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To what extent does the salinity flux influence phytoplankton blooms? – Baltic Sea modeling study

Agata Cieszyńska and Małgorzata Stramska
Institute of Oceanology Polish Academy of Sciences, Sopot, Poland

This work is focused on numerical modeling of biological-physical interactions and their influence on phytoplankton production and vertical distribution of biomass and its variability in the surface waters of the Baltic Sea. The area of interest is an inland sea with water salinity much smaller than observed in the global ocean (about one fifth of the open ocean value). Vertical distribution of the salinity has a significant influence on water column density stratification, and therefore influences intensity of mixing and the depth of mixed layer. This, in turn, defines environmental conditions for phytoplankton growth. Vertical distribution of water salinity in the basin is controlled by processes such as evaporation/precipitation, freezing/melting of sea ice and runoff of freshwater from land.
There are a lot of different phytoplankton species in the area of the Baltic Sea. Every single one has its own characteristics and is sensitive to distinct complex environmental conditions. Biological-physical interactions controlling these microorganisms' life cycles are multiplicitous and because of their complexity difficult to quantify. The best and probably only way to study presented issue is the usage of numerical modeling tool. The results presented here are based on 1D numerical simulations carried out with Princeton Ocean Model (POM, http://www.ccpo.odu.edu/POMWEB/) merged with the Ecological Regional Ecosystem Model (ERGOM, http://ergom.net/) developed for the Baltic Sea research by German scientists from the Leibniz Institute for Baltic Sea Research in Warnemünde.
In model simulations surface salinity flux was determined from the difference between the precipitation and evaporation rate at the air-sea interface. Data for parameterization of atmospheric forcing were defined based on data sets from National Centers of Environmental Prediction (NCEP). We carried out systematic calculations using different values of surface fluxes encompassing the range of variability observed in the Baltic Sea region. We run numerical scenarios using real data and synthetic but representative parameters' values. The goal was to change environmental conditions in a systematic and controlled manner in order to obtain extended data sets with the information about the role of atmospheric forcing, vertical profiles of water salinity and temperature in the described interactions. In this presentation we will summarize the results from our numerical simulations.
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