

Modeling as a tool to assess the effects of environmental parameters in the Arctic



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Kongsfjorden (Svalbard) has been described as a harbinger of changes in the Arctic. This fjord is strongly influenced by the inflows of Atlantic Water. The magnitude of these inflows appears to explain a significant part of the physico-chemical and biological interannual variability of Kongsfjorden, with an increasing water temperature trend over the last ~2 decades, paralleled by an increase in the presence of Atlantic species. We implemented a three-dimensional physical-biogeochemical model (K160_bgc) to evaluate the effects of environmental change on ecosystems services such as fjord primary production and its carbon sink-source role.

What did we do?

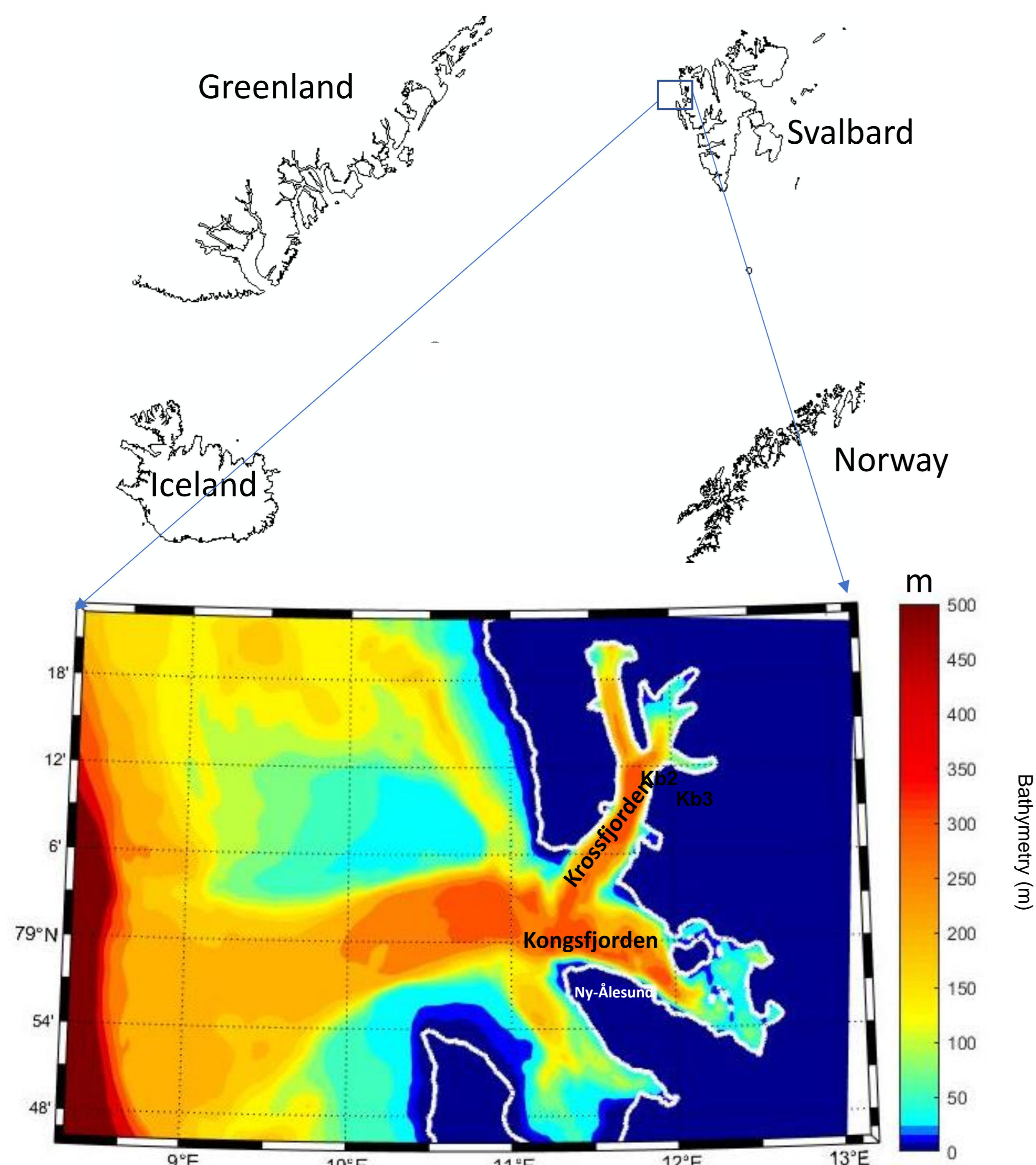


Fig. 1 Location of Kongsfjorden (Svalbard) in the Arctic (above) and model domain, including Kongsfjorden, Krossfjorden and part of the adjacent shelf. Kb2 and Kb3 designate two sampling stations used to evaluate model results.

The model was implemented using The Regional Ocean Modeling System (ROMS) coupled with the Los Alamos Sea Ice Model (CICE Forum). It has a horizontal resolution of 160 m. It includes surface and submarine outflows from the glaciers, during the melting season. Apart from the physical variables describing the ocean and the sea ice, it includes nitrate+nitrite, ammonia, silicic acid, phosphate, oxygen, total inorganic carbon, alkalinity, flagellates, diatoms, zooplankton and detritus.

Comparing model and observation

Model results are being evaluated against observations from the stations Kb2 and Kb3 with focus first on physical variables, such as salinity and temperature.

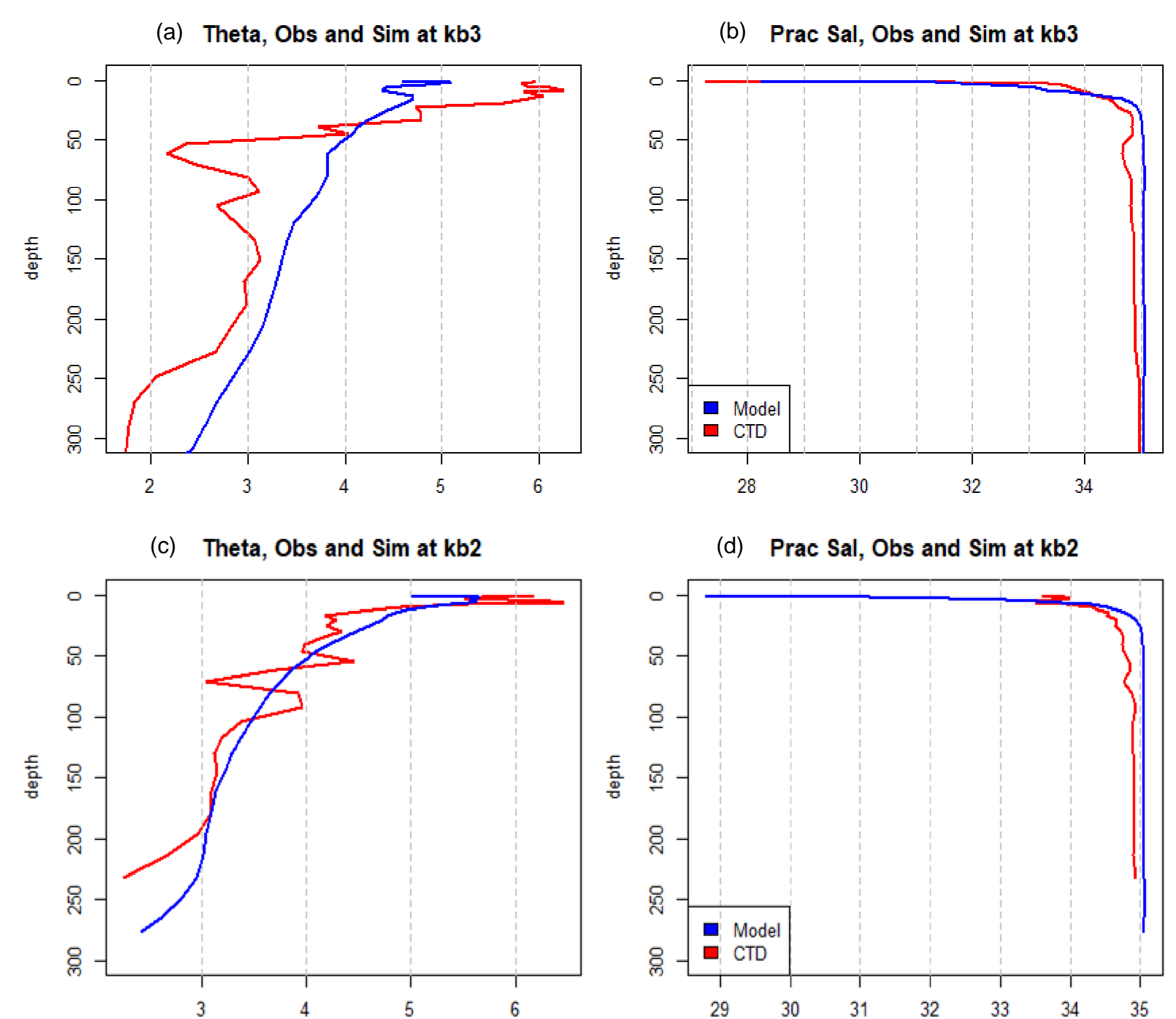


Fig. 2 Example of comparisons between observations and model results for two stations depicted in Figure 1: Kb3 (a, b) and Kb2 (c, d), in the lower and in the upper panels, respectively. The left and the right panels show observed (red) and modeled (blue) potential temperature (a, c) and Practical Salinity (b, d), as a function of depth.

The evaluation of biogeochemical variables is now being carried out.

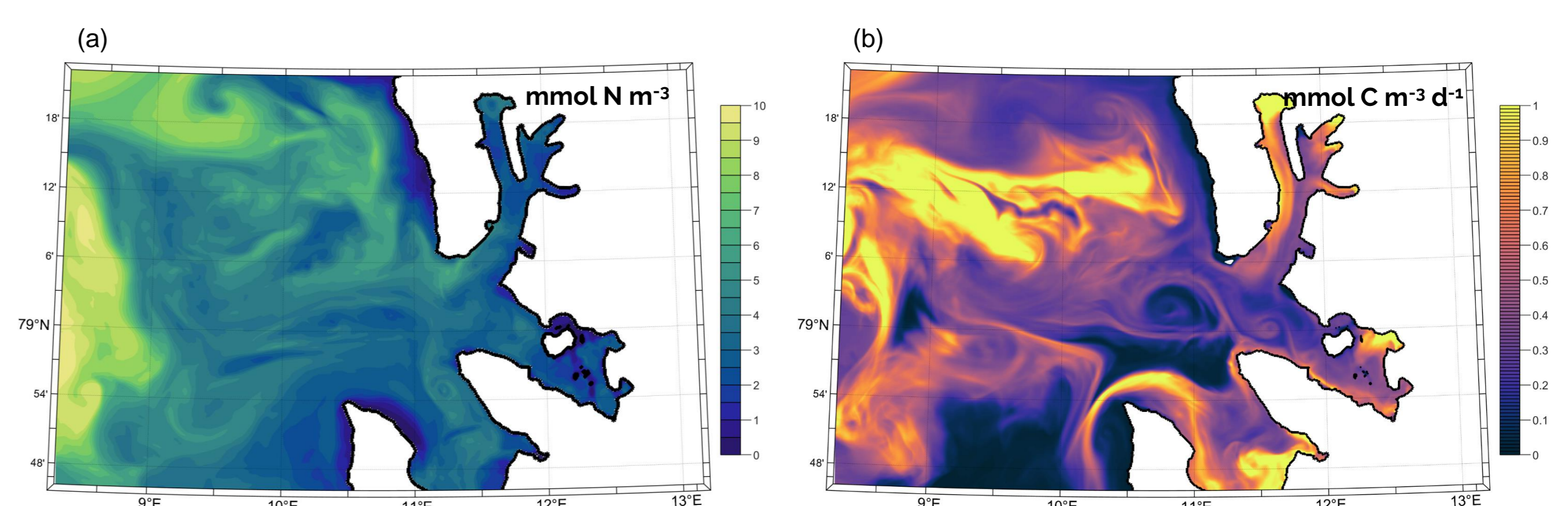


Fig. 3 Snapshots of surface nitrate concentrations (a) and net primary production (b).

A coupled physical-biogeochemical model was implemented for Kongsfjorden (Svalbard). Obtained results show a good agreement with observations of water temperature and salinity. The performance of the biogeochemical components is being evaluated but first results are encouraging. This model will be used as a template to model Young Sound in Greenland. It will also be used to downscale IPCC projections for the middle of the 21st century.