Here we value respectful dialogue, please...

Offer Constructive Feedback

Consider New Ideas

Share The Air

NCAR
UCAR

Show Appreciation

Acknowledge Teamwork

Encourage Innovation

Time	Topic	Speakers
Overview: *Location*		
8:30	**Welcome and logistics**	Gunter Leguy + Miren Vizcaino
8:35	LIWG highlights	Gunter Leguy
8:55	Improving Seasonality of Glacier Runoff in CESM	Kate Thayer-Calder
9:15	New features and enhancements in CLM snow albedo modeling	Cenlin He
9:35	NorESM2 climate evolution until 2300 with an evolving Greenland ice sheet	Konstanze Haubner
	BREAK	
10:30	Minor contribution of ablation area expansion to future Greenland Ice sheet mass loss	Miren Vizcaino
10:50	High-resolution, Fully-coupled Simulations of the Greenland Ice Sheet in a Future, Strong Warming Scenario	Ziqi Yin
11:10	Global Sources of Moisture for Atmospheric Rivers over Antarctica	Tri Datta
11:30	Modeling the drift and decay of giant tabular icebergs	Alex Huth
11:50	Discussion	
12:15	**Adjourn**	

Poster(s):

	Exploring Conditions of WAIS collapse during the Last Interglacial	Mira Berdahl

Discussion topics

1. Diagnostic packages
2. Ice-ocean interaction
3. Using CISM and CESM-CISM for actionable science.
4. The important questions for the LIWG to investigate

LIWG highlights

Gunter Leguy, Bill Lipscomb, Samar Minallah, Kate Thayer-Calder
and many LIWG collaborators

NCAR

NSF

14 June 2023

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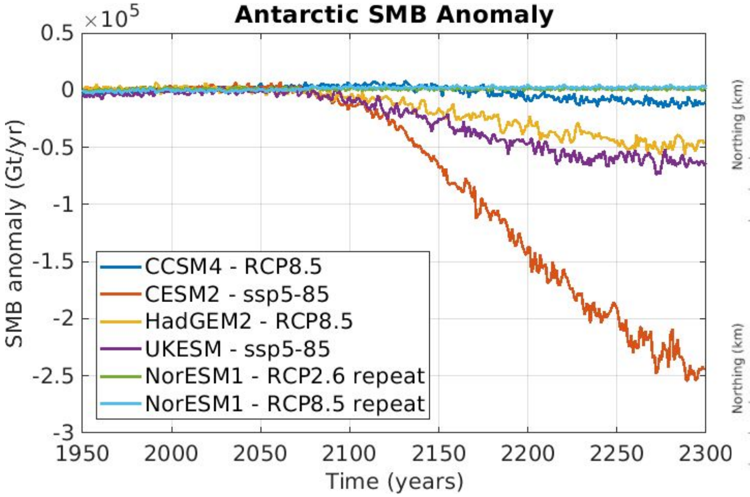
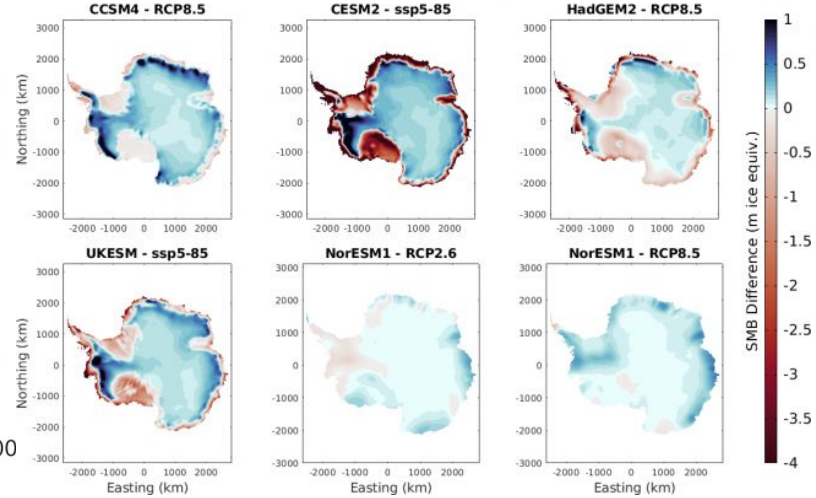
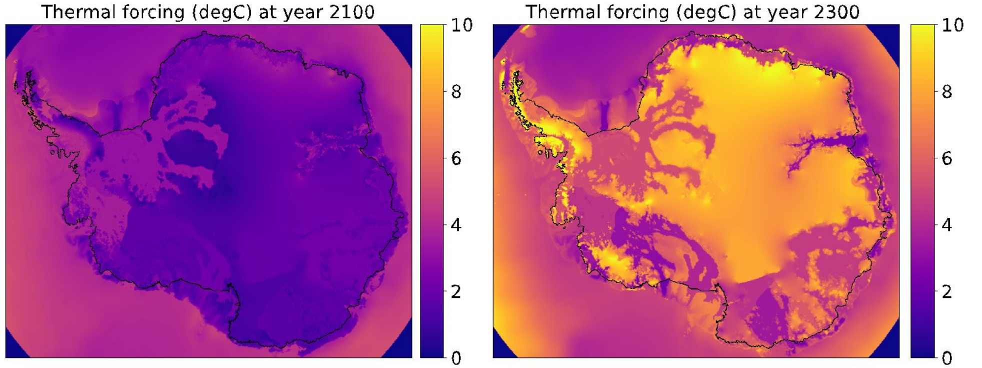
ISMIP6 Antarctica extension to 2300



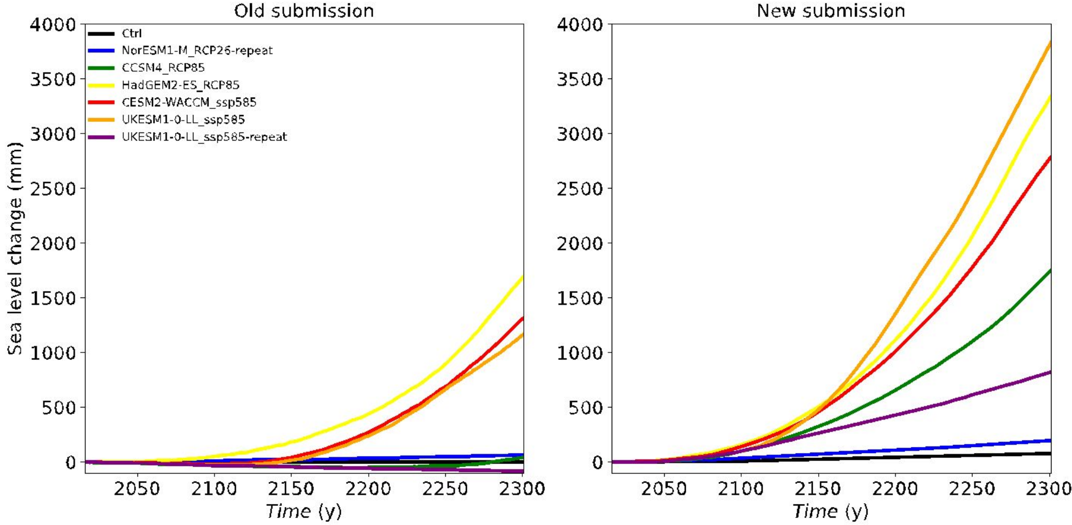


Figs. : (left) SMB anomaly (Gt/yr) timeseries. (right) : Change in SMB between the projection start and end date (2300 minus 2015) for the AOGCMs shown in (left). (Figures from extended protocol: https://www.climate-cryosphere.org/wiki/index.php?title=ISMIP6-Projections2300-Antarctica)

(TF(5 degC) -> melt rate of ~ 100 m/y)



Figs: (top) Thermal forcing from CESM2 shown at -690 m depth. (bottom) Sea level change time series for the Tier1 experiments comparing the old and new submissions. The new submission includes new inversion procedure and uses the Zoet-Iverson (Zoet and Iverson 2020) as opposed to a powerlaw sliding law (Schoof 2007).



- New model spin-up inverts for average basin temperature instead of basal melt rates for floating ice (among other things).
- Modest sea level contribution by 2100.
- Large and wide spread sea level contribution by 2300 when using projected forcing (as opposed to repeat or low forcing).
- The initialization procedure and choices of physics impacts the results by up to a factor of ~3.

Sensitivity to thermal forcing and basal sliding

(Mira Berdahl, Gunter Leguy, William H. Lipscomb, Nathan M. Urban, and Matthew J. Hoffman (TC 2023))

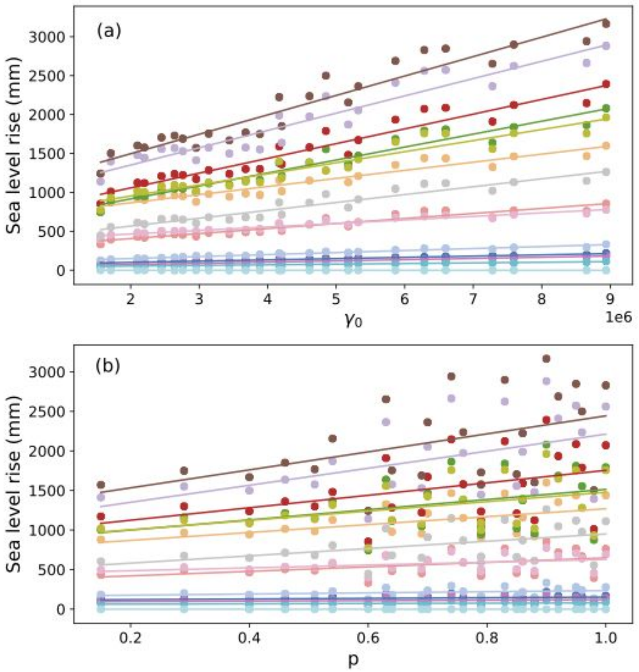
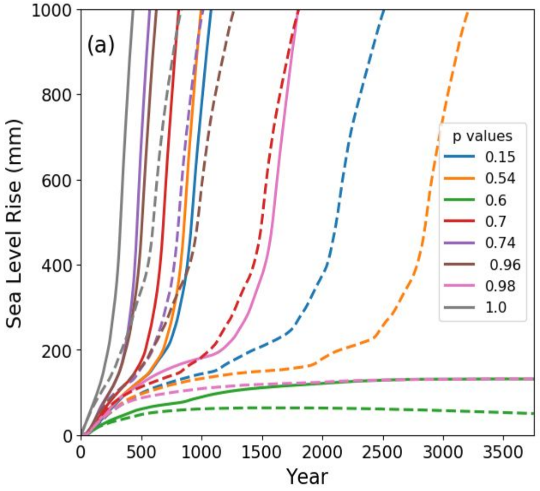
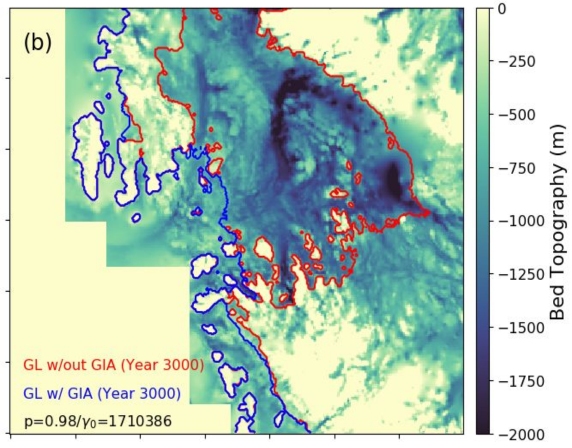


Fig: Continental SLR fits forced with CMIP5 and CMIP6 GCMs as a function of (a) thermal forcing and (b) basal sliding with best linear fits.





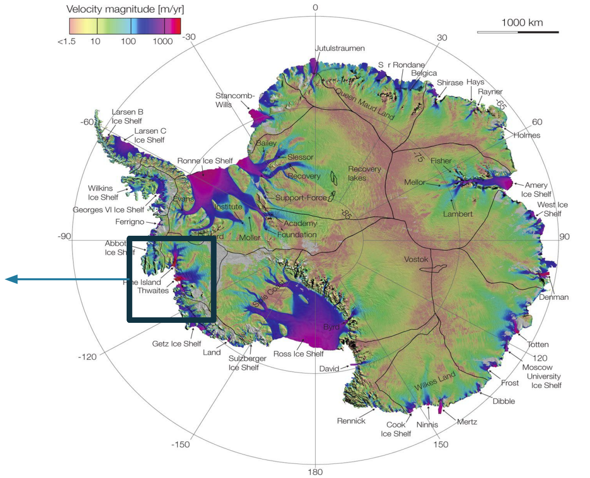


Fig: Results of a 2degC synthetic run. (left) Sea level rise with (dashed lines) and without (solid lines) a GIA model. The y-axis is truncated at 1~m sea level rise. (center) Amundsen region grounding line location evolution without GIA (red) and with GIA (blue) after 3000 years of simulation. The shaded background shows seafloor topography (m) without isostatic adjustment. (right) Antarctic map with a box showing the Amundsen region.

- In CISM, thermal forcing is a stronger dynamical driver compared to basal sliding.
- GIA can delay sea level response from centuries to millennia.
- GIA rarely prevents Thwaites collapse.

Incorporating present-day mass changes rates in a CISM Antarctica runs

(Tim van den Akker (t.vandenakker@uu.nl), Bill Lipscomb, Gunter Leguy, Roderick van de Wal, Willem Jan van de Berg)

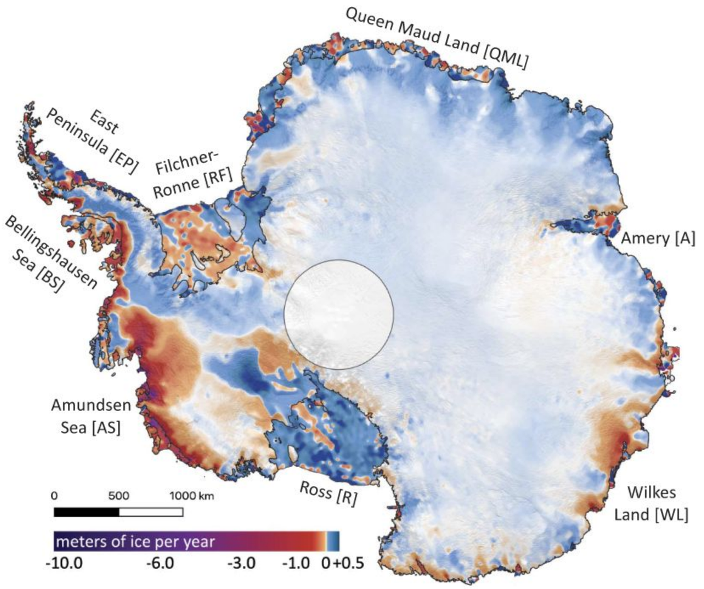
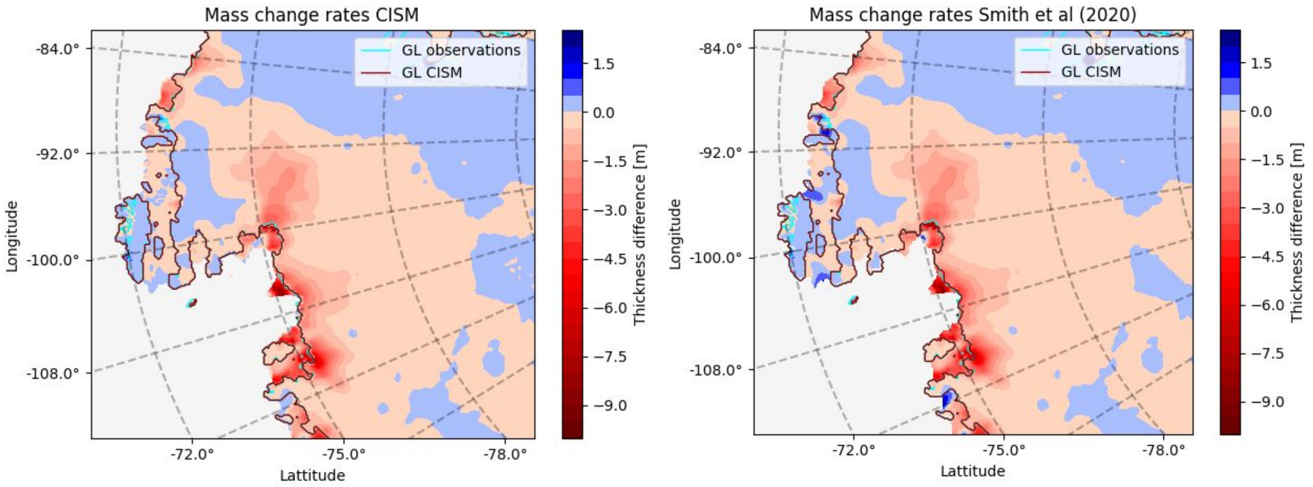
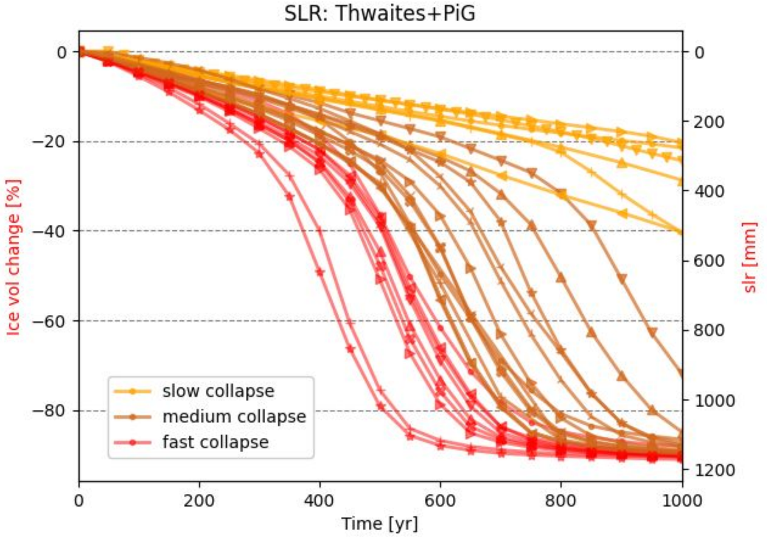


Fig: Antarctic mass change (2003-2019; Smith et al. 2020)

- We can now run with observed dh/dt
- We can simulate what happens to the AIS under current climate conditions
- We found in many cases a collapse of Thwaites and Pine Island
- Results mainly sensitive to model choices around basal melting and thermal forcing



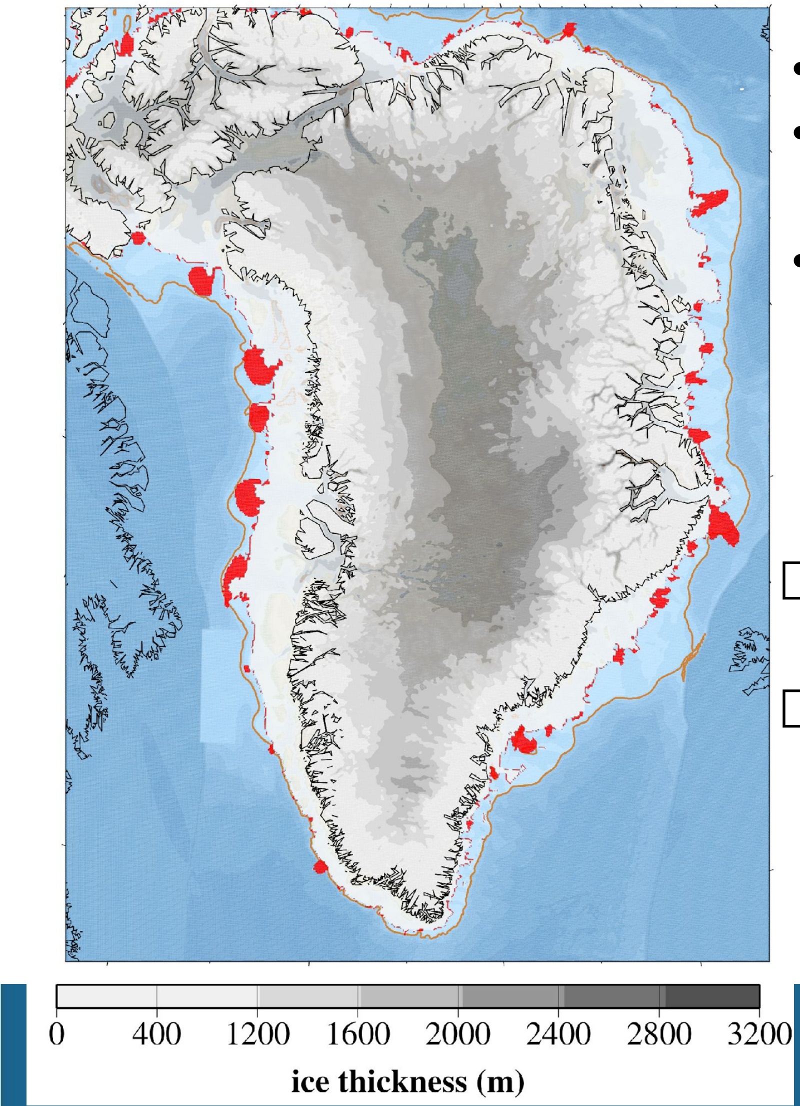


Figs: (top) Comparison of mass rate change at the end of spin-up (left) and observation (right) and the grounding line location. (bottom) Simulation ensemble with various parameter perturbation exploring Thwaites collapse.

Greenland ice sheet transient simulation from 24 ka to 1850 with CISM

Sarah Bradley and Tancrede Leger

Spun-up initial extent at 24 ka BP



Work in progress!

- The aim is to investigate evolution of the GrIS from 24 ka to 1850.
- Would the future GrIS projections differ with a “Holocene-calibrated” transient spinup?
- How does the choice of ice sheet model and higher order physics impact on the ice sheet evolution? (Previous set of simulations performed with PISM and the SIA-SSA solver.)

- atmosphere forcing –iCESM1.3 and iTRACE (*thanks to Dr Jiang Zhu*)

- Ocean forcing *Osman et al., 2021*

work with Dr Tancrede Leger, University of Sheffield (t.p.leger@Sheffield.ac.uk)

Response of the GrIS to temperature overshoots

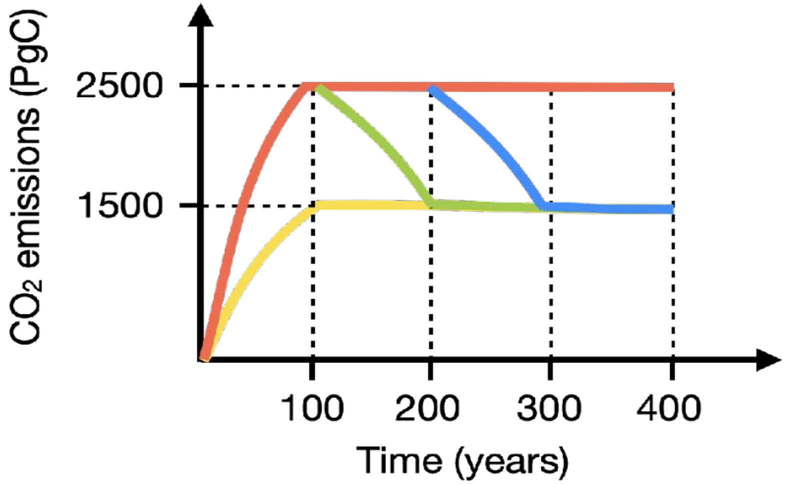
- **CISM simulations for 4 idealised scenarios:**

  B1500 (reference): cumulative CO_2 emissions ~SSP4-6.0;

  B2500 (high emission): cumulative CO_2 emissions ~SSP5-8.5;

  $OS_0$1500 (short overshoot): -1000 PgC yrs 100-200 (not realistic!);

  OS_{100}1500 (long overshoot): -1000 PgC yrs 200-300 (not realistic!);

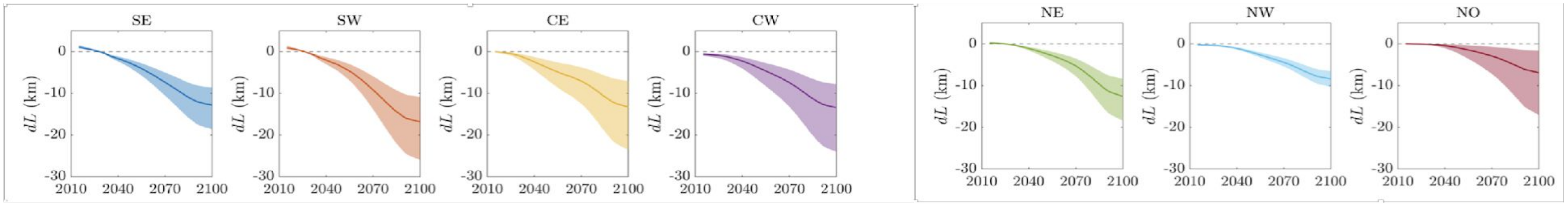


- **Surface Mass Balance (SMB) from previous NorESM2-LM runs:**

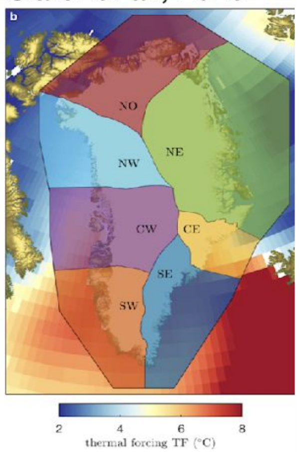
  SMB updated while GrIS topography changes (virtual Elevation Classes method);

- **Ocean forcing: ISMIP6 semi-empirical parametrisation (min-med-max):**

  Forced (offline!) with ocean temperatures & runoff from NorESM2-LM runs;

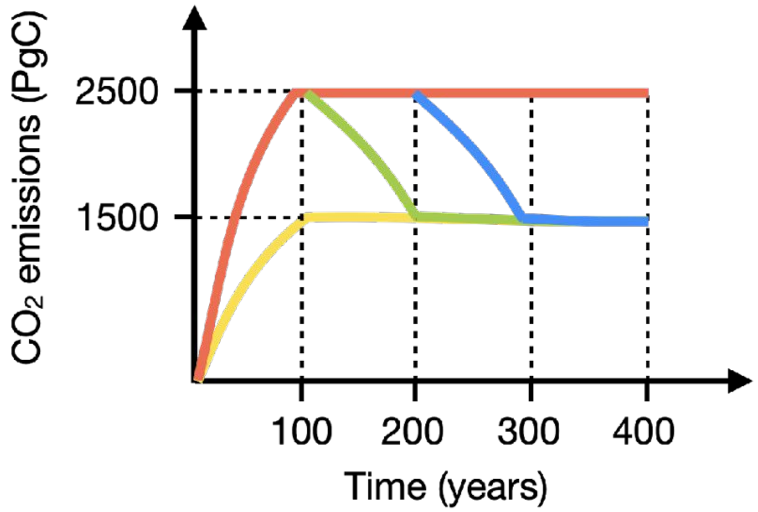


Slater et al., 2020

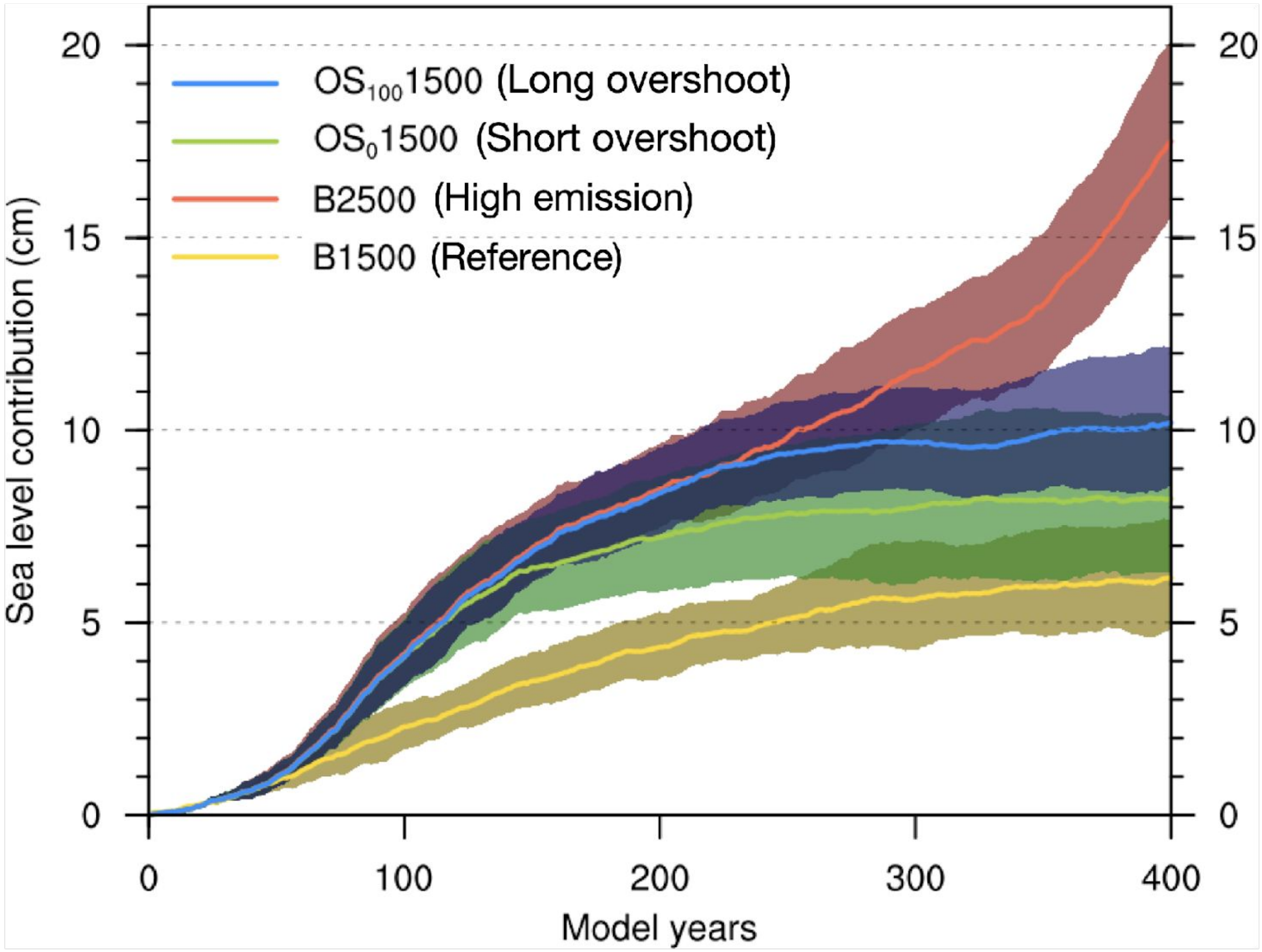


Michele Petrini, Heiko Goeltzer, Petra Langebroek and Jörg Schwinger

Response of the GrIS to temperature overshoots



- Reference run: 6 cm [5-7.5]
- Short overshoot: 8 cm [5-10];
- Long overshoot: 10 cm [7.5-12];
- Mass loss stabilisation, but **SLR is not fully reversible!**
- Ongoing work to assess **GrIS long-term stability** & **committed sea-level contribution**



Adding CISM to the Indian Institute of Tropical Meteoroly (IITM-ESM)

Sandeep Narayanasetti, Swapna Panickal, R.Krishnan

INPUTS to CISM (PDD scheme)
- **Precipitation**
- **Temperature**

IITM-ESM

GFS-MOM4p1-Noah LSM

CISM Configured for Greenland

INPUT to IITM-ESM

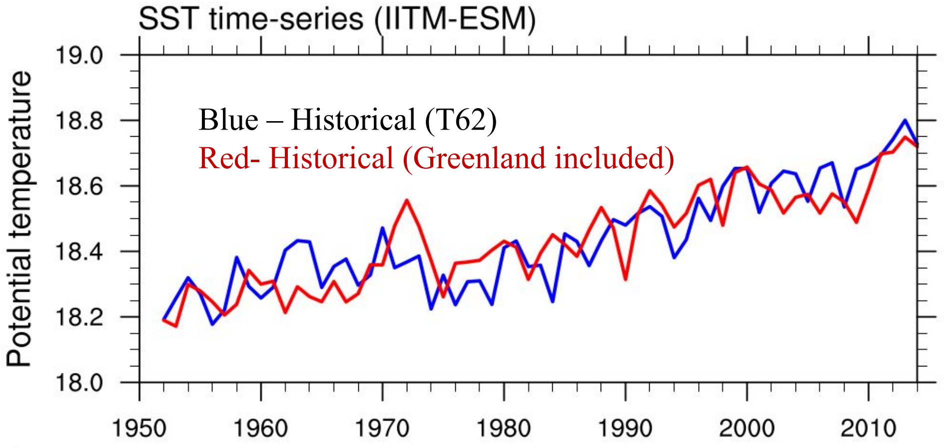
Feedback
- Fresh water flux

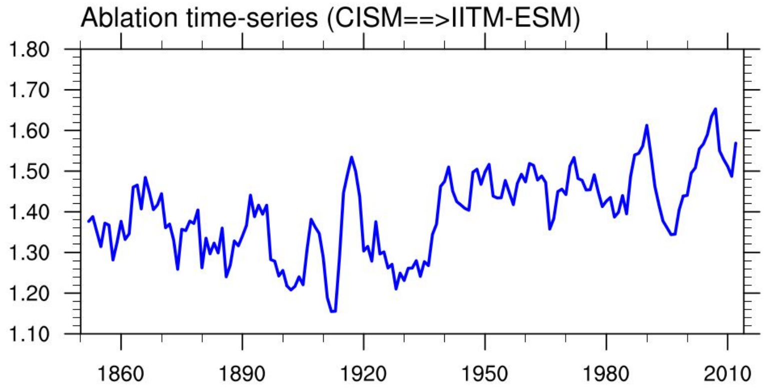
OUTPUTS from CISM
- Accumulation/Ablation
- Ice temperature
- Air temperature
- Basal melt rate
- Ice thickness

GOAL: Understand the role/impact of Greenland glacial ice melt on:
- Total sea level rise
- The strength of the Atlantic Meridional Overturning Circulation. (AMOC)
- The tropical precipitation and circulation in present and future warming scenarios

Incorporation of CISM in IITM-ESM (preliminary results)

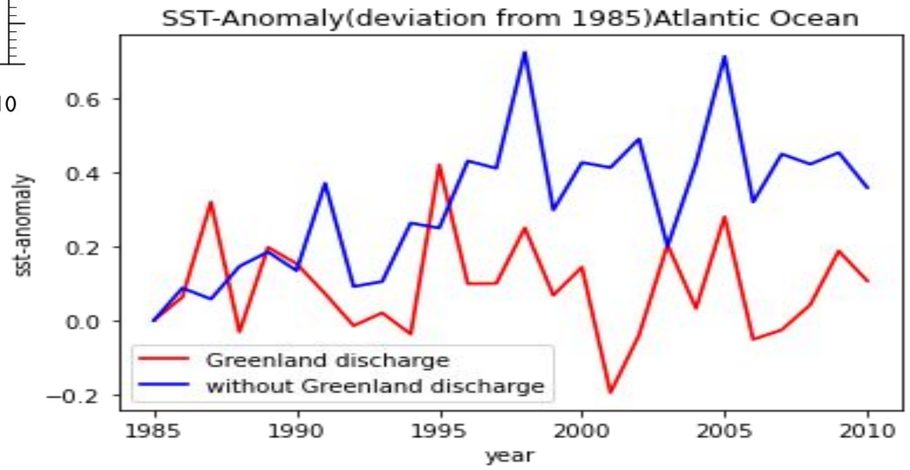
Historical simulation with inclusion of Greenland show a cooling and freshening in the North Atlantic.





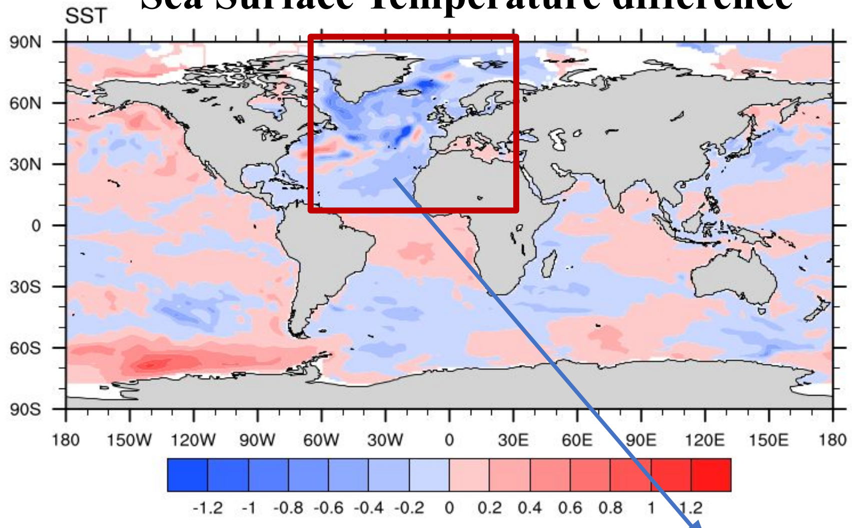
Annual Ablation (mm/year) averaged over Greenland computed from CISM and provided as input to IITM-ESM

Global mean SST from both Historical simulation and Historical with Greenland show almost similar trend. Last 25years were analyzed further since Greenland contribution is higher after 1985



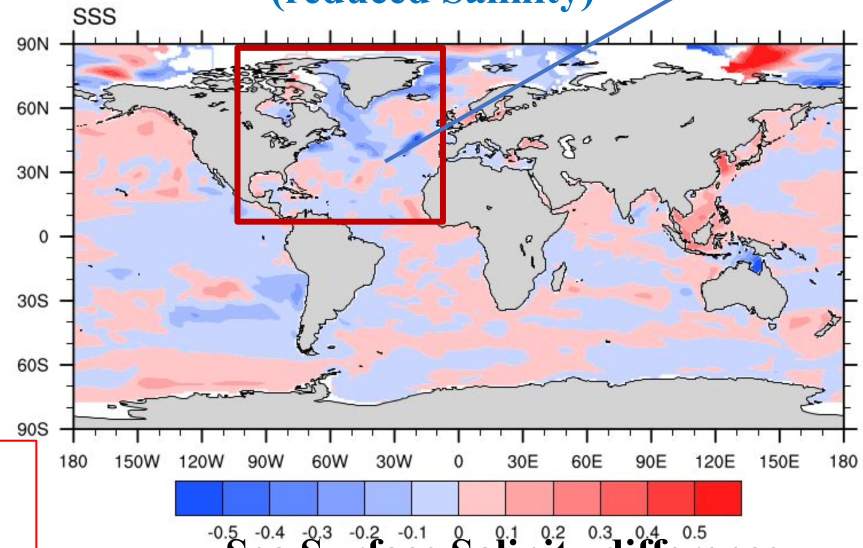
Atlantic ocean SST from both Historical simulation and Historical with Greenland show a clear cooling with inclusion of Greenland discharge.

Sea Surface Temperature difference



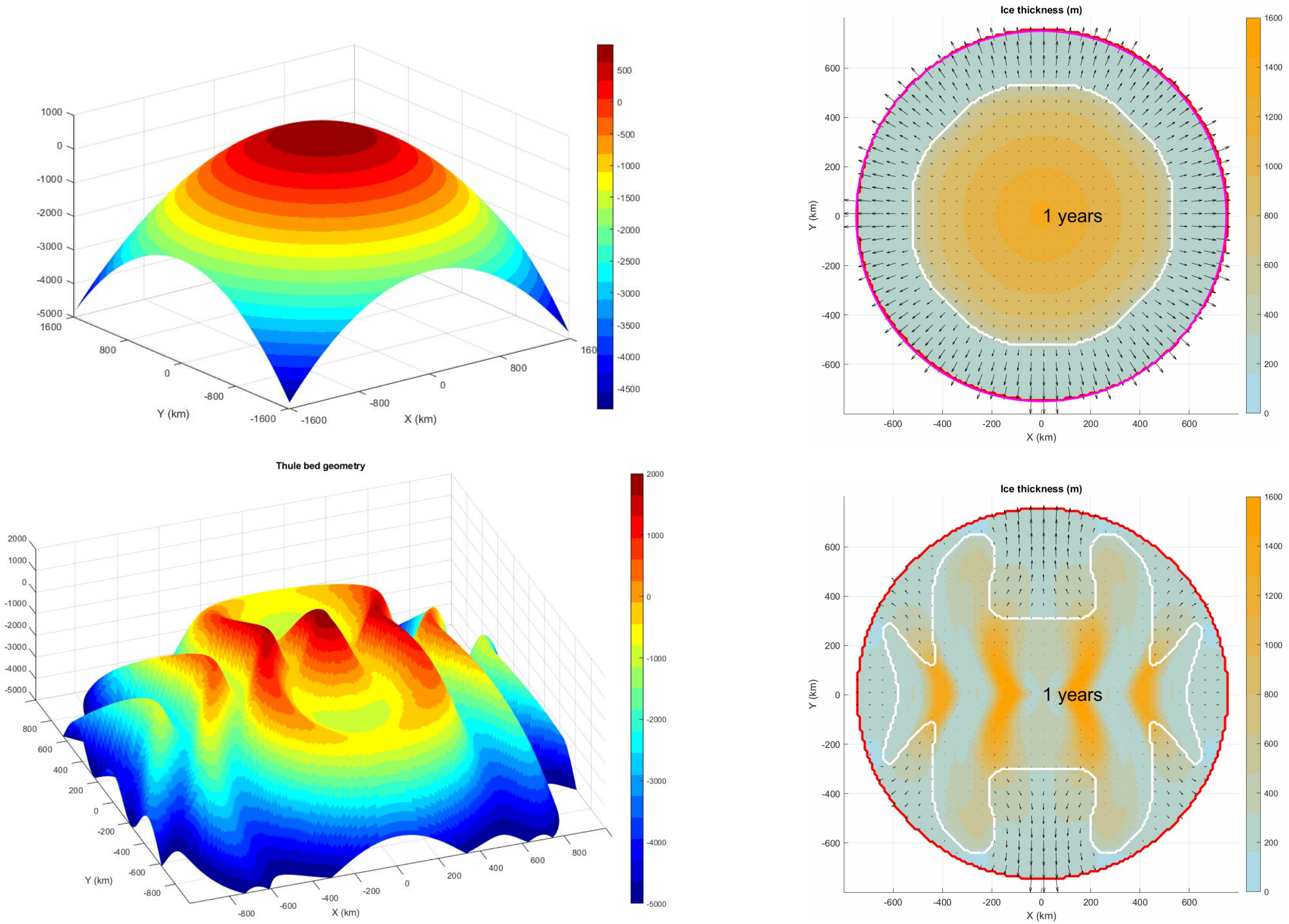
Cooling due to enhanced Greenland melt

Freshening due to enhanced Greenland melt (reduced Salinity)



Sea Surface Salinity difference

Calving MIP



Figs: (left) Idealized circular (top) and Thule (North West Greenland; bottom) bed geometries used in calvingMIP. (right) Ice evolution from the Kori model with applied rate of calving front retreat and advance.

- Phase 1 of calving MIP only uses idealized domain to show model capabilities of advancing and retreating ice using retreat/advance rates.
- Phase 2 is still in the design phase.
- We will participate to this MIP in collaboration with Heiko Goeltzer, Michele Petrini, and Alex Huth.

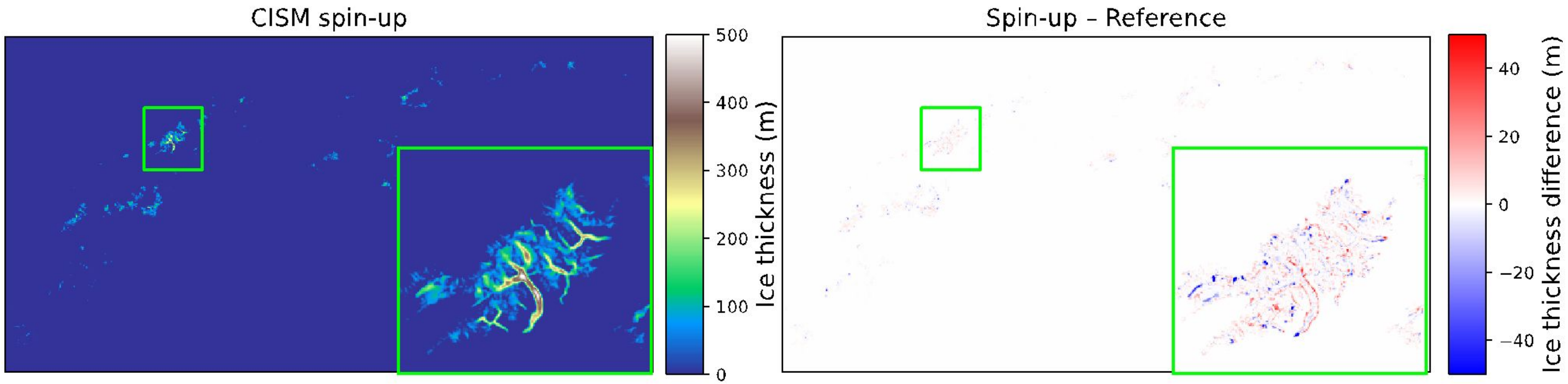
ISMIP7

- YES, we plan on participating in it.
- The land ice team and collaborators are actively participating in the ongoing effort.
- The experimental protocol is still in the development phase.
- Stay tuned!

Using CISM for mountain glacier simulations

Samar Minallah, Bill Lipscomb, and Gunter Leguy

Bernese Alps glaciers
(NASA Earth Observatory)



Left: CISM ice thickness simulation for the full Alps and the Bernese region (inset).
Right: Ice thickness difference between CISM spin-up and reference thickness (Farinotti et al. 2019).

Using CISM for mountain glacier simulations

> First 3d higher-order ice sheet model used to simulate mountain glaciers
> Simulations performed at a resolution of 200 m or finer
> Good agreement with observations

Ongoing work

> Submission to the GlacierMIP3 project
> High Mountain Asia simulation is underway

Future work

> Simulate all Randolph Glacier Inventory (RGI) regions
> Study fresh water availability and security at decadal time scales
> Couple to CLM within the CESM framework

Ongoing and future work towards CISM3

Ice sheet physics

- New Coulomb basal sliding law (Zoet-Iverson)
- Flux-routing basal hydrology scheme
- Sub-ice-shelf cavity ocean T&S interpolation
- Improved Isostatic adjustment from ELRA (1d) to ELRA (2d)

New Initialization procedures

- Matching of historical mass change rate

Mountain glaciers

- Inversion methods for glacier spin-up

Test cases (for HPC and laptop)

- Antarctica
- Greenland
- CalvingMIP

Code validation

- LIVVkit (Michael K.)

User friendliness

- Update documentation

Ongoing and future work towards CESM3

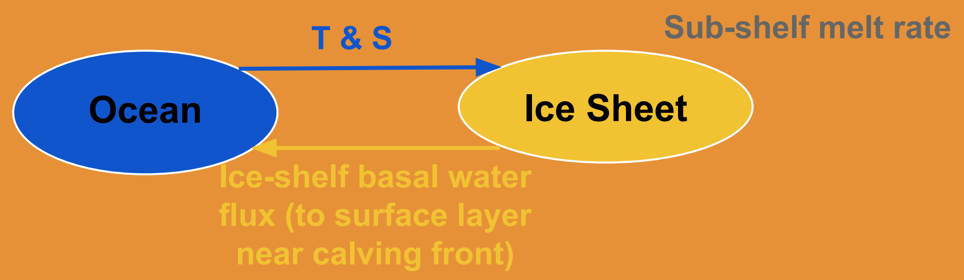
Ice Sheet-Land coupling (Kate T-C)

- Update one way coupling water flux behavior

Ocean: Modular Ocean Model (MOM6)

- 2/3 degree (currently running)
- MOM6-CISM coupling results submitted to MISOMIP

Ice Sheet–Ocean Coupling (fixed land–sea mask, w/out ocean circulation in ice-shelf cavities)



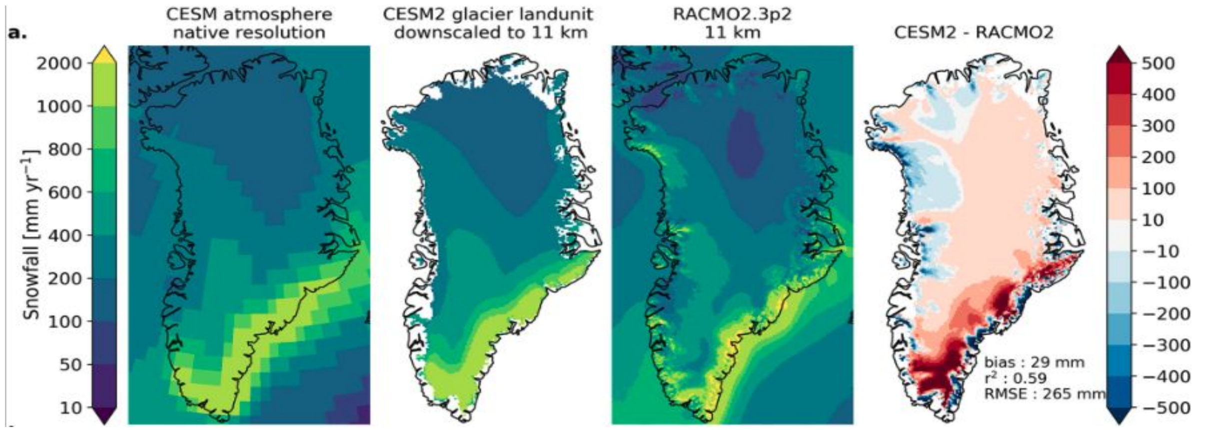
Ice Sheets: CISM

- Coupled Antarctic ice sheet (4km)
- Simultaneous evolution of multiple ice sheets

Initialization procedure

- Reducing SMB and ocean biases in fully coupled CESM runs
- Creating input files for different scientific purposes

van Kampenhout et al. 2020



CESM tutorial

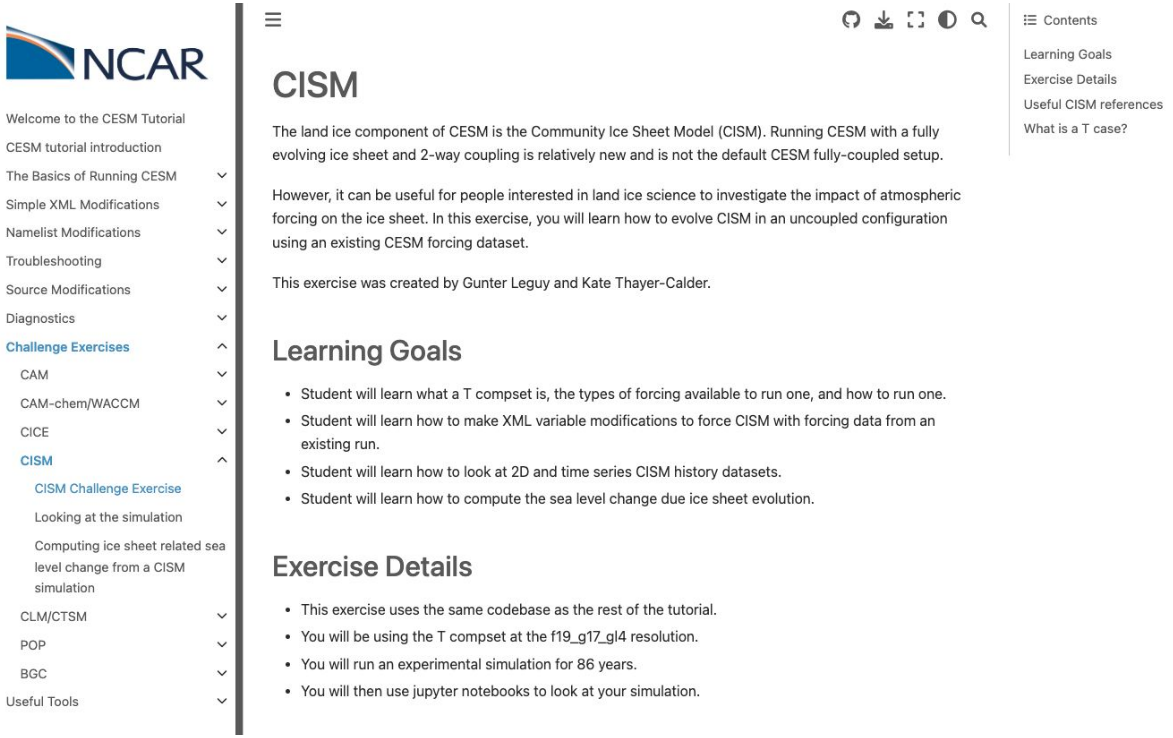
Committee

Alice DuVivier, Cecile Hannay, Peter Lawrence, Gustavo Marques, Adam Phillips, Jesse Nusbaumer, Hui Li, Gunter Leguy, Brian Dobbins

Many other NCAR employees and collaborators are part of the organization of the tutorial (50+ people)

Exercises moved to github (and use Jupyter Notebooks):
https://github.com/NCAR/CESM-Tutorial

io version:
https://ncar.github.io/CESM-Tutorial/README.html



CISM content created by Gunter Leguy and Kate Thayer-Calder

- You too can create material!
- Share with anyone who would like to get started with CESM
- Let us know if you have a cool experiment that would fit nicely in the Land Ice exercise suite.

Contact information

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

Co-chairs:

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

Liaisons:

- Gunter Leguy, NCAR, gunterl@ucar.edu
- Kate Thayer-Calder, katec@ucar.edu

Discussion

Discussion

1. Using CISM and CESM for actionable science:
   - We are using CISM to investigate sea level change across time scales.
   - We are now developing CISM with glacier representation to study fresh water availability.
   - What other areas shall we consider and prioritize?
   - Are there modeling needs?

2. What are the important questions within the LIWG?

3. Diagnostic package needs?

4. Ice-ocean interaction.

5. Any topic not listed here?