Additional information on preprint *Oceanic gateways to Antarctic grounding lines – Impact of critical access depths on sub-shelf melt* (DOI: 10.5194/egusphere-2023-2583)

How we derive access depths based on bathymetry data

We determine the access depth of each point on the continental shelf (including the ice-sheet's grounding line) through a flood-fill algorithm (for more information on this algorithm, see e.g. https://en.wikipedia.org/wiki/Flood_fill, last access: 16.01.2024). We let the algorithm start in the open ocean (off the continental shelf) at a depth of -2000m. Like a slowly filling bathtub, the flood-fill iterates through the dataset grid and fills / connects pixels that are connected (at the same or lower depth). Since the continental shelf lies shallower than -2000m, at a certain depth the flood-fill "flows" onto the continental shelf. This is indicated by the white arrows in Figure 1. Once done, one can then compare the bathymetry value from the BedMachine Dataset with the value from the Access Depth array, which results from the flood-fill: if the bathymetry is deeper than the derived access depth at the same point x,y; the point may be "shielded" by shallower topography "blocking" the way of e.g. warm water onto the continental shelf. Evaluating the access depth array as a 2D field (Figure 2), and more closely at the grounding line we can discuss the connectedness of the cavity and grounding line to the open ocean.

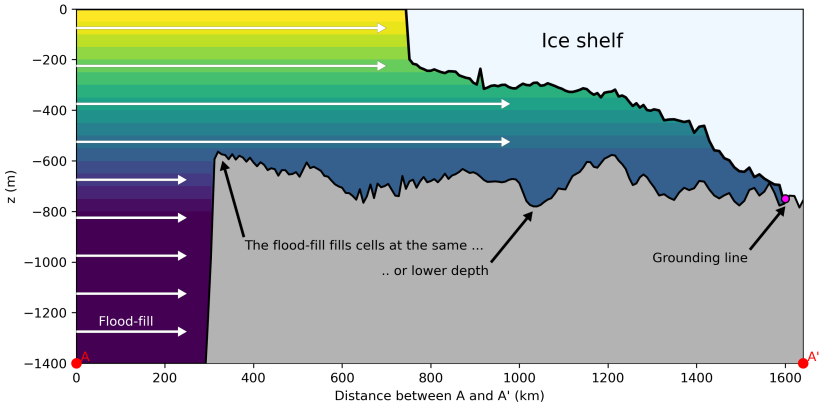

Figure 1. Transect at Ross Ice Shelf showing how flood-fill algorithm determines access depth at grounding line (marked with magenta dot). Location of A and A' are marked in Figure 2.

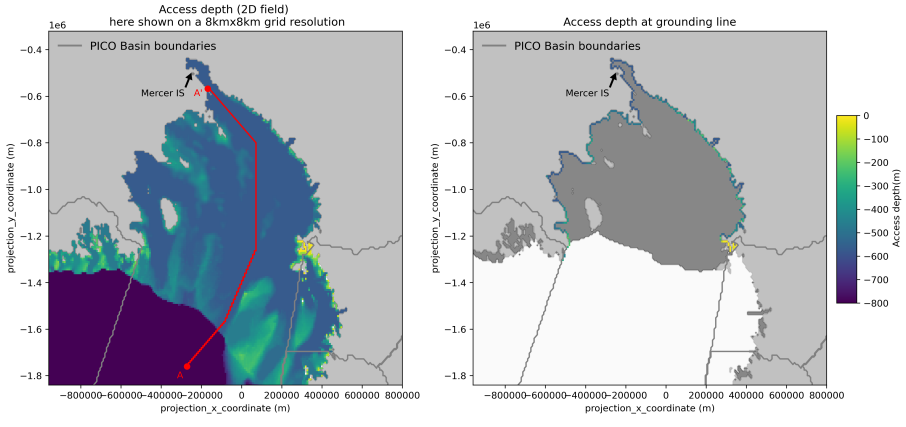

Figure 2. Overview of 2D-field of obtained access depths at Ross Ice Shelf.

In Figure 2, one can see that for instance Mercer Ice Stream has a deep access depth; other parts of this region's grounding line have shallower values of access depths. To quantify this situation, we express the critical access depth of the region's grounding line in terms of how much percent of the total grounding line in the Ross Sector has the access depth of d=x m. For example, for the Ross Sector, 30% of the grounding line has the deepest access depth of -570m. This evaluation of ocean access to the different sectors' grounding lines is displayed in Fig. 3 of the submitted manuscript. The different concepts can be summarized in the following Figure 3:

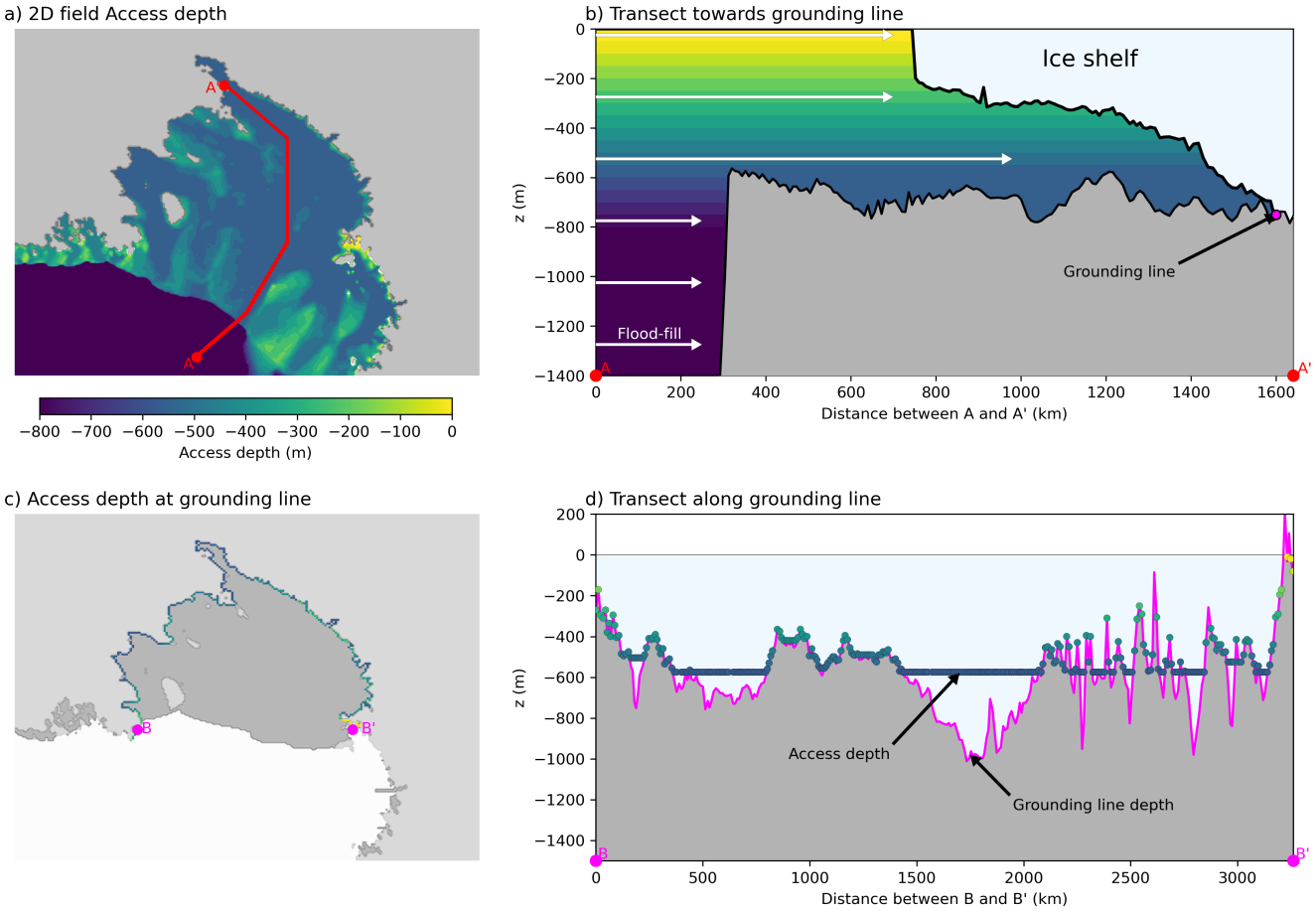

Figure 3. Overview of used concepts applied to the Ross Ice-Shelf region.

Two animations showing how the flood-fill iteratively fills cells around Antarctica will be added in the supplement of the revised manuscript.