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Ice fabrics in natural flows: moving away from pure and simple shear

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Antarctic ice flow shows deviation from the deformation regimes of pure and simple shear. By analysing the vorticity number from surface velocity data it is found that approximately 80% of the flow is outside these regimes. These deformations are both between pure and simple shear, as well as highly rotational, highlighting the need for fabric predictions away from the commonly studied regimes of pure and simple shear.

We use the numerical scheme SpecCAF, which has been shown to accurately reproduce experimentally observed fabrics with no free parameters, to study ice fabrics in such general deformations. By exploring the parameter space of temperature and vorticity number, we present a definitive classification of fabrics patterns which arise, and construct a universal regime diagram for ice fabrics under general two-dimensional deformation. We find that intermediate deformations see a smooth transition between a cone-shape fabric and a secondary cluster. We present the first investigation of the fabrics produced in highly rotational deformations, which produce a weak girdle fabric with the axis aligned to the vorticity axis. We also show that across deformation and temperature space fabrics only reach a true steady-state above strains of 200%, and there is significant variation in this across the parameter space.