Geophysical Research Abstracts
Vol. 21, EGU2019-7068, 2019
EGU General Assembly 2019

The interaction of the North Atlantic subpolar gyre and the AMOC during DO-like climate variability

Marlene Klockmann (1,2), Uwe Mikolajewicz (2), Hannah Kleppin (3), and Jochem Marotzke (2)

(1) Helmholtz-Zentrum Geesthacht, Institute for Coastal Research, Geesthacht, Germany (marlene.klockmann@hzg.de), (2) Max-Planck-Institut für Meteorologie, Hamburg, Germany, (3) MARUM, Bremen, Germany

We analyse the interaction between the North Atlantic subpolar gyre (SPG) and the Atlantic Meridional Overturning Circulation (AMOC) during DO-like AMOC oscillations. The oscillations occur in a simulation with the coupled climate model MPI-ESM under constant forcing with a CO_2 concentration of 206 ppm and prescribed modern continental ice sheets. The AMOC oscillates between a strong and a weak state on timescales between 700 and 1500 years, which is comparable to the timescales of DO-events.

The strong AMOC state is characterised by high temperatures over Greenland, a warm and salty North Atlantic, a weak SPG, and partially ice free Nordic Seas with active deep convection. The weak AMOC state is characterised by low Greenland temperatures, a cold and fresh North Atlantic, a strong SPG, extensive sea-ice cover and sporadic deep convection south of Iceland. The transition between the two states is driven by a redistribution of salt between the tropical and the subpolar North Atlantic which is controlled by the strength and extent of the SPG. The SPG oscillates between a strong and extensive state and a weak and contracted state. The AMOC and SPG are anti-correlated and coupled via a feedback loop between the northward salt transport, the location of deepwater formation and the resulting density structure in the subpolar North Atlantic. Changes in the wind-driven component of the SPG seem to play a key role in triggering the transition from the weak to the strong AMOC state.

Even though the simulated AMOC/SPG oscillations occur with modern ice sheets, the presented mechanism supports the hypothesis that DO-events could have been the result of unforced changes in the North Atlantic circulation system.