Year in Review: Land Ice-Relevant Changes in CESM Since Last June

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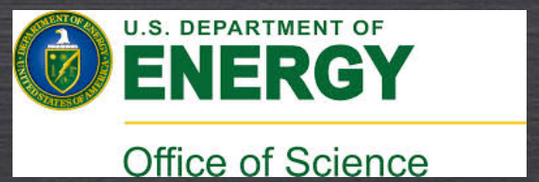
With contributions from many others in the LIWG and the CESM Software Engineering Group (CSEG)



Towards CESM2

- CESM2 science still not completely finalized
  - Possible problem with sensitivity to aerosol forcings
- Earliest possible release: August
- Land ice-related changes just about finalized now
  - Major remaining change is bringing CISM2.1 release into the CESM development trunk

Land Ice: From CESM1 to CESM2

CESM1.0	CESM2.0
One-way coupling	Two-way coupling
Serial, shallow ice approximation	Parallel, higher-order: CISM2.1
No way to run standalone CISM	TG compset for running standalone CISM
1-m snow pack in CLM	10-m snow pack in CLM, with substantially improved physics
Only 3 land/atm resolutions supported	All land/atm resolutions supported
SMB only computed in runs done by LIWG	SMB computed in all runs

CLM Changes in the Last Year

Changes to Snow and Ice Physics

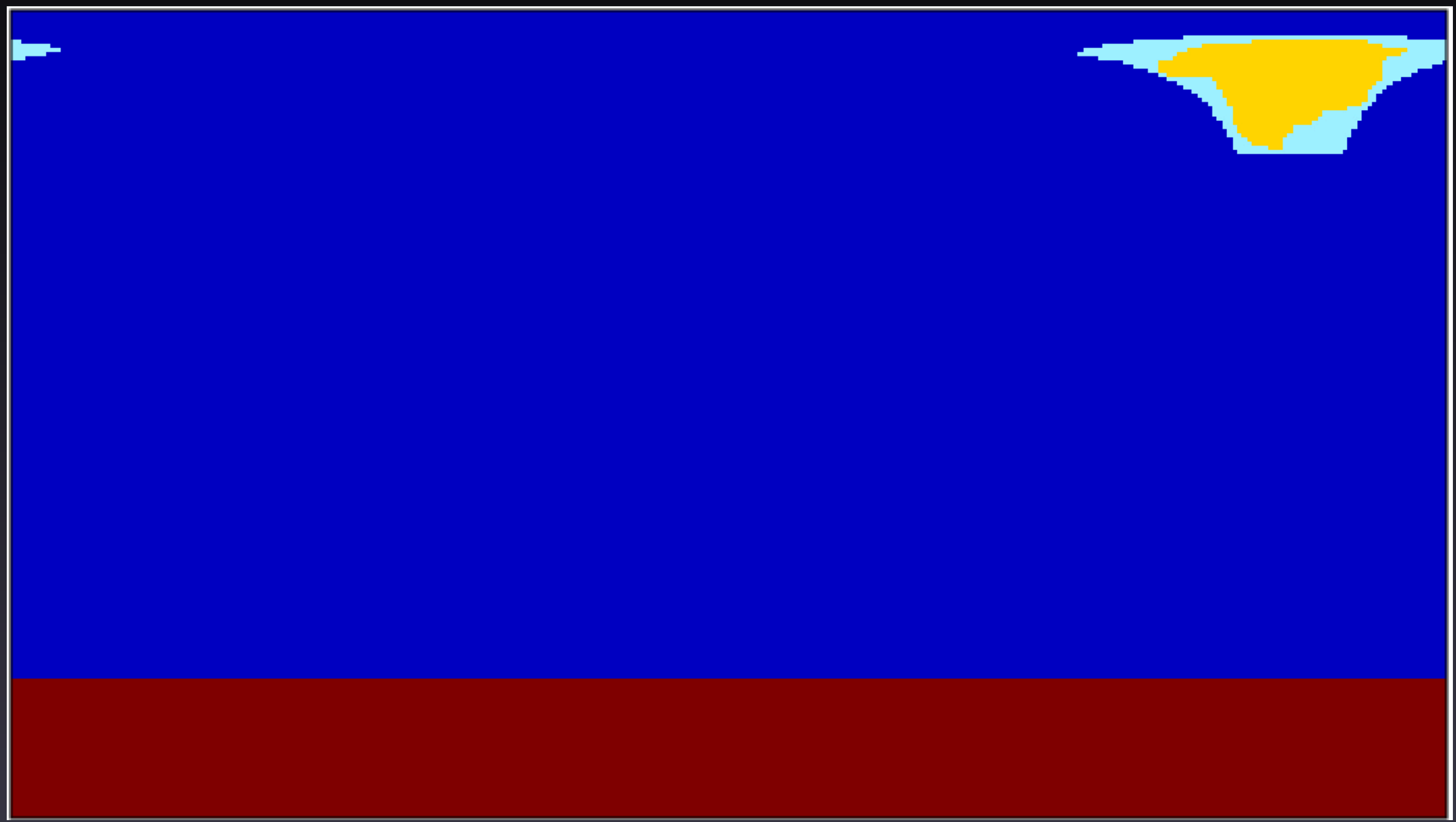
Leo van Kampenhout, Jan Lenaerts, Bill Lipscomb

- New parameterizations for snow overburden compaction and wind drift compaction
- Modified snow cover fraction during melt: generally lower SCF in ablation regions
- Changed bare ice albedo from 0.6/0.4 (vis/nir) to 0.5/0.3
- Change rain-snow partitioning: -2°C to 0°C rather than 0°C to 2°C for glaciers
- New longwave downscaling: simple linear lapse rate

Other CLM Changes

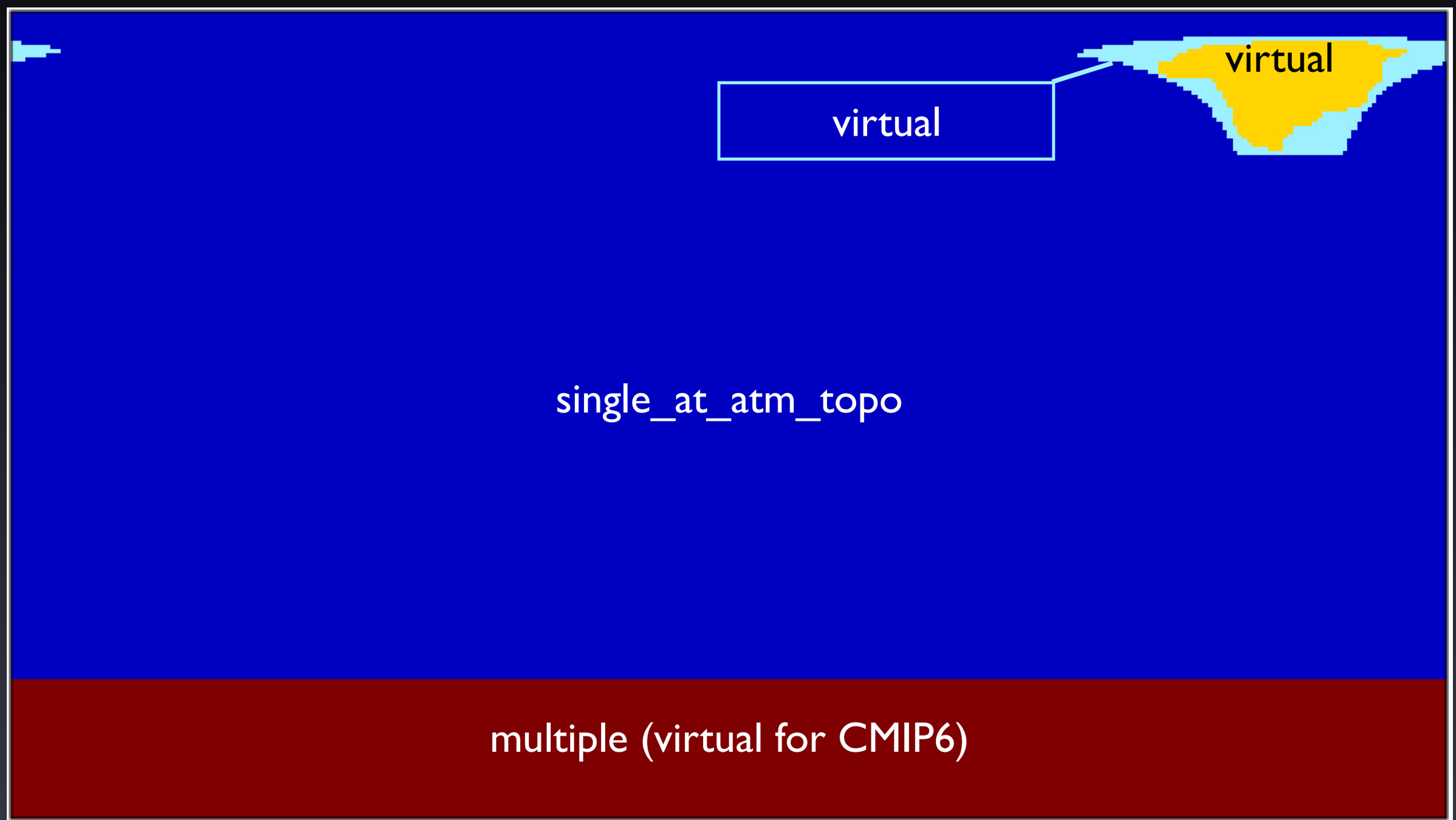
- Dynamic landunits carbon & nitrogen conservation complete
- Dynamic landunits water & energy adjustment fluxes:
  - Major fixes to bugs in these fluxes
  - Dribbled throughout the year
- Snow bug fixes (Leo van Kampenhout)
- New option to reset initial snow pack over non-glacier columns
  - Can be used when transitioning from offline spinup to coupled run
- Consolidation of code in GlacierSurfaceMassBalanceMod.F90

CLM's Glacier Regions



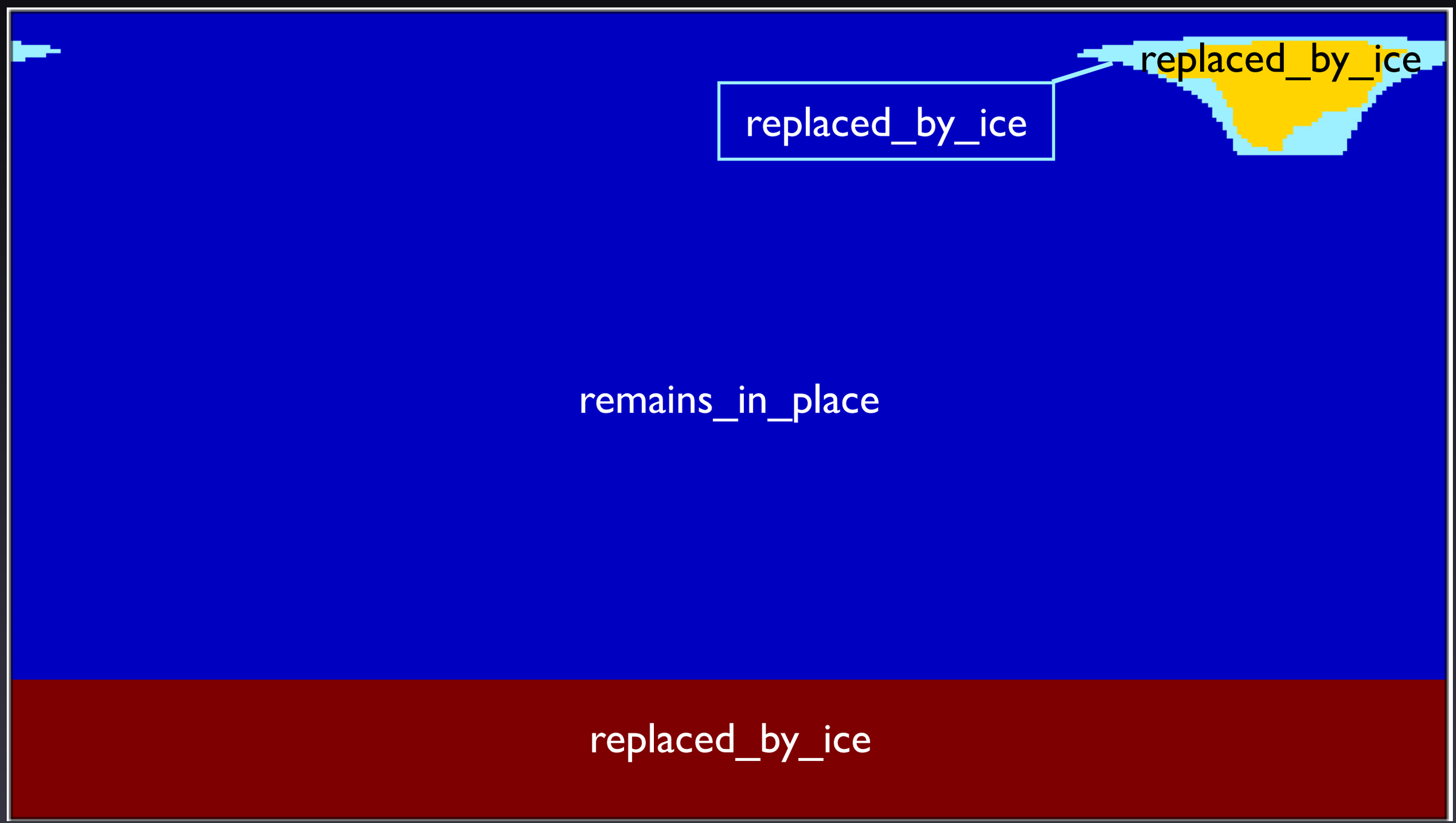
CLM's Glacier Regions

glacier_region_behavior



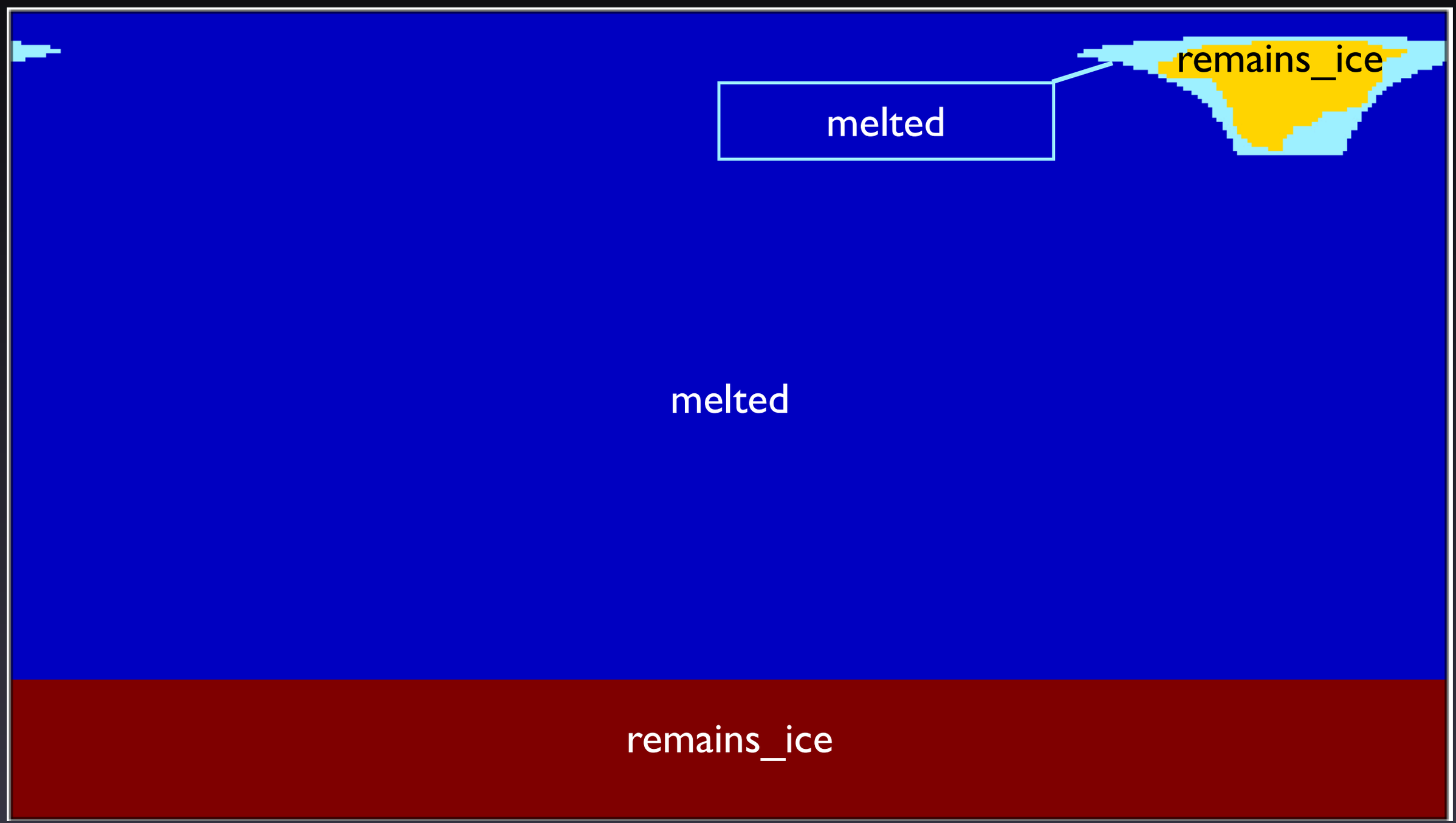
CLM's Glacier Regions

glacier_region_melt_behavior



CLM's Glacier Regions

glacier_region_ice_runoff_behavior



Other Changes in the Last Year

New 4-km Greenland Input File

Joe Kennedy

- Fixed / updated source data
  - Includes peripheral glaciers
- New projection (EPSG3413) for easier comparison with observations
- Number of grid cells a large power of 2 to facilitate studies at different resolutions
- Available at 1km, 2km, 4km, 5km, 8km
  - CESM only provides 4km out-of-the-box

Compset Changes

- CISM2 now the default; CISM1 available via "G1" in some compsets

- "G" now at the end – e.g., `T1850G, T1850G1`
  - Meaning of G is: Evolving, 2-way interactive ice sheet

- Compset long name now requires explicit "%EVOLVE"
  - e.g., `_CISM2%EVOLVE_`

- Only two TG compsets: `T1850G` and `T1850G1`
  - Should only be used for software testing

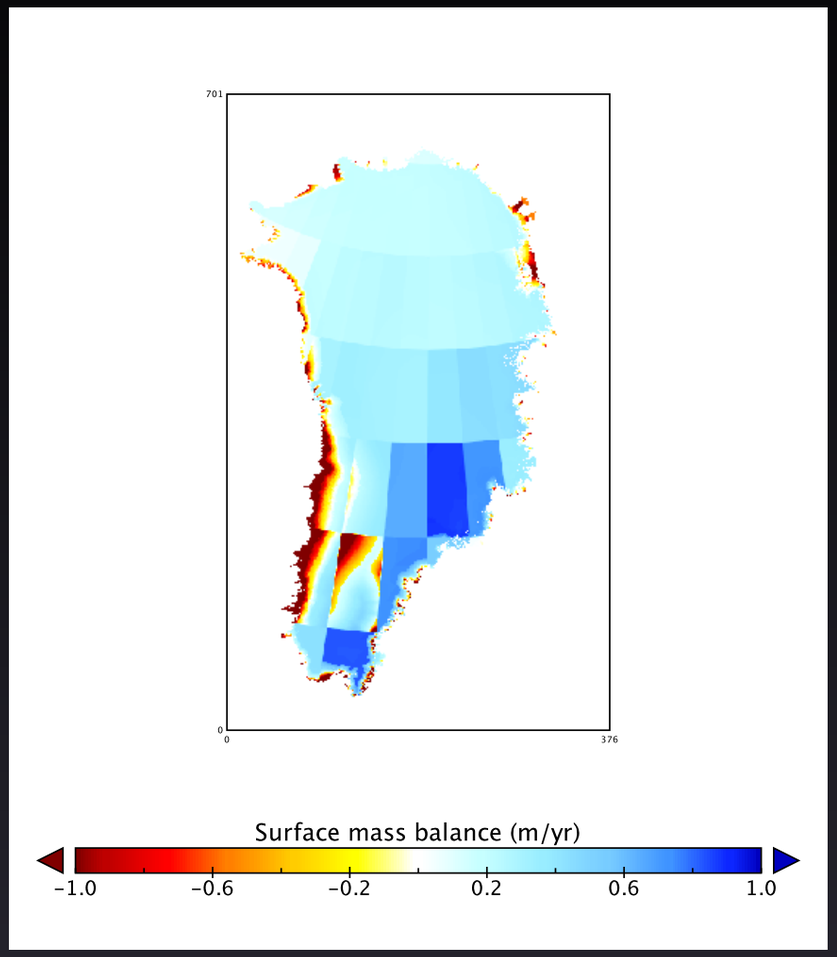
- JG compset (`J1850G`) available for spinup (Jeremy Fyke)
  - All active except data atmosphere

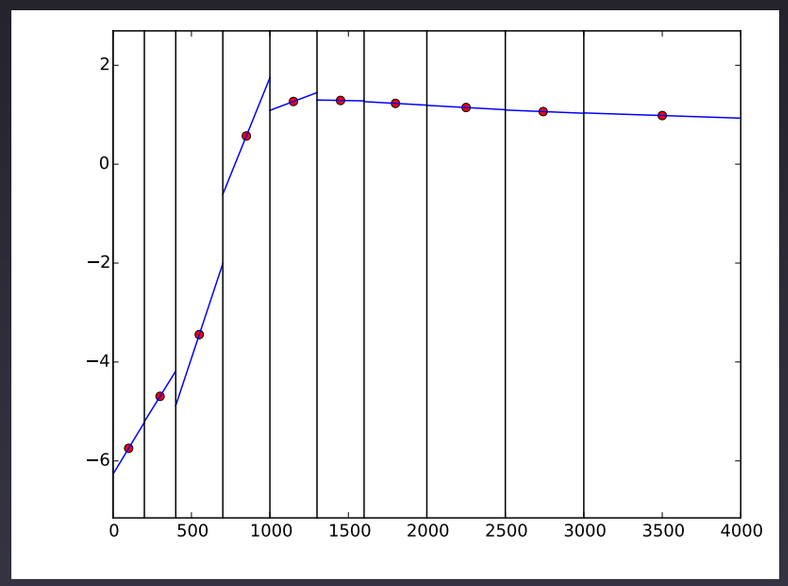
Remapping Changes

Bill Lipscomb, Mariana Vertenstein, Jeremy Fyke

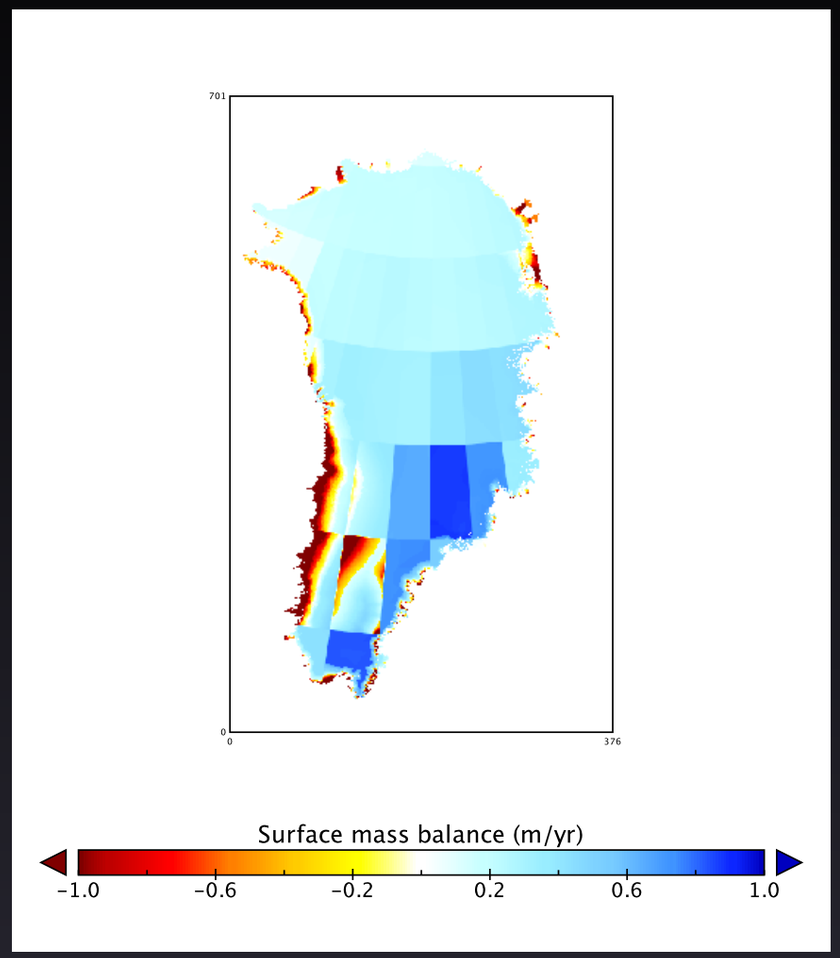
- Smooth, conservative downscaling
  - Bilinear horizontal interpolation
  - Smooth vertical interpolation
  - Global conservation correction
- Only do downscaling once per year, on annual-average fluxes
  - Finally allows mid-year restarts!

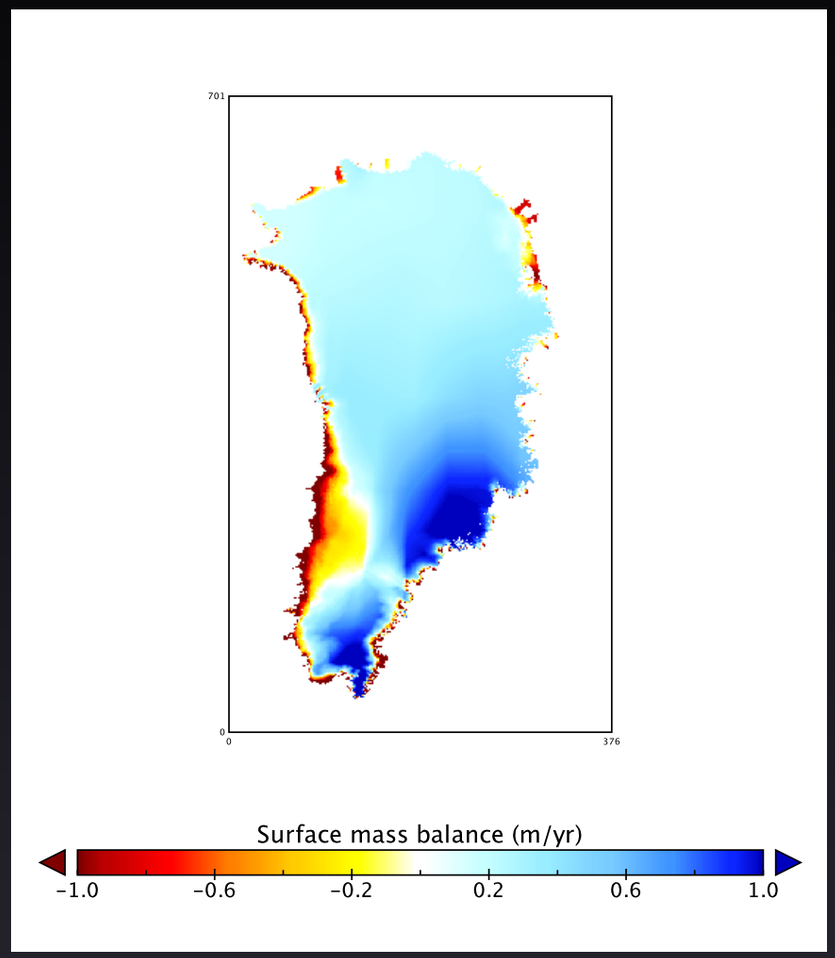
Remapping Changes

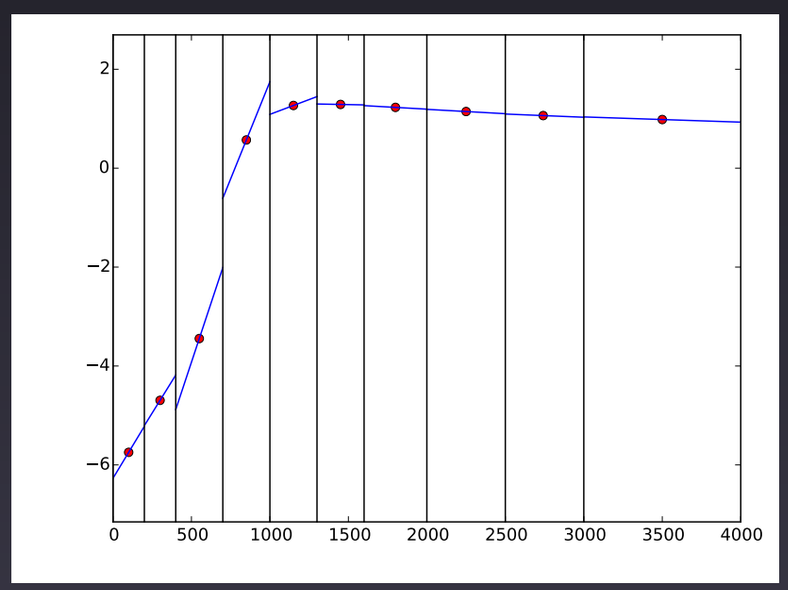


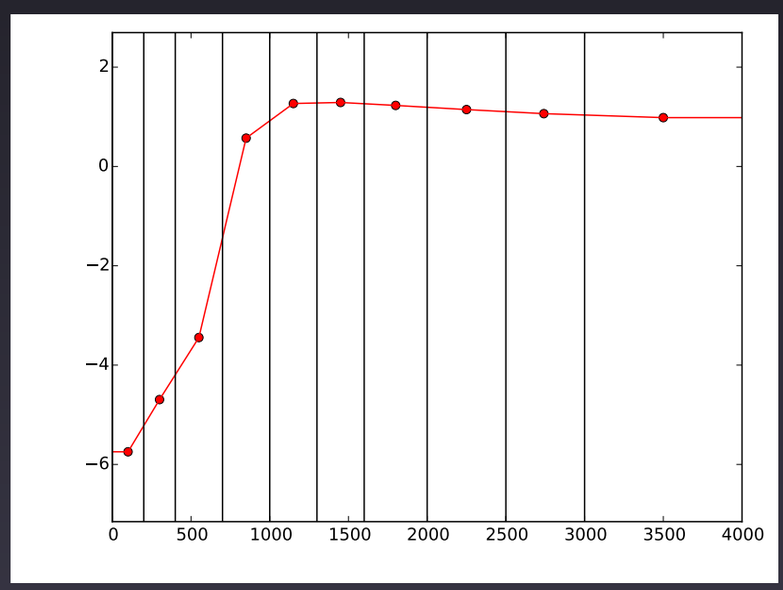


Remapping Changes









What Will NOT Make CESM2

- Fixing generation and use of TG forcings
  - TG compsets should only be used for software testing, not science
- Improved handling of water and energy conservation with dynamic landunits
  - Avoiding large, fictitious fluxes
- Some coupling edge cases
  - e.g., CLM dictates more melt than CISM can accommodate
- Consistent atmospheric topography when running an I or JG compset with cplhist forcings
  - Should be possible to get the right behavior, but not out-of-the-box

CLM's Glacier Regions

glacier_region_behavior

glacier_region_melt_behavior

glacier_region_ice_runoff_behavior