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Two-dimensional insights into the signal formation in low-accumulation firn-cores

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Ice-cores have been proven to be a key climate archive to reconstruct glacial interglacial changes in temperature, greenhouse gases and many other climate parameters. By contrast, the reliability of ice-cores as a recorder of the Holocene climate evolution is less clear. The small amplitude of Holocene climate changes, and the aim to reconstruct high-temporal resolution records, poses a challenge to the interpretation of ice-core signals. This is especially true for low accumulation sites as here the non-climate noise may often be too high to accurately extract a climatic signal.

To develop a mechanistic understanding of the signal and noise in low-accumulation firn and ice cores, we undertook a study of the signal formation in firn and ice-cores at Kohnen station on Dronning Maud Land, Antarctica. This included extensive surface sampling, replicate coring of firn cores, and the analysis of water isotopes and the snow stratigraphy in snow pits and snow trenches. Thereby, we provide the basis for a systematic interpretation of the climate signal stored in ice at this site.

In this contribution, we present first results from two 1m deep, 45m long snow trenches which were probed in two dimensions to provide a two-dimensional image of the dielectric properties and oxygen isotopes. The statistical analysis of the results provides insight about the horizontal and vertical scales of stratigraphic noise, the relation between the dielectric stratigraphy and the oxygen isotopes, and the ability of firn-cores to reconstruct high-resolution records of past climate changes.