If near-surface warming exceeds +7.5°C, the **atmosphere** will **shift** from a **mitigating** to an **amplifying** factor of **Antarctic mass loss**

Disentangling the drivers of future Antarctic ice loss with a historically-calibrated ice-sheet model

OR What can the past decades tell us about future Antarctic ice loss?

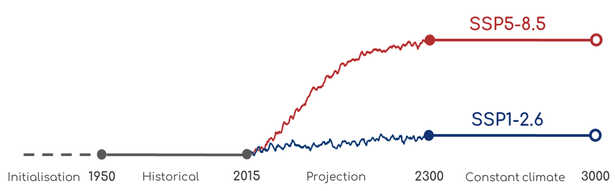
Why?

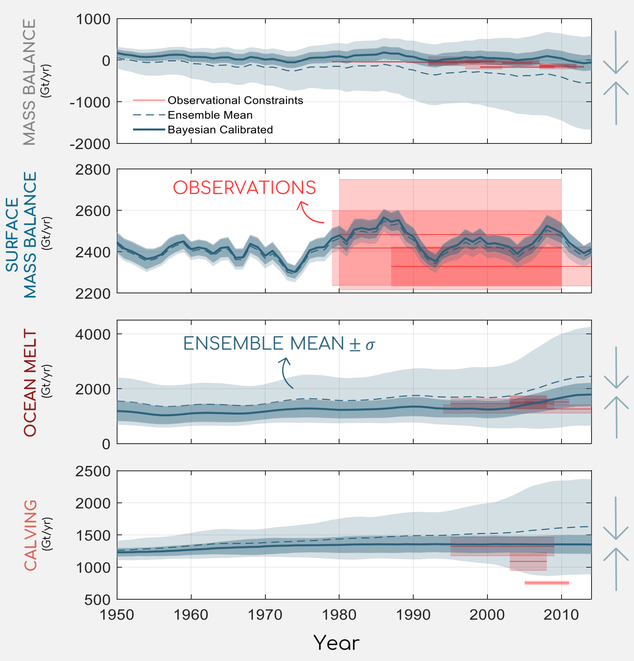
- **Current Antarctic ice loss** is mainly **driven by the ocean**, but its **future evolution** remains **uncertain**.
- Under a warming climate, we may expect an **increase in competing processes**

What will be the balance between these competing processes and their influence on the evolution of the Antarctic ice sheet in the future ?

How?

- We use the ice-sheet model Kori to run an **ensemble of 100 simulations** that covers **uncertainties in ice–ocean and ice–atmosphere interactions**.
- We perform a **Bayesian calibration** using **satellite-based estimates** of **regional mass balance** over the historical period.
- We then extend the calibrated ensemble to the end of the millennium using projections from a subset of CMIP6 climate models under low and high emissions scenarios.





CALIBRATION OF THE ENSEMBLE

Data used for the calibration: rates of ice sheet mass change
(IMBIE – Otosaka et al., 2023)

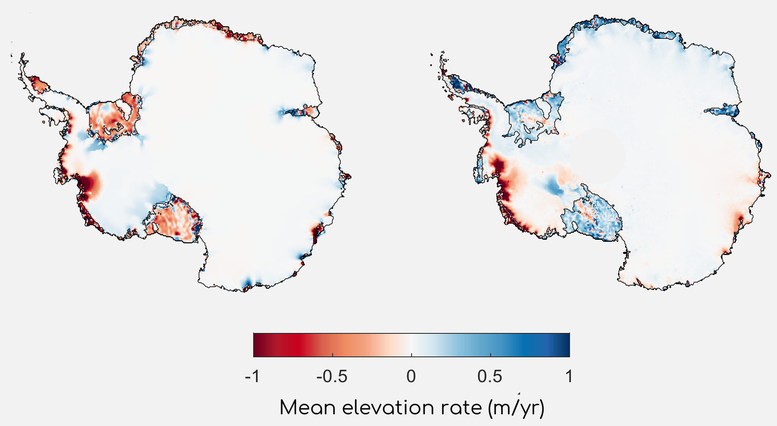
	WAIS (Gt/yr)	EAIS (Gt/yr)	Peninsula (Gt/yr)
1992 – 1996	-37 ± 19	-27 ± 33	-7 ± 11
1997 – 2001	-42 ± 19	21 ± 32	2 ± 11
2002 – 2006	-64 ± 20	21 ± 34	-20 ± 11
2007 – 2011	-129 ± 23	19 ± 36	-21 ± 12

✓ Calibrating allows to reduce the spread in ice-sheet response.

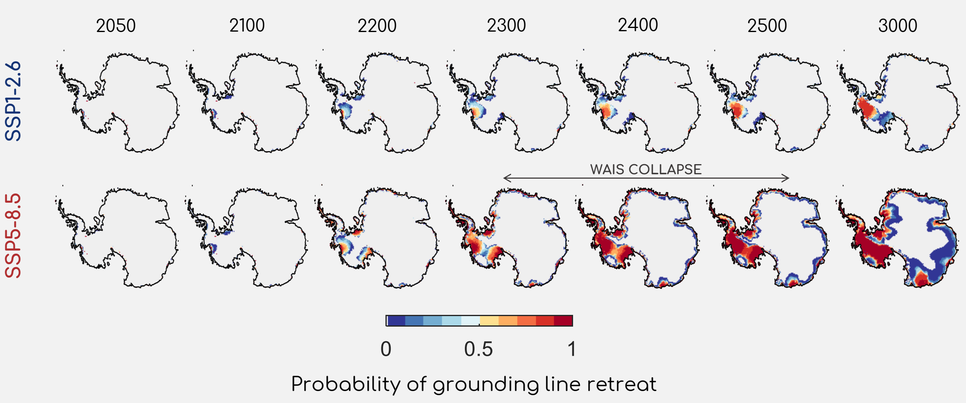
✓ The calibrated ensemble reproduces the historical trends in good agreement with observations

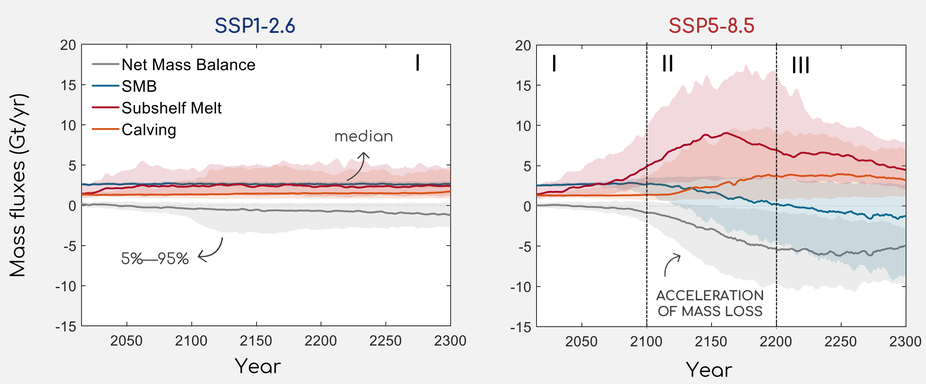
MODELLED – 2000-2015
Bayesian calibrated mean

OBSERVED – 2003-2019
[From Smith et al., 2020]



EVOLUTION OF THE CALIBRATED ENSEMBLE

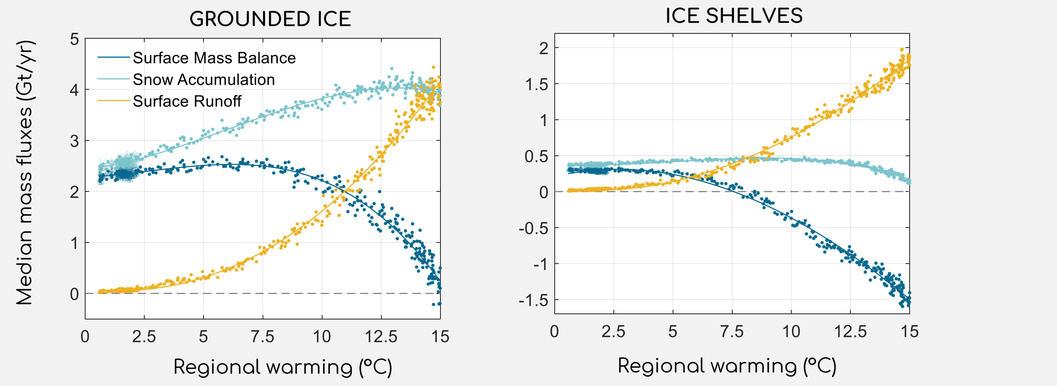




I. **Short-term** Antarctic **ice loss** is driven by the ocean, triggering significant retreat in West Antarctica, even under limited warming.

II. **Acceleration of ice loss** in conjunction with a decrease in surface mass balance

III. **Sub-shelf melt decreases** and **mass loss** becomes **dominated by the atmosphere**



+7.5°C regional warming

✓ SMB **mitigating potential decreases** as the **increase in surface runoff** outweighs the **increase in snow accumulation**

Violaine Coulon, Ann Kristin Klose, Christoph Kittel, Tamsin Edwards, Fiona Turner, Ricarda Winkelmann, and Frank Pattyn

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