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Sea ice induced changes in ocean circulation during the Eemian

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Changes in the seasonality of the insolation forcing are generally believed to initiate snow accumulation during the early stages of a glacial. The growth of continental scale ice sheets and the translation into a full glacial, however, requires amplification by the internal dynamics of the climate system. The role of the Atlantic Ocean circulation has been controversial in this regard, partly because of its sensitivity to freshwater changes as supposed by the build-up of major ice masses in the same drainage basin, but also because of its connection to the Arctic Ocean. Because the largest part of the Arctic sea ice is younger than 5 years, it responds fast to changes in boundary conditions. In this study, we argue that due to this fast response time and its location at latitudes that experience the largest amplitudes in insolation forcing, Arctic sea ice played an important role during early stages of the last glacial inception.

Two simulations will be analyzed, one for the time of maximum high latitude summer insolation during the last interglacial, the Eemian, and a second for the subsequent summer insolation minimum, when boundary conditions were favourable for a persistent snow cover on the northern continents, the last glacial inception. During the glacial inception, increased Arctic freshwater export by sea ice shuts down Labrador Sea convection and thus weakens the overturning circulation and oceanic heat transport. A positive feedback of the Atlantic subpolar gyre doubles the initial freshening by sea ice. These results highlight the importance of a proper respresentation of sea ice dynamics and advection for the study of climate changes.