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Tropical air-sea coupling accelerates the recovery of the Atlantic Meridional Overturning Circulation after glacial meltwater event

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During "Heinrich events" brief and exceptionally large discharges of icebergs from the Laurentide and European ice sheets coincide with cold periods followed abrupt warmings. Climate reconstructions suggest that the freshwater pulses caused a temporary collapse of the Atlantic Meridional Overturning Circulation (AMOC) by stabilizing the stratification in the regions of North Atlantic Deep Water (NADW) formation.
Using a coupled ocean sea-ice atmosphere model of intermediate complexity we trigger a complete shut-down of the AMOC by injection of a freshwater pulse to the northern North Atlantic. (Analyzing)The analysis of fully and partially coupled freshwater perturbation experiments under glacial conditions reveals that the reduction of northward heat transport in the North Atlantic leads to a cooling north of the thermal equator. Due to advection of cold air and an intensification of the tradewinds the Intertropical Convergence Zone (ITCZ) is shifted southward. Changes of the accumulated precipitation lead to generation of a positive salinity anomaly in the northern tropical Atlantic and a negative anomaly in the southern tropical Atlantic. During the shut-down phase of the AMOC, the cross-equatorial oceanic surface flow is halted, preventing a dilution of the positive salinity anomaly in the North Atlantic. Advected northward by the wind driven ocean circulation the positive salinity anomaly increases the upper ocean density in the deep water formation regions, thereby accelerating the recovery of the AMOC considerably.

Partially coupled experiments which neglect tropical air-sea coupling reveal that the recovery time of the AMOC is almost twice as long as in the fully coupled case.