PAL MOD | GERMAN CLIMATE MODELING INITIATIVE

Using PISM to account for dynamic ice-sheet changes in long-term Earth System Model simulations

Ocean Physics Group at the Max Planck Institute for Meteorology

MAX-PLANCK-INSTITUT FÜR METEOROLOGIE

Federal Ministry of Education and Research

DLR Project Management Agency

FONA Research for sustainability

Why we need dynamic ice sheets

- The Earth’s climate has undergone several transitions between cold glacial periods and warm interglacial conditions

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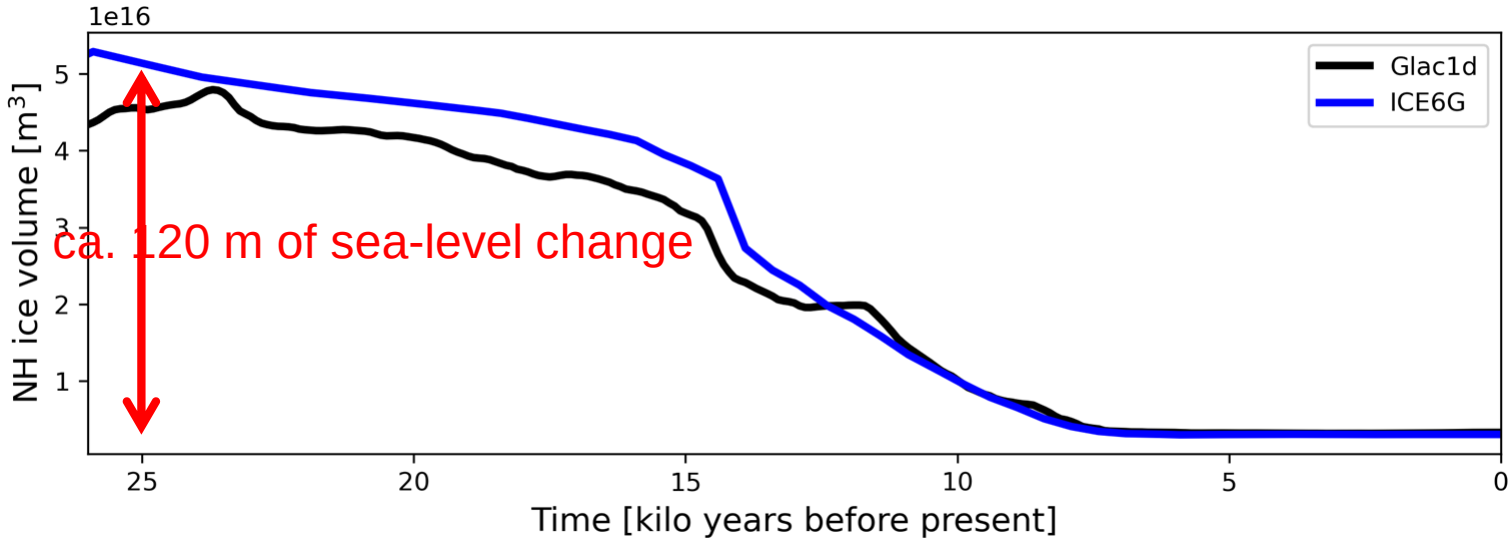
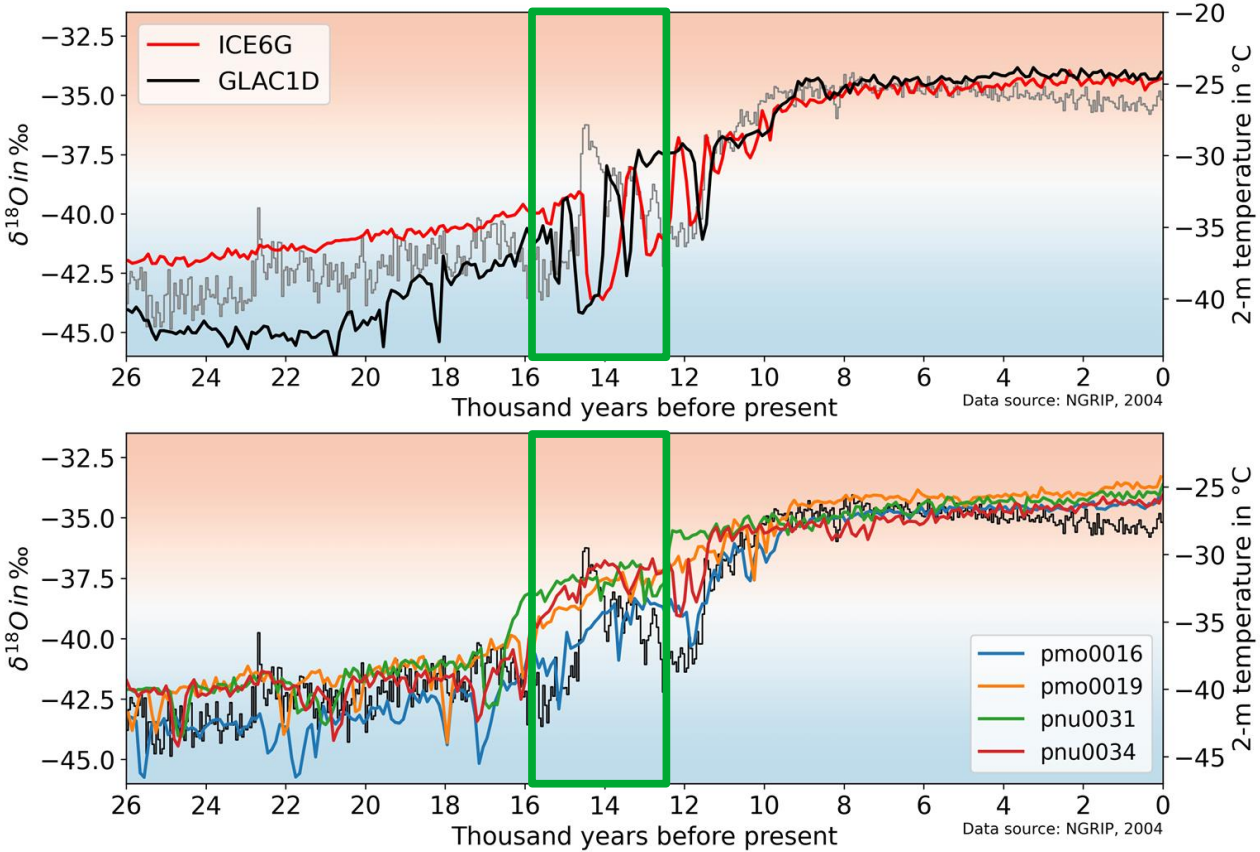


Why we need dynamic ice sheets

- The Earth's climate has undergone several transitions between cold glacial periods and warm interglacial conditions
- Waxing and waning of the ice sheets results in surface topography changes and modulates ocean circulation through the release of meltwater
- This can induce strong non-linear climate responses in the ocean and atmosphere
- When ice sheets and climate do not evolve together, the modelling system is physically not consistent

Why we need dynamic ice sheets



Prescribed ice sheets simulations fail to reproduce abrupt warming event during the deglaciation while the signal is present in the simulations with interactive ice sheets

Our model system: MPI-ESM/PISM/VILMA

Climate

MPI-ESM

- MPI-ESM-CR
  (ECHAM6-T31L31, MPIOM GR30L40, JSBACH)
- Iceberg module (Erokhina and Mikolajewicz, under review)

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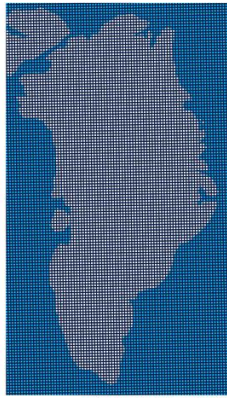

PISM

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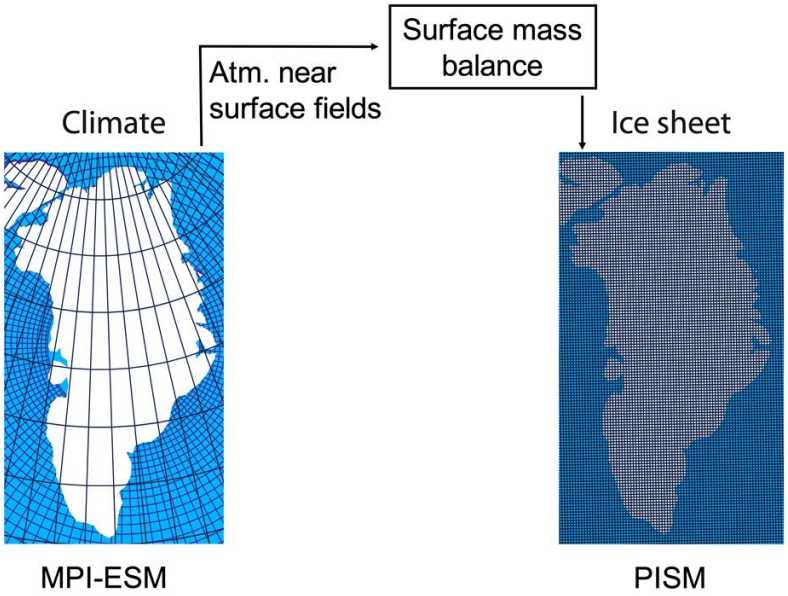

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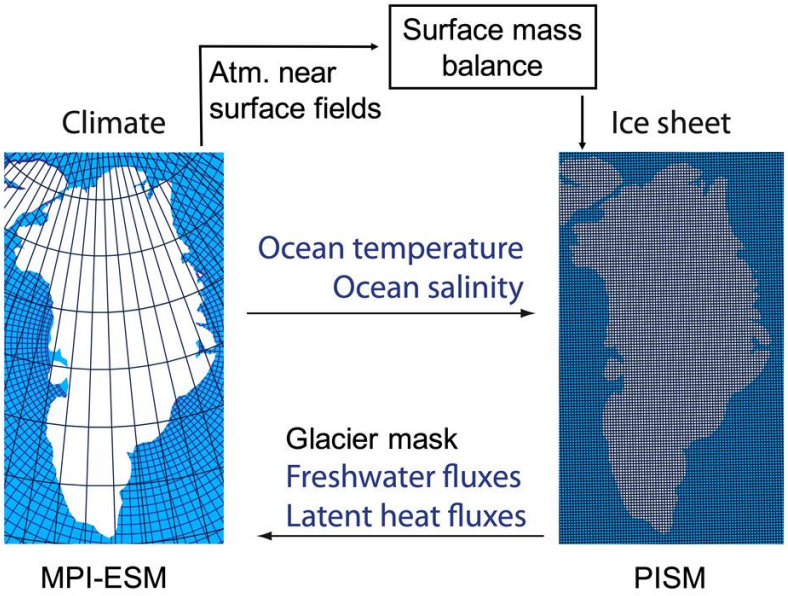

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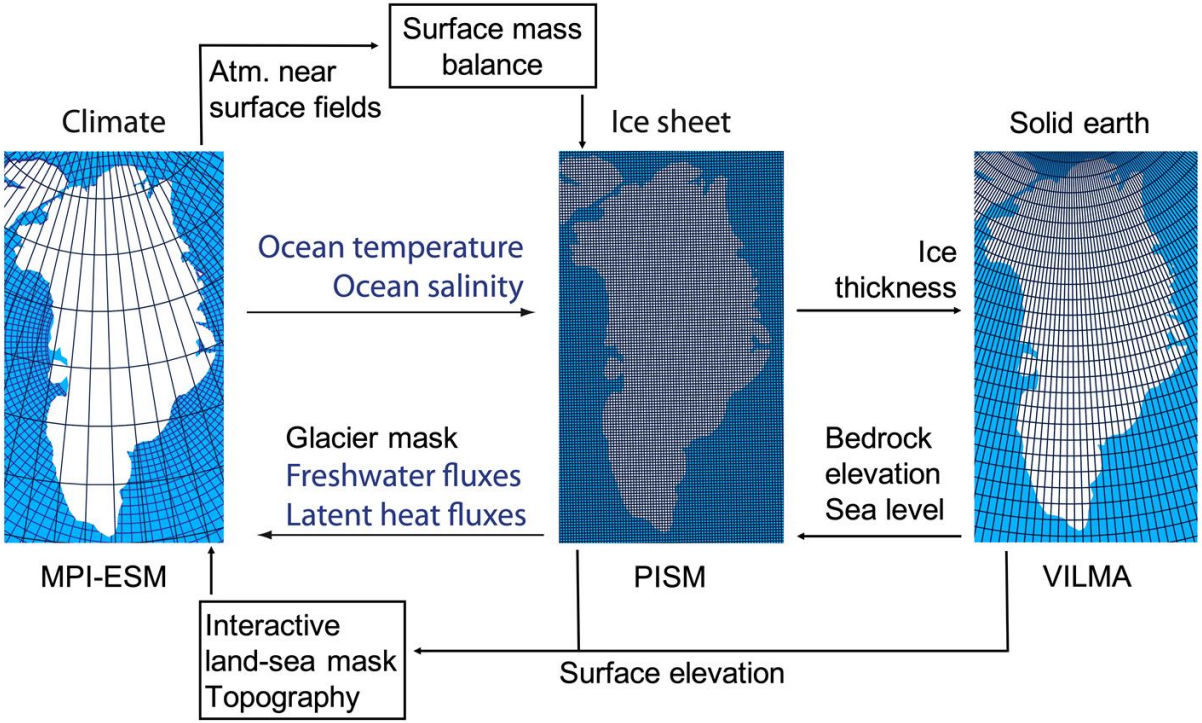

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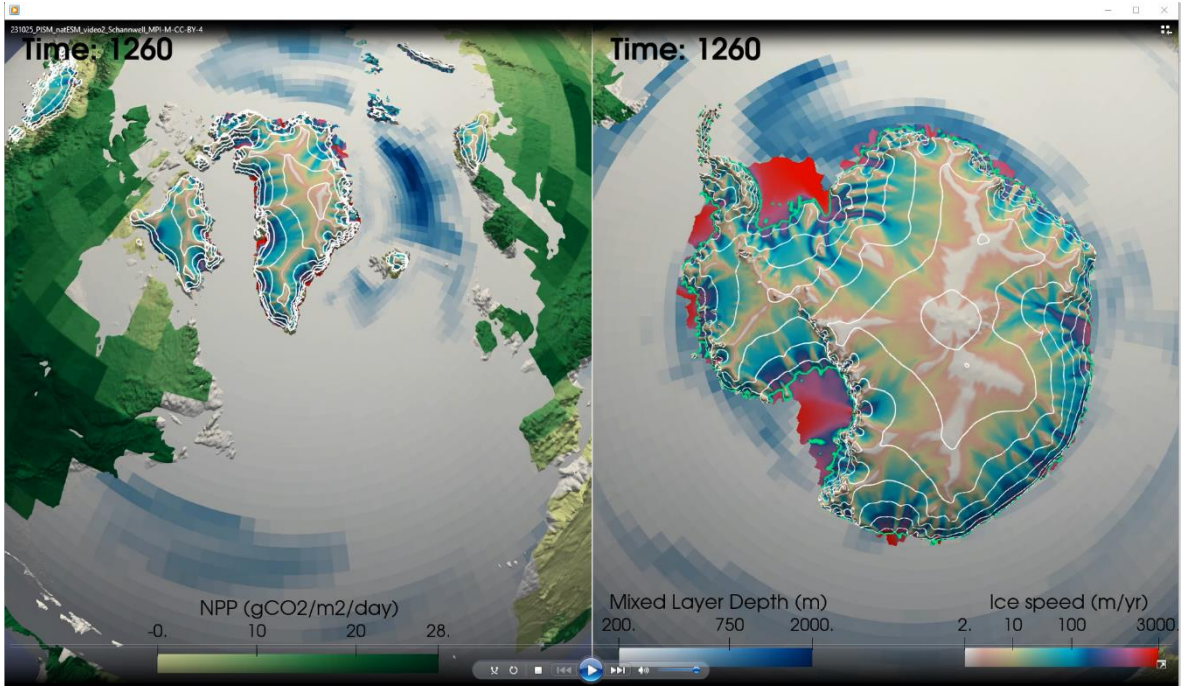
- VILMA solid earth model to calculate glacial isostatic adjustment
- Coupling between MPI-ESM, PISM, and VILMA every 10 years

Simulation of the last deglaciation

→ Please click on the picture to see the full video !

Long-term future projections (SSP85)



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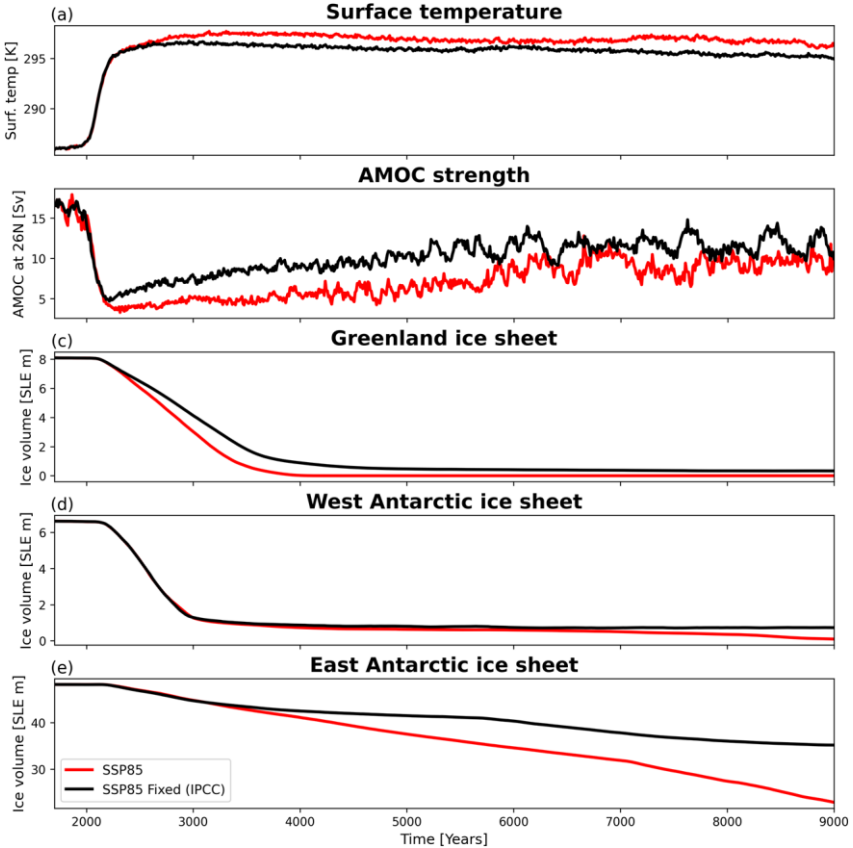

- Simulated warming is amplified by 1K globally when two-way coupling is considered
- The recovery of the AMOC is delayed
- The effect of the two-way coupling becomes important a couple of centuries after the initial CO2 increase
- Largest differences occur for the East Antarctic ice sheet

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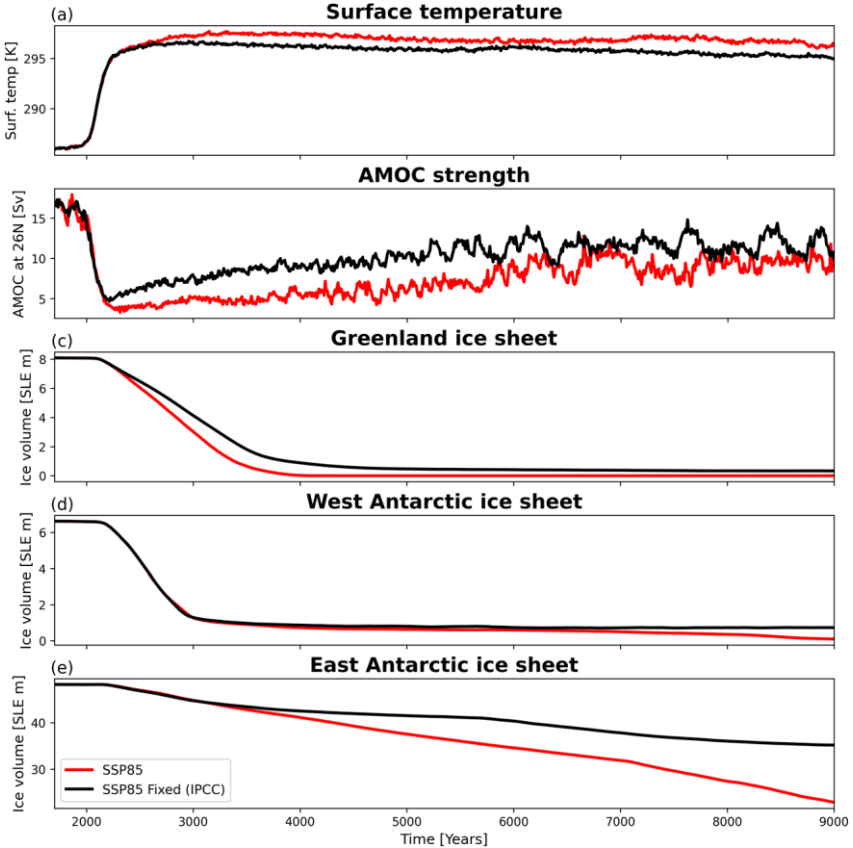

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Thanks!