

could a warming climate induce ice flow piracy in East Antarctica?

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Antarctic mass increases due to accumulation, and decreases due to ablation in response to climate warming^[1]

But ice dynamics can also change mass balance, as evidenced in the Siple Coast, where ice flow piracy and the shutdown of Kamb Ice Stream has led to continuing ice mass increases over 170 years later^[2]

Could similar ice flow piracy occur from the Totten to the Vanderford Glacier as the climate warms?

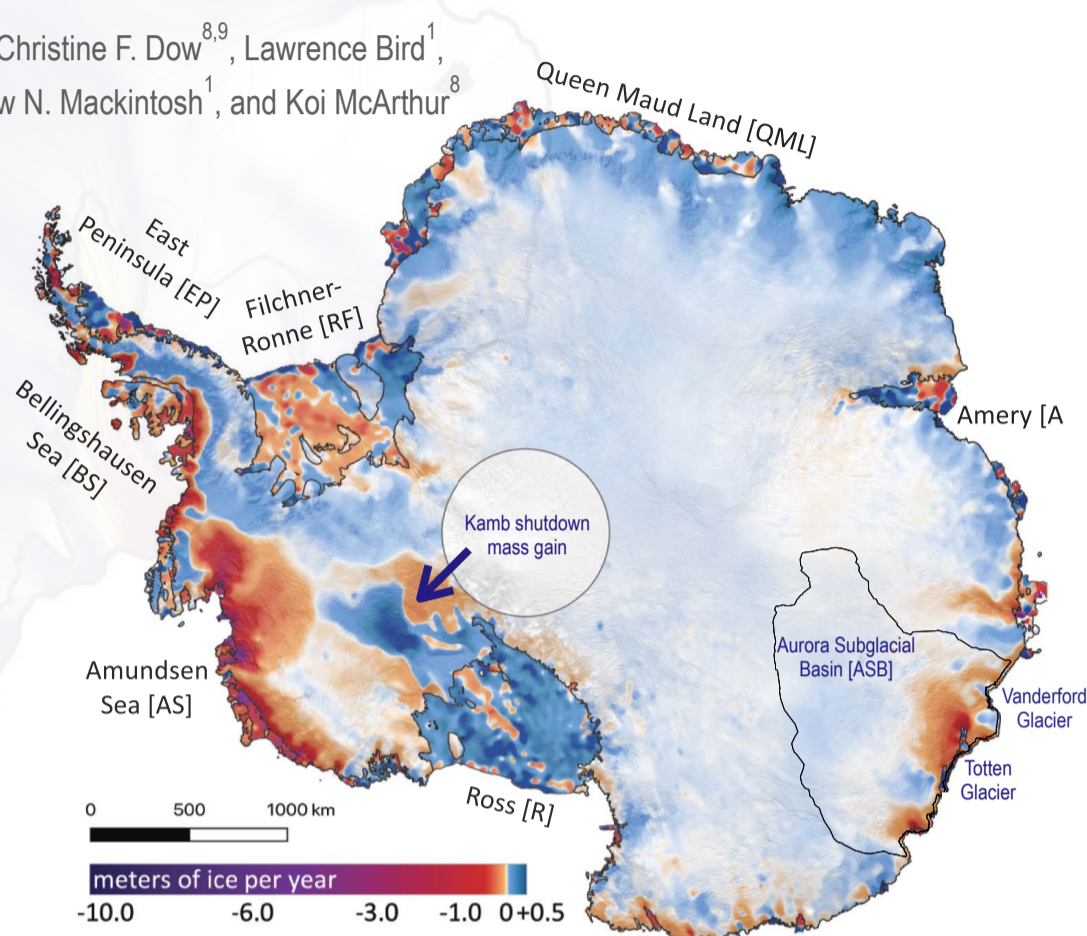


Figure: ice surface elevation change, 2001-2018, from ICESat^[5]

what we did

Using the Ice-sheet and Sea-level System Model (ISSM)^[3], we generated steady-state ice sheet surface elevations, resulting from:

- Increases in surface mass balance in the Totten Catchment representing 1, 2, ..., 7°C warming (expSMB)^[4]
- Increases in dynamic thinning in the Vincennes Bay Catchment of equivalent magnitude as the SMB experiments (expFriction)
- Combination of expSMB and expFriction (expComb)

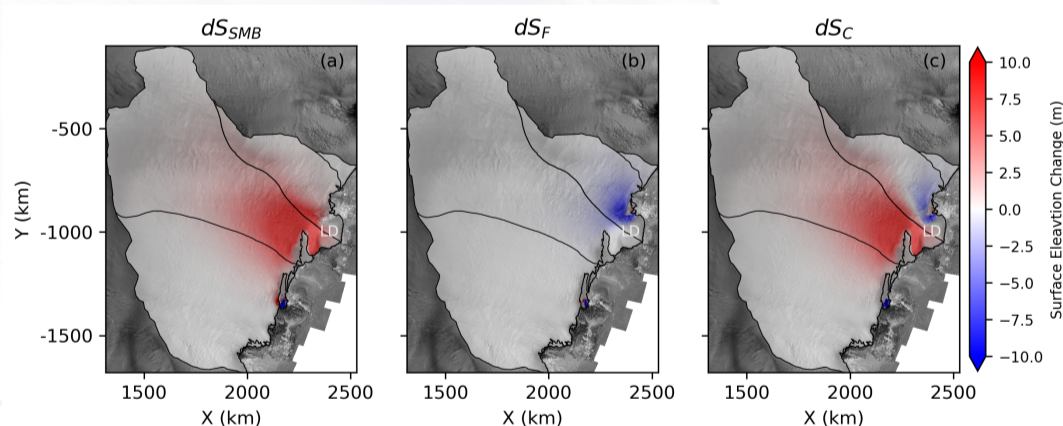


Figure: Surface elevation change fields generated using ISSM for (a) expSMB; (b) expFriction; (c) expComb.

what this means

Totten Glacier dominates present-day mass loss, but Vanderford Glacier is rapidly retreating.

Ice and basal water flow piracy to Vanderford could impact the timing of future rapid mass loss events.

Following up steps: coupled ice sheet-subglacial hydrology modelling to investigate timing and implications of ice and basal water flow piracy.

what we found

The drainage divide between Totten and Vanderford migrates under minor changes in thickness due to climate perturbations.

This leads to ice and basal water flow piracy towards Vanderford Glacier, with up to 42% increase in discharge at Vanderford.

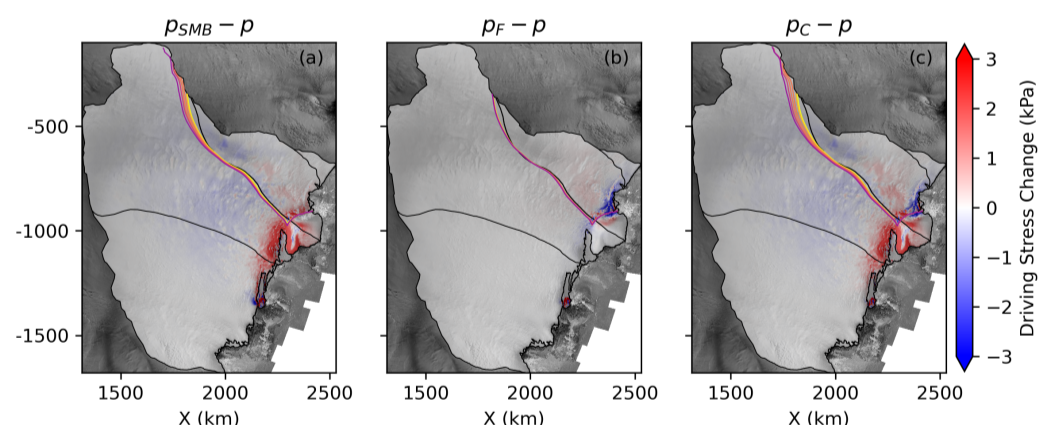
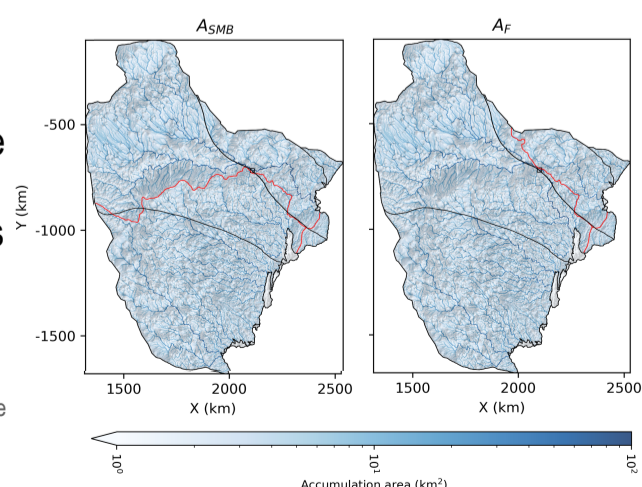


Figure: catchment divide migration and driving stress changes for 1°C surface elevation perturbations in (a) expSMB; (b) expFriction; (c) expComb. The Vincennes Bay catchment area increases in all cases.

Basal water piracy “switches” at a critical change in ice thickness ~200 km upstream of Totten’s present-day grounding line

Figure: basal water routing in (a) expSMB; (b) expFriction. Red line shows hydrological catchment.



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