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Investigation of a rift zone in the western Fimbulisen by means of airborne radio echo sounding, satellite imagery, and ice flow modelling

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The Fimbulisen, an ice shelf located roughly between 3°W-8°E at the coast of Dronning Maud Land, East Antarctica, consists of the fast flowing extension of Jutulstraumen and slower moving parts west and east of it. The largely rifted western part of the Fimbulisen is the subject of this study, which combines observations and modelling.

Airborne radio echo sounding performed by the Alfred Wegener Institute between 1996 and 2008 with a frequency of 150 MHz and pulse length of 60 ns, respectively 600 ns, is analysed in order to study the internal structure of the ice in parts of the rift zone and to estimate the ice thickness in this area precisely. High-resolution radar imagery acquired by the TerraSAR-X in 2008 and 2009 is used to evaluate principal deformation axis at characteristic locations, to detect crack modes as well as to classify zones of similar structural characteristics.

These zones were incorporated in a 2D diagnostic ice flow model as sub-domains with variable stress enhancement factor and thus treated as zones of different damage related stiffness. The temperature-dependent stiffness is calculated by applying the solution of a validated 3D temperature model of the ice shelf and thus the simulations focus on the softening effect caused by cracks. Extensive parameter studies show the effect of the stress enhancement factor on the principal deformation rates and axis. Comparison with the estimated deformation pattern aims to confine the softening effect for each zone separately.