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The anatomy of past abrupt warmings recorded in Greenland ice

Content

Several model-based mechanisms have been suggested to explain the abrupt climate variability evidenced in Northern Hemisphere paleoclimate reconstructions during the Last Glacial. However, because of the limited temporal resolution achievable in most climatic archives and relative dating uncertainties between paleoclimate records, it remains challenging to test the proposed processes with data allowing a subcentennial-scale investigation of the anatomy – the duration and temporal phasing – of the changes in different parts of the world.

Here, we overcome these limitations by using new and existing high/resolution records from the Greenland NGRIP and NEEM ice cores across the Last Glacial to map the pluriannual-scale evolution of tracers (δ18O, d-excess, Ca2+, Na+, annual layer thickness) which contain signatures of climatic changes in different regions of the Northern Hemisphere.

We highlight the absence of a systematic pattern in the anatomy of abrupt changes as recorded in different ice parameters. This diversity in the sequence of changes seen in ice-core data is also observed in climate parameters derived from numerical simulations which exhibit self-sustained abrupt variability arising from internal atmosphere-ice-ocean interactions. Our analysis of two ice cores shows that the diversity of abrupt warming transitions represents variability inherent to the climate system and not archive-specific noise. Our results hint that during these abrupt events, it may not be possible to infer statistically-robust leads and lags between the different components of the climate system because of their tight coupling.

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