CESM/CISM Software Engineering Update: Towards CESM2.0

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With contributions from many others in the LIWG and the CESM Software Engineering Group (CSEG)
Timeline for CESM2.0 Release

- **Feb 2016**: WG meetings
  - All WGs define final additions - timeline

- **Mar. 1 2016**: CESM2.0 Sessions at Breckenridge
  - Definition of CESM2.0

- **June 2016**: Code Freeze
- **Jul. 1 2016**: Code Freeze

- **Sep. 1 2016**: CESM2.0 Release
  - Full release - All functionality - CMIP6 1°

- **Dec 2016**: Document impacts in coupled simulations

- **Mar. 1 2016**: Code available through developers’ access
# Land Ice: From CESM1 to CESM2

<table>
<thead>
<tr>
<th>CESM1.0</th>
<th>CESM2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-way coupling</td>
<td>Two-way coupling</td>
</tr>
<tr>
<td>Serial, shallow ice approximation</td>
<td>Parallel, higher-order</td>
</tr>
<tr>
<td>No way to run standalone CISM</td>
<td>TG compset for running standalone CISM</td>
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<tr>
<td>1-m snow pack in CLM</td>
<td>10-m snow pack in CLM</td>
</tr>
<tr>
<td>Only 3 land/atm resolutions supported</td>
<td>All land/atm resolutions supported</td>
</tr>
<tr>
<td>SMB only computed in runs done by LIWG</td>
<td>SMB computed in all runs</td>
</tr>
</tbody>
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Major Science Changes Since Last Year

- Improvements to CISM code and default configuration options to support robust, higher-order Greenland Ice Sheet simulations
  - Bill Lipscomb, Jeremy Fyke, Lauren Vargo, Steve Price

- Improved snow physics in CLM
  - Leo van Kampenhout, Jan Lenaerts, Bill Lipscomb, Drew Slater
  - Allow deeper snow pack: 10m water equivalent for CLM5
  - Reworked snow capping: mass taken from bottom rather than from top
  - Wind-dependent snow density

- Downscaling to elevation classes: repartition rain/snow from atmosphere
CIME: Common Infrastructure for Modeling the Earth

Mariana Vertenstein, Jim Edwards, and others in CSEG and ACME

• Clean extraction of the CESM infrastructure
  ▸ Scripting infrastructure
  ▸ Driver/coupler
  ▸ Data & stub models
  ▸ Code shared between components

• Promotes collaboration between earth system modeling groups (CESM, ACME, NOAA, etc.)
  ▸ For LIWG, especially relevant for coupling infrastructure

• Promotes swappability of components
Remapping Moved into CESM Coupler

- Previously: CLM-CISM remapping done by glint
  - Only worked with regular lat/lon land grids
  - Bilinear interpolation – not conservative
  - Big burden on alternative ice sheet models

- Remapping now in coupler
  - glint replaced by lighter-weight interface: glad

- Still need to handle some edge cases

- Note: PDD no longer supported at all
Fixed Interpolation of CLM Initial Conditions

• Needed when changing CLM resolution, number of elevation classes, number of snow layers, etc.

• Had been broken for multiple elevation classes – finally fixed!

• Handles
  ▸ Changing number of elevation classes
  ▸ Changing number of snow layers: new vertical interpolation

• Now done at runtime, rather than with a separate tool
Specifying Glacier Regions in CLM

CLM surface dataset field: GLACIER_REGION

CLM namelist item:
glacier_region_behavior = 'single_at_atm_topo', 'virtual', 'multiple'

60°S
In Progress: Carbon and Nitrogen Conservation with Dynamic Landunits
In Progress: Carbon and Nitrogen Conservation with Dynamic Landunits
In Progress: SMB Computed in all CESM RUNS

• Beginning with CESM2: SMB will be computed in all runs
  ▸ For analyzing SMB given current ice sheet geometry
  ▸ For forcing later standalone CISM runs

• Compset naming: IG/BG indicates two-way coupling; others use CISM as a diagnostic component

• This has required
  ▸ Moving remapping into coupler
  ▸ Removing resolution-specific glacier files from CLM
  ▸ Porting CISM to the NAG compiler

• Big things left to do
  ▸ Enable mid-year restarts
  ▸ Make a lot of mapping files
Big Remaining Tasks for CESM2

• Create new out-of-the-box TG forcing data
  ▸ Need to determine what model configuration(s) to use for this

• Rework SMB definition: all snow accumulation (melt) contributes to positive (negative) SMB
  ▸ Need to determine whether this should be done for CESM2