Your Abstract Submission Has Been Received

PRINT THIS PAGE

You have submitted the following abstract to 2025 Joint Mathematics Meetings (JMM 2025). Receipt of this notice does not guarantee that your submission was complete or free of errors.

Finite element method errors in Stokes models of glacier evolution

---

Review Status: Unrated

Ed Bueler, University of Alaska Fairbanks

Abstract Text:
The primary data which determine the evolution of glaciation are the bedrock elevation and the surface mass balance. From this data, which we assume is defined over a fixed land region, the glacier's geometry solves a free-boundary problem which balances the surface velocity from the Stokes flow and the surface mass balance. A surface elevation function for this problem is admissible if it is above the bedrock topography, equivalently if the ice thickness is nonnegative. For an implicit time step, this free-boundary problem can be posed in weak form as a variational inequality. After some preparatory theory, recalling and expanding upon what is known about the glaciological Stokes problem, we conjecture that the continuous-space, implicit time step problem for the surface elevation is well-posed. This conjecture is supported both by physical arguments and numerical evidence. We then prove a general theorem which estimates the error made by a finite element approximation of a variational inequality problem over a Banach space. The provided estimate is a sum of error terms of different types, essentially special to variational inequalities. In the case of the implicit time step for glacier geometry these terms are of three types: errors from discretizing the bed elevation, errors from the numerical approximation of the Stokes velocity, and finally an expected quasi-optimal finite element error in the surface elevation itself. Practical approaches to reduce these errors are then discussed.

Session Selection:

SIAM Minisymposium on Mathematical Foundations of Climate and Earth System Modeling

Slot:
SIAMSS6A: Friday, January 10, 2025: 1:00 PM-6:00 PM

Scheduled Time:
1:00 PM

Subject Level 1:
86 Geophysics

Subject Level 2:
86 - Geophysics [See also 76U05, 76V05]

Subject Level 3:
86-08 - Computational methods for problems pertaining to geophysics

Submitter's E-mail Address:
elbueler@alaska.edu

Is this a preliminary report?
No

Is this paper suitable for undergraduates?
Yes

See Title step for Recording Permission Selection.

Agreements:
By submitting this abstract, I am committing to register for the meeting if my abstract is accepted and I am able to participate in the meeting.I understand that I have not submitted my abstract until I hit "Submit" on the last step in the submission process, receive an immediate confirmation screen, and a subsequent email confirming a successful submission.

Invited
Y

First: Presenting Author

Ed Bueler
Email: elbueler@alaska.edu-- Will not be published
University of Alaska Fairbanks

If necessary, you can make changes to your abstract submission.

To access your submission in the future, use the direct link to your abstract submission from one of the automatic confirmation emails that were sent to you during the submission.
Or point your browser to /math/reminder.cgi to have that URL mailed to you again. Your username/password are 38055/877332.

Any changes that you make will be reflected instantly in what is seen by the reviewers. You DO NOT need to go through all of the submission steps in order to change one thing. If you want to change the title, for example, just click "Title" in the abstract control panel and submit the new title.

When you have completed your submission, you may close this browser window.

Tell us what you think of the abstract submission process

Home Page