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Sea-ice cover in the Nordic Seas and the sensitivity to Atlantic water temperatures

Mari F. Jensen (1), Kerim H. Nisancioglu (1), and Michael A. Spall (2)

(1) University of Bergen and Bjerknes Centre for Climate Research, Department of Earth Science, Bergen, Norway (mari.f.jensen@uib.no), (2) Woods Hole Oceanographic Institution, Woods Hole, USA

Changes in the sea-ice cover of the Nordic Seas have been proposed to play a key role for the dramatic temperature excursions associated with the Dansgaard-Oeschger events during the last glacial. However, with its proximity to the warm Atlantic water, how a sea-ice cover can persist in the Nordic Seas is not well understood. In this study, we apply an eddy-resolving configuration of the Massachusetts Institute of Technology general circulation model with an idealized topography to study the presence of sea ice in a Nordic Seas-like domain. We assume an infinite amount of warm Atlantic water present in the south by restoring the southern area to constant temperatures.
The sea-surface temperatures are restored toward cold, atmospheric temperatures, and as a result, sea ice is present in the interior of the domain. However, the sea-ice cover in the margins of the Nordic Seas, an area with a warm, cyclonic boundary current, is sensitive to the amount of heat entering the domain, i.e. the restoring temperature in the south. When the temperature of the warm, cyclonic boundary current is high, the margins are free of sea ice and heat is released to the atmosphere. We show that with a small reduction in the temperature of the incoming Atlantic water, the Nordic Seas-like domain is fully covered in sea ice. Warm water is still entering the Nordic Seas, however, this happens at depths below a cold, fresh surface layer produced by melted sea ice. Consequently, the heat release to the atmosphere is reduced along with the eddy heat fluxes. Results suggest a threshold value in the amount of heat entering the Nordic Seas before the sea-ice cover disappears in the margins. We study the sensitivity of this threshold to changes in atmospheric temperatures and vertical diffusivity.