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Earth System Dynamics
Discussions

Interactive comment on "Uncertainties in projections of the Baltic Sea ecosystem driven by an ensemble of global climate models" *by* Sofia Saraiva et al.

Anonymous Referee #2

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This manuscript investigated the uncertainties/changes in future projections of ecosystem processes, such as primary production, nitrogen fixation and hypoxic areas, over the Baltic Sea. The authors employed a regional ocean model with capabilities of simulating coastal and ocean biogeochemical processes, driven by output from regional coupled atmosphere-ocean climate and hydrological models. The regional models, in turn, were forced by boundary conditions from global GCMs (IPCC models). The authors argued that uncertainties in ecosystem processes originate mainly from various scenarios of nutrient load, rather than model deficiencies or future greenhouse gas emissions.

This study could be of interest to ESD readers and contribute to understandings of the uncertainties in future projections of Baltic Sea ecosystem. However, I feel that the authors' manuscript needs to be improved substantially, both in terms of their analysis and general writing on their results, before it can be published in ESD. Please see my detailed comments bellow.

Major comments: 1. So far, description of experimental configuration (section Methods in the authors manuscript) is not very clear to me. It would be better, if the authors could make a schematic diagram to illustrate how their experiments are setup. For example, they can show how the "Baltic Sea model" is forced by variables from reginal hydrological and climate models, and how the regional models are forced by global GCMs. A good schematic diagram could help readers tremendously.

2. I suggest the authors also validate their regional ocean experiments individually against historical observations of ocean temperature, salinity, sea-ice cover, etc. Currently, it is done as ensemble mean and standard deviation compared with observations (e.g., Figures in Appendix). It is beneficial to show, out of the four GCMs, which provides a better forcing fields for the regional model during historical period? How do the biases in GCMs propagate to the regional ocean model used by the authors?

3. Sea-ice processes were not mentioned at all in the current manuscript. In fact, sea ice plays an important role in the budget of heat, freshwater, carbon and nutrients over the Baltic Sea (Granskog et al., 2006; Vihma and Haapala, 2009). I think the authors should discuss how sea ice is treated in their experimental setup, how well sea-ice processes are simulated in their model, and how response in sea ice influences their results.

4. The authors keep using the word "model deficiencies" when discussing results from experiments forced by four GCMs but fail to describe what exactly these model deficiencies are, and how these deficiencies influence regional simulation of the physical climate and biogeochemistry over the Baltic Sea. Also, spread between multiple mod-

els is not always the same as deficiencies in models. Internal variability could also contribute to some of the multiple-model spread. Model deficiency are usually discussed with some exact physical/biogeochemical processes.

5. The authors simply described results from their experiments and did not provide in-depth analysis/assessment on physical and biogeochemical processes producing these results. Some degree of mechanistic interpretation of their results could be interesting.

Minor comments: The writing of the current manuscript needs improvement. I do have some editing suggestions, but I feel there is no point in addressing them in this early stage.

Reference: Granskog, M., Kaartokallio, H., Kuosa, H., Thomas, D. N., & Vainio, J. (2006). Sea ice in the Baltic Sea–a review. Estuarine, Coastal and Shelf Science, 70(1-2), 145-160. Vihma, T., & Haapala, J. (2009). Geophysics of sea ice in the Baltic Sea: A review. Progress in Oceanography, 80(3-4), 129-148.

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