

Review of Frank et al. (2023): Reconciling ice dynamics and bed topography with a versatile and fast ice thickness inversion (revised)

Summary

This paper presents a new method for inverting for ice thickness and, optionally, basal friction at a glacier by iteratively minimising misfit between observed and modelled dh/dt through adjusting an initial guess at the bed (to which the method is insensitive), and by adopting the same approach with observed and modelled surface velocity for the basal friction field. The authors test their method on a synthetic ice cap in order to quantify its performance and sensitivity, and then apply it to Kronebreen, a tidewater glacier in Svalbard, finding that the method generally reproduces the bed well, and is fairly robust when subjected to a wide range of model parameters and input data perturbations. They also show that their method allows the creation of a self-consistent model glacier that can then be used in prognostic simulations without any relaxation.

This is a revised version of the paper, which I also reviewed in its original state. I congratulate the authors for their thorough and considered response to both my review and that of the other reviewer, and feel that this revision adequately responds to all the concerns I raised in my original review. Beyond picking up a few typos, I have no further points to raise at this review stage and recommend that the paper should be accepted for publication. Well done!

Samuel

Line numbers refer to the clean version of the revised manuscript.

Major points

- None

Minor points

- p.6, l.146: 'attributed to errors in the bed'
- p.22, l.498: 'between the two regimes'
- p.23, l.528-9: 'allowing us to consider that differences between observed and modelled ice dynamics (...) primarily originate from errors in the assumed bed shape'