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## ***Interactive comment on “Physical processes mediating climate change impacts on regional sea ecosystems” by J. Holt et al.***

**J. Holt et al.**

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Received and published: 2 May 2014

Dear Dr Marilaure Grégoire (Editor),

We acknowledge that this paper requires a substantial revision in order to be acceptable for publication in Biogeosciences. Here we provide detailed plan to revise the paper. We would appreciate your guidance on whether this is an appropriate way to proceed with this paper.

Regards,

Jason Holt

**Plan for Revision**

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Here we outline our plan for revising this paper. We feel it will fully meet the issues raised by these reviewers' comments, but are also open to further suggestions from the editor and reviewers.

A primary aim of this revision is to refocus the paper on the five regional model simulations and so develop the presentation of model results to better support the process analysis. In this way we will make the paper a more coherent whole and strengthen the analysis to provide better evidence to support (or question) the conceptual view of which processes are important. It will also improve the description of modelling approaches and experiment design.

To readdress the original bias towards the NW shelf, we plan to remove some POLCOM-ERSEM specific results, notably those relating to figs 9 and 10. These will be replaced with new results from the other regions that will illustrate the processes important in each region. Examples include changes in sea ice, upwelling and horizontal transport, as related to changes in primary production. Much of the descriptive text from 2.4 and 2.5 will be moved alongside these to discuss the new results. Aspects from 2.4, 2.5 that cannot be covered by these experiments, will be left to a brief discussion on gaps in the approach.

Fig 11 will be developed as a quantitative comparison between these three POLCOMS-ERSEM results and the ECOSMO model, focusing in the North Sea.

The framework for a common analysis will be extended to better explore common aspects of the climate change impacts to inform the comparison between the regions. This will include changes to the seasonal vertical nutrient transport, and changes in the total nutrient inventory. This should enable us to demonstrate that changes to vertical diffusive nutrient fluxes are not such an important control in Black Sea and Baltic Sea, but are an important control in the central/north North Sea, Celtic Sea and N Atlantic. It should also demonstrate the general importance to changes in the surface water N inventory. A detailed description of the modelling approaches and experiment

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design will be provided as an appendix.

Section 4 will be removed with pertinent details and points added to the appendix and elsewhere in the text.

New structure: (numbers in parentheses refer to original structure)

## 1. Introduction

### 1.1 Background/motivation (1)

### 1.2 Processes: forcing/response - general principles in brief (Summary of 2)

## 2. Methods (introduction to 3)

### 2.1 Brief model description and experiment overview

### 2.2 Common analysis

## 3. Contrasting the climate change impacts on PP in 5 regional models (3)

### 3.1 Process analysis for each region, illustrated by model results, drawing on 2.4, 2.5

#### 3.1.1 Baltic Sea

#### 3.1.2 Black Sea

#### 3.1.3 North Sea (both models)

#### 3.1.4 Celtic Seas

#### 3.1.5 Barents Sea

### 3.2 Common analysis results and comparison, based on 3.1 and new analysis

## 4. Discussion and conclusions, common themes from these results, guide for future work.

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## Appendix

### Model descriptions and experiment design

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