LINEAR SEA-LEVEL RESPONSE OF ANTARCTIC TRIBUTARIES TO STRONG PROJECTED OCEAN WARMING UNDERNEATH FILCHNER-RONNE ICE SHELF

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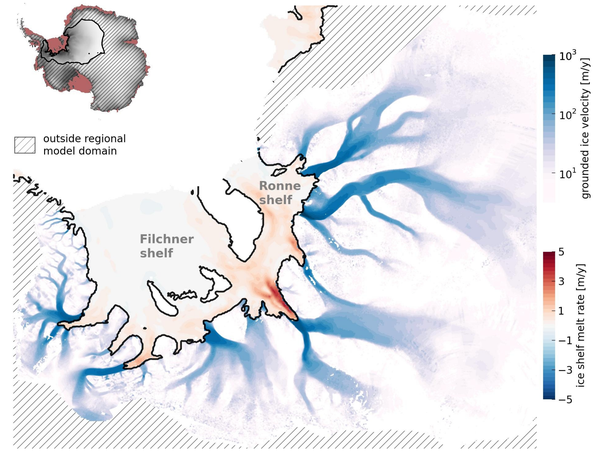

Fig. 1 Region of interest

PROBLEM

- Antarctica's contribution to global sea-level rise has recently been increasing
- Ocean models indicate possibility of an abrupt intrusion of warm circumpolar deep-water into the cavity below Filchner-Ronne ice shelf (FRIS) within the next two centuries
- The ice basin's retrograde bed slope would allow for an unstable ice-sheet retreat
- Buttressing of the large ice shelf and the narrow glacier troughs tend to inhibit such instability

Here we explore the response of the Antarctic ice sheet to a perturbation of FRIS using projected sub-shelf melt rates in dynamic ice-sheet simulations.

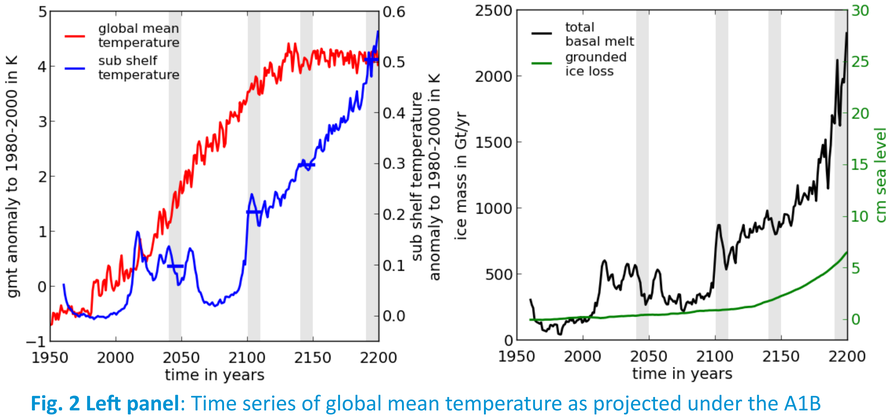

Fig. 2 Left panel: Time series of global mean temperature as projected under the A1B scenario with the Had-CM3 AOGCM (red line) and mean ocean subsurface temperature under FRIS from Had-CM3-driven FESOM (blue line). **Right panel**: Simulated total ice loss rate through basal melt (black line, in Gt/yr) and sea-level relevant ice loss (green, in cm sea level) under the A1B scenario.

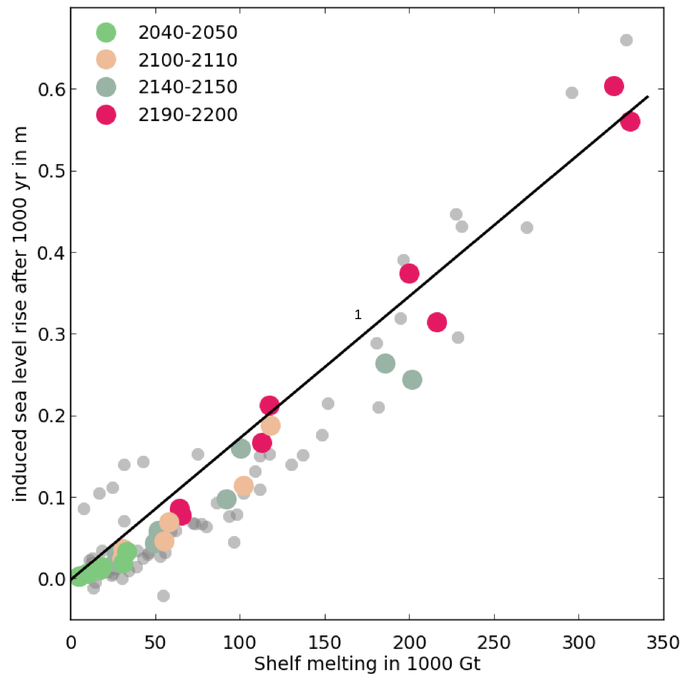

Fig. 3 Induced sea level rise (y-axis) for the integrated amount of anomalous melting (x-axis) as diagnosed in the ice sheet model. Colored dots show regional simulations with colors indicating different melting periods. Grey dots are whole-Antarctica simulations.

METHOD

- Regional (FRIS basin, 5 km) and continental-scale (12 km) ice-sheet simulations with Parallel Ice Sheet Model (PISM)
- Sub-shelf melting from ocean model FESOM (Had-CM3 atmosphere, A1B scenario)
- Start from equilibrium ice sheet under present-day conditions
- Apply melting pulses beneath FRIS for different time lengths constructed from FESOM projections

RESULTS

- Ice loss reduces after each pulse of projected warm-water intrusion
- Long-term sea-level contribution is approximately proportional to the total ice-shelf melt
- Weak ocean forcing: local instabilities might dominate ice loss
- Stronger ocean forcing: ice discharge determined by forcing and not by the marine ice-sheet instability

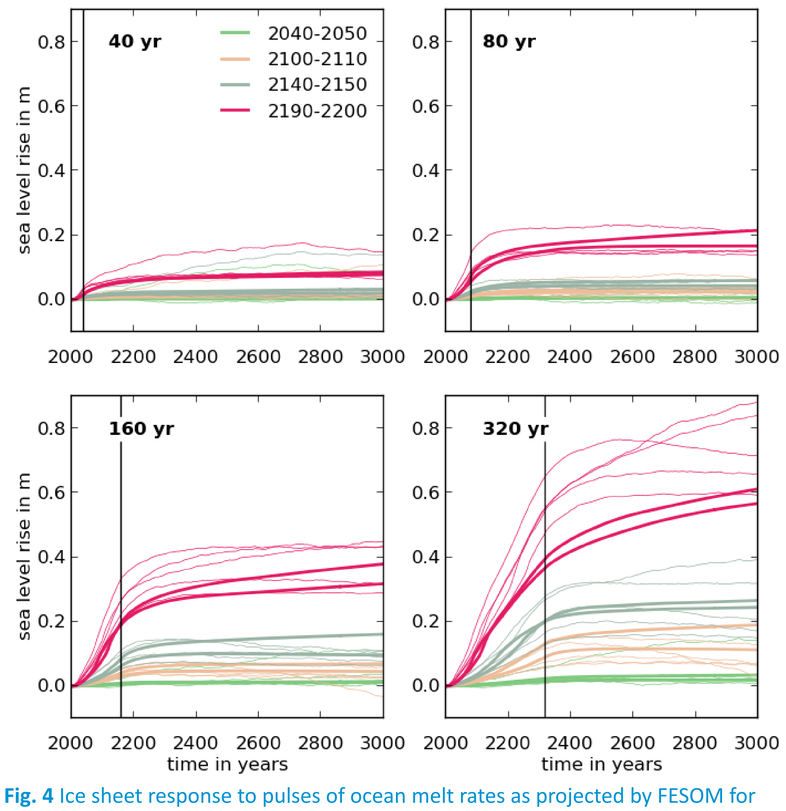

Fig. 4 Ice sheet response to pulses of ocean melt rates as projected by FESOM for different time periods (colors of lines) and for length between 40 and 320 yr (different panels). Thin lines indicate whole-continent simulations and thick lines regional simulations.