

Reaching the 1.5 degree limit: what does it mean for West Antarctica and the global mean sea level?

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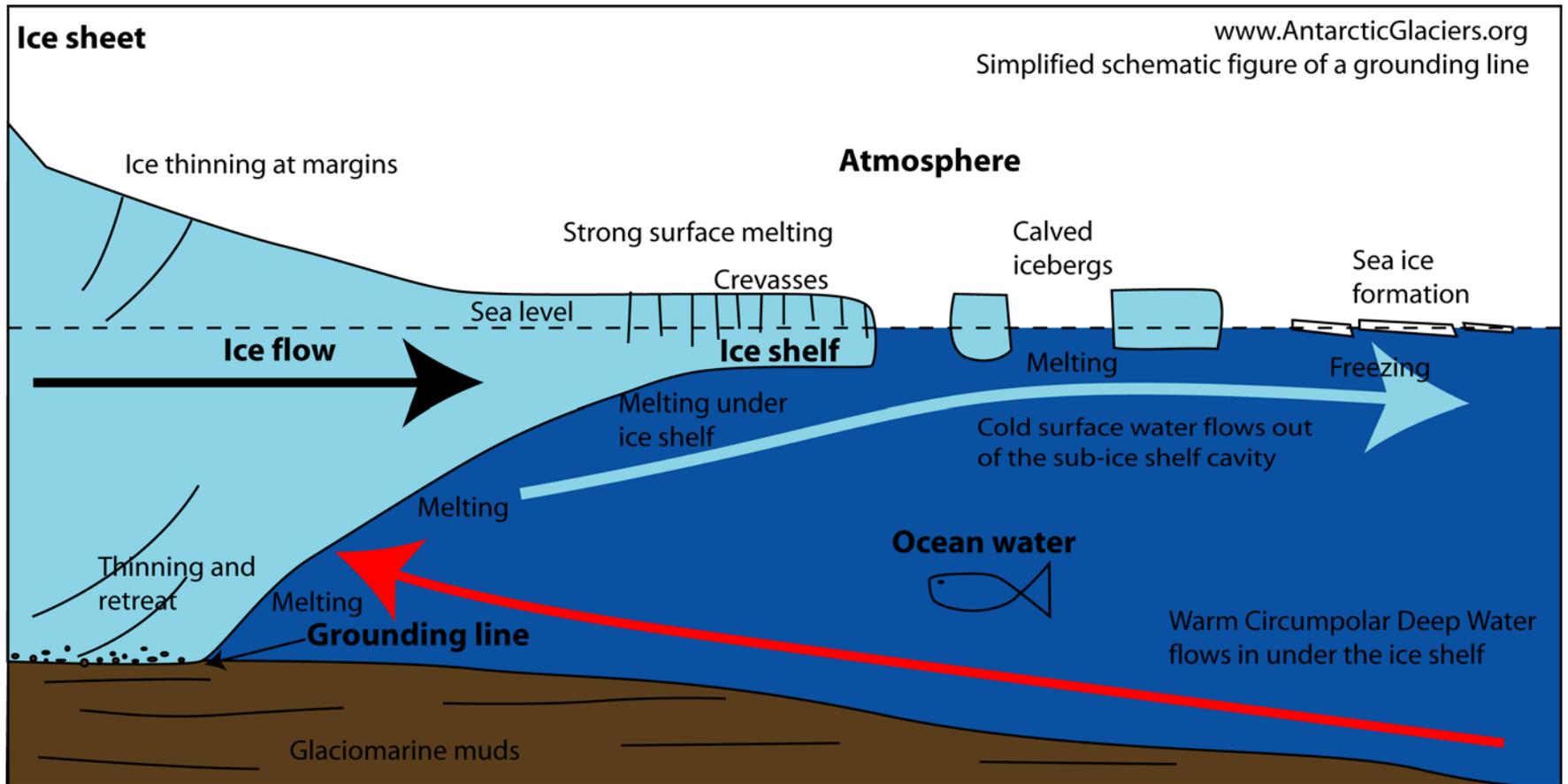
- Can the West Antarctic ice sheet be saved when limiting global warming to 1.5°C above pre-industrial?
- Paleo studies show that in the LIG 125 kyr B.P. a collapse of the West Antarctic ice sheet occurred at 1.5 to 2°C globally and 2 to 3°C around Antarctica above pre-industrial levels -> accounting for 3 to 4 meter sea level rise!

Sutter et al., 2016

- IPCC Special Report on the 1.5 degree limit is due to be published next year
- Our project is supported by the German Federal Ministry of Education and Research
- ZUWEISS: 1.5 degree limit and the West Antarctic Ice Sheet

Proposed mechanism

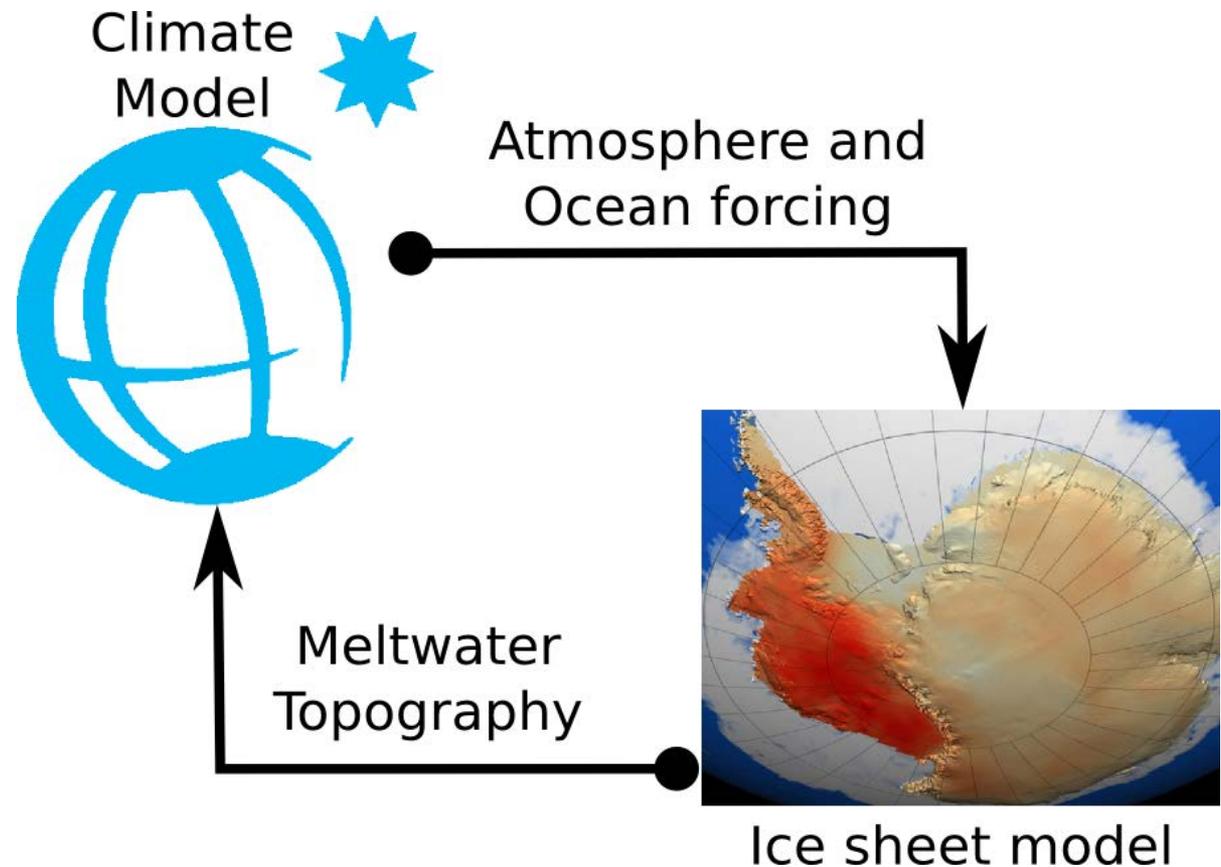
- Melting from below and from above



Source: Bethan Davies

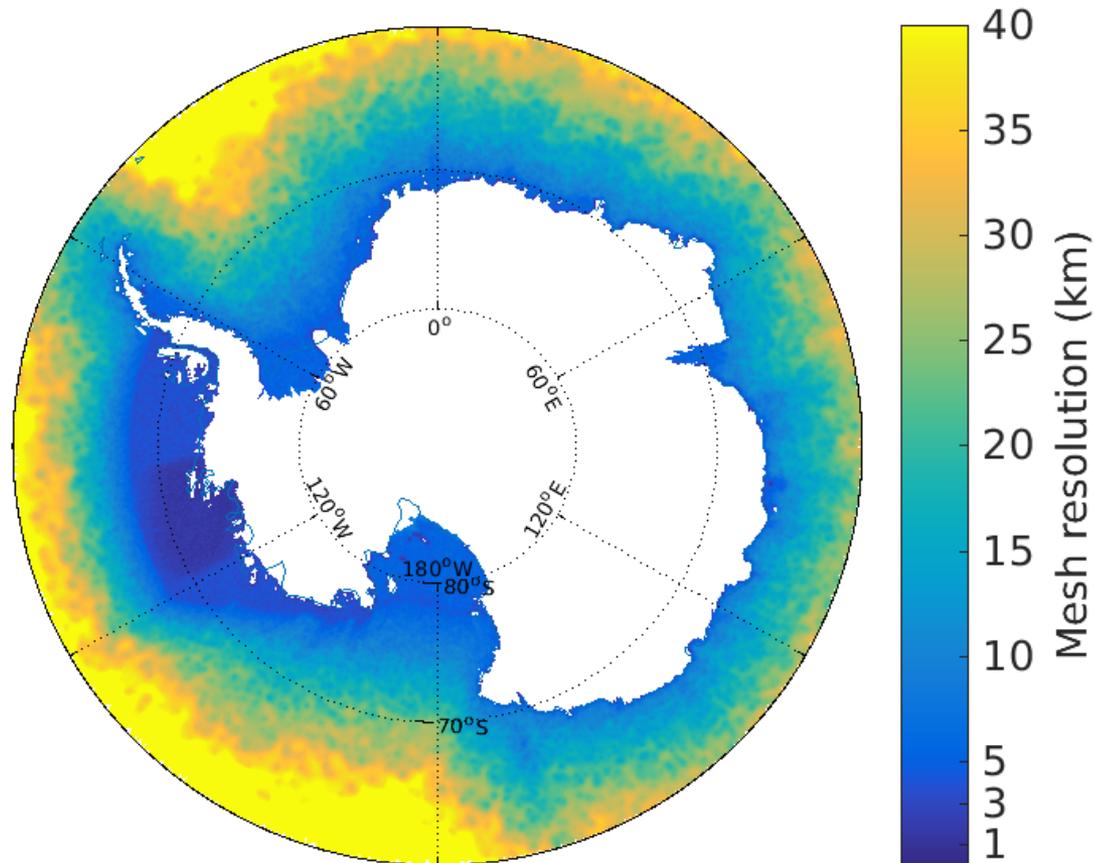
How to tackle the question?

- AWI-CM (Alfred Wegener Institute Climate Model consisting of FESOM1.4 and ECHAM6.3) coupled to PISM (Parallel Ice Sheet Model)



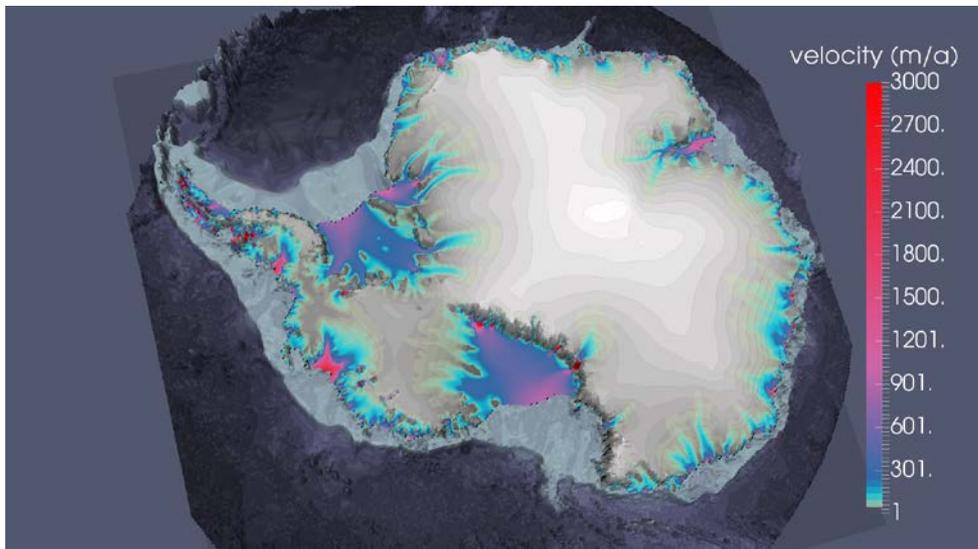
Locally refined ocean mesh

With the unstructured mesh approach in FESOM it is possible to locally refine the ocean mesh in areas of interest – in our case to be able to resolve small-scale ocean - ice shelf interactions.



PISM spin-up simulation

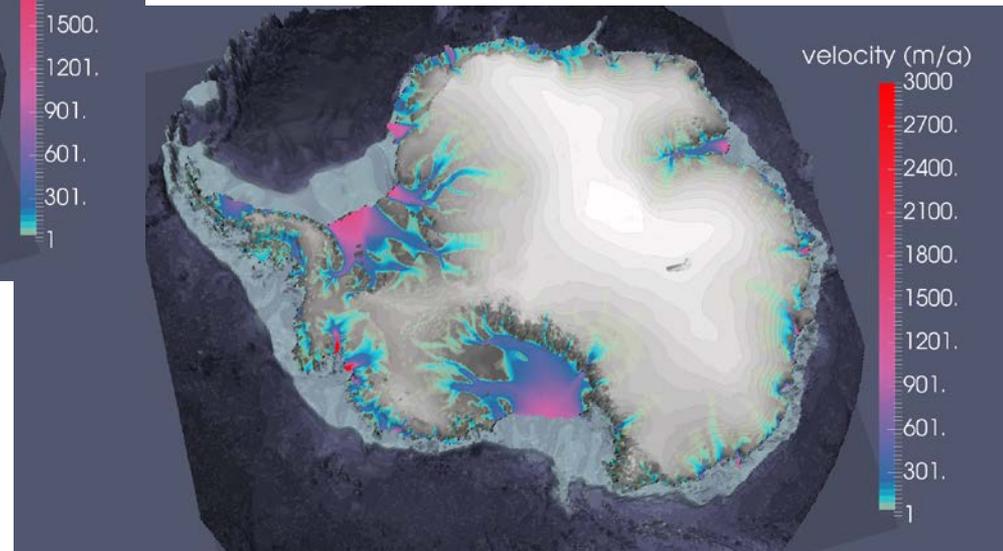
- 50,000 years of PISM spin-up to bring ice sheet into equilibrium



Simulation

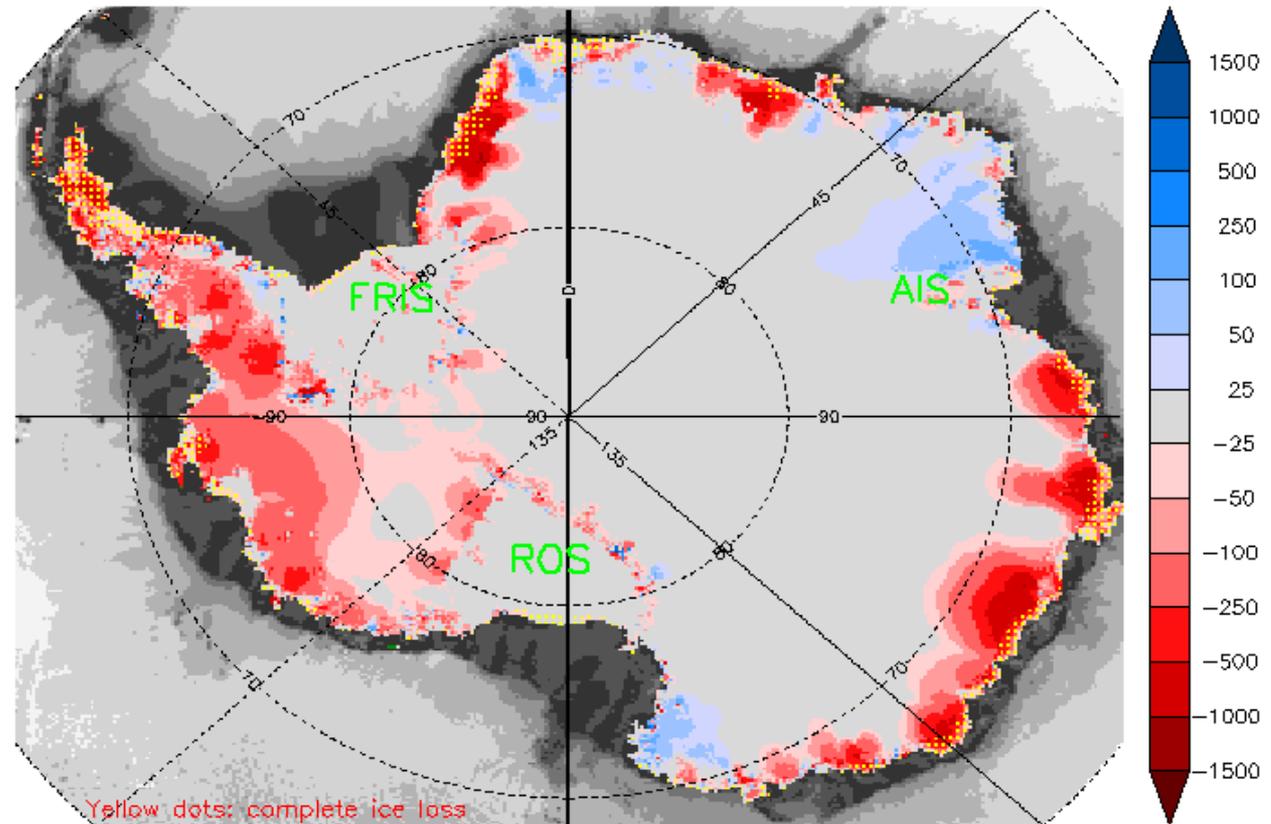
*Simulated and observed
ice sheet velocity (m/a)*

Observation



Results: PISM driven by CCSM4

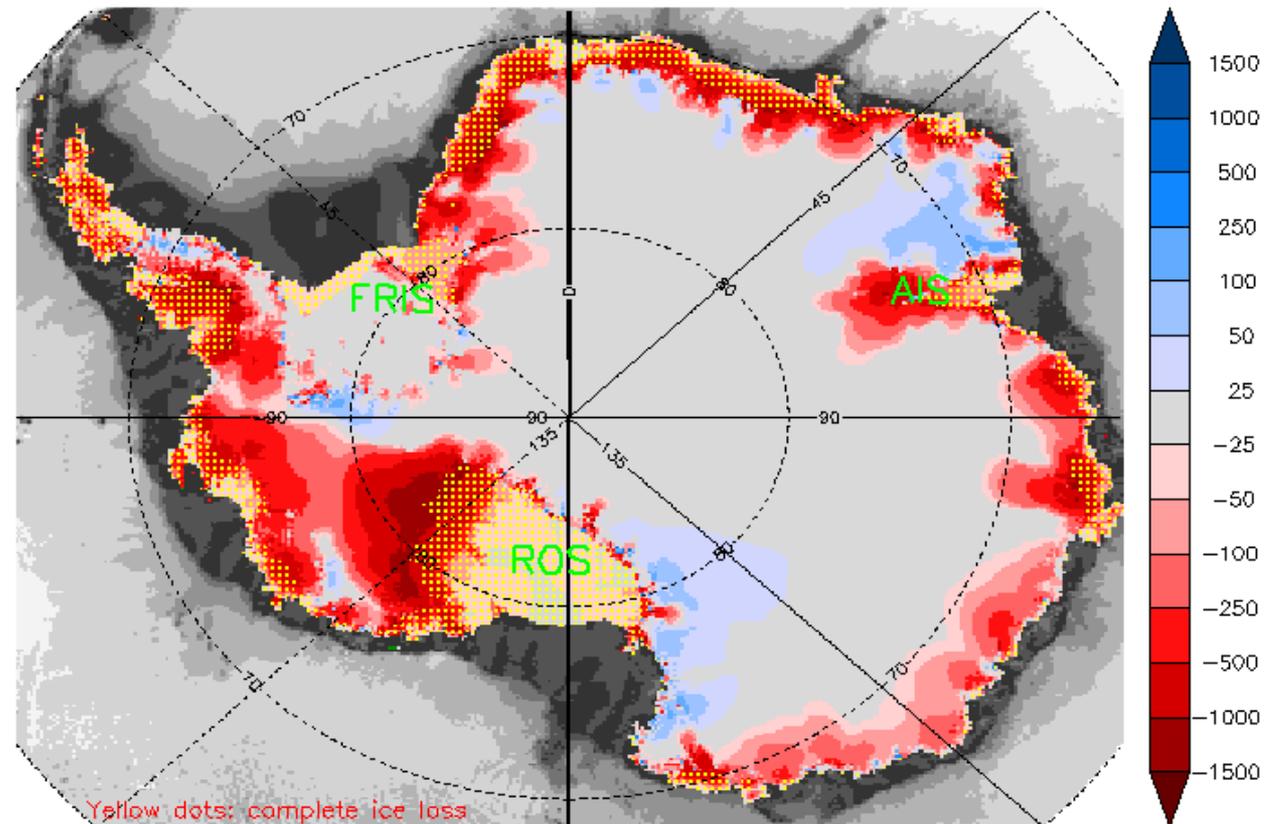
- Snapshot control



Ice elevation anomaly (m)

Results: PISM driven by CCSM4

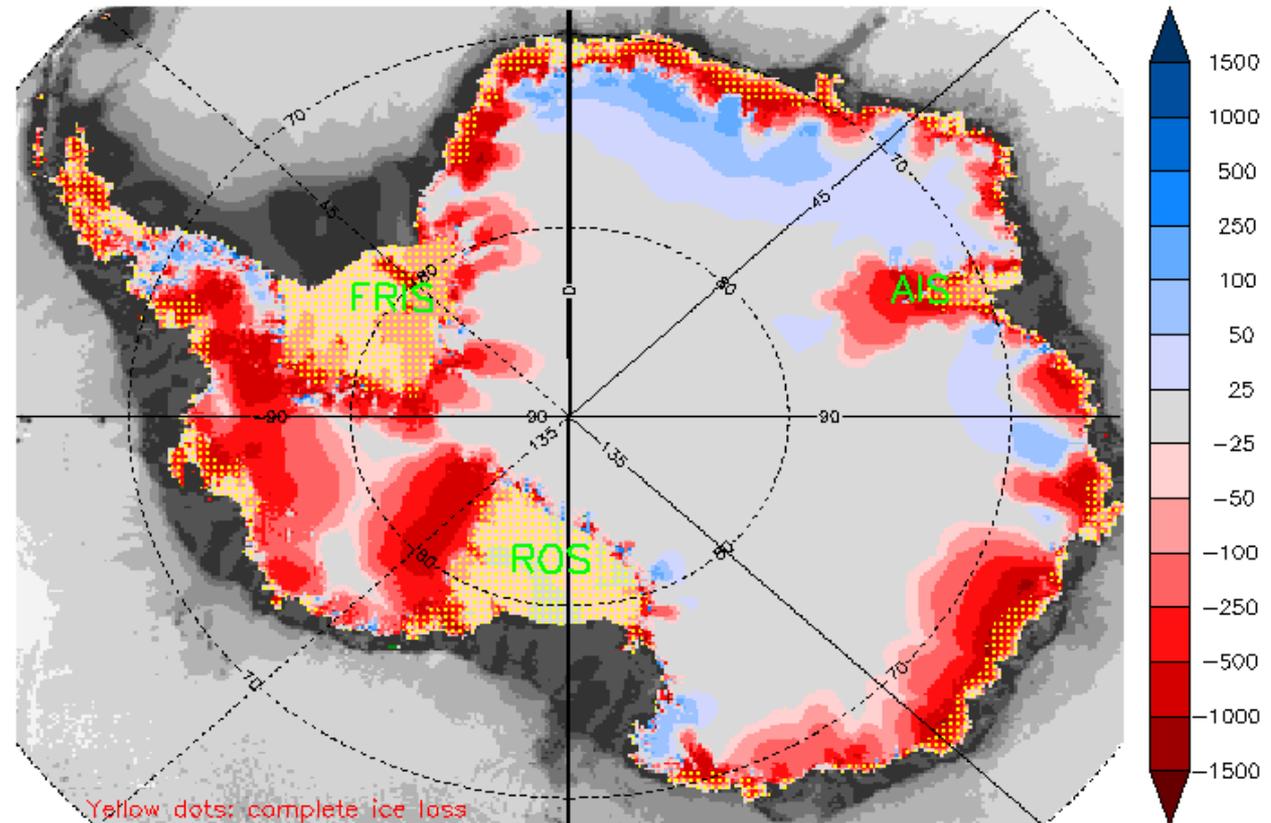
- Snapshot RCP 4.5



Ice elevation anomaly (m)

Results: PISM driven by CCSM4

- Snapshot RCP 8.5



Ice elevation anomaly (m)

Conclusions

- Global warming of 1.5 to 2°C may be a tipping point for stability of West Antarctic Ice Sheet
- With uncoupled ice sheet simulations difficult to detect such a tipping point:
 - Driving the ice sheet model PISM with different coarse-resolution CMIP5 models and different forcings gives a wide spread of possible outcomes for Antarctica
- We hope that our novel coupled simulations with highly-resolved ocean-ice shelf-ice sheet interaction can help to reduce the uncertainty