The LIWG's "hottest" topic: meltwater

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Department of Atmospheric and Oceanic Sciences
University of Colorado Boulder

Photo: Kelvin Trautman

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How well is CESM2 representing melt across the Antarctic Ice Sheet?

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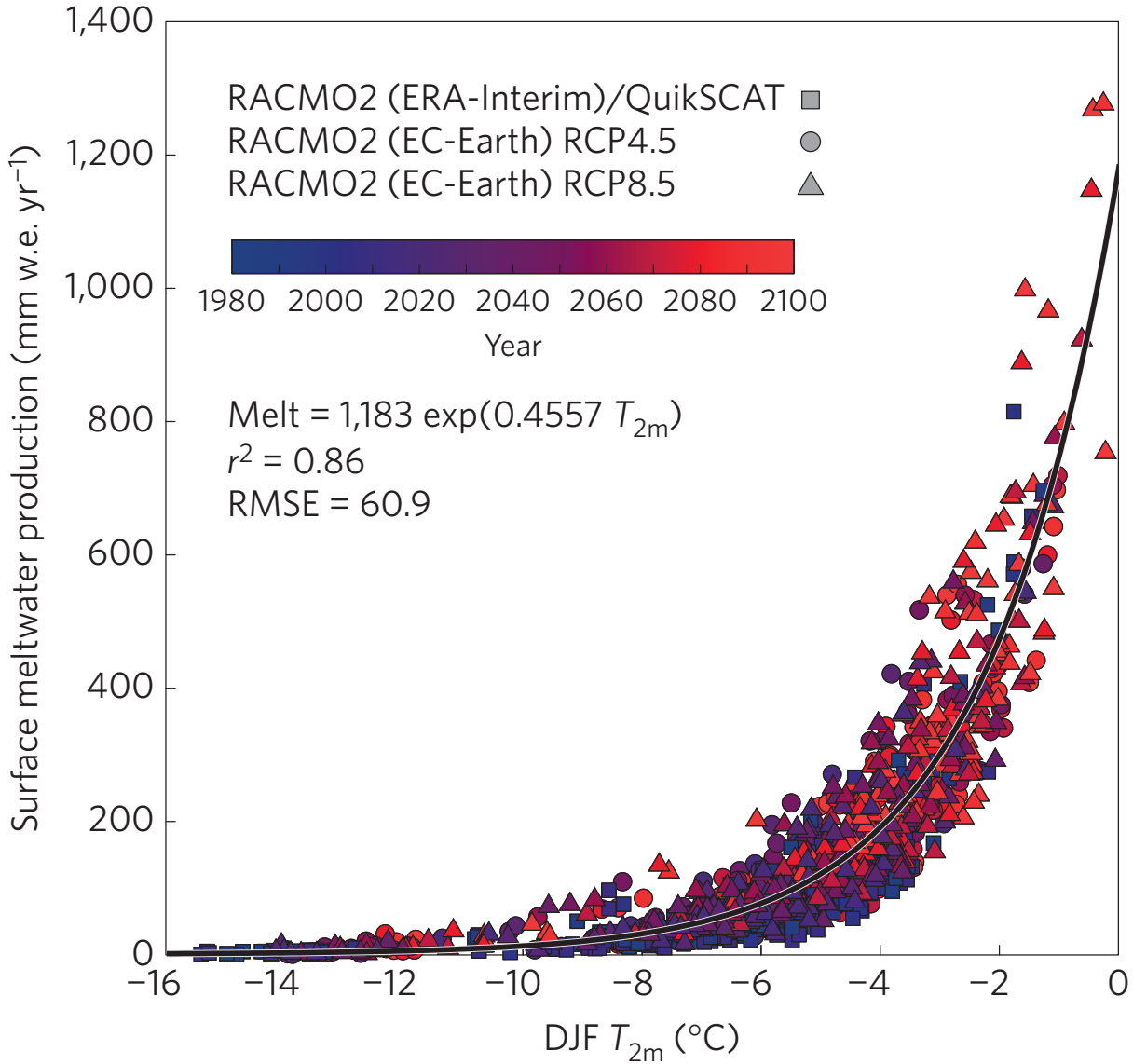
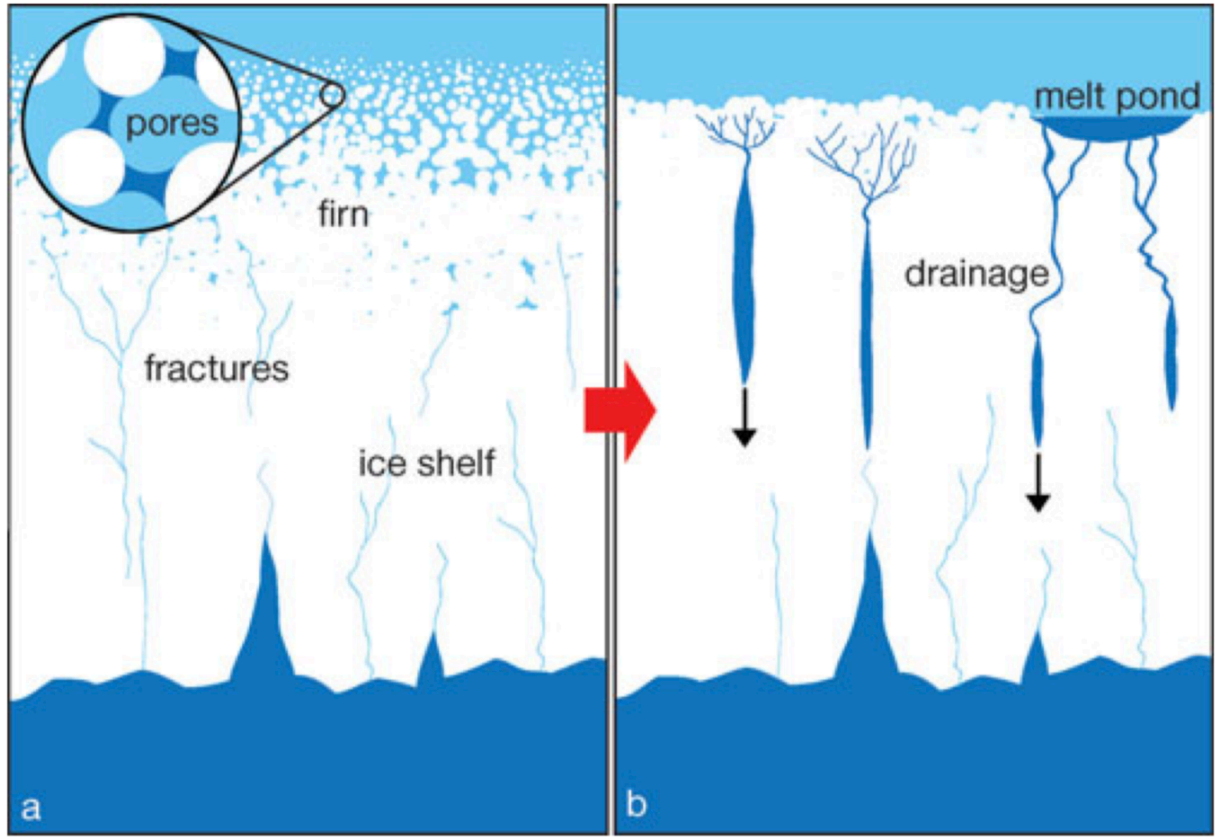
Melt increases exponentially with temperature

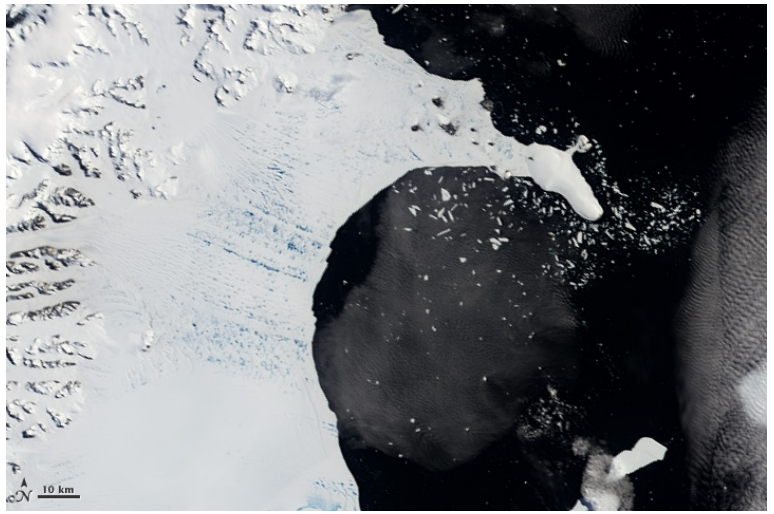


Trusel et al., 2015

Firn air depletion fueling ice shelf hydrofracture



Kuipers Munneke et al., 2014



Research Questions

What conditions are necessary for the Antarctic firn to become depleted of air?

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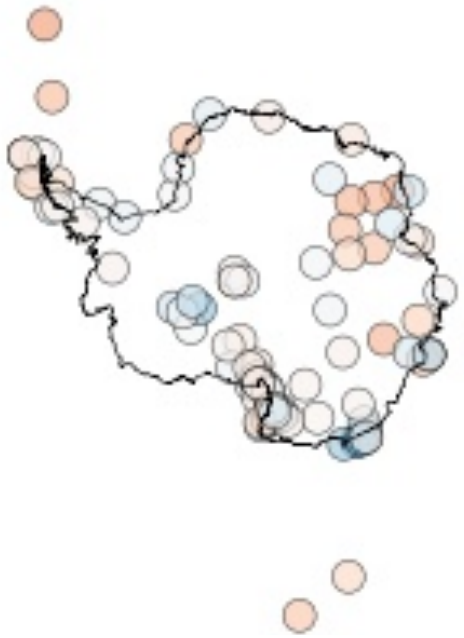
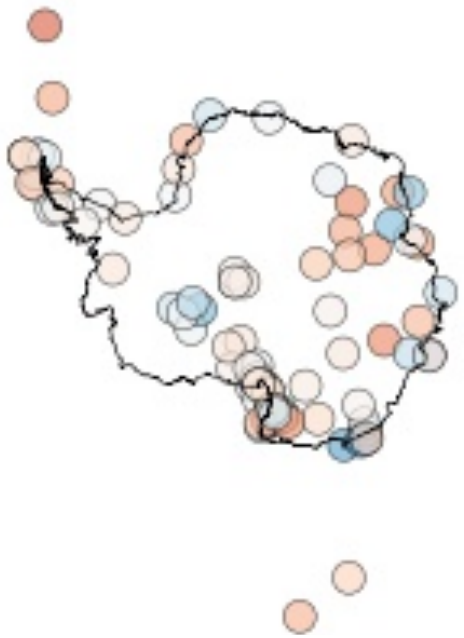
When will these conditions be met across Antarctica?

How well is CESM2 doing? – Wind Speed

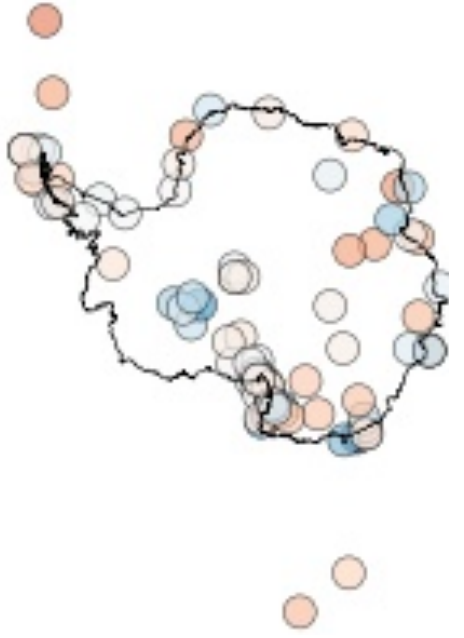
Dec-Jan-Feb
Bias = 0.15 m/s



Mar-Apr-May
Bias = 0.50 m/s

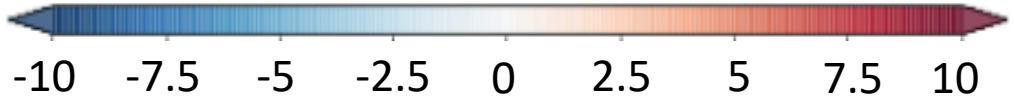


Jun-Jul-Aug
Bias =0.23 m/s



Sep-Oct-Nov
Bias = 0.10 m/s

10-m wind speed bias (model – obs)



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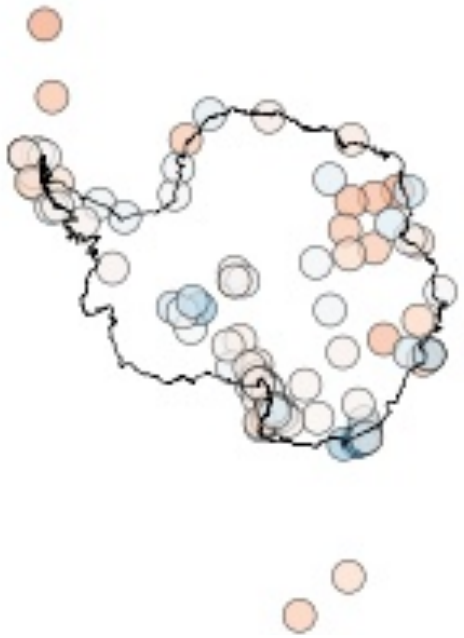

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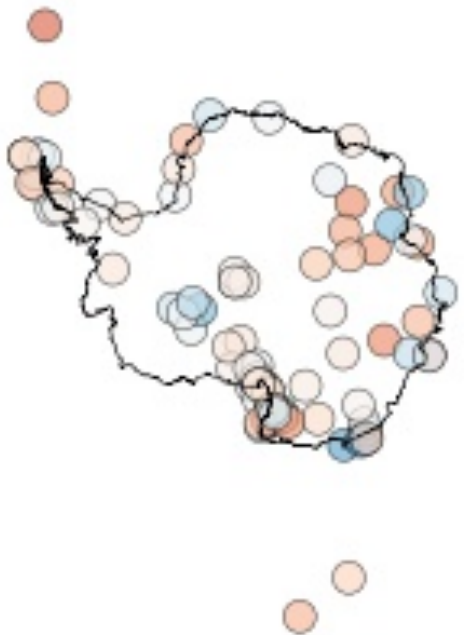

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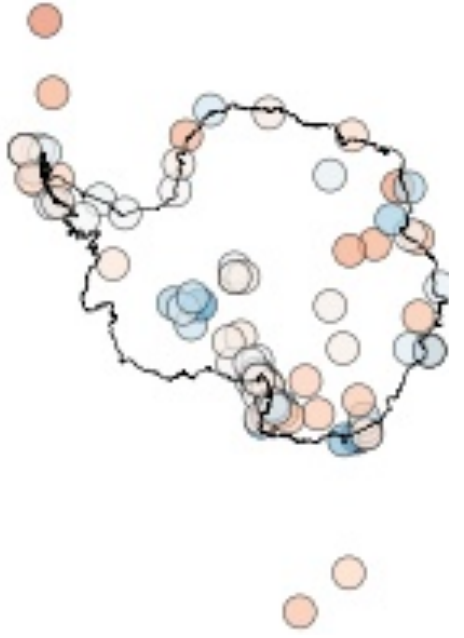

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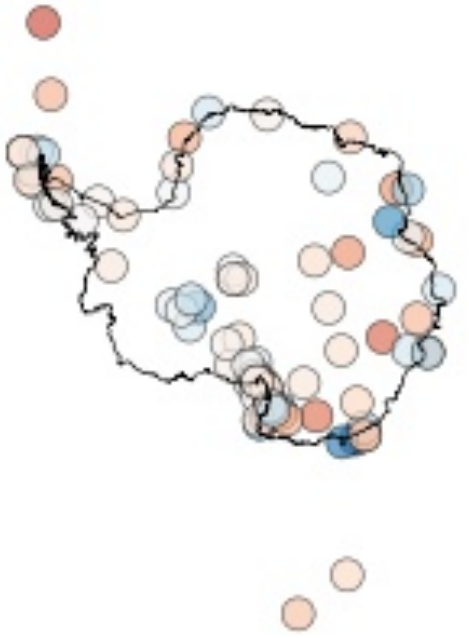

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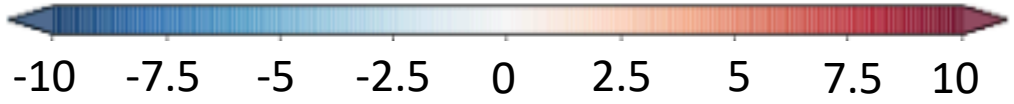


Annual Bias = 0.27 m/s

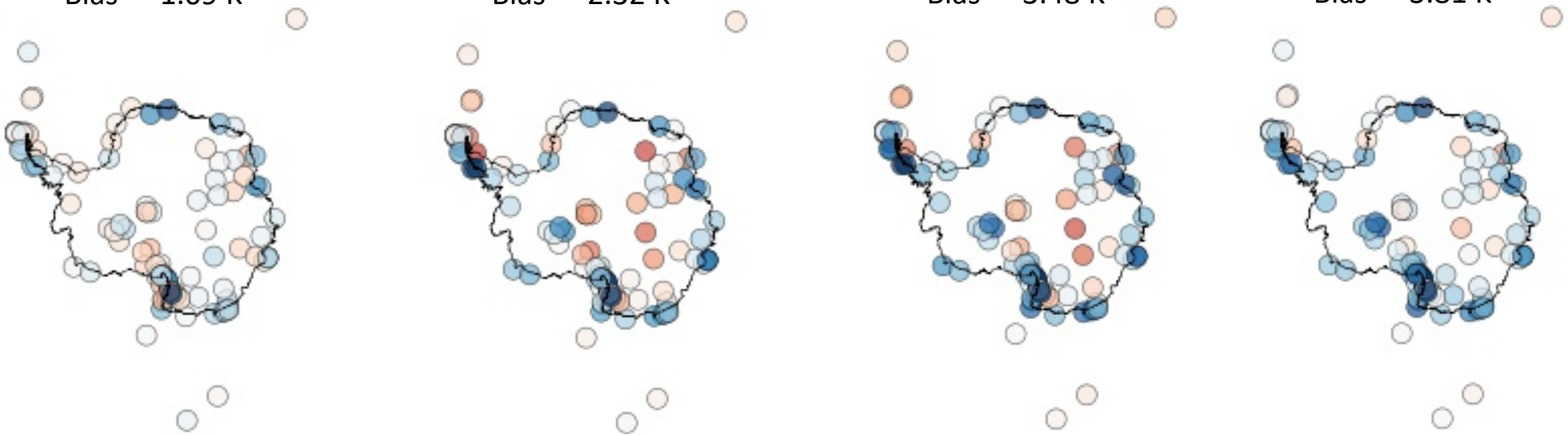
How well is CESM2 doing? – Temperature

Dec-Jan-Feb
Bias = -1.09 K

Mar-Apr-May
Bias = -2.32 K

Jun-Jul-Aug
Bias = -3.48 K

Sep-Oct-Nov
Bias = -3.81 K



2-m temperature bias (model – obs)

-10 -7.5 -5 -2.5 0 2.5 5 7.5 10

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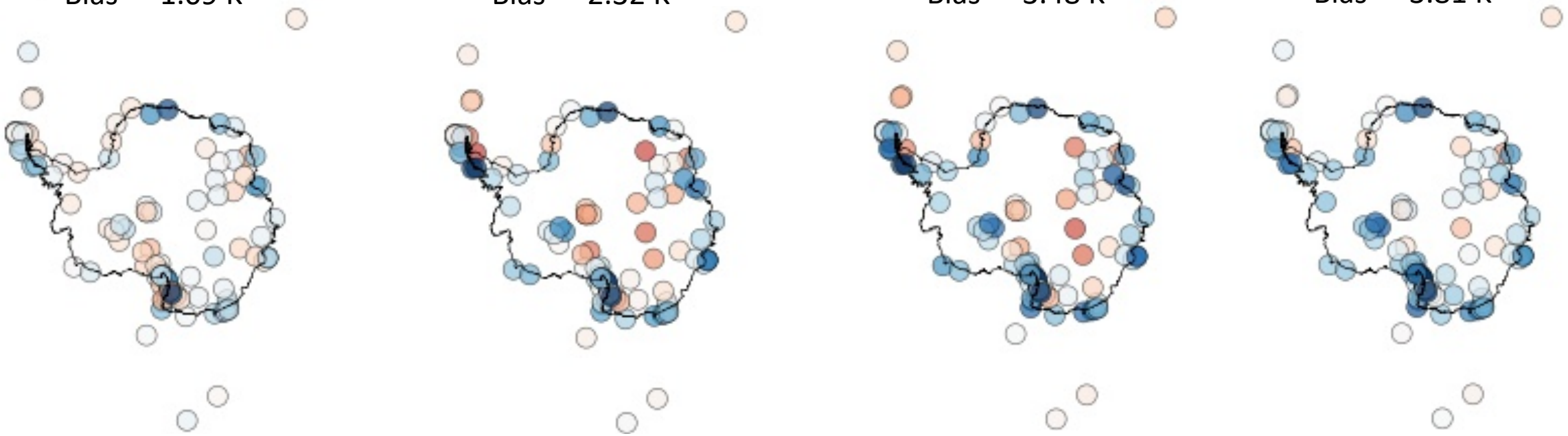
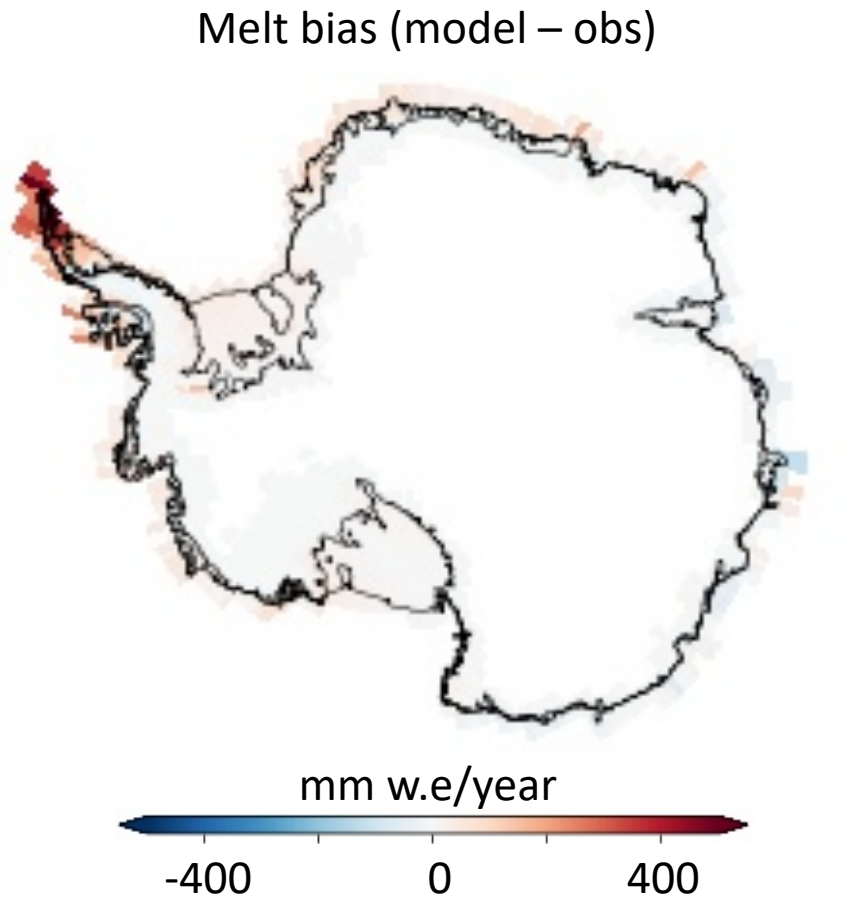


2-m temperature bias (model – obs)

-10 -7.5 -5 -2.5 0 2.5 5 7.5 10

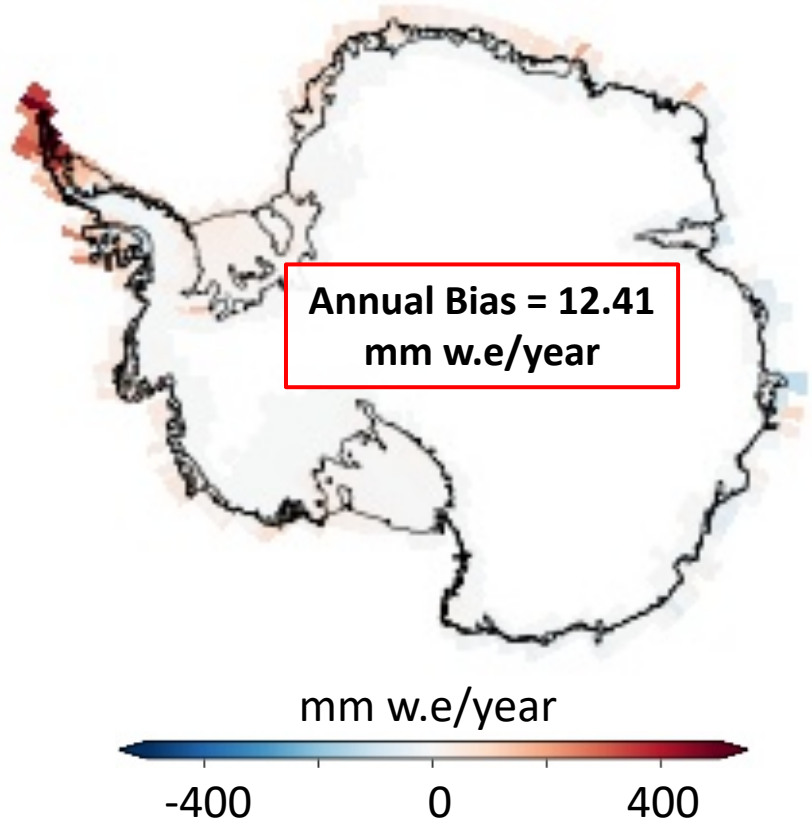
Annual Bias = -2.69 K

How well is CESM2 doing? – Melt



How well is CESM2 doing? – Melt

Melt bias (model – obs)



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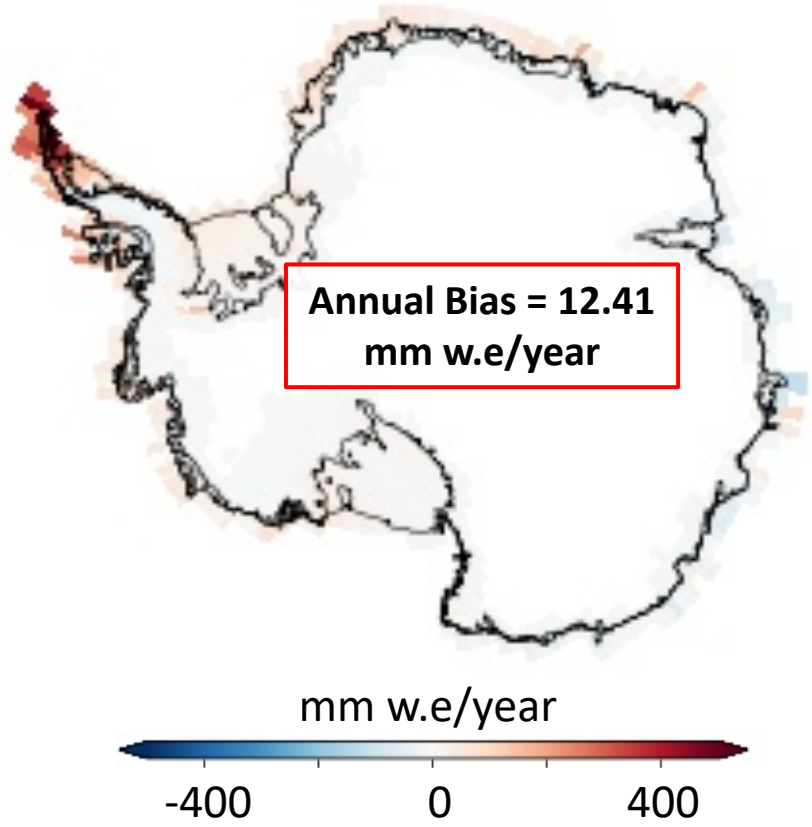
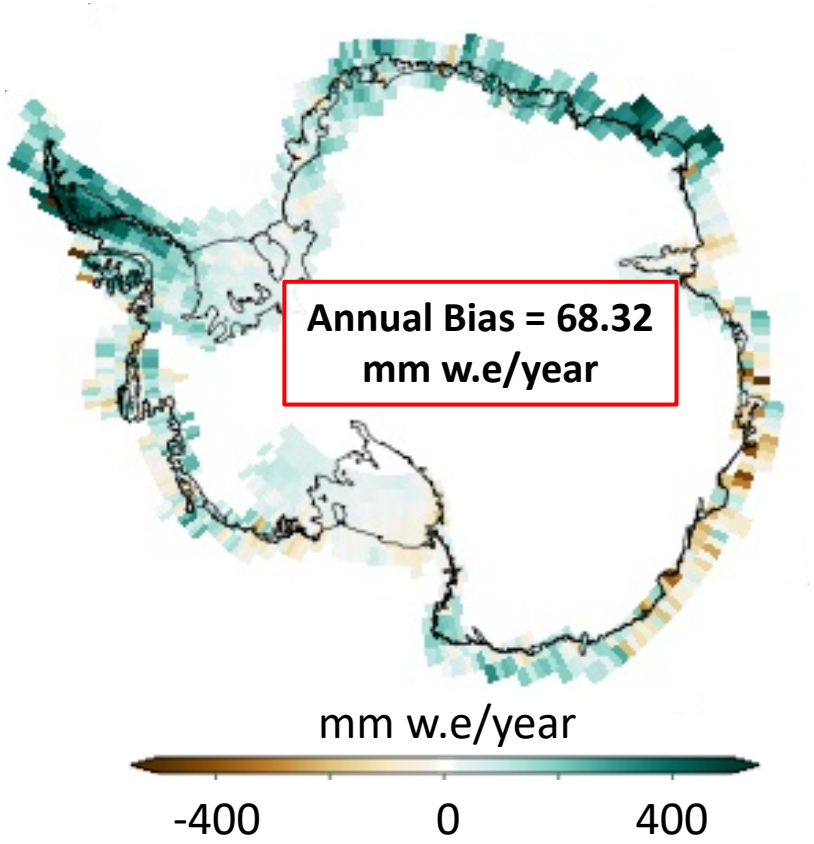
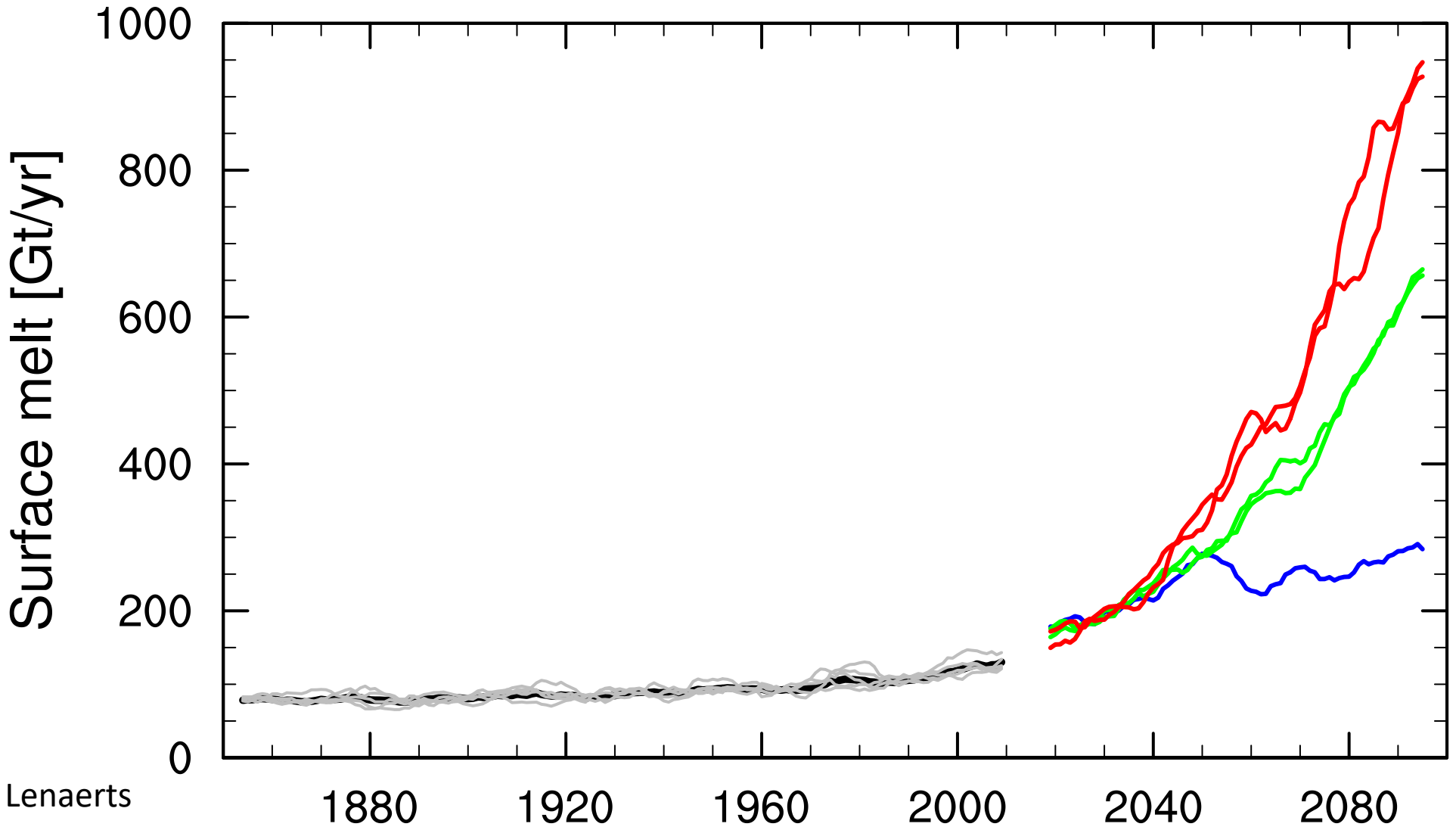


Snowfall bias (model – obs)



All results are Antarctic ice shelf integrated/averaged
10-year running means

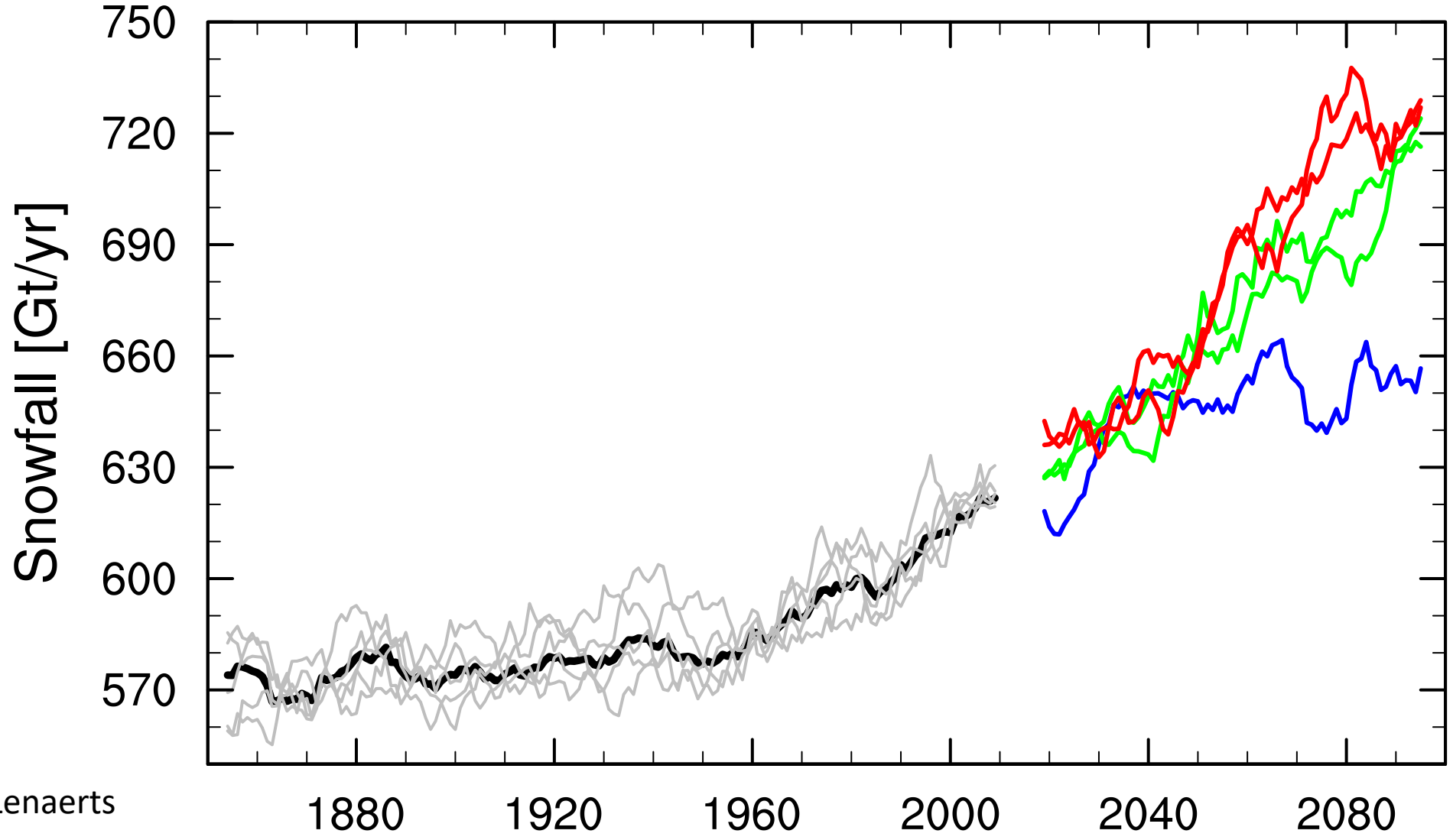
Surface melt: 150% to 800% increase



Credit: Jan Lenaerts

All results are Antarctic ice shelf integrated/averaged
10-year running means

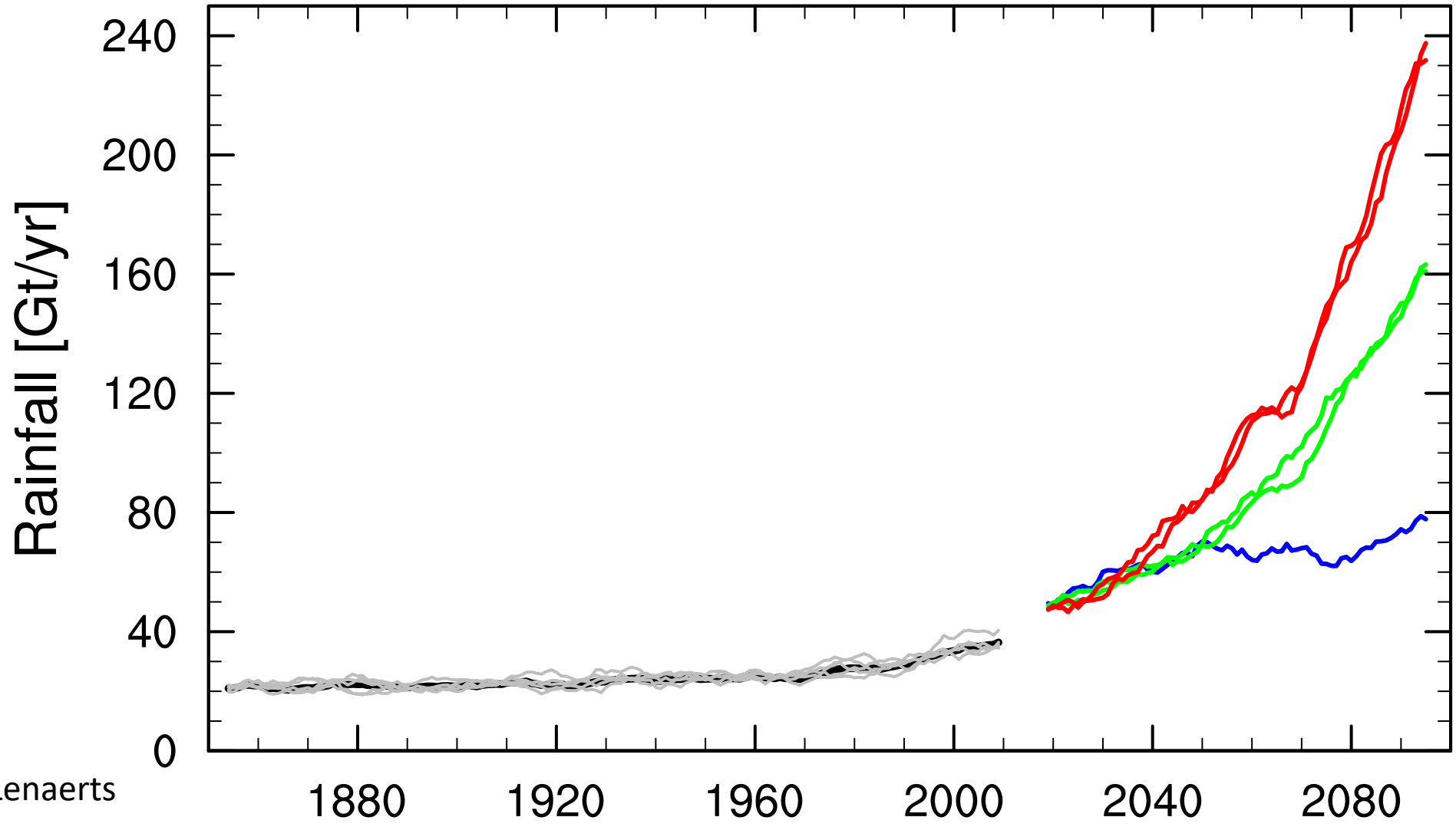
Snowfall increases only 10-25%



Credit: Jan Lenaerts

All results are Antarctic ice shelf integrated/averaged
10-year running means

while rainfall increases strongly (100-700%)



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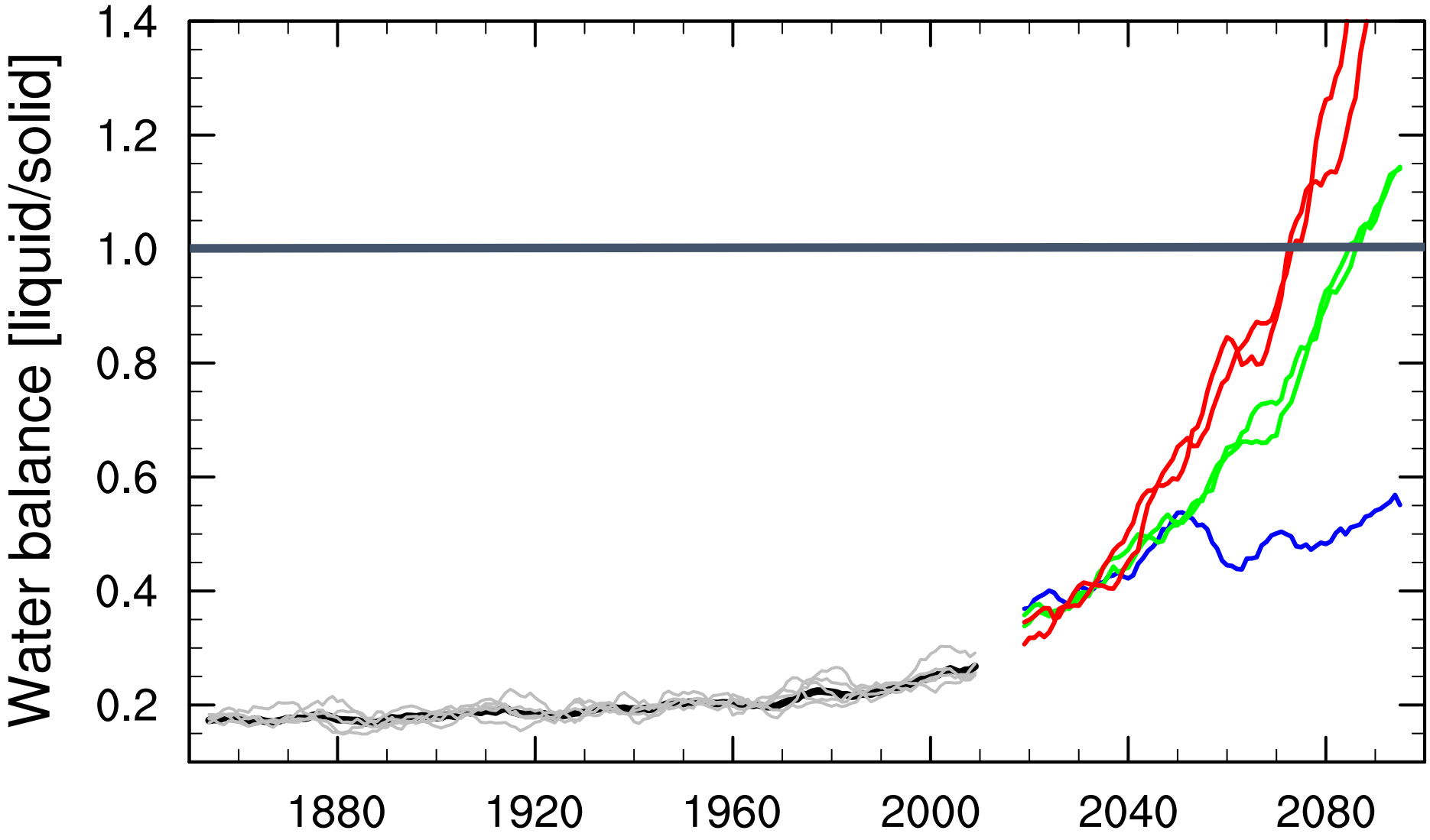
Towards liquid water dominated ice shelves



Summary

- Wind – No significant bias
- Temperature – CESM2 is cold
- Melt - CESM2 has more melt on Peninsula
- Snowfall – CESM2 has more snowfall

- Trend towards more liquid production on ice shelves

Research Questions

What conditions are necessary for the Antarctic firn to become depleted of air?

When will these conditions be met across Antarctica?

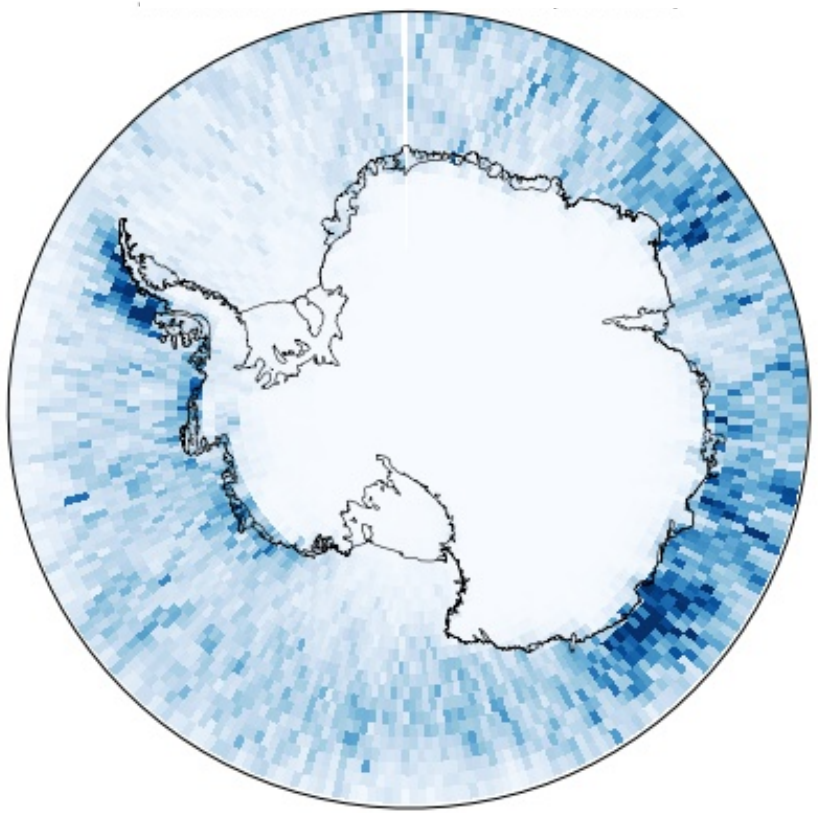
How well is CESM2 doing? – Melt volume

Observations - CloudSat

CESM2

How well is CESM2 doing? – Snowfall

Observations - CloudSat



CESM2