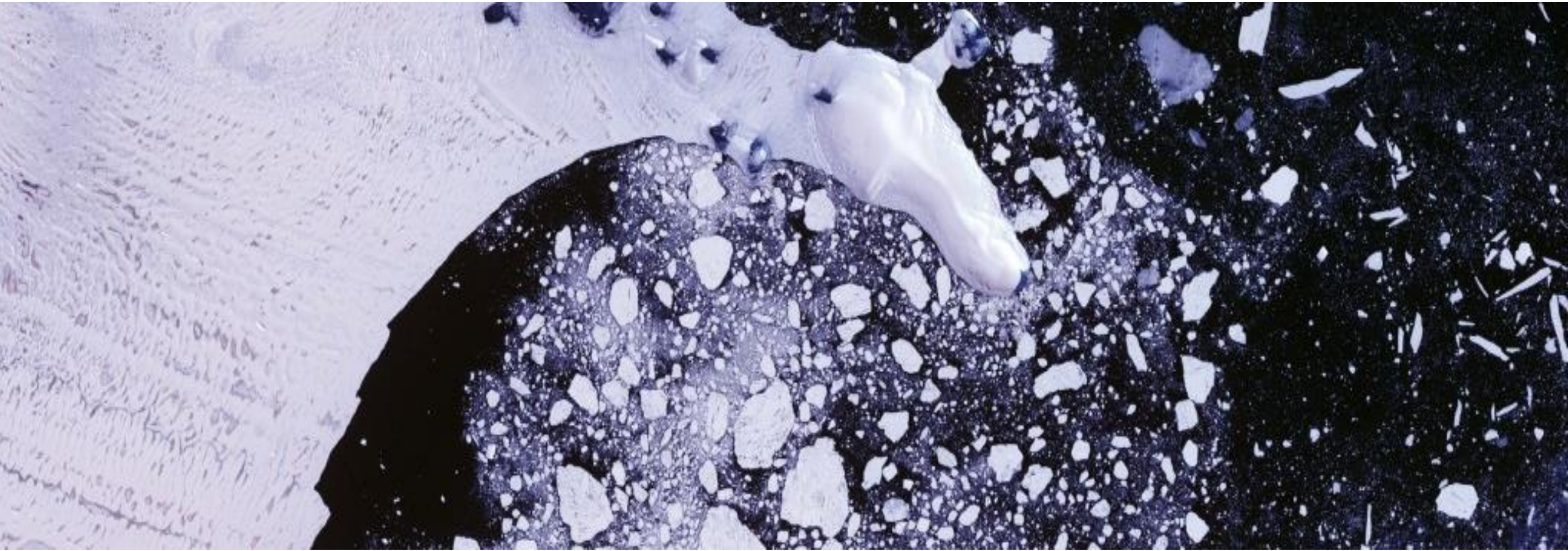


A 3D MODEL OF ANTARCTIC ICE SHELF SURFACE HYDROLOGY



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Background

Ice shelves play an important role in buttressing grounded ice



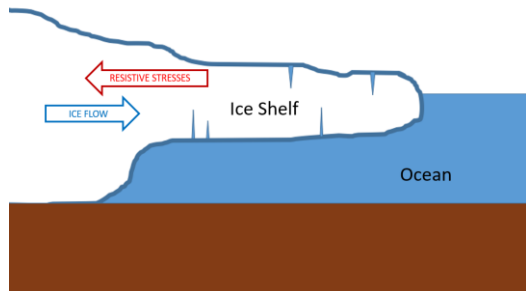
Surface lakes have been associated with sudden ice shelf collapse (such as Larsen B in 2002)



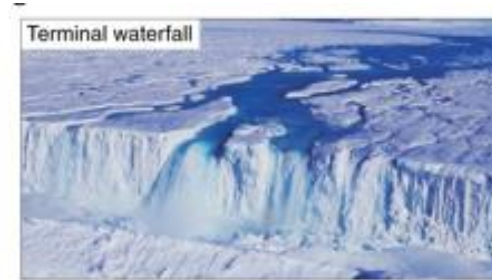
Antarctic ice shelves have all kinds of surface hydrological features.



In order to understand Antarctica's future sea level contribution we need to understand more about its surface hydrology and the impact of that on ice shelf stability.



NASA MODIS Imagery

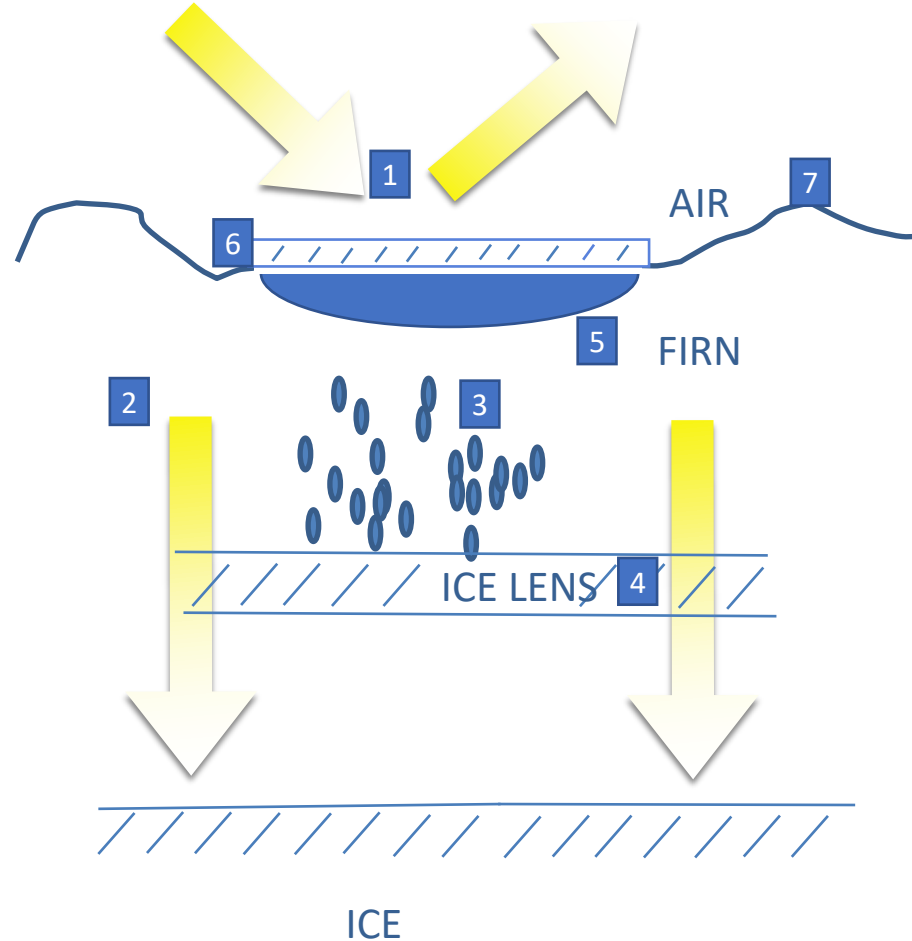


Nansen Ice Shelf
12 January 2014

From Bell et al. 2018 (Nature Climate Change)

Previous Work

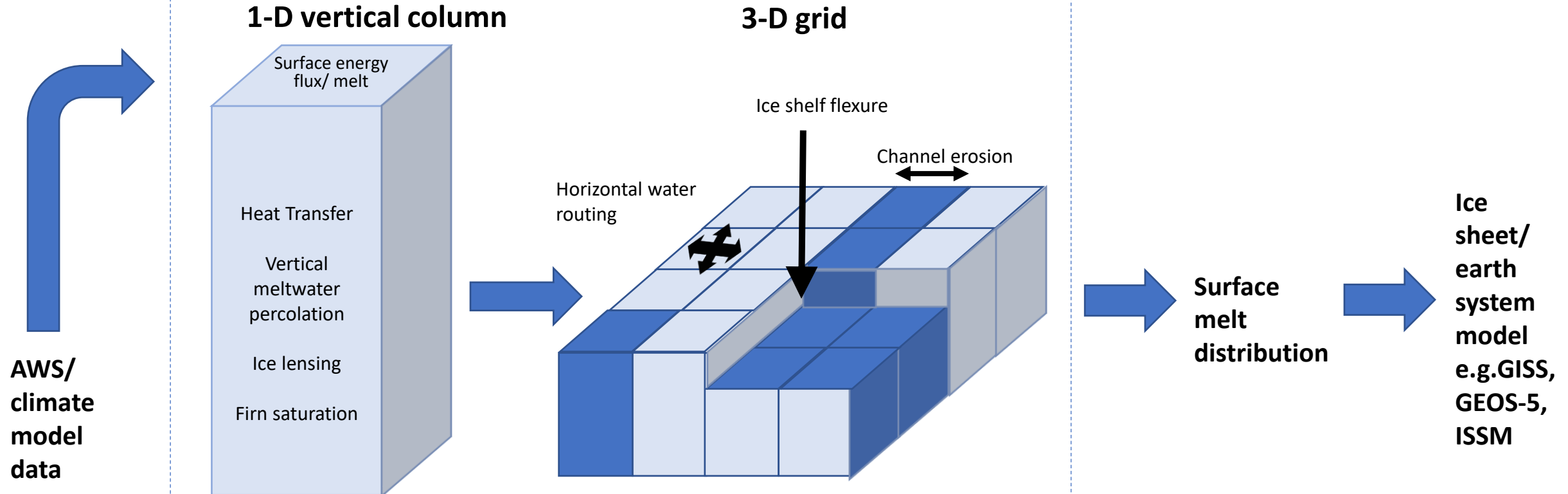
The Buzzard et al. (2018) model was the first to model the full life cycle of lakes on Antarctic ice shelves over multiple years. It includes the following processes:



1. Surface energy balance
2. Heat transfer through ice shelf
3. Meltwater percolation into firn
4. Ice lens formation
5. Surface lake formation
6. Surface lake refreezing
7. Surface albedo variation

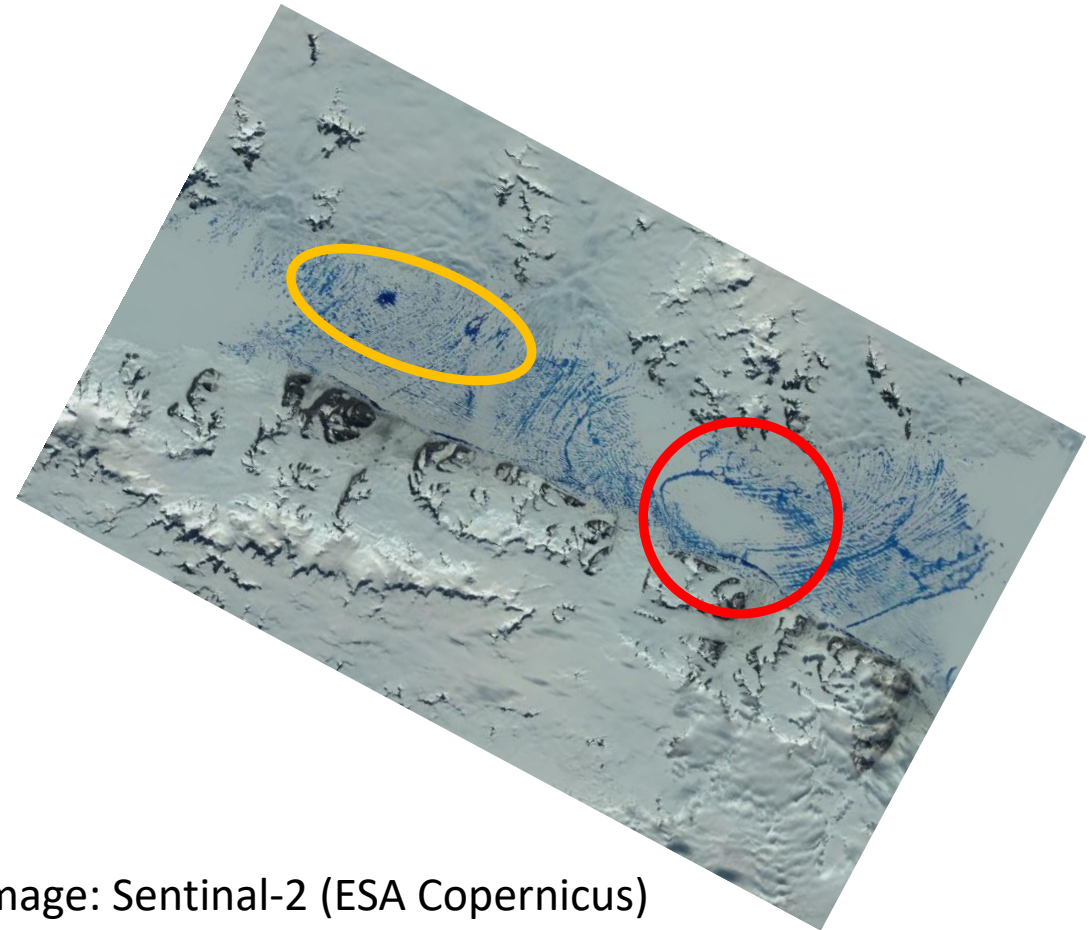
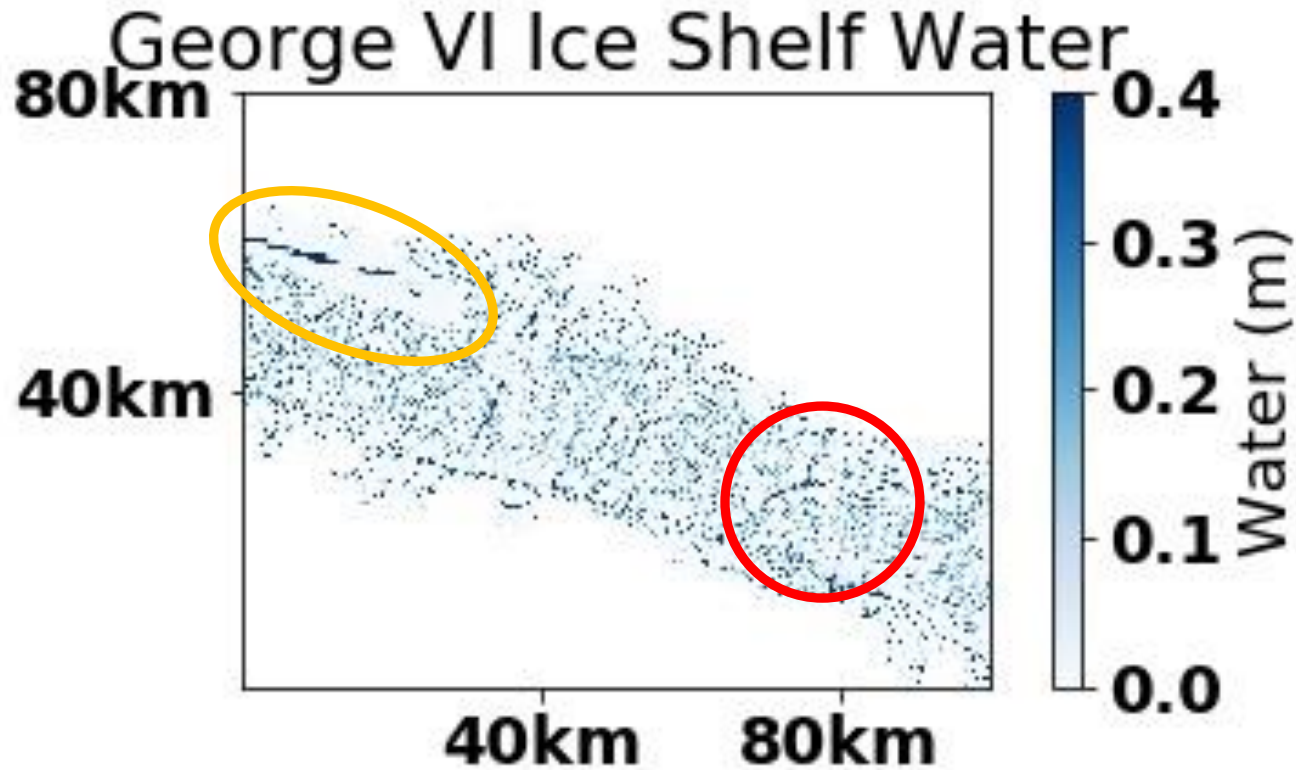
A new model for Antarctic surface hydrology

MONARCHS (Model of aNtARctic iCe shelf surface Hydrology and Stability) takes the 1-D column model of Buzzard et al. (2018) and creates a 3-D grid of these columns, allowing water to move laterally between them. This allows us to model features such as rivers, and ultimately to provide a surface melt distribution for any ice shelf. MONARCHS has the potential to be coupled to larger ice sheet and earth system models, and this is currently planned to be carried out with NASA's ISSM.



Example

A case study of the 2020 extreme melt event on the George VI Ice Shelf showed that MONARCHS is able to recreate surface melt features (red), but also provided an argument for the inclusion of additional physics and the careful selection of the most accurate Digital Elevation Model (DEM) for each ice shelf (yellow).



Work with us

- MONARCHS will be submitted for publication imminently at which point the code will be open access (it's also written in Python for ease of use).
- Our goal is for MONARCHS to be an open access model, driven by the needs of the community- so please tell us which processes you think we should incorporate into it next.
- If you can see a use for MONARCHS for your research please get in touch. I am always open to new collaborations, or to assist you in getting the model set up for you to run yourself.
- It is important for the processes MONARCHS models to be accounted for in larger scale ice sheet or earth system models- please get in touch if you want to discuss how this can be done with your favorite ice sheet or earth system model.

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