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Characterizing ice domes in Dronning Maud Land (Antarctica) using geophysical methods and ice-flow models

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Many ice rises are situated in a drawn-out ice-shelf belt boardering the Dronning Maud Land coast. The defined catchment area and high accumulation rates appear suited for new ice-core climate records focusing on the last 2000 and 40000 years. The internal stratigraphy of ice rises is imprinted by the flow history of their surrounding, which, if combined with ice-flow models, enables the deduction of past flow patterns and changes thereof. The focus of this study is set on Halvfarryggen ice dome, which is characterized by using remote sensing techniques in combination with on-site radar and GPS measurements. Airborne and ground-based radar surveys image bedrock topography and internal layering in the vicinity of the dome, which is located near a triple junction where three ice divides merge. The surface topography is determined by a combination of different remote-sensing techniques resulting in an elevation model with a grid spacing of 100 m x 100 m and a standard deviation along ground control points of 11 m. The internal layering as seen via radar bends upwards beneath the divides, indicating the operation of the Raymond effect. The upward-bending increases in amplitude with larger depths down to the lower third of the ice column, where the isochrone arch develops into a double bump in some radargrams. We visualize the three dimensional characteristics in internal layering in a 15–20 km radius around the dome. Accumulation estimates from internal layers near the surface vary from 400–1670 kg/(m^2a) with an asymmetry caused by preferred wind directions and changing surface slope. We use the derived datasets as input for a two dimensional full Stokes, anisotropic ice-flow model to predict the age–depth relationship and compare the modelled isochrones with the radar layer architecture. In the vicinity of the dome we estimate 13 ka old ice at 90% of the total ice thickness.