LIWG Software Engineering Update

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Land Ice Working Group
Software Engineering Liaison

With contributions from many others in the LIWG and the CESM Software Engineering Group (CSEG) especially Bill Sacks!
About Me

- BS Computer Science (RHIT)
- 3 years working in SE at
- MS, Phd Atmospheric Science (CSU)
  Cloud Parameterizations
- Post-doc (UWM at NCAR)
  Monte Carlo MG-CLUBB interface in CAM
- Started with CSEG in 2015
- Promoted (?) to LIWG Software Liaison last Sept
- One cool kid, likes rock climbing, skiing, camping, triathlons, etc
Overview

- 2018 Software Engineering Work
- CESM2 Timelines
- JG-BG Land Ice Spinup
- CMIP6-ISMIP6 Timelines
- Data Issues and Cheyenne Storage Changes
- Software Engineering 2019 Tasks
- Working Group Diagnostics?
2018 Software Engineering with CISM

- CISM 2.1 included in CESM 2.0 and 2.1 releases
- Fixes to the generation and use of T compset forcing for running stand-alone CISM in CESM
- Update to CISM time manger to allow for 200k+ year runs
- Changed CESM-CISM build to automatically generate history output files each time (so no need to do offline prep work when making a change to CISM output).
- Changes to the coupler to support the JG-BG runs:
  - Set the highest elevation class to 1m above the second highest
  - Add a weighting factor to smooth the transition between real and virtual elevation classes
Recent CLM Fixes

- Antarctica “wetlands”
  - Problem: Antarctica’s ice shelves were mistakenly treated as frozen wetlands rather than glaciers in initial CMIP6 runs
  - Small impact on historical runs, because these regions are fully snow-covered. Larger impact for warm climates.
  - Fixed for CMIP6 future scenarios, and for any runs done with CESM2.1.1 or later
Recent CLM Fixes

- New option for rain-to-snow conversion
  - Problem: CAM generates too much cold-temperature rain. We had been converting this to snow, but this contributes to too-high Greenland SMB.
  - New option: cold-temperature rain immediately runs off rather than being converted to snow. Region-specific; just in CESM2.1.x code base.
  - We are applying this option over Greenland in ISMIP6 runs.
Lots of Work on Documentation

CESM2: CISM Documentation

Introduction

CISM is a next-generation ice sheet model that is used for predicting ice sheet retreat and in a warming climate. This model is freely available to the glaciology and climate modeling community and serves as the ice dynamics component of the Community Earth System Model (CESM).

CISM Documentation

- CESM Land Ice Documentation and User's Guide
- CISM Documentation and User's Guide
- CISM namelist/configuration settings
- CISM CASEROOT variable definitions
Lots of Work on Documentation
CESM 2 Releases & Timelines

- CESM 2.0 (released June 8, 2018): Code base for CMIP6, but not the final CMIP6 configuration
- CESM 2.1 (released December 10, 2018): Support for scientifically validated configurations used in CMIP6, as well as data from early CMIP6 simulations
- CESM 2.1.1 (spring 2019): Additional CMIP6 and scientifically supported compsets and data will be released incrementally through the spring/summer.
- CESM 2.2.0 (summer/fall 2019?): New science release! Allows for some answer changes and new model development on the path to CESM 3.0
  - Support for python 3, remove CLM 4.0, bug fixes in CAM (mg number evap, wet/dry mixing ratios), CISM 2.1 updates going into this release, etc.
JG-BG Land Ice Spinup

- Goal is to produce a Greenland ice sheet state that is in equilibrium with the CESM2 climate
- Initial ice sheet state from 9000 years ago
- 35 year fully coupled synchronous run (BG) followed by a 150 year run forced with atm output from the previous BG at 10x glacier speedup (JG). Repeat.
- Currently finishing with BG_iteration_7: 9300+ ice sheet years simulated
- Large group working on this: See Marcus Lofverstrom, Jeremy Fyke, Laura Muntjewerf, Sarah Bradley, or Bill Lipscomb for more information and science background.
JG-BG Land Ice Spinup

** Plots from Laura Muntjewerf

** sum (red=BG, blue=JG)

** ice mass

** total basal mass balance flux

** kg

** Gt/yr
CMIP6-ISMIP6 Timelines

- Finished up the **JG-BG Spinup** last weekend with a 100+ year fully coupled synchronous (BG) segment.
- Current CMIP6 simulations piControl-WACCM, piControl-CESM2, historical-WACCM, AMIP-WACCM and AMIP-CESM2, 1pctCO2-WACCM, abrupt-4xCO2-WACCM complete.
- Starting on some WACCM Scenario runs (SSP5-8.5) recently
- Aiming to start our first **ISMIP6** run - **piControl-withism** - at the end of this week or the beginning of next
- Currently scheduled for these ISMIP6 runs:
  - piControl-withism: 300 years, 1pctCO2-withism: 350 years
  - Historical-withism: 165 years (1850-2014)
  - SSP5-8.5-withism: 86 years (2015-2100)
  - SSP5-8.5-withism extended: 200 years (2101-2300)
Data Issues and Cheyenne Storage Changes

Some changes were made to Cheyenne cluster storage facilities this year. What is available now...

- **Home** (/glade/u/home/<username>):
  - 25GB quota, backed up, **not purged**

- **Scratch** (/glade/scratch/<username>):
  - 10TB quota, *not backed up*, **60 day purge**

- **Work** (/glade/work/<username>):
  - 1TB quota, *not backed up*, not purged (currently, could have a purge in the future)

- **Project** (/glade/p/cesm/liwg and /glade/p/cesm/liwg_dev):
  - No quota, *not backed up*, **1 year purge**

- **Collections** (/glade/collections/cdg/cmip6):
  - No quota, no purge, curated data only
Data Issues and Cheyenne Storage Changes

Some changes were made to Cheyenne cluster storage facilities this year. What is available now...

- **HPSS:**
  - Long term robotic tape archive, no purge, maintained while your project code is active
  - Data sets larger than 100 MB for time periods longer than 30 days
  - [https://www2.cisl.ucar.edu/resources/storage-and-file-systems/hpss/access](https://www2.cisl.ucar.edu/resources/storage-and-file-systems/hpss/access)

- **Campaign Storage:**
  - Built for storage of data on publication timescales, is preferred alternative to older HPSS
  - Five year purge, contact CISL’s Digital Asset Services Hub (DASH) to develop data migration plans for storage needs that exceed five years
    - [https://www2.cisl.ucar.edu/dash](https://www2.cisl.ucar.edu/dash)
  - Transfer and manage files using Globus transfers (works across GLADE too!)
    - [https://www2.cisl.ucar.edu/resources/storage-and-file-systems/globus-file-transfers](https://www2.cisl.ucar.edu/resources/storage-and-file-systems/globus-file-transfers)
Data Issues and Cheyenne Storage Changes

Will you produce data products through your proposed project?

Yes

Does your funder (including NSF Core activities) require a data management plan?

Yes

Does your funder (including NSF Core activities) have a designated repository for your project?

Yes

1. Follow your funder (including NSF Core activities)'s instruction to deposit the asset(s)
2. Document the asset(s) per DASH metadata
3. Submit the metadata to DASH Search

No

Do you plan on publishing papers based on results derived from your data products?

Yes

Submit a request for repository support using the NCAR Dataset Submission Request System

No

There are no additional required NCAR data management steps for the proposal.

No

There are no additional required NCAR data management steps for the proposal.
Software Engineering 2019 Tasks

- Finish ISMIP6 simulations
- Improve CISM and CISM-CESM testing. Nightly test suite of the master branch?
- Diagnostic packages
- Allow Antarctica in CESM runs
- Allow multiple ice sheets in CESM runs
LIWG Diagnostics Package?

Many working groups have developed and maintain a diagnostic package that is directly applicable to the development and testing goals of their models/science


- Usually, a straight-forward script where you set a few variables and then a webpage and plots are generated for you

- There are land ice diagnostics in the land package

- Other diagnostics packages in development (LIVV)

- Do we want to build something similar to specifically look at Greenland (and Antarctica?) ice sheets on the ice sheet grid?
Thanks!!