

LIWG Software Engineering Update

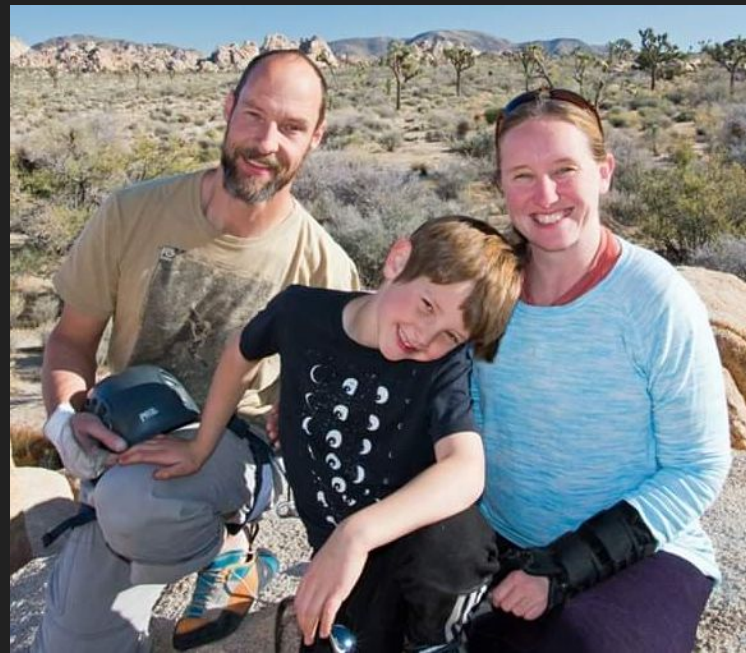
Kate Thayer-Calder

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 manager 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

The image displays two browser windows side-by-side, illustrating the documentation for CESM2.0. The left window shows the main page at www.cesm.ucar.edu/models/cesm2/land-ice/, featuring a title 'CESM2: CISM Documentation' and an 'Introduction' section. The right window shows a 'Table of contents' for the 'CESM Land Ice Documentation and User Guide' located at <https://escomp.github.io/cism-docs...>. Both windows include navigation links like 'next' and 'index'.

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 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](#)

CESM Land Ice Documentation and User Guide

Table of contents

- [1. Introduction](#)
 - [1.1. Scientific background](#)
 - [1.2. Ice sheets in CESM](#)
 - [1.3. Limitations](#)
 - [1.4. What's new in CESM2.0 with respect to ice sheet modeling?](#)
- [2. Running and modifying the CESM land ice component](#)
 - [2.1. Choosing a CESM configuration for land ice work](#)
 - [2.2. Modifying namelist settings](#)
 - [2.3. Modifying source code](#)
- [3. Running the standalone ice sheet model within CESM: T compsets](#)
 - [3.1. Background](#)
 - [3.2. Running with existing forcing data](#)
 - [3.3. Creating and running with your own forcing data](#)
 - [3.4. Changes to some CESM defaults for T compsets](#)
- [4. The dynamic ice sheet model](#)
 - [4.1. The Community Ice Sheet Model](#)
- [5. Controlling output from CISM and CLM](#)
 - [5.1. Controlling CISM output](#)
 - [5.2. Producing land ice-specific output from CLM](#)
- [6. Acknowledgments](#)
- [7. References](#)

Lots of Work on Documentation

CESM2 Quickstart Guide — CIME x

Secure | <https://escomp.github.io/cesm/release-cesm2/>

CESM documentation »

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Introduction

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CESM2 Quickstart Guide

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- Introduction
 - How To Use This Document
 - CESM Model Version Naming Conventions
 - CESM2 Software/Operating System Prerequisites
- Downloading CESM2
 - Downloading the code and scripts
 - Downloading input data
- CESM2 Configurations
 - CESM2 Components
 - CESM2 Component Sets
 - CESM2 Grids
 - CESM2 Machines
 - CESM2 Validation
- Quick Start (CESM2 Model Workflow)
 - Create a case
 - Setting up the case run script
 - Build the executable using the case.build script
 - Run the case

CIME documentation — CIME x

esmci.github.io/cime/

CIME 5.6 documentation »

next | modules | index

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 - Addendum
 - Python Module Indices and Search

Next topic

What is CIME?

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CIME documentation

The Common Infrastructure for Modeling the Earth (CIME - pronounced "SEAM") provides a Case Control System for configuring, compiling and executing Earth system models, data and stub model components, a driver and associated tools and libraries.

Table of contents

- What is CIME?
 - Overview
 - Development
- Case Control System Part 1: Basic Usage
 - 1. Introduction
 - 2. Creating a Case
 - 3. Setting up a Case
 - 4. Building a Case
 - 5. Running a Case
 - 6. Cloning a Case
 - 7. Customizing your input variables
 - 8. CIME user config directory
 - 9. Troubleshooting
- Case Control System Part 2: Configuration, Porting, Testing and Use Cases
 - 1. Main Configuration File
 - 2. Component sets
 - 3. Model grids
 - 4. Defining the machine
 - 5. Controlling processors and threads
 - 6. Porting and validating CIME on a new platform
 - 7. Timers and timing
 - 8. Testing
 - 9. Fortran Unit Testing
 - 10. Multi-instance component functionality
 - 11. Workflows
 - Indices and tables

CESM 2 Releases & Timelines

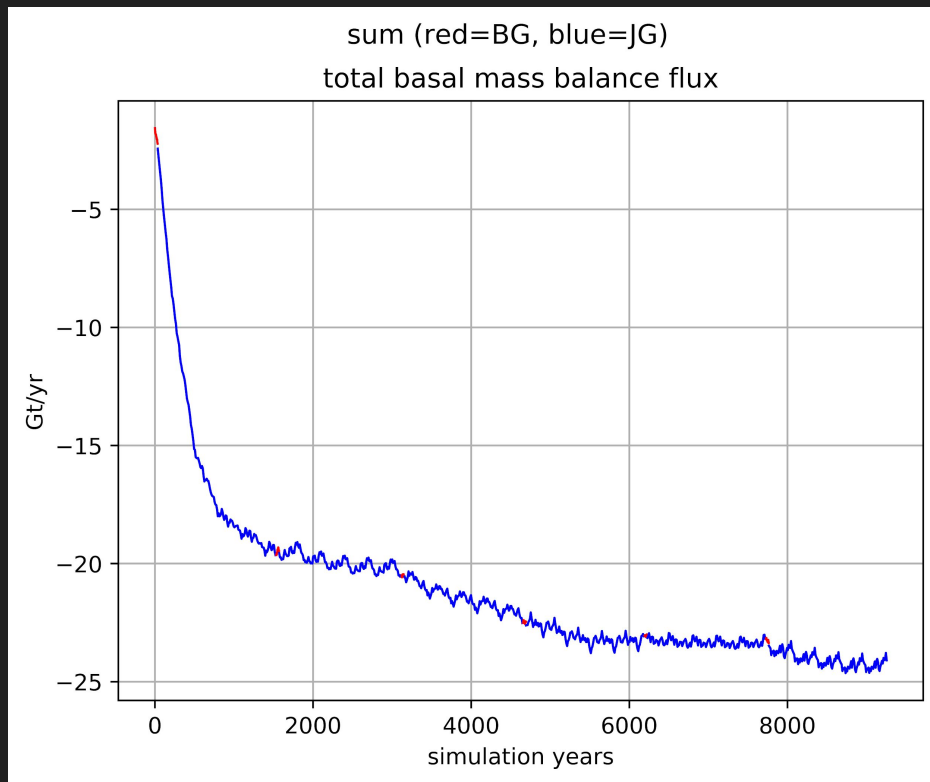
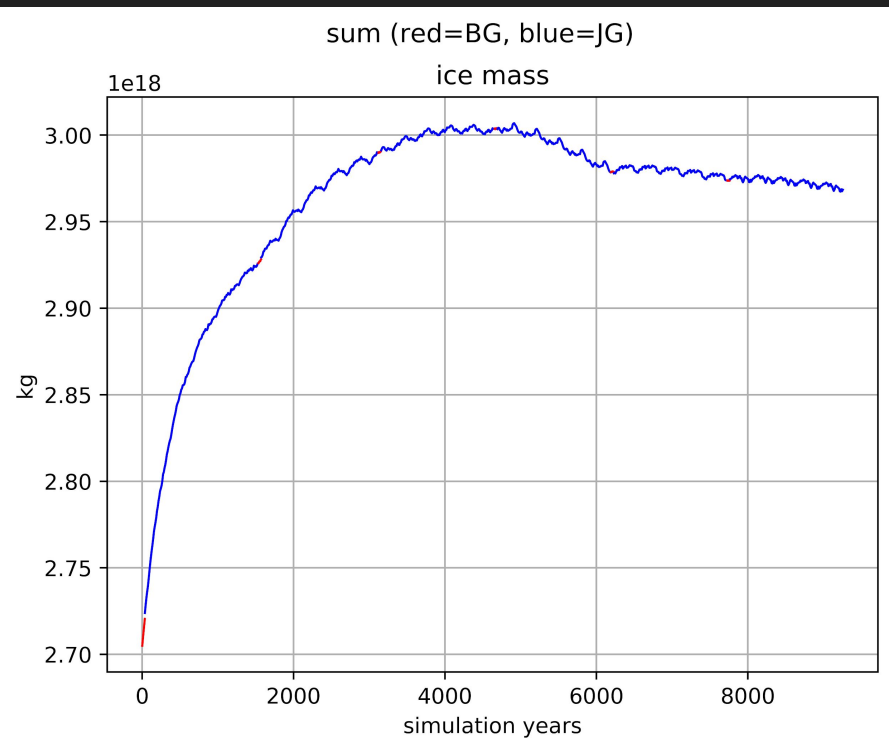
- **CESM 2.0 (released June 8, 2018)**: Code base for CMIP6, but not the final CMIP6 configuration
- **CESM 2.1 (released December 10, 2018)**: Support for scientifically validated configurations used in CMIP6, as well as data from early CMIP6 simulations
- **CESM 2.1.1 (spring 2019)**: Additional CMIP6 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



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...

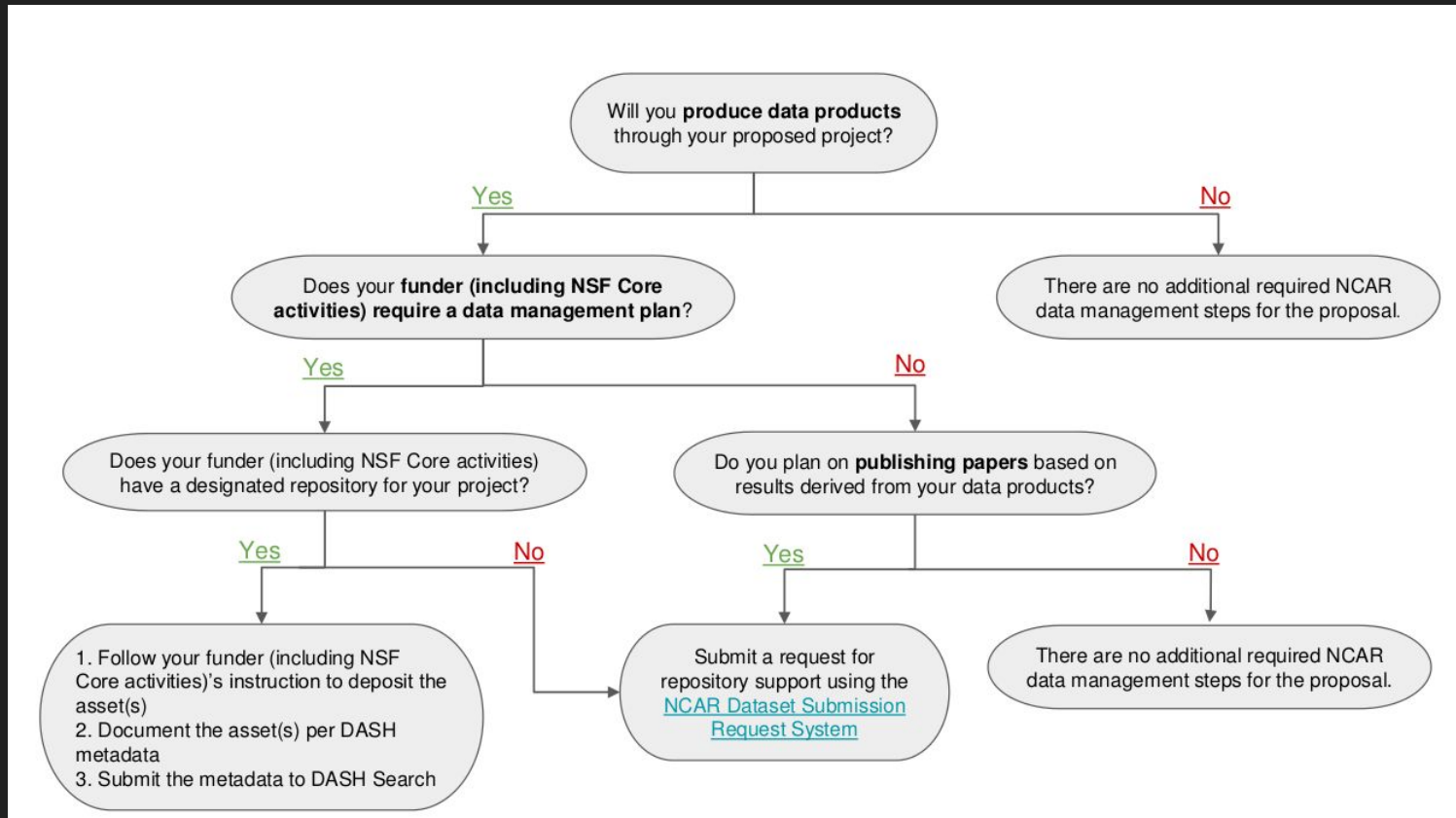
- **Home** (/glade/u/home/<username>):
 - 25GB quota, backed up, **not purged**
- **Scratch** (/glade/scratch/<username>):
 - 10TB quota, *not backed up*, **60 day purge**
- **Work** (/glade/work/<username>):
 - 1TB quota, *not backed up*, not purged (currently, could have a purge in the future)
- **Project** (/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>
- **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>
 - Transfer and manage files using Globus transfers (works across GLADE too!)
 - <https://www2.cisl.ucar.edu/resources/storage-and-file-systems/globus-file-transfers>

Data Issues and Cheyenne Storage Changes



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

- http://webext.cgd.ucar.edu/B1850/b.e21.B1850.f09_g17.CMIP6-piControl.002_wetland.glacier/
- 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!!