Atmospheric dynamic adjustments as potential triggers for abrupt climate changes during the last deglaciation: Results from an ensemble of transient climate simulations

Heather Andres

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ABSTRACT: Twelve thousand years after the peak of the last ice age (~ 21 ka ago), the climate reached conditions very similar to those at the start of the industrial period. This transition included[1], among others:

- the loss of ice cover over Northern Europe and much of the cover over North America,
- increases in global-averaged sea level by approximately 100m,
- increases in global surface temperatures of approximately 4°C,
- increases in atmospheric concentrations of CO_2 of approximately 70ppm.

This transition was not smooth, but included episodes of abrupt warming (by as much as 14°C across the Northern Hemisphere over a span of decades[1]) and abrupt cooling. The abruptness of these episodes suggests the presence of non-linear feedback processes within the climate system.

The atmosphere is often assumed to play a passive role in the abrupt climate changes of the last deglaciation due to its short response times (~years) and the more gradual nature of climate drivers. However, atmospheric dynamical responses to changes in ice sheet topography and albedo can affect the entire Northern Hemisphere through the altering of stationary wave patterns in atmospheric pressures and changes to the predominant winds. These responses appear sensitive to the particular configuration of Northern Hemisphere land ice, so small changes have the potential to generate reorganizations of the atmospheric circulation with impacts on precipitation distributions, ocean surface currents and sea ice extent.

To assess how the transition (or transitions) between the glacial state and the interglacial state occurred, we performed an ensemble of transient simulations of the last deglaciation using a simplified atmosphere-ocean general circulation model and a new reconstruction of ice sheet configuration. These simulations do not exhibit abrupt climate changes at the times determined historically, which is not surprising given the inability of most models to capture abrupt transitions such as these. However, the simulations do exhibit abrupt shifts in wind positions and variability, which are more robust, large-scale climate features. I will characterize these atmospheric changes and the climate context that triggers them. In particular, I will document the range of timescales for these changes and assess their potential as triggers of past abrupt climate transitions.

1. Ivanovic et al. (2016) *Geoscientific Model Development* 9:2563-258

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