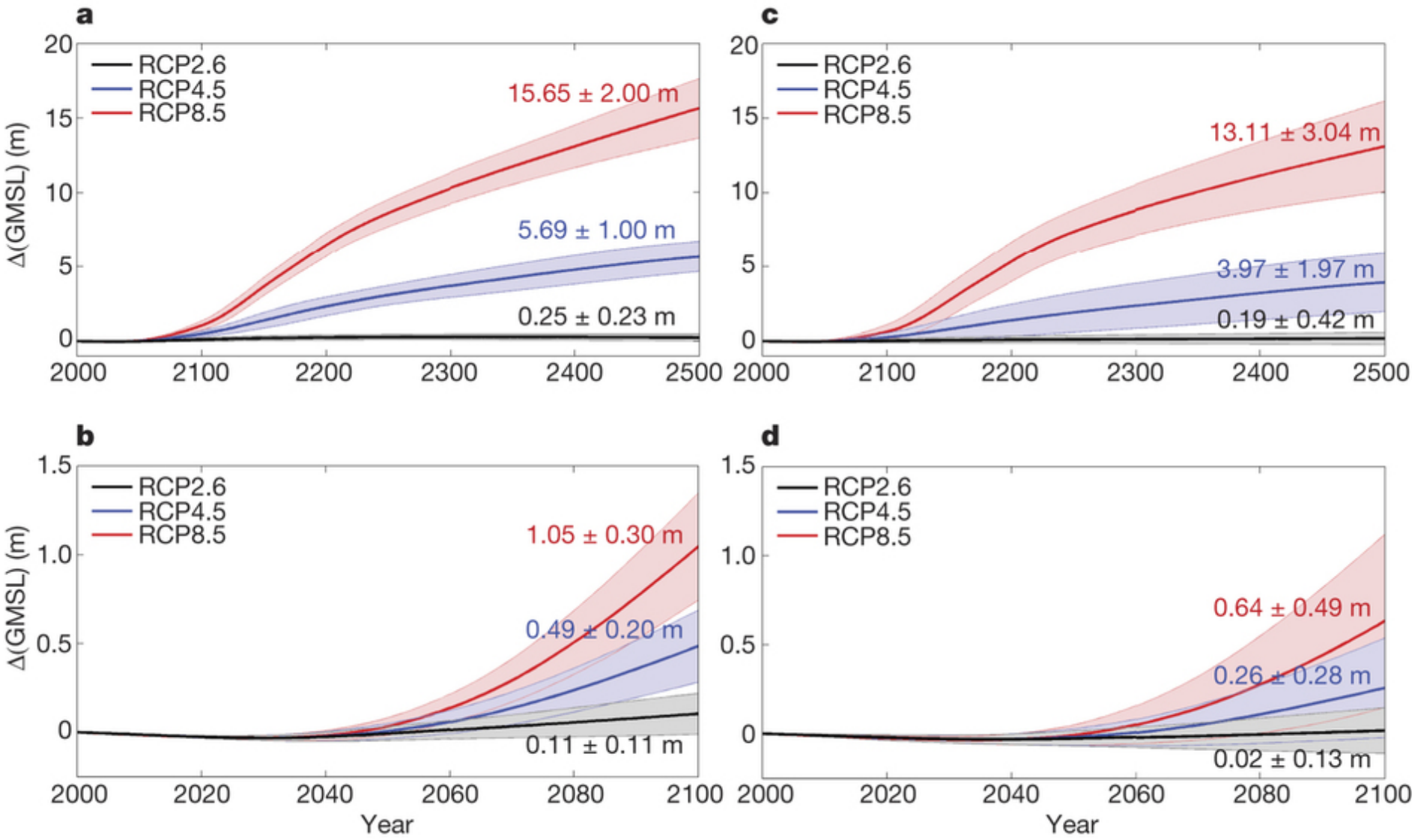
Antarctic contribution to global sea level by 2500



DeConto and Pollard (2016), *Nature*

Are we facing an ice apocalypse?

COVER STORY

Ice Apocalypse

Rapid collapse of Antarctic glaciers could flood coastal cities by the end of this century.

By Eric Holthaus on Nov 21, 2017

In a remote region of Antarctica known as Pine Island Bay, 2,500 miles from the tip of South America, two glaciers hold human civilization hostage.

Stretching across a frozen plain more than 150 miles long, these glaciers, named Pine Island and Thwaites, have marched steadily for millennia toward the Amundsen Sea, part of the vast Southern Ocean. Further inland, the glaciers widen into a two-mile-thick reserve of ice covering an area the size of Texas.

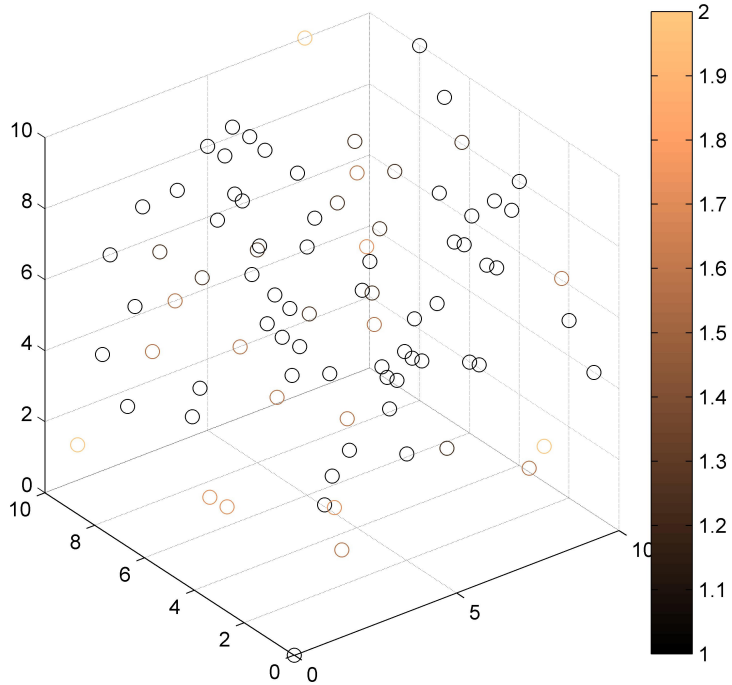
There's no doubt this ice will melt as the world warms. The vital question is when.

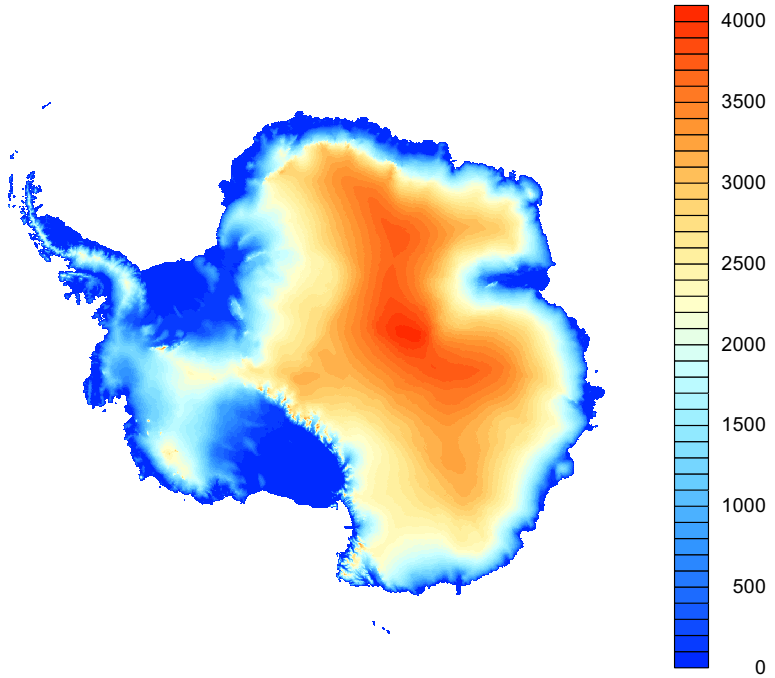
The glaciers of Pine Island Bay are two of the largest and fastest-melting in Antarctica. (A Rolling Stone feature earlier this year dubbed Thwaites "The Doomsday Glacier.") Together, they act as a plug holding back enough ice to pour 11 feet of sea-level rise into the world's oceans — an amount that would submerge every coastal city on the planet. For that reason, finding out how fast these glaciers will collapse is one of the most important scientific questions in the world today.

To figure that out, scientists have been looking back to the end of the last ice age, about 11,000 years ago, when global temperatures stood at roughly their current levels. The bad news? There's growing evidence that the Pine Island Bay glaciers collapsed rapidly back then, flooding the world's coastlines — partially the result of something called "marine ice-cliff instability."

Constraining ice sheet model parameterisations

- 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.



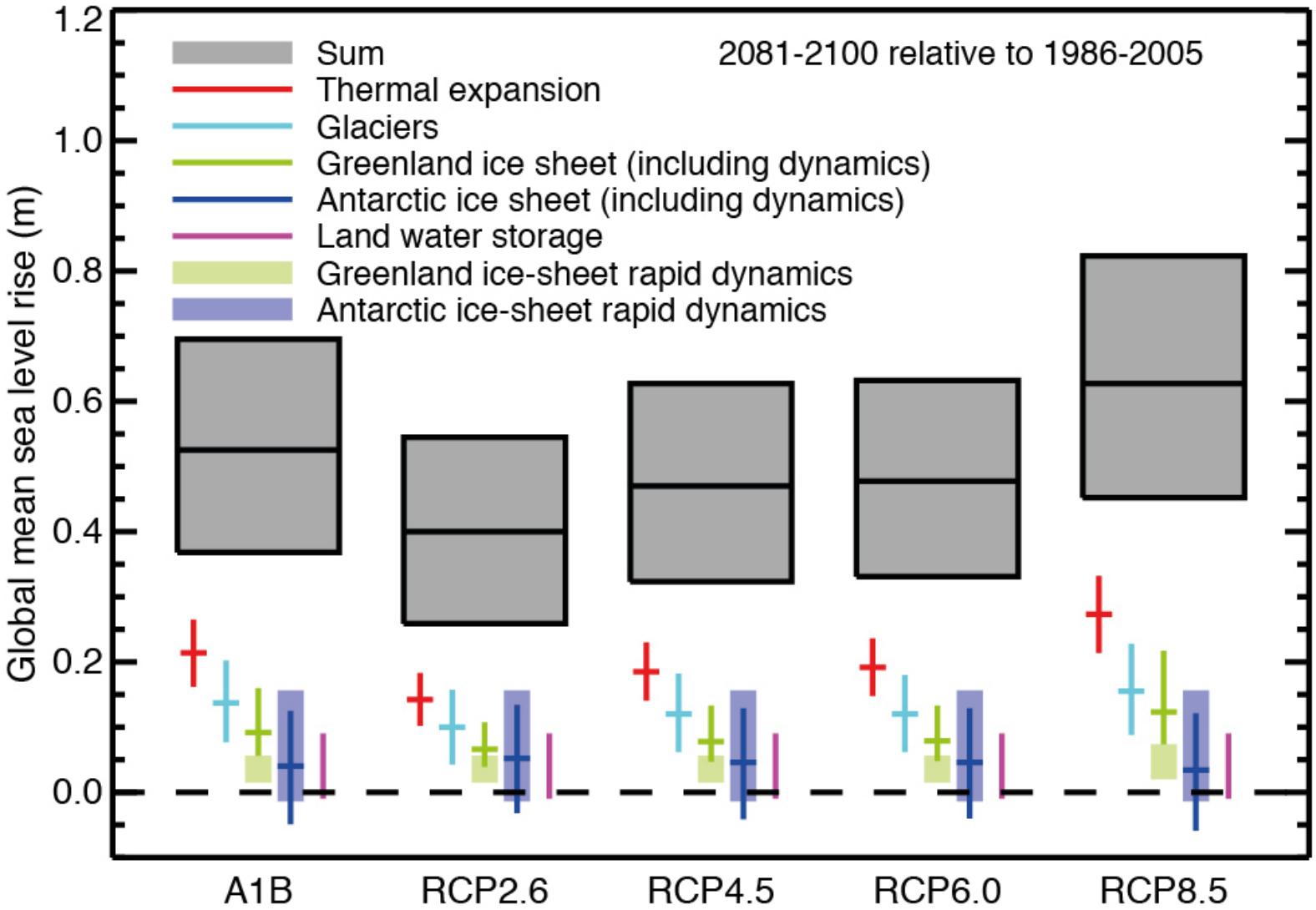


ANTARCTIC GATEWAY PARTNERSHIP

PICO 4.5

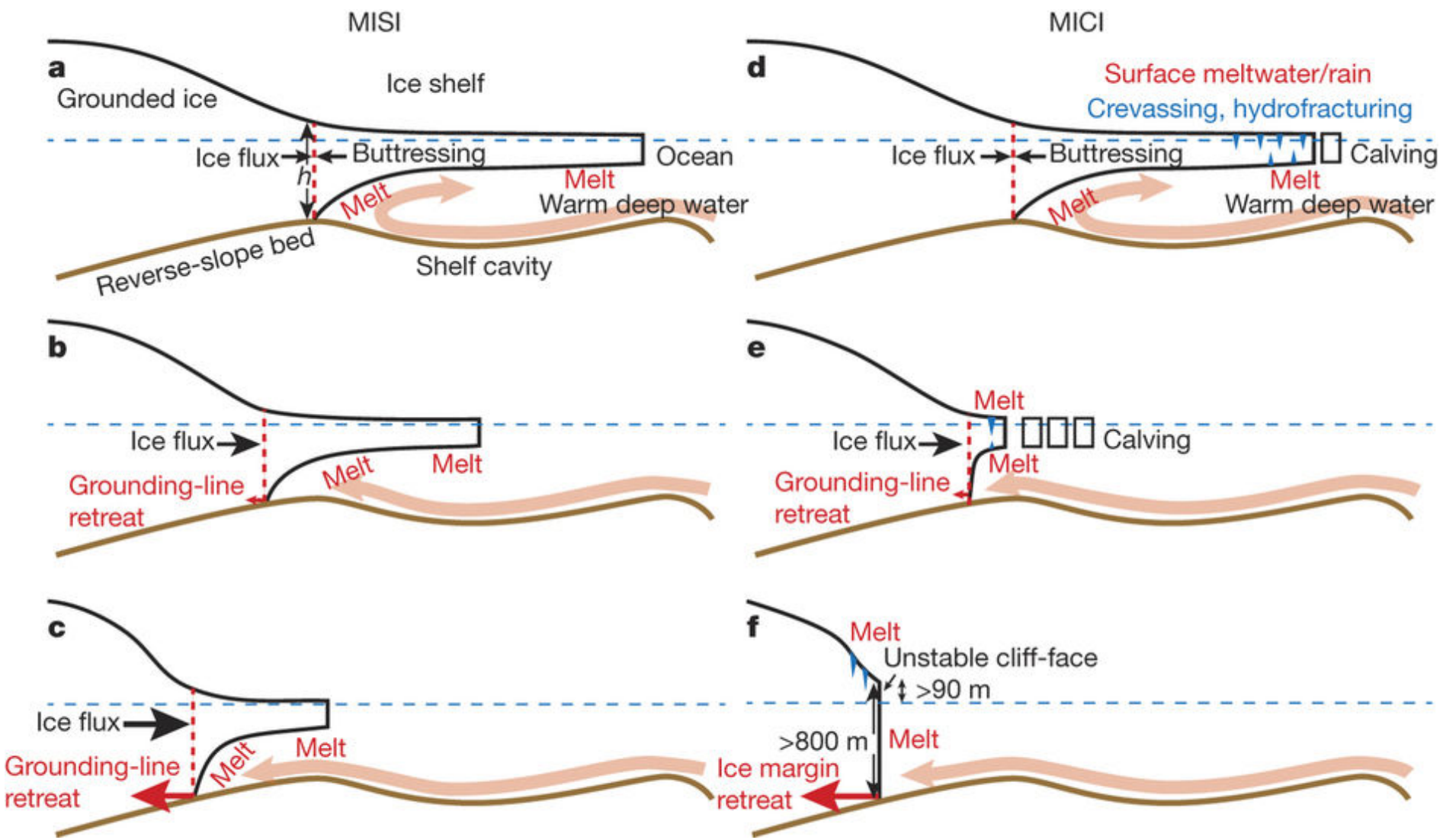
0900–0930

Likely changes in global sea level by 2081–2100



IPCC AR5 WG1 report (2013)

Mechanisms of ice sheet instability



DeConto and Pollard (2016), *Nature*

How do we project changes in global sea level?

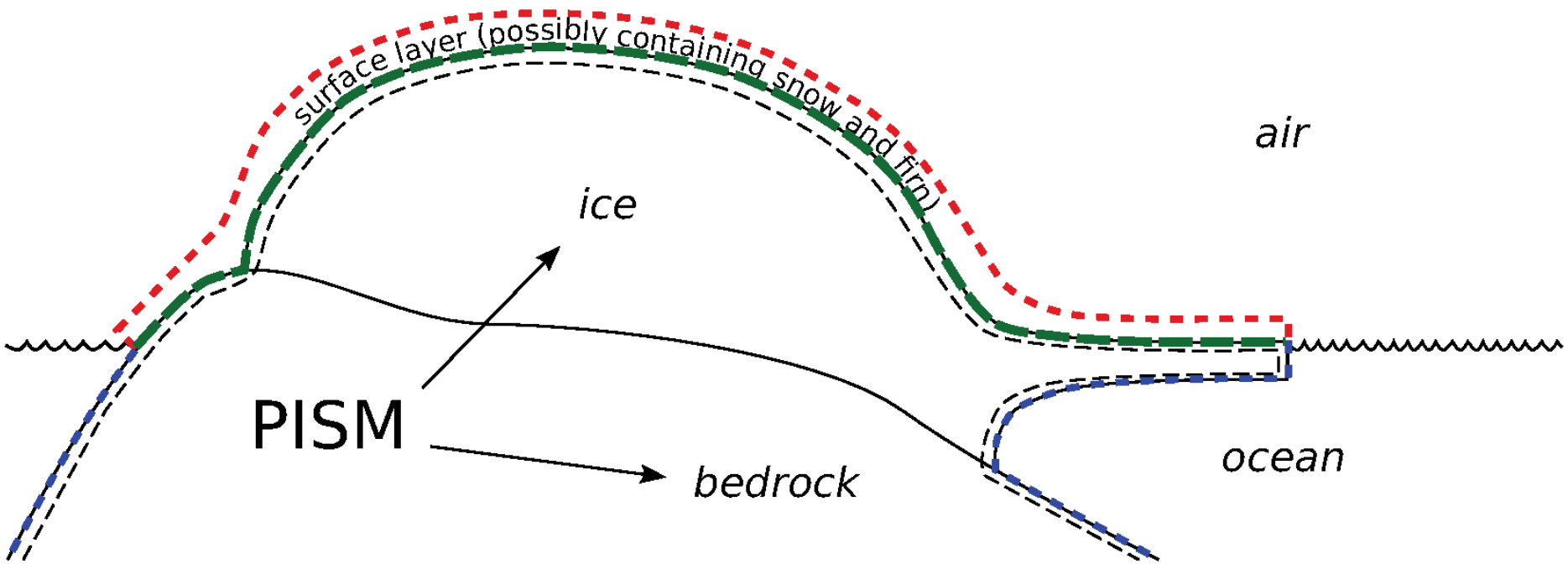


Figure 15: PISM's view of interfaces between an ice sheet and the outside world

Ice sheet models are highly under-constrained

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-meltfactor_pik 5e-3 -ssa_method fd -ssa_e 0.6 -pik -calving
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-thickness_calving_threshold 200.0 -stress_balance ssa+sia
-hydrology null -pseudo_plastic -pseudo_plastic_q 0.25
-till_effective_fraction_overburden 0.02
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-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
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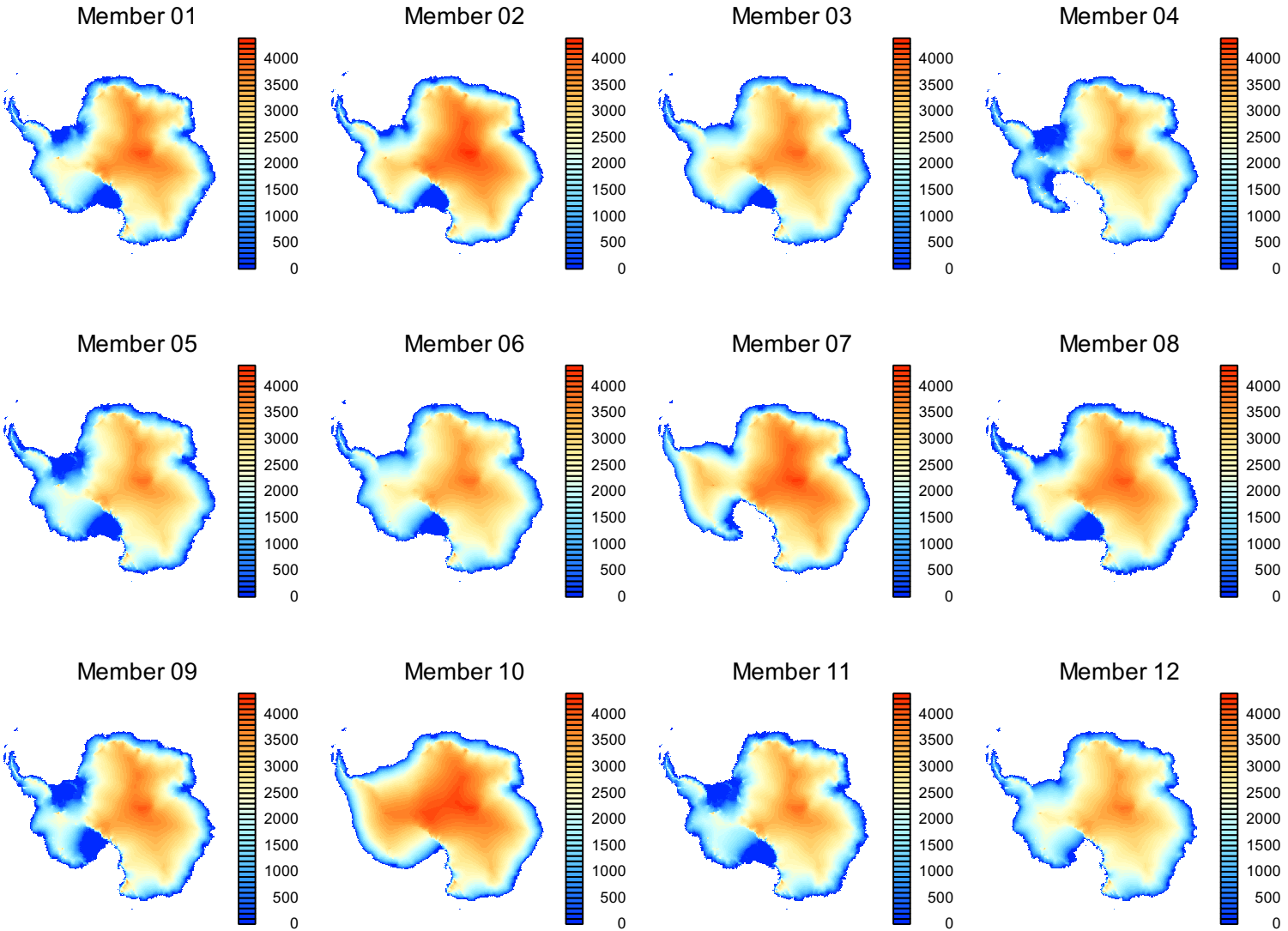
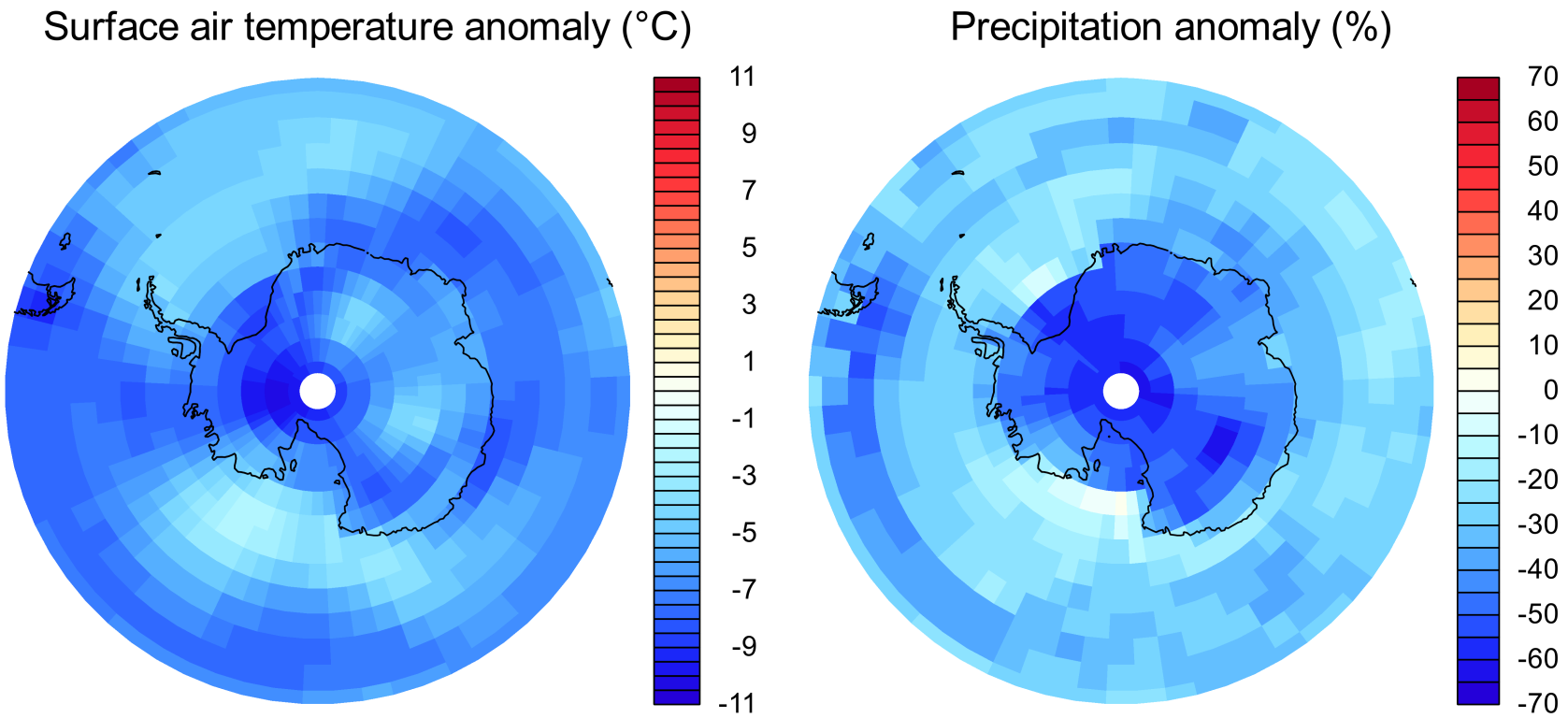
Constraining ice sheet model parameterisations

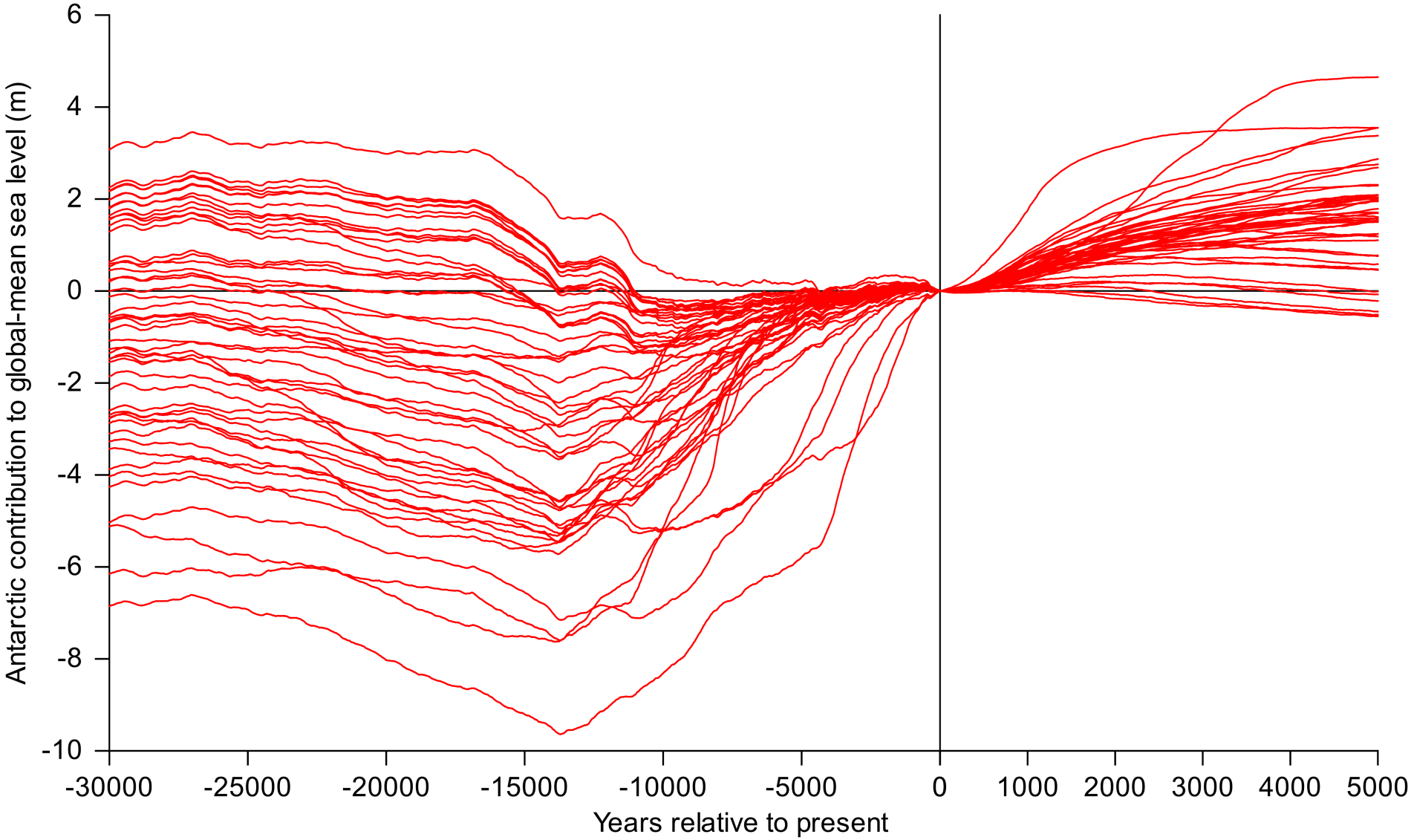


Constraining parameterisations: Using the past

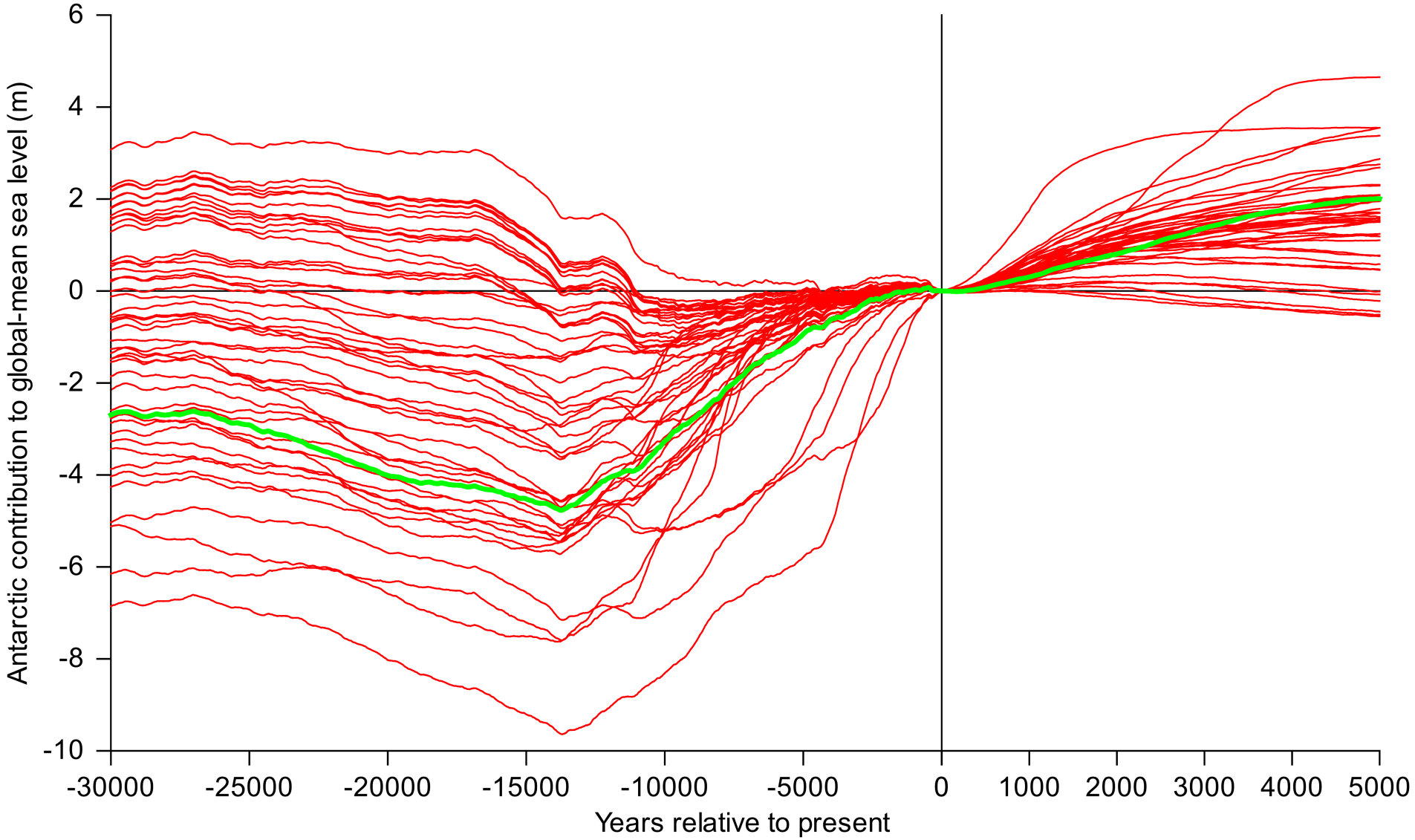


- Use the CSIRO Mk3L climate system model to simulate the period 56–0 ka, then 5,000 years into the future under the RCP8.5 scenario

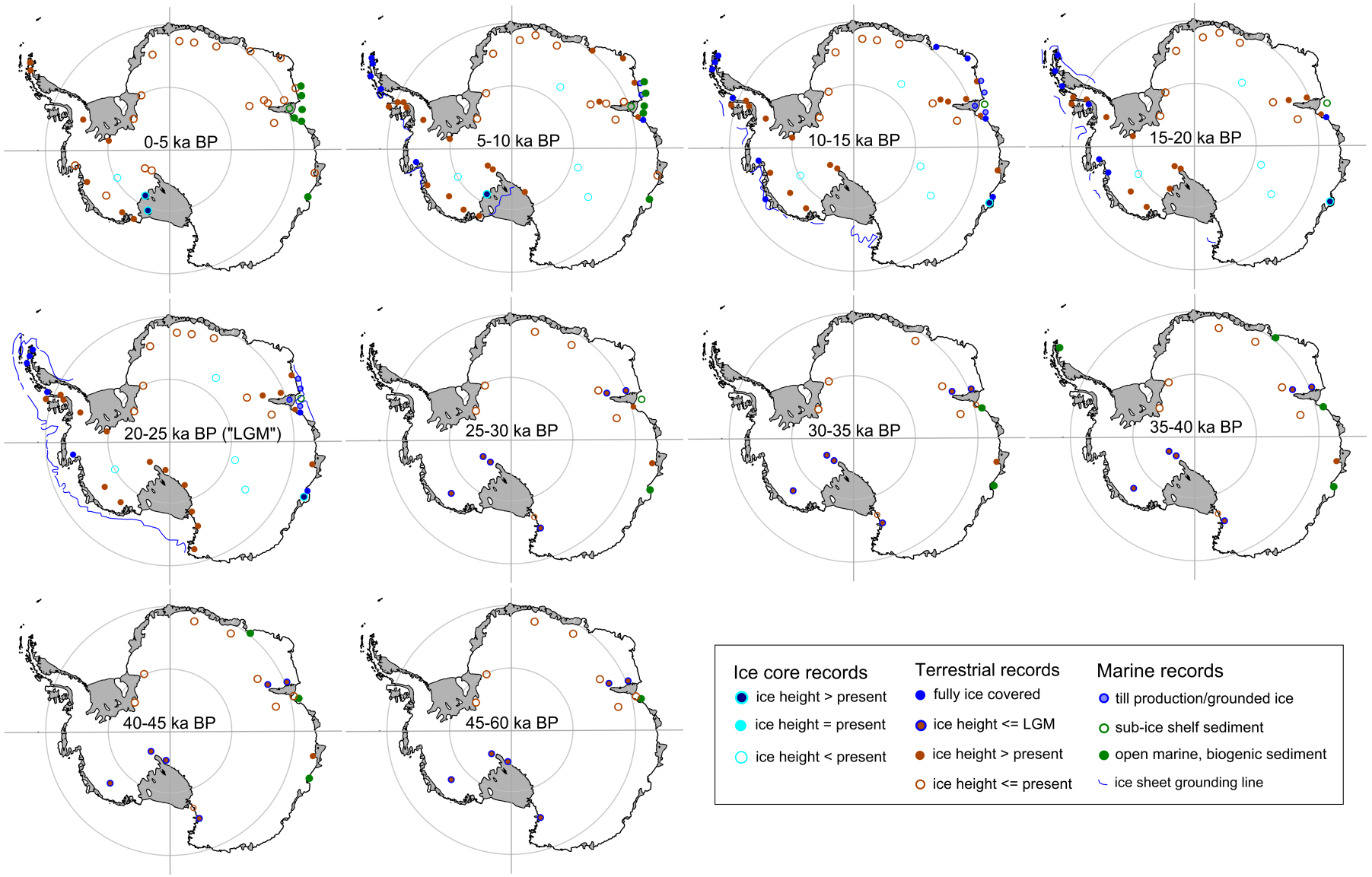
Constraining parameterisations: Using the past



Constraining parameterisations: Using the past



Constraining parameterisations: Using the past



Duanne White/University of Canberra

Constraining parameterisations: Using the past