Antarctic ice shelves and warm ocean currents

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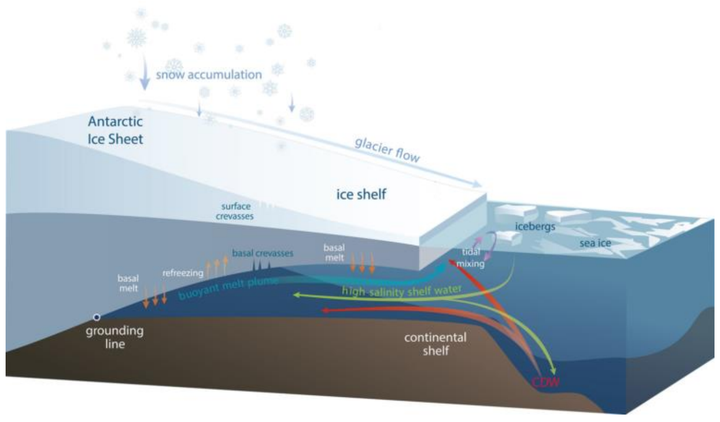
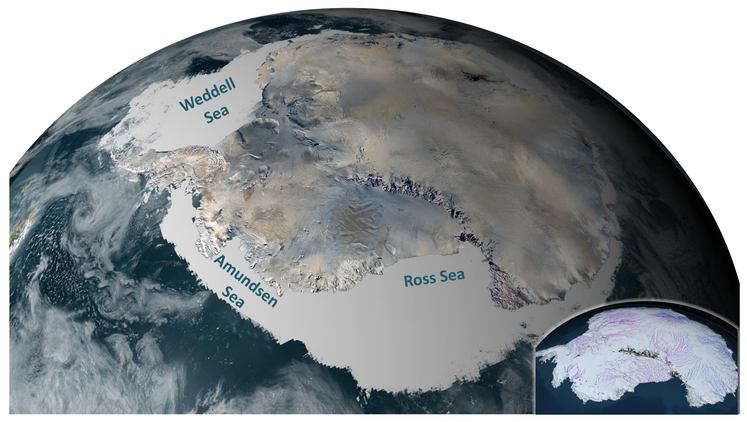
Ice shelves are …



Schematic of a floating Ice shelf. Warm water in the cavity under the ice shelf lead to basal melting, which can affect the stability of the ice shelf and the ice sheet upstream. Image credit: Helen Amanda Fricker, Professor, Scripps Institution of Oceanography, UC San Diego.

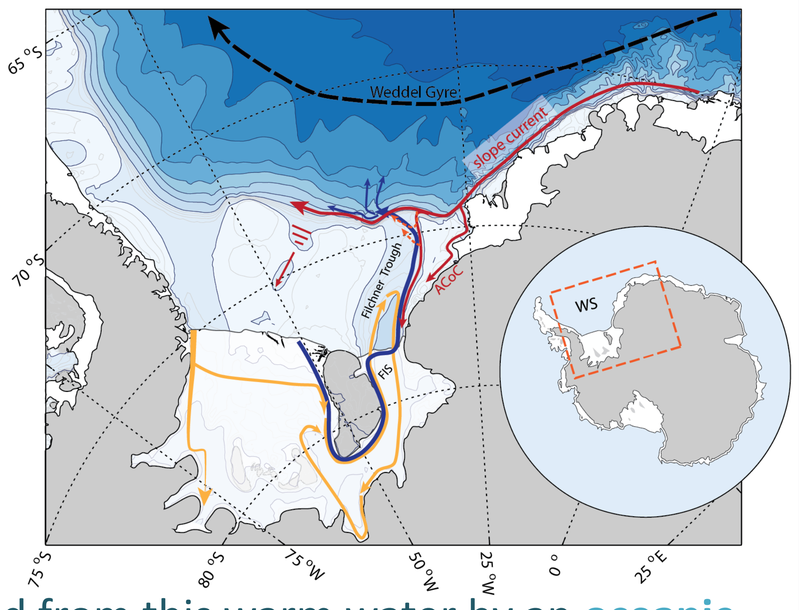
- **Floating** extensions of the ice sheet
- **Slowing down** the ice sheet flow and limiting the sea level rise
- In **contact with the ocean**
- **Vulnerable** to changes in the ocean circulation and the water temperature



Satellite image of Antarctica.
Image credit: NASA/GSFC Scientific Visualization Studio

Circulation in the southern Weddell Sea

The shallow continental shelf is mostly filled with cold and dense water. The Weddell Sea produces large amounts of dense **Antarctic Bottom Water**, which is an important driver of the **global thermohaline circulation**.

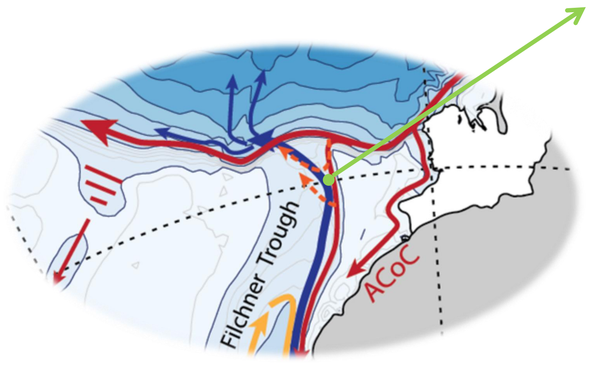


North of the continental slope, **warm water** (above freezing) resides at depth. The continental shelf is to a large degree protected from this warm water by an **oceanic front**. But observations show that warm water can flow onto the shelf during summer, and reach the ice shelf front.

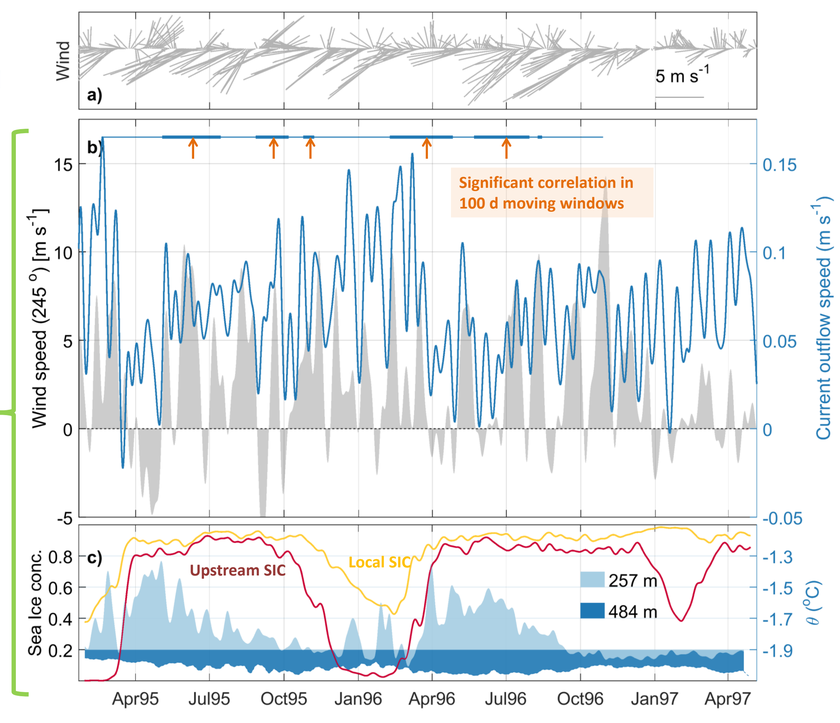
A deep **trough** cross-cuts the continental slope. Warm water can more easily enter into the trough, than over the flat shelf. Ongoing studies indicate that parts of the **slope current** can enter and **recirculate** in the trough, bringing warm water southwards while **increasing the outflow speed** of the dense water.

We find **significant correlation** between wind and current outflow speed when there is:

- Warm water in the upper layer
- Strong along-slope wind
- «Normal» Sea Ice Conc.



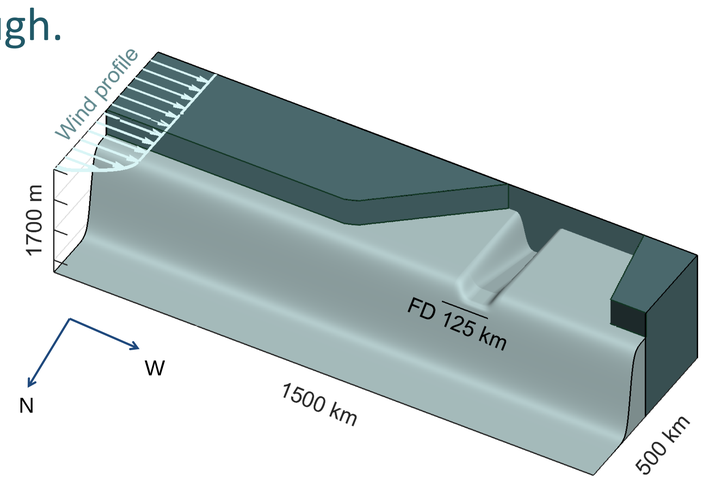
Recirculation over the trough sill



a) Wind vectors in the upstream continental slope region. b) wind speed towards 245° (gray) and current outflow (blue) on the trough sill. c) Temperature at 257 and 484 m (light/dark blue), and SIC upstream (red) and locally in the trough region (yellow).

An idealized model

We constructed an idealized, eddy-resolving numerical model, to study mechanisms through which warm deep water enters the continental shelf and trough. The geometry is smooth but contains the main topographic features of the Weddell Sea, such as the continental slope, shelf and trough.

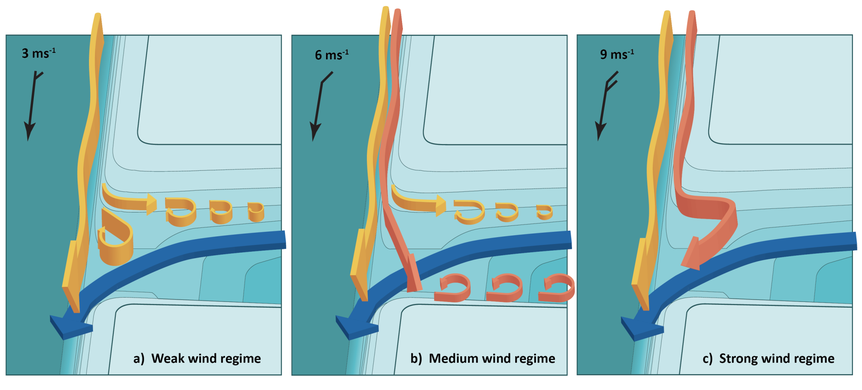


We identified **Three inflow regimes:**

a) Weak wind:
- Warm water into eastern side of trough.
- Sensitive to dense water properties

b) Medium wind:
- Inflow along western side of trough
- More inflow than in weak wind regime

c) Strong wind:
- **Recirculation** over the trough sill
- Limited warm inflow
- Insensitive to dense water properties



ACKNOWLEDGEMENTS

This study was funded by the Research Council of Norway, FRINATEK Program, under the project ‘‘Inflow of Warm Deep Water on the Antarctic Continental Shelves’’ (WARM) and through the NARE program under the project “Antarctic Ice Shelves and Ocean Climate (WEDDELL)”. The research was supported by the Centre for Climate Dynamics at the Bjerknes Centre.

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