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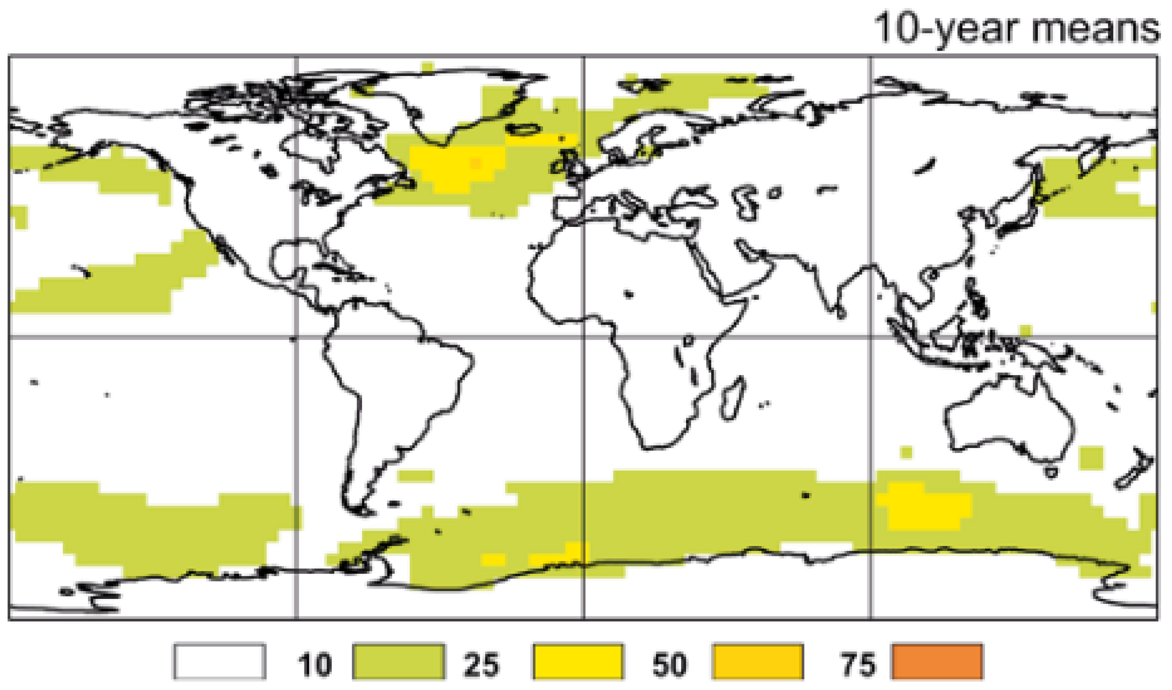
A regional Southern Ocean configuration for investigating polar decadal predictability

TECLIM
Belgium

C. Pelletier, H. Goosse, P. Mathiot, G. Van Achter
charles.pelletier@uclouvain.be

The Southern Ocean (SO) plays a key role in global ocean heat uptake and circulation. Previous studies have shown that polar regions could withhold predictability on 1 – 10y time scales, further investigations are required for fully understanding the processes accounting to it. We aim at assessing decadal predictability in the SO, eventually relying on a five-component coupled configuration.

Motivations

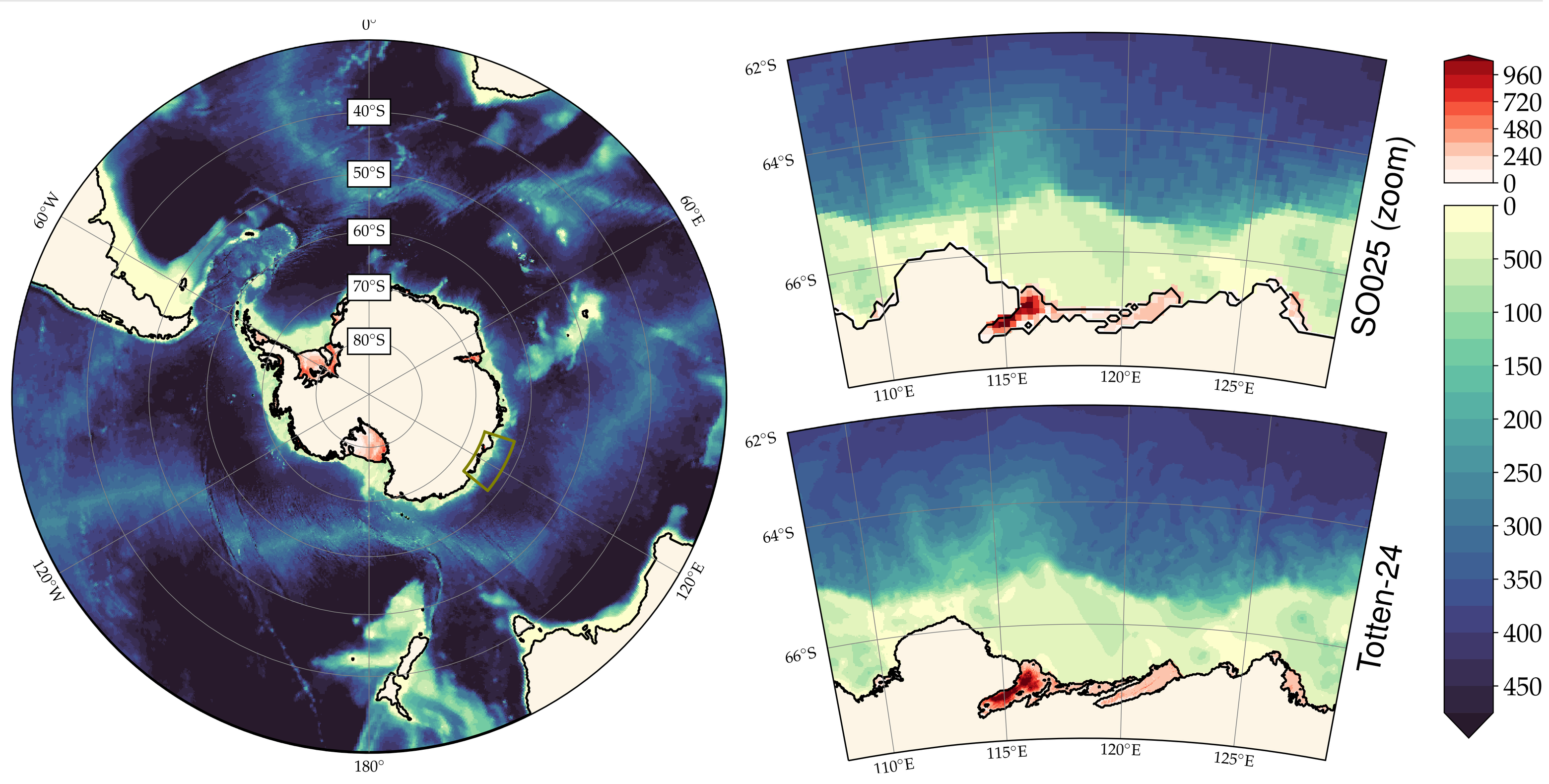


Geographical distribution of the potential predictability fraction for the SST on the 10-year time scale.

- Polar regions potentially holds significant **predictability** on seasonal to decadal timescales.
- Possibly due to **slower climate components** (e.g. ice sheets) and their interactions with the ocean and atmosphere.
- Need to develop cutting-edge **fully coupled** configuration.

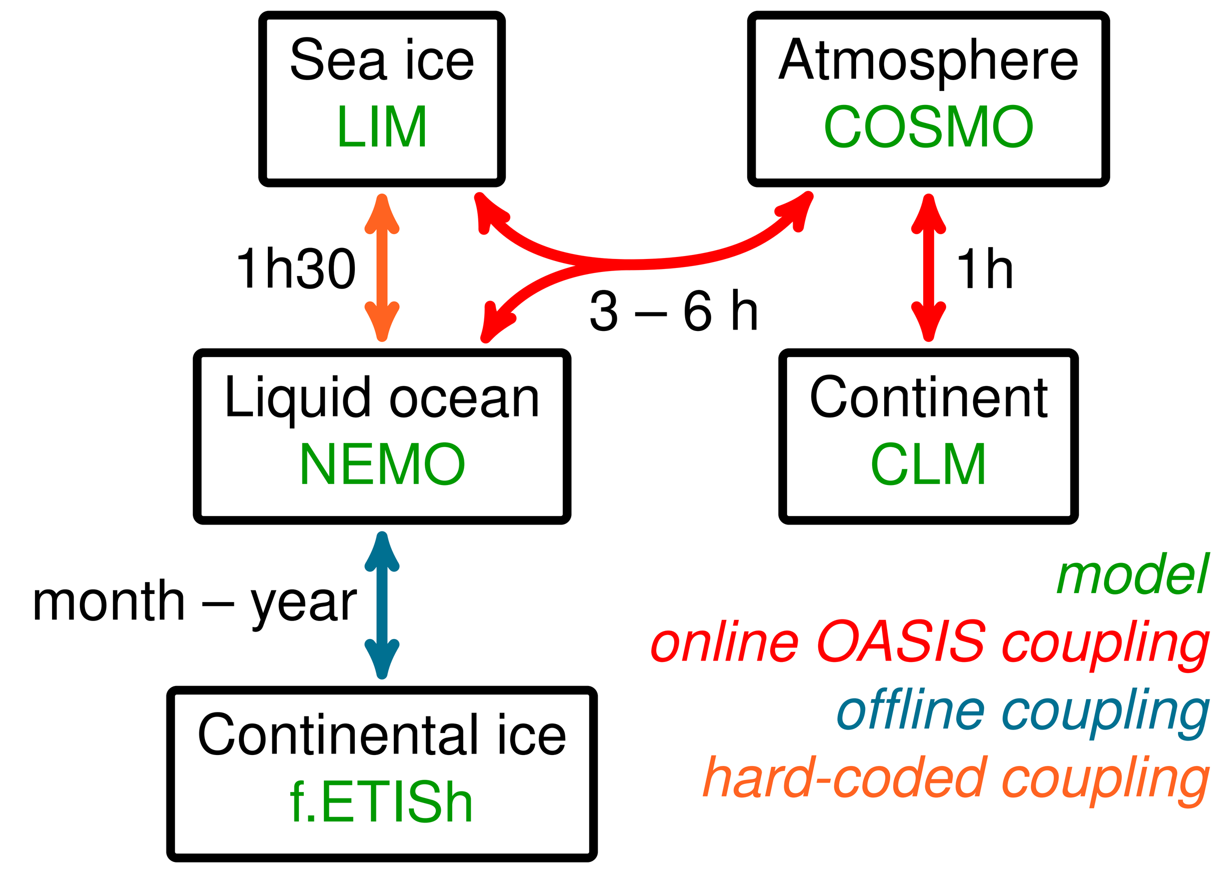
Ocean configuration specifications

- NEMO-LIM v3.6, eORCA025 grid (1/4°, 75 levels) cut at 30° S ;
- z^*-ISF coordinate;
- GO7 (UKMO) initialization;
- ORAS5 ocean reanalysis on lateral boundary (not *very* constraining);
- ERA-I. atmosphere reanalysis;
- BedMachine2 & ETOPO1 bathymetry;
- + Nested configuration: **Totten glacier** at 1/24°.



Planned coupling implementation

Five subcomponents, four coupling mechanisms.



COSMO ↔ NEMO-LIM3.6

- **COSMO** computes air-sea turbulent fluxes (TKE surface-layer scheme).
- COSMO computing **real-time fluxes**; NEMO receiving 3 – 6h **delayed** ones.
- Flux **tile distribution** over land, ocean and sea ice categories.

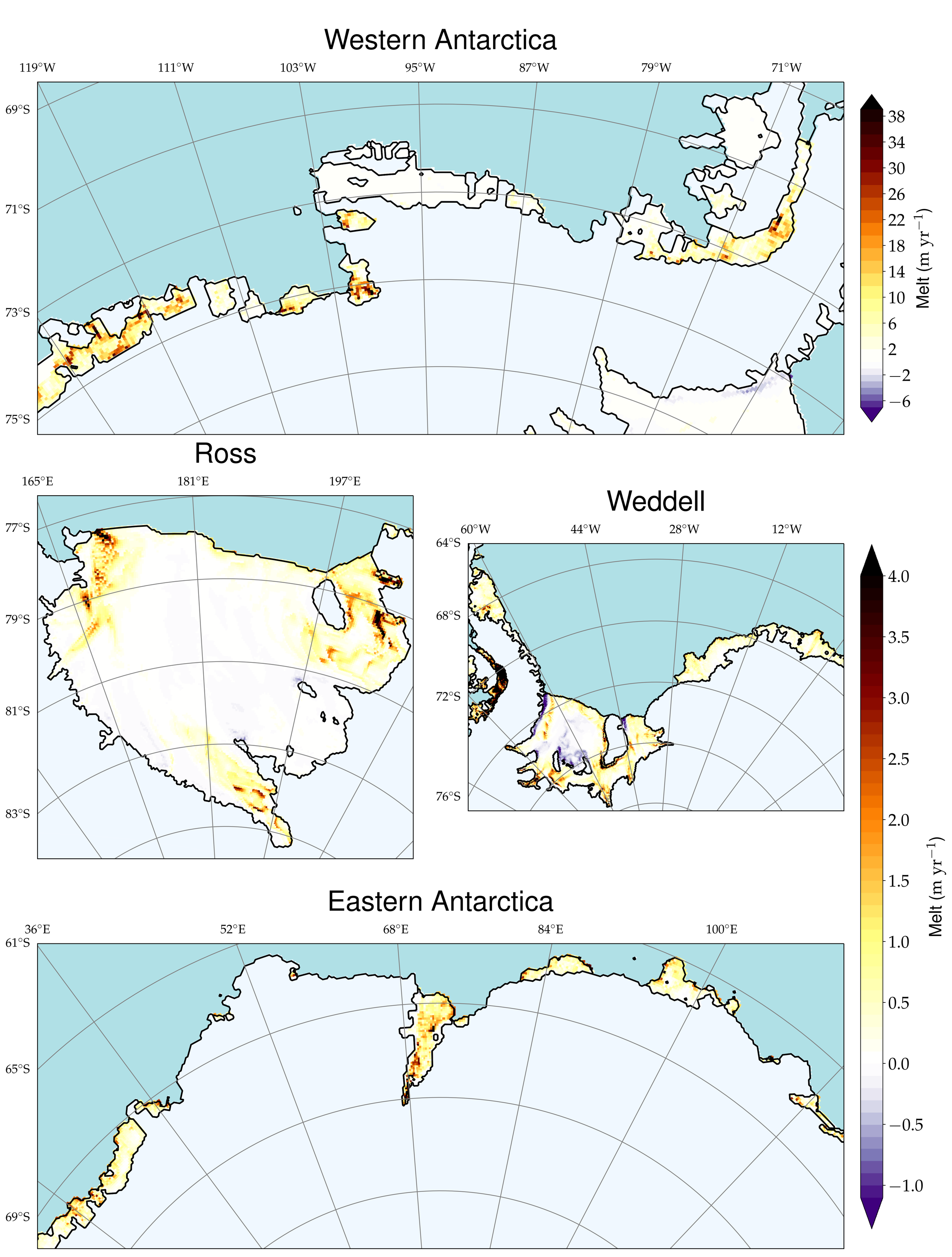
NEMO-LIM3.6 ↔ f.ETISH

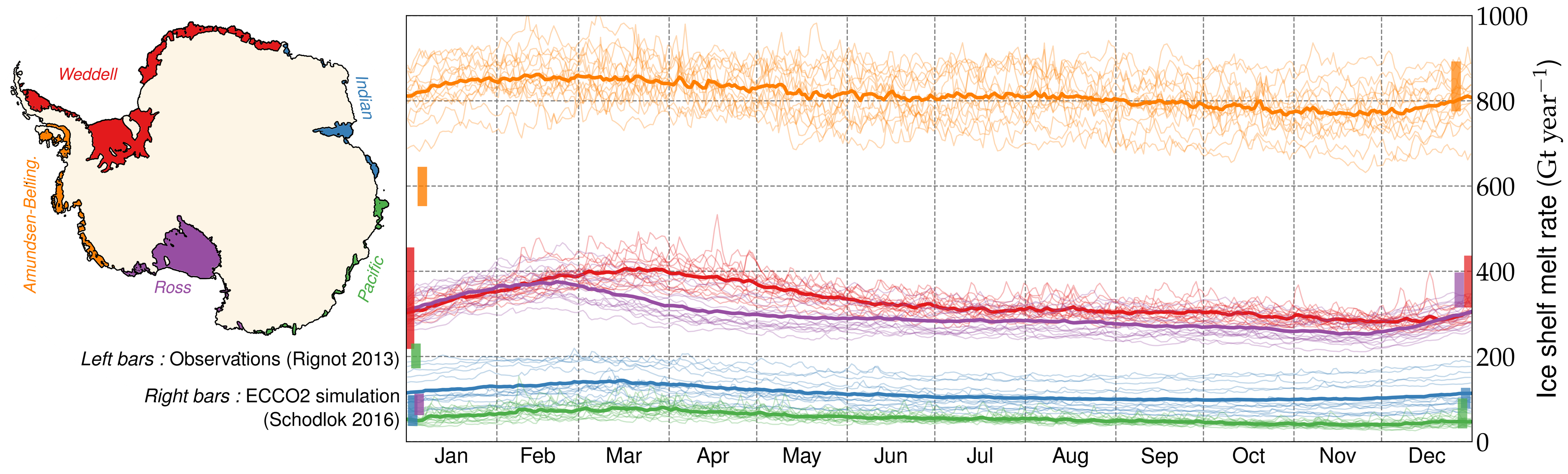
- NEMO sends the **melt rate** to f.ETISh.
- f.ETISh provides NEMO an updated **cavity geometry**.

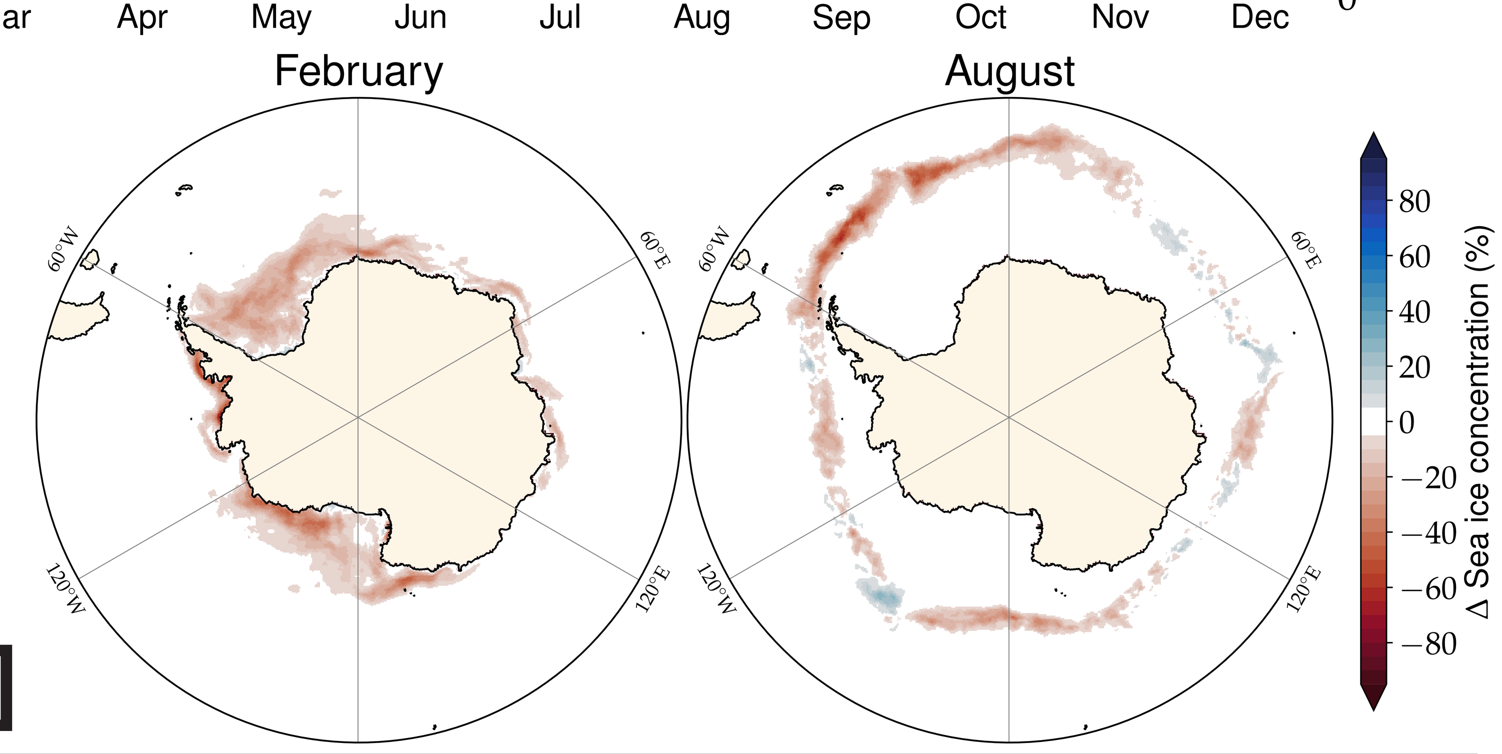
Ice shelf melt computation

- "Large enough" ice shelf cavities **opened** to ocean circulation (Mathiot 2016);
- 3-equation **conservative** method (Jenkins);
- **Velocity-dependent** γ_t coefficient;
- **TEOS-10** adaptation of freezing point linearization (Jourdain).

Results from an ocean-only, ice shelf cavity-including simulation







Left, top: ice shelf melt rates (left, top). Right: impact of ice shelf inclusion on sea ice concentration. Simulated 2004 - 2018 climatology.

- Acceptable melt rate magnitude;
- Ice shelves significantly decrease summer sea ice cover;
- Region-dependent seasonality on melt rate.

Early results under investigation.

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