

# Global coupled climate - ice sheet model simulations with iLOVECLIM-GRISLI

- *preliminary results* -

UNIVERSIT

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# Project outline and short summary



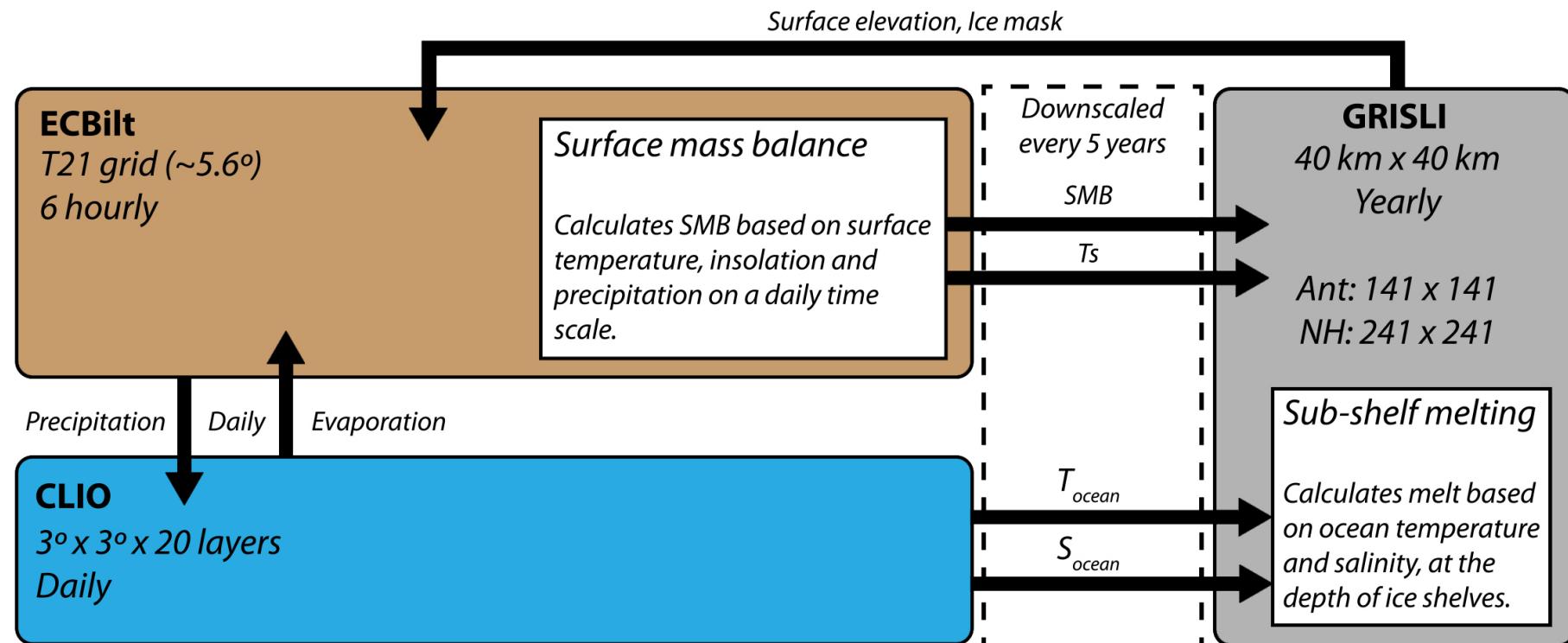
We present model experiments with iLOVECLIM. We use imposed ice-sheet scenario together with preliminary results with both North and South interactive ice sheets using GRISLI. Coupling is initiated with optimal ice sheet parameter settings from an LHS ensemble. Optimal ice sheets are used for future experiments (starting at 1750), and will be used for LIG simulations (sorry, currently running.. it takes a while).



# Coupling iLOVECLIM and GRISLI

Coupling setup (when running together with GRISLI).

Currently, melt-water from ice to ocean is not turned on.



# Forcing of spin-up experiments (240 – 0 kyr ago)

iLoveclim 1.1.4 (ECBilt-Clio-Vecode)

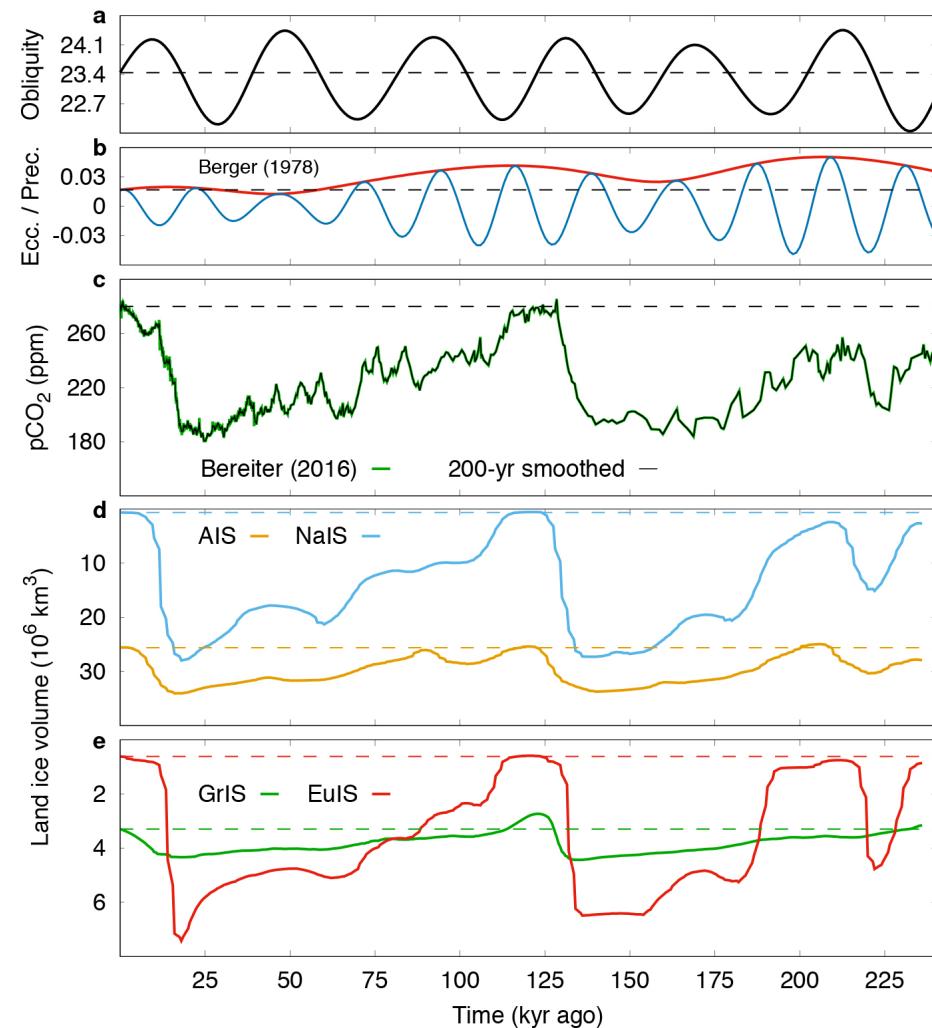
**ORB**: Orbital forcing only

**GHG**: Orbital + GHG ( $\text{CO}_2 + \text{CH}_4 + \text{N}_2\text{O}$ )

**ICE**: Orbital + Ice

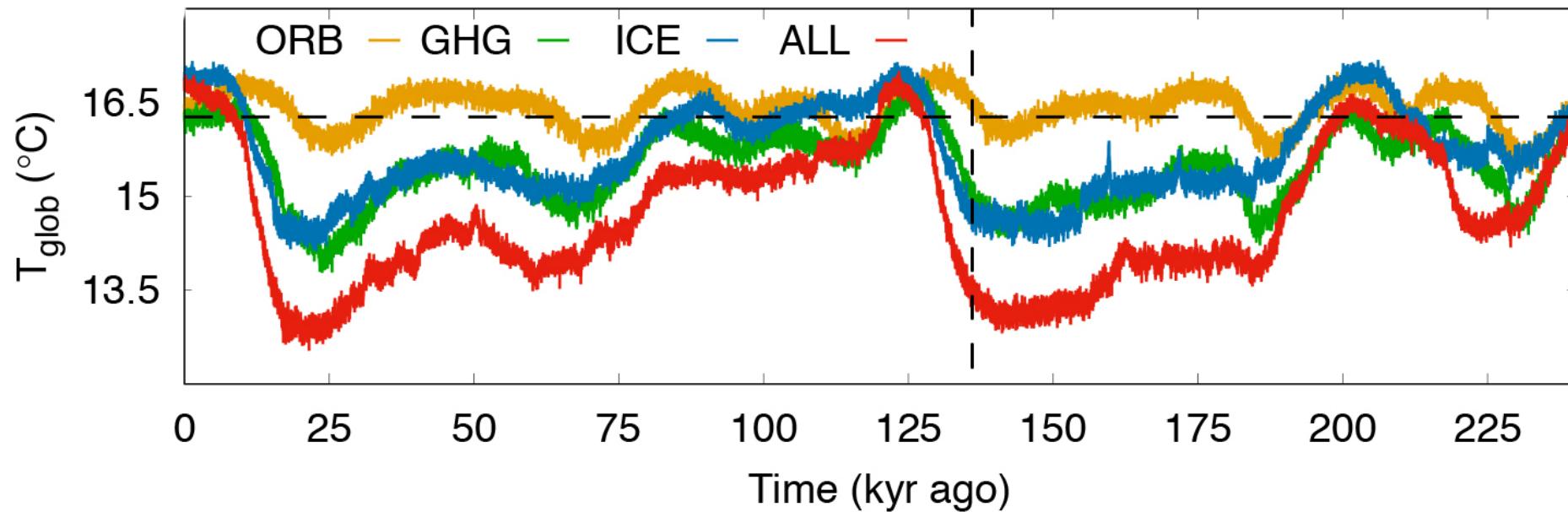
**ALL**: Orbital + GHG + ice

Ice: Berends et al. (2019) & GrIS: Bradley et al. (2018)



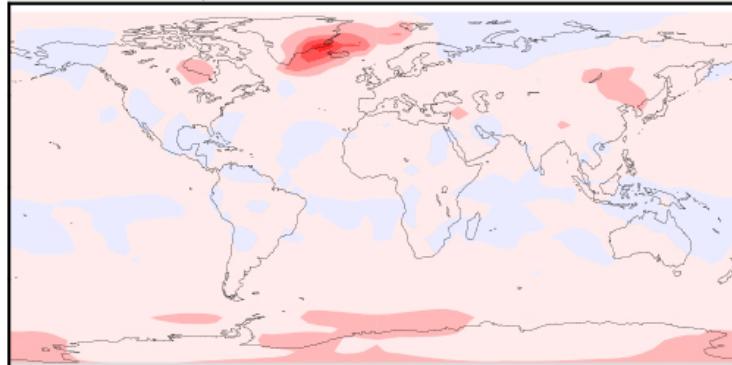
# iLoveclim results (annual mean 240-0 kyr ago)

Climatic forcing experiments as a side step. **ALL** simulation from 136 kyr ago is used as spin-up for coupled experiments (ensemble runs use 120-0 kyr).

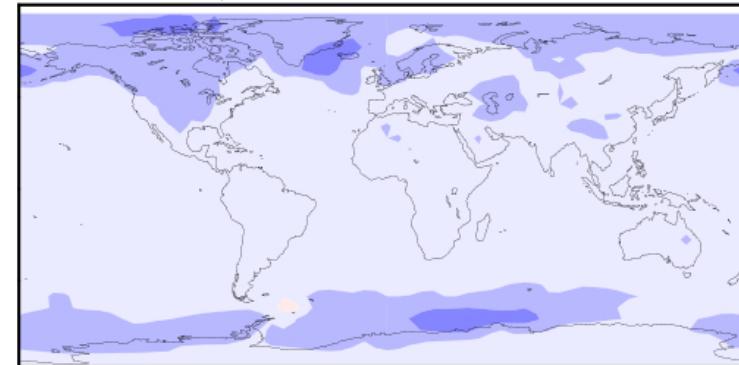


# iLoveclim results (at 136 kyr ago)

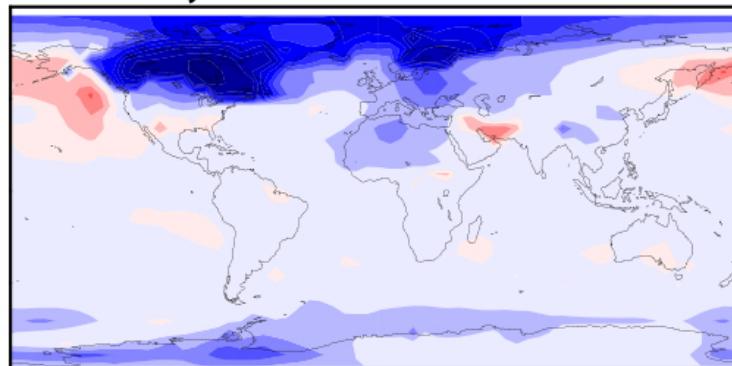
ORB Anomaly



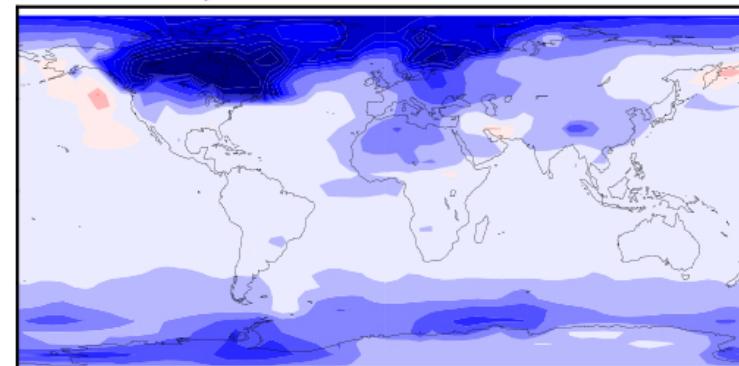
GHG Anomaly



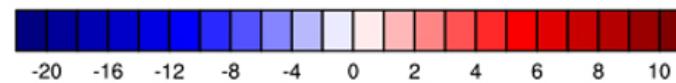
ICE Anomaly



ALL Anomaly



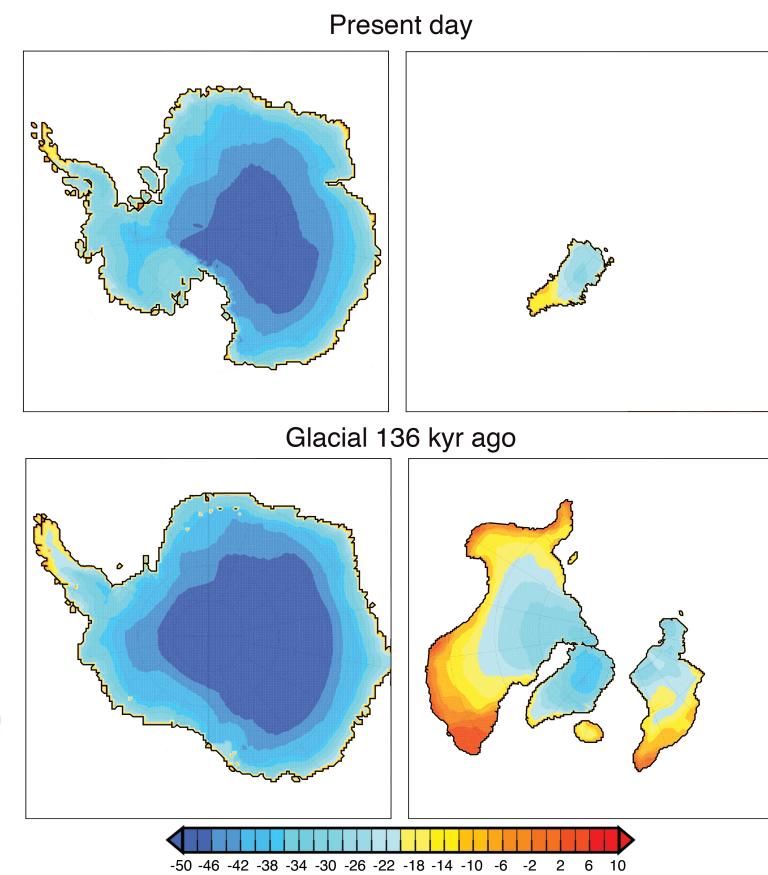
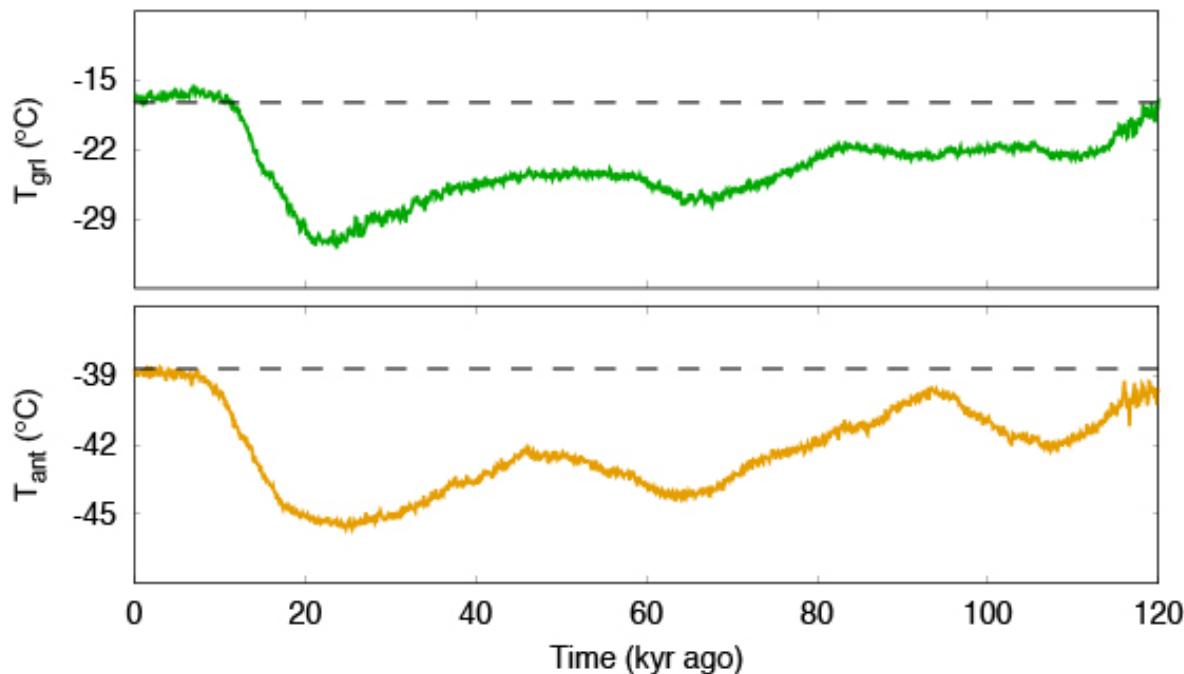
Temperature Anomaly ( $^{\circ}\text{C}$ )



# Glacial spin-up and tuning (120 – 0 kyr ago)



Surface air temperature over **Greenland** and **Antarctica**,  
interpolated on the GRISLI 40 x 40 km grid.



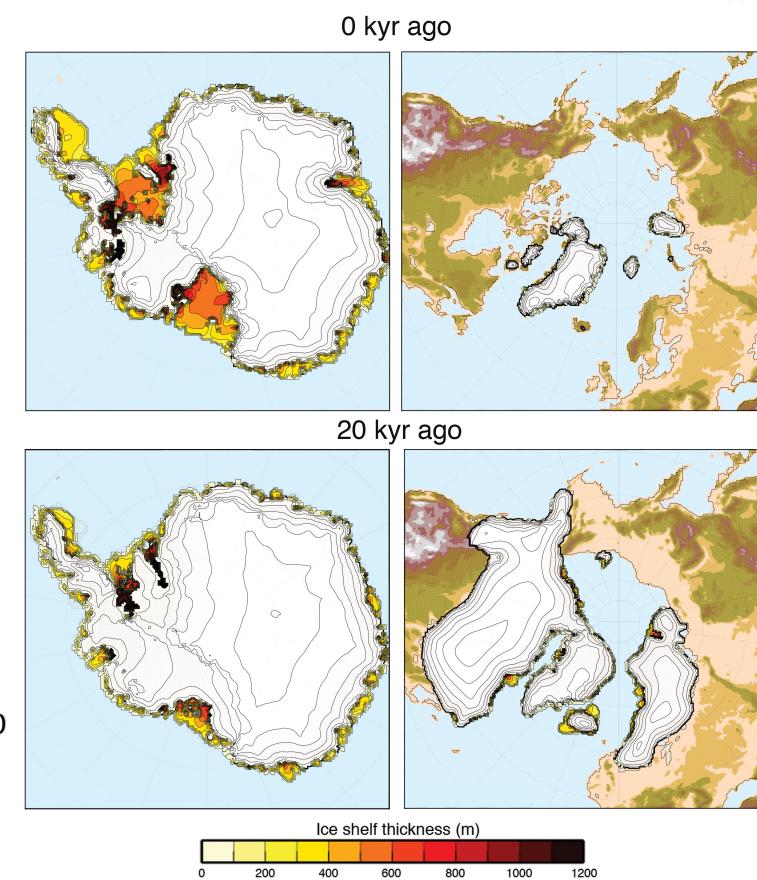
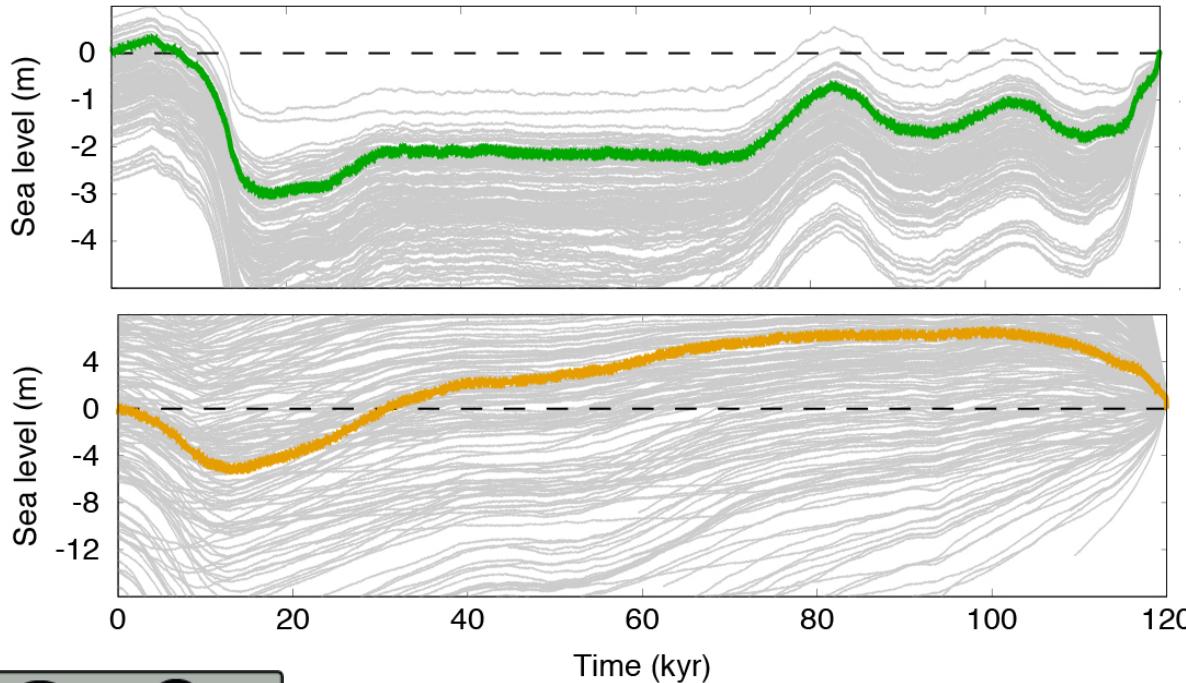
# Calibration of GRISLI – LHS experiments



GRISLI ice-sheet simulations using iLOVECLIM forcing from previous slide.

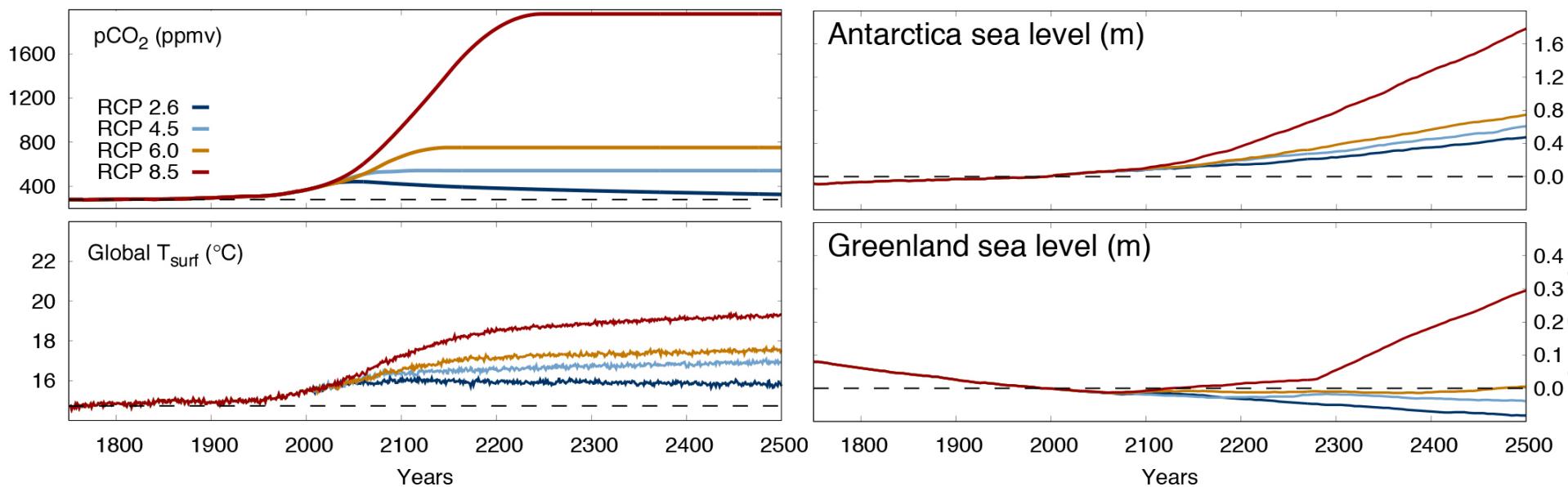
Optimal **Greenland** and **Antarctica** (based on comparison with PD observed ice)

Grey lines are ensemble (n=200 AIS, n=128 GrIS)



# Coupled experiments for the future

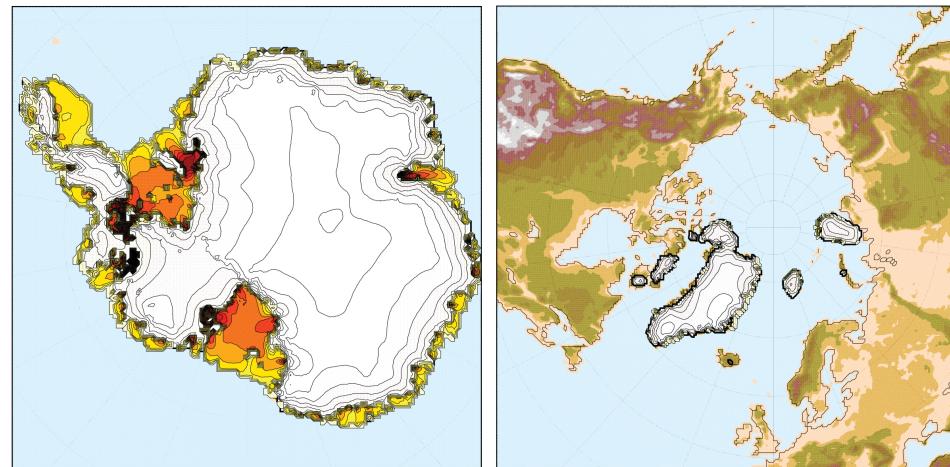
Future experiments using the four RCP scenarios. Initial ice sheets are the optimal settings from the previous slide.



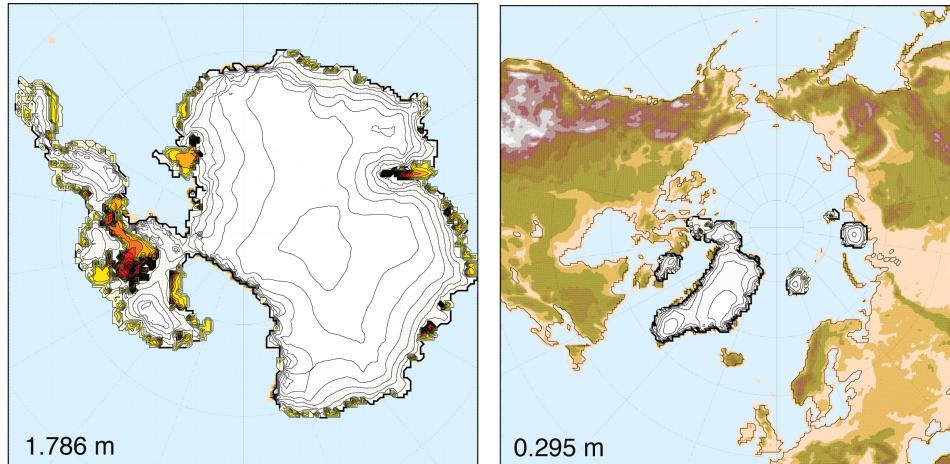
# Final ice sheets

GRISLI ice sheets from coupled experiment RCP 8.5.

1750



2500



# Summary / Conclusions

- Polar amplification is present in both GHG and ICE runs
- Optimal ice sheets selected from large ensemble
- AIS shows imbalance starting at 120 kyr
- Future experiments show retreat of AIS, growth of GrIS  
(except RCP 8.5)



# Future plans

- Coupling for LIG simulations (136 – 120 kyr ago)
- Coupling for LGM simulations (20 – 0 kyr ago)
- Coupling for future, sensitivity testing (ECS, GRISLI parameters) – calibration against observations (e.g. IMBIE).





# Calibration of GRISLI – LHS experiments

Parameter	Minimum	Maximum	Description
Sf	1.0	5.0	SIA enhancement factor (-)
Cf	0.5E-3	5.0E-3	Basal drag coefficient (yr m <sup>-1</sup> )
K0	2.0E-5	20E-5	Till conductivity (m s <sup>-1</sup> )
Fmelt	1E-3	20E-3	Sub-shelf melting parameter (-)



# Comparison with other EMICs

**ALL** simulation compared to Stap et al. (2018) with CLIMBER-2 and Friedrich et al. (2016) with LOVECLIM. All simulations show global mean surface temperature, relative to value at t=0 kyr ago.

