

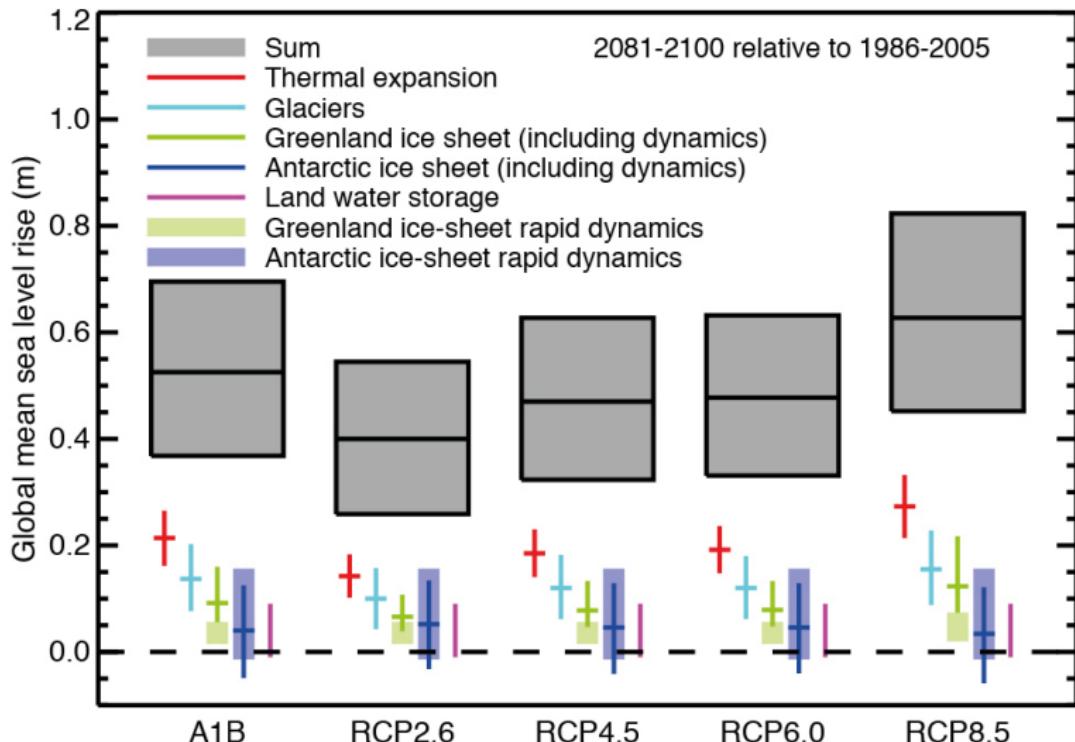


Using past changes to improve models of the Antarctic Ice Sheet

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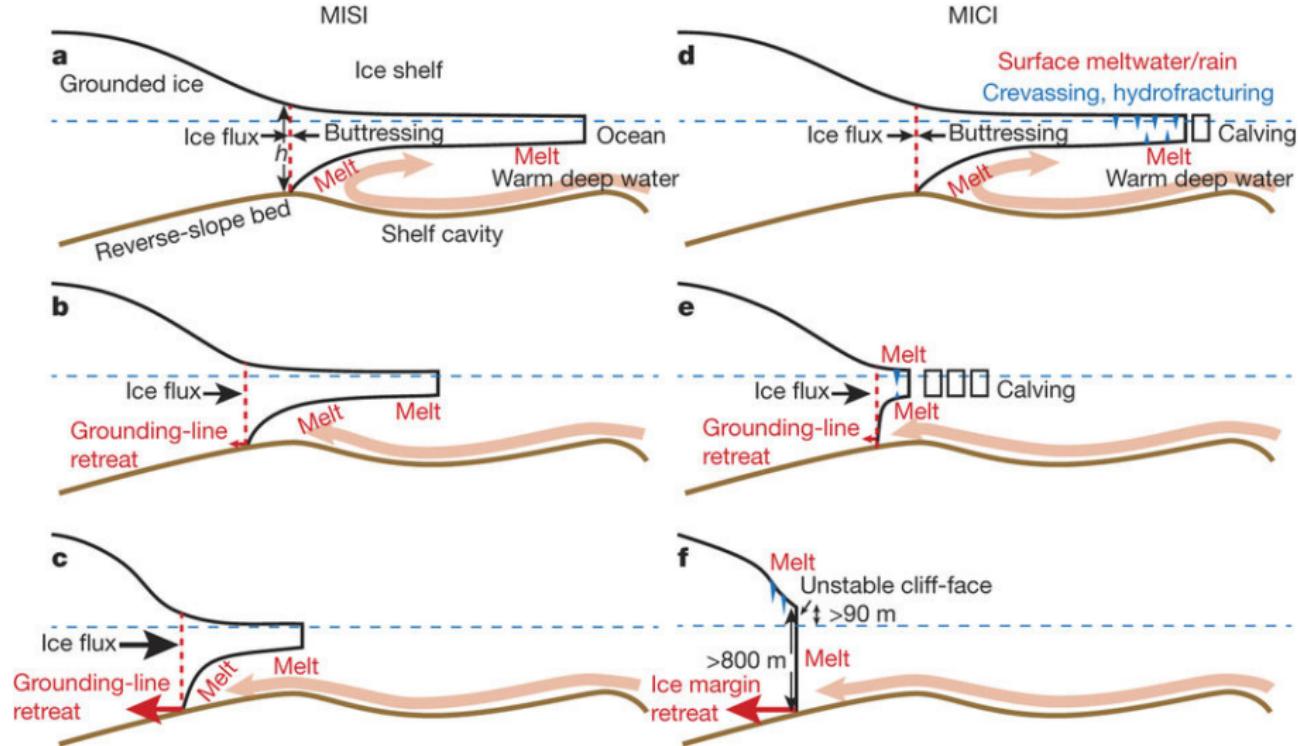
AMOS-ICSHMO 2018
5-9 February 2018

Likely changes in global sea level by 2081–2100



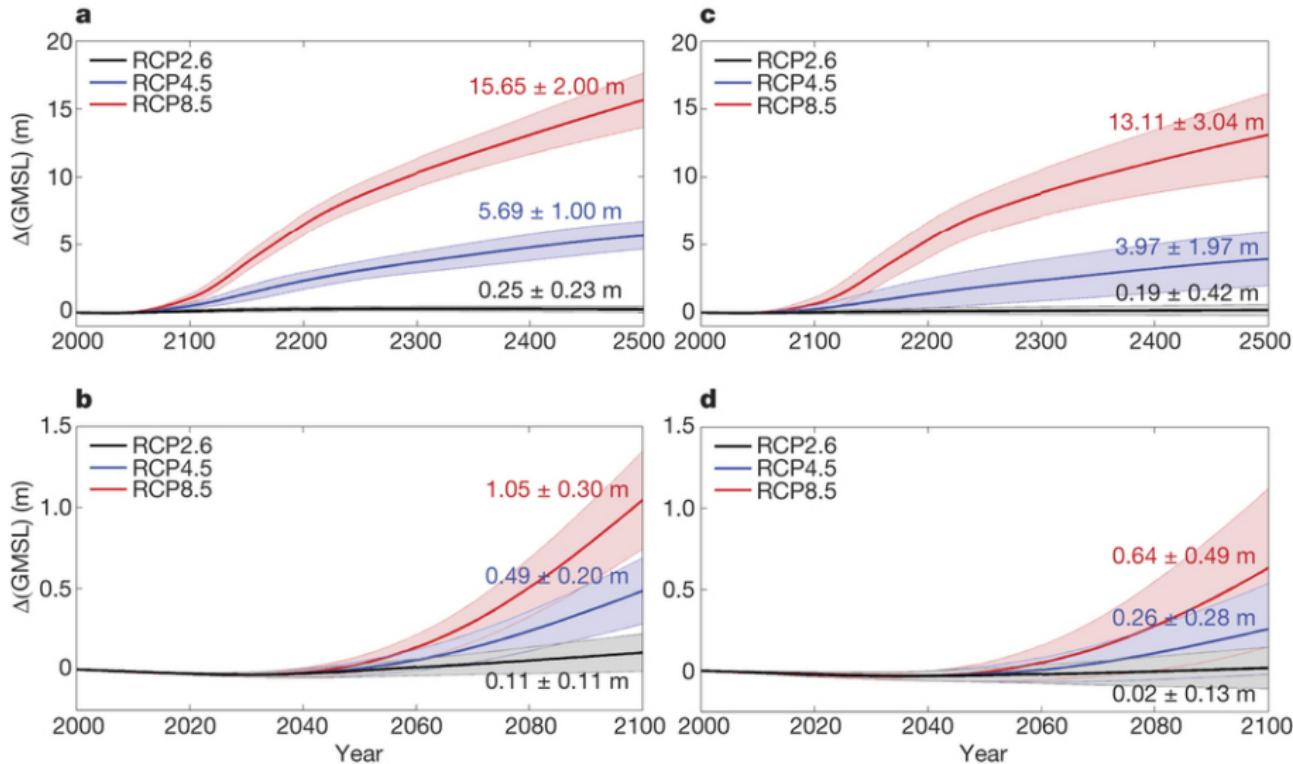
IPCC AR5 WG1 report (2013)

Mechanisms of ice sheet instability



DeConto and Pollard (2016), *Nature*

Antarctic contribution to global sea level (2000–2500)



DeConto and Pollard (2016), *Nature*

How do we project changes in global sea level?

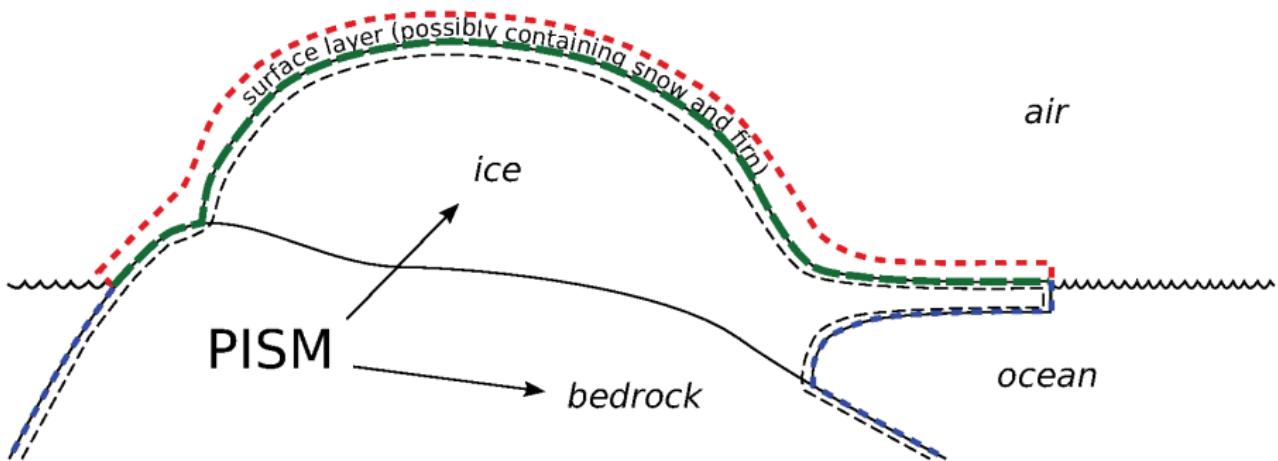


Figure 15: PISM's view of interfaces between an ice sheet and the outside world

Ice sheet models are highly under-constrained

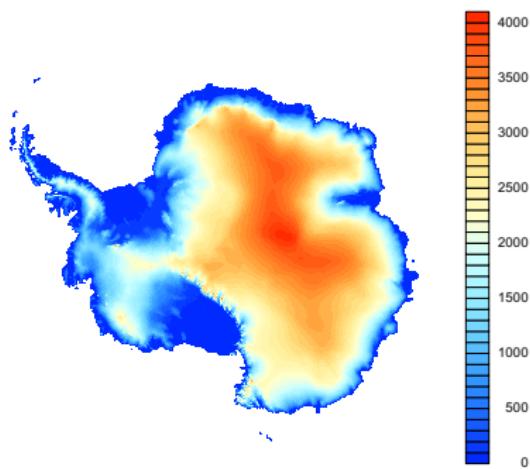
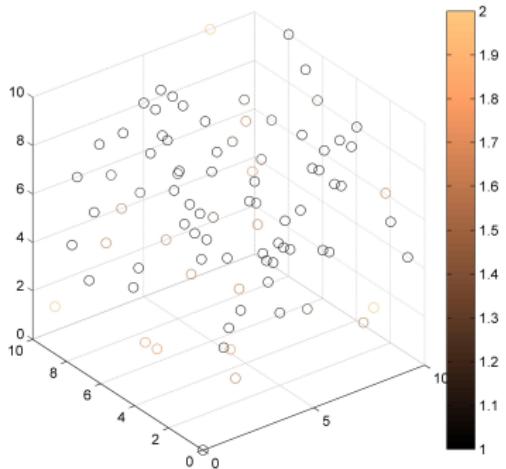
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mpieexec -n 4 pismr -skip -skip_max 10 -i nomass_20km.nc  
-sia_e 3.0 -atmosphere given -atmosphere_given_file  
pism_Antarctica_5km.nc -surface simple -ocean pik  
-meltfactor_pik 5e-3 -ssa_method fd -ssa_e 0.6 -pik -calving  
eigen_calving,thickness_calving -eigen_calving_K 2.0e18  
-thickness_calving_threshold 200.0 -stress_balance ssa+sia  
-hydrology null -pseudo_plastic -pseudo_plastic_q 0.25  
-till_effective_fraction_overburden 0.02  
-tauc_slippery_grounding_lines -topg_to_phi 15.0,40.0,  
-300.0,700.0 -ys 0 -y 100000 -ts_file ts_run_20km.nc  
-ts_times 0:1:100000 -extra_file extra_run_20km.nc  
-extra_times 0:1000:100000 -extra_vars thk,usurf,  
velbase_mag,velbar_mag,mask,diffusivity,tauc,bmelt,  
tillwat,tempabase,hardav,Href,gl_mask -o run_20km.nc  
-o_size big
```

Ice sheet models are highly under-constrained

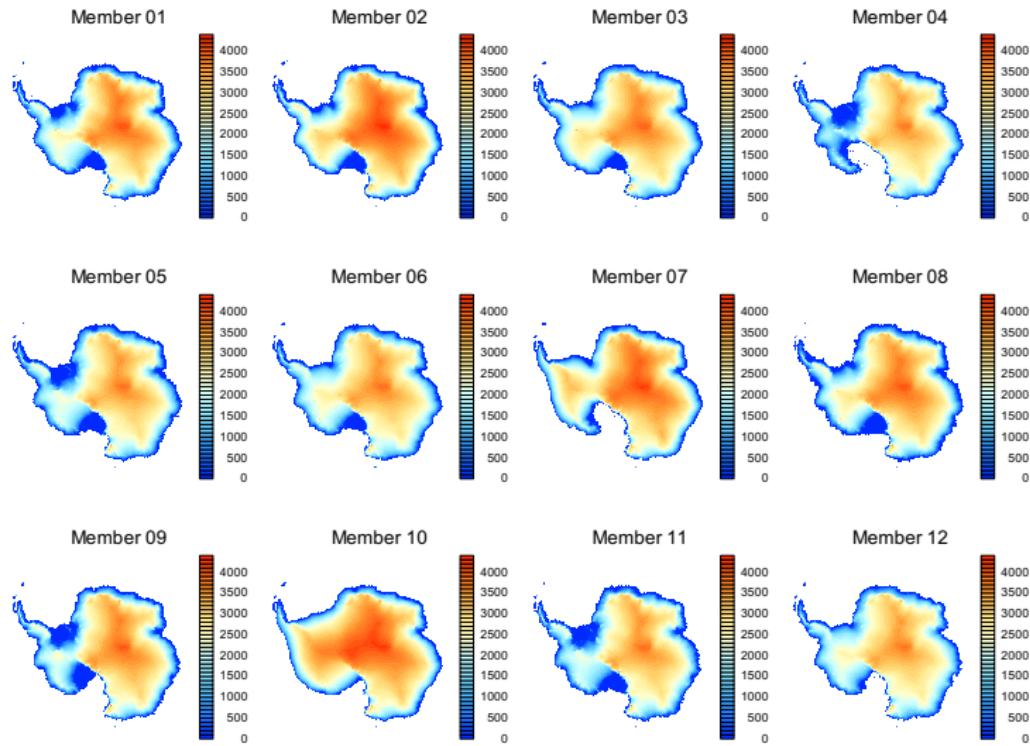


Constraining parameterisations: Using the present

- Use PISM to simulate the present state of the Antarctic Ice Sheet.
- Run the model many times. Perturb the model physics each time, sampling as many different parameter combinations as possible.
- Identify the model configurations where the simulated evolution of the ice sheet agrees best with observations.

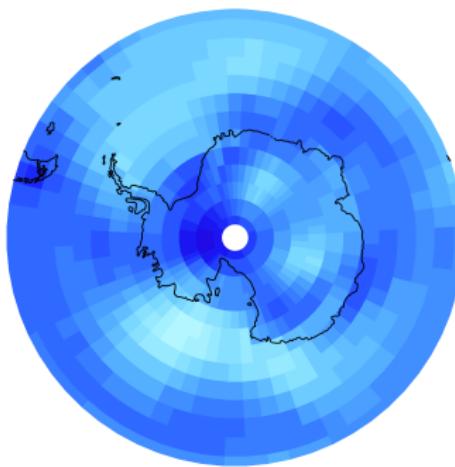


Constraining parameterisations: Using the present

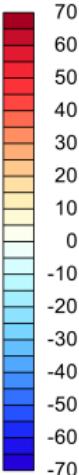
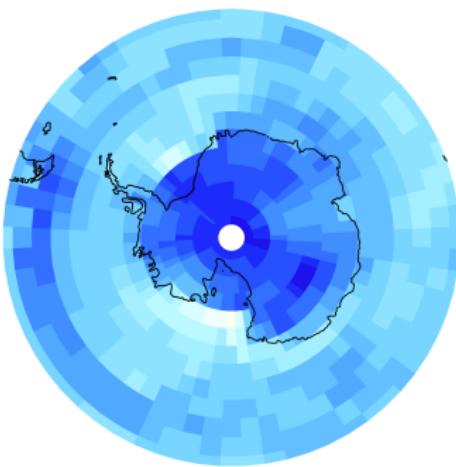


Constraining parameterisations: Using the past

Surface air temperature anomaly ($^{\circ}\text{C}$)

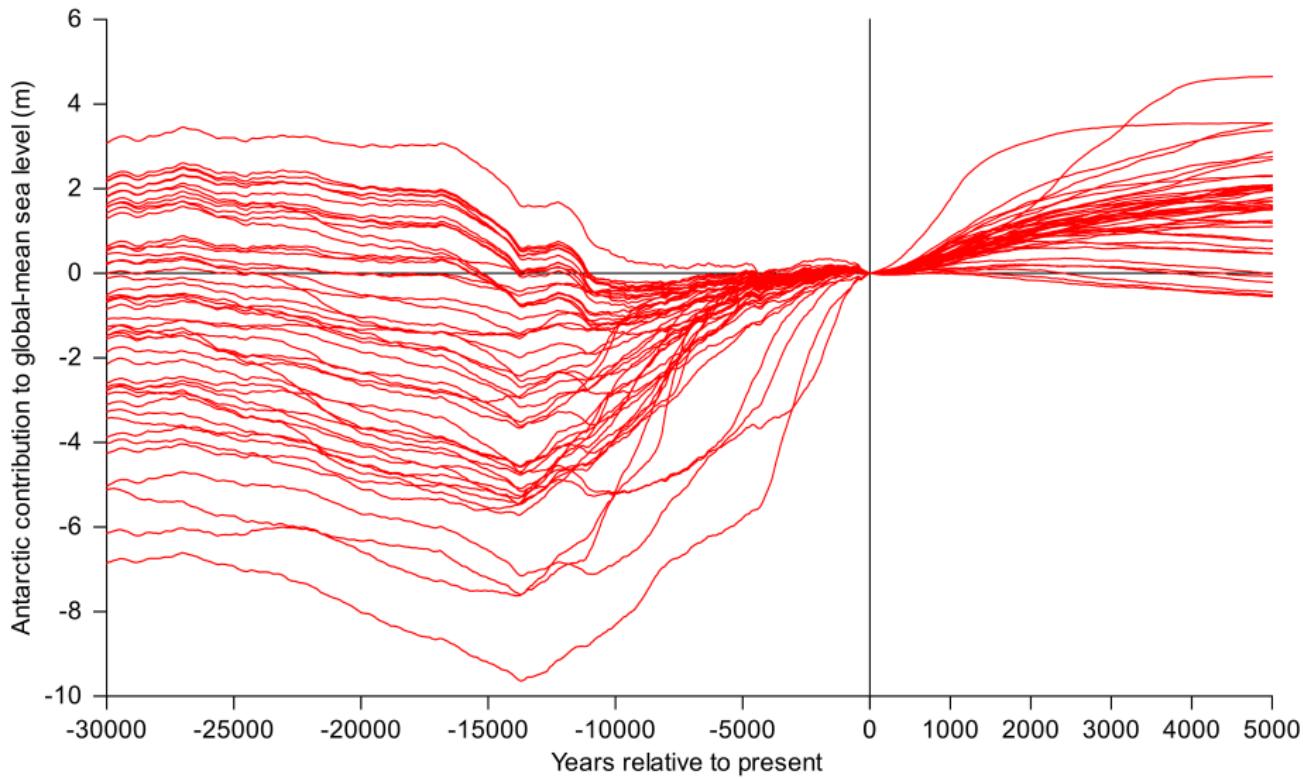


Precipitation anomaly (%)

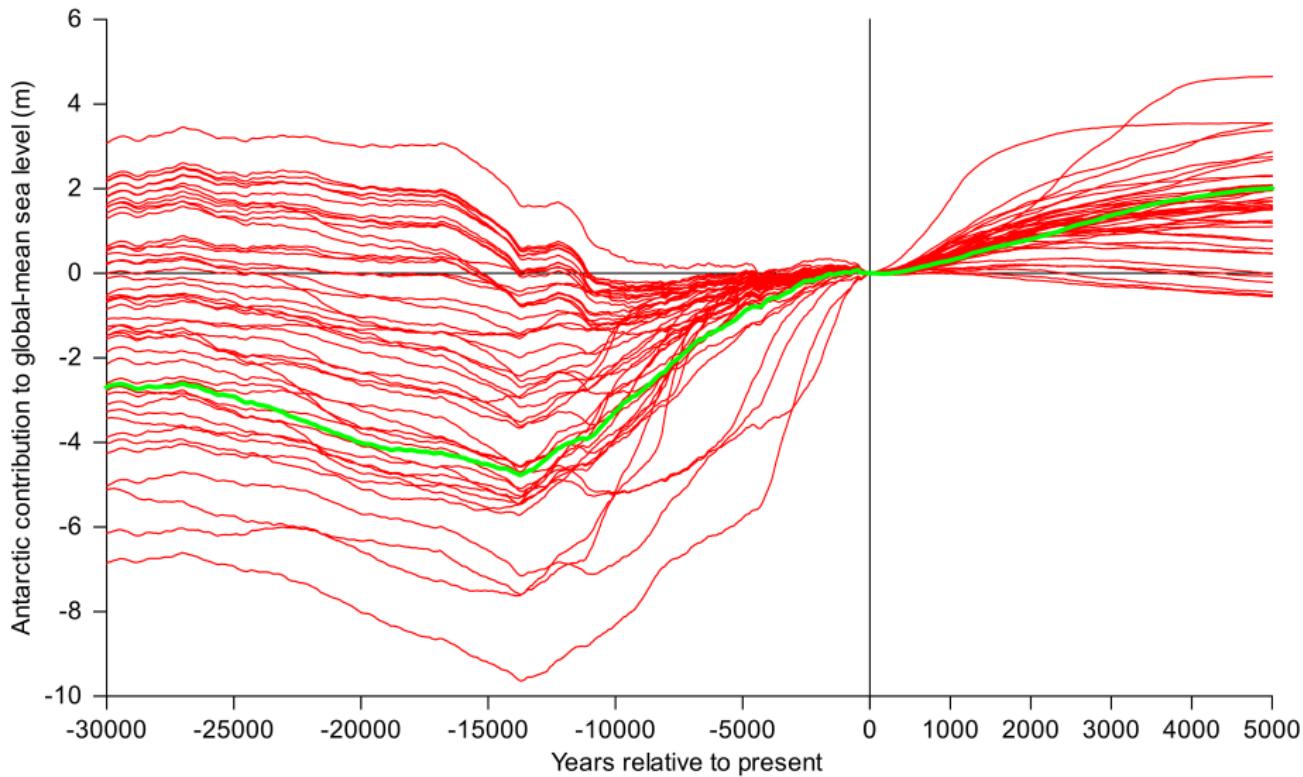


- Use the CSIRO Mk3L climate system model to simulate the period 56–0 ka, then 5,000 years into the future under the RCP8.5 scenario

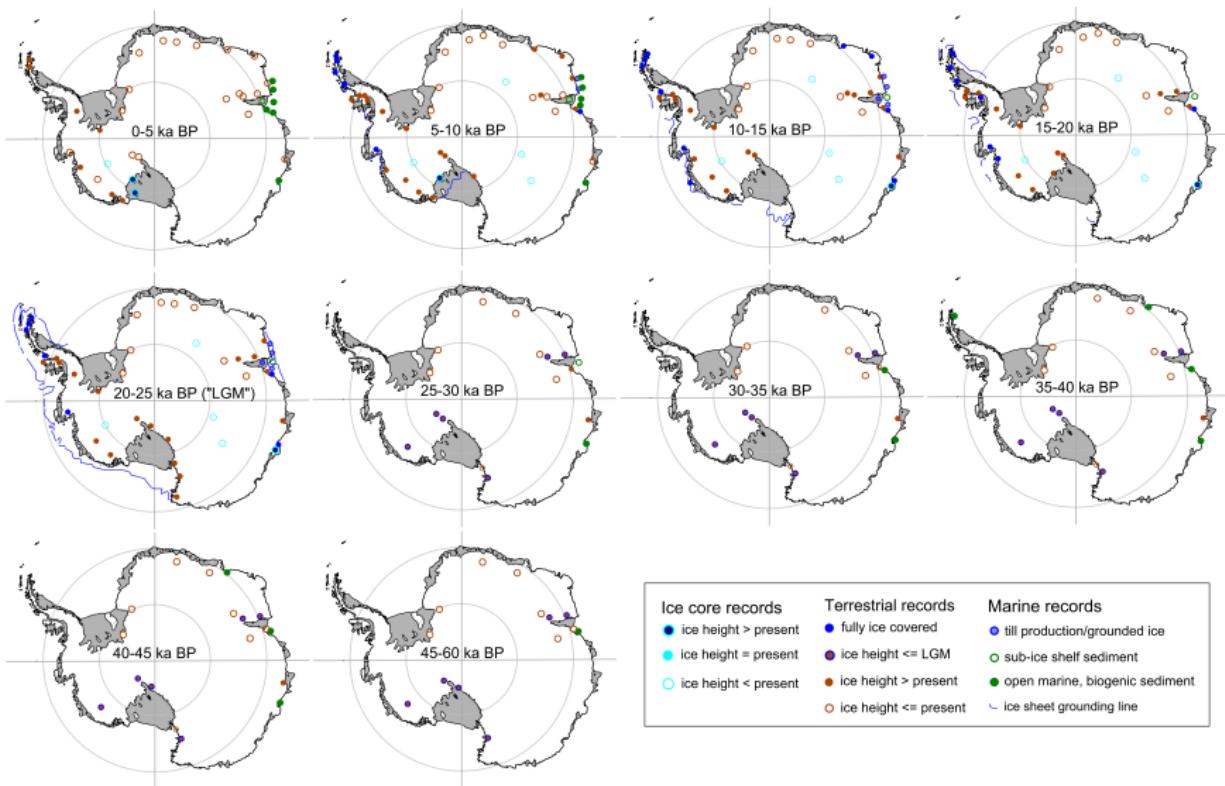
Constraining parameterisations: Using the past



Constraining parameterisations: Using the past



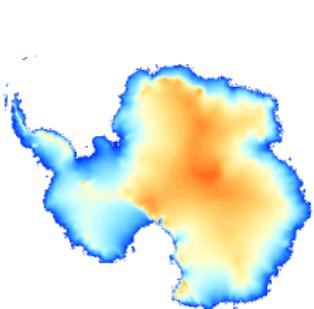
Constraining parameterisations: Using the past



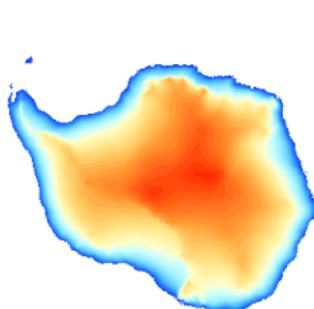
Duanne White/University of Canberra

Constraining parameterisations: Using the past

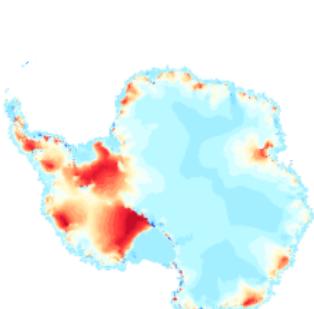
a. 20-25ka elevation (BEST)



b. 20-25ka elevation (WORST)



c. 20-25ka anomaly (BEST)



d. 20-25ka anomaly (WORST)

