Geophysical Research Abstracts
Vol. 17, EGU2015-13324, 2015
EGU General Assembly 2015

Spatial sensitivity of inorganic carbon to model setup: North Sea and Baltic Sea with ECOSMO

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In ocean biogeochemical models it is critical to capture the key processes adequately so they do not only reproduce the observations but that those processes are reproduced correctly. One key issue is the choice of parameters, which in most cases are estimates with large uncertainties. This can be the product of actual lack of detailed knowledge of the process, or the manner the processes are implemented, more or less complex. In addition, the model sensitivity is not necessarily homogenous across the spatial domain modelled, which adds another layer of complexity to biogeochemical modelling.
In the particular case of the inorganic carbon cycle, there are several sets of carbonate constants that can be chosen. The calculated air-sea CO_2 flux is largely dependent on the parametrization chosen. In addition, the different parametrizations all the underlying processes that in some way impact the carbon cycle beyond the carbonate dissociation and fluxes give results that can be significantly different. Examples of these processes are phytoplankton growth rates or remineralization rates.
Despite their geographical proximity, the North and Baltic Seas exhibit very different dynamics. The North Sea receives important inflows of Atlantic waters, while the Baltic Sea is an almost enclosed system, with very little exchange from the North Sea. Wind, tides, and freshwater supply act very differently, but dominantly structure the ecosystem dynamics on spatial and temporal scales. The biological community is also different. Cyanobacteria, which are important due to their ability to fix atmospheric nitrogen, and they are only present in the Baltic Sea. These differentiating features have a strong impact in the biogeochemical cycles and ultimately shape the variations in the carbonate chemistry.
Here the ECOSMO model was employed on the North Sea and Baltic Sea. The model is set so both are modelled at the same time, instead of having them run separately. ECOSMO is a 3-D coupled physical-biogeochemical model, which resolves the cycles of nitrogen, phosphorus and silicate. It includes 3 functional groups of phytoplankton and 2 groups of zooplankton. In addition, an inorganic carbon module has been incorporated and coupled. Alkalinity and DIC are chosen as prognostic variables, from which pH, pCO_2 and air-sea CO_2 flux are calculated.
The model is run with different sets of carbonate dissociation parameters, air-sea flux parametrizations, phytoplankton growth and remineralization rates. The sensitivity of the inorganic carbon variables will be assessed, both in the whole model domain and the North and Baltic Sea independently. We search for the critical parameters that have a larger impact, whether such impact is spatially dependent and the effect on the validation of the carbonate module.