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North Atlantic eddy-driven jet in interglacial and glacial winter climates

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The atmospheric westerly flow in the North Atlantic (NA) sector is dominated by atmospheric waves or eddies generating via momentum flux convergence the so-called eddy-driven jet. The position of this jet is variable and shows for the present-day winter climate three preferred latitudinal states: a northern, central, and southern position in the NA. Here, we analyze the behavior of the eddy-driven jet under different glacial and interglacial boundary conditions using atmosphere-land-only simulations with the CCSM4 climate model. As state-of-the-art climate models tend to underestimate the trimodality of the jet latitude we apply a bias correction and successfully extract the trimodal behavior of the jet within CCSM4. The analysis shows that during interglacial times (i.e. the early Holocene and the Eemian) the preferred jet positions are rather stable and the observed multimodality is the typical interglacial character of the jet. During glacial times, the jet is strongly enhanced, its position is shifted southwards, and the trimodal behavior vanishes. This is mainly due to the presence of the Laurentide Ice Sheet (LIS). The LIS enhances stationary waves downstream thereby accelerating and displacing the NA eddy-driven jet by anomalous stationary momentum flux. Additionally, changes in the transient eddy activity caused by topography changes as well as other glacial boundary conditions lead to an acceleration of the westerly winds over the southern NA at the expense of more northern areas. Consequently, both stationary and transient eddies foster the southward shift of the NA eddy-driven jet during glacial winter times.