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The role of longitudinal stresses in the ISMIP-HEINO experiment.

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We present our results for the Ice Sheet Model Intercomparison Project - Heinrich Event INtercOmparison (ISMIP-HEINO) experiment performed by a novel ice sheet model based on the SIA-I algorithm, developed by the authors. The benchmark is focused on modeling of the Heinrich events that are considered to be intrinsic thermo-mechanical instabilities in ice sheets caused by successive activation and deactivation of ice streams over sedimentary basal areas. The process is driven by the coupling between the evolving ice-sheet geometry, temperature and basal sliding velocity. We inspect the effect of the inclusion of longitudinal stresses by employing the SIA-I algorithm, which improves the solution obtained by the Shallow Ice Approximation (SIA) in an iterative procedure. For sufficiently flat geometries with a small vertical-to-horizontal aspect ratio, as in the ISMIP-HEINO experiment, the iterative procedure converges well and gives a higher-order solution of the ice-flow problem. Its relation to a numerical full-Stokes solution has been investigated in the ISMIP-HOM benchmark. Here, we deal with the response of the SIA-I numerical model to the ISMIP-HEINO setting and evaluate the change in the response characteristics concerning occurrence, frequency and amplitude of the modelled Heinrich events when, in addition to the SIA, the longitudinal stresses are employed in the momentum equation.