



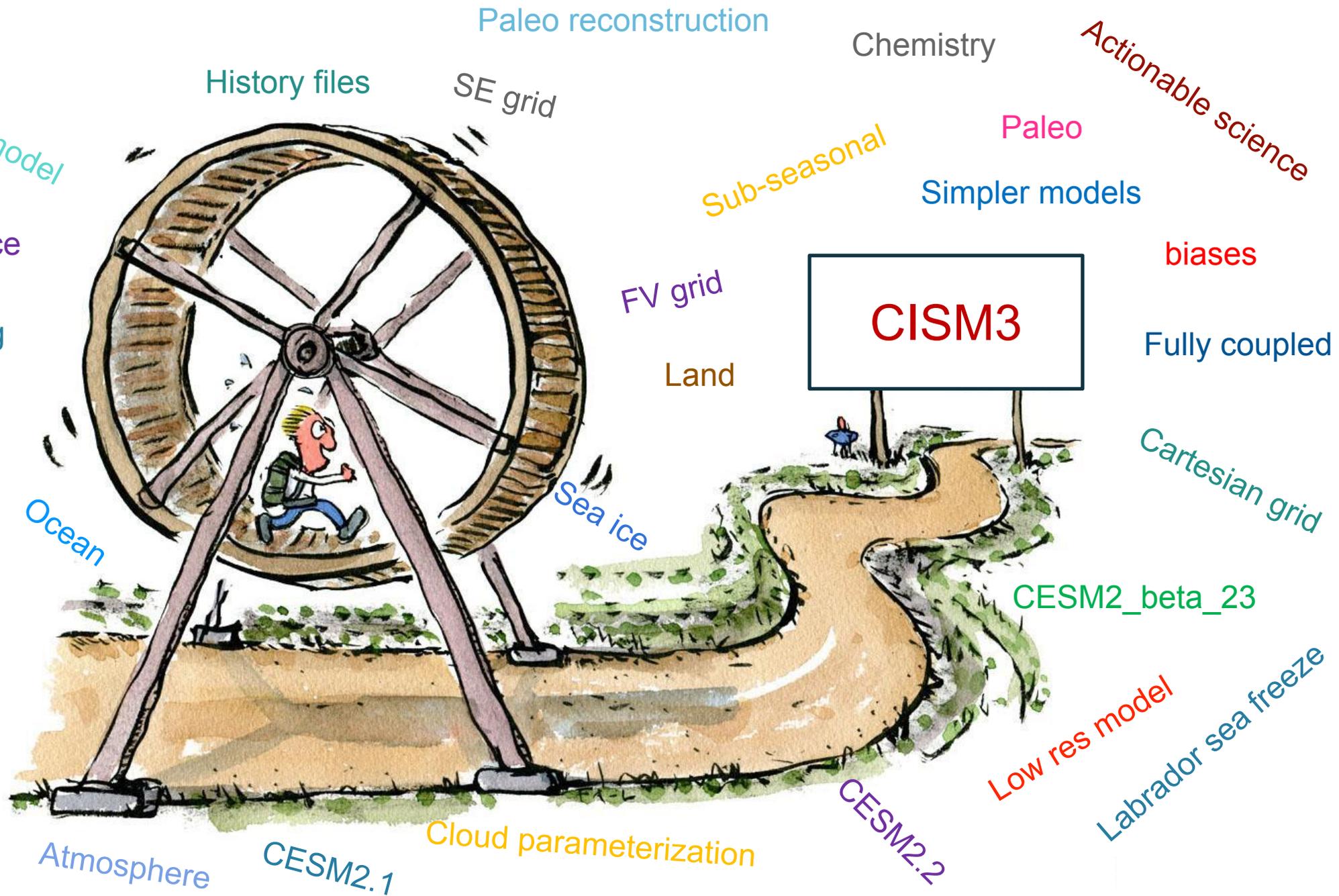
NCAR
OPERATED BY UCAR

February 11, 2026

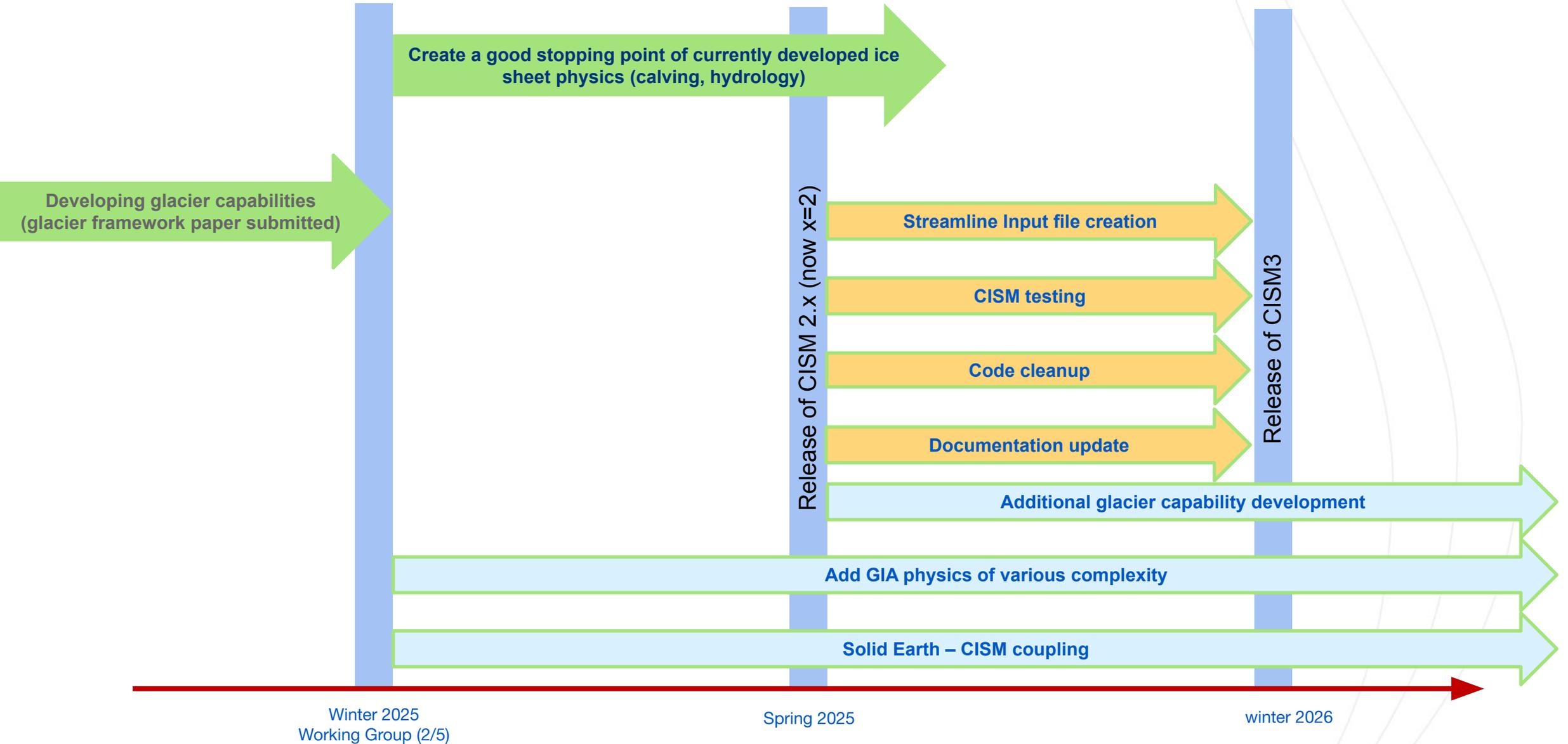
Land Ice Updates

*Gunter Leguy, Bill Lipscomb, Kate Thayer-Calder,
Samar Minallah, and the LIWG community*

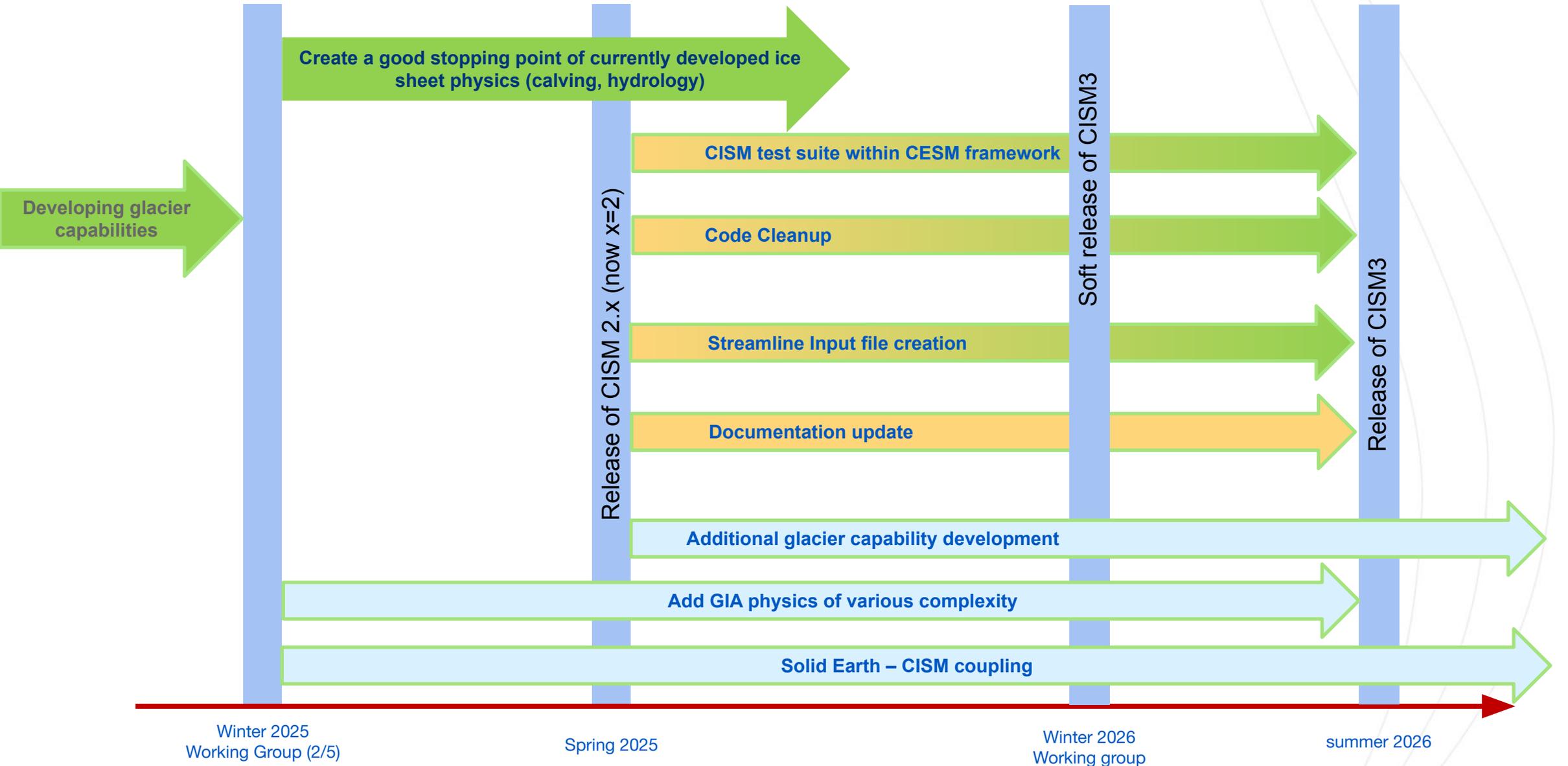
This material is based upon work supported by the NSF National Center for Atmospheric Research, a major facility sponsored by the U.S. National Science Foundation and managed by the University Corporation for Atmospheric Research. Any opinions, findings and conclusions or recommendations expressed in this material do not necessarily reflect the views of NSF.



CISM3 release



CISM3 release



CISM3 (soft) release



ESCOMP / CISM

Type to search

Code Issues 20 Pull requests 12 Discussions Actions Projects Wiki Security Insights Settings

CISM Public

Edit Pins Unwatch 9 Fork 15 Star 11

main 80 Branches 41 Tags

Go to file Add file Code

Katetc Merge pull request #75 from ESCOMP/lipscomb/smb_cleanup.v2 ae1c836 · 3 months ago 2,552 Commits

| | | |
|-------------|---|--------------|
| builds | adopting for running on Norwegian HPC betzy | 9 months ago |
| cism_driver | Turned off verbose variables | 3 months ago |
| libdycore | More work on parallel code to support multiple ice-sheet i... | 5 years ago |
| libglad | Replaced 'write(6,*)' with 'write(iulog,*)' | 4 months ago |

About

Community Ice Sheet Model

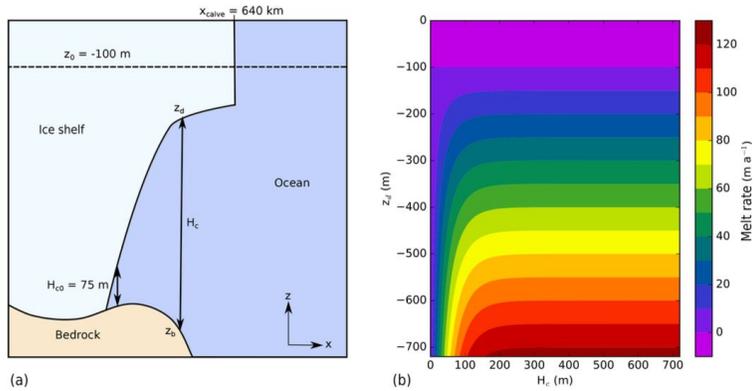
- Readme
- LGPL-3.0 and 2 other licenses found
- Code of conduct
- Activity
- Custom properties
- 11 stars
- 4 watchers

- CISM on github -> <https://github.com/ESCOMP/CISM>
- Latest code onto main -> CISM3
- Newest tag into CESM3 to date: [cism_main_2.02.003](#)
- A new pull request underway
 - Few bug fixes
 - More code cleanup
 - Reproducible sums



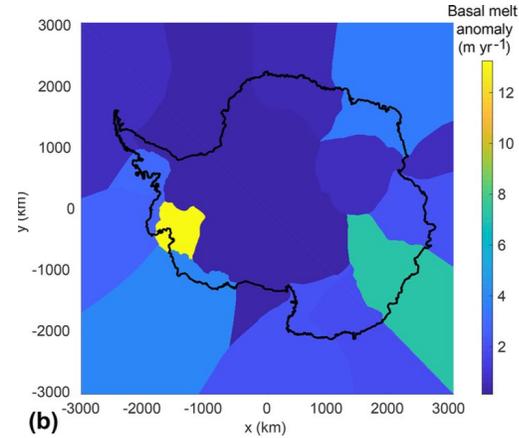
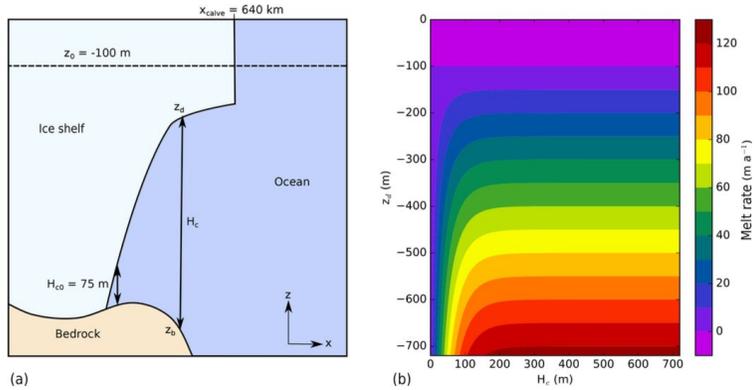
Major updates since CISM2

Enabling Antarctic science: melt rate in ice shelf cavities



Simple melt profile in an idealized setting:
MISMIP+ (Cornford et al., 2020)

Enabling Antarctic science: melt rate in ice shelf cavities

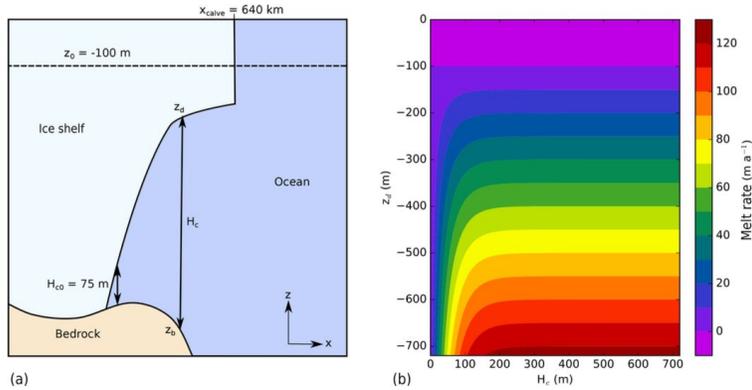


Simple melt profile in an idealized setting:
MISMIP+ (Cornford et al., 2020)

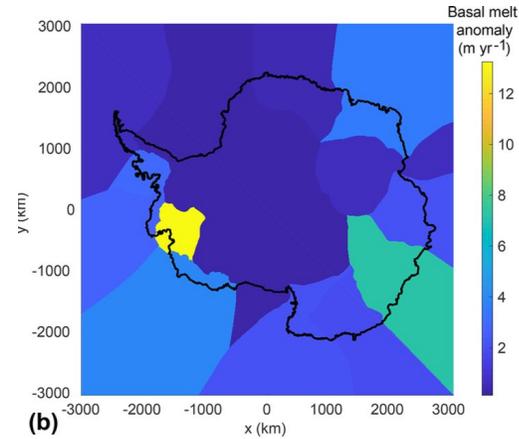
Applying idealized melt rates in AIS ice shelf cavities based on ocean basins:

- InitMIP (Seroussi et al., 2019)
- ABUMIP (Sun et al., 2020)
- LARMIP2 (Levermann et al., 2020)

Enabling Antarctic science: melt rate in ice shelf cavities



Simple melt profile in an idealized setting: MISMIP+ (Cornford et al., 2020)



Applying idealized melt rates in AIS ice shelf cavities based on ocean basins:

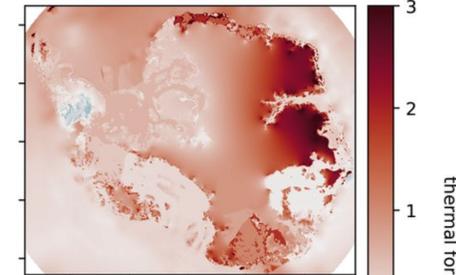
- InitMIP (Seroussi et al., 2019)
- ABUMIP (Sun et al, 2020)
- LARMIP2 (Levermann et al., 2020)



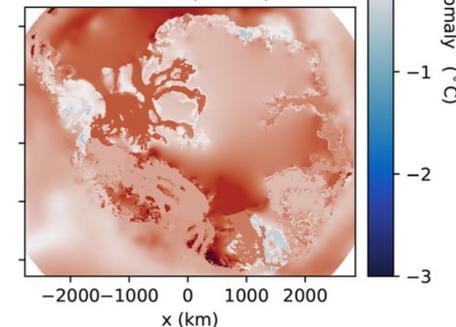
Using physically based parameterization to generate melt rates with ocean thermal forcing (or ocean T & S) generated by GCMs:

- ISMIP6 (Seroussi et al, 2020)
- AIS study (Lipscomb et al. 2020)

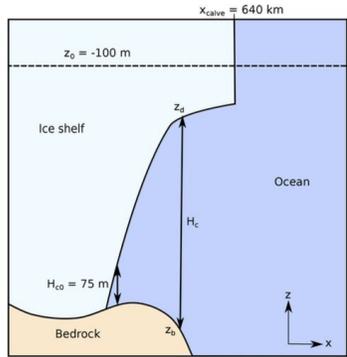
CESM2 (CMIP6)



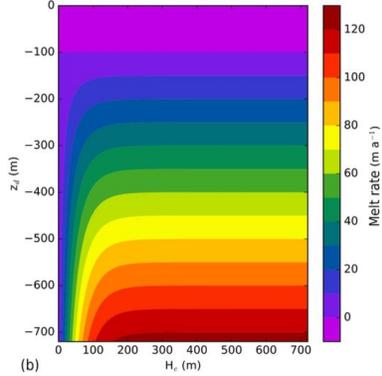
UKESM (CMIP6)



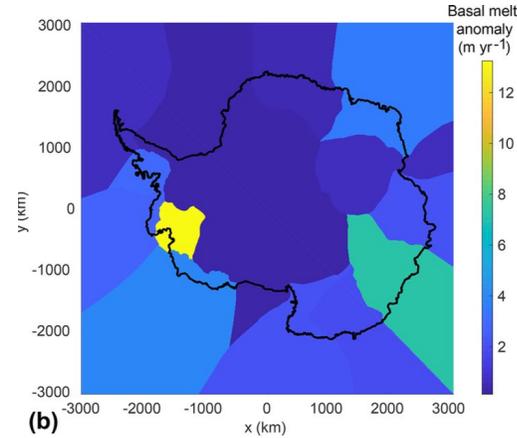
Enabling Antarctic science: melt rate in ice shelf cavities



(a)



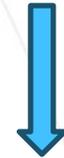
(b)



(b)

Applying idealized melt rates in AIS ice shelf cavities based on ocean basins:

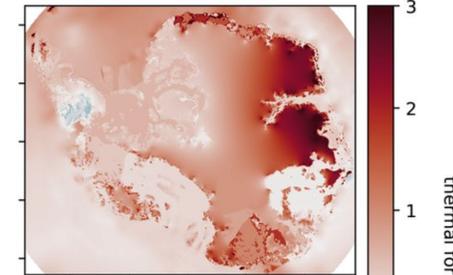
- InitMIP (Seroussi et al., 2019)
- ABUMIP (Sun et al, 2020)
- LARMIP2 (Levermann et al., 2020)



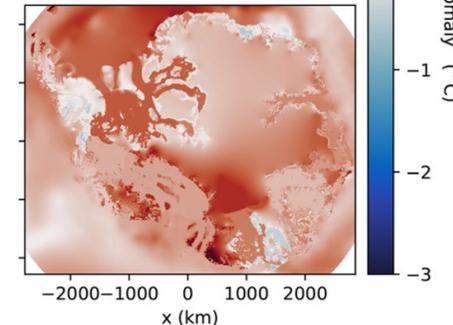
Simple melt profile in an idealized setting:

- MISMIP+ (Cornford et al., 2020)

CESM2 (CMIP6)

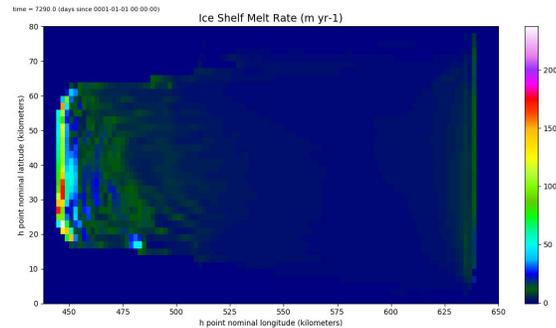


UKESM (CMIP6)

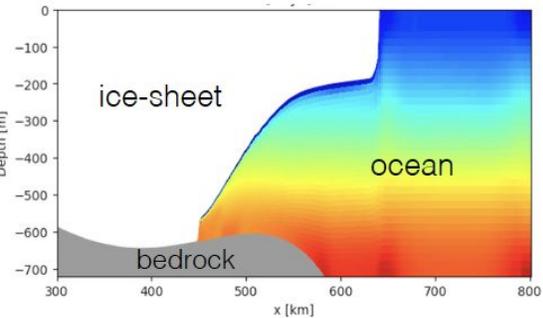


Using physically based parameterization to generate melt rates with ocean thermal forcing (or ocean T & S) generated by GCMs:

- ISMIP6 (Seroussi et al, 2020)
- AIS study (Lipscomb et al. 2020)



Sub-ice-shelf melt rate (m/yr) for an idealized experiment with CISM coupled to the MOM6



Schematic of sub-ice-shelf cavity

Generating melt rates directly from ocean model circulating in cavities:

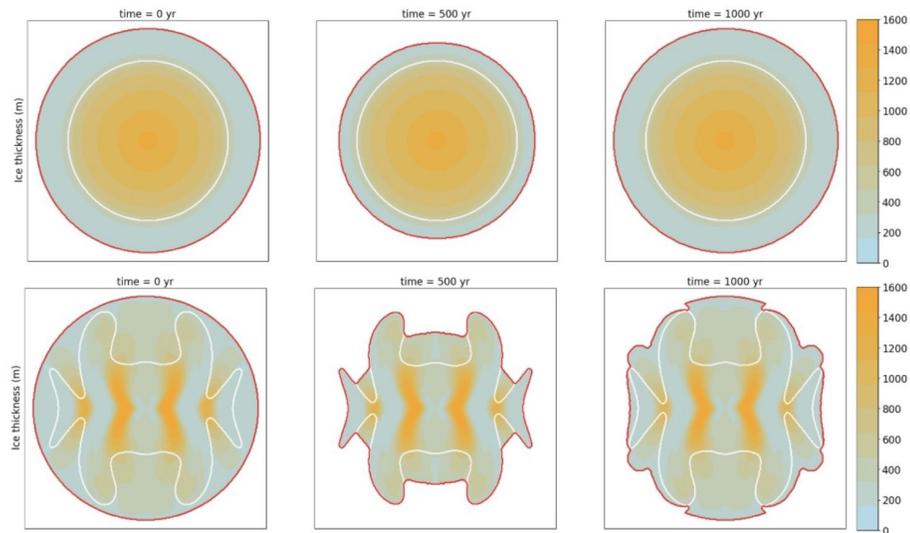
- MISOMIP (with G. Marques)



CalvingMIP

Assessing and improving approaches to calving in ice sheet models (coordinated by Jim Jordan, paper in prep.)

Phase 1: test calving algorithms in idealized domains with a prescribed lateral calving rate.

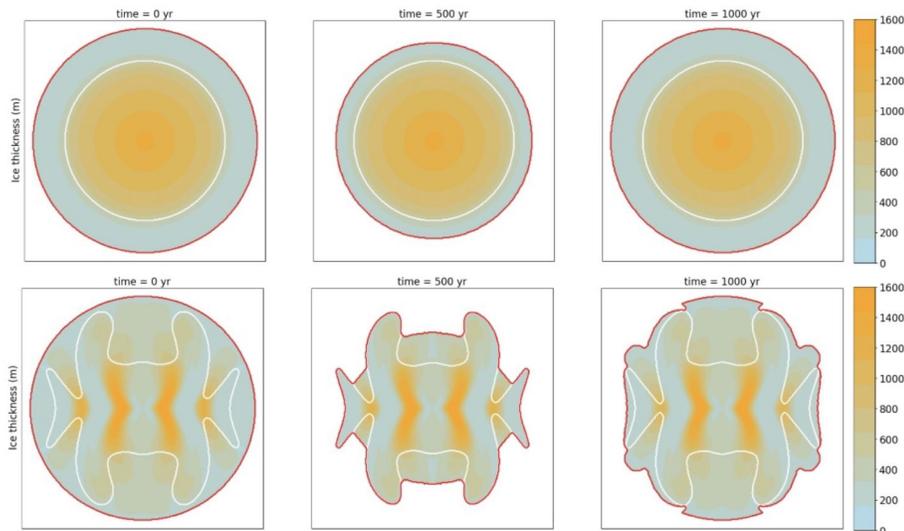


Ice shelf retreat and advance over 1000 years as simulated by CISM. (top) circular domain, (bottom) Thule domain. Orange = grounded ice, gray = floating ice

CalvingMIP

Assessing and improving approaches to calving in ice sheet models (coordinated by Jim Jordan, paper in prep.)

Phase 1: test calving algorithms in idealized domains with a prescribed lateral calving rate.



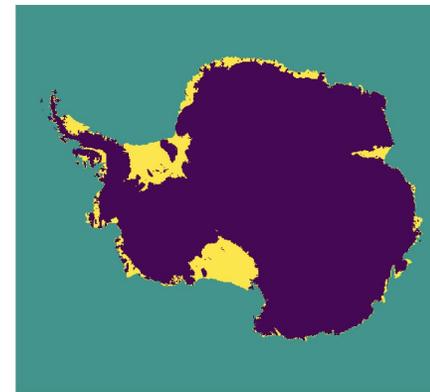
Ice shelf retreat and advance over 1000 years as simulated by CISM. (top) circular domain, (bottom) Thule domain. Orange = grounded ice, gray = floating ice

Calving law for CISM

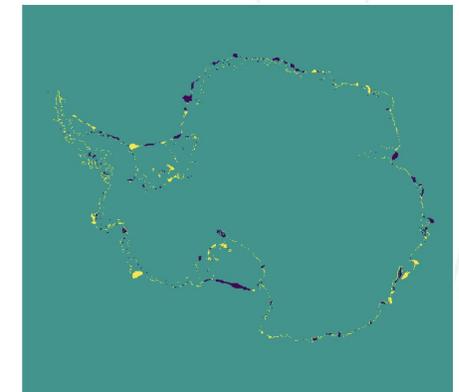
Computation of lateral calving rate as a function of the ice state (thickness, velocity, strain rates, stresses).

Calving law based on horizontal stresses at the calving front similar to Morlighem et al. (2016) and Lipscomb et al. (2019)

Simulated grounded and floating ice for a 5000-year AIS spin-up



CISM



CISM versus observations

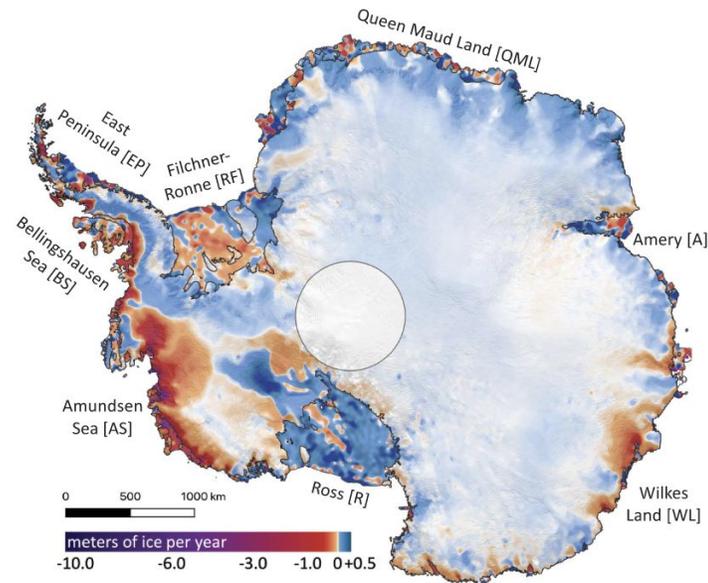
Yellow = floating ice
Purple = grounded ice

Yellow = floating in CISM but not in obs
Purple = floating in obs but not in CISM

Initialization method



A new spin-up technique optimizes the match to both observed **ice thickness** and **recent thickness changes**.

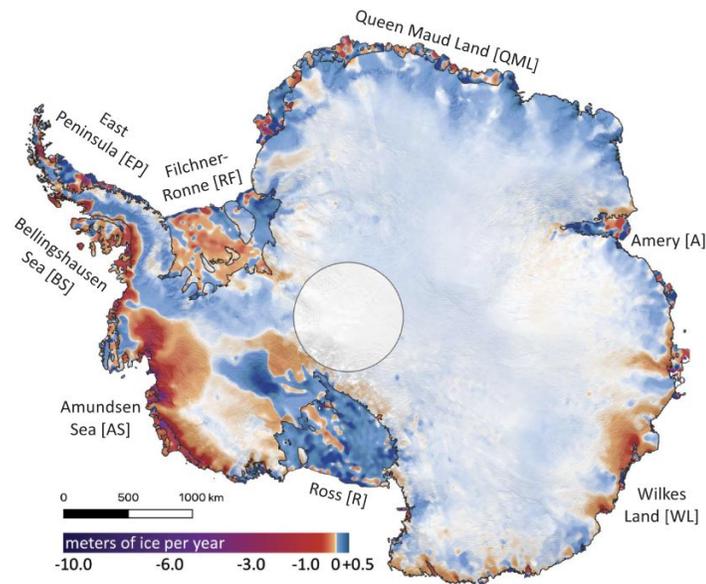


Observed ice thickness change (m/yr),
2003–2019 (Smith et al. 2020)

Initialization method

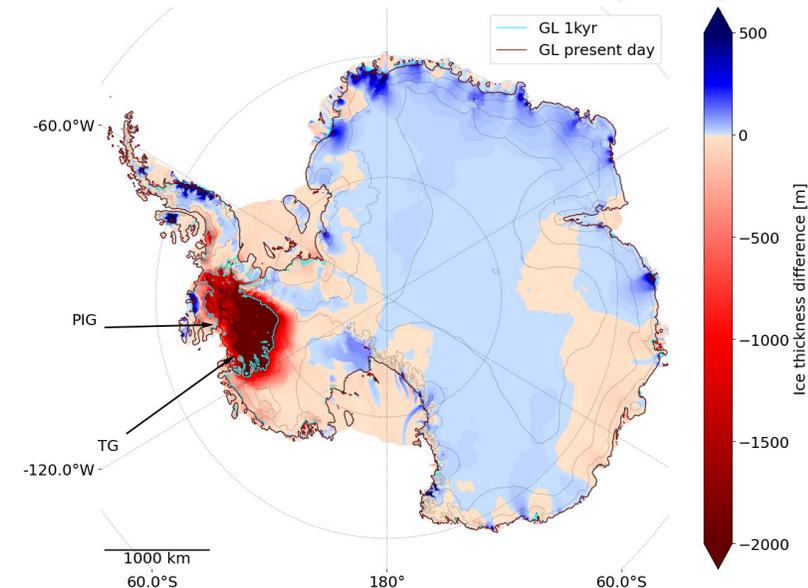


A new spin-up technique optimizes the match to both observed **ice thickness** and **recent thickness changes**.



Observed ice thickness change (m/yr),
2003–2019 (Smith et al. 2020)

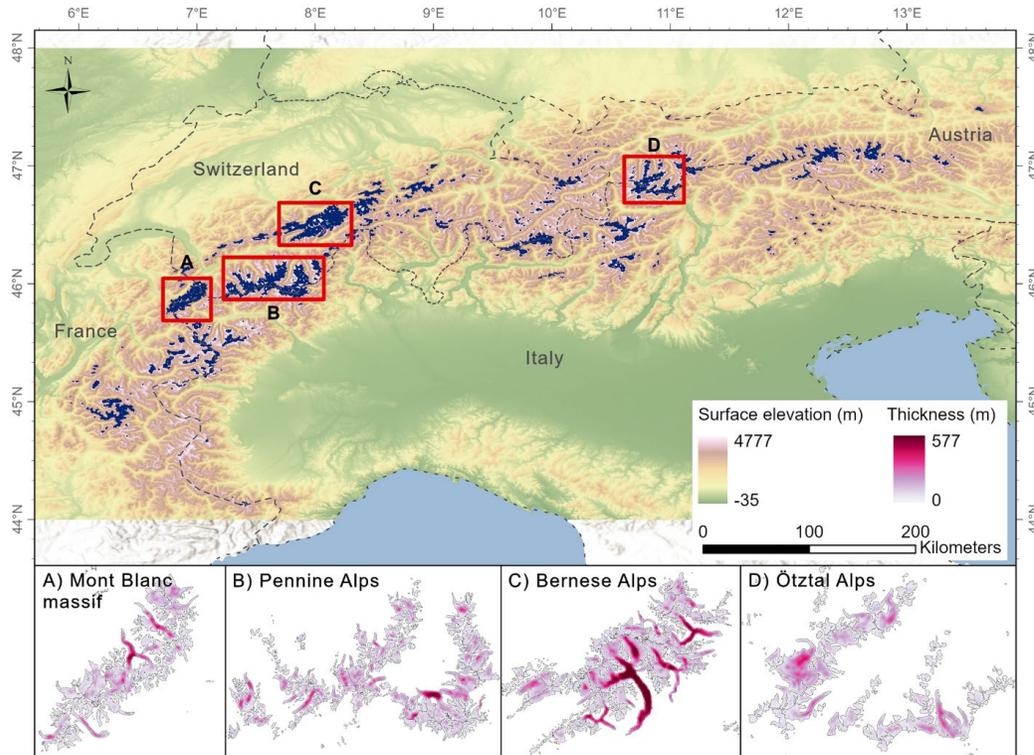
In CISM simulations, **Pine Island and Thwaites Glaciers collapse** over several centuries **even with no further warming**.



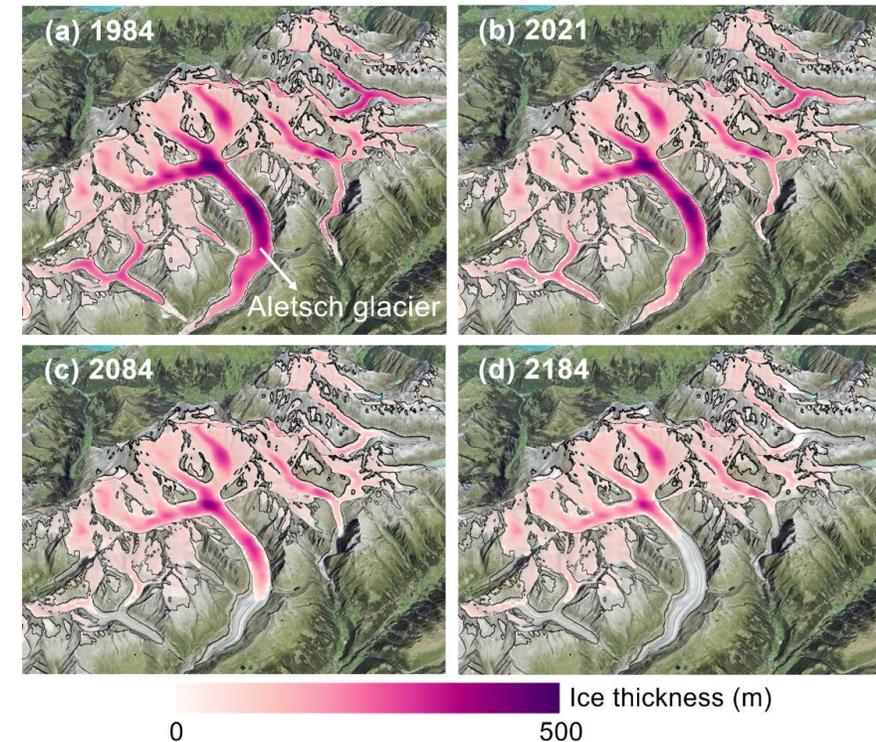
Simulated thickness change (m) over 1000 years with
present-day climate forcing (van den Akker et al., 2024)

Simulating Alpine glaciers

- Using CISM's 3D higher-order ice-flow capability to study glacier dynamics and impacts (Minallah & Lipscomb et al., 2025)
- Participated to GlacierMIP3 (Zekollari et al., 2025)



Top: CISM domain elevation profile (m) for the European Alps.
Bottom: Input ice thickness remapped to the 100 m CISM grid.
(figure from Minallah & Lipscomb et al., 2025)



Ice thickness evolution of the Aletsch glacier (Bernese Alps) assuming the continuation of recent climate (2000-2019).
(figure from Minallah & Lipscomb et al., 2025)

Other updates (including)



CISM physics

- New sliding laws
- Quasi steady-state basal hydrology scheme
- ...

CISM configuration

- New grids for AIS and GrIS (uniform 4km by default)
- Hybrid restart
- Block domain partitioning -> speed up the model (10ky GrIS inversion in ~10 hours on 256 processors)
- Increased flexibility for reading input files (as many instances as we want)
- Increased flexibility for writing output files (several instances each with their own writing time interval, very handy for separating scalars, velocity-grid and thickness-grid output).

- **Define several input file in the CISM config file**

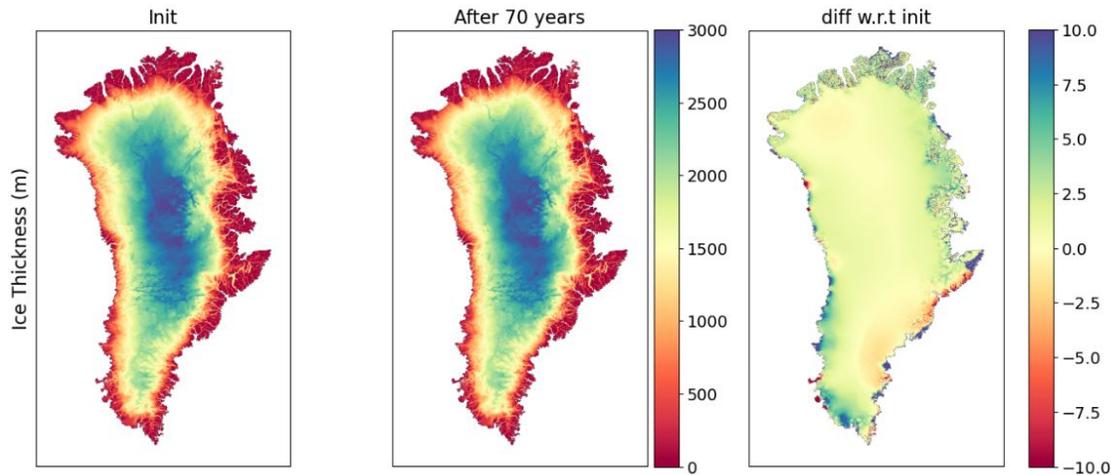
Config layout in CISM:

```
[CF input]
name = input_file_name1.nc
[CF input]
name = input_file_name2.nc
...
```

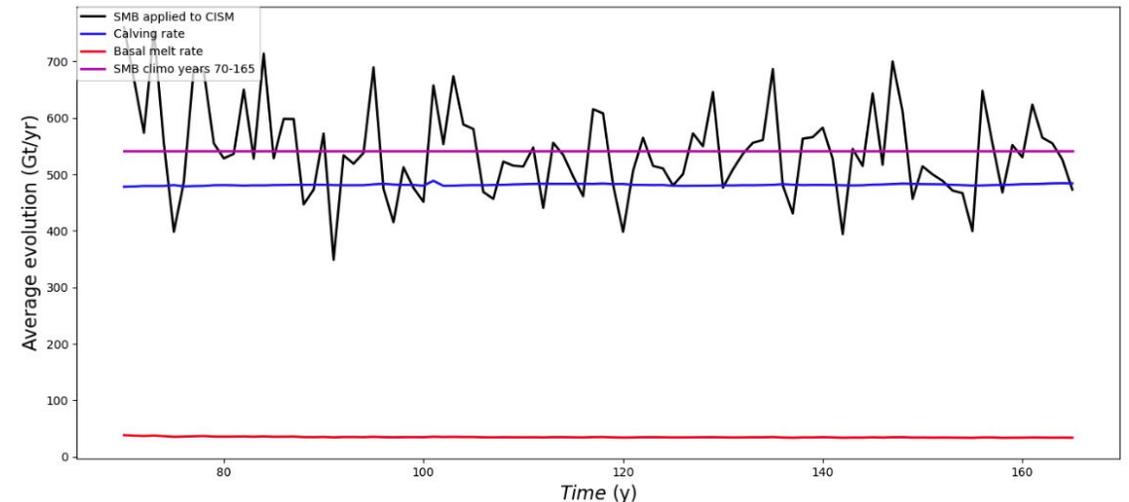
- **CISM reads the input files in order**

CISM3 with CESM3

- Ice sheet grids updated in CESM3.
- All the new CISM physics can be used in CESM3 (namelist variable updates).
- Reproducible sums in CISM3 (exact restart with different processor counts).
- Many more other software updates (Kate's presentation).



Thickness evolution of a fully coupled CESM3 run with an evolving GrIS.



Mass balance terms evolution of a fully coupled CESM3 run with an evolving GrIS.

CISM3 full release: what's next



- **Streamline Input file creation**

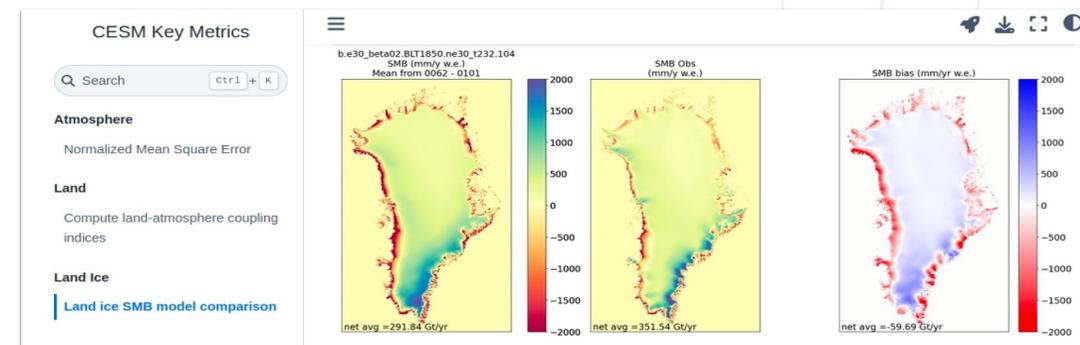
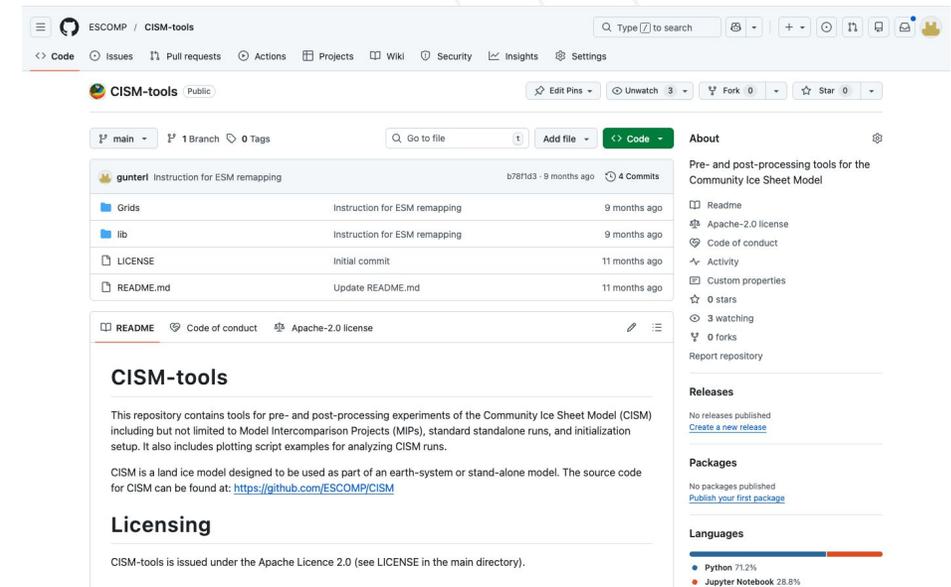
- Create interpolated input dataset onto a CISM grid.
- Making it accessible to the community.
- Github page exists!

- **Update documentation and website**

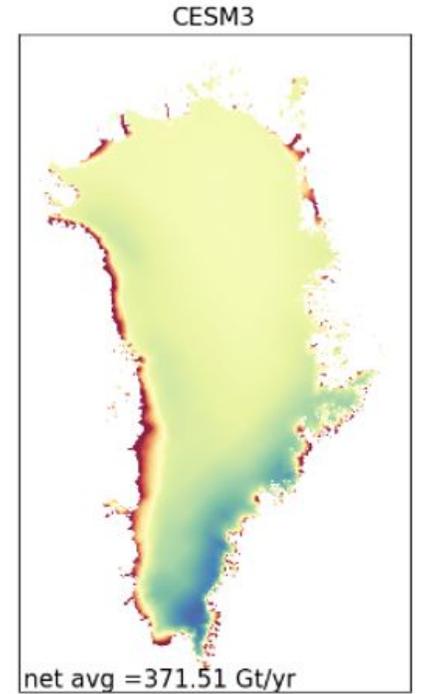
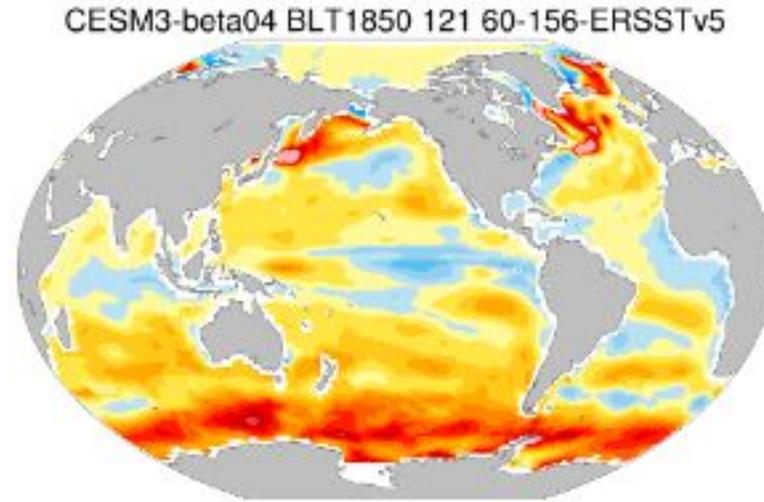
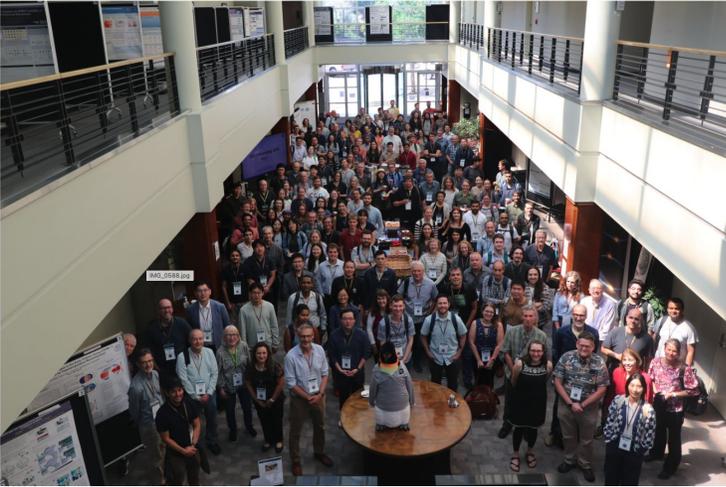
- Will move away from latex to improve community involvement

- **Land Ice diagnostic**

- For standalone simulations
- For CESM3 simulations (started with the CUPiD effort: <https://github.com/NCAR/CUPiD>)



Future events



CESM summer workshop June 15-17 2026

CESM summer tutorial July 6-10 2025

- Deadline for registration: February 17th 2026

Contact information

Website: <https://www.cesm.ucar.edu/working-groups/land-ice>

Co-chairs:

- Gunter Leguy, gunterl@ucar.edu
- Miren Vizcaino, M.Vizcaino@tudelft.nl

Liaisons:

- Software: Kate Thayer-Calder, katec@ucar.edu
- Science: Gunter Leguy, gunterl@ucar.edu

Code development:

- Bill Lipscomb, lipscomb@ucar.edu

