Influence of the freshwater forcing pathway on the AMOC during 8.2k event in a high resolution coupled model

Aixue Hu[1], Bette Otto-Bliesner[1], Justin Small[1], Cecilia Bitz[2], and Nan Rosenbloom[1]

[1]Climate and Global Dynamics Lab, National Center for Atmospheric Research, Boulder, CO 80305, USA
[2]Atmospheric Sciences Department, University of Washington, Seattle WA 98195 USA

The collapse of the proglacial lakes of Agassiz and Ojibway and the discharge of the lake water into the Hudson Bay were identified as the cause of the cold event occurred around 8.2 thousand years before present day (8.2ky BP). This event has been widely studied using coupled climate models by adding freshwater forcing into the subpolar North Atlantic. However, the pathways of the discharged freshwater from the coarse resolution coupled models differ from that of a high resolution forced standalone ocean model simulation. Here we use a state-of-art fully coupled high-resolution climate model (CESM1) with 0.1^{o} horizontal resolution for the ocean and sea ice, and 0.25^{o} for the atmosphere and land components to study the influence of the freshwater forcing to the Atlantic Meridional Overturning Circulation (AMOC) during 8.2k event. In this simulation, 2 Sv freshwater is added into the North Atlantic along a narrow band of west Baffin Bay to North of Labrador Sea for two years, then the freshwater forcing is switched off. Results show that AMOC weakens by over 30% within the first 10 years, and gradually recovers afterwards. The added freshwater were partly transported into the subpolar North Atlantic, partly into the subtropical gyre and a portion travelling along the US coast southward. The freshwater entering the subtropical gyre was carried by Gulf Stream back into the subpolar North Atlantic about 20 years later which keeps the AMOC from fully recover. Thus, our results partially agree with previous coarse resolution model simulation and partly agree with the previous high-res simulation. The southward penetration of the freshwater along the US coast is associated to the wind stress anomalies corresponding to the cooling in the Labrador Sea caused by the freshwater forcing there.