Modelling Northern Hemisphere Glacial Inception

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Project

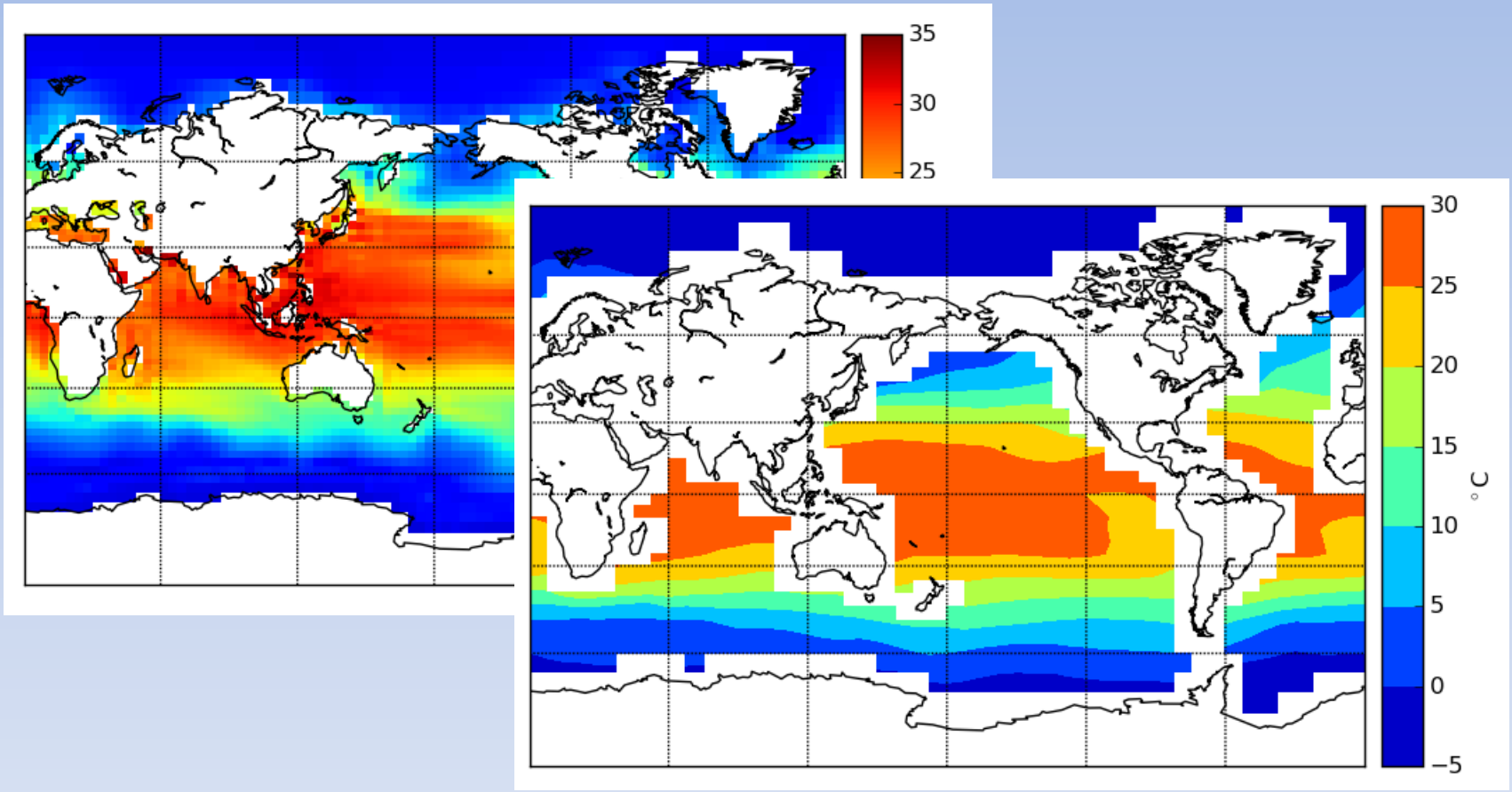
- Simulate the climate and NH ice-sheets during the last glacial cycle (in a “realistic” manner)

- Today I’m talking about new improvements to the SMB scheme, and applying an AGCM/ice-sheet model to the problem of glacial inception.

FAMOUS

- **FA**st **M**et **O**ffice/UK **U**niversities **S**imulator
- Same Physics/Dynamics as HadCM3 AOGCM.
- Reduced resolution for faster runs (long paleo):
  - Atmosphere: 5^{o}x7.5^{o}, 11 vertical, 1h timestep
  - Ocean:2.5^{o}x3.75^{o}, 20 vertical, 12h timestep

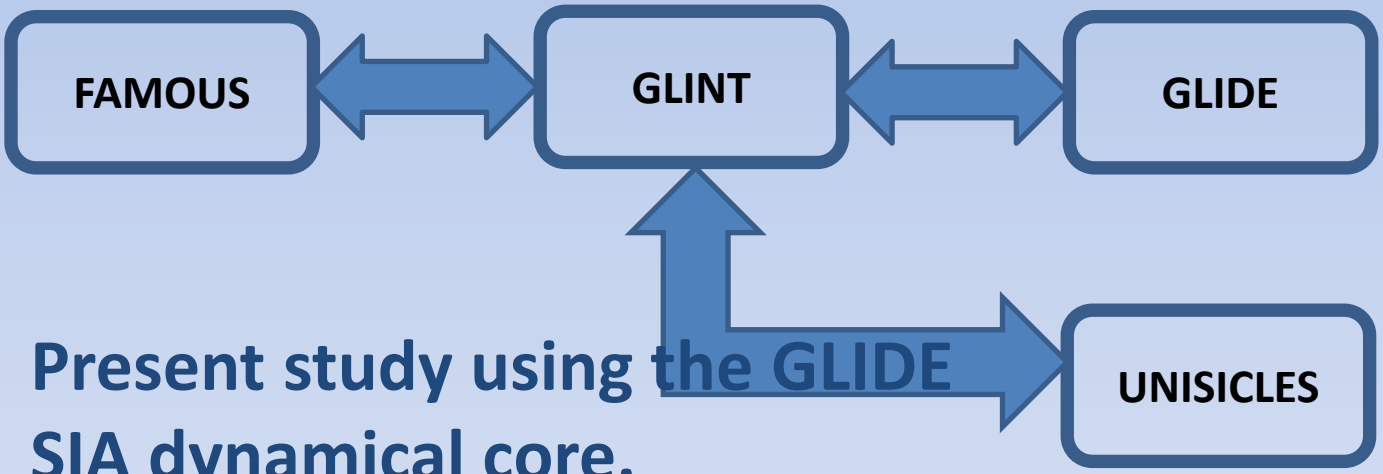
FAMOUS



Coastal Tiling (MOSES 2.2 backport)

GLIMMER-CISM

- Suite of libraries with many names!



Present study using the GLIDE SIA dynamical core.
Full Northern Hemisphere.
50km horizontal resolution,
with 11 vertical levels

FAMOUS-GLIMMER Coupling

- Previous work at Reading:

- Employed a positive degree-day (PDD) scheme for surface ablation

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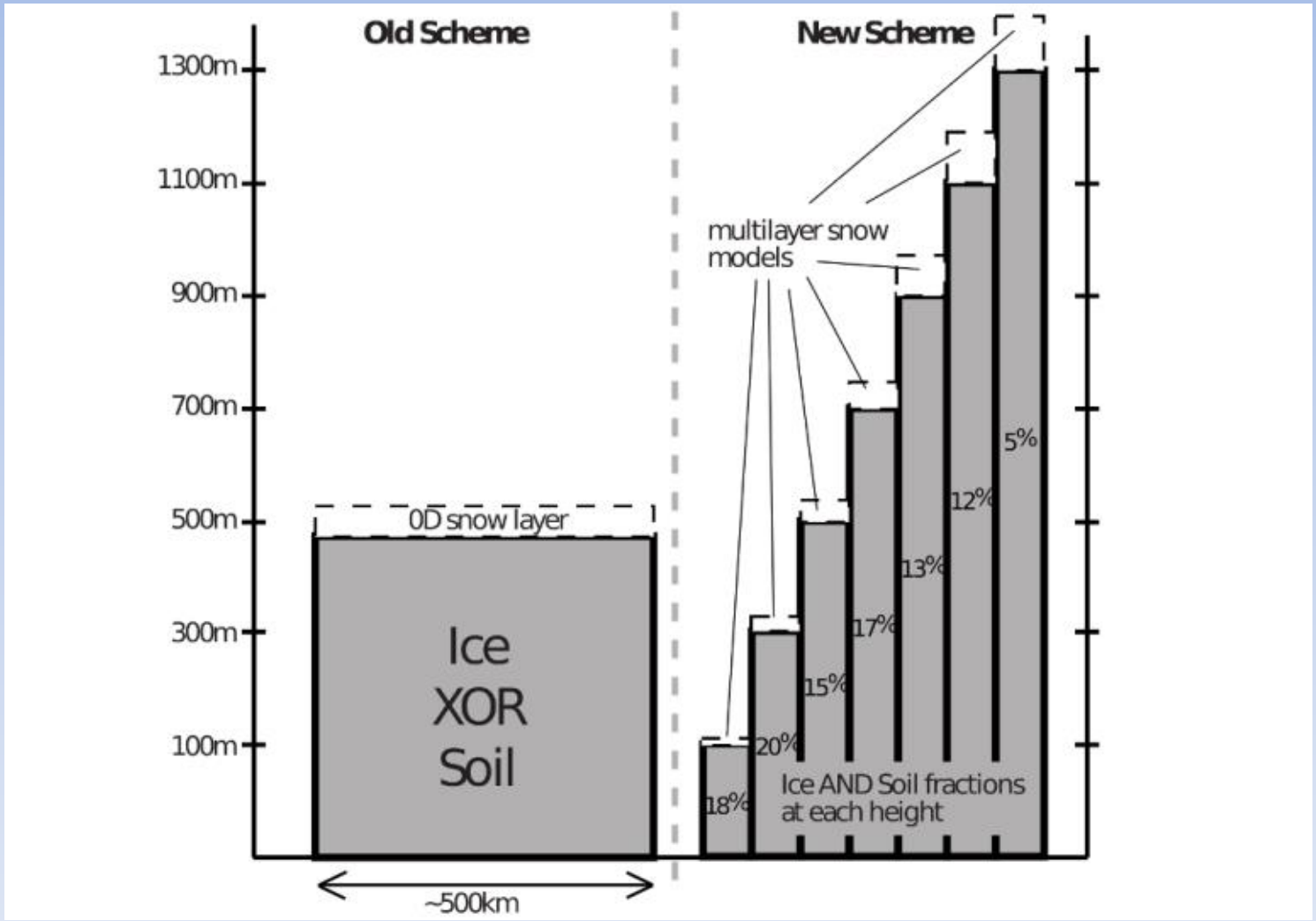
PDD SMB Scheme

- Ablation depends on daily temperature alone.
- FAMOUS provides GLINT with monthly temperatures.
- Downscaled onto GLIDE resolution, PDD distributions used in conjunction with degree-day factors to produce SMB.
- **Problem:** SMB strongly sensitive to choice of empirical parameters.

New SMB Scheme

- SMB now fully calculated within FAMOUS
- MOSES 2.2; 9 fractional surface types on 25 elevation classes (sub-gridscale hypsometry)
- JULES; multi-layer snow scheme (number required is ongoing work).
- SMB, heatflux, surface temperature (plus related passed to GLINT for interpolation).

New SMB Scheme



Thanks to Robin Smith

New SMB Scheme

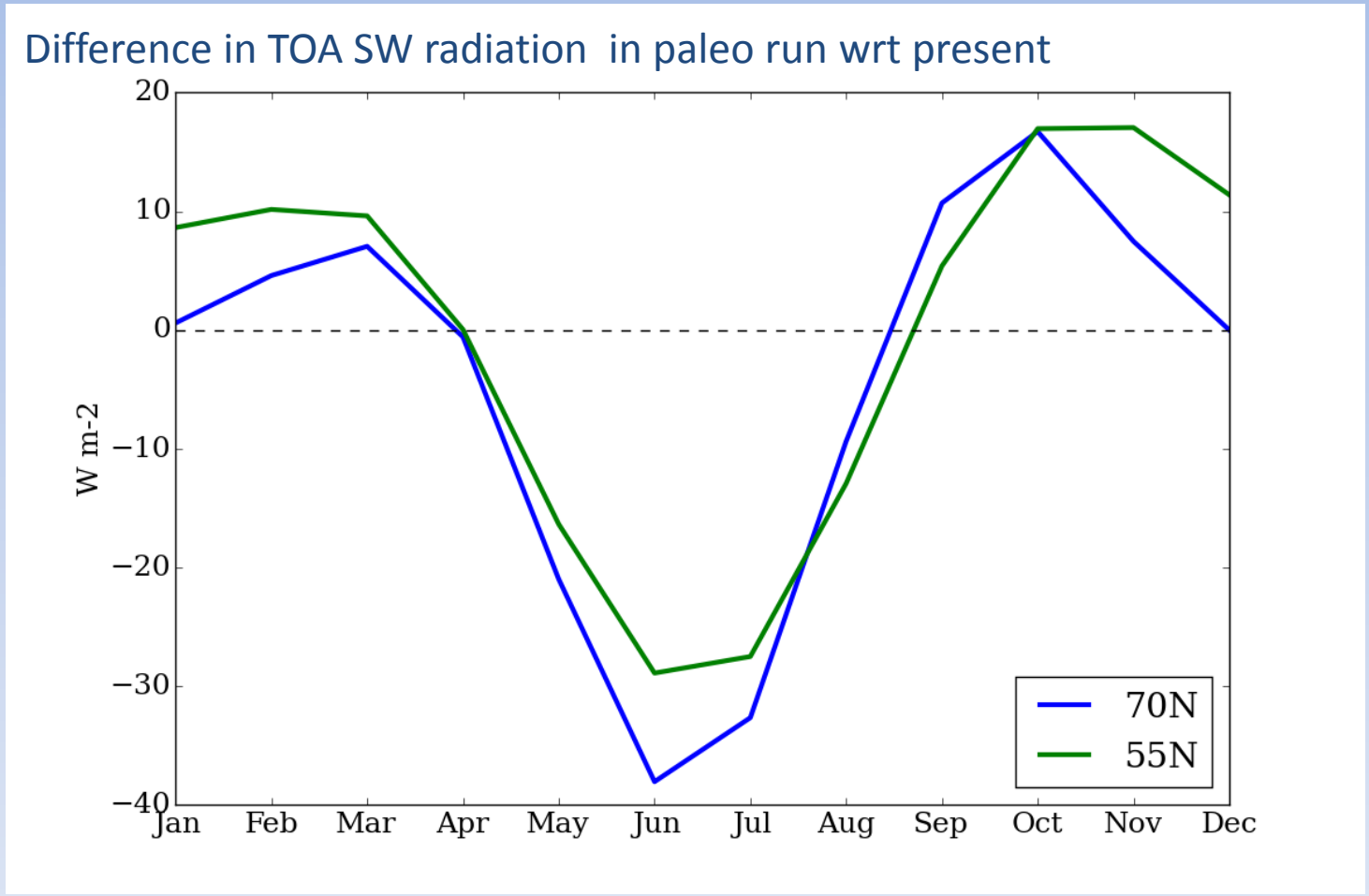
- Two way coupling: ice can be created by FAMOUS accumulating non-ice fraction snow or Glimmer dynamically advancing into adjacent grid boxes.
- Allows for glacial inception in previously ice-free regions.

Initial Experiments

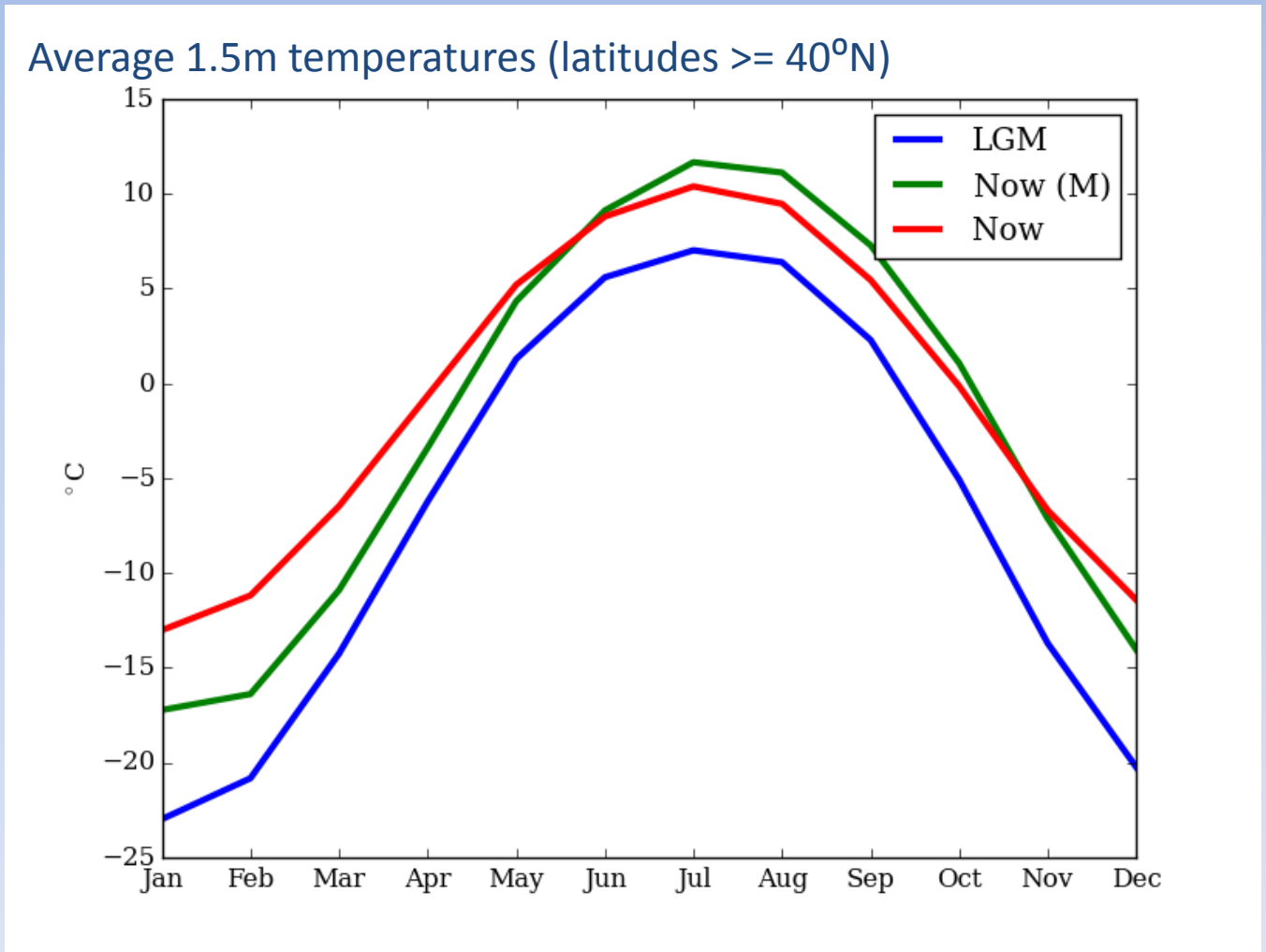
- Snow layers n=3 (not enough!)

Experiment	Properties
xlmpf	Present day Observed SST/Ice climatologies Current CO2 mixing ratio
xlmph	As above but with FAMOUS SST/ice
xlmpg	Glacial inception run LGM SST/ice from FAMOUS LGM CO2 Orbital forcing 115000BP

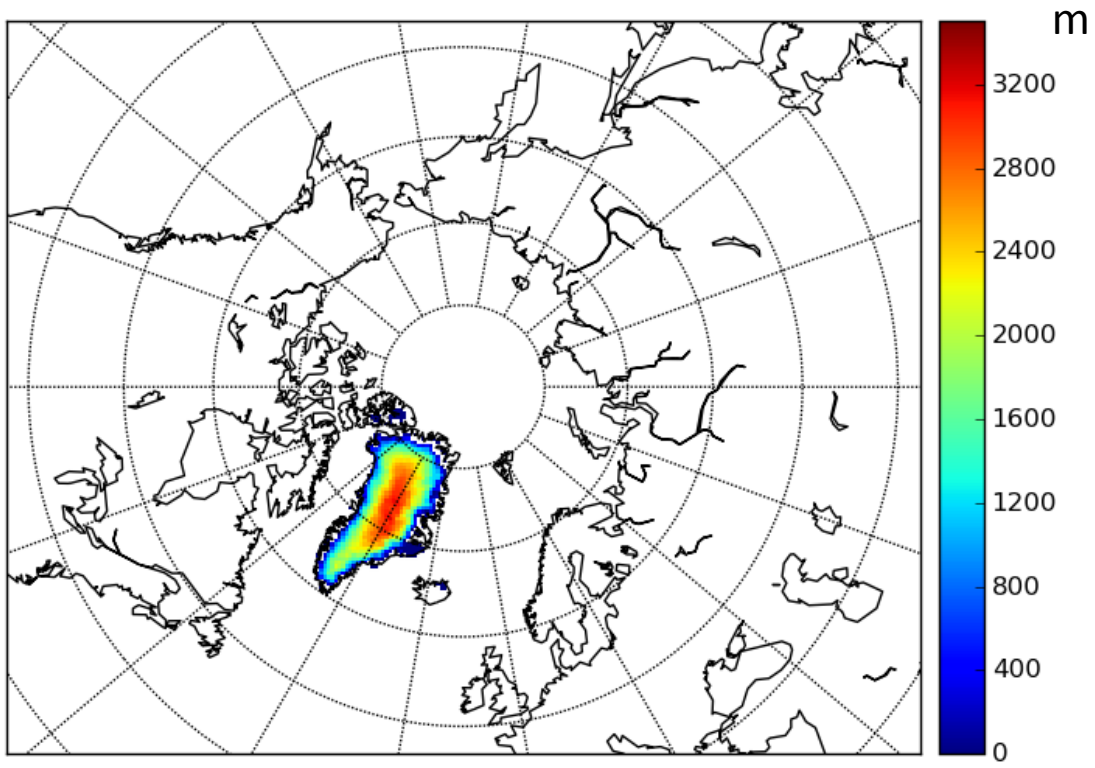
What's that in numbers?



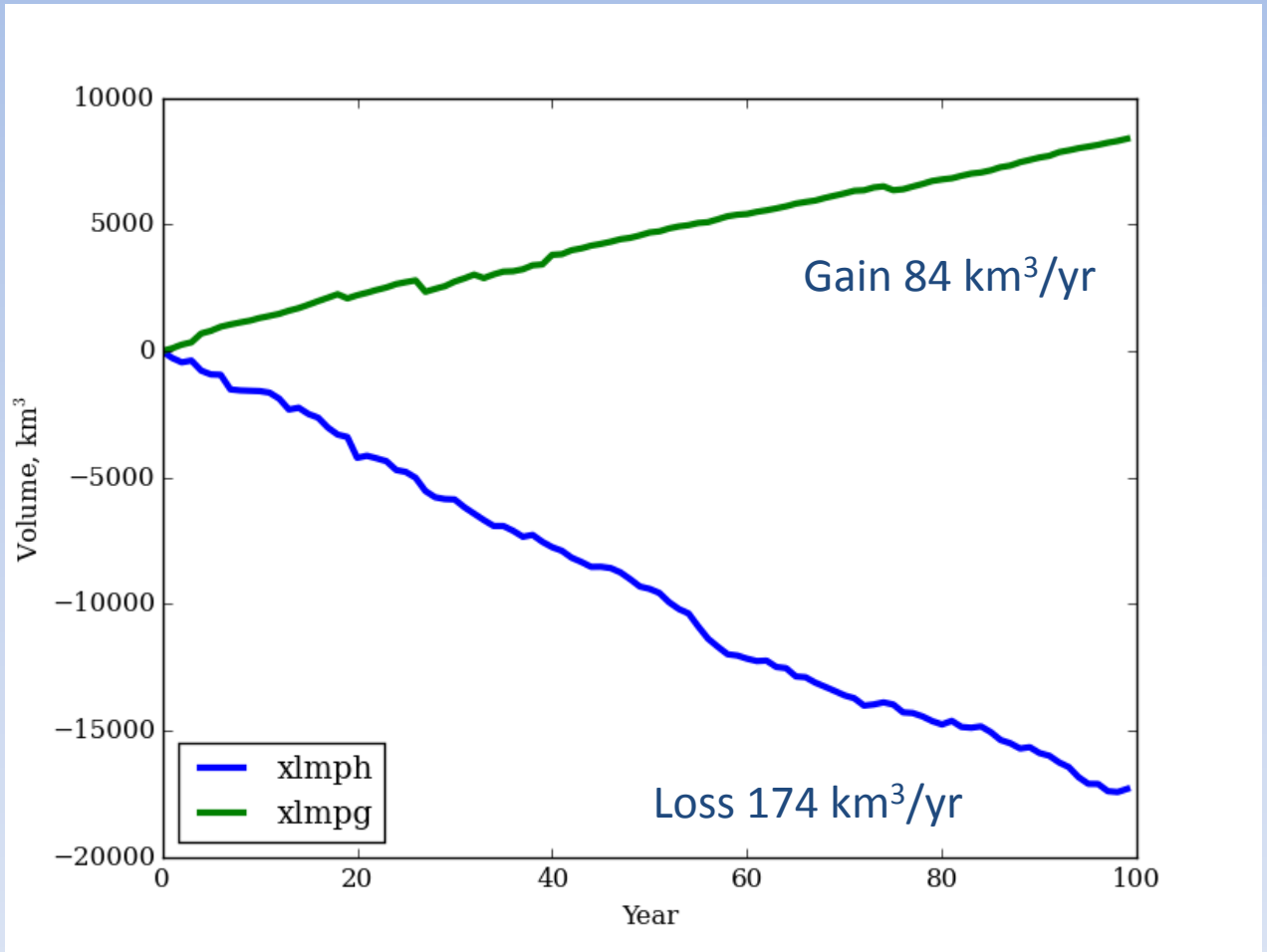
And the temperatures?



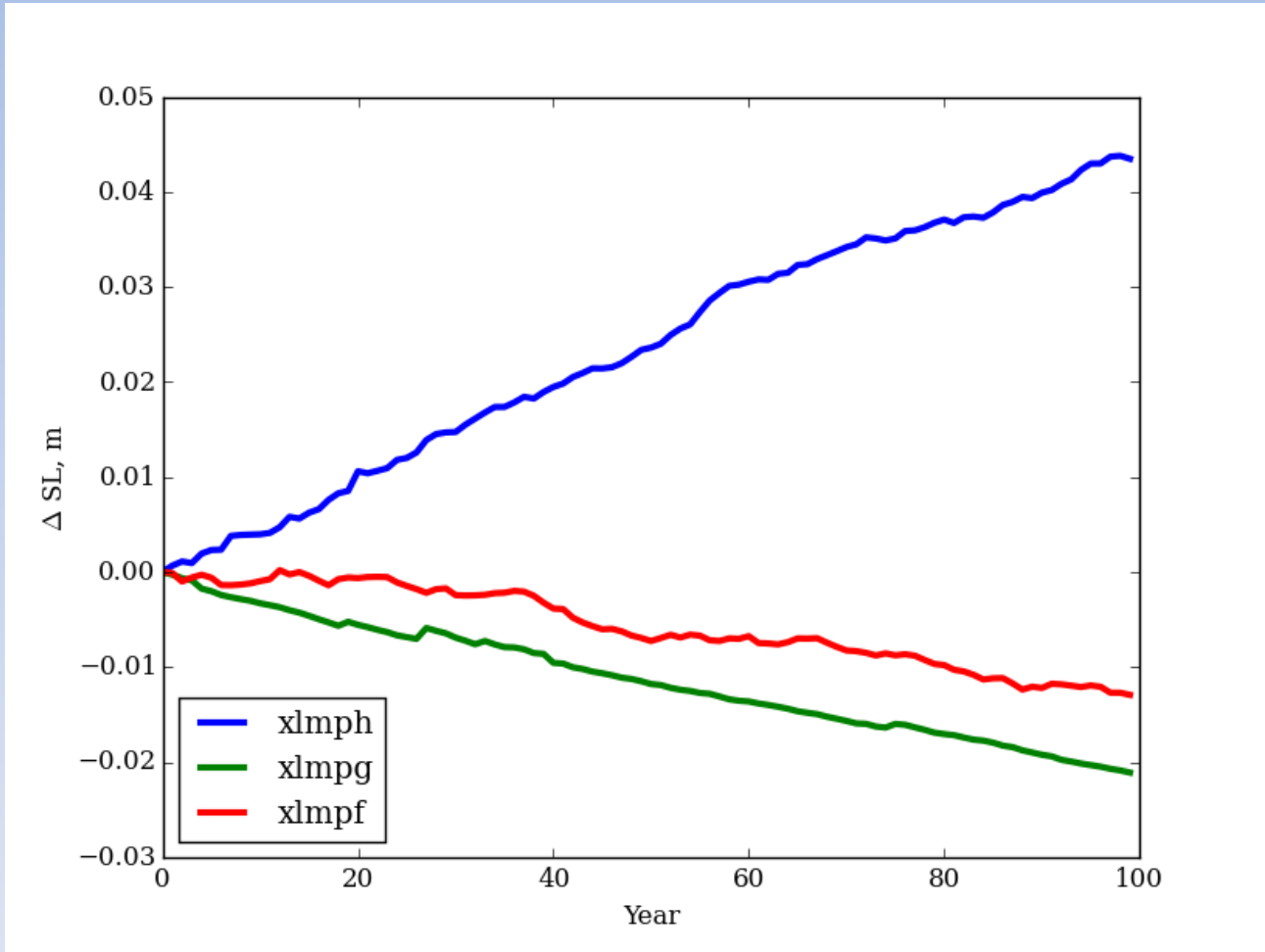
Ice at t=0



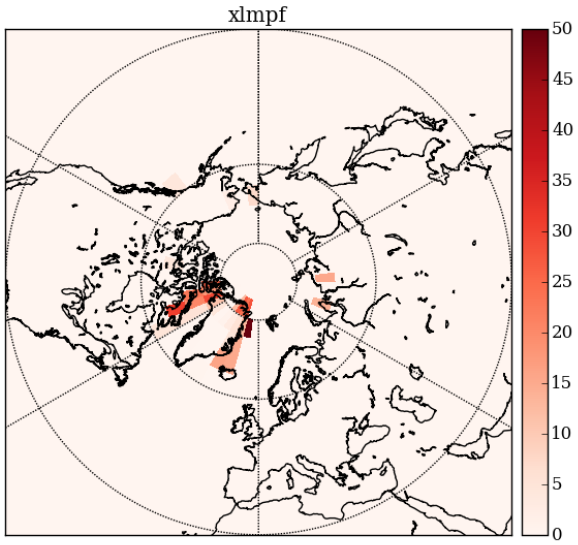
Ice Volume Change

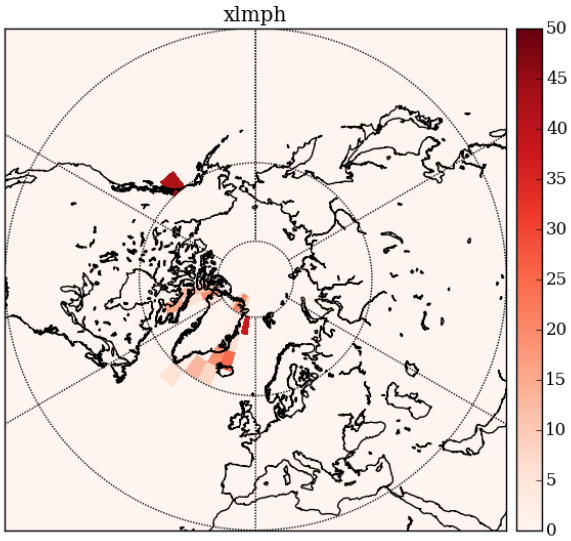


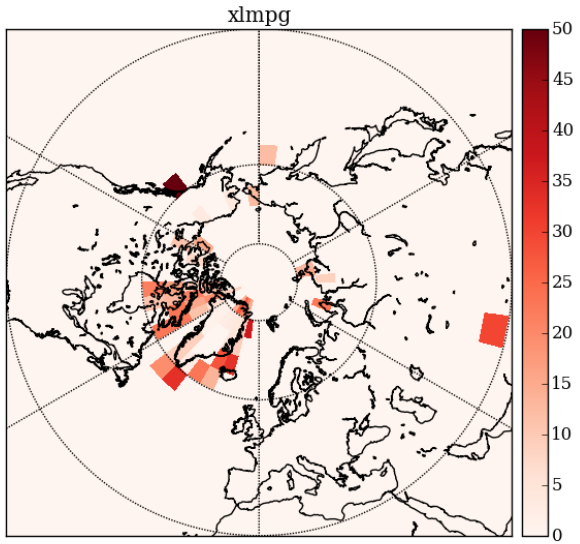
Barystatic Sea Level Change



Non-ice snow accumulation (m)







Ongoing Work & Questions

- SIA ice-model replaced with BISICLES (UNISICLES): allow ice-streams, ice-shelves, grounding line.
- Hudson Bay pre-LGM. Dry land or sea? Use fractional tiling to represent as shallow lake.
  - Avoids Land/sea mask (basin volume issues)
- Number of layers in snow model (to allow in-snowpack run-off).