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Two-stage climate response to Heinrich events

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Heinrich events are among the most prominent events of climate variability recorded in proxies. Nevertheless, their governing processes and climatic impacts are far from being fully understood. We address open questions by studying Heinrich events in transient glacial simulations with a coupled ice sheet - general circulation model framework, where Heinrich events occur as part of the model generated internal variability.
The framework consists of a Northern Hemisphere setup of the modified Parallel Ice Sheet Model (mPISM) bidirectionally coupled to the global atmosphere-ocean-vegetation model ECHAM5/MPIOM/LPJ. The simulations were performed with transient orbital and greenhouse gas forcing.
The modeled Heinrich events show a peak ice discharge of about 0.05 Sv and raise sea level by 2.3 m on average. A two-stage response in the climate system is evident. First, the freshwater release decreases the deepwater formation in the North Atlantic, resulting in a slowdown of the Atlantic Meridional Overturning Circulation and a Northern Hemispheric cooling. In the second phase, the lowered surface elevation after the surge results in a widening and zonalization of the jet stream. The experiments show that both response pathways need to be considered to understand the climatic impacts of Heinrich events.