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Insights from 3D Firn Microstructure into Near-Surface Snow Melt Conditions

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Coastal low-elevation ice caps of the (Ant-)Arctic and mountain glaciers are at the forefront of climate change. Retrieving ice core records from these regions is crucial to assess current, and predict future, environmental changes. However, climate reconstruction from melt-affected ice cores is challenging. It requires a comprehensive understanding of the site-specific, near-surface melt conditions, which are fundamental to consequent melt-induced alteration of climate proxies.

Here, we use core-scale microfocus X-ray computer tomography to investigate melt layer microstructure in firn core sections from three (sub-)Antarctic sites (Young Island, Smyley Island, and Sherman Island) at 120-µm resolution. We present density, pore and grain cluster size of 3D melt features and discuss how the secondary imprint of the melt-refreeze process is visible in firn microstructure. We further show that the appearance of melt features varies both within profiles and from site to site. Given that local climate drives the near-surface snow properties and melt conditions, we suggest that melt layer microstructure could be further developed as a useful climate proxy itself.