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Modelling of Kealey ice rise, Antarctica, reveals stable ice-flow conditions in East Ellsworth Land over millennia

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Ice divides are dynamical features, and their evolution or stability reflects the conditions of the surrounding ice masses. The East of Ellsworth Land, West Antarctic Ice Sheet, is ringed by divides showing linear features parallel to the ridge in satellite imagery and a conspicuous layering in the ground-penetrating radar data known as Raymond bumps. These features have been shown to be the result of stability over a time-scale comparable to the characteristic time of the divide, ice thickness divided by accumulation, that varies between centuries and millennia in this area. In this study, we focus in Kealey ice rise, an ice divide situated between two distributaries of Rutford ice stream, Carlson and Talutis Inlets.Through numerical modelling, by using an anisotropic full-Stokes thermomechanical flow solver, we analyze the stability of Kealey ice rise and the time-scales involved. We show that our modelling approach can reproduce the radar data only if we use a non-linear anisotropic rheology, and that the asymmetry observed in radar data is forced mainly by the topography of the bedrock. We conclude that the features observed in the surface and stratigraphy of Kealey ice rise are a consequence of, at least, 5 kyr of flow regime stability. However, we can not exclude the possibility of a recent flow reorganization in the last century that could only be reflected in the shallower areas of the ice rise. We stress that the signs of stability observed in Kealey Ice Rise are widespread in the Ellsworth Land area, suggesting recent stability on the millennium time-scale.