The effect of bed topography on modeled grounding line migration in a conditional simulation of Thwaites Glacier, West Antarctica

LIWG 2015

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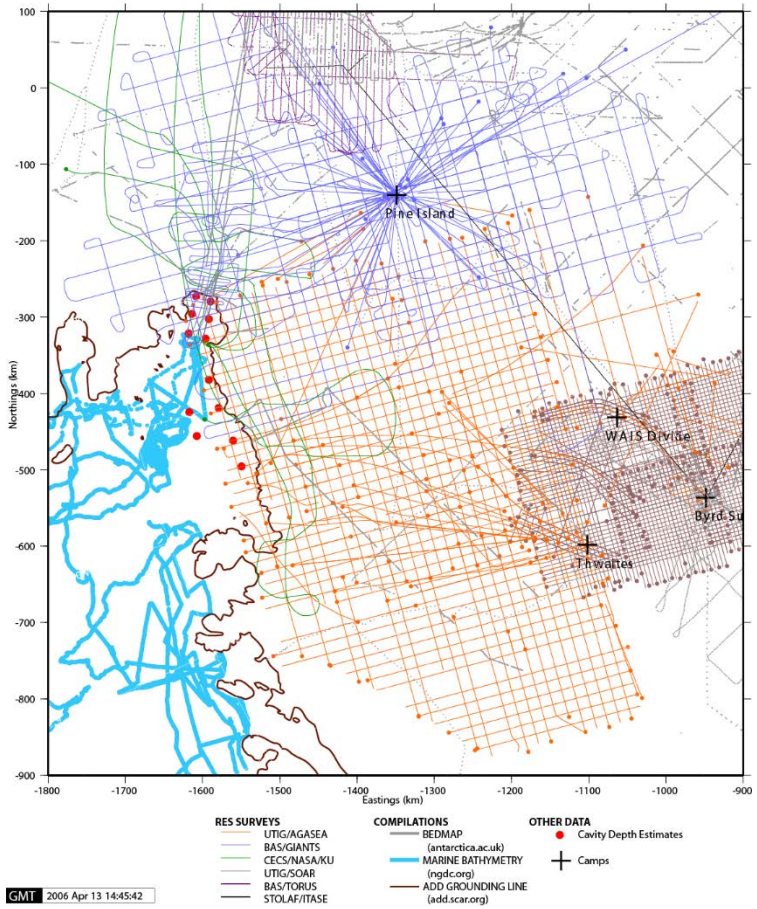
OBJECTIVE

- We want to know how the representation of the bed affects predictions of sea level rise.
  - Measurements of bed data are sparse



--image from UTIGs AGASEA-BBAS First Results, http://www.ig.utexas.edu/research/projects/agasea/agasea_results.htm

OBJECTIVE

- Data contains information about characteristics, which is lost within standard representation.

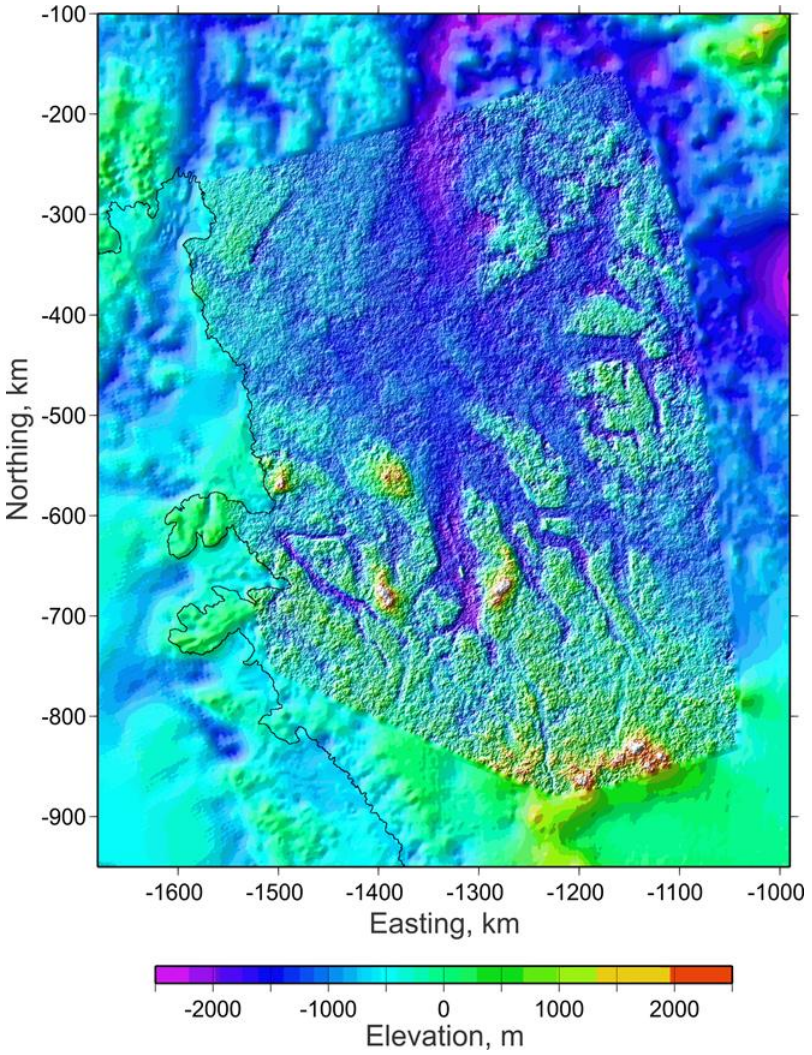
- We are testing the impacts of alternate beds that are all statistically consistent with observations. However, individual bumps may not be correct.

Methods

- Use the BISICLES code
  - Block-structured finite volume method with AMR (Cornford et al., 2013)
  - Modified L1L2 (Schoof-Hindmarsh) – SSA*

Methods

- Realizations of the bed
  - BEDMAP2
  - “mass conserving” bed
  - The Goff conditional simulation
    - Multiple times representing one aspect of its uncertainty

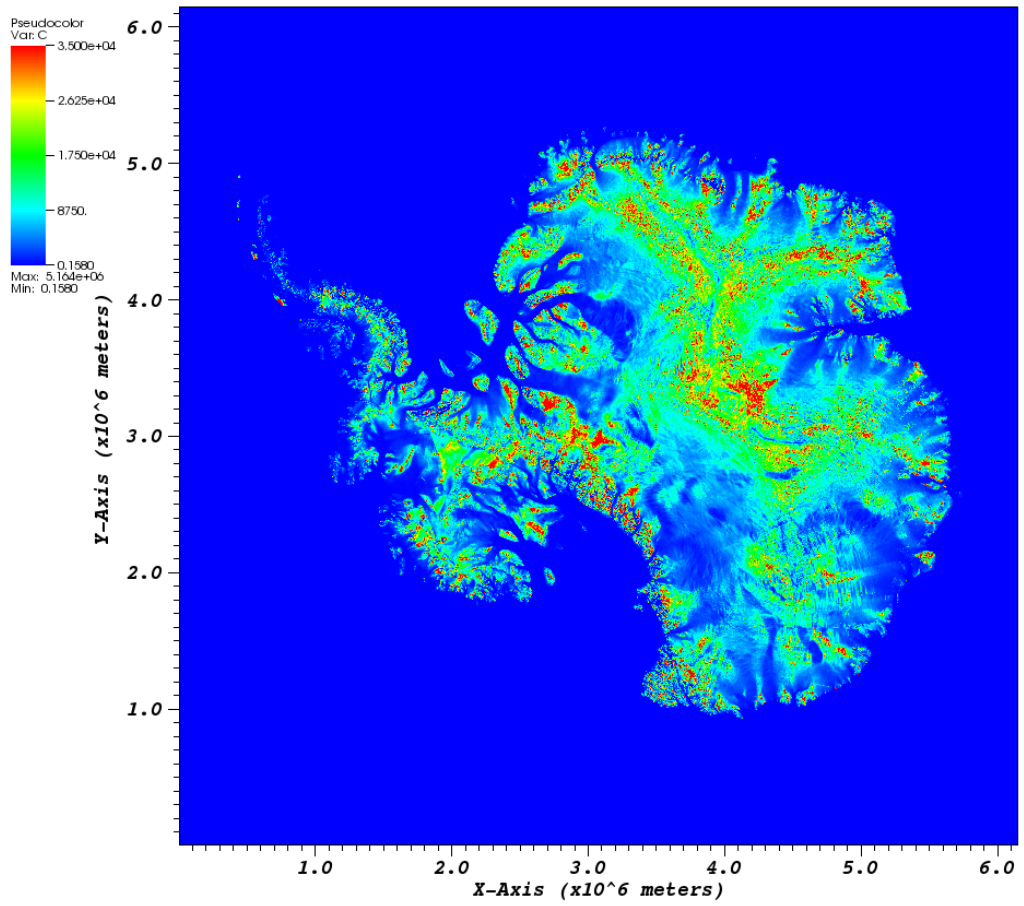


Methods

- Forcing: We will impose a forcing that determines the ice sheet's stability point and allow us to estimate the role of topography in governing retreat rates
  - Slow ramp in forcing until collapse is complete
  - Restart at point of instability with no anomalous forcing to remove effects of changing forcing on rate of collapse

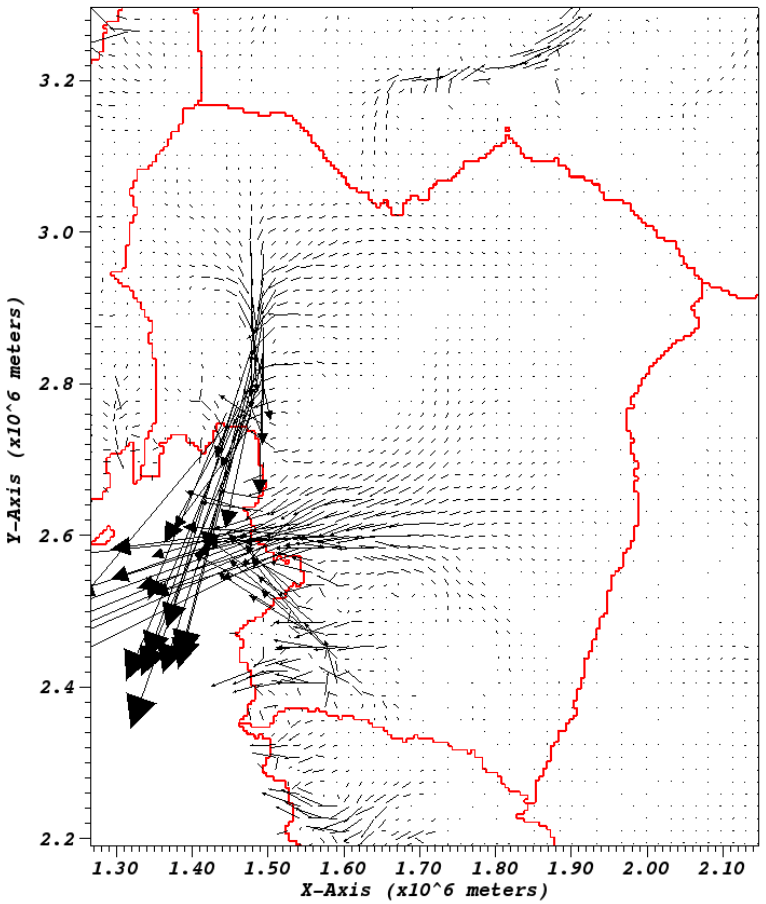
Progress

- Continental control problem
  - Establish a realistic modeled velocity field
    - Issues pushing resolution



Progress

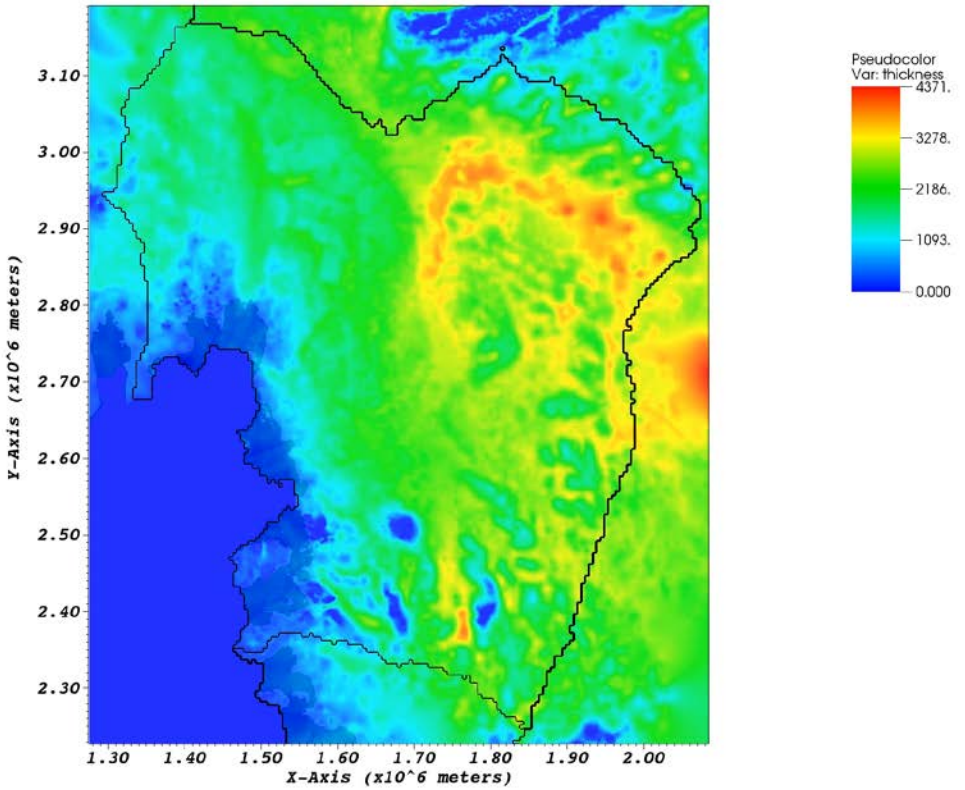
- Velocity field from continental control run used to delineate ASE catchment and establish no flow BCs
- Control problem then run for the ASE catchment using Bedmap2 topography
- This regional control problem is the starting point for future experiments

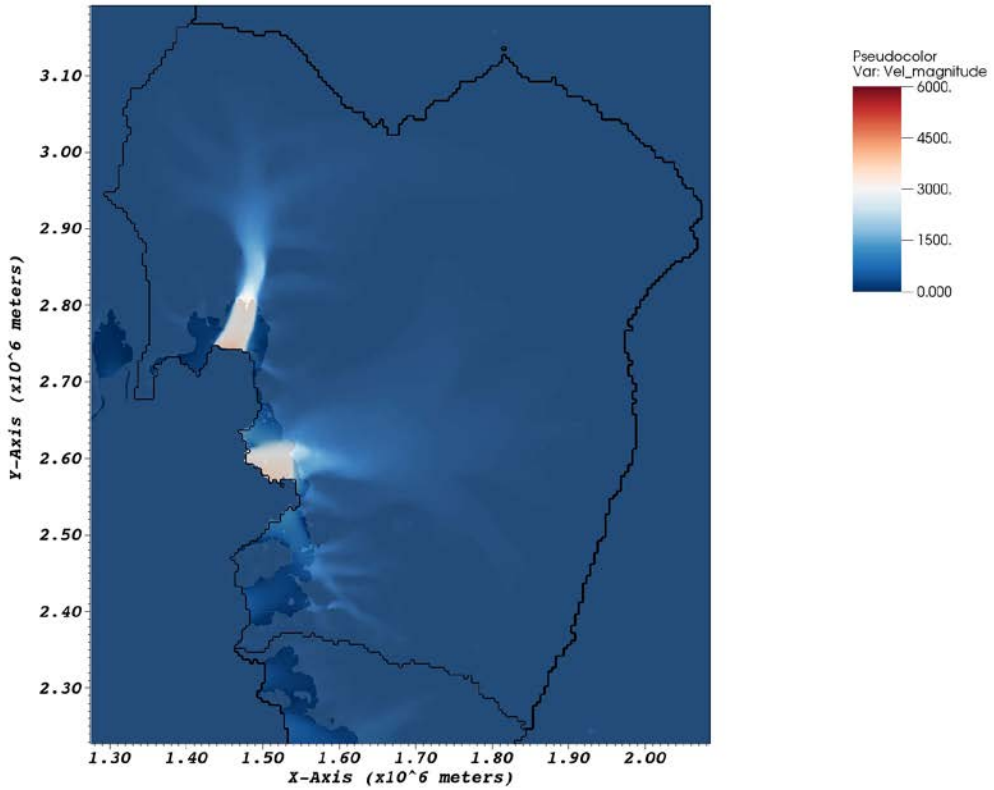


Progress

- Regional flow model
  - Relaxation Run
    - SMB from the work of Arthern et al. (2006)
    - Suglacial temperature field from the work of Pattyn (2010)
    - No geothermal flux specified
    - 50 years, close to steady state?
  - Production Run
    - Forcing: piecewise linear relation for ice shelf melt rate
    - Fixed calving front
    - Bed topography, ice thickness, ice shelf thickness, and ice surface elevation from Bedmap2 dataset (Fretwell et al,. 2013)
    - Run for 325 years

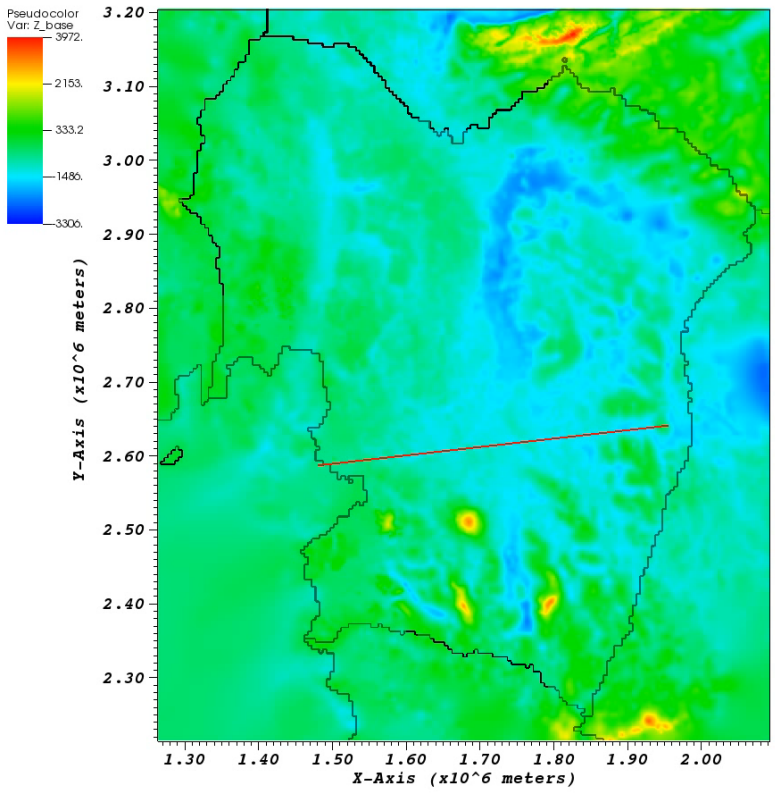
Outcome so far

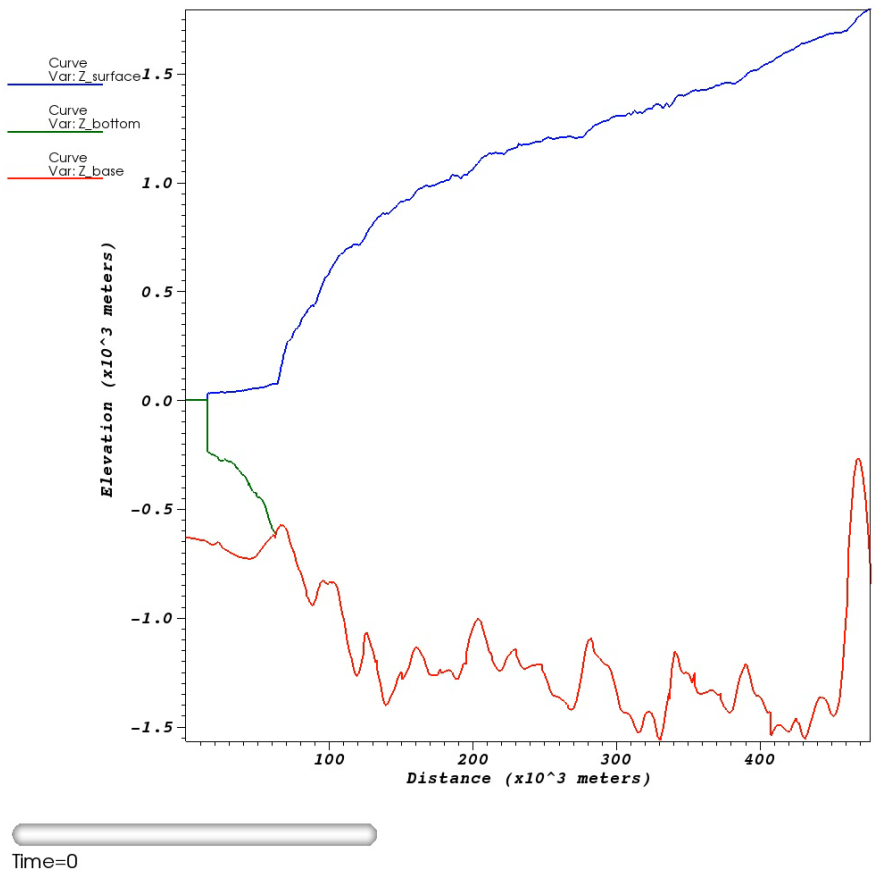




Time=0

Outcome so far





Time=0

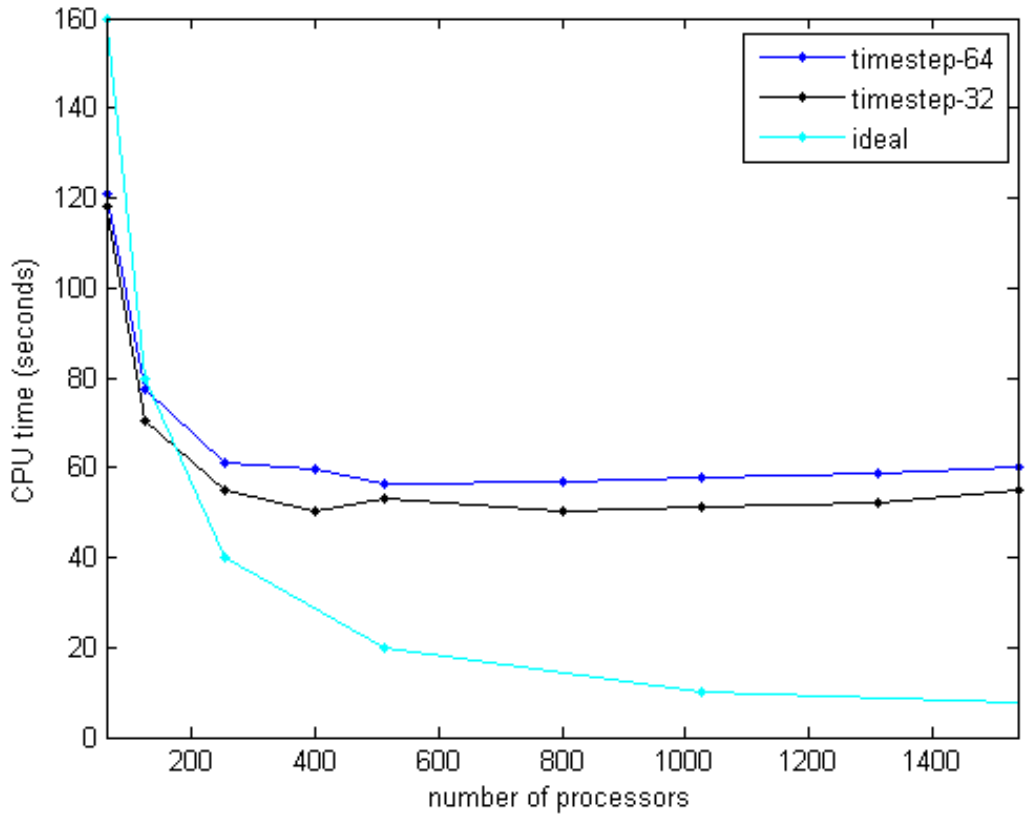
Outcome so far: What we've learned about the collapse of Thwaites through simulation

- Result demonstrates the need to keep the effect on retreat rates from the forcing separate from the effect of topography
  - Parizek and Walker (2010) state that basal melting feedbacks can offset stabilizing effects of bedrock bumps in grounding zone

- Variable retreat rates
  - Where is it easily traced to bed characteristics?
  - Vice versa

Outcome so far: What we've learned

Scaling study



References

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- Parizek, B. R., and Walker, R. T., 2010, Implications of initial conditions and ice–ocean coupling for grounding-line evolution: Earth and Planetary Science Letters, v. 300, no. 3, p. 351-358.
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