



Aim

This study was to use modelling approaches to project how seawater environmental characteristics within the south west marine plan areas may change over the two decades. The study then considers how potential changes may influence specific marine sectors and receptors within the time-frame and geographical extent of the South West Inshore and Offshore Marine Plans. This study was a collaboration between the South West Partnership for Environmental and Economic Prosperity (SWEEP) program and the Marine Management Organisation

Introduction and methodology

Physical and chemical characteristics of the marine environment are responding to climate change induced by anthropogenic activities. It is almost certain that the rate of change will accelerate over the coming decades in the absence of dramatic and immediate mitigation efforts.

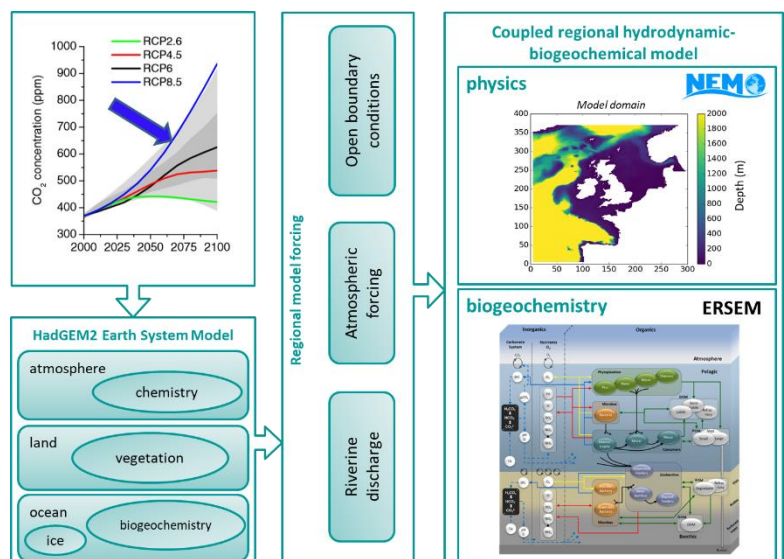
Existing evidence indicates that amongst these changes, global seawater temperature has increased while global seawater pH has decreased. Such changes influence marine life, with evidence for modifications to activity and distribution of species across temporal and spatial scales, and levels of biological organisation. At regional scales, change within the marine environment influences the suitability of marine habitats for indigenous marine life and ultimately impacts upon ecosystem function, sustainability and service provision.

Within the context of marine planning, there is a specific interest in the influence global climate change exerts at the regional and local scale within and among marine plan areas and within the 20-year timescales applicable to England's marine planning process.

Simulation results were obtained from a three-dimensional modelling framework consisting of an ocean circulation model (NEMO) coupled with a model of marine biogeochemistry and the lower trophic food web (ERSEM) (Figure 1) with forcing from the climate model (HadGEM2) under a high greenhouse gas emission scenario (RCP8.5).

Environmental variables predicted included temperature, pH, O₂, Chlorophyll, salinity, DIN, DIP and N:P

Figure 1 – High level model



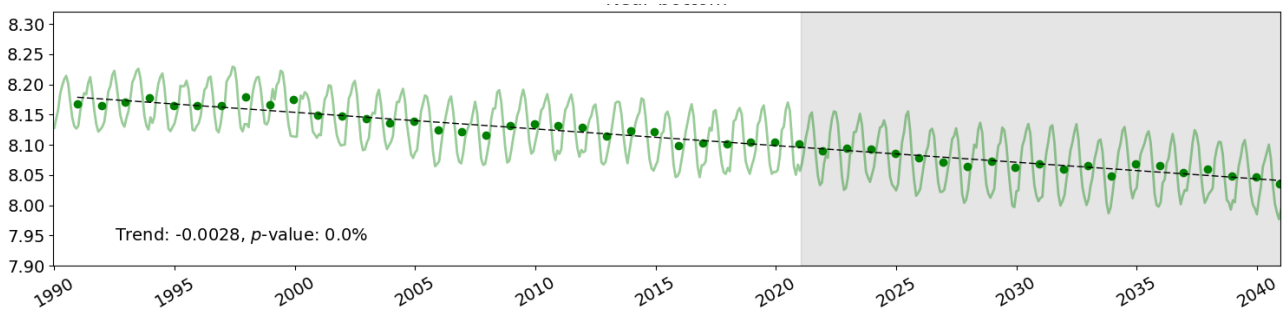


Results

Model projections identify a set of environmental factors that do not change significantly within the next 20 years and are therefore unlikely to influence ecosystem function within the current time horizon of current marine plans. These include dissolved inorganic nitrogen, dissolved inorganic phosphorus and chlorophyll.

Projections identify significant changes in a further set of environmental factors with seasonal variability within the next 20 years that is not beyond the range experienced in the recent past. These factors include N:P ratio, dissolved oxygen, temperature and salinity. Changes in these factors have been reported to individually influence marine species physiology, distribution, and diversity. Projections also highlight trends in seawater pH that are both significant and extend beyond seasonal variability of the recent past.

Model output for seawater pH (meq y⁻¹) from 1990-2041 in south west inshore near bottom waters.



Conclusions and Recommendations

Change across a number of environmental variables is projected over the next 20 years. It is important to note that in natural marine systems such as the European shelf, all of these environmental factors will change simultaneously. It is feasible that such simultaneous and progressive change in multiple factors will lead to an environment that differs from that of the present day.

By integrating best knowledge and state-of-the-art understanding of marine systems, models contribute to decreasing this uncertainty and improving our understanding of system complexity, in turn supporting regional economies and policy development.

MMO Comments

This project provides spatial and temporal projections of significant environmental change in the south west marine plan areas under high greenhouse gas emission scenarios (RCP8.5). This work will be utilised by MMO to act more confidently in developing climate relevant marine plan policy and to inform on how higher resolution climate projections may inform policy development. The North Devon Marine Pioneer' programme will draw on this evidence as part of its testing of innovative ideas for governance of the environment to inform the Government's 25 Year Environment Plan.