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New insights into polar ice crystal fabrics from radar polarimetry

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Ice is one of the most anisotropic natural materials but it is common knowledge in our community that a) it is a second order factor b) it can be assimilated into isotropic models by tuning certain parameters or c) it is so complicated to interpret that it is better to ignore. Interestingly, analysis of polar ice in the laboratory and different geophysical techniques, polarimetric radar and active or passive seismics, confirm that macroscopic samples of polar ice tend to develop crystal preferred-orientation fabrics and show strong mechanical, optical and dielectric anisotropic properties. Here, we look in detail at polarimetric radar measurements in different dynamical areas (ice rises, ice domes, fast-flowing ice-streams) in different regions of East and West Antarctica. We use a phase-sensitive frequency-modulated continuous-wave radar (ApRES) to obtain the data and a matrix-based model to study the radio-waves depolarization and Scattering (Fujita et al, 2006). We find that azimuthal anisotropy is widespread, even in areas of low horizontal flows as ice domes and divides where it is difficult to predict as a consequence of flow induction. Also, we observe transitions at depth in the bearing of the preferred orientation of the anisotropic axis, are they consequence or recent dynamical changes or a transition in the properties of ice due to climatic differences at the time of deposition or, maybe, our analysis of the polarimetric data needs further understanding? In any case, ice azimuthal anisotropy is widespread and can not be assimilated into isotropic models as it shows different mechanical properties in different directions.