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Climatic variability based on Greenland isotopes during the last glacial cycle and the role of the polar front

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The climatic information from ice cores is normally based on the mean isotopic signal. High resolution isotope data can reveal the short term variability of the annual isotope and climatic signal when a solid chronology is available for the ice core. Deeper in the core where the ice temperature is increasing, diffusion in the ice can weaken the short term signal. An advanced ice flow model, which follows a layer with time since deposition, takes into account the initial firn diffusion as well as past strain rate and temperature history of the particular layer. The model also calculates the diffusion lengths for oxygen 18 and deuterium which make it possible to correct for the diffusion smoothing by deconvolution. The annual isotope RMS variability for oxygen 18 is found as follows for the GRIP and North-GRIP ice cores: Holocene 0.7 ‰ interstadials 1.5 ‰ and stadials 3.0 ‰Ṫhe very high variability in the stadials is most likely due to vigorous climatic instability together with some depositional noise caused by the much reduced accumulation rates. Deconvoluted North-GRIP annual isotope data in the LGM anti-correlate clearly with the high resolution dust and chemistry signals indicating the global nature of the rapid isotopic variability. This points to a hemispheric nature of the high climatic variability suggested by the isotope records. We propose a link to a highly unstable atmospheric polar front during the stadials, which seems to be much more stable during the interstadial and interglacial periods. We also suggest that the high dust levels are caused by the strong westerly zonal winds which helps keep the warm Gulf Stream further south as well as the oceanic and atmospheric polar fronts. The positions of the polar fronts are directly linked to the Greenland temperatures, the isotopic signal and the latitudinal temperature gradients, which are driving the strength of the zonal winds.