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Influence of accelerated Greenlandic meltwater and nutrient release on marine primary production

Christian Rodehacke (1,2) and Matthias Gröger (3)

(1) Alfred-Wegener-Institut für Polar- und Meeresforschung, Climate Sciences/Paleoclimate Dynamics, Bremerhaven, Germany, (2) Danish Meteorological Institute, Arctic and Climate, Copenhagen, Denmark, (3) Swedish Meteorological and Hydrological Institute, Rossby Centre, Norrköping, Sweden

The northern Atlantic Ocean is more stratified under climate warming, which hampers water mass exchange between near surface and deeper water layers. This weakens the replenishing of nutrients in the photic zone by nutrient-rich deep water masses. In contrast several studies address the tremendous release of organic material and nutrients from outlet glaciers of Greenland. Could an enhanced melting Greenland ice sheet under climate warming compensate the restrained nutrient supply from deep water masses? To address this question, we have performed simulations under pre-industrial conditions, which serve as a base line experiment, and simulations under the strong warming scenario RCP8.5.

Marine primary production (PP) impacts on global climate by fixing carbon dioxide and by the production of aerosols affecting cloud formation. Climate projections indicate that under a warmer climate PP is expected to decrease by up to 20% at the end of the 21 century thereby accelerating climate change. Estimations of future marine PP have so far neglected the additional nutrient release by accelerated Greenlandic ice sheet melting although enormous amounts of nutrients are trapped there. We here compiled currently available information on nutrients trapped in Greenlandic ice and analyze the combined effect of meltwater and nutrient release on marine primary production using a state of the art earth system model from the CMIP5. We show that already at the end of the current century, the applied meltwater and nutrient release corresponding to a 6.5% loss of the Greenlandic ice almost completely mitigates negative effects of climate change on marine primary production and aerosols. However, the associated increase in living biomass is enhanced by $\sim$10% compared to the historical period. This may reinforce eutrophication in marginal Seas surrounding the North Atlantic north of 40°N.