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North Atlantic eddy-driven jet in paleoclimate simulations

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Much of the observed extra-tropical weather and climate variability is associated with variations in the westerly eddy-driven jet stream. Moreover, the predictability of extra-tropical weather systems is connected with the persistence and transitions between different states of the eddy-driven jet position. In recent efforts, the behavior of the North Atlantic (NA) eddy-driven jet for present-day climate has been intensively studied whereby interesting features as multimodality in terms of jet stream latitude has been found.

In this study, we test the response of the NA eddy-driven jet to different glacial and interglacial boundary conditions. The analysis is based on atmosphere/land-only simulations with the CCSM4 climate model and includes simulations for the early Holocene (EH, 8 ka), the last glacial maximum (LGM, 21 ka), the Middle Weichselian (MW, 65 ka) glacial and the Eemian (EEM, 125 ka) interglacial. Moreover, for EH, MW and EEM we have conducted several time-slices differing in the implemented ice-sheet topography.

Preliminary results show that the CCSM4 model reasonably simulates the seasonal cycle in terms of latitude and velocity of the NA eddy-driven jet. However, during winter the model has some problems to realistically simulate the trimodality of the jet position whereas in summer the model matches the observations much better. In the glacial simulations (e.g., LGM), the jet position shifts during winter to more southerly positions. Moreover, this southward shift seems to scale with the elevation of the Laurentide ice sheet. In contrast, the extensive ice sheets and the glacial boundary conditions just lead to a moderate shift of the summer jet latitudinal position. During interglacial climate conditions (i.e. early Holocene and Eemian) the behavior of the NA eddy-driven jet is similar as today and moderate changes of Greenland's topography do not have a substantial impact on the jet behavior. In a next step, we will study in more details the eddy-forcing in order to identify the key mechanisms leading to a latitudinal shift of the eddy-driven jet. In doing so, we hope to find out why the seasonality of the eddy-driven jet largely differs during glacial compared to interglacial conditions.