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

Bill Sacks
Land Ice Working Group
Software Engineering Liaison

With contributions from many others in the LIWG
and the CESM Software Engineering Group (CSEG)
Towards CESM2

• Run #125 is being used as the benchmark
  ▸ Not quite final

• Science freeze imminent

• Only tuning changes, bug fixes, and bit-for-bit code changes allowed past that point

• Release around Breckenridge (mid-June)
<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>
</tr>
<tr>
<td>1-m snow pack in CLM</td>
<td>10-m snow pack in CLM, with substantially</td>
</tr>
<tr>
<td>Only 3 land/atm resolutions supported</td>
<td>improved physics</td>
</tr>
<tr>
<td>SMB only computed in runs done by LIWG</td>
<td>All land/atm resolutions supported</td>
</tr>
<tr>
<td></td>
<td>SMB computed in all runs</td>
</tr>
</tbody>
</table>
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
Handling Ice Melt in CLM

Old glacier scheme
Handling Ice Melt in CLM

Old glacier scheme

New glacier scheme

Liquid to ocean

Ice from ocean – negative ice runoff (heats ocean)
Handling Ice Melt in CLM

Old glacier scheme

Problem: Some people find negative ice runoff unappealing

Solution: Use new scheme for ice sheets, old for mountain glaciers
Carbon and Nitrogen Conservation with Dynamic Landunits
Carbon and Nitrogen Conservation with Dynamic Landunits
Other CLM Changes

• Dynamic landunits: Dribble water & energy adjustment fluxes

• Snow bug fixes (Leo van Kampenhout)
  ▶ Snow capping
  ▶ Snow radiation absorption
  ▶ Energy budget with fractional snow cover

• Consolidation of code in biogeophys/GlacierSurfaceMassBalanceMod.F90
Other Changes in the Last Year
New 4-km Greenland Input File

Joe Kennedy

• Fixed / updated source data
  ▸ Includes peripheral data

• 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 will be: Evolving, 2-way interactive ice sheet

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

Bill Lipscomb, Mariana Vertenstein, Jeremy Fyke

Mostly complete on branches; needs to come to trunk

• 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!
CIME Pythonization

Jim Edwards, Jim Foucar, and many others across CESM & ACME

- CIME: Common Infrastructure for Modeling the Earth
  - Clean extraction of the CESM infrastructure
  - Scripts and non-prognostic-component Fortran code
- Scripts completely rewritten in python
- Substantially increased testing of scripts
Remaining To-Do List for CESM2

- Incorporate CISM2.1 (Bill Lipscomb)
- Fix TG compsets, and create new out-of-the-box TG forcing data
- Improve usability of having CISM on by default
  - Ice evolution and two-way feedbacks off by default