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Dynamical sequence of ocean, atmosphere, and sea ice changes during an abrupt stadial-to-interstadial climate transition

Chuncheng Guo (1) and Kerim Nisancioglu (2)

(1) Uni Research Climate, and Bjerknes Centre for Climate Research, Bergen, Norway, (2) Department of Earth Science, University of Bergen, and Bjerknes Centre for Climate Research, Bergen, Norway

Marine Isotope Stage 3 (MIS3; $\sim$ 60 ka to 30 ka BP) was punctuated by abrupt climate transitions between colder stadial and warmer interstadial climate conditions. The fluctuations are known as Dansgaard–Oeschger (D-O) events which are featured by a rapid warming from stadial to interstadial in a few decades as recorded by the Greenland ice cores.

In this work, using a state-of-the-art climate model, the Norwegian Earth System Model (NorESM) configured for paleoclimate simulations (two-degree atmosphere and one-degree ocean), we investigate the transient response of the climate system from a stadial to interstadial climate state. The stadial state is realised by applying freshwater flux to a MIS3 control simulation. With support from a high-resolution marine sediment core in the Nordic Seas (MD99-2284), we addressed the key role played by sea ice in modulating the Greenland temperature change during the transition, and identify a sequence of changes in the ocean and its interactions with sea ice and the atmosphere. We found that in agreement with proxy reconstructions, changes in the ocean (e.g. AMOC and heat/salt transport) precede deep convection and melting of sea ice in the Nordic Seas, with the latter process occurring simultaneously with rapid changes in Greenland temperature.