Improvement in thermodynamics computation in a numerical ice-sheet model IcIES

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Computation of temperature field by numerical ice-sheet models is a key issue, in particular, for long-term and large-scale ice-sheet simulation. The velocity fields depend on the ice temperature field, because it determines the softness of the ice, and because the basal temperature determines the ice sliding condition. On the other hand, the evolution of temperature is affected by advection and strain-heating, which are function of those ice velocity and softness. These feedbacks may sometimes induce oscillation and/or instability. Many ice-sheet modeling studies have reported such characteristic features of ice-sheet dynamics, however, there still remain uncertainties to decide what is robust and what is not. Improvement in computation of temperature is one of the current major subjects on development of a numerical ice-sheet model IcIES. Toward this goal, (a) introduction of a higher-order numerical advection scheme (b) introduction of the enthalpy scheme to replace the current temperature equation are set as present development tasks in IcIES. The present study will report the progress in development of the two subjects and will show some demonstration how they affect the simulated temperature and ice-sheet evolution.