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Simulation of the ice flow of the Fimbulisen, Antarctica

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The ice shelf code FESSACODE provides a numerical Finite Element solution of the system of partial integro-differential equations of the Shallow Shelf Approximation that describe the flow of an ice shelf. Glen's flow law relates the strain rate and the stress with the rate factor. This rate factor has itself a strong temperature dependence. Therefore, a depth integration of the rate factor has been derived, using a prescribed temperature-depth function and realistic surface temperatures. The rate factor relation is based on Hooke's approach. This system has been validated in the past in an application to the Ross Ice Shelf.

The code was applied to the Fimbulisen, the largest ice shelf in the Haakon VII Sea and the only ice shelf overhanging the continental shelf. The inflow is governed byone main contributor, the Jutulstraumen. The Fimbulisen attracts attention because of its unusual temperature depth profile, that showed a cooling towards the ice/ocean interface. Oceanographic measurements prooved that the Fimbulisen is underlying bottom melting.

We will show simulations using different shapes of temperature depth functions. In addition, studies with different enhancement factors were carried out, which were advanced by implementing shear zones. The results, surprisingly, show that the speeds derived by using the measured temperature profile give poor agreement with the flow field, whereas a temperature profile assigned to bottom melting yields to good consistency!