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The genesis of a climate archive: snow pack studies at four polar sites

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Understanding the deposition history and signal formation in ice cores from polar ice sheets is fundamental for the interpretation of paleoclimate reconstruction based on climate proxies. Polar surface snow responds to environmental changes on a seasonal time scale by snow metamorphism, displayed in the snow microstructure and archived in the snowpack. However, the seasonality of snow metamorphism and its link to the deposited signal in isotopes and impurity load is poorly known.

Here, we apply core-scale microfocus X-ray computer tomography to continuously measure snow microstructure of four snow cores from Greenlandic (Renland ice cap-drill site (2m), EASTGRIP drill site (5m)) and Antarctic sites (EDML-drill site (3m), COFI7/Plateau station (4m)) covering a wide range of annual temperatures from -18°C down to -56°C. In our multi-parameter approach we compare the derived microstructural properties on the mm- to cm-scale to discretely measured trace components and stable water isotopes, commonly used as climate proxies. We will show how ice and pore intercepts, the geometrical anisotropy, specific surface area, crusts anomalies and small-scale density distributions are represented under different climate conditions. Their profiles will be discussed in the context of snow metamorphism and deposition history using trace components and isotopes as additional constraints on timing.