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Paleotemperatures derived from the EPICA Dome-C core based on isotopic diffusion in the firn pack.

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Water isotope ratios as measured from ice core samples have been used as a proxy for past temperatures. Based i.a. on a Rayleigh fractionation process they record the cloud temperature during snow formation. However, changes in the temperature and humidity of the vapor source can also affect the isotopic signal of the polar precipitation, thus inducing isotopic artifacts. Furthermore, for the case of the Antarctic ice cap, temperature inversions frequently occur during snow formation. As a result, the cloud temperature as recorded by the water isotopes can differ significantly from the temperature at the surface.

After the deposition of snow and until pore close off, a diffusive process occurs in the pore space of the firn pack, mixing water vapor from different layers and smoothing the isotopic profiles. The smoothing depends only on the resulting diffusion length. This process is temperature dependent and it presents a slightly different rate between the two isotopic species of water, $H_2{}^{18}O$ and $HD^{16}O$. This is because the fractionation factors as defined for these two isotopic species have a different dependence on temperature.

In this study we present a temperature reconstruction based on the different diffusion rates of $H_2{}^{18}O$ and $HD^{16}O$ water molecules in firn. The advantage of such an approach is that the temperatures estimated represent the actual conditions in the firn stack. As a result, we can surpass the artifacts that can possibly disrupt the use of the classical technique. We will present temperature estimations as extracted from two high resolution (2.5 cm) data sets, from the EPICA Dome C deep core focused on the Holoene Climatic Optimum and the Last Glacial Maximum and compare them with results obtained with the classical slope method as well as constrains imposed by the measured temperature profile. We will also address the problems of spectral power estimation for determining the diffusion lengths.