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The quantification of layering in polar firn: first results from core-scale microfocus X-ray-computer tomography

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Polar firn is a layered porous medium. The layering affects most of the bulk properties of the firn column including air and heat transport, air enclosure as well as optical properties and mechanical hardness. First attempts to parameterize all these properties by mean densities (a simple measured property) have shown large deviations of model data in relation to measured profiles. In order to investigate the limits of the correlation between density and other bulk properties we performed high resolution measurements on a firn core from Dronning Maud Land (Antarctic plateau) with the means of a microfocus X-ray-computer tomograph especially designed for whole segments of firn cores. We quantify the layering in terms of Minkowski functionals (density, specific surface area, Euler number and curvature) and in terms of shape and size of pores and ice grains. To illuminate the impact of layering we compare diffusion-depth and permeability-depth profiles derived with the assumption that firn has a homogeneous structure with profiles from stratified firn.