

A circumpolar coupled ocean – Antarctic ice sheet configuration for investigating recent changes in Southern Ocean heat content

C. Pelletier ¹ L. Zipf ² K. Haubner ² H. Goosse ¹ F. Pattyn ² P. Mathiot ³

EGU2020: Sharing Geosciences Online, May 2020

¹ELI/TECLIM, UCLouvain, Louvain-la-Neuve, Belgium

²Laboratoire de glaciologie, Université Libre de Bruxelles, Belgium

³MetOffice, Exeter, UK

PARAMOUR



fnrs | fwo

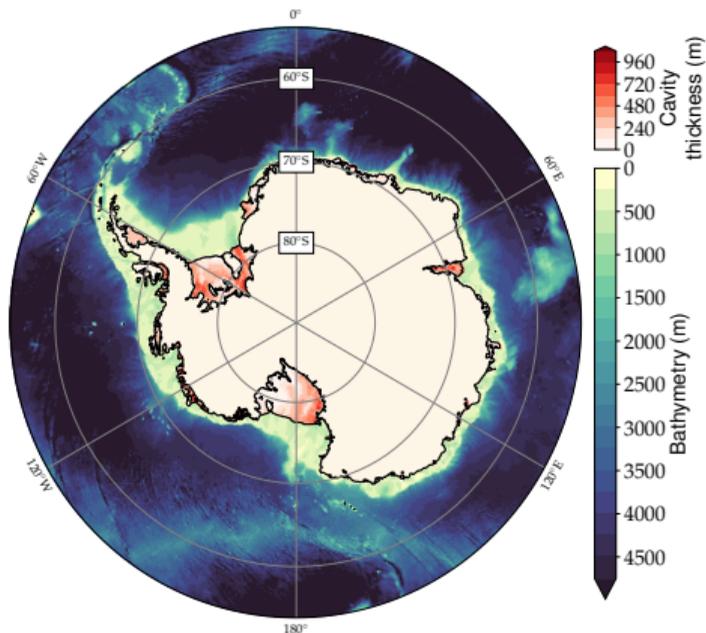


EOS
THE EXCELLENCE
OF SCIENCE

UCLouvain



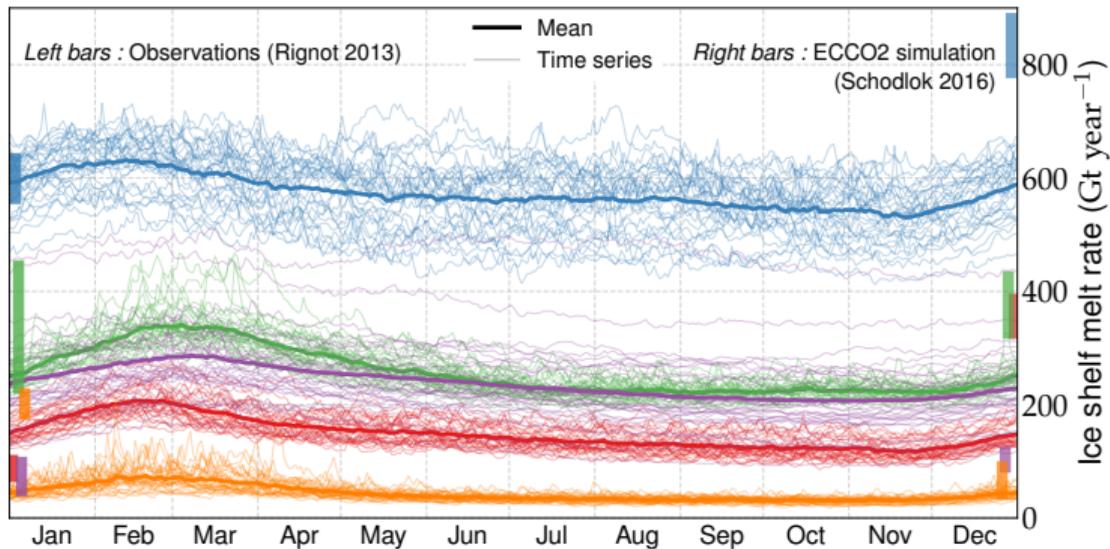
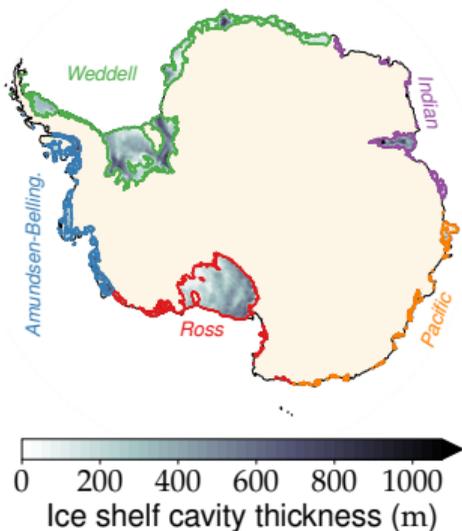
Motivations



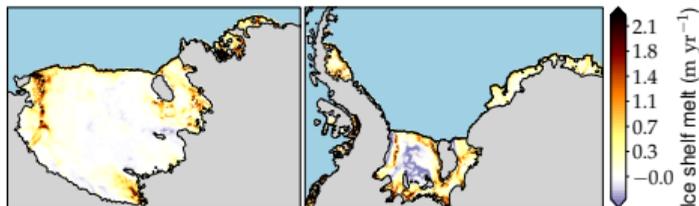
- ▶ Antarctic sea ice (SI) extent has **increased** from (at least) 1979 to 2016.
- ▶ CMIP models miss this trend.
- ▶ Unrepresented ice shelf melt may have played a determining role.
- ▶ Perform ocean simulations using NEMO-LIM3.6 ($1/4^\circ$) with ice shelf melt parameterized

Aim: evaluate the impact of this **freshwater injection** on the Southern Ocean by comparing runs **with and without cavities**.

Ice shelf melt evaluation

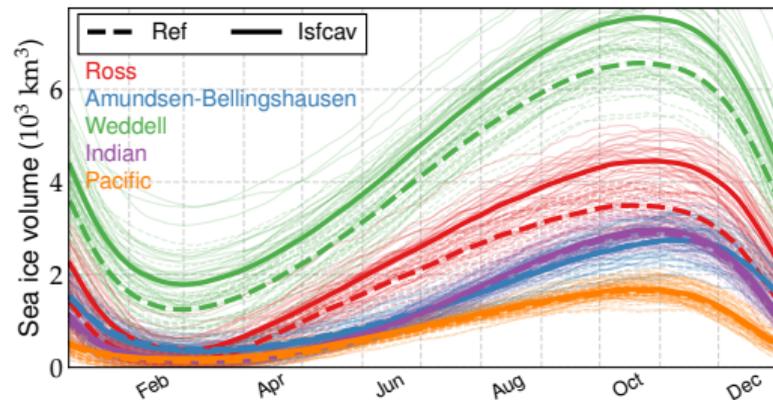
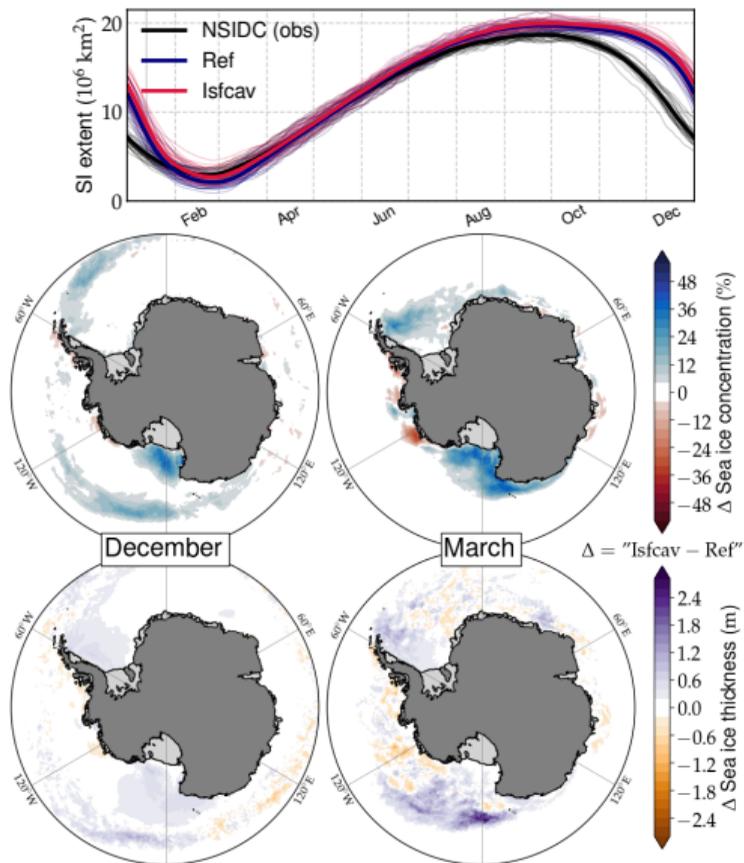


Top: simulated ice shelf melt rate compared with observations; bottom left: time-averaged spatial pattern.



- ▶ Good agreement with observed melt rates.
- ▶ Strong seasonality and interannual variability.

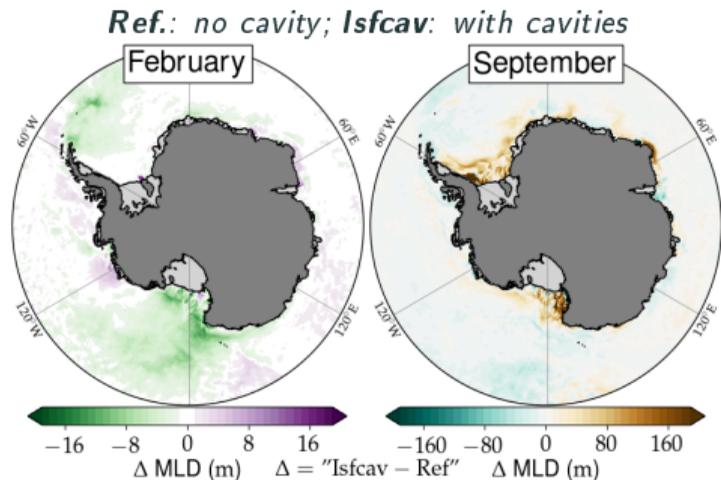
Impact on sea ice



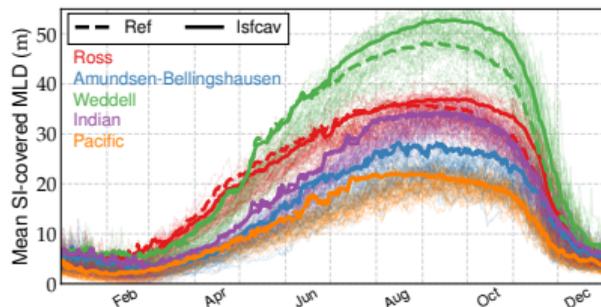
- ▶ Isfcav: more sea ice production, especially in front of large ice shelves
- ▶ Anomalies in ice volume are more patent

Top left: simulated and observed sea ice extent seasonal cycle; bottom left: simulated sea ice concentration & thickness anomalies; right: simulated sea ice volume seasonal cycle.

Potential causes of melt-induced sea ice increase

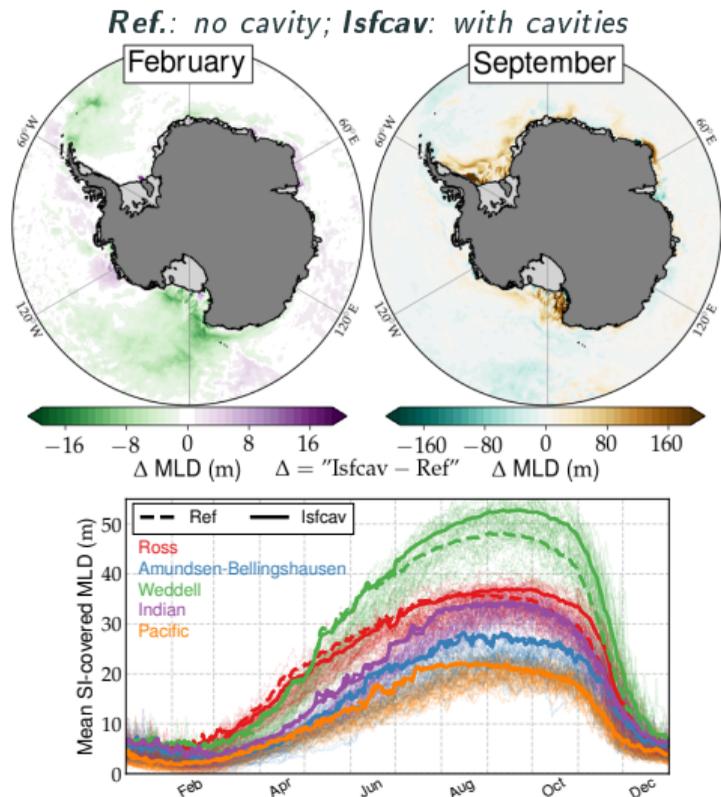


- ▶ Stronger winter mixing in Weddell and Ross
- ▶ Ice shelf melt yielding fresh and cold bias

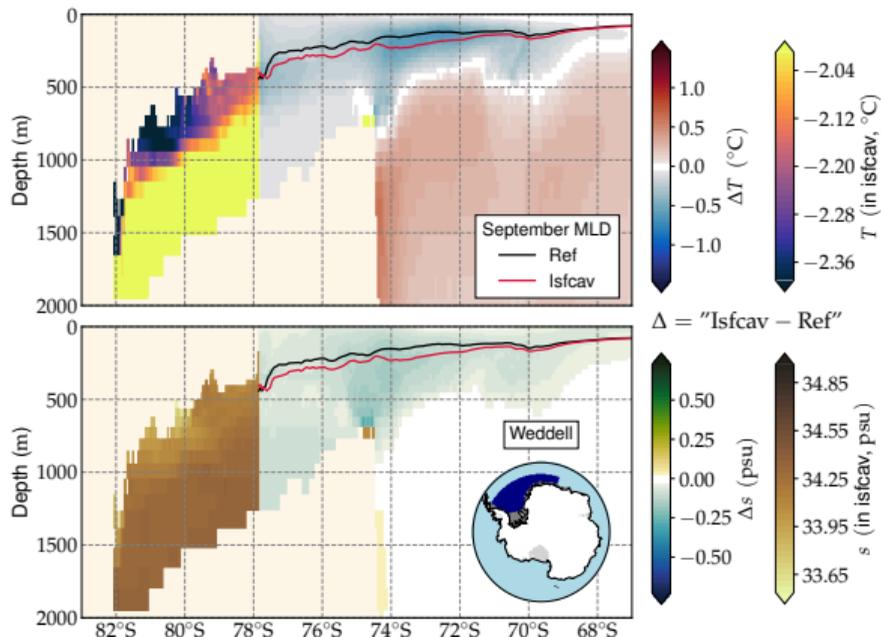


Top left: spatial pattern of simulated seasonal anomaly in MLD; bottom left: seasonal cycle of sea ice covered MLD in both simulations.

Potential causes of melt-induced sea ice increase

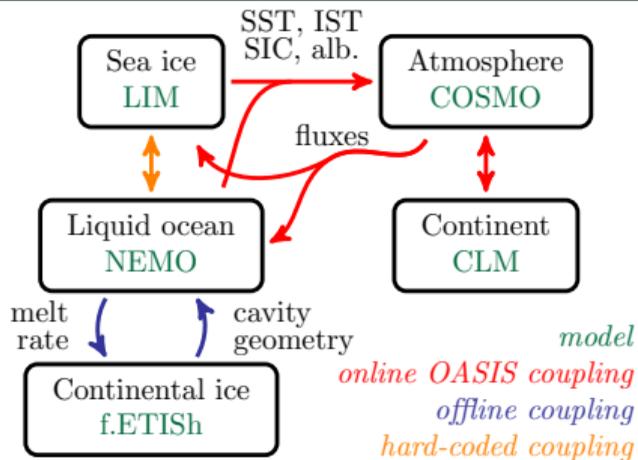


- ▶ Stronger winter mixing in Weddell and Ross
- ▶ Ice shelf melt yielding fresh and cold bias

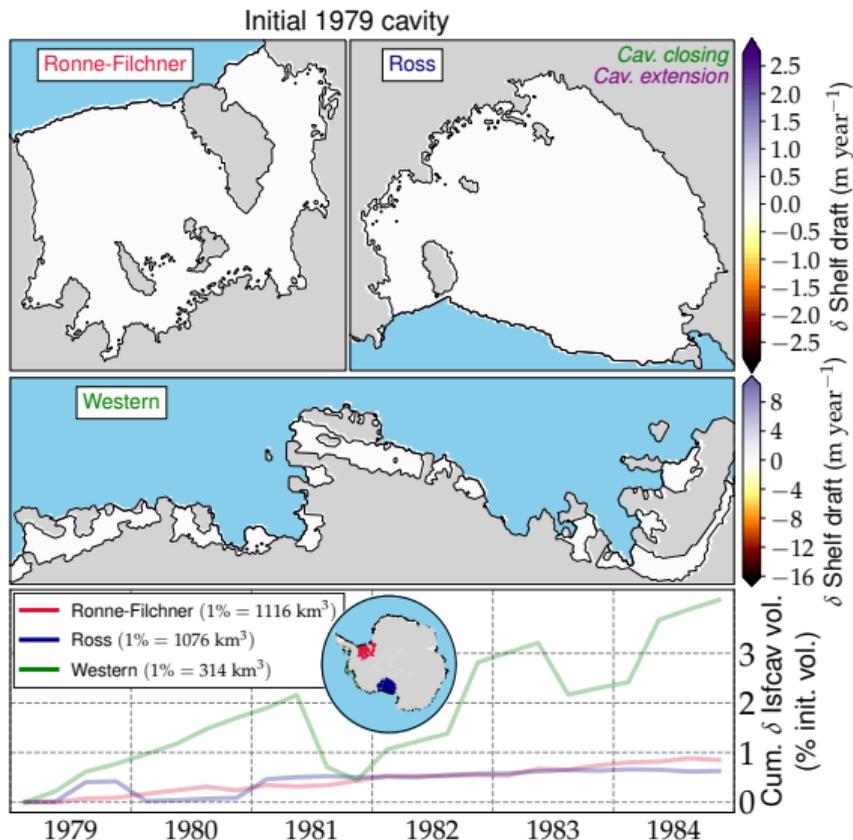


Top left: spatial pattern of simulated seasonal anomaly in MLD; bottom left: seasonal cycle of sea ice covered MLD in both simulations; right: longitude-averaged (over Weddell) temperature and salinity anomalies.

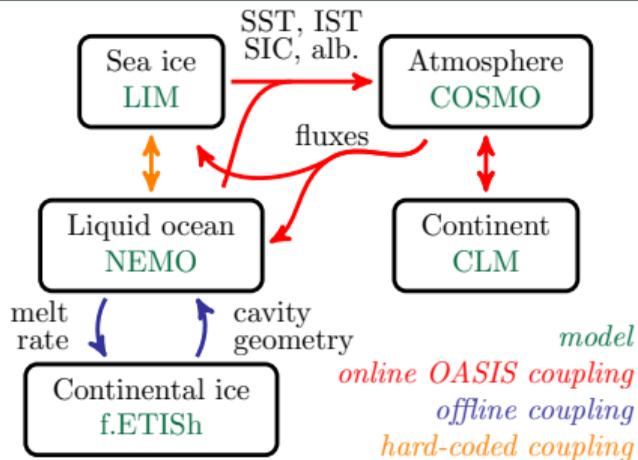
Ongoing work: coupling



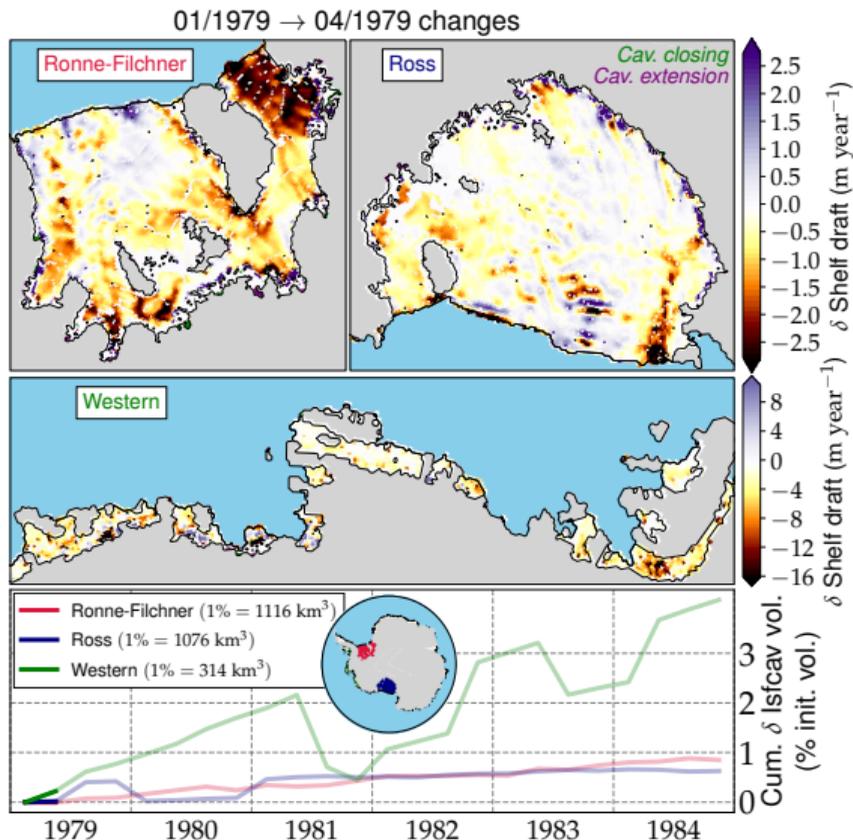
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



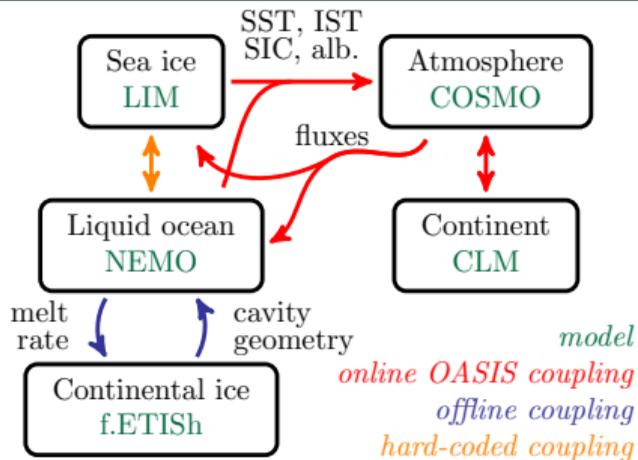
Ongoing work: coupling



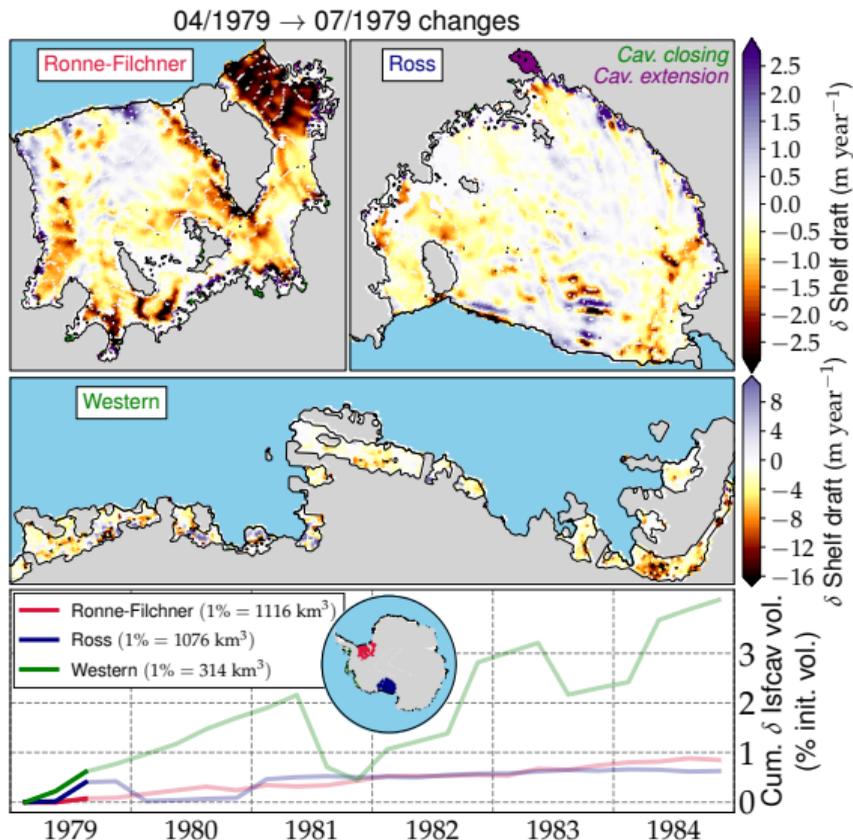
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



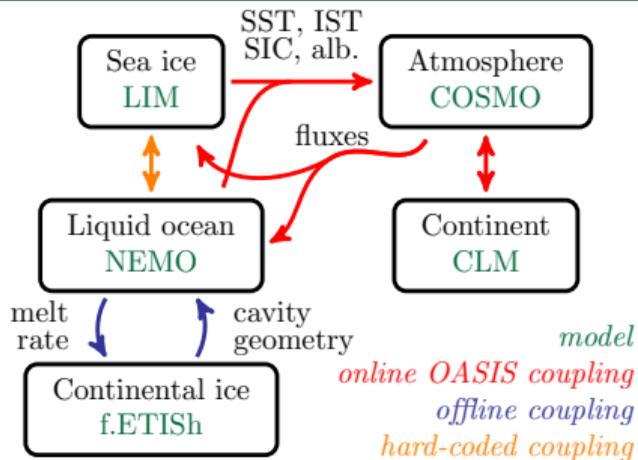
Ongoing work: coupling



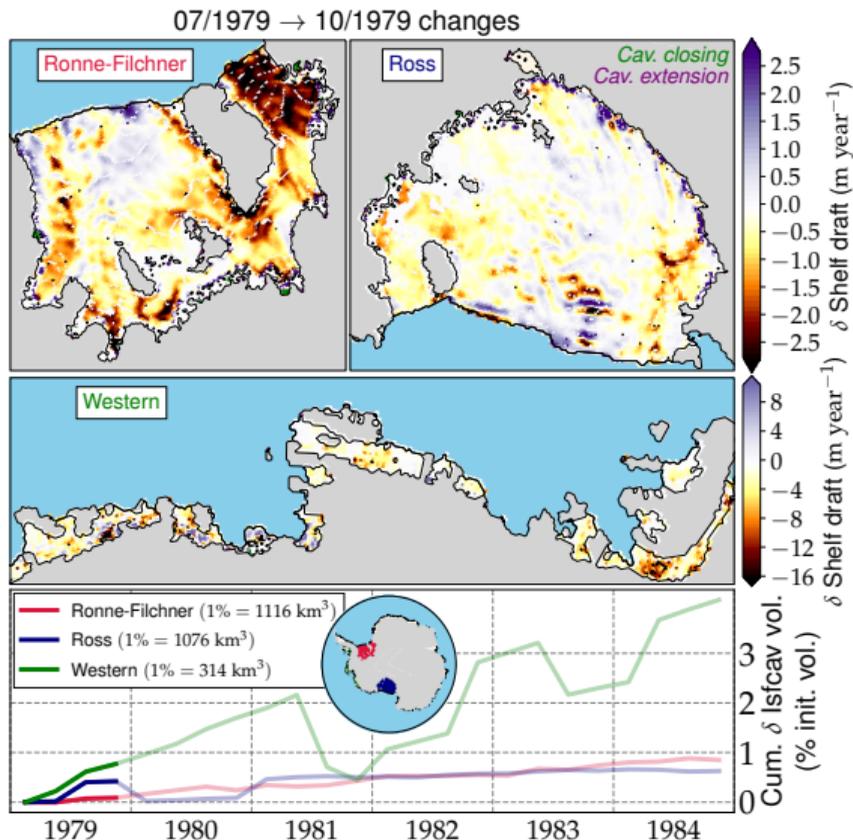
- Five-component coupling
- Investigate **decadal predictability** in Antarctica
- Assess the impact of **slower** climate components, and **coupling feedbacks**



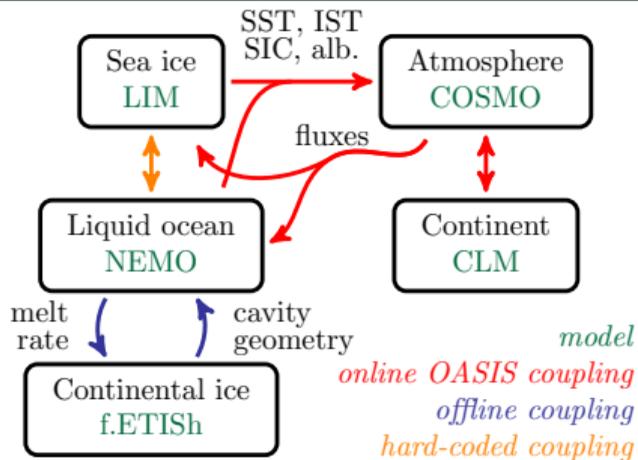
Ongoing work: coupling



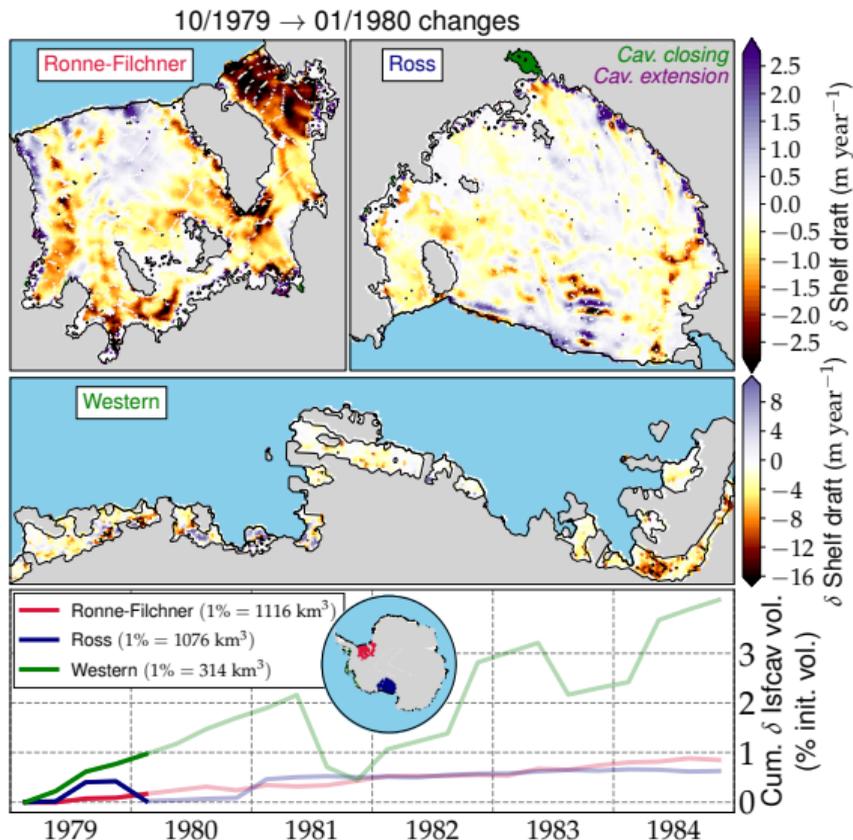
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



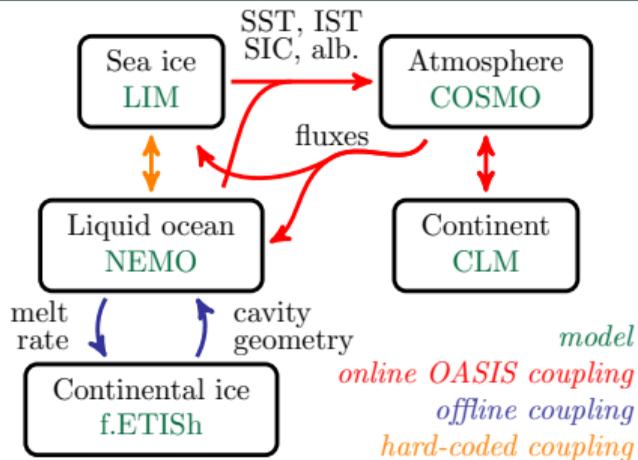
Ongoing work: coupling



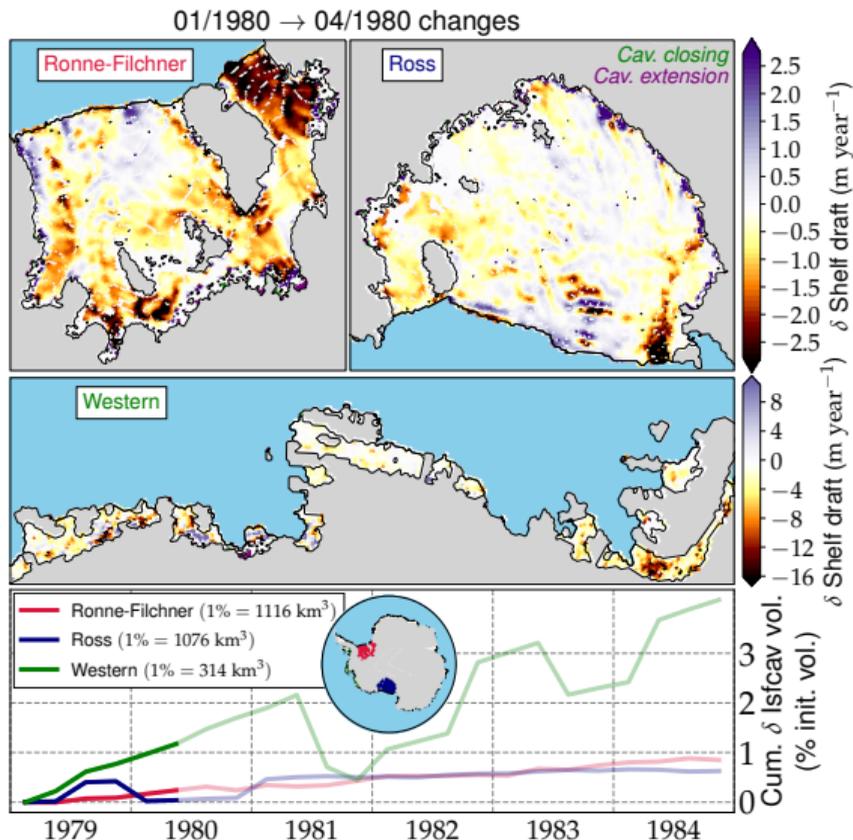
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



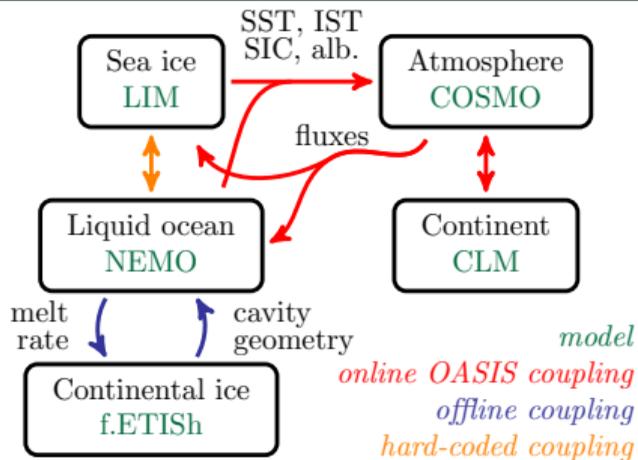
Ongoing work: coupling



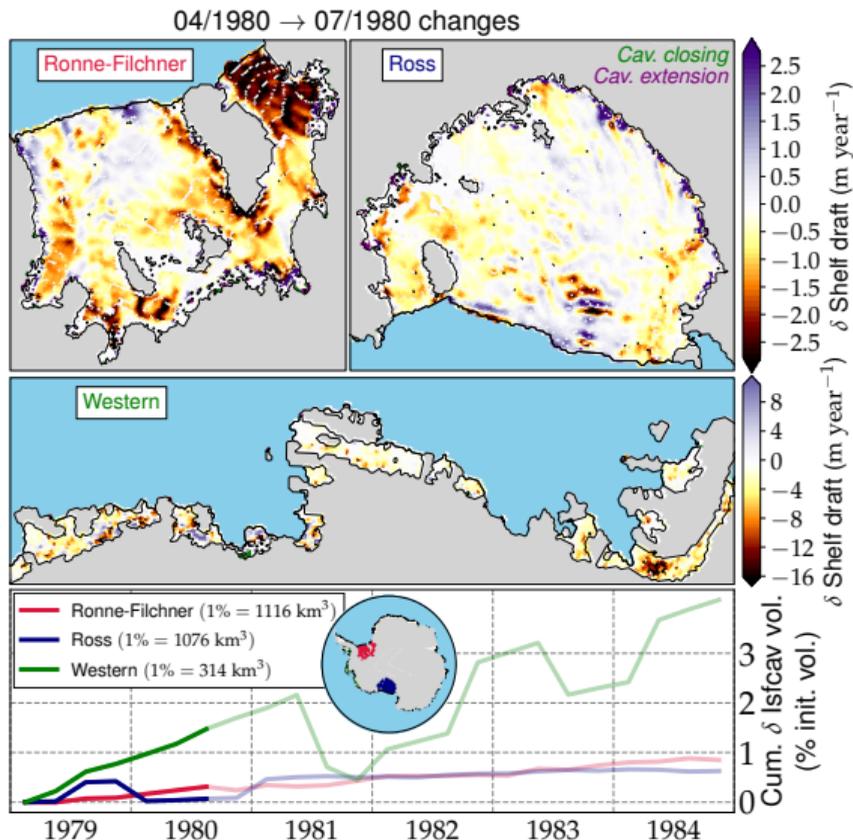
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



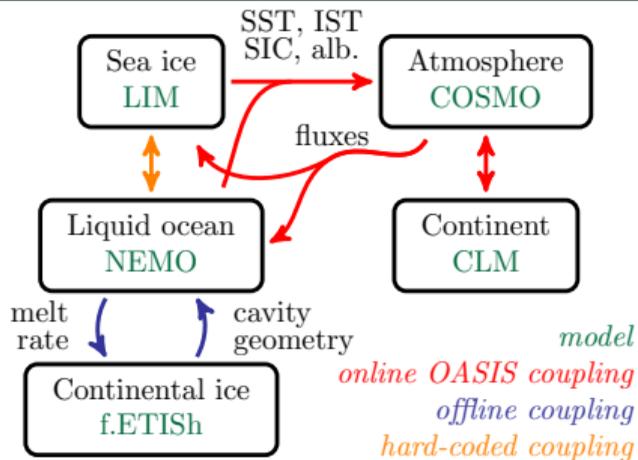
Ongoing work: coupling



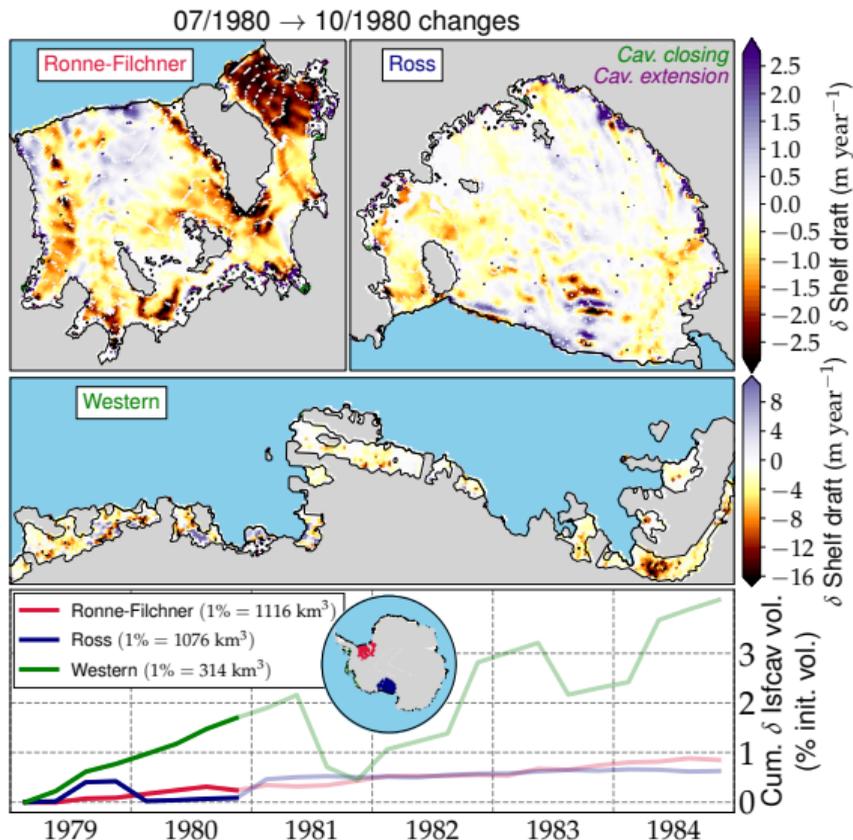
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



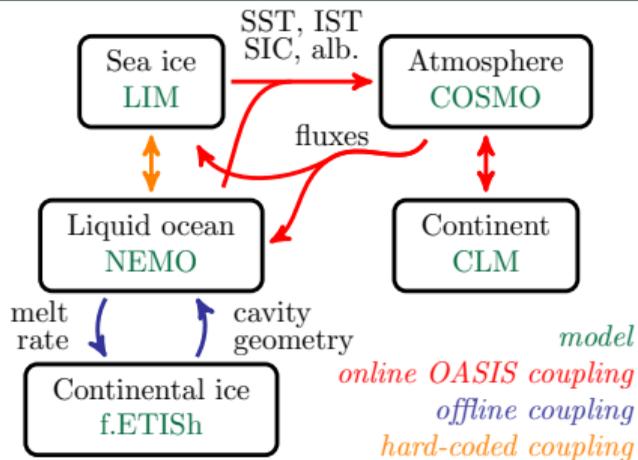
Ongoing work: coupling



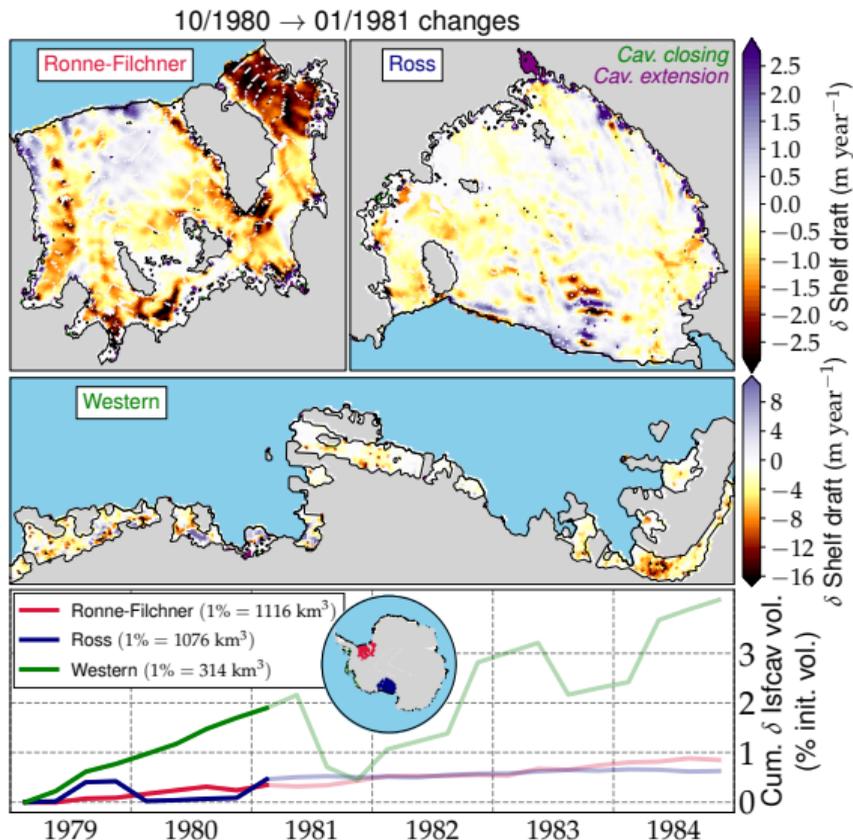
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



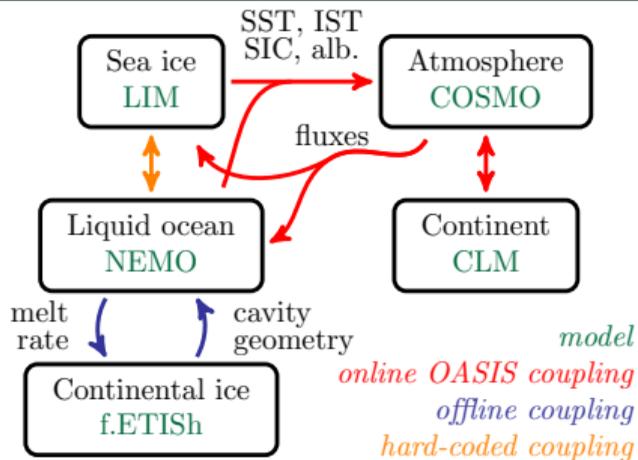
Ongoing work: coupling



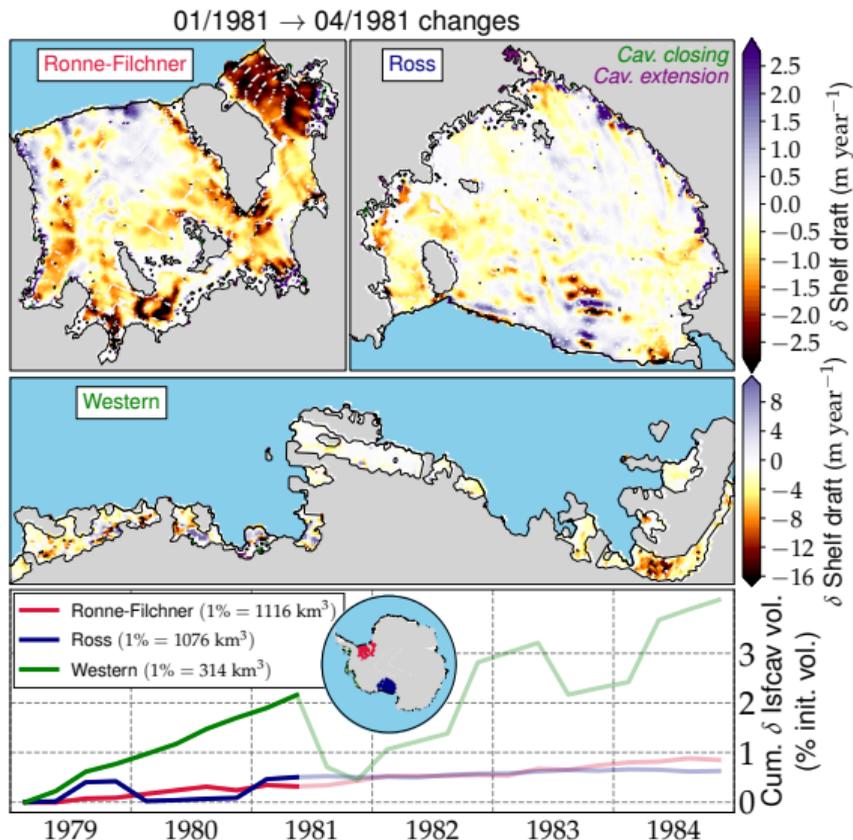
- Five-component coupling
- Investigate **decadal predictability** in Antarctica
- Assess the impact of **slower** climate components, and **coupling feedbacks**



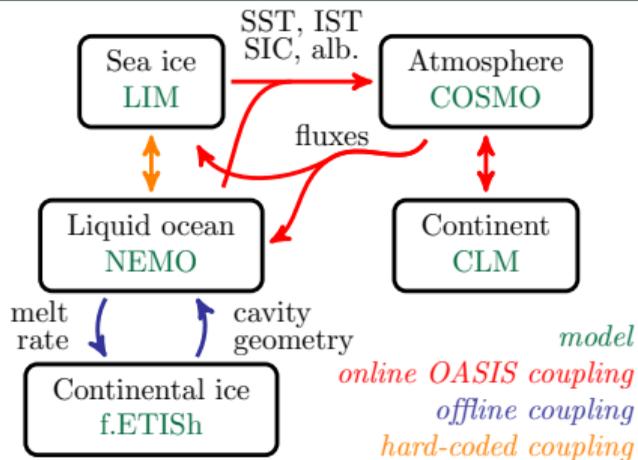
Ongoing work: coupling



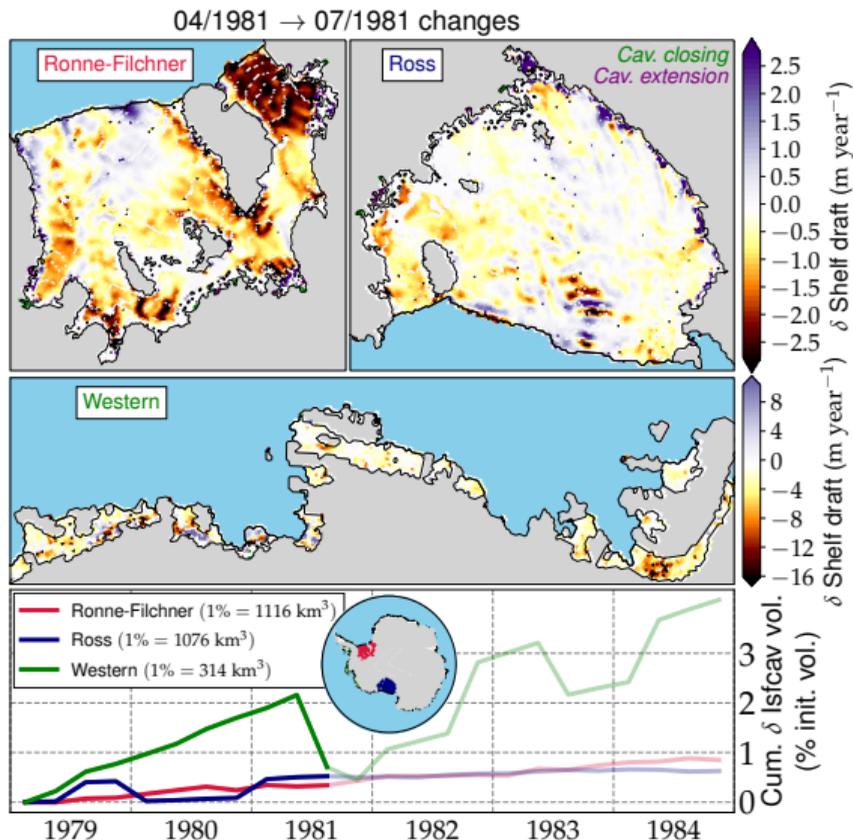
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



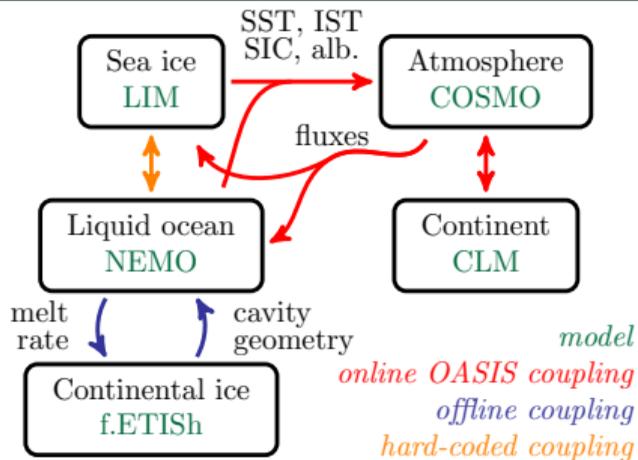
Ongoing work: coupling



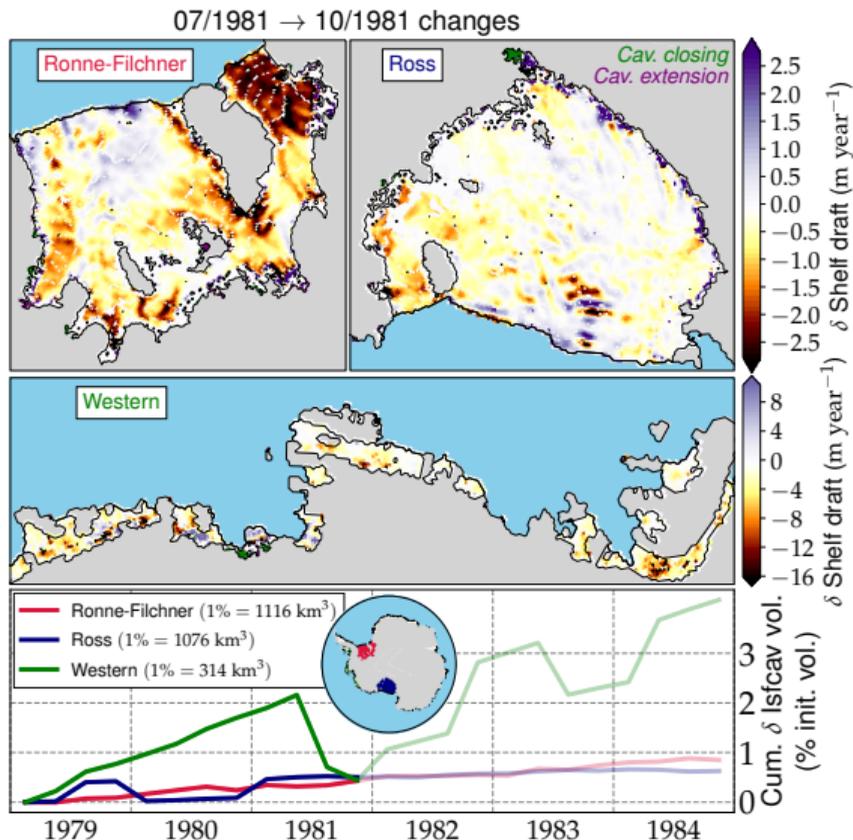
- Five-component coupling
- Investigate **decadal predictability** in Antarctica
- Assess the impact of **slower** climate components, and **coupling feedbacks**



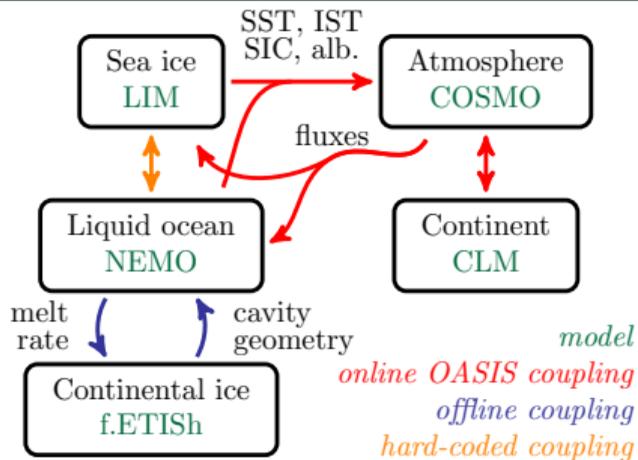
Ongoing work: coupling



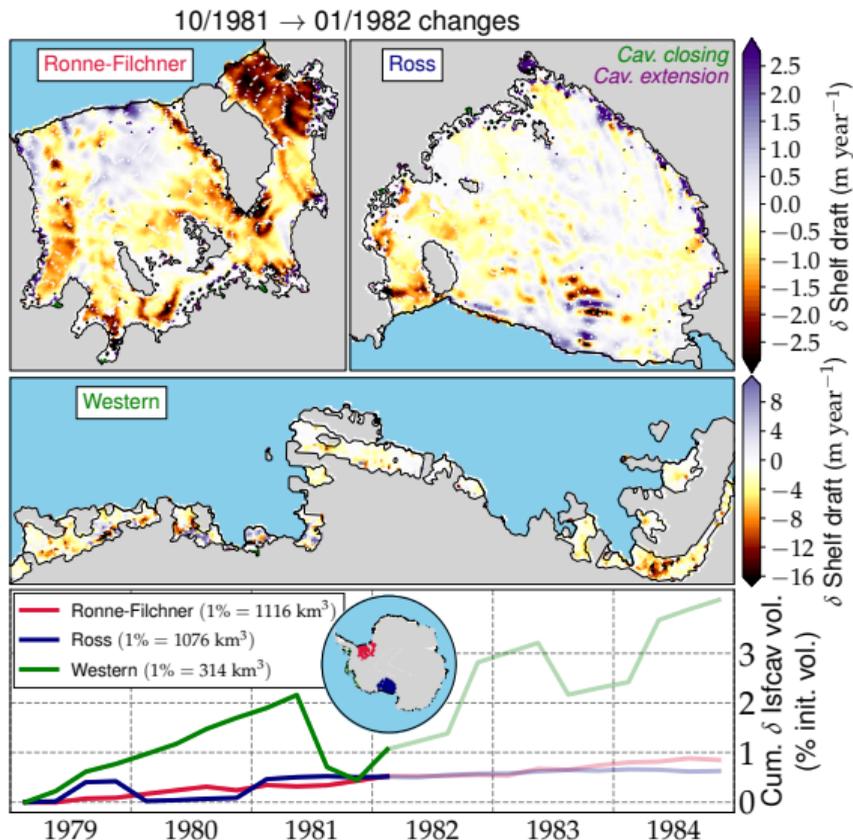
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



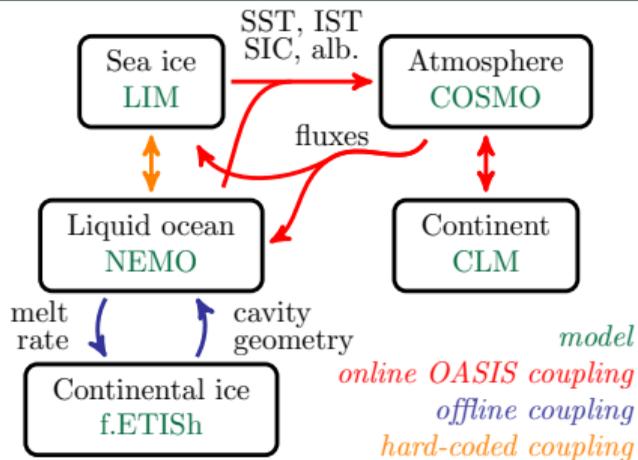
Ongoing work: coupling



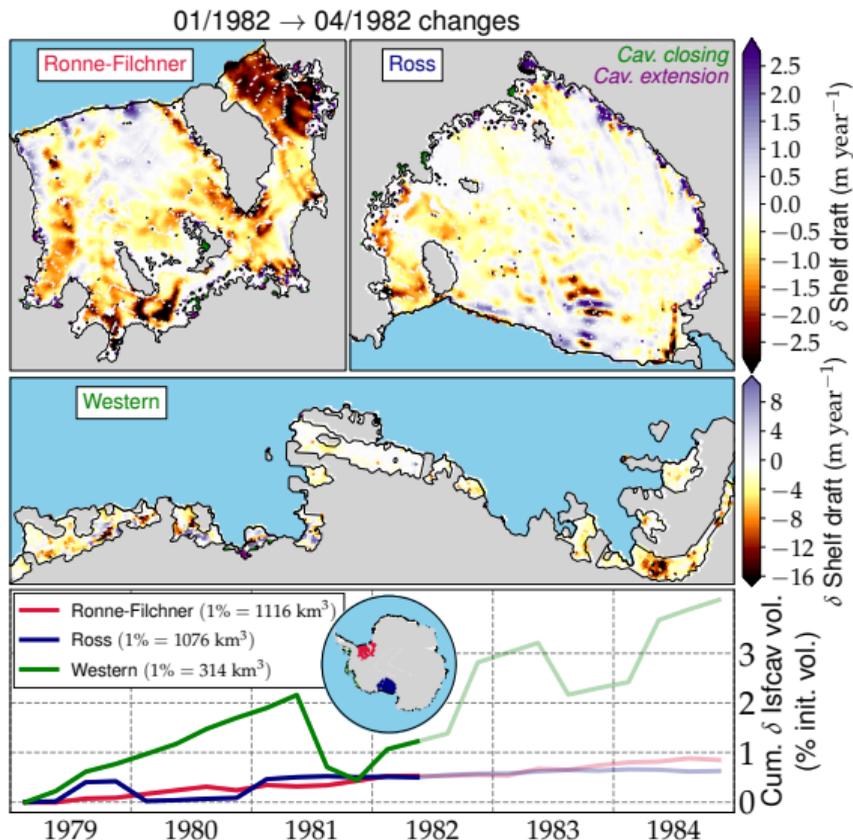
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



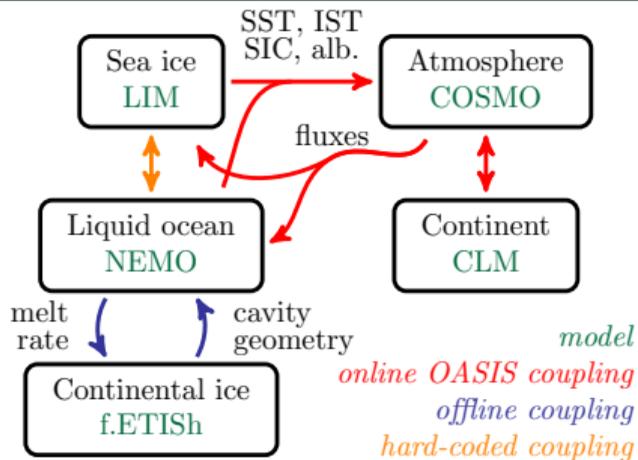
Ongoing work: coupling



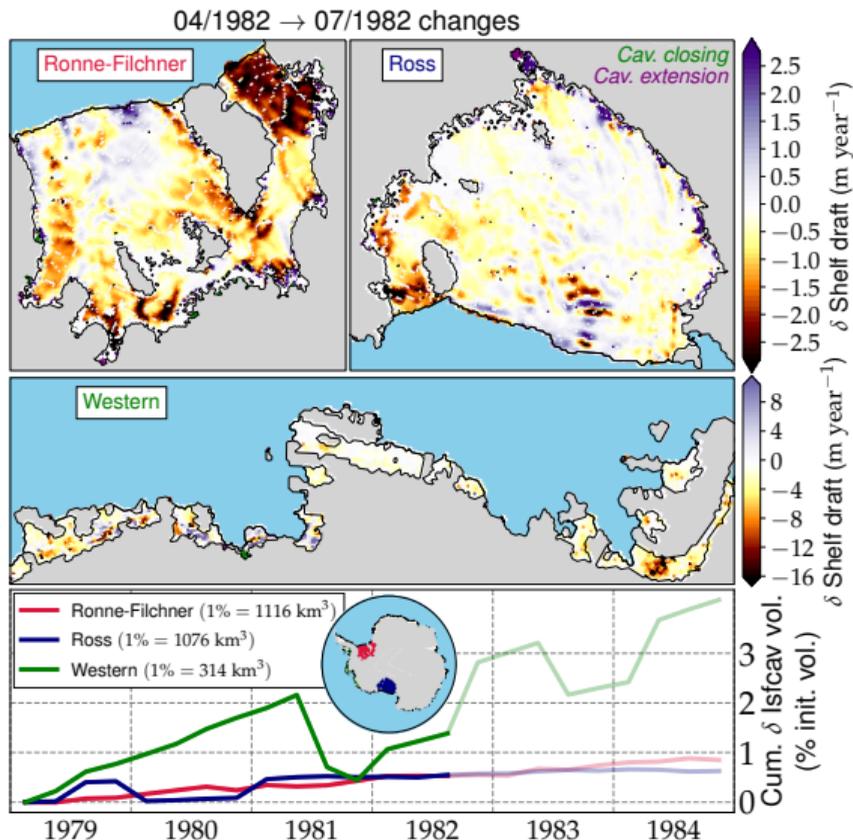
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



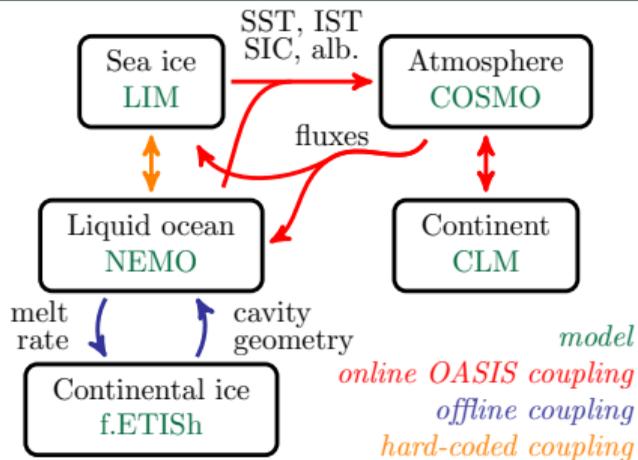
Ongoing work: coupling



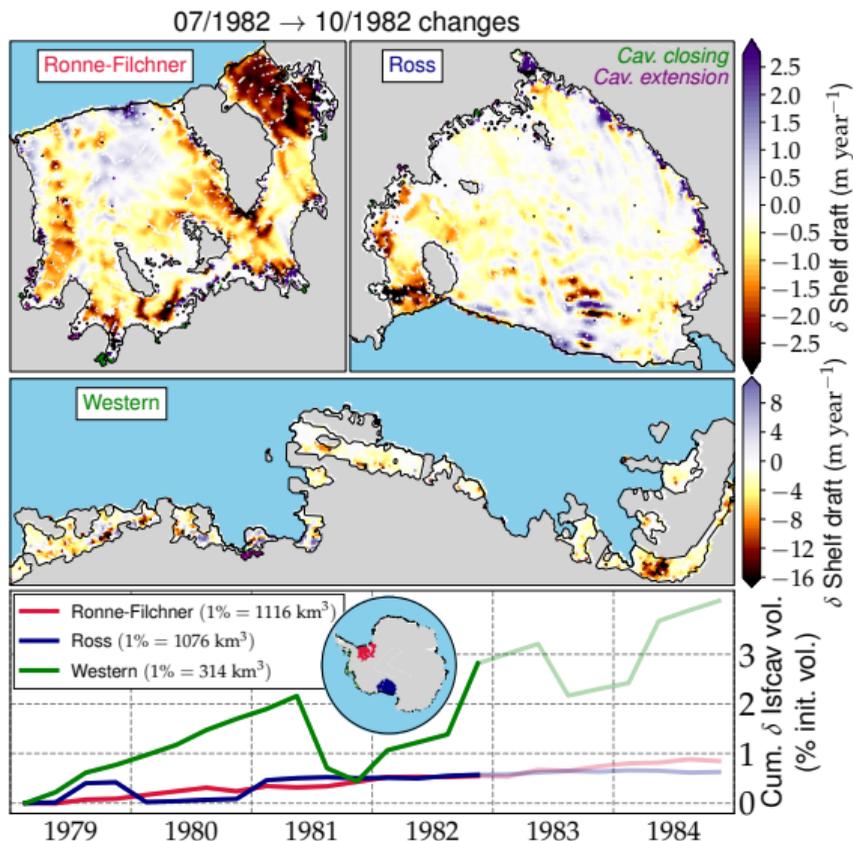
- Five-component coupling
- Investigate **decadal predictability** in Antarctica
- Assess the impact of **slower** climate components, and **coupling feedbacks**



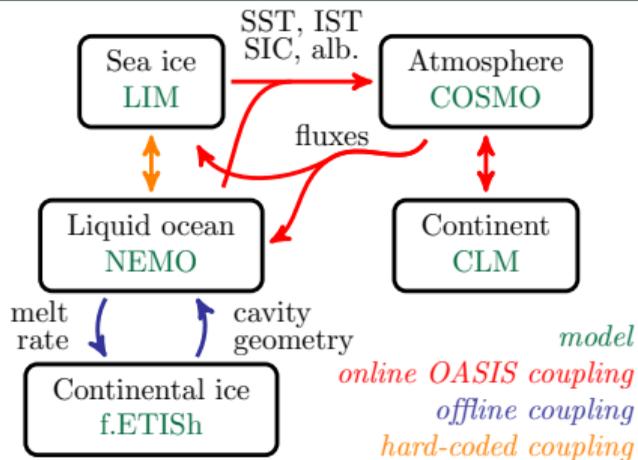
Ongoing work: coupling



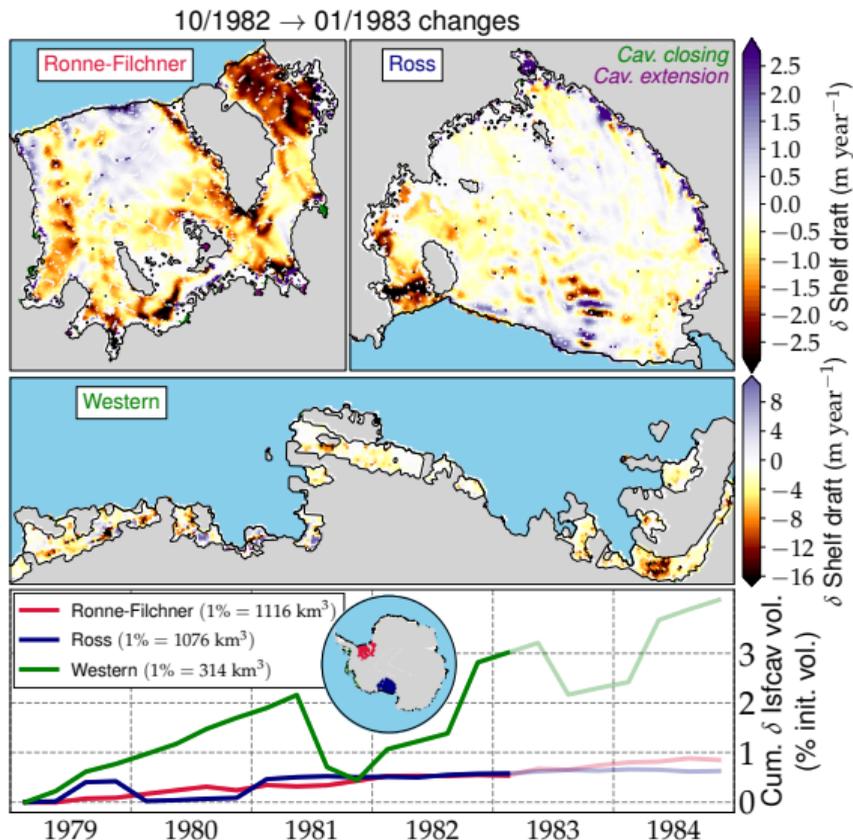
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



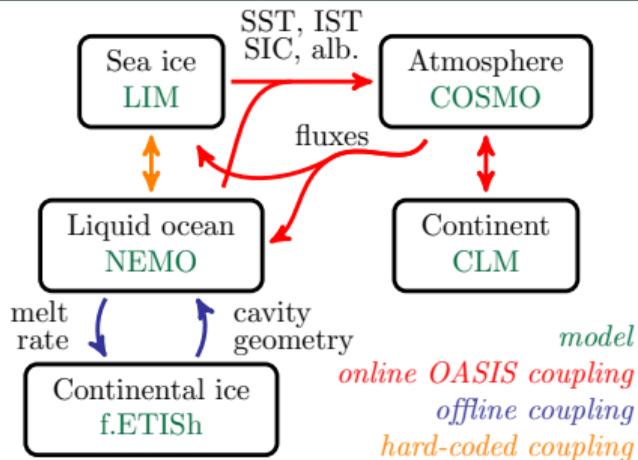
Ongoing work: coupling



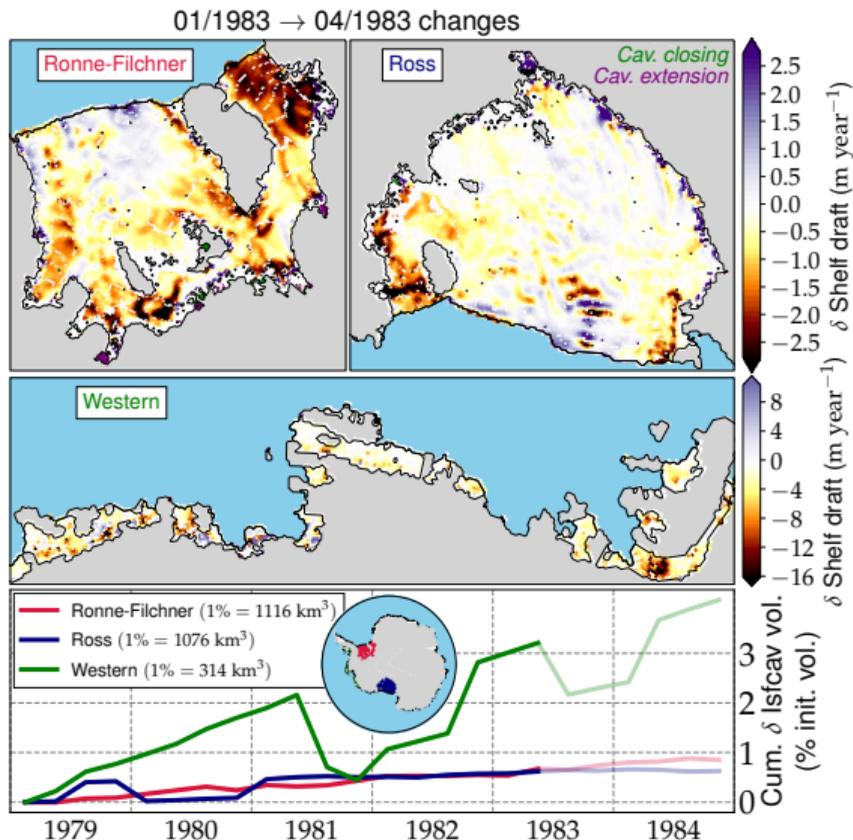
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



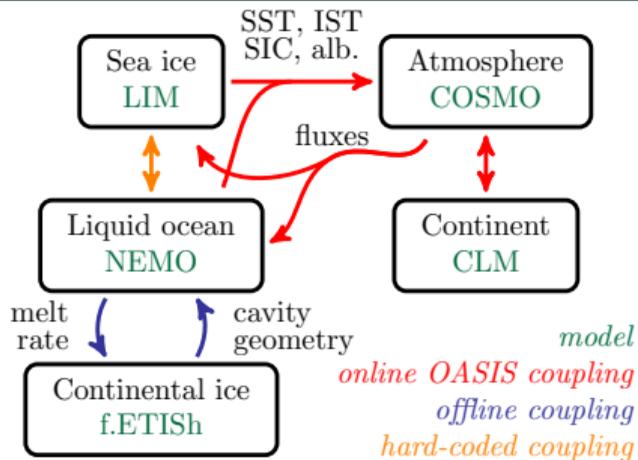
Ongoing work: coupling



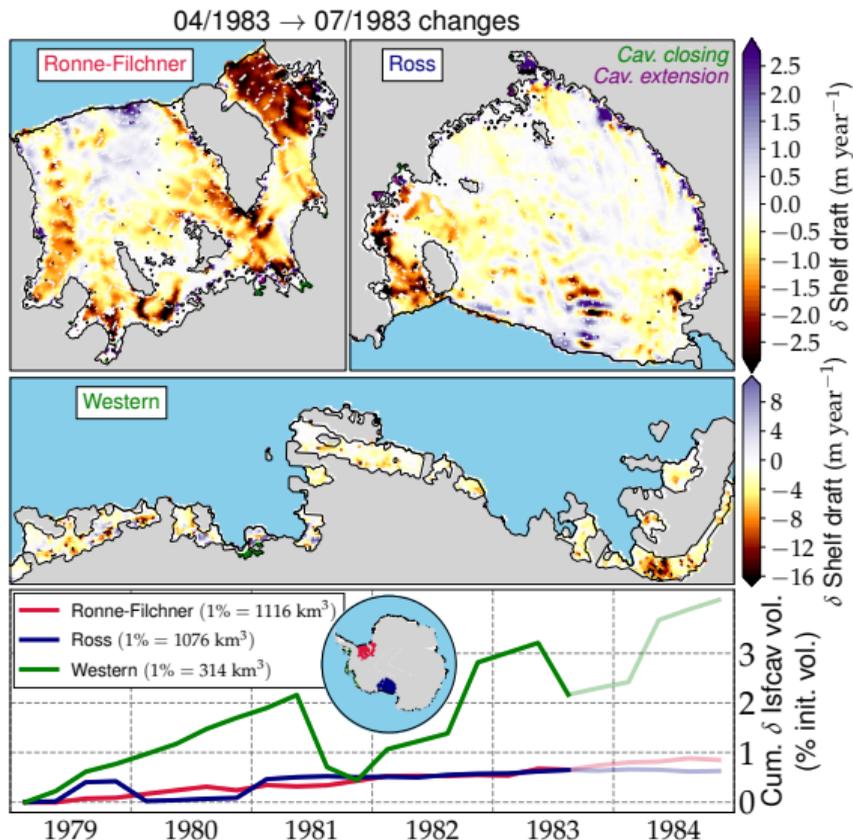
- Five-component coupling
- Investigate **decadal predictability** in Antarctica
- Assess the impact of **slower** climate components, and **coupling feedbacks**



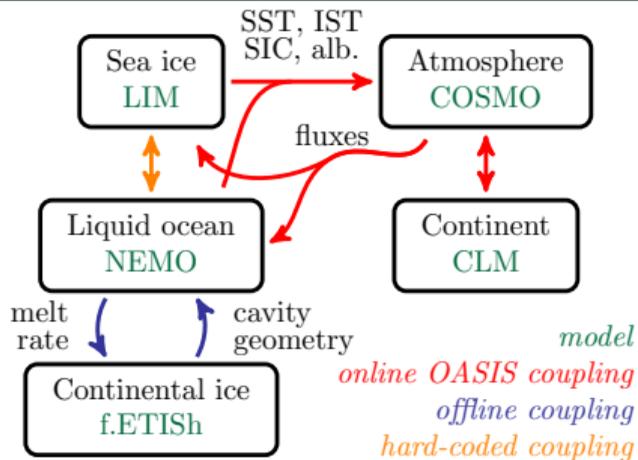
Ongoing work: coupling



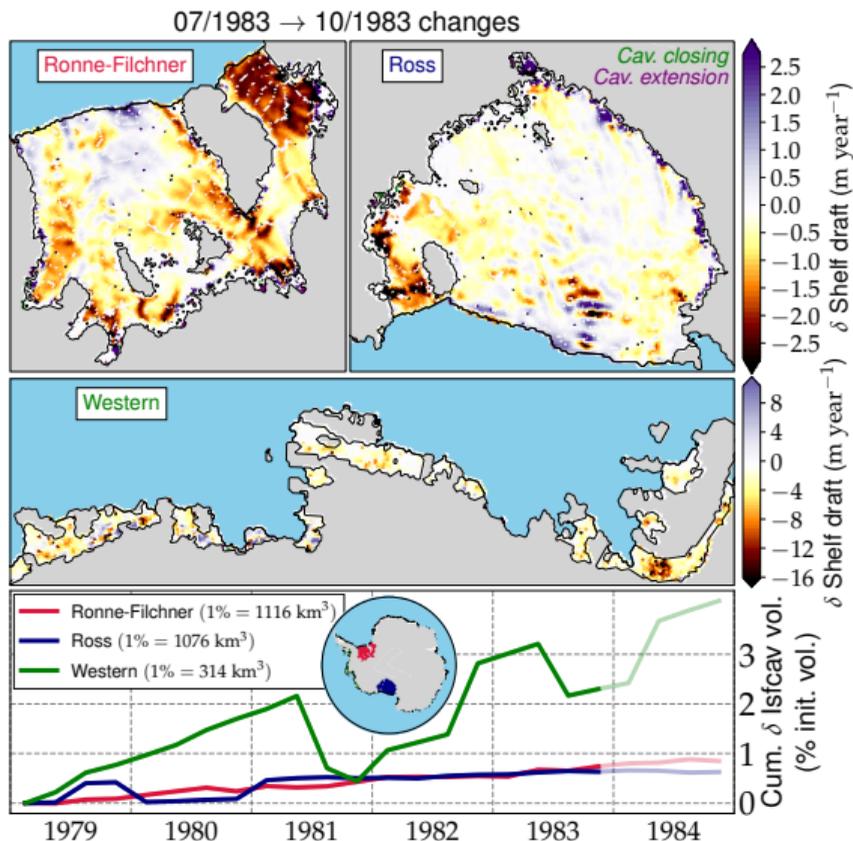
- Five-component coupling
- Investigate **decadal predictability** in Antarctica
- Assess the impact of **slower** climate components, and **coupling feedbacks**



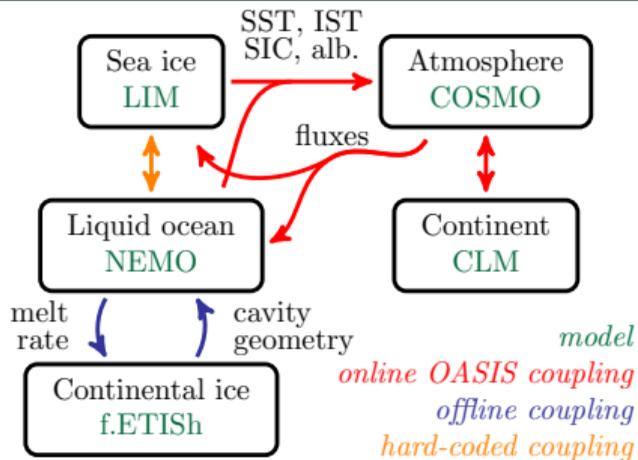
Ongoing work: coupling



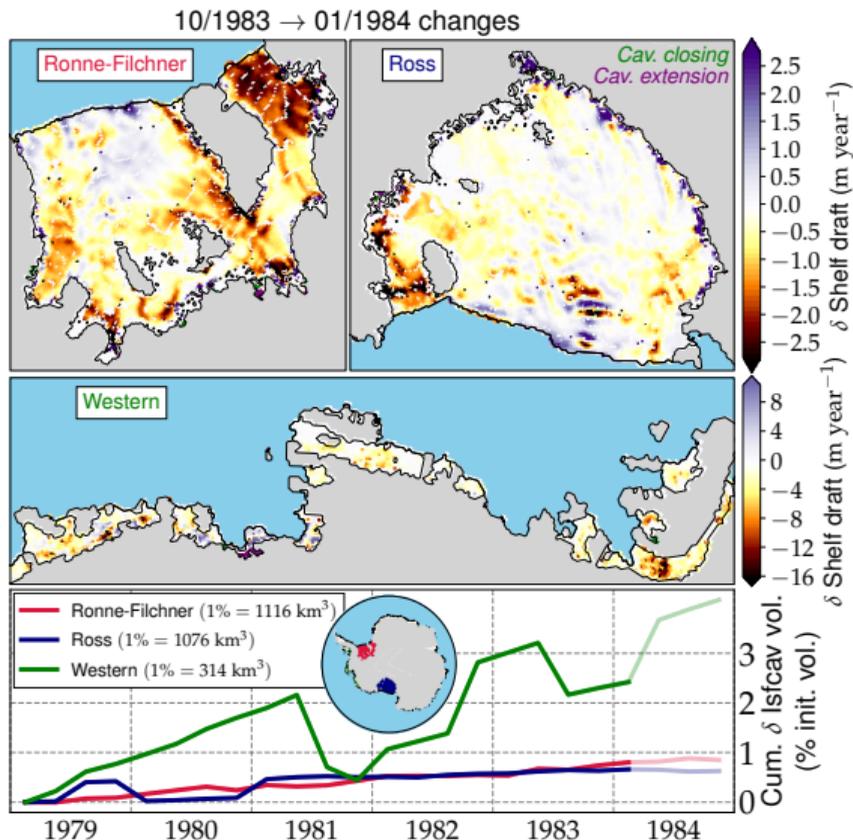
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



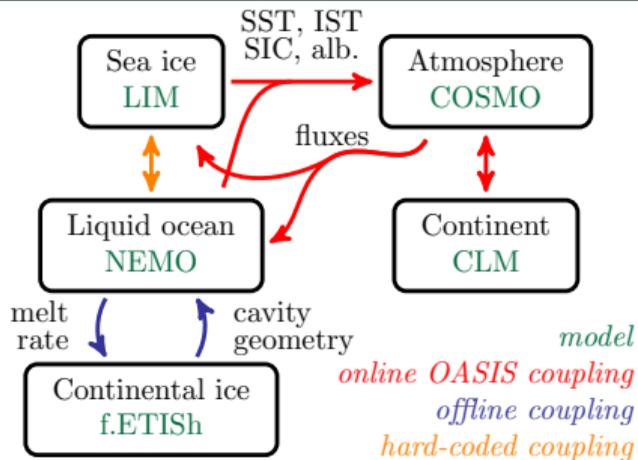
Ongoing work: coupling



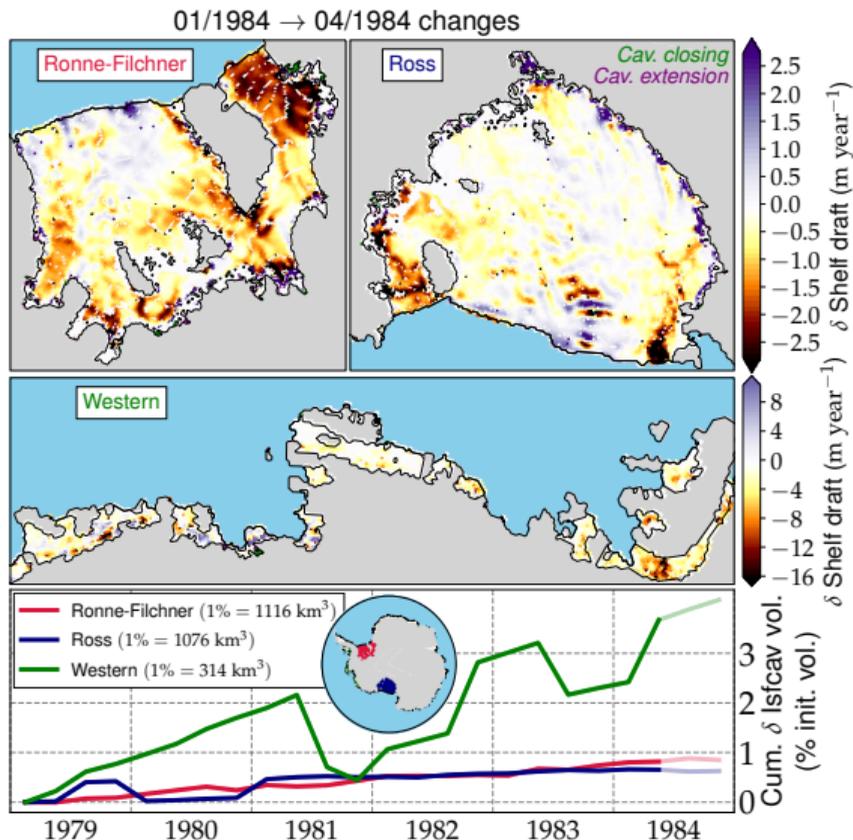
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



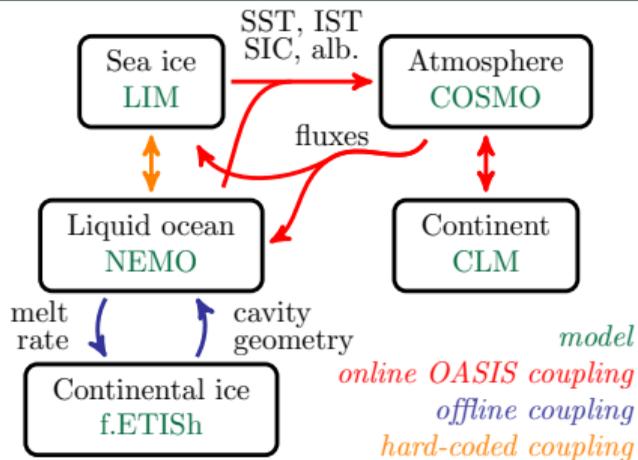
Ongoing work: coupling



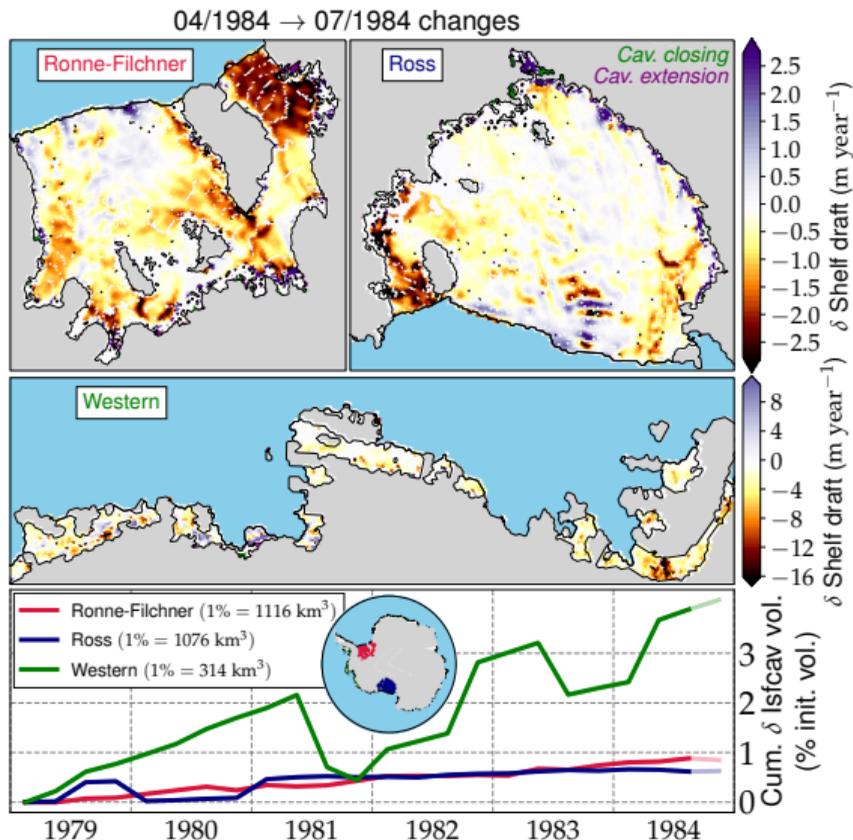
- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



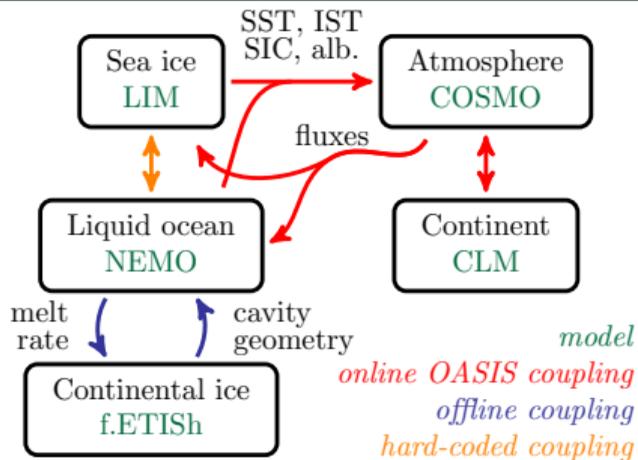
Ongoing work: coupling



- ▶ Five-component coupling
- ▶ Investigate **decadal predictability** in Antarctica
- ▶ Assess the impact of **slower** climate components, and **coupling feedbacks**



Ongoing work: coupling



- Five-component coupling
- Investigate **decadal predictability** in Antarctica
- Assess the impact of **slower** climate components, and **coupling feedbacks**

