Progress and Challenges in Testing and Coupling Land Ice Models in ACME

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New ice/ocean coupling in ACME

Primary components of ice/ocean coupling implemented in coupler. Upcoming challenge: moving ice sheet/shelf boundaries in coupler code.

Ocean-to-land-ice coupling infrastructure: code modifications

Land-to-ocean coupling infrastructure: code modifications

Realistic and Robust ice sheet simulations

Progress towards realistic, high-resolution, whole-ice sheet simulations with MPAS-Land Ice. Challenges: Robust solver convergence and evolution using refined meshes and resolutions adequate to resolve grounding line dynamics.

Idealized ice/ocean testing

New idealized test cases for land ice/ocean interactions: ISOMIP+ and MISOMIP.

Challenges for MPAS-LI as a GLC component

Challenges in Software Engineering/ACME Capabilities:

- GLC-LND coupling:
  - GLC in CESM was not a fully developed component but was intimately tied to the LND component. (e.g., there was no GLC grid)
  - Land / ice sheet coupling and downscaling (of precipitation and temperature) in CESM was dependent on CISM code, which is not part of or available to MPAS-LI.
  - Recent work has generalized GLC coupling in CESM to remove these restrictions. It is unclear when these changes will be available in ACME.
  - Existing land/ice sheet coupling and downscaling in ACME may be adversely impacted by proposed land model changes.

- GLC-OCN coupling:
  - Currently being developed in ACME (see top left panel for details).
  - Addition of wetting / drying and grounding-line representation in ocean model remains to be implemented and tested.

- Works towards enabling support of multiple MPAS components within the same executable (ACME) is ongoing.
- Currently, SE support for the coupling of land ice models in ACME is limited to LANL efforts towards coupling of MPAS-LI

Challenges in Scientific Quality:

- Ice sheet spin-up/initialization within a high-resolution climate model
- Quantifying acceptable biases in coupled Antarctica / climate simulations
- Ocean model initialization while coupled to ice sheet model
- ACME sub-ice-shelf melt rates in agreement with observations, requiring:
  - Depth and temperature of Warm Deep Water (WDW) in Southern Ocean
  - Transport and mixing of WDW on the continental shelf and under ice shelves
  - Formation and transport of dense, salty water through sea-ice growth and export

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