

Using models to support marine policy: The MEECE Model Atlas

The web-based MEECE Model Atlas provides information relevant to the EU Marine Strategy Framework Directive and other European policy drivers by illustrating the present state of the marine environment and how it might change when subject to external pressures. The Atlas provides direct, free access to outputs from marine ecosystem models applied at both a Global and Regional Sea level.



MEECE is an EU FP7 project which has developed regionally-focused ecosystem models. The European Marine Strategy Framework Directive (MSFD) provides a transparent, legislative framework to apply an ecosystem-based approach to the management of human activities in the marine environment. The Directive aims to achieve 'Good Environmental Status' (GES) across Europe's regional seas by 2020.

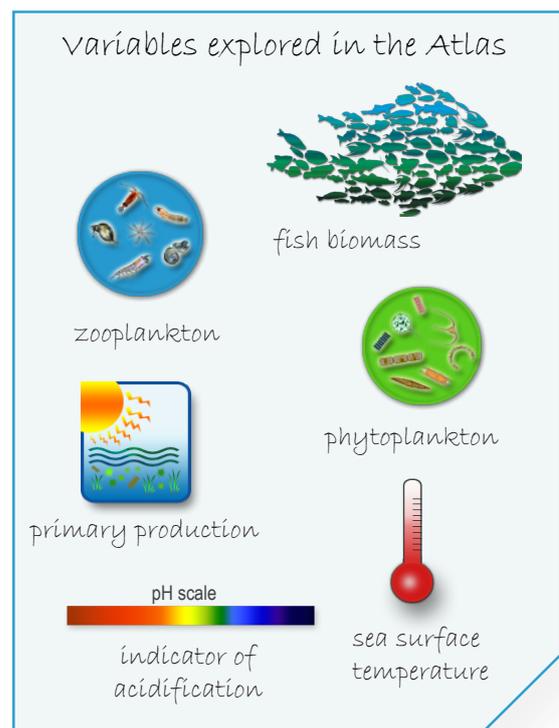
Modelling change in European Seas

The MEECE Model Atlas presents information derived from models. Numerical models are mathematical descriptions of the real world which allow us to explore how the world works. Models are a powerful tool for describing the current state of a system and how it may respond to external pressures. Every effort has been made to ensure the model outputs are of the highest possible quality. However one should bear in mind that the scenarios presented in the Atlas represent only a limited subset of possible future states and should be regarded as projections rather than actual predictions.

End-to-end models of marine ecosystems aim to represent the entire ecosystem by including all relevant processes in the system, from ocean biology, including plankton and fish, to physics, chemistry and human components as well. In MEECE, end-to-end models are used to evaluate marine ecosystem response to future scenarios of climate change, acidification, and human pressures such as fishing, eutrophication and pollution in regional seas.

The MSFD aims to assess the environmental status of European Seas at a regional level. MEECE therefore presents its results at a regional scale. The Model Atlas provides for each region a short summary of the present state of the system and how it may respond to different climatic and human induced pressures. In addition full model descriptions, skill assessments and points that should be consider when looking at the outputs are also provided to help ensure the results are not taken out of context. The main aim of the Atlas is to provide access to real model data, the data has been converted into maps and graphs to provide a simple picture of the model projections. Graphs and maps are presented for the following seas:

- Global
- Adriatic Sea
- Atlantic margin
- Baltic Sea
- Barents Sea
- Bay of Biscay
- Benguela Upwelling
- Black Sea
- N. Aegean Sea
- Nordic Sea
- North Sea



Understanding the complex world of modelling

One of the unique points about the MEECE project is that the models have been developed to explore the combined impacts of drivers, so the impact of a changing climate along with changes in human activity for example pollution. Looking at these drivers in combination provides a more realistic projection of potential future change which could be feed into the decision making process, particularly in terms of future planning and assessment and the development of indicators through which to measure environmental status.

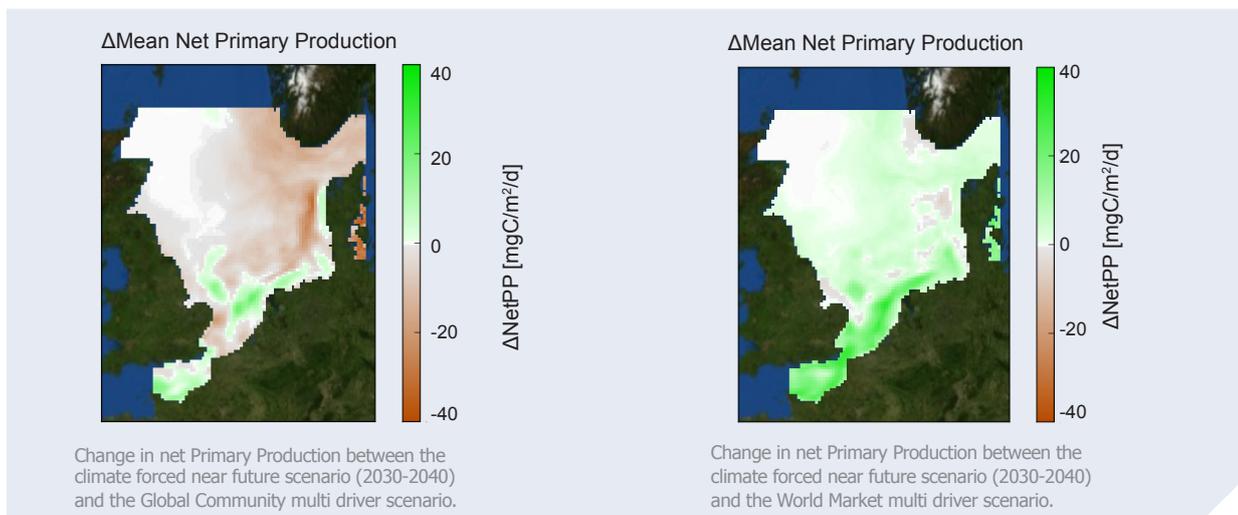
Ecosystem models vary in their structure and composition. In MEECE each regional sea was modelled using a different model and thus presentation of results may vary across regions. Where no output is shown for a particular variable or scenario, this is due to a lack of available data or resources in that particular region.

Tailoring the results to suit your needs; driven by the MSFD, the Model Atlas is, for ease of use and relevancy, structured regionally. To increase user control and flexibility a comparison tool has been developed which allows you to specify which to view unconstrained by geography or variable. For example if you are developing a management plan for the Black Sea you could select to view the change in all variables at once across the region, or if you were interested in broad changes in seas surface temperature you can view this across all regions. This tool allows the user to tailor the display of the Model Atlas's outputs to meet their specific interests.

Case Study: net Primary Production in the North Sea

One of the interesting messages that the Model Atlas clearly demonstrates is sub-regional variation. Let's look at the net primary production in the North Sea. Here the model is forced by a climate scenario (2030-2040) and two potential anthropogenic scenarios. The Global Community scenario (GC) looks at the combined effects of human drivers e.g. application of fertilisers to farmland and the near future climate scenario, in this scenario nutrient loading is reduced in the future. The second scenario World Markets (WM) shows the same combined impacts of climate

and human activity, but in this case the future scenario involves an increased nutrient load from rivers. The maps of change show the difference between the pure climate scenario and combined anthropogenic/ climate change scenarios. The Atlas makes it easy to identify areas of sensitivity within a region, in this case those sensitive to riverine nutrients. Model results are a useful tool for regional planning and management, highlighting areas of relative regional sensitivity and monitoring how indicators of ecological status may change under future scenarios of change.



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