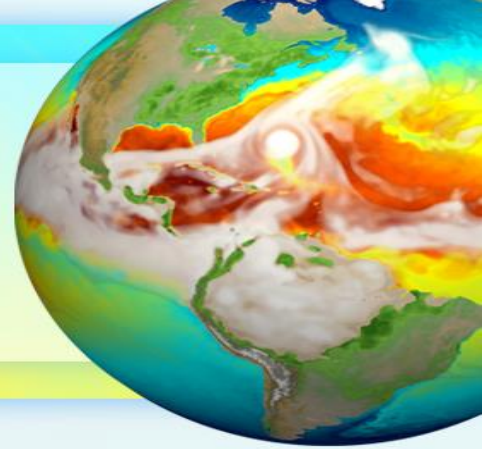
E3SM BISICLES Next Generation Development (NGD)



Dan Martin

Lawrence Berkeley National Laboratory

DOE LAB Staff

LBNL: Dan Martin, Terry Ligocki, Mathias Jacquelin

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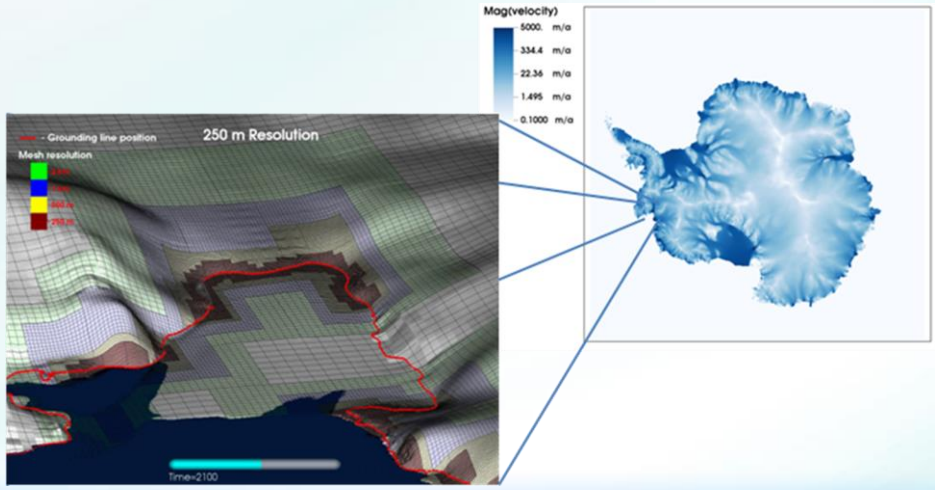
NGD-BISICLES

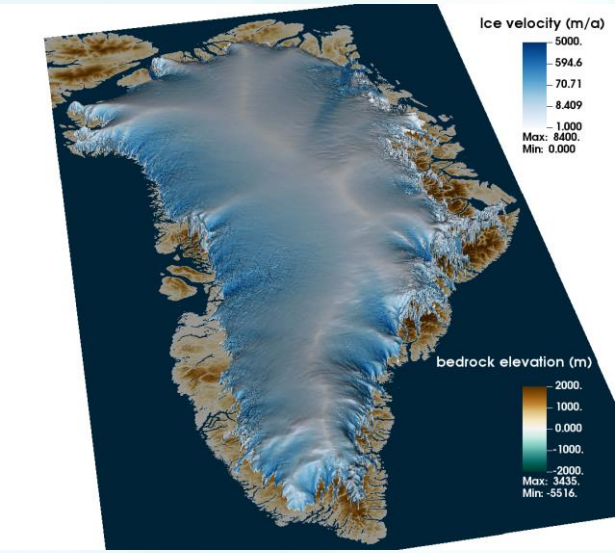
- Coupled interaction between the ice sheets and overall climate forcing is essential to projections of sea level rise and other impacts.
- Currently two DOE-supported Ice sheet models
  - MALI – Trilinos-based unstructured mesh finite-element
  - BISICLES – Chombo-based adaptive mesh refinement finite-volume
- Each has its strengths.
  - Fine resolution (~1km or finer) is required to resolve ice dynamics near grounding lines
  - BISICLES AMR approach is uniquely suited for modeling marine ice sheets (like Antarctica) – grounding lines can sweep over hundreds of km.

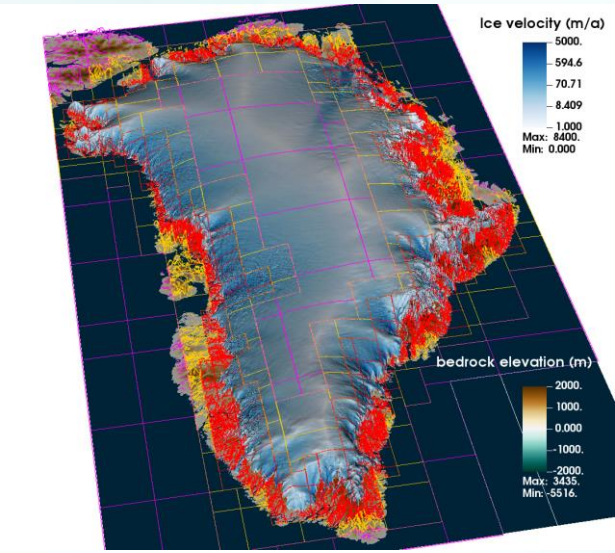
NGD Goal: Incorporate BISICLES into E3SM as an alternate ice sheet model



Where we are:

- BISICLES currently coupled to E3SM as an alternate ISM
  - Operates in stand-alone mode.
  - Ice Sheet initializes and evolves in E3SM, but no coupling to external E3SM dynamics.
- Substantial progress toward full coupling, but not fully implemented yet.
- Starting with Greenland…
  - Figure at right is BISICLES Greenland AMR setup and run in E3SM
  - Upper figure – ice velocity. Lower figure: Mesh resolution





Challenges:

- Staffing challenges – behind schedule due to staff being pulled into other projects (ECP)
- Documentation challenges – Coupling a new model in to E3SM is one of the less-well-documented parts of E3SM, partly because much of the infrastructure is fairly old (imported from CESM at the outset of ACME)
- Software continuity challenges – updates to main code cause build issues when merged to our development branch

Expected Impact:

- Enhanced E3SM predictive capability for understanding the role of ice sheets in the fully-coupled climate system and the resulting contributions to SLR.
- Will provide E3SM a singular capability to model Antarctic response to marine forcing using ***two*** modern state-of-the-art ice sheet models.
- Will also provide a useful companion to the in-development MALI ice-sheet model for V&V purposes