Sensitivities in ice-sheet simulation
due to a variation of numerical formulation of the ice/temperature transport equation

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Generally the evolution of ice-sheet thickness in an ice-sheet model is formulated using the divergence term of horizontal ice flux and the mass balance terms at the upper and lower surfaces, derived from the continuity equation with the assumption of incompressible fluid. There are many variation of the formulation, which differs in numerical aspects such as stability, accuracy, numerical diffusivity and/or conservation. Several studies have argue that uncertainties in the ice-sheet simulation due to the variation of such numerical formulation (e.g., Hindmarsh & Payne, 1996). Moreover, since simulation of ice temperature and/or age involves *transport* by definition, numerical design of these equations in ice-sheet models may affect the results via internal feedbacks. However, systematic experiments, are not performed.

Currently, other numerical schemes that have relatively less diffusivity (e.g., Interpolated Differential Operator scheme, IDO) are being examined to introduce in to I_CIES both for mass and temperature transport. This study show preliminary results as a reference to study the effect of these sophisticated numerical schemes.

References

Hindmarsh, R. C. A. & A. J. Payne (1996): Time-step limits for stable solutions of the ice-sheet equation. *Ann. Glaciol.*, **23**, 74–85.