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High vs low latitude sequence of events over the last deglaciation using ice core isotopic proxies and an isotope-enabled climate model

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The last deglaciation is recorded with annual resolution in the ice d18O records from Greenland ice cores. In addition to long term change associated with orbital variations, the last deglaciation is associated with abrupt changes in the northern hemisphere with the sequence of Heinrich 1, Bølling-Allerød and Younger Dryas. The combination of orbital and millennial scale variability during deglaciations has also been recorded in many other continental and marine records. Still, the underlying mechanism linking orbital and millennial changes over deglaciation is not fully understood. Limitations come from the exact description of the sequence of events between external forcing, high and low latitudes climate and environmental changes.
In order to progress on this issue, our study combines low and high latitudes climate proxies measured in ice cores as well as transient modeling simulations of the last deglaciation run with an intermediate complexity model equipped with water isotopes (iLOVECLIM).
New high resolution measurements of 17O-excess and d-excess from the NorthGRIP ice core covering the last deglaciation are used to decipher the local from the distant effect on the water isotopic records measured in Greenland ice cores. These second order parameters are indeed sensitive to climatic conditions at the oceanic evaporative regions and to the trajectories of the water mass toward the polar precipitation sites. These new measurements clearly highlight a decoupling between Greenland and lower latitudes over the time period corresponding to Heinrich event 1. This time period is recorded as a two phase sequence in the 17O-excess and d-excess records. This two phase sequence is confirmed by atmospheric d18O (d18Oatm) data from ice cores covering the same time period. d18O atm is a global atmospheric signal measured on the air trapped in ice cores interpreted as a proxy for low latitude water cycle that can be compared to calcite d18O records from East Asian caves. Similarities are also observed in other marine and continental records despite dating limitations when compared to ice core records. Finally, we use the iLOVECLIM model to test possible scenarios leading to this two phase sequence of Heinrich 1 in mid-low latitudes with a muted signature in Greenland ice d18O record.