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Atmospheric dynamical changes as a contributor to deglacial climate variability: results from an ensemble of transient deglacial simulations

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The atmosphere is often assumed to play a passive role in centennial- to millennial-timescale climate variations of the last deglaciation due to its short response times (∼years) and the absence of abrupt changes in external climate forcings. Nevertheless, atmospheric dynamical responses to changes in ice sheet topography and albedo can affect the entire Northern Hemisphere through the altering of Rossby stationary wave patterns and changes to the North Atlantic eddy-driven jet. These responses appear sensitive to the particular configuration of Northern Hemisphere land ice, so small changes have the potential to reorganize atmospheric circulation with impacts on precipitation distributions, ocean surface currents and sea ice extent.

Indirect proxy evidence, idealized theoretical studies, and "snapshot" simulations performed at different periods during the last glacial cycle indicate that between the Last Glacial Maximum and the preindustrial period the North Atlantic eddy-driven jet weakened, became less zonally-oriented, and exhibited greater variability. How the transition (or transitions) between the glacial atmospheric state and the interglacial state occurred is less clear. To address this question, we performed an ensemble of transient simulations of the last deglaciation using the Planet Simulator coupled atmosphere-ocean-vegetation-sea ice model (PlaSim, at an atmospheric resolution of T42) forced by variants of the GLAC1-D deglacial ice sheet chronology. We characterize simulated changes in stationary wave patterns over this period as well as changes in the strength and position of the North Atlantic eddy-driven jet. In particular, we document the range of timescales for these changes and compare the simulated climate signatures of these transitions to data archives of precipitation and sea ice extent.