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Simulation of the ice flow of the Ross Ice Shelf, Antarctica

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The diagnostic, dynamic/thermodynamic ice-shelf model FESSACODE (Finite Element Shallow-Shelf-Approximation Code) is applied to the Ross Ice Shelf. We simulate the present ice flow which results from the ice-thickness distribution, the inflow at the grounding line and the surface and bottom temperature, and compare results with measured flow velocities from the RIGGS campaign. Studies using different temperature depth profiles for the flow parameter of Glens flow law were carried out. Our reference simulation reproduces the general flow pattern and the magnitudes of the flow velocities reasonably well. The ice flow is found to be very sensitive to the flow enhancement factor, the ice thickness and the ice temperature, but robust against inflow velocities from ice streams, glaciers and ice rises. The ice rises (Roosevelt Island, Crary Ice Rise) stabilize the ice shelf by significantly decreasing the flow velocities for the entire ice-shelf area. The ice shelf is susceptible to global warming, in that a $2^{\circ}\mathrm{C}$ surface warming entails an increase of the flow velocities by a factor 1.25, whereas a $10^{\circ}\mathrm{C}$ warming leads to an increase by a factor 3.1.