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Variagated glacier surge flow as a setup for new higher-order ice flow models intercomparison

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Variegated glacier, a surge type glacier located in Alaska, has been intensively studied during the last decades, allowing the description of both its quiescent and surge phases. Measurements of its geometry and surface velocities during slow and fast flow constitute a very useful database.
Based on these data, a series of simulations is presented for both the quiescent and surge phases. A two-dimensional longitudinal profil of the glacier is modelled. Three-dimensional effects are accounted for by introducing the width for the convergence/divergence of the flow and the shape factor for the friction on the lateral side of the bed. The ice is assumed isothermal and a non-linear friction law is adopted. The surge phase is initiated by evolving the parameters entering the friction law.
In a first simulation, a steady geometry is computed for fixed friction conditions at the base and an accumulation/ablation function of the surface elevation assuming an initially free of ice bedrock. By modifying the basal condition over a short period, the transient response for the surge phase is then studied. The return to a steady geometry, assuming the quiescent basal condition over a long period, constitutes the third simulation.
For these three simulations, the response of different ice flow models, from the classical shallow ice asymptotic to the full-Stokes model, is compared. Different forms and parameterisations of the friction law for the surge phase are studied and discussed.
The proposed series of simulations should be used as a setup for a new higher-order ice flow models intercomparison for fast flow with evolving basal conditions, with a higher degree of realism compared to the ISMIP-HOM intercomparison exercise.