# Implicit thermo-mechanical coupling for ice sheet modeling

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## ABSTRACT

We present an implicit three-dimensional thermal solver for polythermal ice based on the enthalpy formulation proposed by Aschwanden et. al. [1], with the addition of the gravity-driven moisture drainage model proposed by Schoof and Hewitt [2]. The thermal solver is implicitly coupled with the Blatter-Pattyn ice sheet flow model allowing ice velocity and temperature to be solved together directly, either transiently or at steady state.

The high nonlinearity of the temperature and momentum equations poses significant challenges to the convergence of the coupled problem. We present strategies for improving the convergence, such as the use of continuation algorithms. We show results on simplified geometries as well as for large-scale ice sheet problems, and compare them with results from the literature or obtained with other formulations.

## REFERENCES

[1] A. Aschwanden, E. Bueler, C. Khroulev, H. Blatter, “An enthalpy formulation for glaciers and ice sheets”, *Journal of Glaciology*, 2012

[2] I. Hewitt and C. Schoof, “Models for polythermal ice sheets and glaciers”, *The Cryosphere*, 2017.