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Ice Sheet Model Intercomparison Project: Benchmark Experiments for Higher-Order Ice Sheet Models (ISMIP-HOM)

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During previous model intercomparison exercises (EISMINT 1 and 2), a number of benchmarks were proposed for ice sheet and ice shelf models. The bulk of these ice-sheet models were based on the so-called shallow-ice approximation (SIA). The ISMIP-HOM intercomparison exercise focuses on so-called higher-order models, i.e. models that incorporate further mechanical effects, principally longitudinal stress gradients, or the full Stokes system.

The proposed experiments are made accessible for a variety of model types, i.e. flowline models, vertically integrated planform models, as well as full three-dimensional models. The experiments are valid for both finite difference (FD) and finite element (FE) models. Furthermore, the grid type (regular or not) is unimportant. All thermomechanical effects are neglected and an isotherm ice mass is considered. Experiments include ideal geometry tests as well as a real case experiment on Haut Glacier d'Arolla.

Most proposed experiments are diagnostic, i.e. time evolution is not considered. This means that for a given geometry of the ice mass, a Glen-type flow law, and given appropriate boundary conditions, the stress and velocity field can be calculated. One experiment considers time-dependent response (the experiment is run until the free surface and velocity field reach a steady state) for a constant viscosity (linear flow law). For this experiment analytical solutions exists that are developed by Gudmundsson (2003).

All experiments were tested with a higher-order 2D and 3D model (Pattyn, 2002;

2003). The examples presented here are based on a grid of 81 by 81 grid points in both horizontal directions x and x, and 41 vertical layers in z.

The presentation of the experiments here coincides with the kick-off of the Ice Sheet Model Intercomparison Project.