Progress in full coupling between ice sheets and climate in CESM

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- Overview of ice-sheet/climate coupling in real world
- New coupling links in model
 Ongoing work and future plans



What do we mean by icesheet/climate coupling?

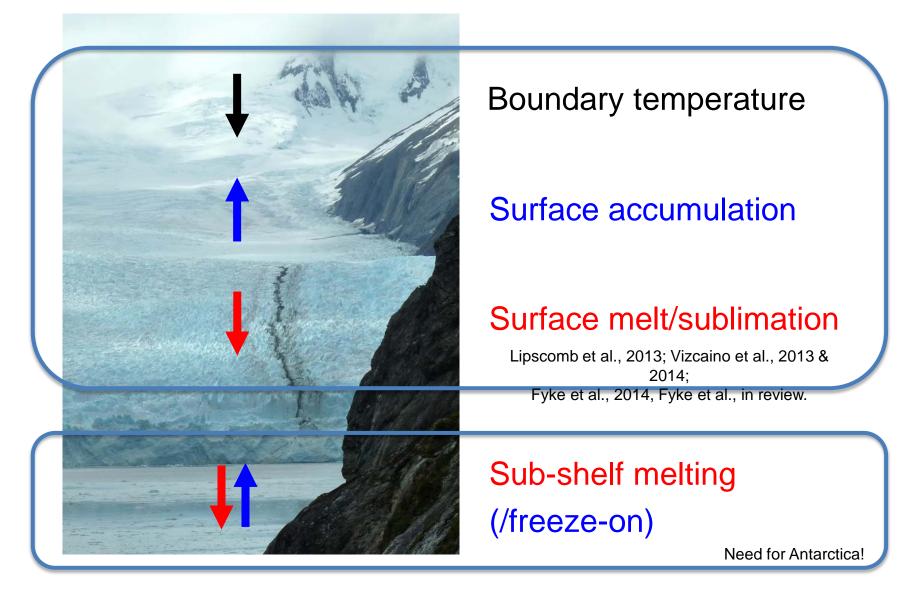
Climate passes:

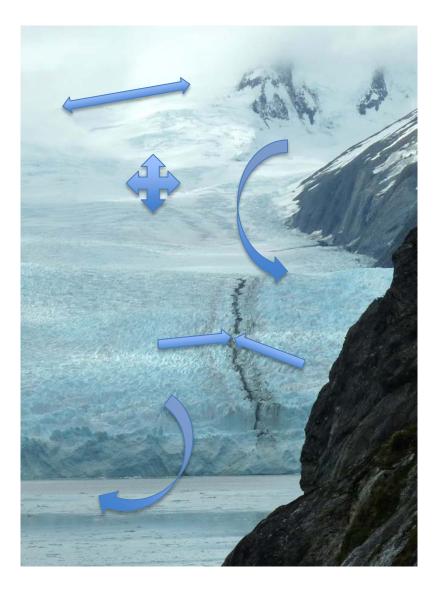
Surface mass balance (SMB)
Boundary temperatures
Sub-shelf melt/freeze rates

Ice sheet passes:

- Elevation
- Ice sheet extent
- Solid ice discharge (icebergs)
 - Sub-shelf geometry

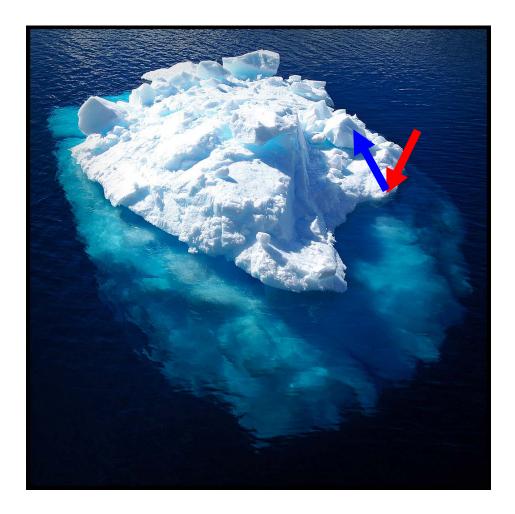
Climate passes:





Ice sheet takes climate-derived forcing and moves

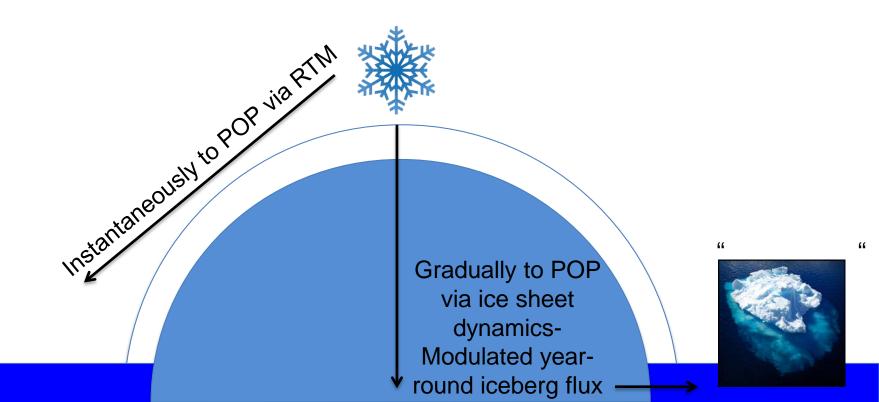
Ice sheet passes: solid ice discharge (calving)



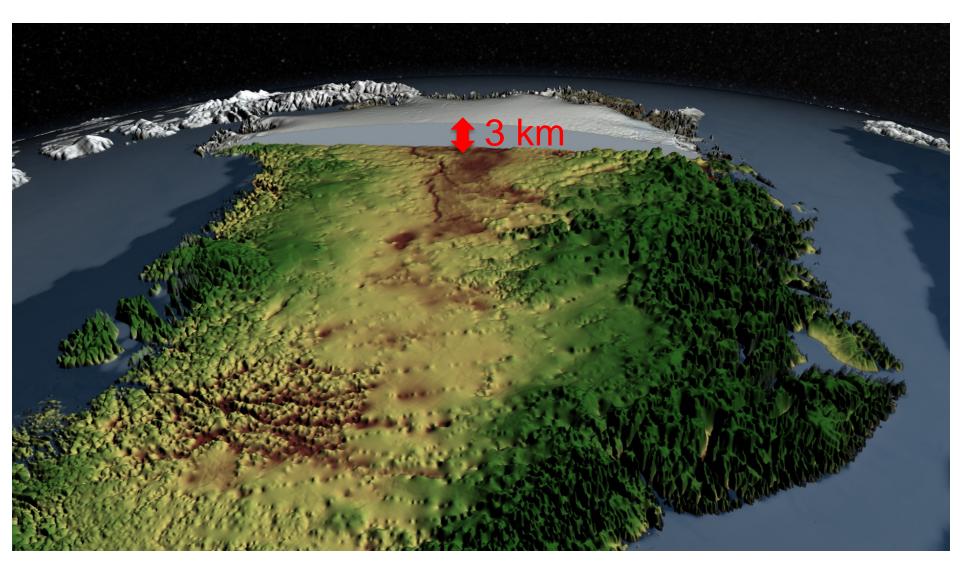
Freshwater addition Heat extraction

Ice sheet passes: solid ice discharge (calving)

- Solid ice routing replaces snow-capping scheme over ice sheets
- Could fix excess frazil ice growth due to artificial concentration of +/- winter POP fluxes of moisture/heat

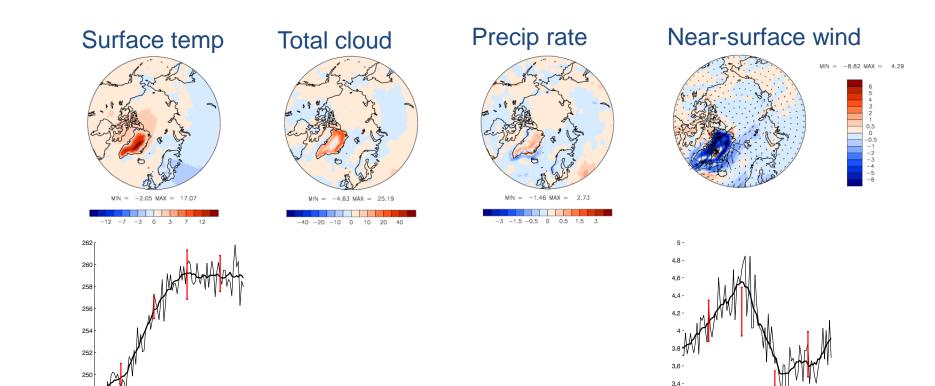


Ice sheet passes: elevation changes



Ice sheet passes: elevation changes

- Script-based approach regenerates global CAM topography at every coupled model resubmission point (~1 year)
- Time series trends from 100-year transient simulation bracketed by snapshot simulations -> coupling appears successful



Ice sheet passes: ice extent changes

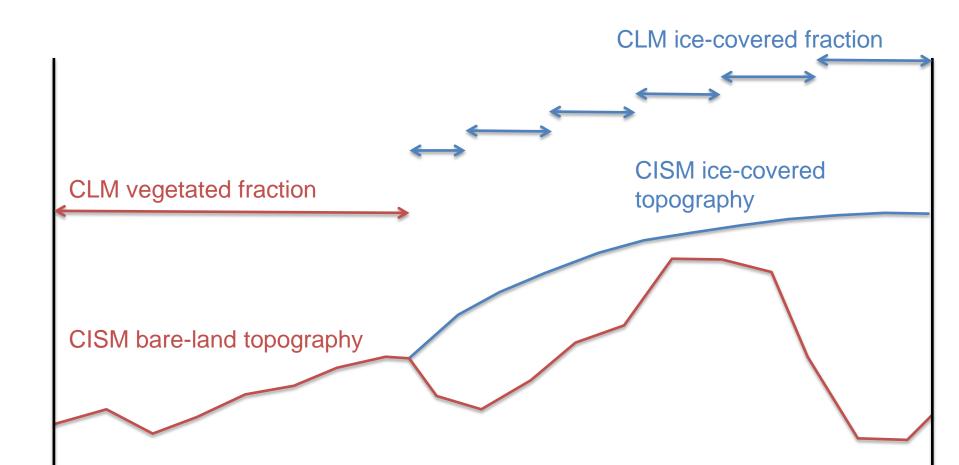




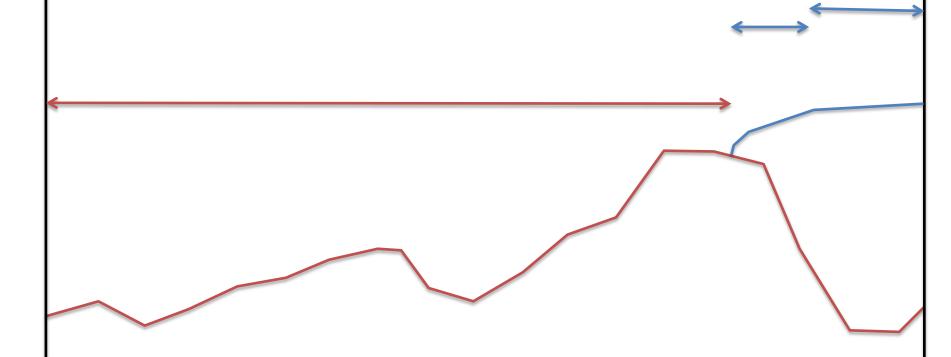




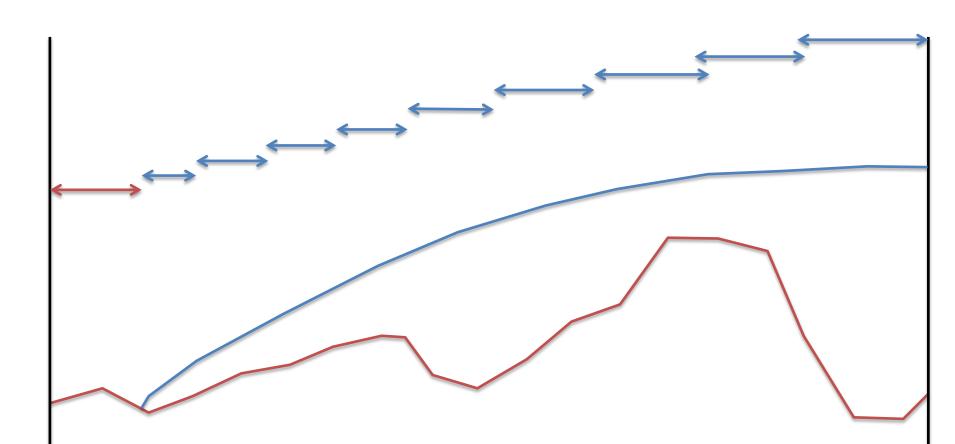
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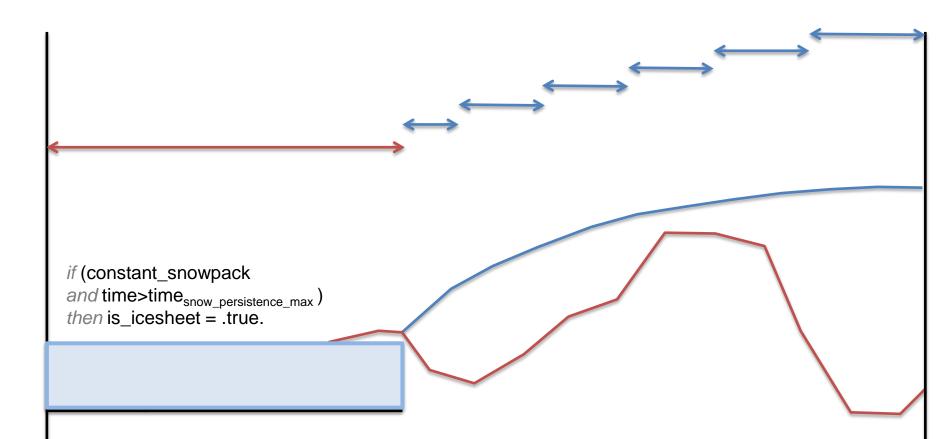
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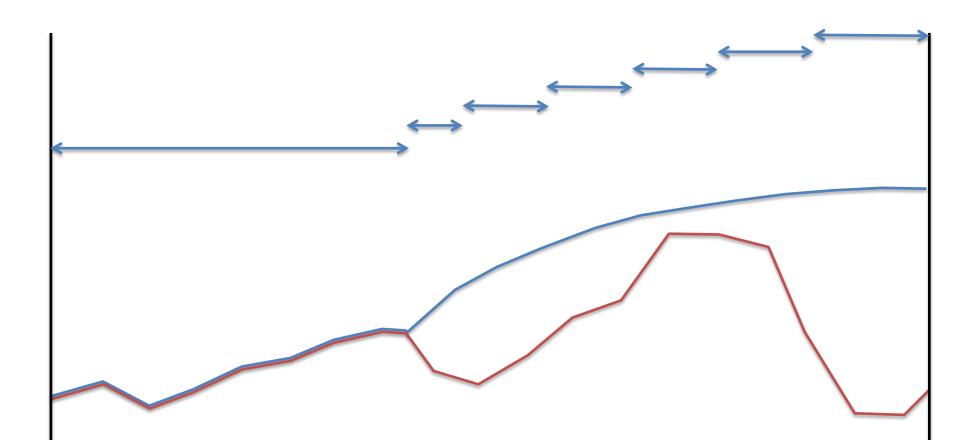
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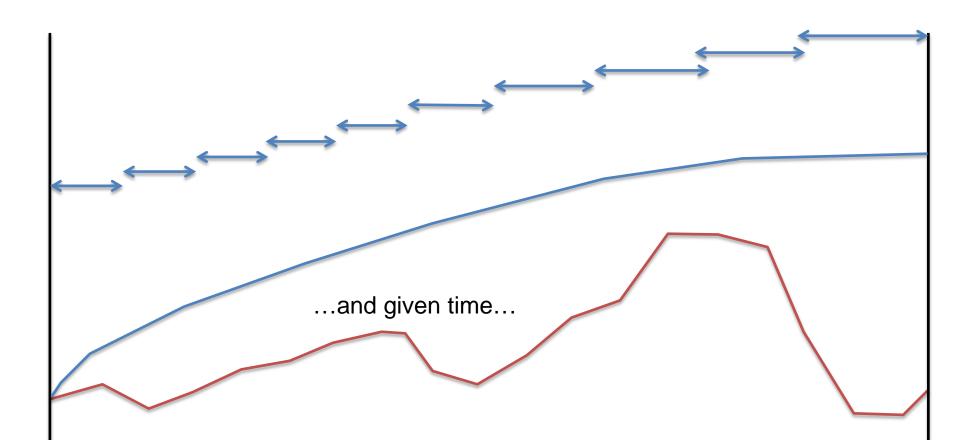
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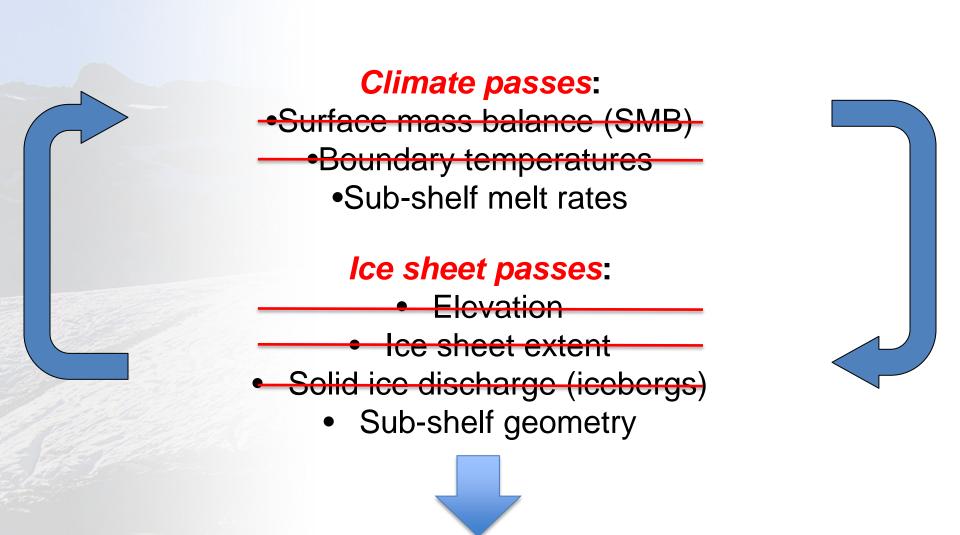


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Two-way coupled model for "primarily grounded" ice sheet complete

Ongoing work and future plans

- 2-way coupling nominally complete (SIA CISM 1, 1 degree CLM4.5, 1 degree CAM 5 FV, POP2, CICE4)
- Description in in-prep GMD-style manuscript
- Stress-testing of coupled model:
 - Development of partially-coupled configurations
 - Development of asynchronous coupling
 - Fixing "coupled-only" bugs and issues
- Validating 2-way coupled model
- Continuing development (e.g. CISM2, firn, multiple ice sheet instances, improved downscaling, explicit icebergs, coupled model tuning...)