CESM workshop 2024 Code of Conduct

Here we value respectful dialogue, please . . .

CGD's Vision: A Culture of Respect & Belonging

https://www.cgd.ucar.edu/about/diversity

Revised June 2023

Land Ice Working Group session

10 minutes talk + 3 minutes for questions

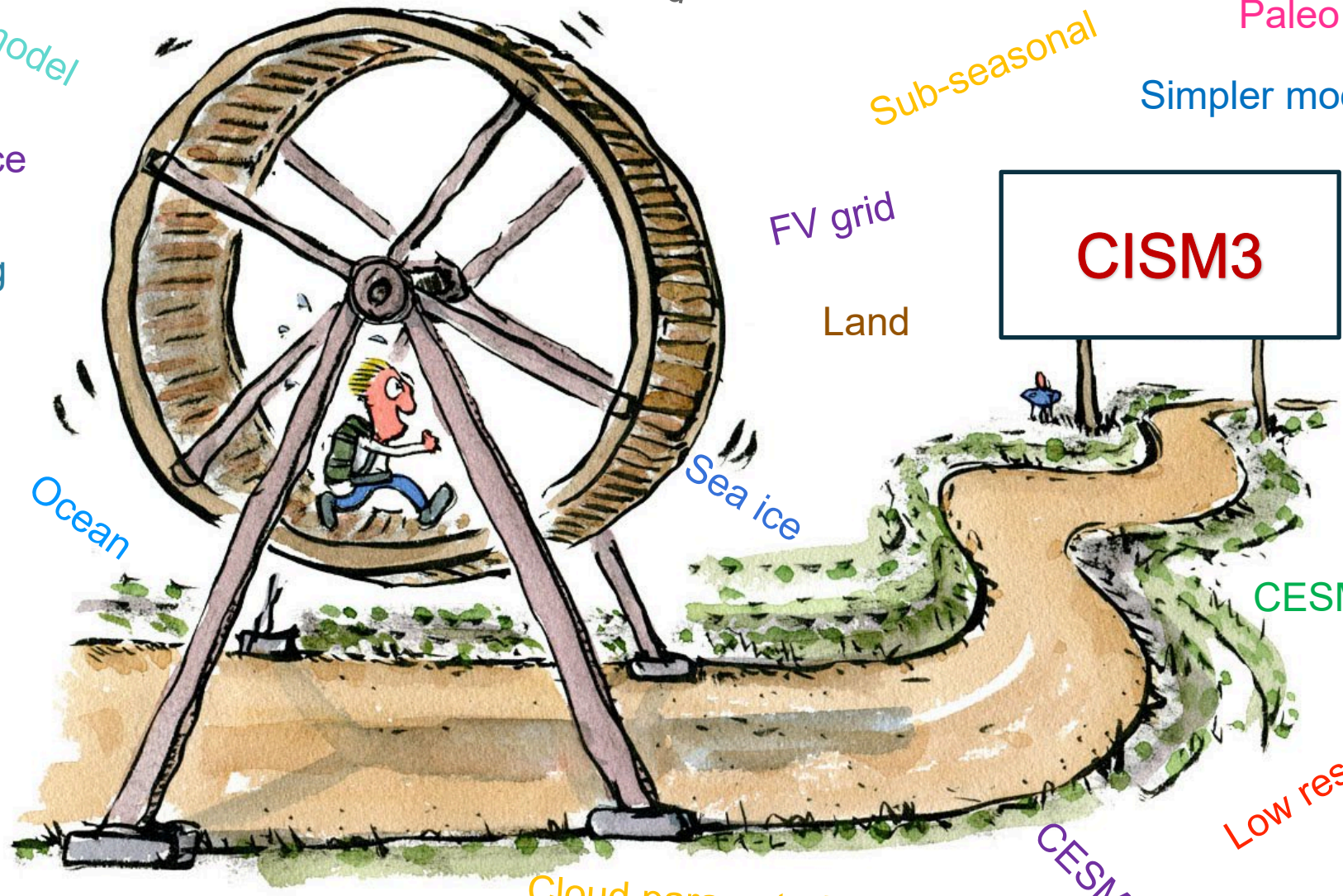
Time	Topic	Speakers
8:30	**Welcome**	co-chairs
8:32	Land ice update	Gunter Leguy
8:42	Updates to Ice Sheet and Ocean Coupling in CESM3	Kate Thayer-Calder
8:55	Influence of Greenland glacial ice-melt on AMOC and its possible climate impact	Sandeep Narayanasetti
9:08	Identifying energy balance drivers and feedbacks of Greenland ice sheet surface melt using causal inference	Ziqi Yin
9:21	Damaged Goods: Impacts of damage-rheology coupling on ice sheet evolution	Dan Martin
9:34	An extreme value theory perspective on large iceberg calving events	Joanna Millstein
9:47	Calving schemes in CISM for CalvingMIP and beyond	Bill Lipscomb
10:00	***Break***	
10:30	Using an ice softness parameter to decrease modeled ice surface velocity errors	Tim van den Akker
10:42	CitcomSVE-3.0: An efficient and open-source finite element package for modeling glacial isostatic adjustment process	Shijie Zhong
10:55	Impact of non-Newtonian rheology on Earth's response to Antarctica ice mass flux	Kaixuan Kang
11:08	Simulation of Last Glacial Maximum northern hemisphere ice sheets climate and surface mass balance with CESM2-CAM5	Miren Vizcaino
11:21	Modeling the Antarctic ice sheet and its contribution to Pliocene sea level	Taylor Deneau
11:34	Simulating mountain glacier mass balance and dynamics with the Community Ice Sheet Model	Samar Minallah
11:47	Forecasting the future of the Southern Patagonian Icefield using the Community Ice Sheet Model	Matthias Troch
12:00	***Session Adjourned***	

CISM and CESM3 updates

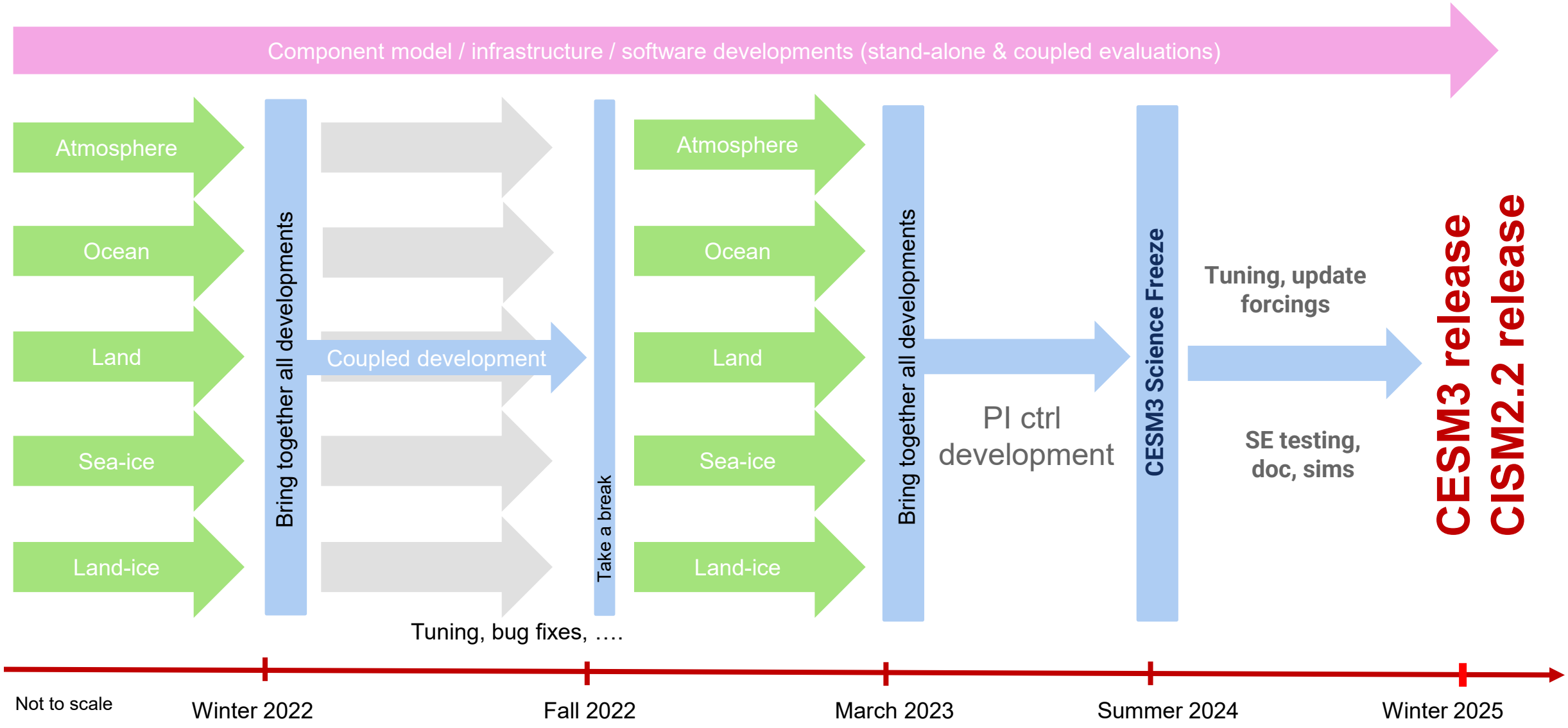
Gunter Leguy, Bill Lipscomb, Kate Thayer-Calder, Samar Minallah

LIWG
CESM Workshop 2024, June 12th

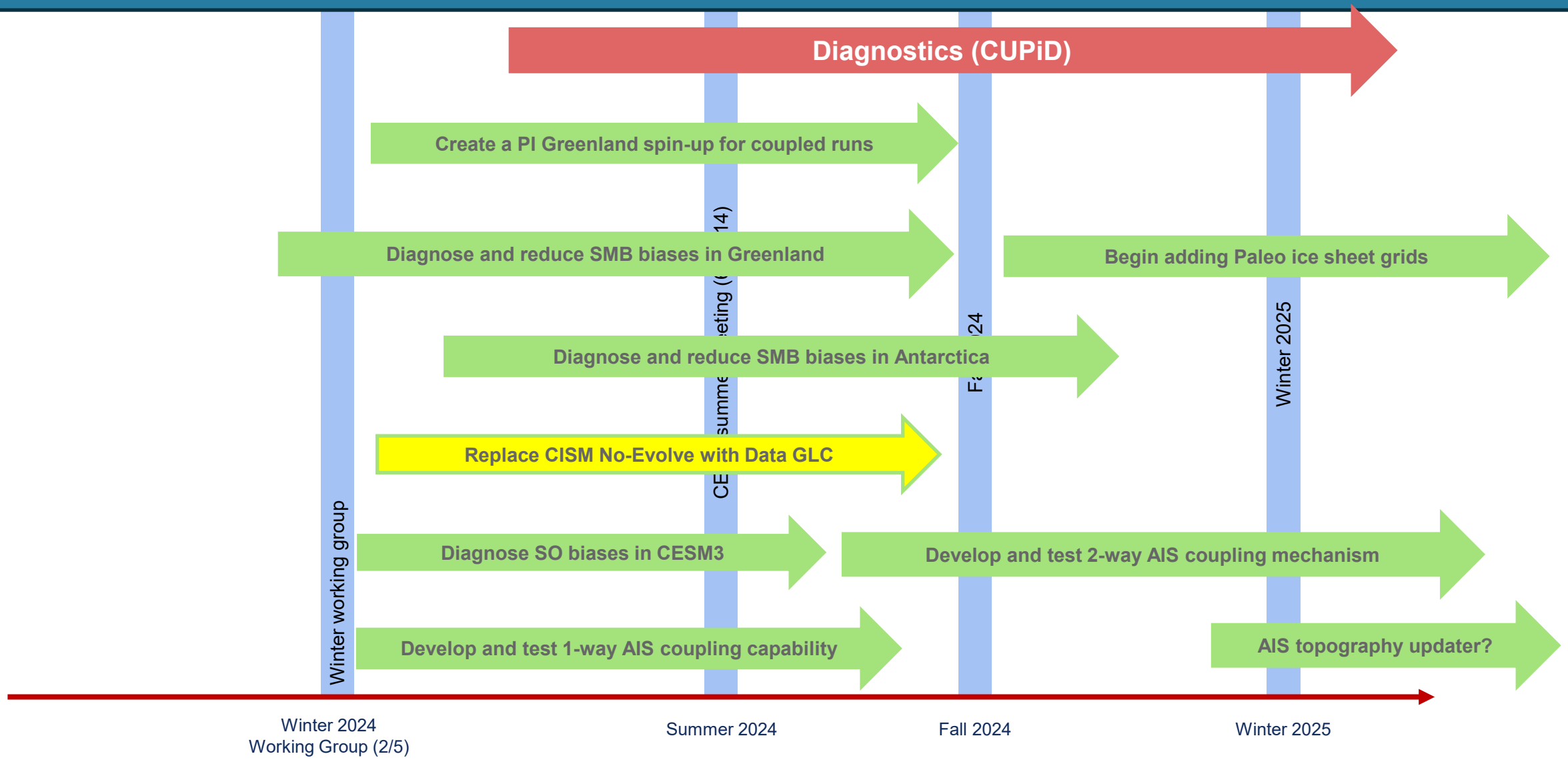
This material is based upon work supported by the National Center for Atmospheric Research, which is a major facility sponsored by the National Science Foundation under Cooperative Agreement No. 1852977.


Machine learning model
Paleo reconstruction
Chemistry
Actionable science
History files
SE grid
Time series
Sub-seasonal
Paleo
Simpler models
Fundamental science
biases
FV grid
CISM3
1-way coupling
Fully coupled
Land
vegetation
Cartesian grid
CMIPs
Ocean
Sea ice
High res model
CESM2_beta_23
Diagnostics
Low res model
Labrador sea freeze
Ocean cavities
CESM2.2
Cloud parameterization
Atmosphere
CESM2.1

Towards CESM3 and CISM3

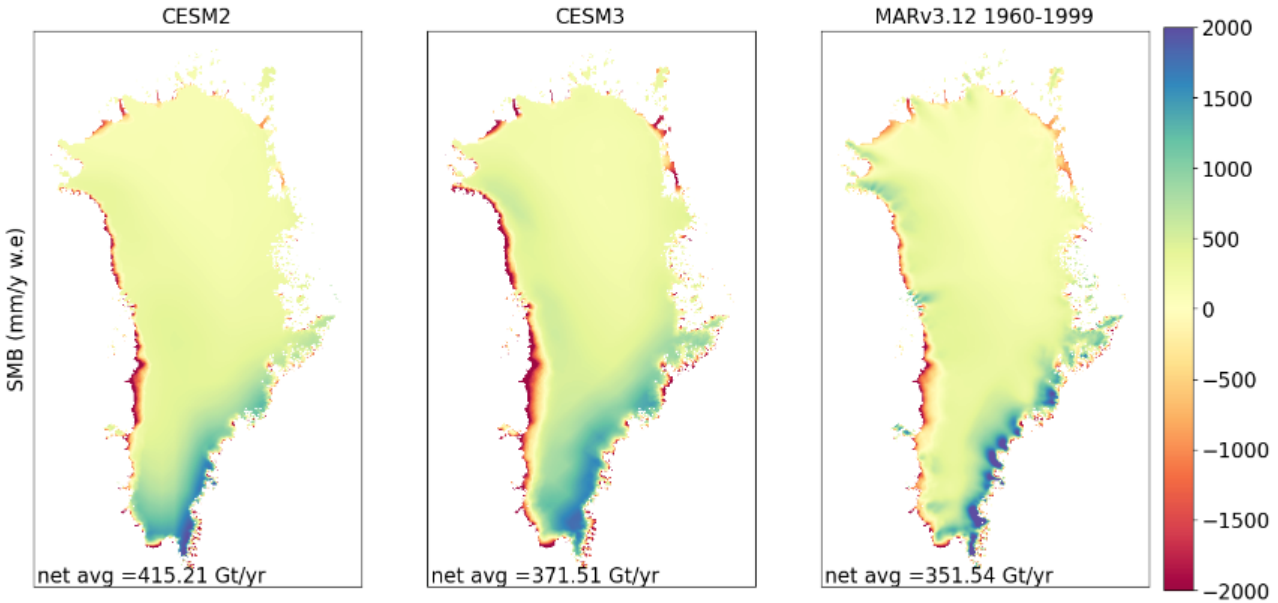


LIWG land ice plans for CESM3



Greenland SMB in CESM3 (so far)

Greenland climate/SMB



- MAR is averaged between 1960 and 1999.
- CESM/CISM averaged PI control.
- Good agreement between CESM and MAR in the ablation zone (red).
- Wider ablation zones in CESM3.
- Too much snowfall in Southern Greenland interior (resolution dependent).
- CISM set to no-evolve: ice is not added where there is no ice originally. (But CLM can form ice over bare tundra.)

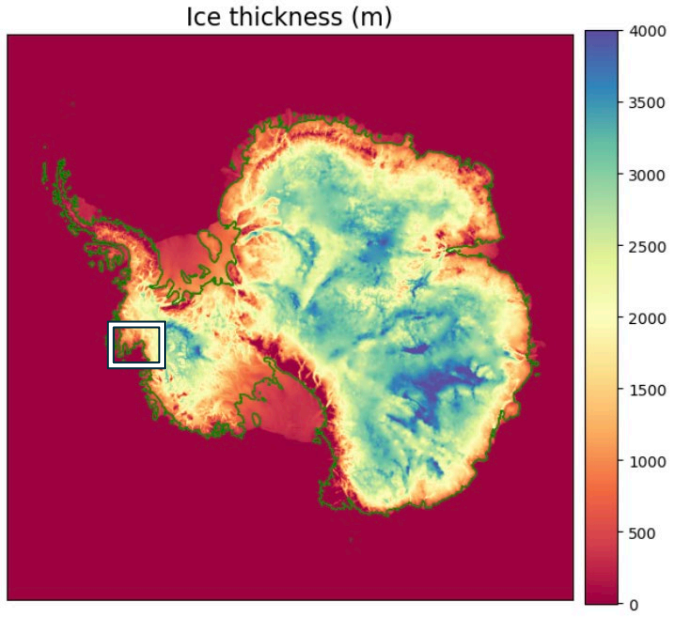
Net SMB average is slightly smaller for CESM3 due to compensation between wider ablation areas and larger snowfall (in particular in the south).

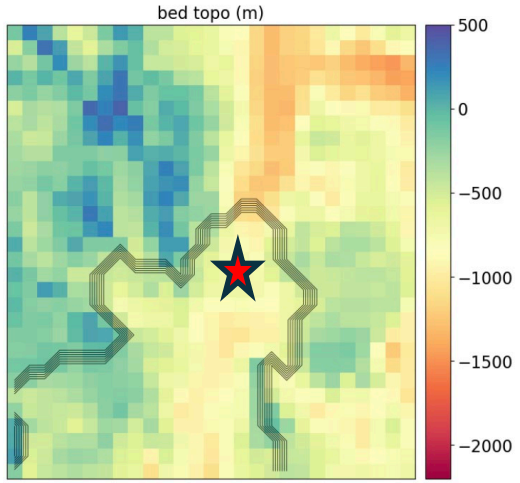
Improved snow physics and soil temperature in CLM might help with the biases TBD

Overall, the CESM3 SMB looks very promising considering we have not done any tuning yet!

Creating a Pre-industrial Antarctic Spin up

(in collaboration with Mira Berdahl and Eric Steig (UW), Bette Otto-Bliesner (NSF NCAR))





Challenges (sample)

- Grounding line retreat and unknown mass loss during the historical period.
- Some data about past groundling line location (PIG, Clark et al. 2023).
- Crude representation of ocean thermal forcing in ice shelf cavities without ocean model representation.
  - Could use some information from MOM6 for Ronne-Filchner and Ross ice shelves.
  - Add sub-ice-shelf cavity circulation module
- Need to bias-correct thermal forcing for historical period based on current observations.

Figures: (Top) Antarctic ice thickness at the end of a spin-up with the grounding line location (green). (Bottom) bed topography focused on Pine Island Glacier with suggested grounding line location (red star) in the 1940s from Clark et al. 2023)

Ocean grid and Antarctica

Current MOM6 grid

- does not extend beyond 81 S.
- problematic for ISMIP, PMIP, glacial–interglacial simulations, and multi-century projections.

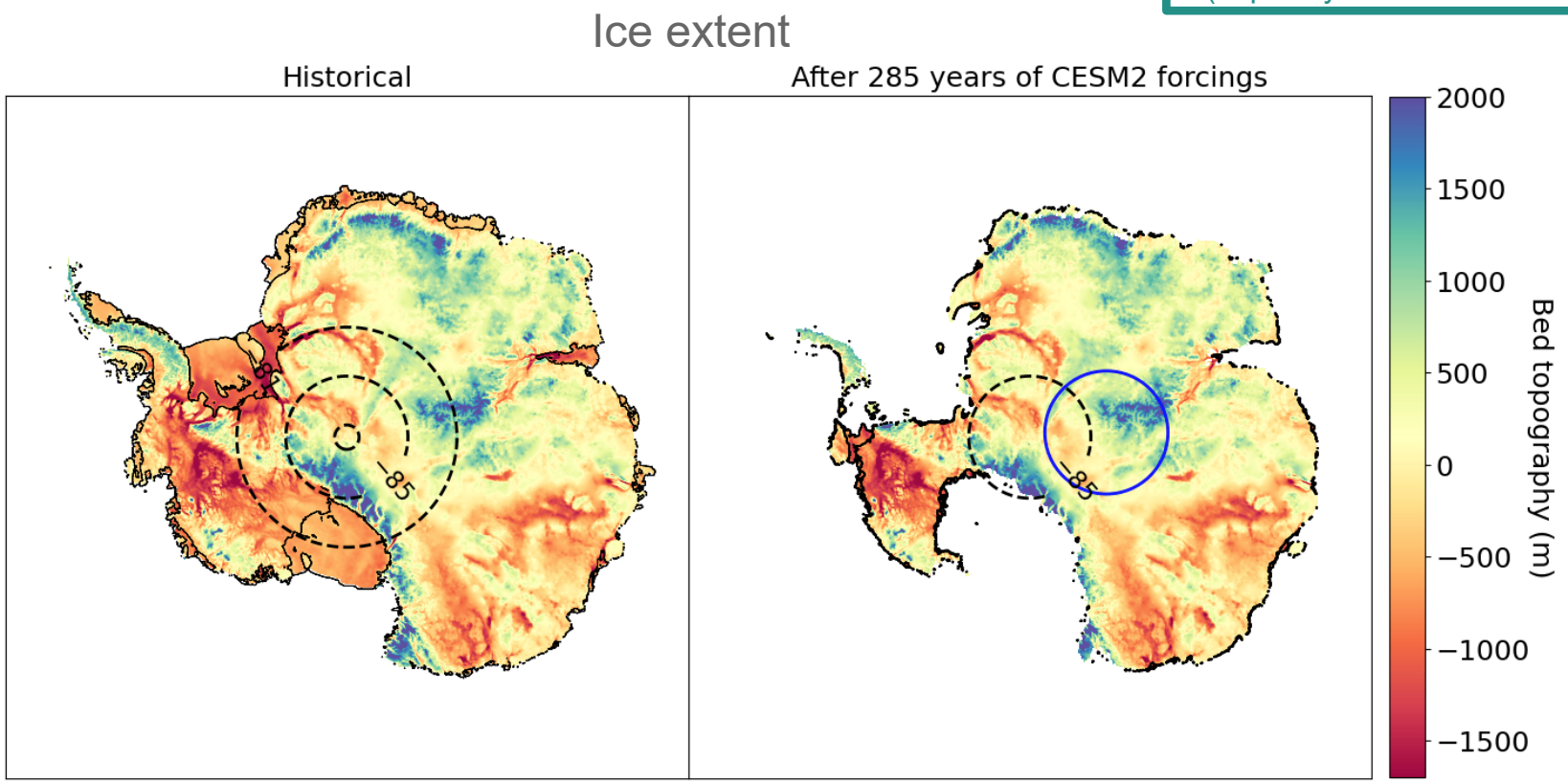
Goal

Allow MOM6 to extend under (at least) Ronne and Ross ice shelves all the way to grounding lines and (possibly) circulate in the cavities.

Potential fixes

- extend the grid to 85S
- move the pole (blue circle)

Note: we don't envision deploying and testing a new grid before the science freeze (hopefully our needs won't be forgotten after)



Questions

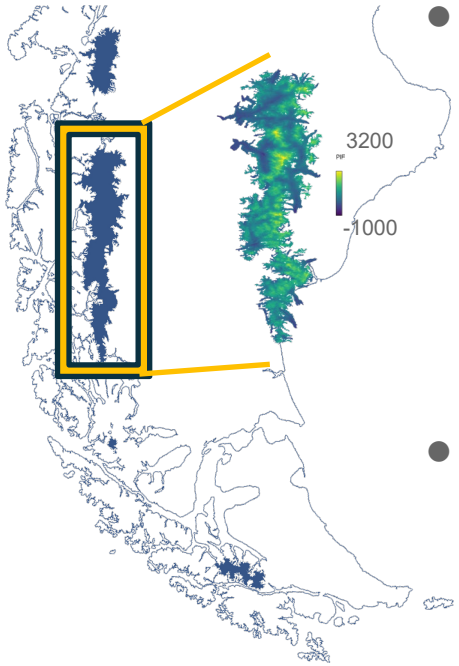
Would extending the grid impact the ocean time step and computing time?

Fig: Antarctic bed topography showing the ice sheet extent (black contours) (left) with latitude contours (81S, 85S, 89S) at the end of the historical, and after 285 years of high emission CESM2 forcing (right) with latitude contour (85S) (black) and shifted 85 S (blue) if pole was moved.

Using CISM for glacier modeling

- Alpine glaciers
  - Submitted results to GlacierMIP3 (paper in prep)
  - Manuscript in prep

Subglacial bed elevation (m)
Fürst et al. (2024)



- Southern Patagonian Icefield
  - In collaboration with Matthias Troch and Bob Anderson (CU Boulder)
  - Challenges include marine-terminating glaciers in fjords

- High Mountain Asia
  - CISM at 200m resolution
  - Domain with actual dynamic glaciers is sparse
  - Nepal region is small but HMA is about 4000 x 2800 km

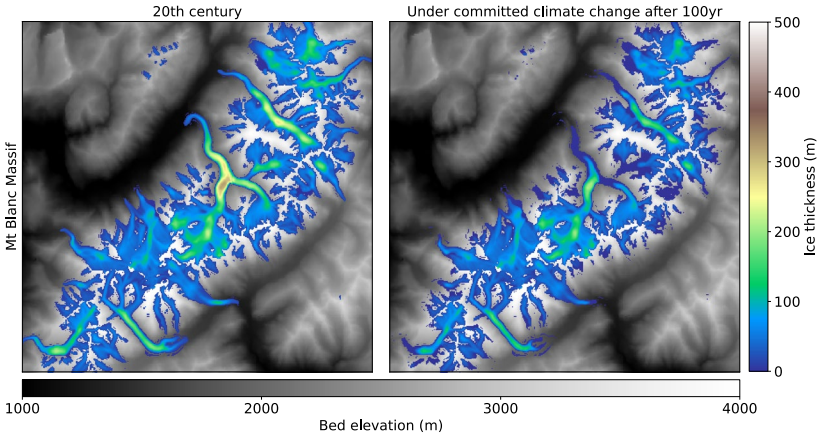


Fig.: *the Mont Blanc Massif ice thickness for the 20th century (left) and after 100 years of committed climate change (right).*

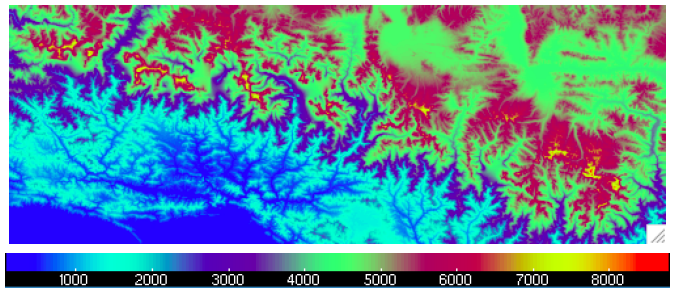
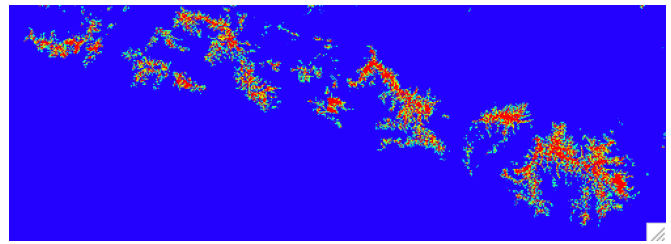


Fig.*: (Top) Nepal region bed topography on the CISM grid. (Bottom) ice mask in the Nepal region on the CISM grid.*



CISM releases

CISM2.2 for CESM3 science freeze

Ice sheet physics
- New Coulomb basal sliding law (Zoet-Iverson) ✓
- Flux-routing basal hydrology scheme ✓
- Sub-ice-shelf cavity ocean T&S interpolation ✓
- Support for glacier modeling ✓

Ice sheet Initializations
- Spin-up with SMB ✓
- Spin-up with SMB + dh_dt ✓

Test cases (for Derecho and laptop)
- Antarctica ✓
- Greenland ✓

Code validation
- LIVVkit ✓

CISM3 (for CESM3.1)

Dynamical core
- C-grid ice velocity solver

Ice sheet physics
- New calving schemes and options ✓
- Sub-ice-shelf cavity circulation module

Mountain glaciers
- Inversion methods for glacier spin-up ✓

Tools and datasets
- Glacier grid generation and mapping tools ✓
- Diagnostics (notebooks) ✓

Documentation

Contact information

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

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