-2009 to b) 2070-2099, and are below a 6 mg/l depletion threshold[4] more often and over larger regions in d) 2070-2099 than during c) 1980-2009.



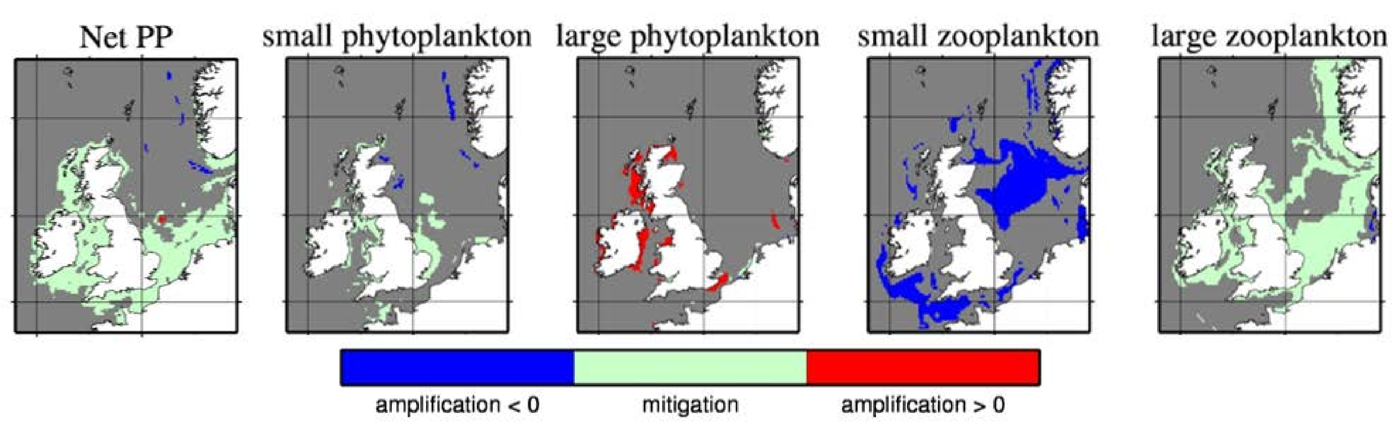
Left: a) Oxygen reduces on the shelf by 2070-2099. b) The solubility changes act across the shelf whilst c) the ecosystem impact varies regionally.

4. COMBINED RIVER NUTRIENT POLICIES AND CLIMATE

Primary production and phytoplankton/zooplankton biomass changes by 2020-2040 compared to 1983-2000: climate change impact (scenario A1b) compared to 50% reduction in river nitrogen and phosphate loads (driver).



Environmental policies reducing river nutrients by 50% amplify or mitigate the impact of climate change by 2020-2040.



Only near some coasts is the impact of anthropogenic changes in river nutrients on primary production and plankton biomass larger than that due to changing climate[3]. Changes in river nutrient loads can mitigate or amplify the impact of climate change depending on phytoplankton and zooplankton size classes.

5. SUMMARY AND FUTURE WORK

- Model projections suggest that the water of northwest European shelf seas will become warmer and fresher with longer periods of seasonal stratification and stronger stratification, contributing to declining oxygen concentrations near the sea bed. Environmental policies may amplify or mitigate the climate response.
- The potential range of physical/ecosystem response of the European shelf to climate change under the RCP8.5 emissions scenario is being investigated in the ReCICLE[5] project using a model ensemble forced by CMIP5 GCMs.

References

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