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Unforced oscillations in sea ice

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Changes in sea ice are proposed as an important component in Dansgaard-Oeschger events; the abrupt climate change events that occurred repeatedly during the last ice age. Here, we study the existence of sea ice in the Nordic Seas using an eddy-resolving configuration of the Massachusetts Institute of Technology general circulation model with idealized topography. We show that a full sea-ice cover and Arctic-like stratification can exist in the Nordic Seas given sufficiently cold Atlantic water and corresponding low transport of heat across the Greenland-Scotland Ridge and in the absence of external freshwater input. There is a non-linear response in sea ice to Atlantic water temperature with large abrupt changes in sea ice given small changes in inflowing temperature. Adding external freshwater input expands the temperature range where a full sea-ice cover is possible and produces unforced oscillations in sea ice. The sea-ice cover disappears completely without a change in freshwater input or temperature. The sea-ice oscillations are accompanied by changes in heat transport, both due to overturning and horizontal circulation, salinity changes and heat build-up at depths. The multidecadal timescale of the oscillations does not agree with the millennial timescale of the Dansgaard-Oeschger events, and we analyse the influence of background climate on the oscillations. Increased freshwater forcing tends to prolong the duration of the oscillations, while increased oceanic vertical mixing decreases the timescale.