Modeling benthic-pelagic interaction for the Arctic Ocean acidification studies

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The Arctic Ocean is predicted to be the most vulnerable to the effect of increased CO2 levels, resulting in the Arctic Ocean Acidification (OAO) (AMAP, 2013). In addition to direct effects of changes in pH and carbonate saturation on marine organisms, there can also be indirect links, through changes in biogeochemical cycling of substances, especially nutrients cycling and their bioavailability for primary production. Benthic-pelagic interactions is an important component of the Arctic Ocean functioning and a question about effects of AOA in processes occurring in the benthic layer remains open.

The goal of this work is to contribute to understanding of processes controlling benthic biogeochemical cycling by studying of how pelagic carbonate system seasonal changes affect the benthic ones.

We used a 1-dimensional C-N-P-Si-O-S-Mn-Fe benthic-pelagic coupled model BROM (Yakushev et al., 2016). This model is modularized within the Framework for Aquatic Biogeochemical Models (FABM, Bruggeman, Bolding, 2014). The BROM domain includes the water column, the Bottom Boundary Layer (BBL) and the upper layer of the sediments. The 1D BROM-transport model allows offline coupling with the outputs of hydrodynamical models. The hydrophysical scenario for the water column was taken from the results of ROMS-20 km runs. We applied a model for a region in the Kara Sea where there were provided observations during the September 2015 cruise of RV “Akademik Mstislav Keldysh”. We used data collected for parameterization of the lower boundary conditions and for validating the runs.

The model can numerically demonstrate that the seasonal changes of the carbonate system parameters in the surface layer (pH, aragonite and calcite saturation states) are accompanied by corresponding delayed changes at the sediment-water interface, that is connected with the seasonality in supply of organic matter.