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Radially Symmetric Polar Ice Sheet Flow with Evolving Anisotropic Fabric

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A radially symmetric, gravity-driven, steady flow of a grounded polar ice sheet with a prescribed temperature field is considered. The ice is modelled as an incompressible, non-linearly viscous and anisotropic fluid with evolving orthotropic fabric. To describe the evolution of the fabric as an initially isotropic free surface ice descends to depth in an ice sheet, a constitutive law relating the deviatoric stress to the strain-rate and strain is applied. The solution is constructed as a leading order approximation derived from asymptotic expansions in a small parameter that reflects the small ratio of stress and velocity gradients in the longitudinal direction to those in the thickness direction. Results of calculations show the effects of a bed topography on the ice sheet thickness profile and the velocity components. Additionally, the influence of the temperature field and the free surface snow accumulation rates on the flow is illustrated.

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