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Imprints of air bubbles & crystal orientation fabric on RES signature

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Radio echo sounding (RES) enables mapping of bedrock topography and internal structure in large ice bodies. Via multi-frequency and multi-polarization sounding, internal reflections can be assigned to non-uniformities in density, conductivity and crystal orientation fabric (COF). The isochronous character of density and conductivity variations allows to deduce a multitude of glaciological parameters (e.g. accumulation, linking of ice cores). The formation of COF interrelates with ice flow and gives insight into ice dynamical behavior.
Polarization dependent backscatter has been observed in numerous cases in Greenland and Antarctica. It is often attributed to changing COF superimposed with birefringence. Radar profiles close to the EPICA ice core drill site in Dronning Maud Land (EDML), Antarctica, are a show-case for varying anisotropy along the ice column. In the upper 900 m, the backscattered power is maximal for polarization perpendicular to the ice divide, whereas below 900 m the maximum is parallel to the ice divide. For the observed anisotropy in deep ice, COF seems to be the dominant factor, as short scale variations (circ. 20 m) have been measured in the micro-structure of the nearby ice core. However, high resolution (circ. 1 m) COF data along depth are missing so far. In the upper ice column the COF distribution is initially isotropic and slowly evolves into an anisotropic girdle towards greater depth.
The depth of rotation in anisotropy coincides with the clathrate transition at EDML. We therefore conclude that the anisotropy in the upper ice column might also be related to an anisotropic distribution of air bubbles caused by ice flow. We examine the effect of statistical variations in COF as well as anisotropic air bubble distribution on the radar response. This is linked to in-situ measurements of COF and air bubble distribution in the EDML ice core. Eventually we aim at reconstructing stress and strain rates in ice from the observed anisotropy in the radar data.