4D Antarctica: Characterizing the supra- and sub- glacial hydrology of the Antarctic Ice Sheet

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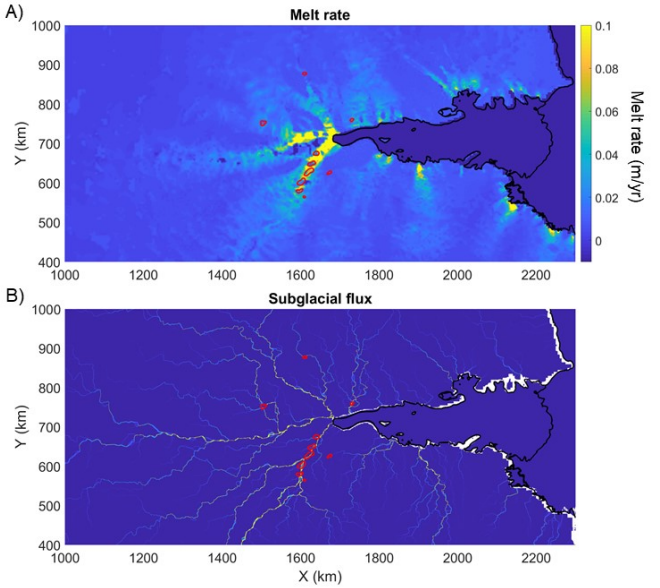
Abstract: *Ice sheets are a key component of the Earth system, impacting global sea level, ocean circulation and bio-geochemical processes. Liquid water is produced and transported at the ice-sheet surface and base. The aim of 4DAntarctica is to advance our understanding of the hydrology of the Antarctic Ice Sheet, its evolution, and role within the broader ice sheet and ocean systems.*

Inferring basal melt rates and subglacial routing within the catchment of the Amery Ice Shelf

Using the ice-flow model STREAMICE, we have inverted for properties at the base of the ice sheet (basal slip, shear stress and velocity). Combining these results with estimates of geothermal heat flux and englacial temperature gradients gives an estimate of basal melt rate (Fig. A). A subglacial routing model shows the pathways meltwater takes towards the ocean (Fig. B). Pathways align well with subglacial lakes identified from satellite altimetry (red outlines).



Project Description

The volume of surface meltwater in Antarctica is largely unknown but projected to rise in the future. The presence of surface meltwater is a trigger for ice-shelf calving and collapse.

Meltwater is generated at the ice-sheet base primarily by geothermal heating and friction associated with ice flow. This meltwater feeds a vast network of lakes and rivers. The presence of subglacial meltwater impacts ice flow, leading to regions of fast-flowing ice. Subglacial drainage at the grounding line generates buoyant plumes that bring warm ocean bottom water into contact with the underside of floating ice shelves, causing them to melt.

Link: https://4d-antarctica.org/

Summary:

- 4D Antarctica is an ongoing interdisciplinary project funded by ESA to advance our understanding of the supra- and sub- glacial hydrology of the Antarctic Ice Sheet.
- The group in Edinburgh are focusing on calculating basal melt rates and subglacial routing.
- We're using inverse ice-sheet modelling to infer properties at the base of the ice sheet.
- Preliminary results have focused on making improvements to the methodology: use of 2 & 5 km ice models; including additional constraints in inversion process; and test case areas (i.e. Amery catchment).
- We hope to build on this work to consider the impact of subglacial outflow on submarine ice-shelf melting.