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Greenland Ice Sheet nutrient export: Towards a reaction-transport model of fjord dynamics

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Glacial runoff has the potential to deliver large quantities of dissolved and particulate bioavailable nutrients to surrounding marine environments. The marine waters bordering the Greenland Ice Sheet (GrIS) host some of the most productive ecosystems in the world, and possess high socio-economic value from fisheries. Furthermore, the productivity of phytoplankton in the North Atlantic sequesters CO_2 from the atmosphere with a potentially important effect on the global coastal ocean CO_2 budget. Providing a link between glacier and coastal ocean, fjords are critical components of the marine coastal system in this region, acting as both transfer routes and sinks for glacial nutrient export. As such they have the potential to act as significant biogeochemical processors, yet are currently underexplored.

We propose to close this knowledge gap by developing a coupled 2D physical-biogeochemical model of the Godthåbsfjord system to quantitatively assess the impact of nutrients exported from the GrIS on fjord primary productivity and biogeochemical dynamics. Here, we present the first results of the hydrodynamic model. Hydrodynamic circulation patterns and freshwater transit times are explored to provide a first understanding of the glacier-fjord-ocean continuum. The hydrodynamic model will be dynamically coupled to a biogeochemical model with the view to providing a comprehensive understanding of the fate of nutrients exported from the GrIS. This will be extended to address the future sensitivity of these coastal systems to a warming climate, knowledge of which is critical when assessing the role of these dynamic and unique environments.