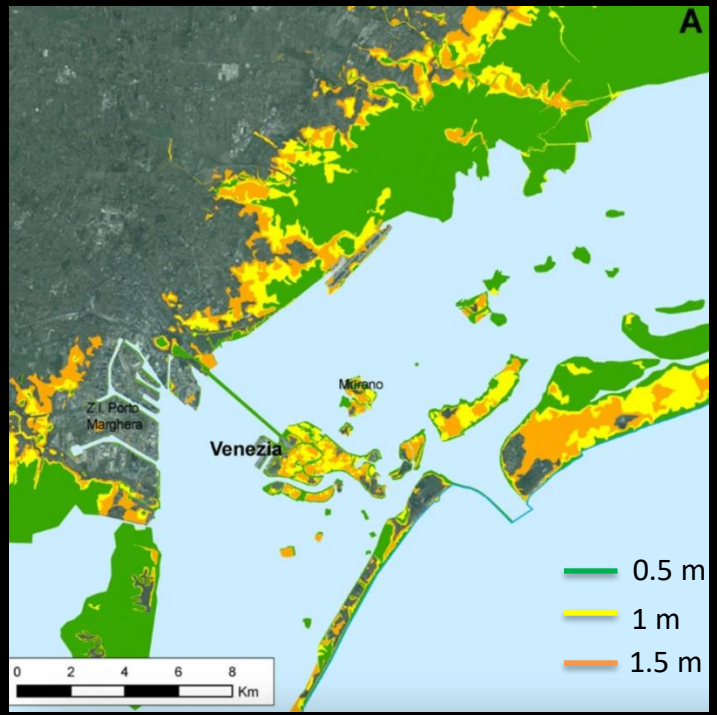
University of Southampton

Alessandro Silvano

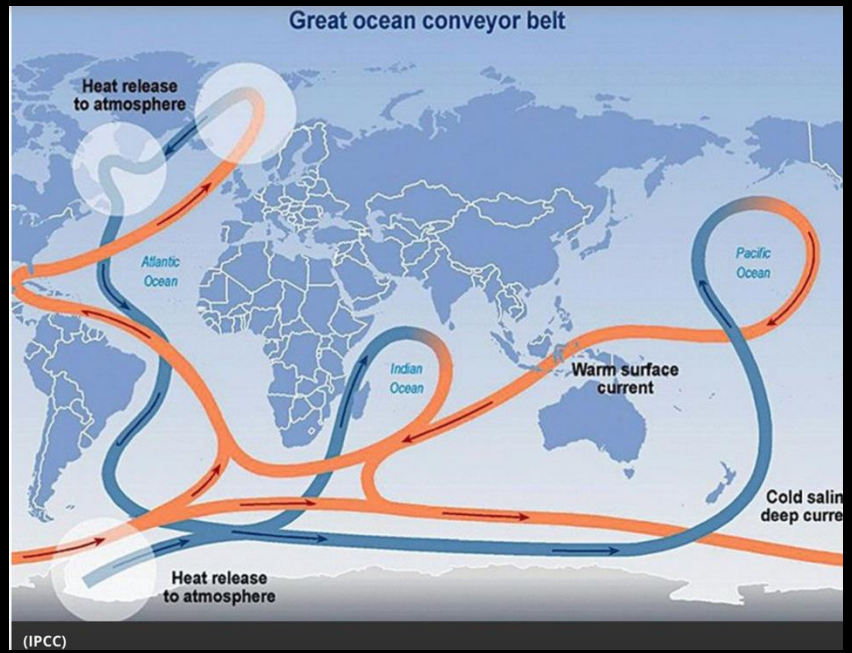
Ice-ocean interactions around Antarctica

Ice – ocean interactions in Antarctica:

global sea level rise

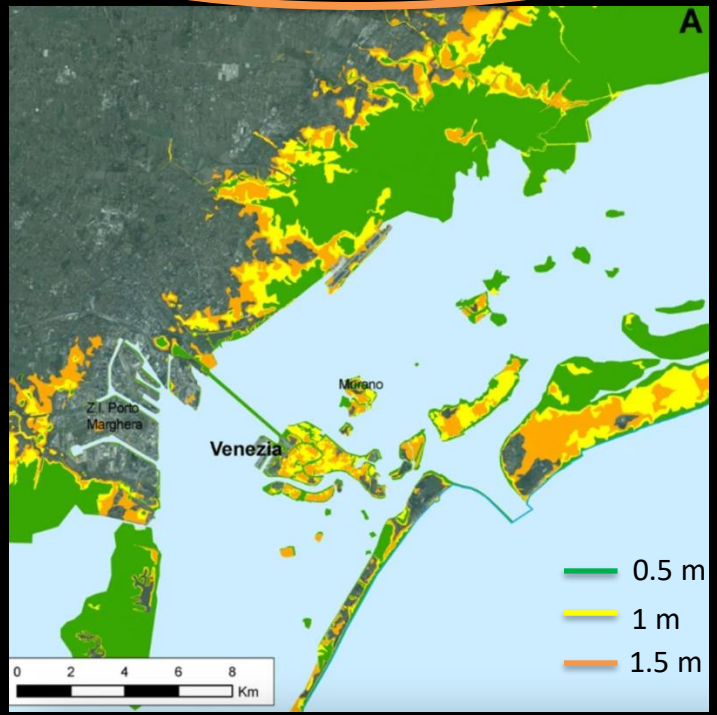


global ocean circulation

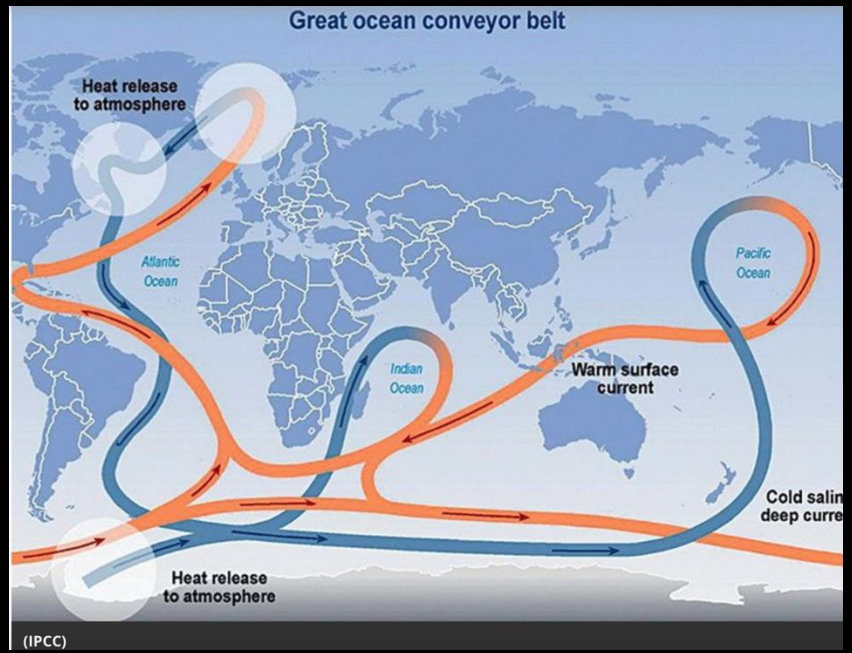


Ice – ocean interactions in Antarctica:

global sea level rise

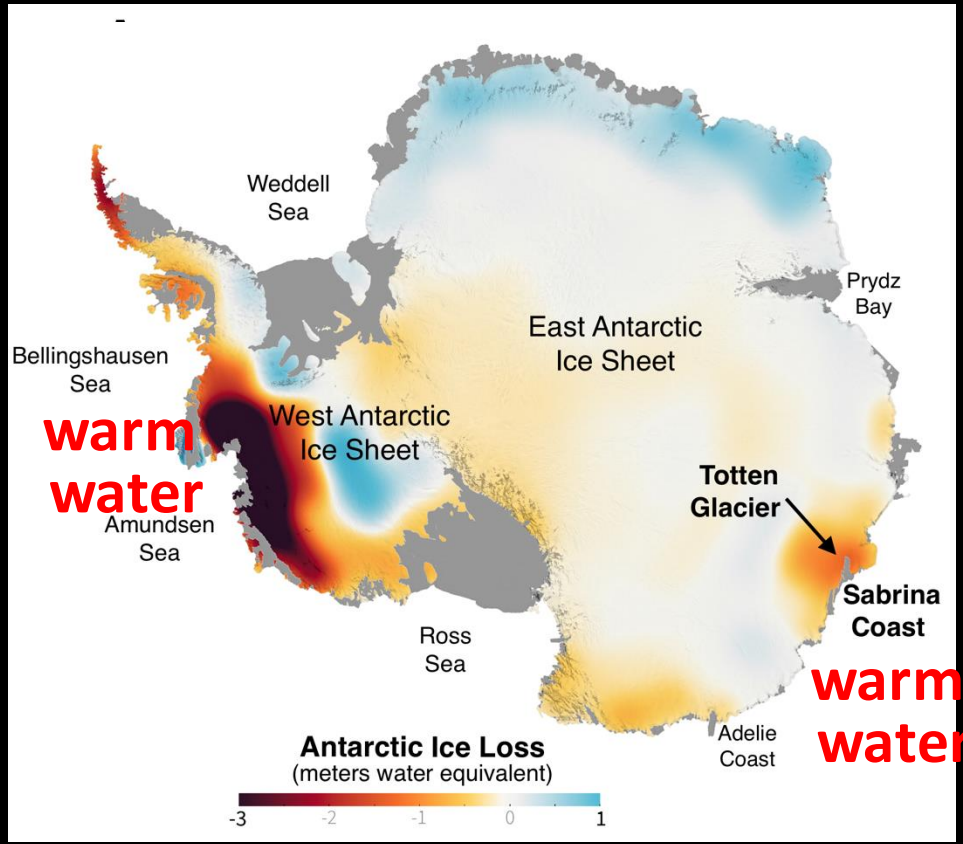


global ocean circulation



Global sea level rise

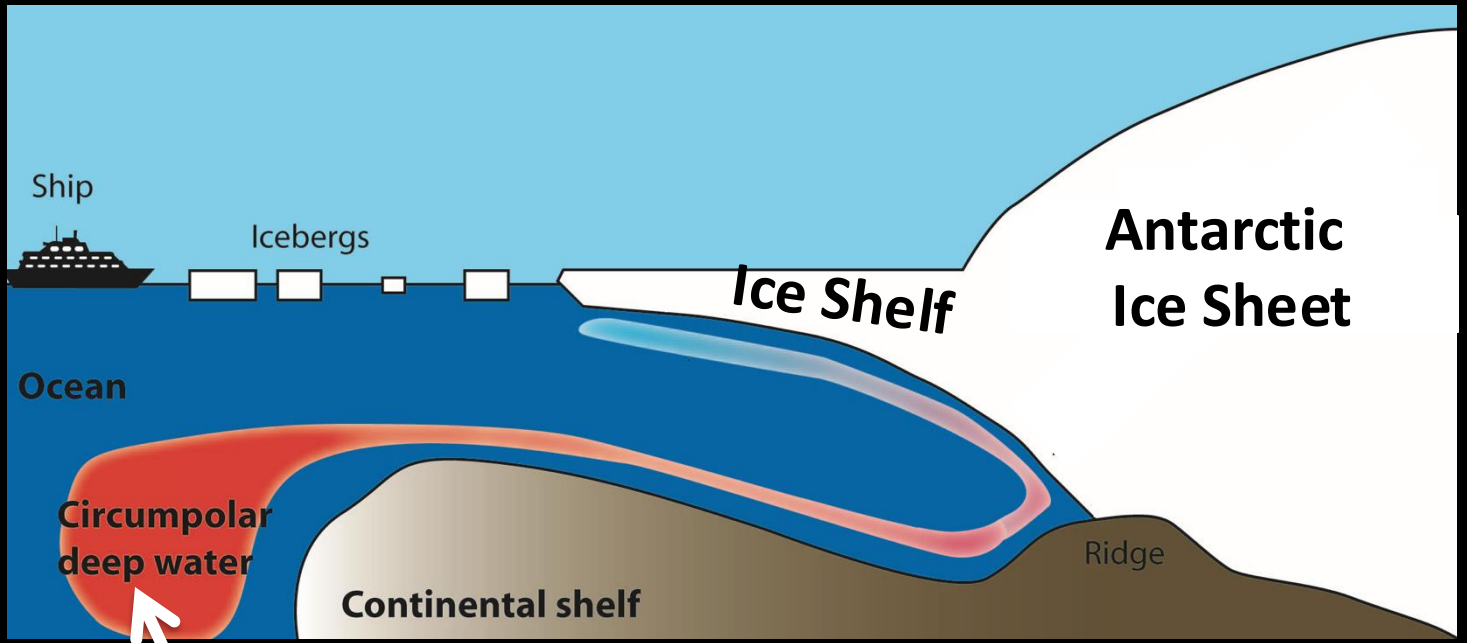
- Largest contribution is from West Antarctica
- Largest uncertainty in future sea level rise



credit: NASA

- East Antarctica (especially the Totten and Denman Glaciers) is also vulnerable to rapid ocean-driven melting.

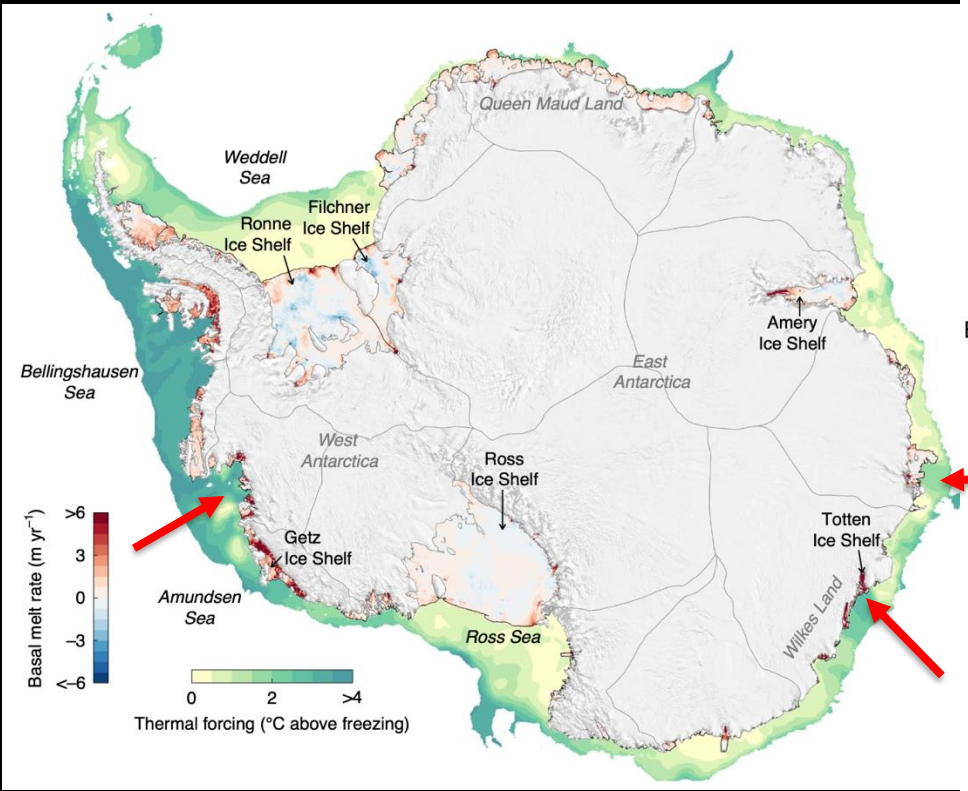
Ocean-driven melting

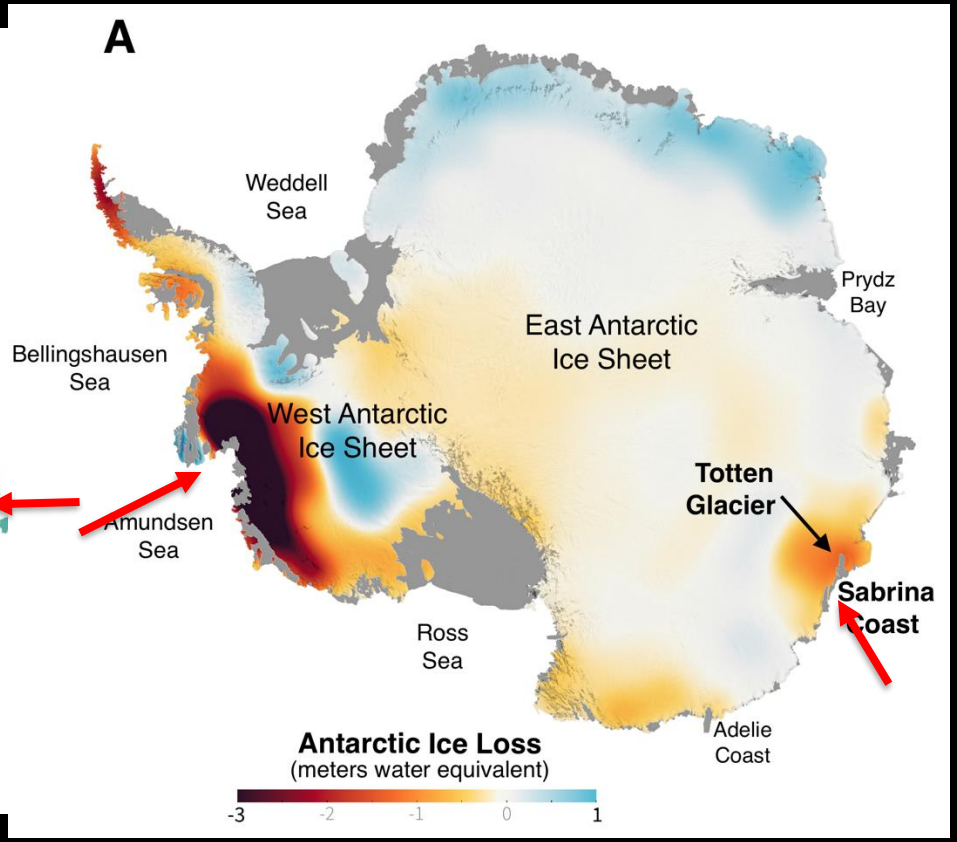


Modified from *www.AntarcticGlaciers.org*

Warm water from the Southern Ocean

Where coastal waters are “warm” the Antarctic Ice Sheet is losing mass

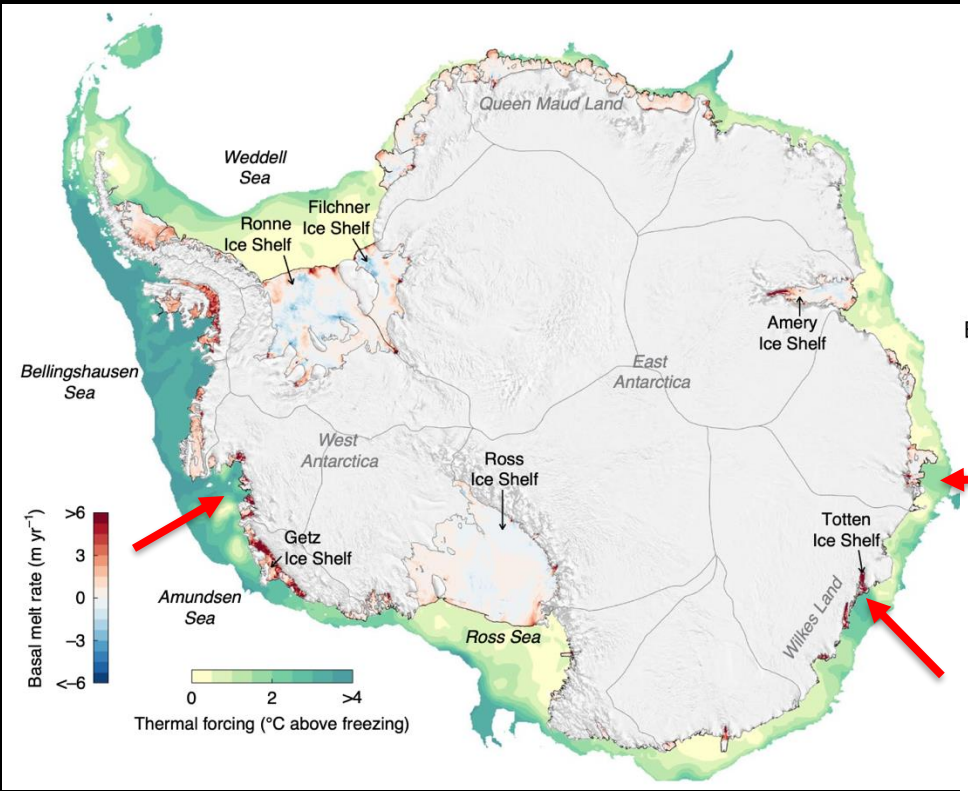




Adusumilli et al. (2020)

NASA

Where coastal waters are “warm” the Antarctic Ice Sheet is losing mass



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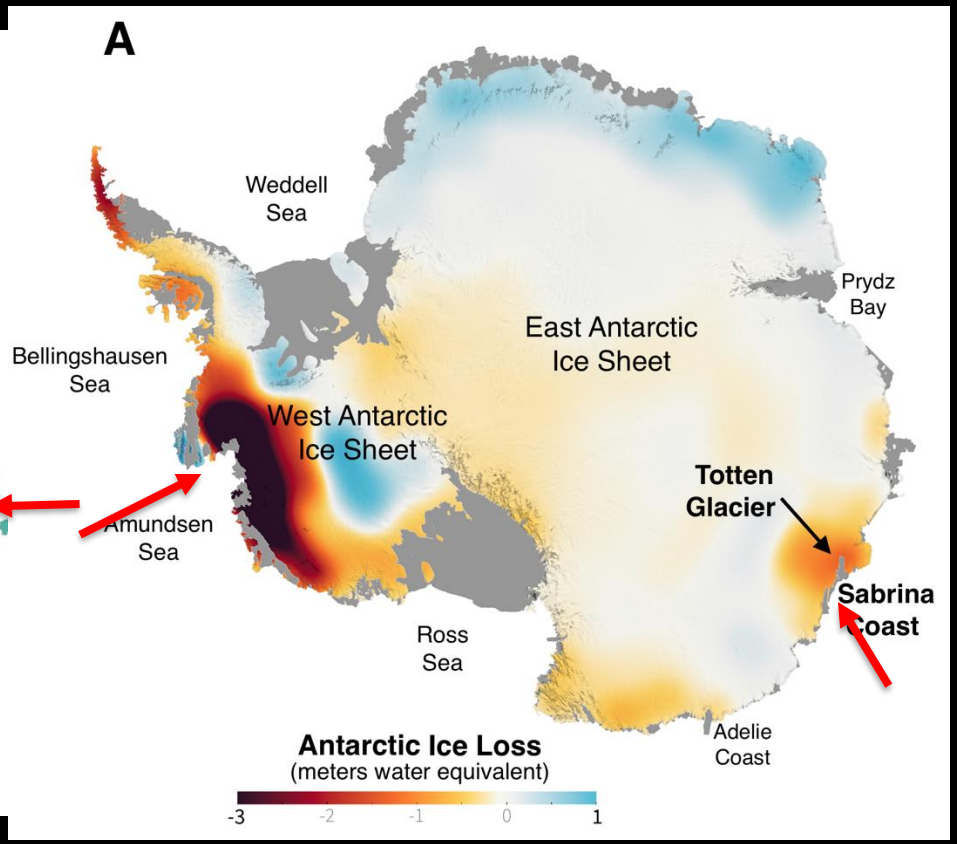
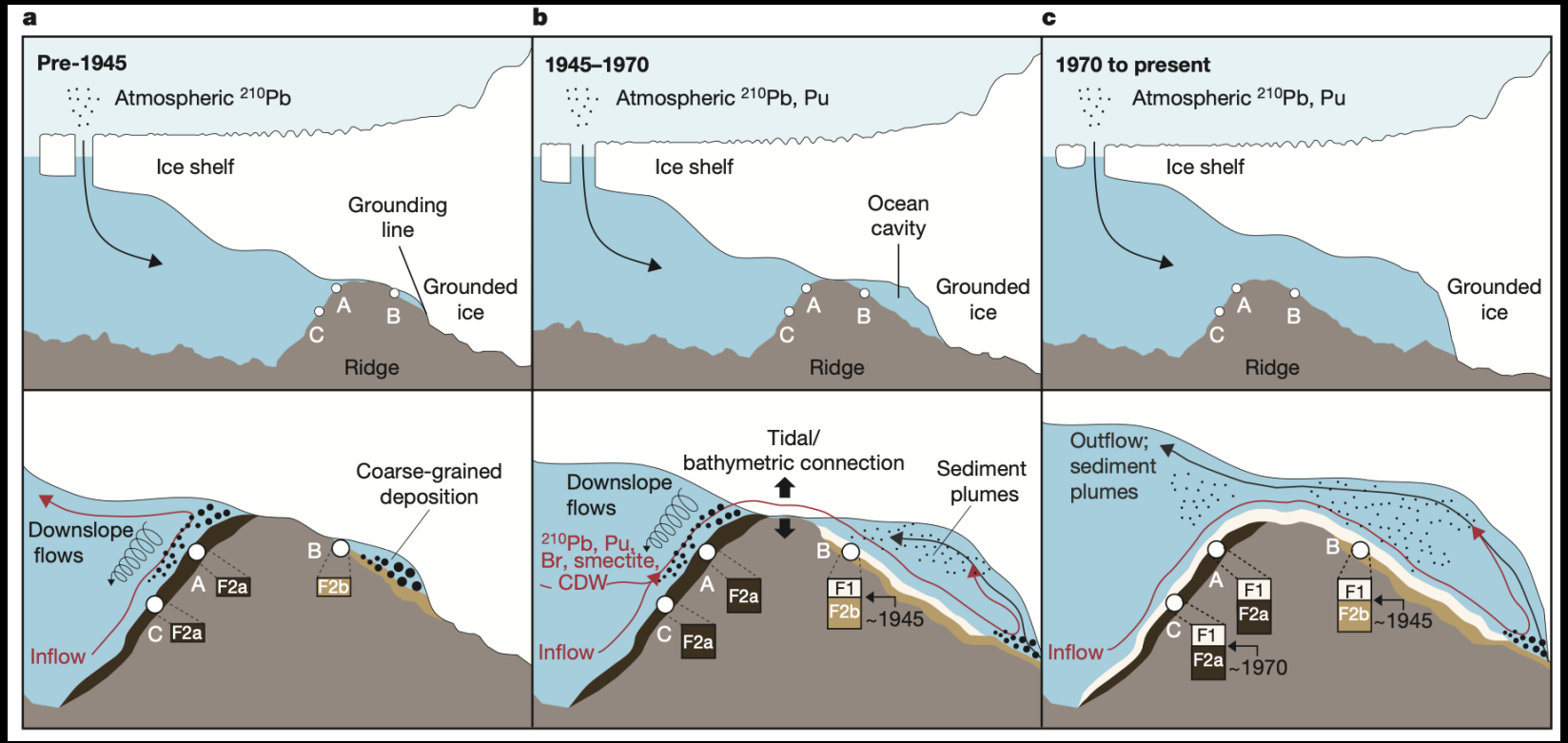


NASA

Is what we see in ocean and ice sheet “synchronous”?

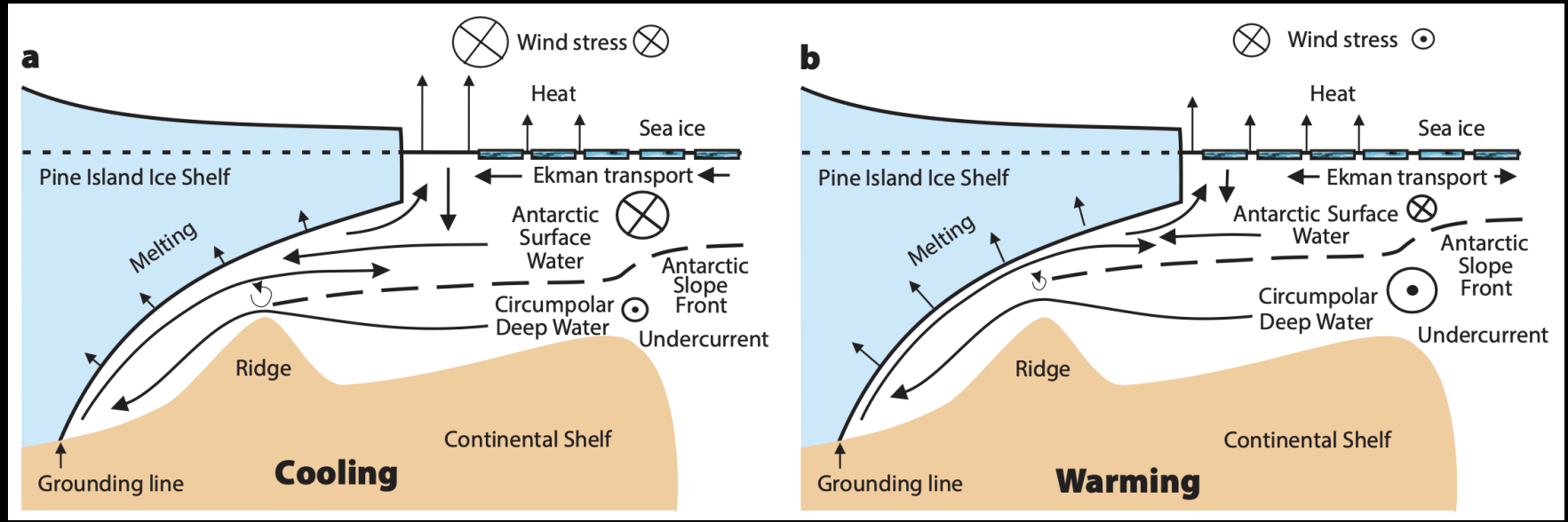
Pine Island Glacier: 1940s!



Paleo proxy essential!

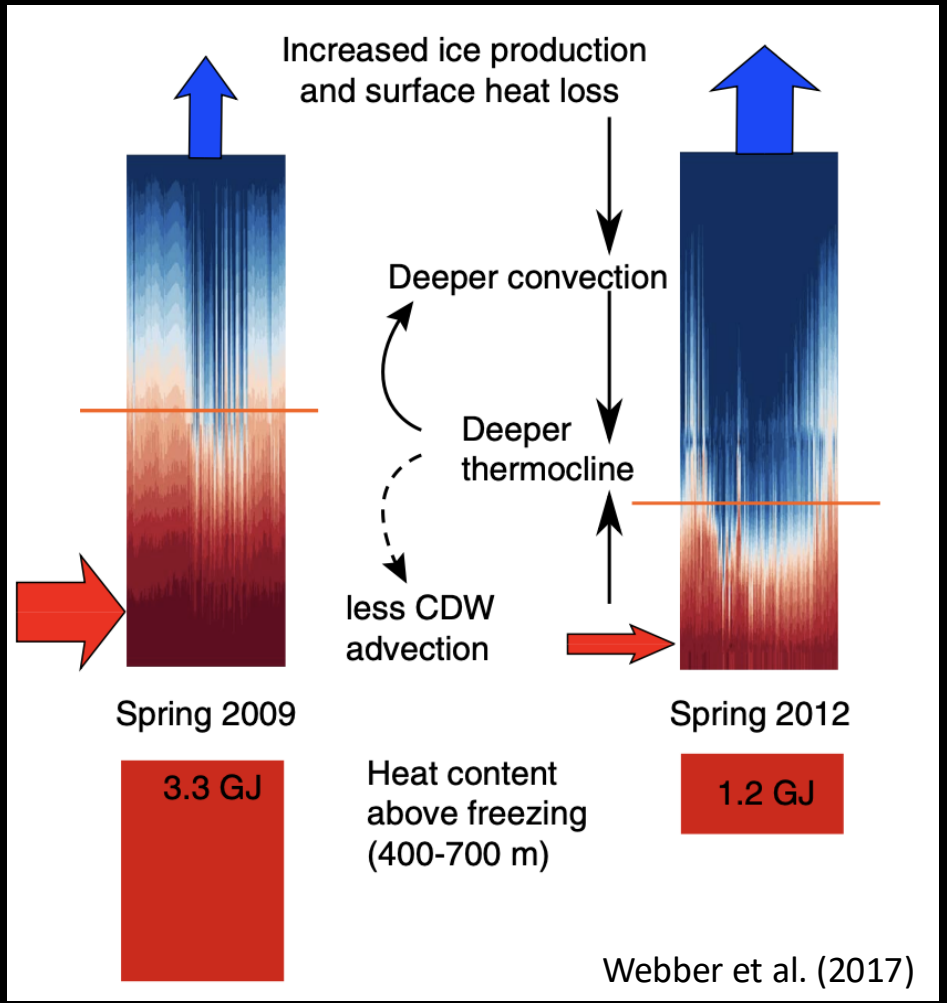
Paleo proxies important also to understand processes driving warming conditions in the Amundsen Sea

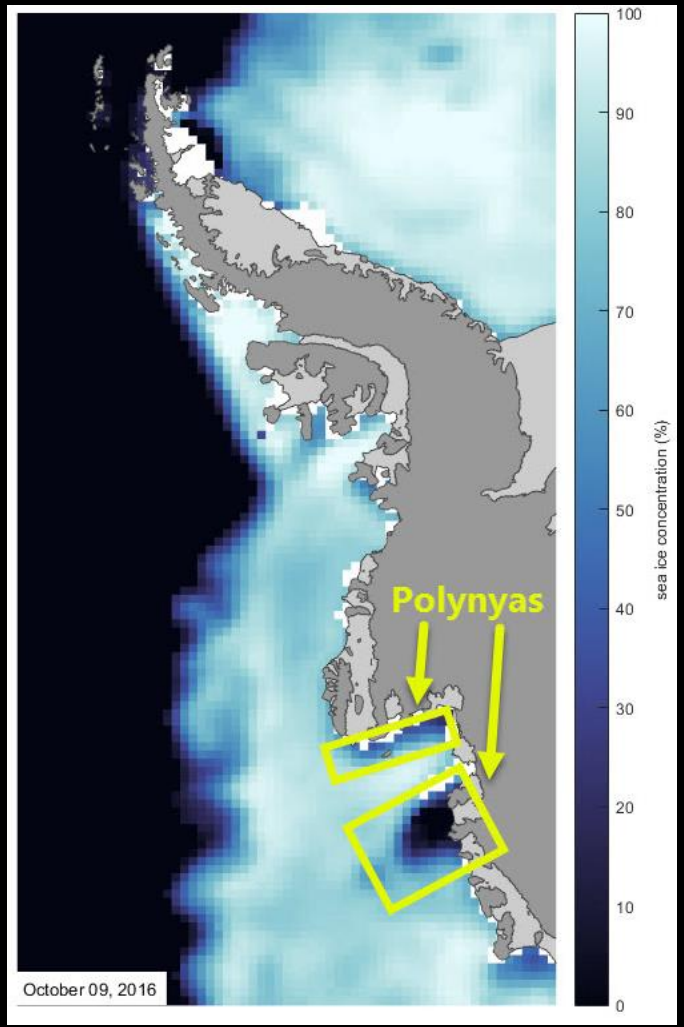
1940s: El Niño
(westerly wind anomalies)



Jenkins et al. (2016)

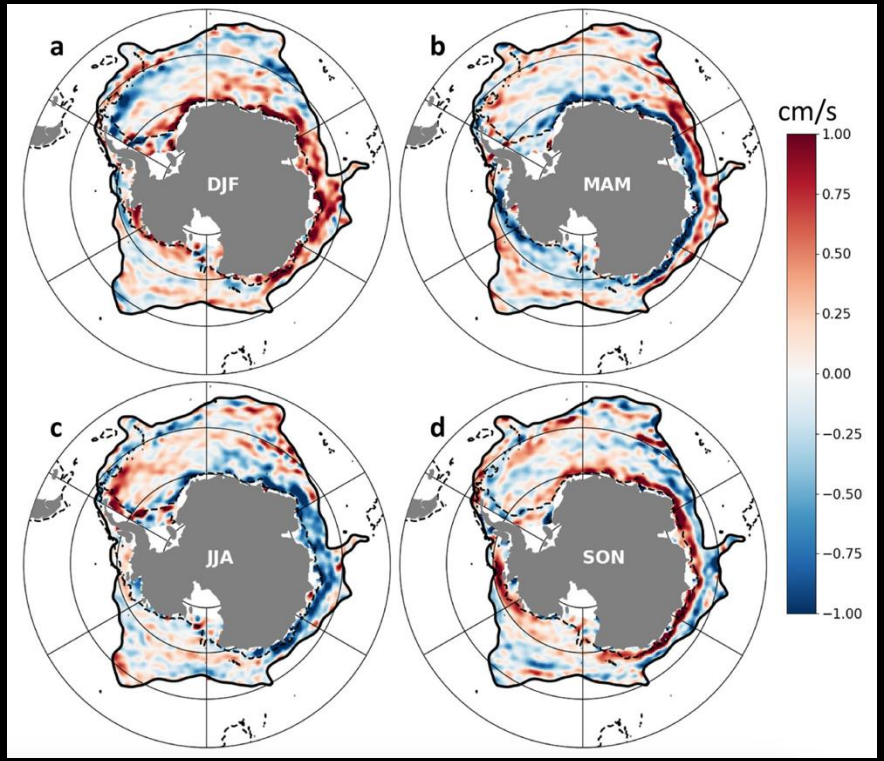
Impact of sea ice-driven cooling



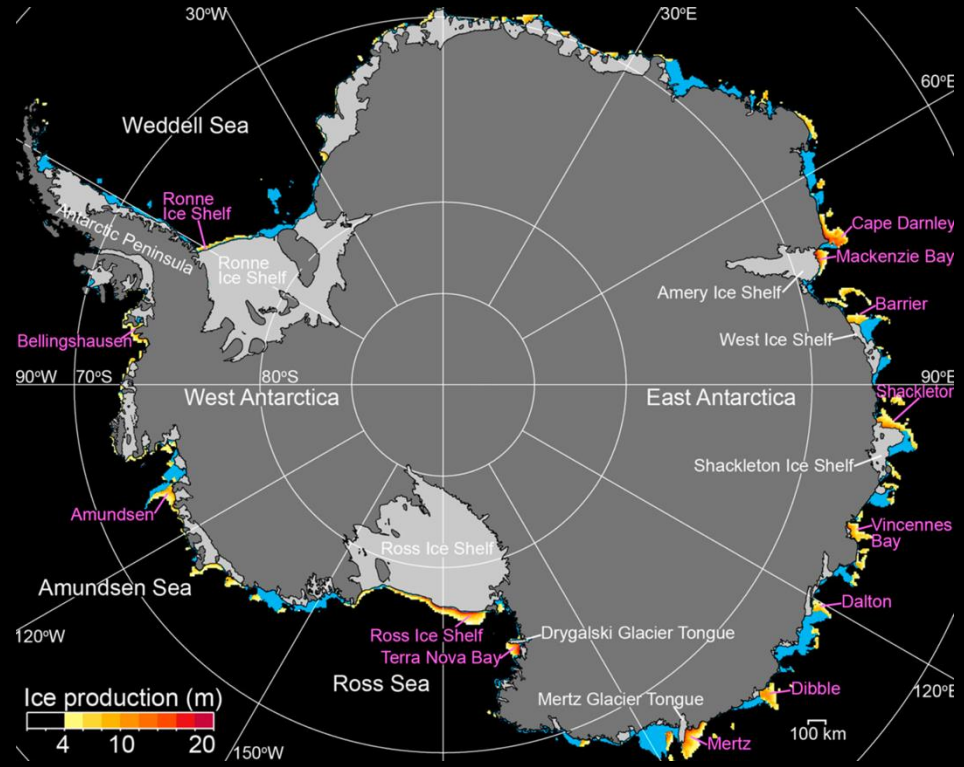


Winds versus sea ice in the Amundsen Sea

Improve satellite derived ocean currents and sea ice fluxes on continental shelf



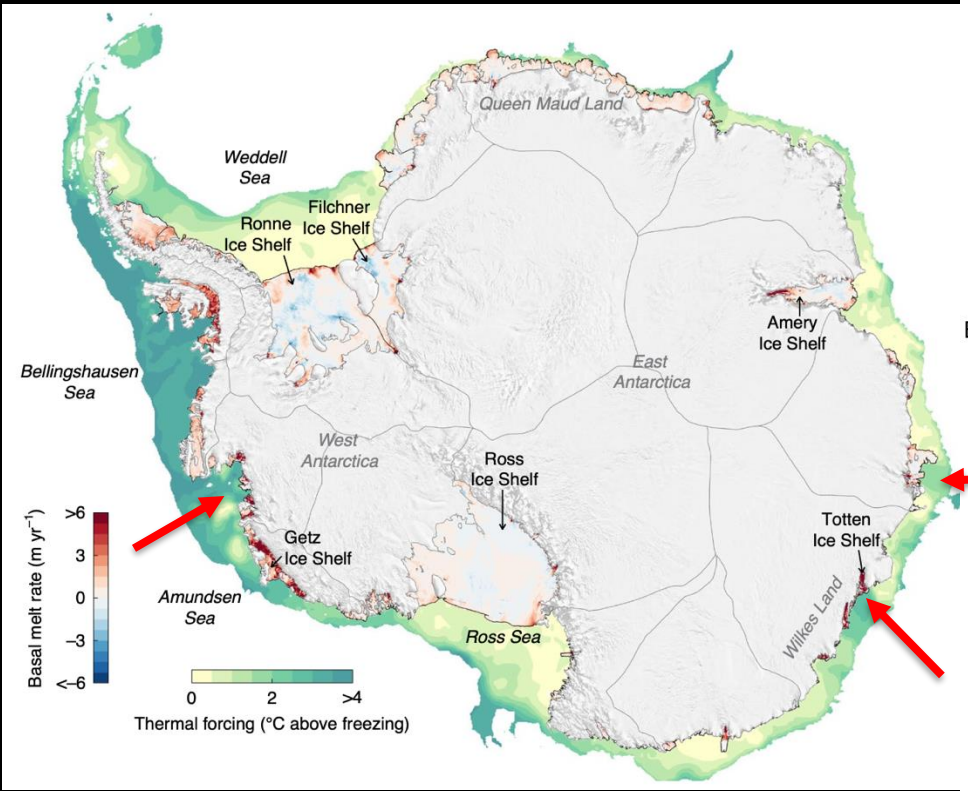
Auger et al. (2022)



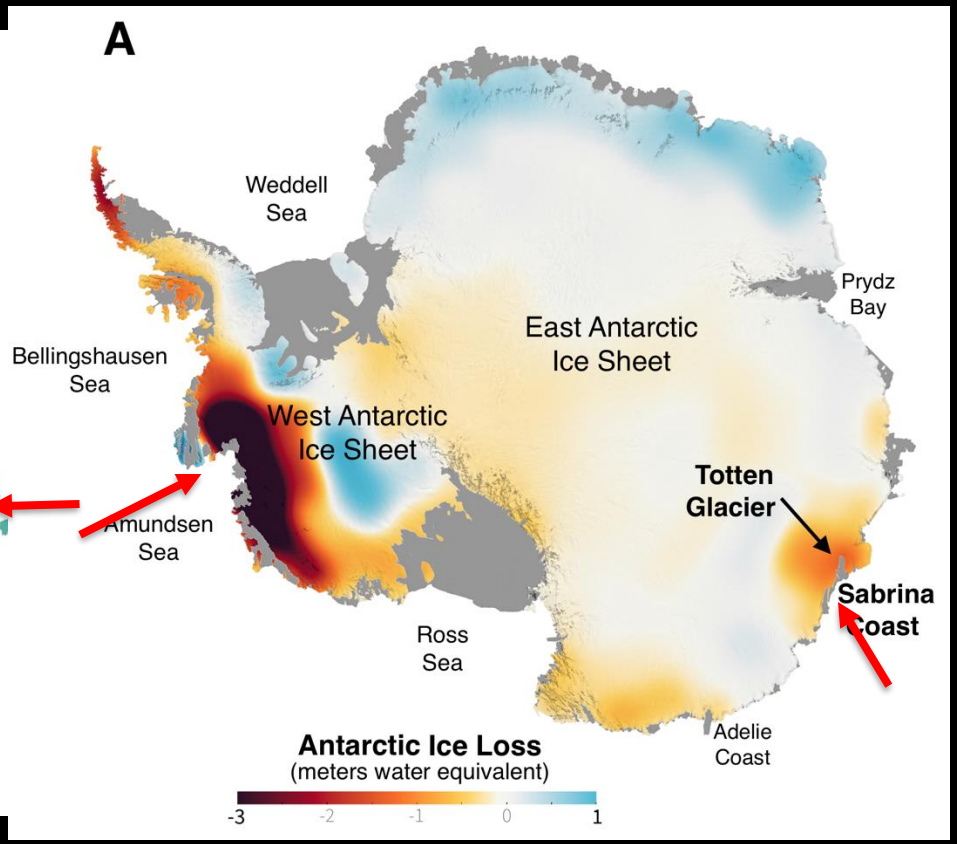
Nihashi and Ohshima (2015)

→ Continue in situ monitoring through moorings and ship surveys

Where coastal waters are “warm” the Antarctic Ice Sheet is losing mass



Adusumilli et al. 2020



NASA

Is what we see in ocean and ice sheet “synchronous”? **Totten**

Article | Open access | Published: 10 July 2023

Satellite record reveals 1960s acceleration of Totten Ice Shelf in East Antarctica

Rongxing Li, Yuan Cheng ✉, Tian Chang, David E. Gwyther, Martin Forbes, Lu An ✉, Menglian Xia, Xiaohan Yuan, Gang Qiao, Xiaohua Tong & Wenkai Ye

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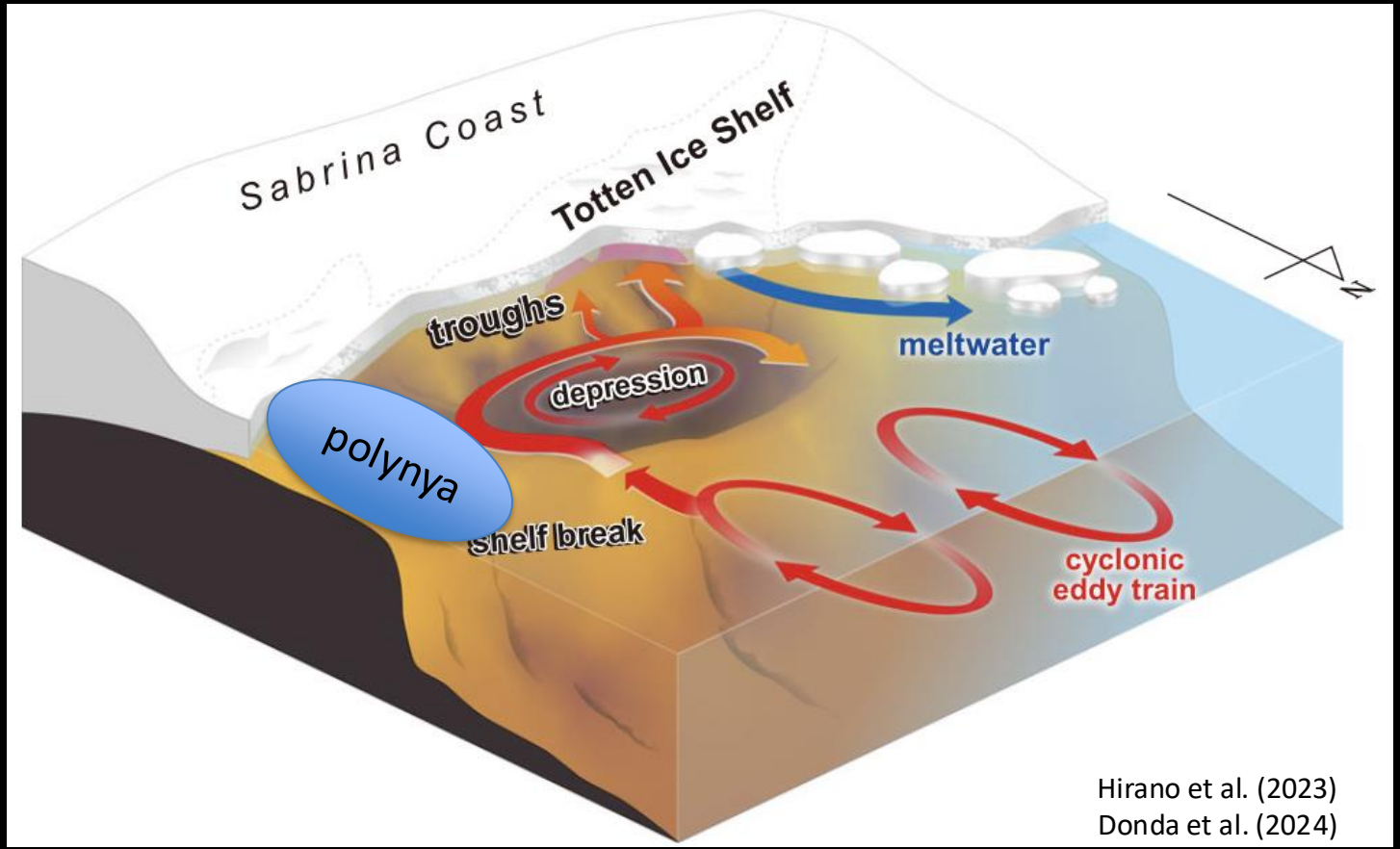
→ Need paleo proxies from the continental shelf!

Circulation: complex!

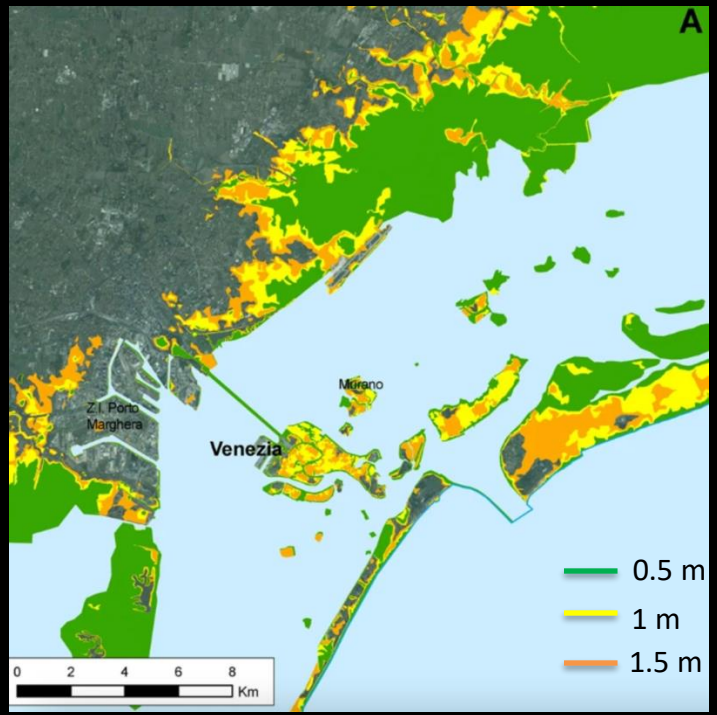


Hirano et al. (2023)
Donda et al. (2024)

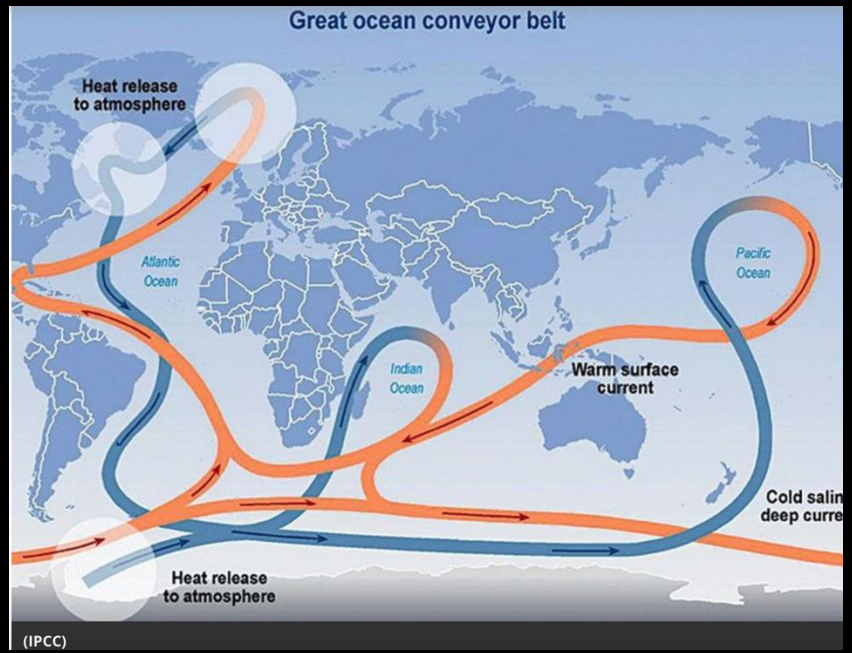
- Satellite derived currents and sea ice fluxes
- In situ observations (including bathymetry)

Ice – ocean interactions in Antarctica:

global sea level rise



global ocean circulation



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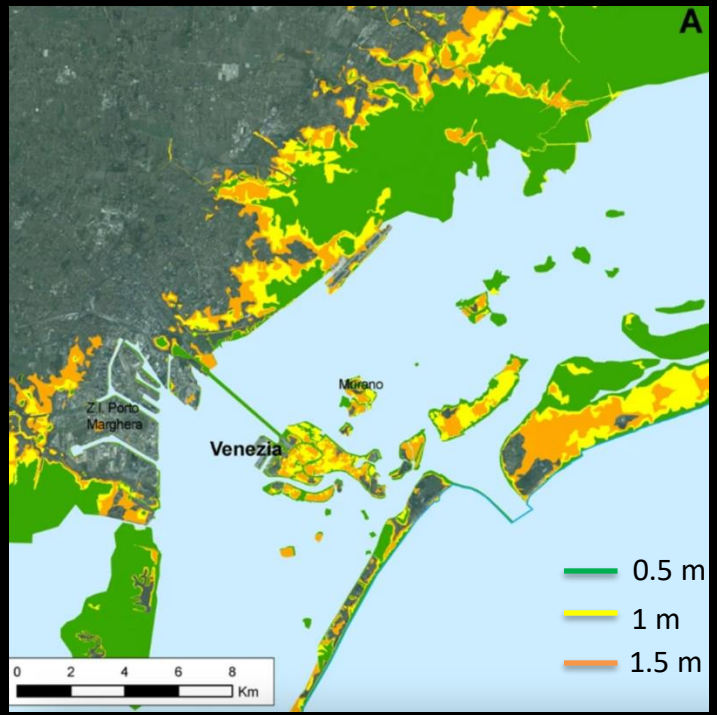

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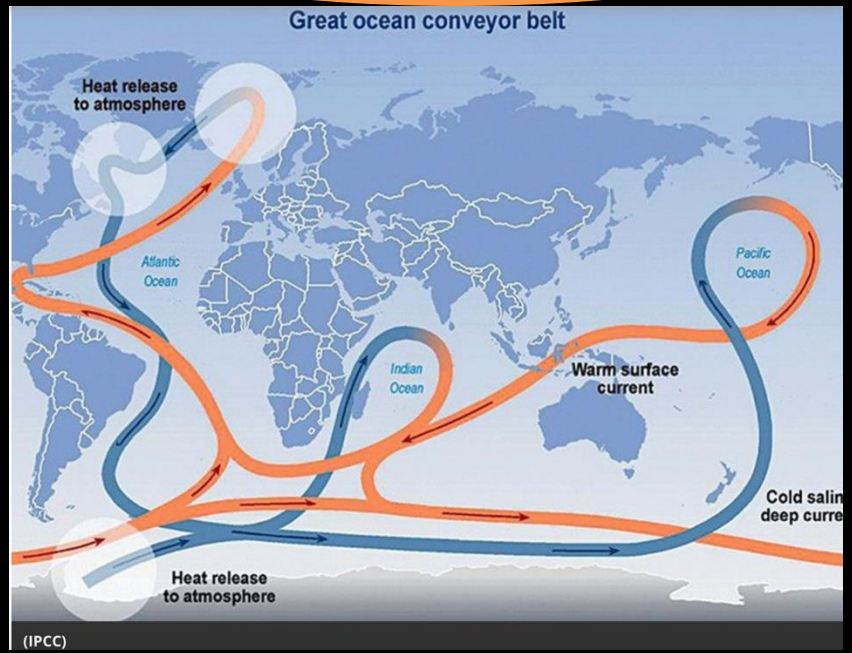
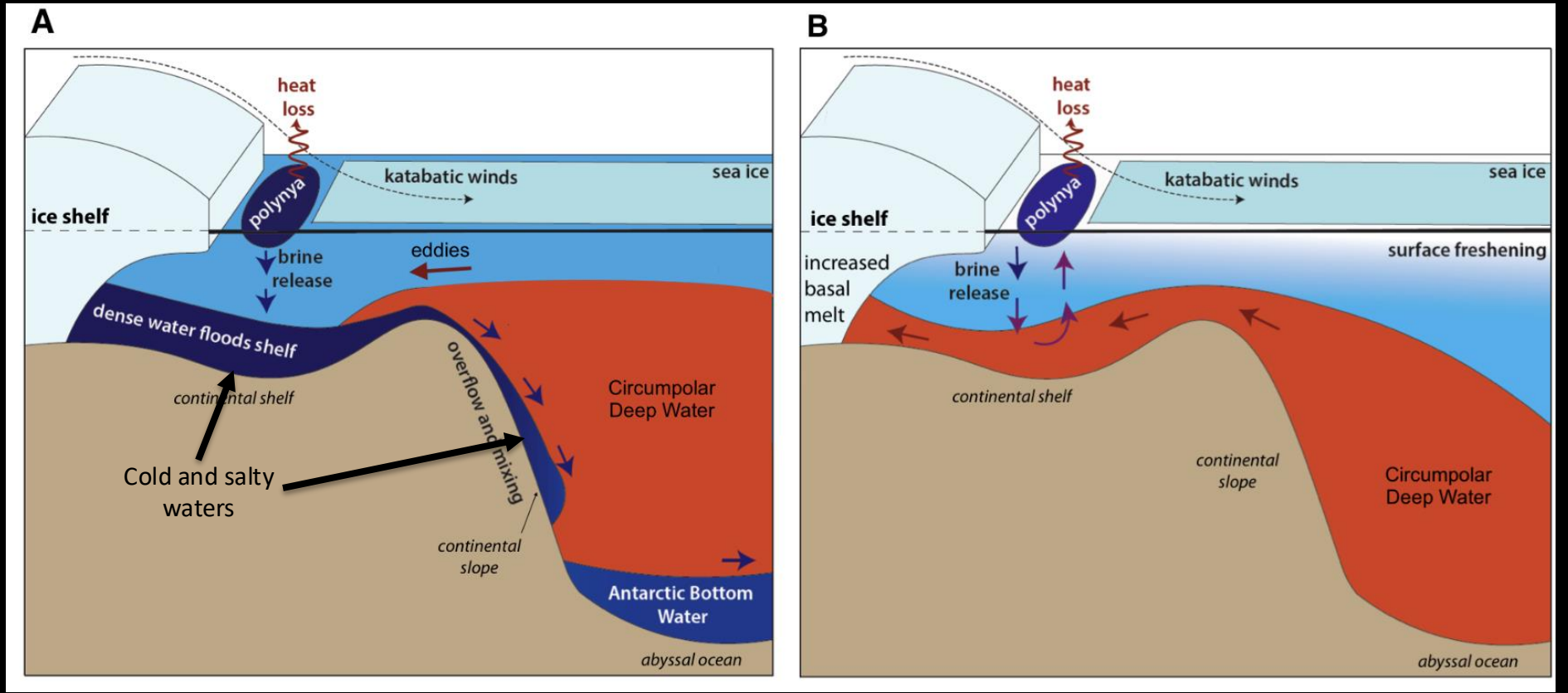


Ocean regimes in Antarctica

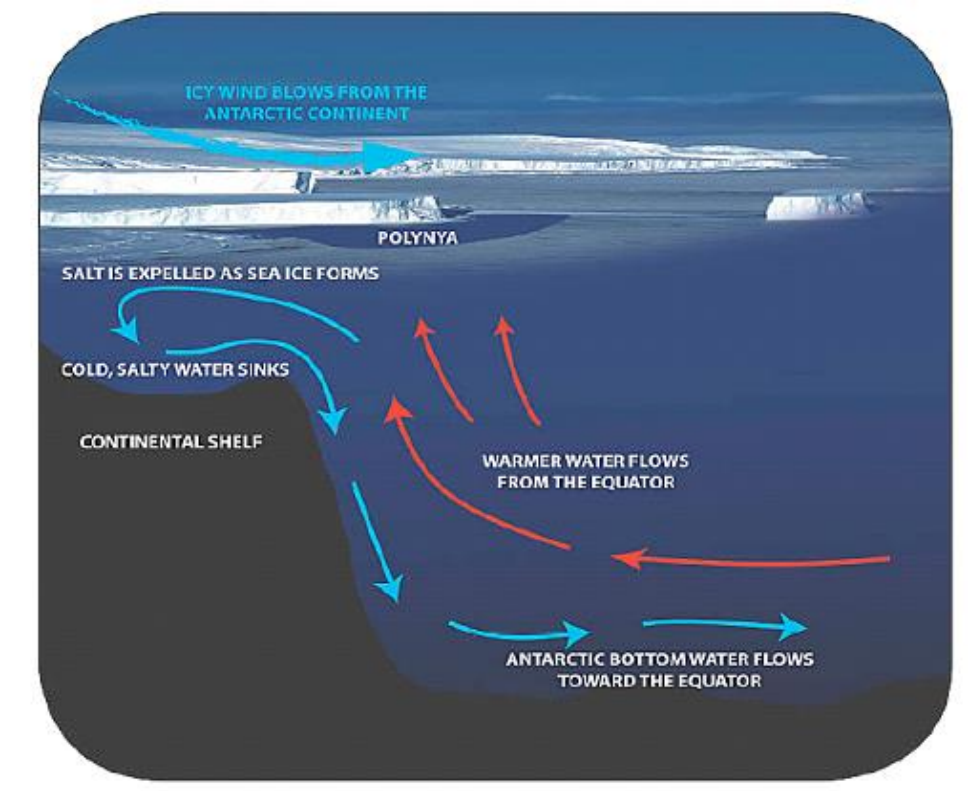
cold regions (e.g. Ross, Weddell Sea)

warm regions (e.g. Amundsen Sea)



Credit: R. Moorman

The Antarctic Overturning Circulation



UNSW website, Matt England

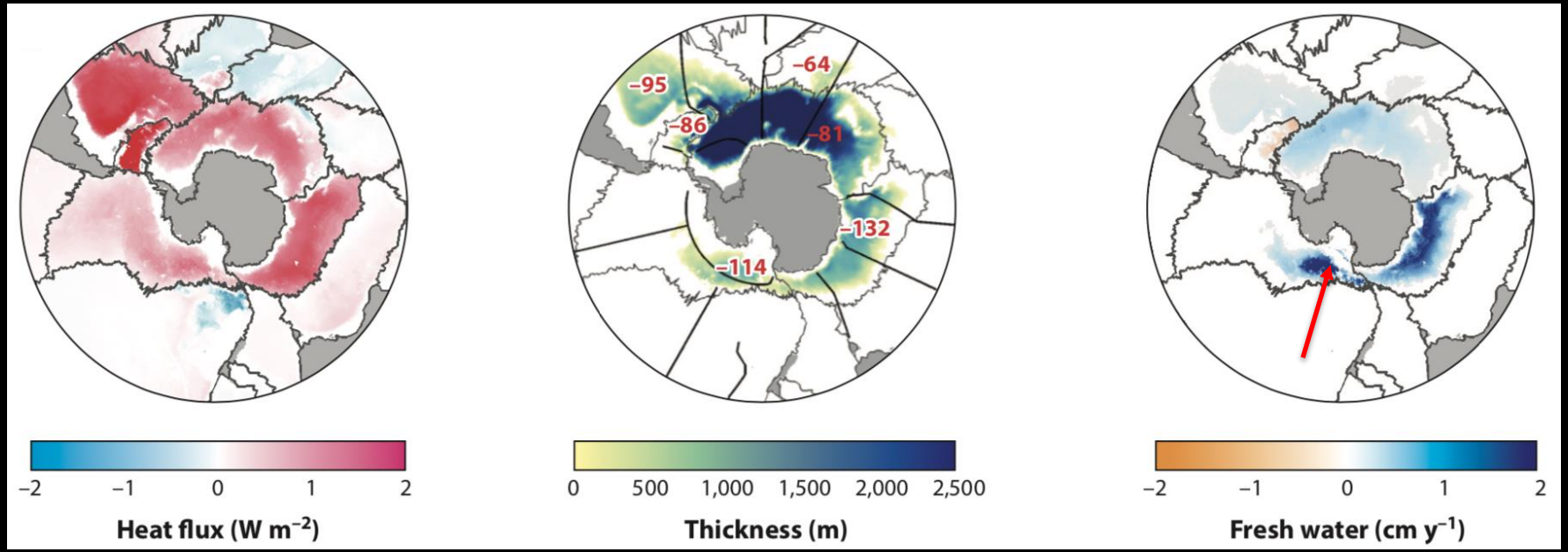
Antarctic Bottom Water (AABW) stores heat and carbon in the abyss for centuries

Multidecadal changes in bottom water

warming

contraction

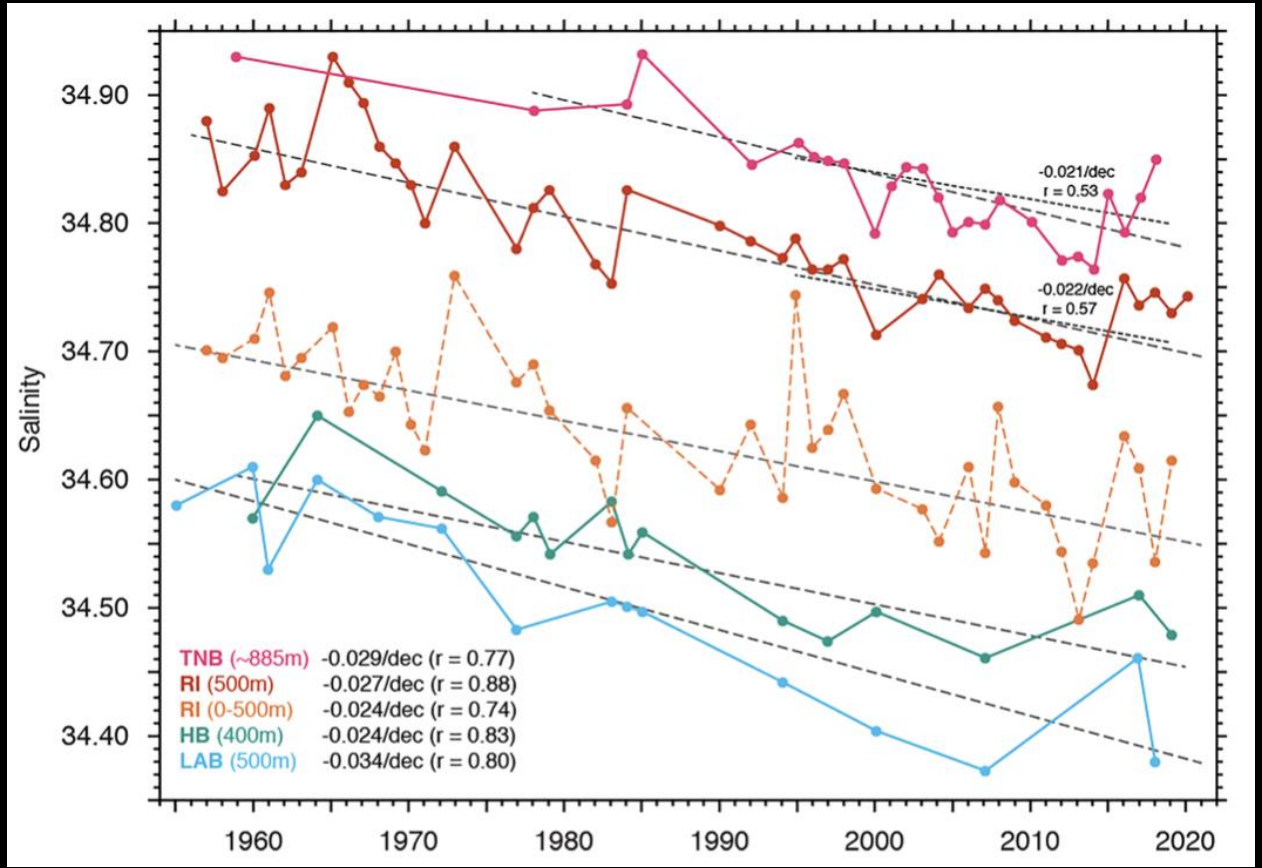
freshening



AABW trends between the 1980s and 2000s

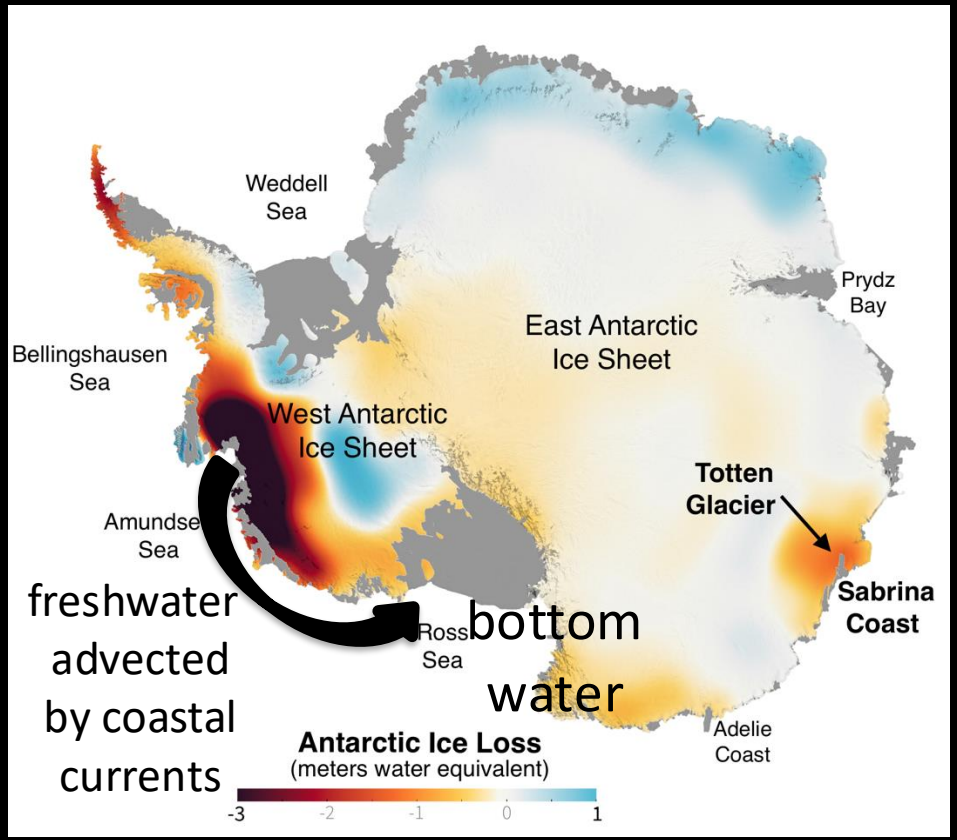
Purkey et al. 2017
Rintoul 2007
Menezes et al. 2017

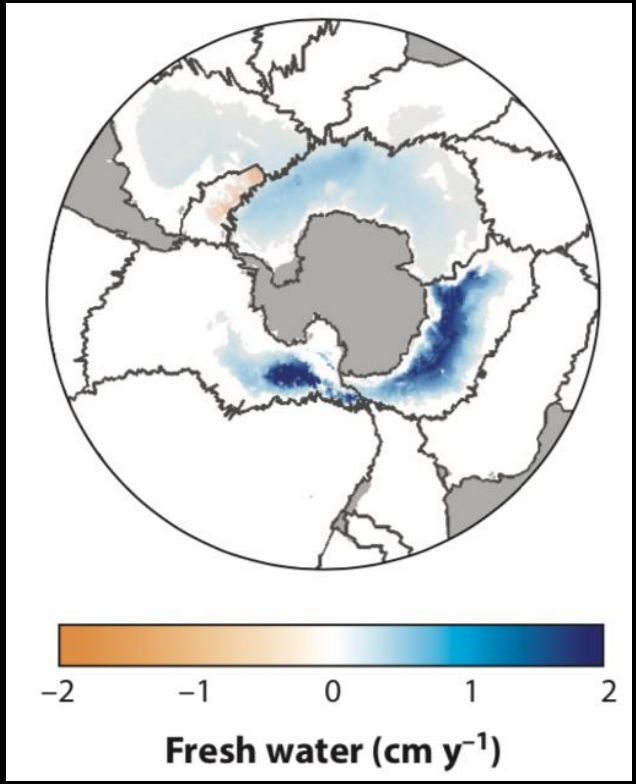
Multidecadal freshening in the Ross Sea



Jacobs et al. (2022)

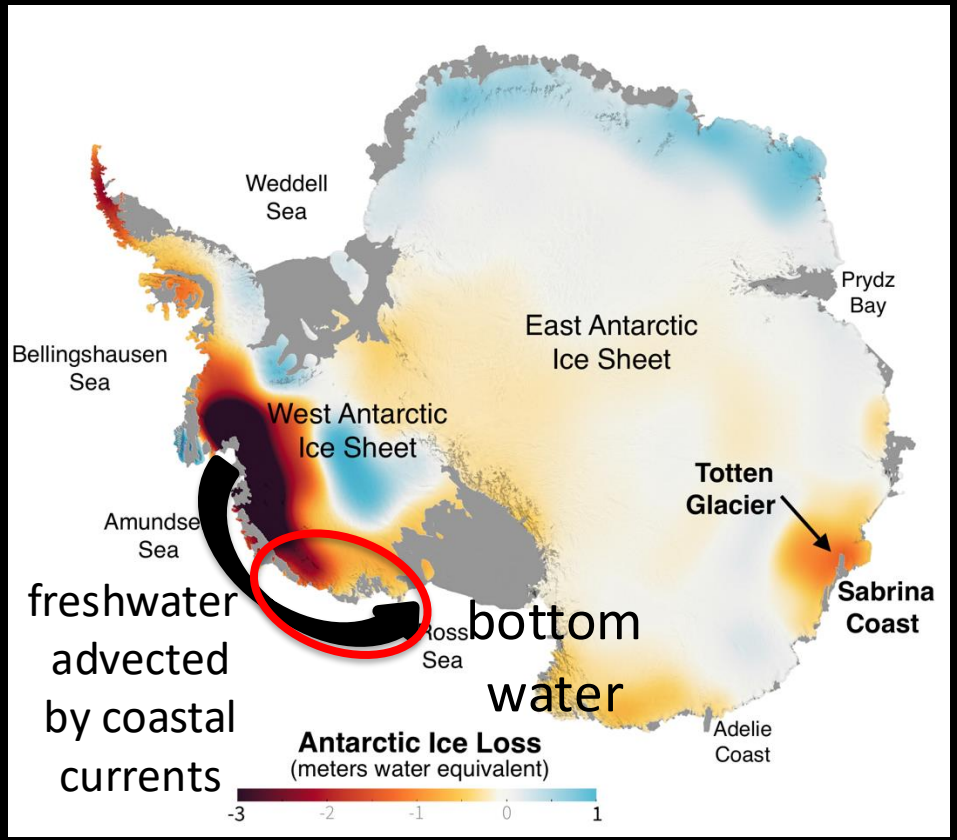
Driver of multidecadal freshening

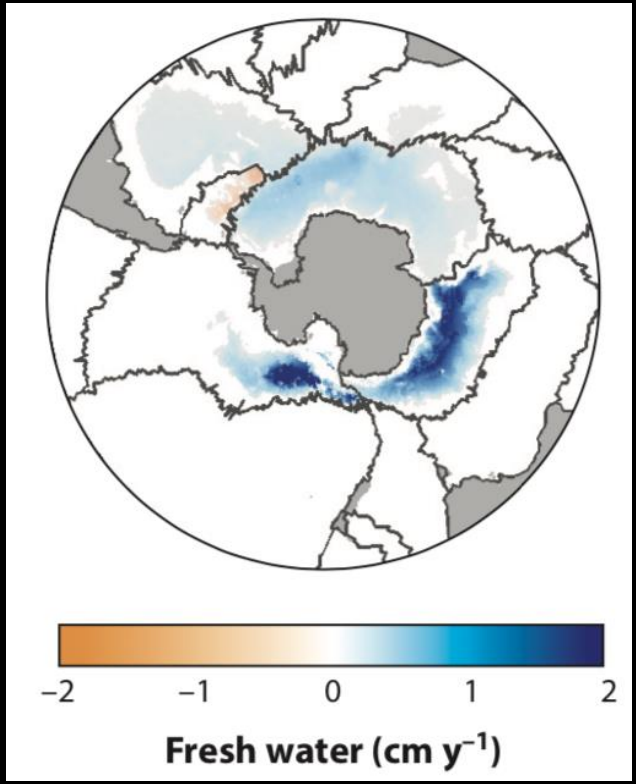




Increased melting of the West Antarctic Ice Sheet is argued to be the main driver

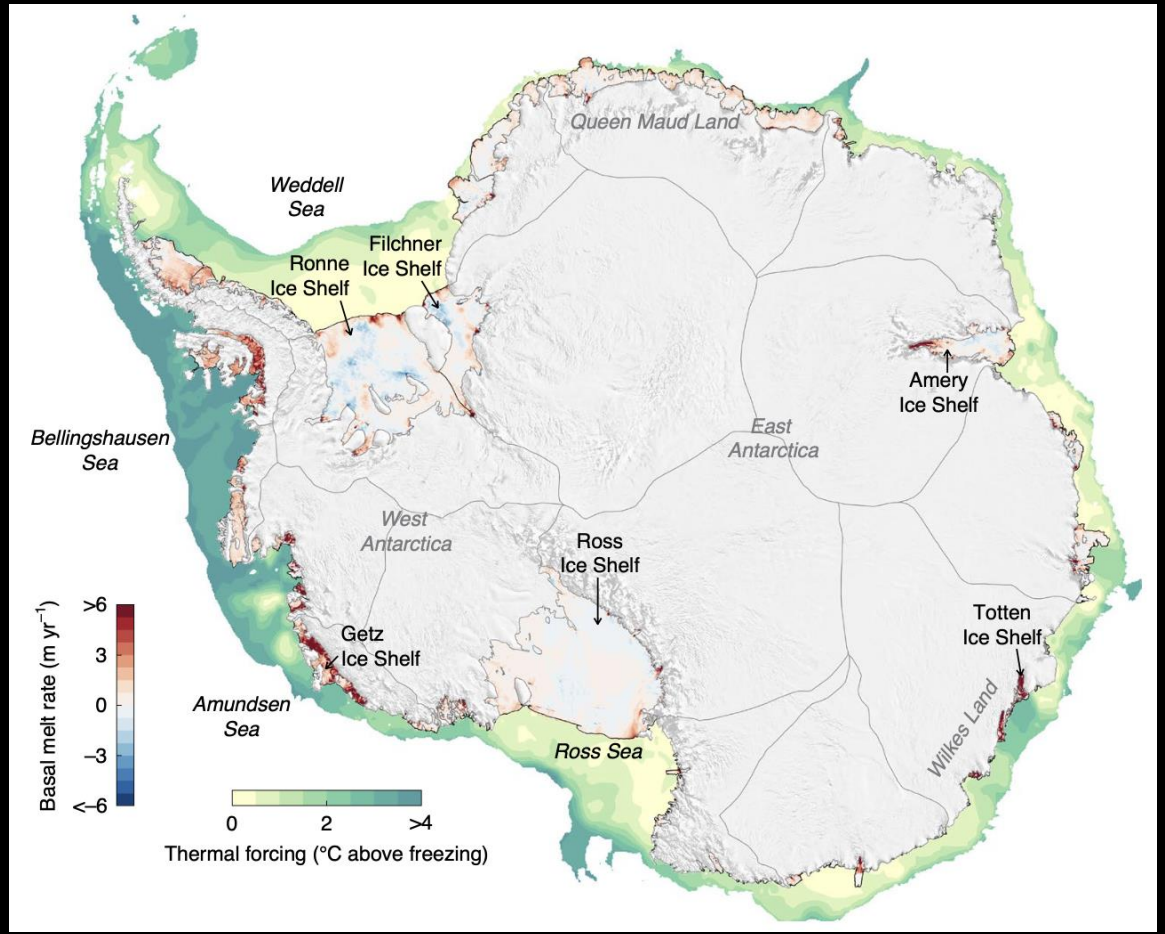
Priority!





→ Target: coastal area between the Amundsen and Ross Sea

Antarctic continental shelf as a key priority for ice-ocean interactions



- Paleo proxies
- Targeted campaigns
- Long term monitoring
- Improved satellite products
- High resolution modelling

Thank you!

Totten Glacier by *Esmee van Wijk*