Les prévisions décennales avec ESM-CO2, la recherche des points de bascule, et la fermeture du cycle de l'eau en Antarctique

Clara Burgard, Laurent Bopp, Patricia Cadule, Julie Deshayes, Guillaume Gastineau, Masa Kageyama, Juliette Mignot, Didier Swingedouw, Olivier Torres…

(1/3) Complétion d'un jeu de prévisions rétrospectives décennales en mode ESM

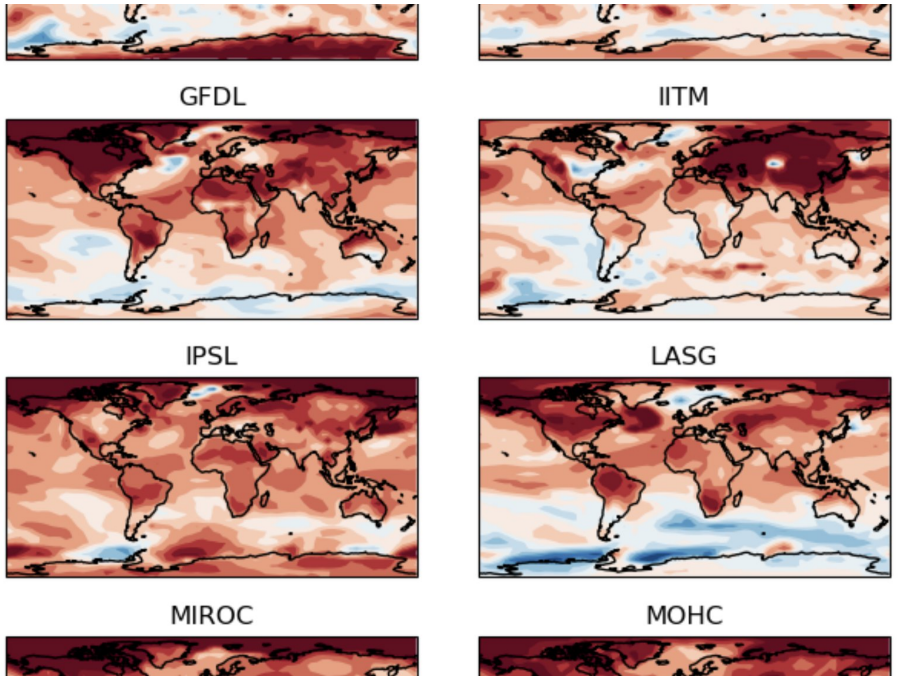
Forecasts | Verification | Timeseries | Regional

Forecast anomalies are relative to the 1991-2020 climatology. Forecasts prior to 2021 have a different climatology indicated below the colour bar. Predictions are initialized at the end of the year issued.

Year Issued: 2023 ⌄ **Forecast period:** Year 1: Annual ⌄ **Element:** Temperature ⌄

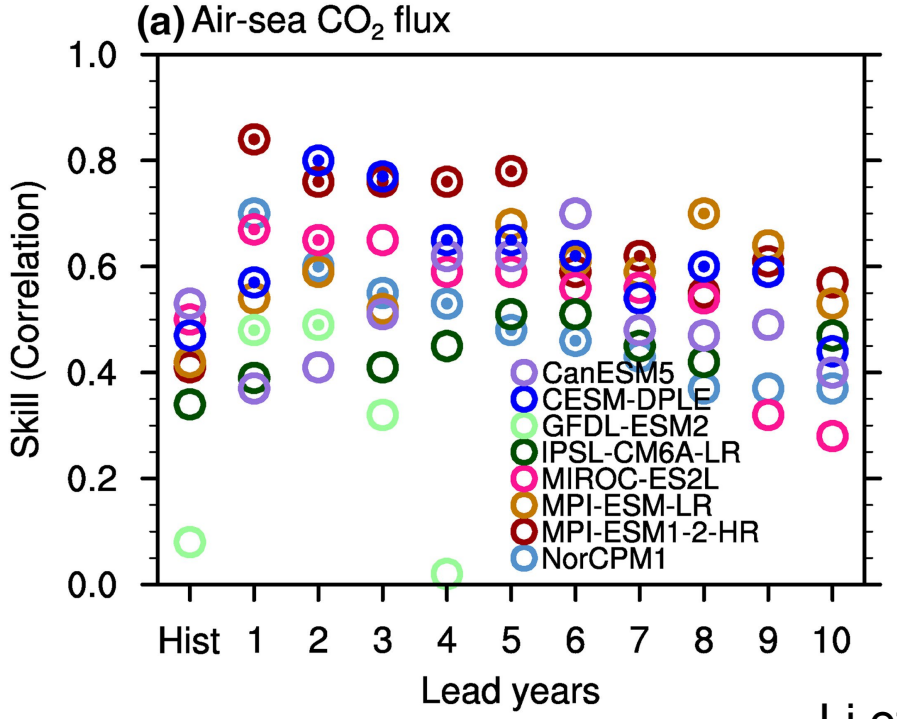
Participation aux prévisions climatiques décennales de **l'Organisation Météo Internationale (*WMO*)** (cf. https://hadleyserver.metoffice.gov.uk/wmolc/).

Depuis 2022, ces prévisions sont basées IPSLCM6 en configuration "emission-driven", ce qui permet d'évaluer la prévision des sources et puits de carbone

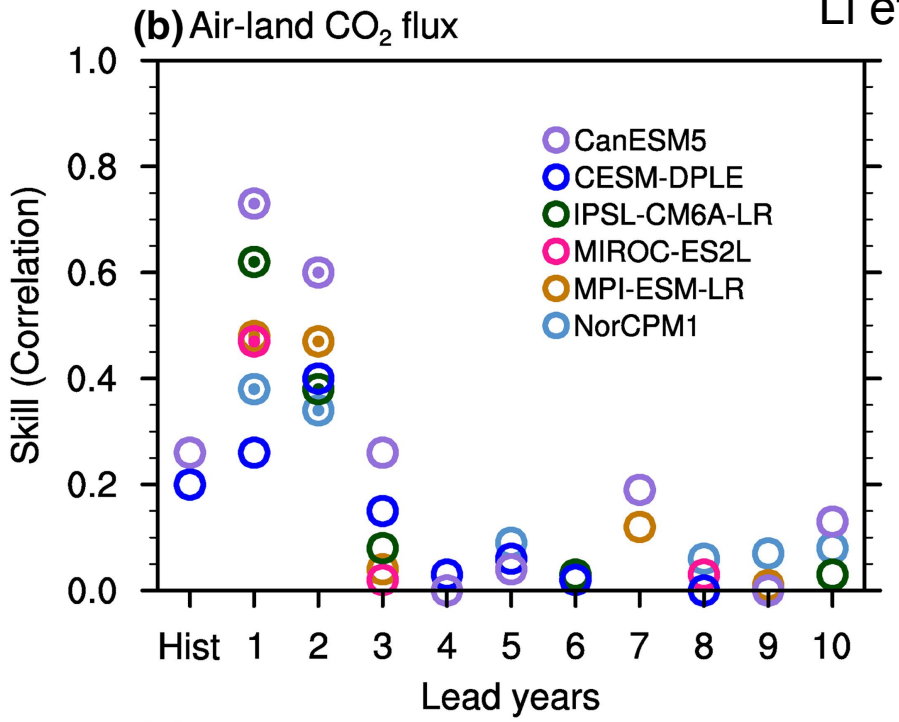


- Recherches autour de la prévisibilité des flux de carbone: performance, mécanismes, …

- Contribution au Global Carbon Budget 2023 et 2024 (Friedlingstein et al 2023, 2024)



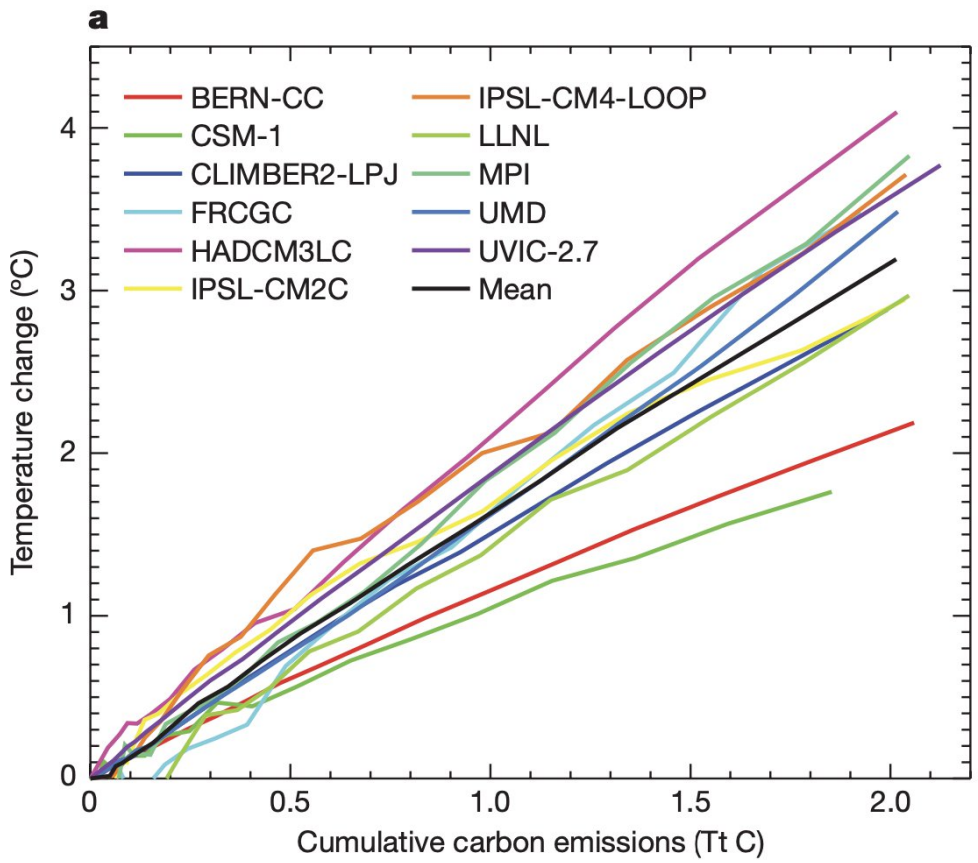
Li et al. 2021



(2/3)

Recherche des points de bascule

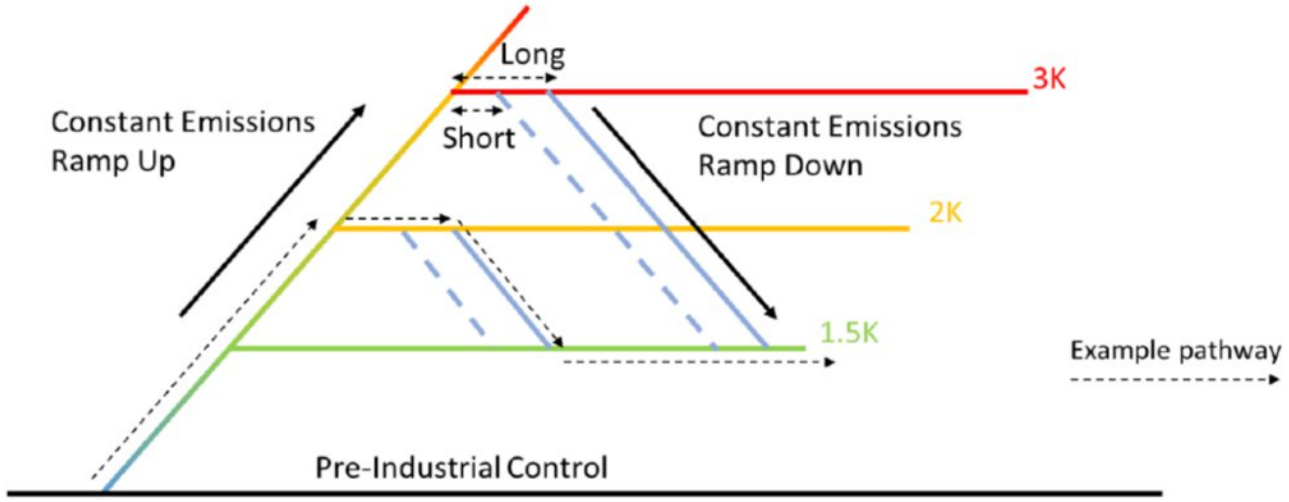
In ESM the temperature change scales with the cumulative carbone emission



Matthews et al., 2009

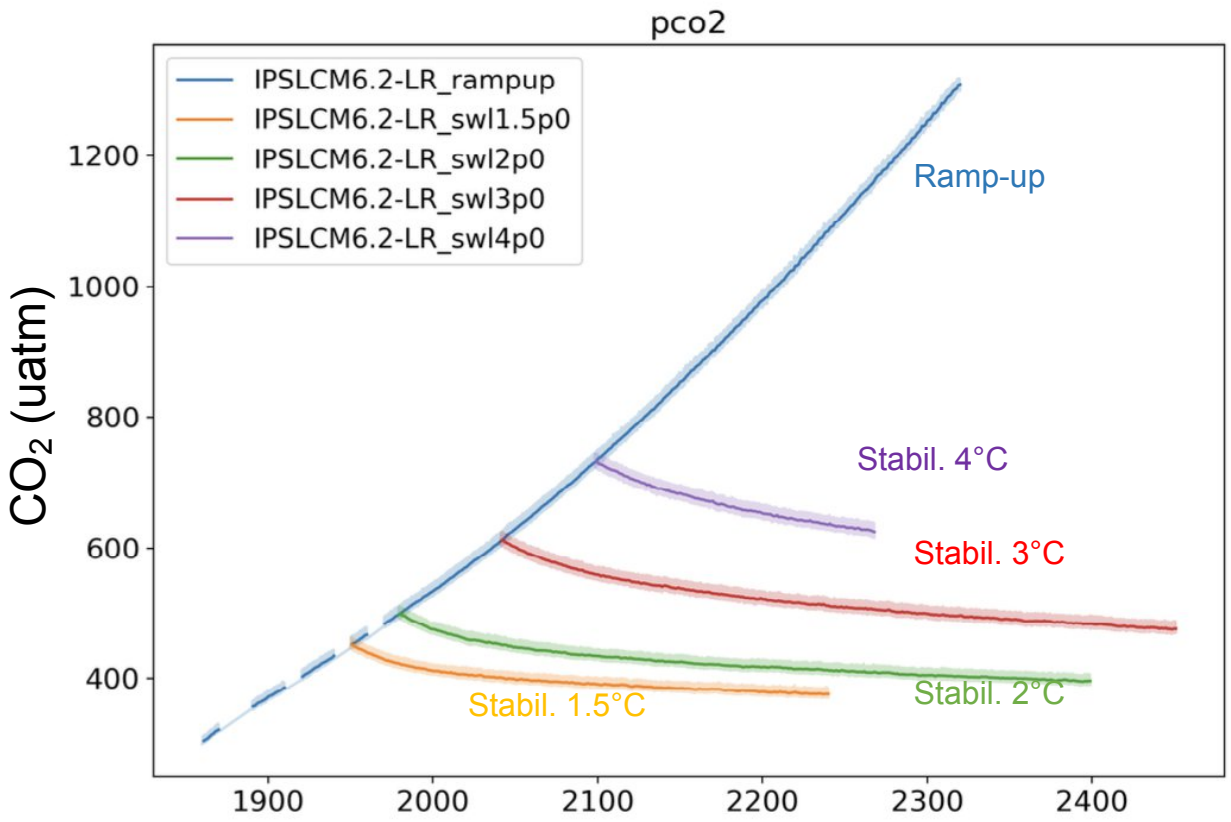
Simulations with IPSL designed with ESM :

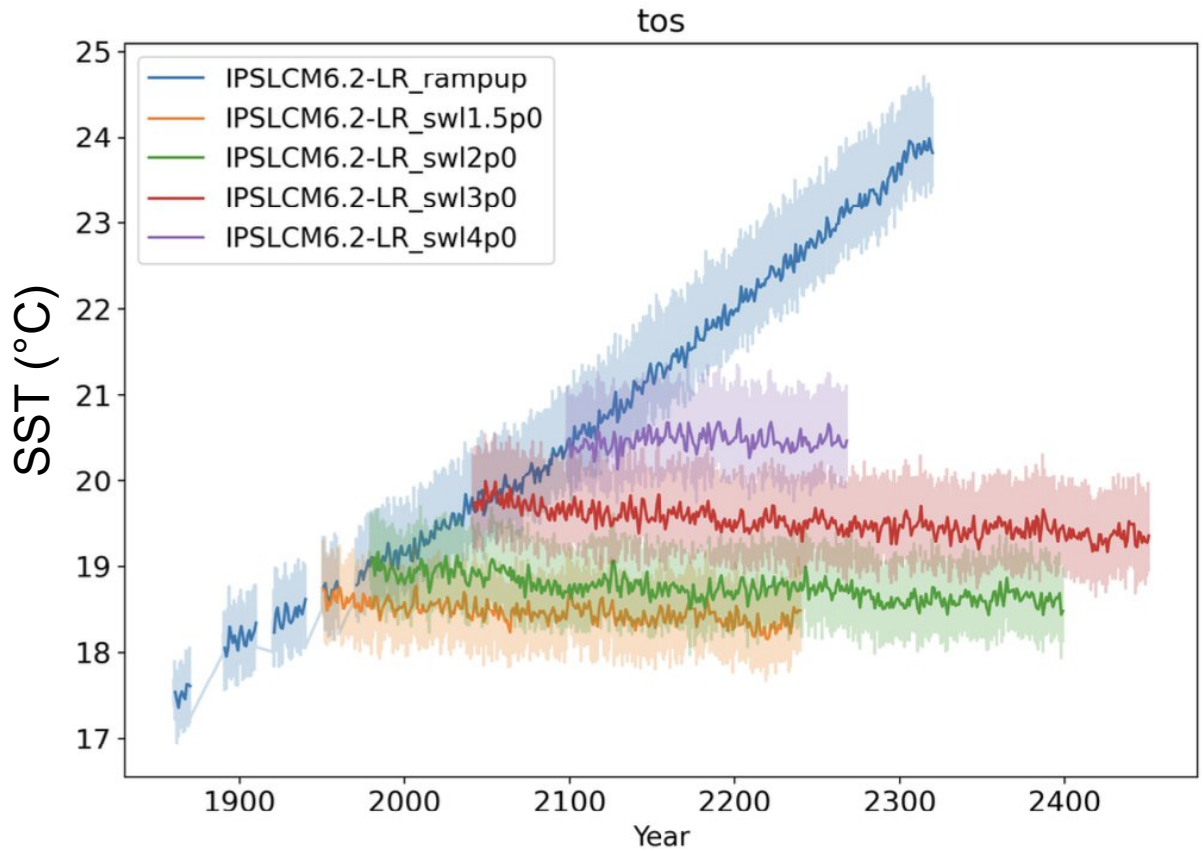
- increasing the cumulative emissions (ramp-up)
- stabilization (emission stopped) at target level of warming
- decreasing cumulative emissions (ramp-down)



Investigation of tipping point / reversibility in climate change.

Ongoing IPSL-ESM Optim-ESM simulations (Patricia Cadule, Olivier Torres, Laurent Bopp)

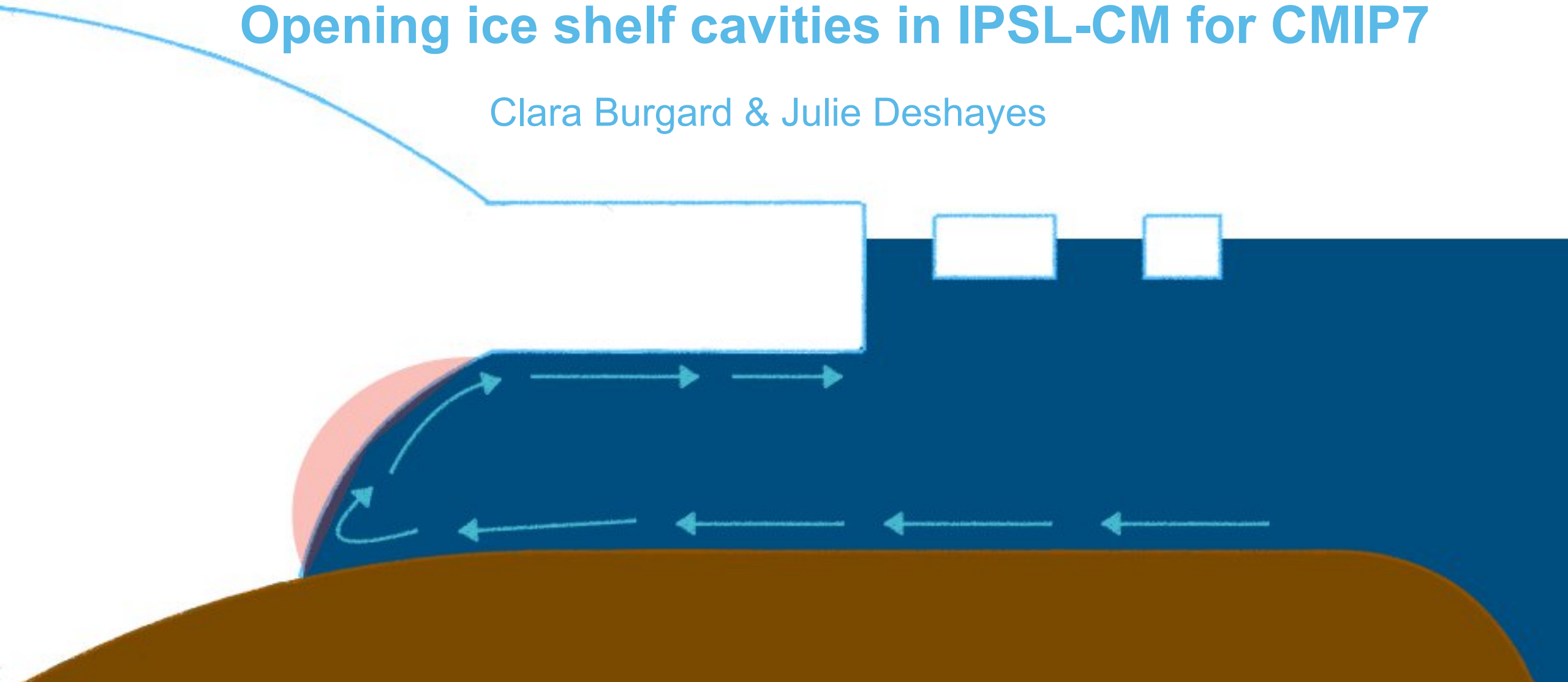




- Investigation of tipping point regarding AMOC (Lucas Almeida, Didier Swingedouw),
- Investigation of tipping point regarding ocean biogechemistry (Eike Köhn, Lester Kwiatkowski, Juliette Mignot, Guillaume Gastineau)

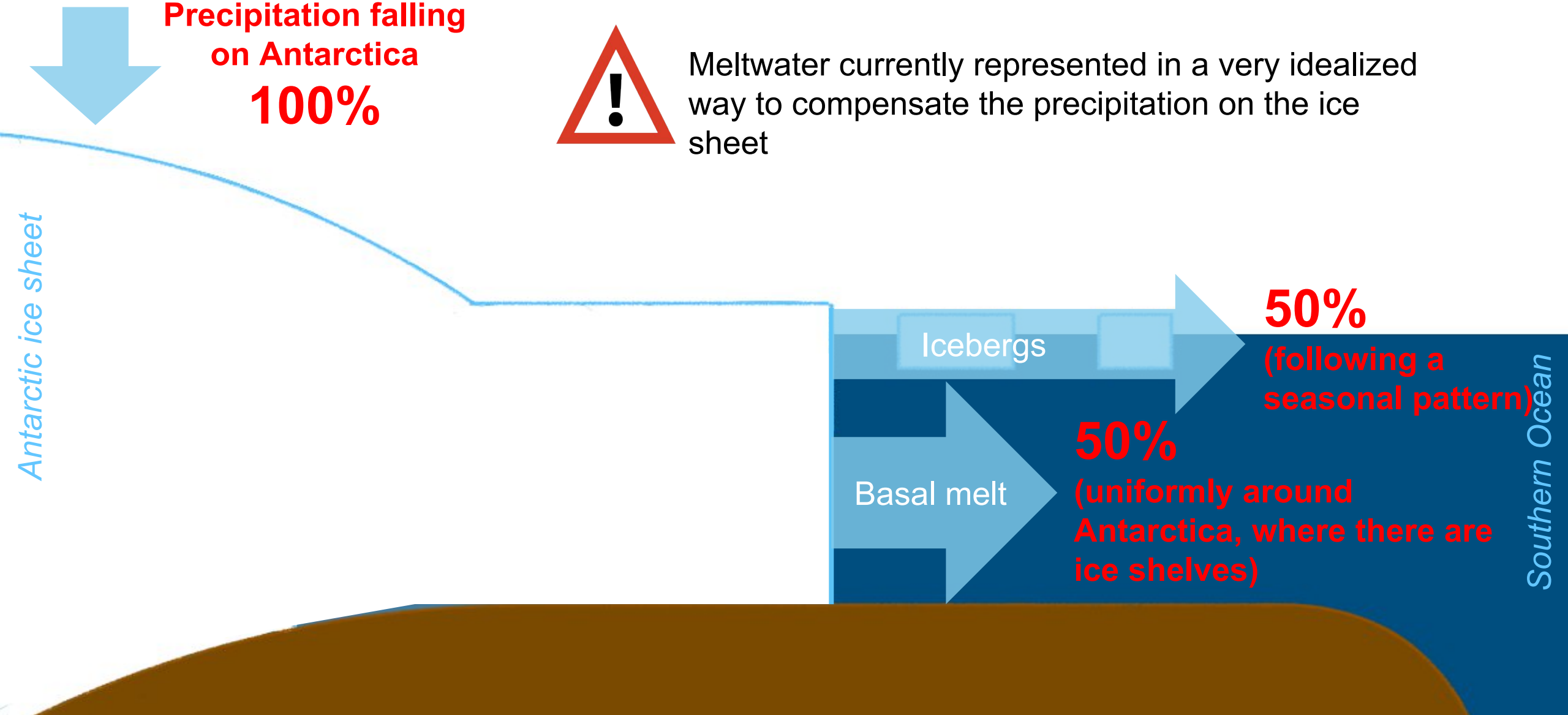
Opening ice shelf cavities in IPSL-CM for CMIP7

Clara Burgard & Julie Deshayes



How it is currently in IPSL-CM7

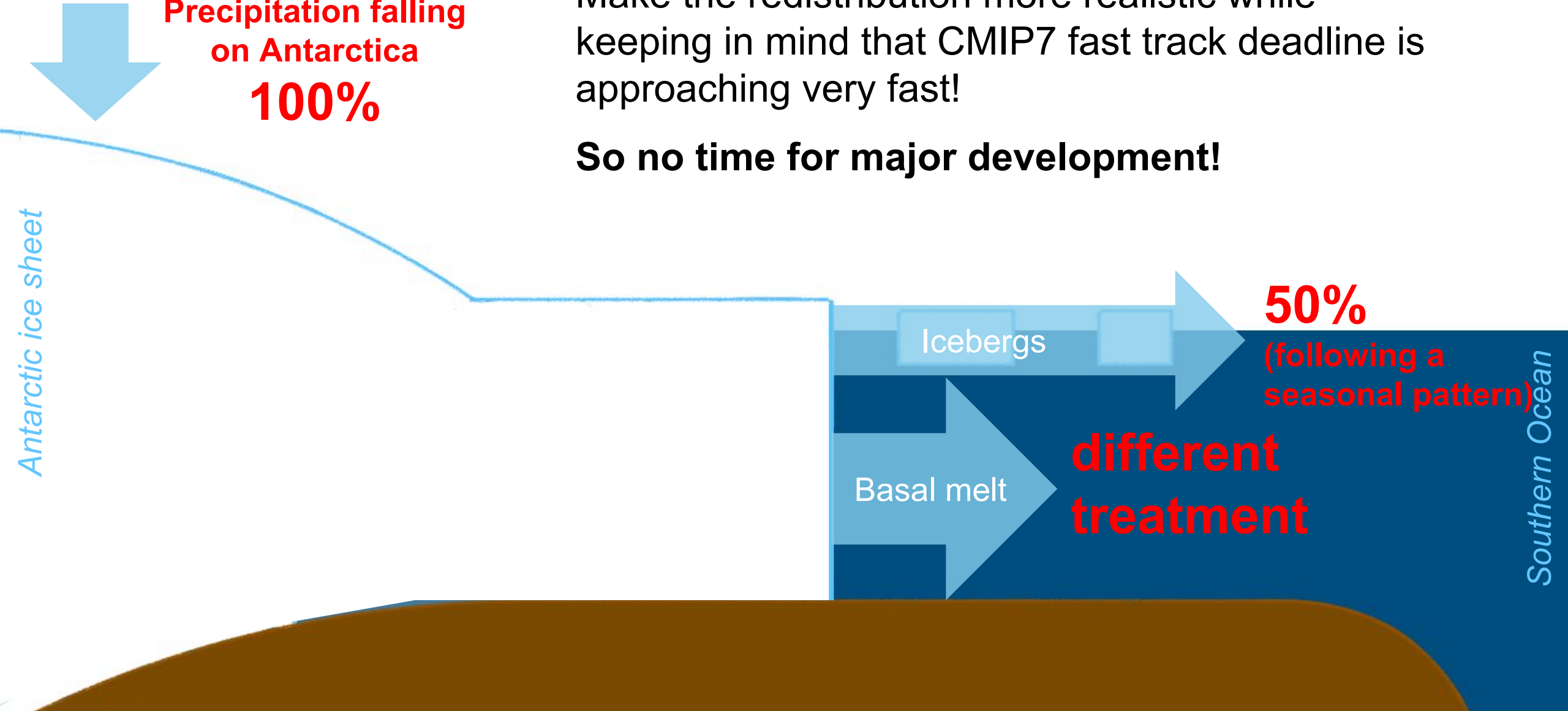
Clara Burgard



Now in progress (for tests and potential use in CMIP7 fast track)

Make the redistribution more realistic while keeping in mind that CMIP7 fast track deadline is approaching very fast!

So no time for major development!



Now in progress (for tests and potential use in CMIP7 fast track)

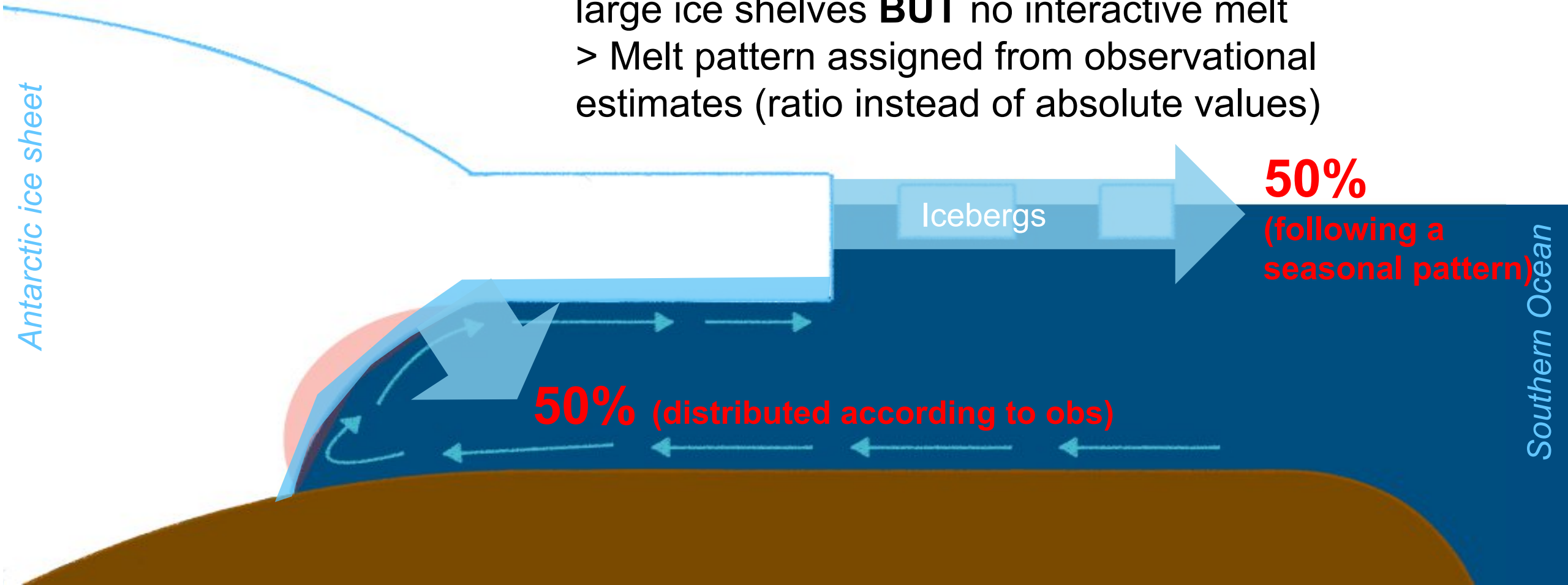
Precipitation falling on Antarctica

100%

For large ice shelves (Filchner-Ronne, Ross, Amery and a few others)

> Let the ocean circulate in the sub-shelf cavities for large ice shelves **BUT** no interactive melt

> Melt pattern assigned from observational estimates (ratio instead of absolute values)



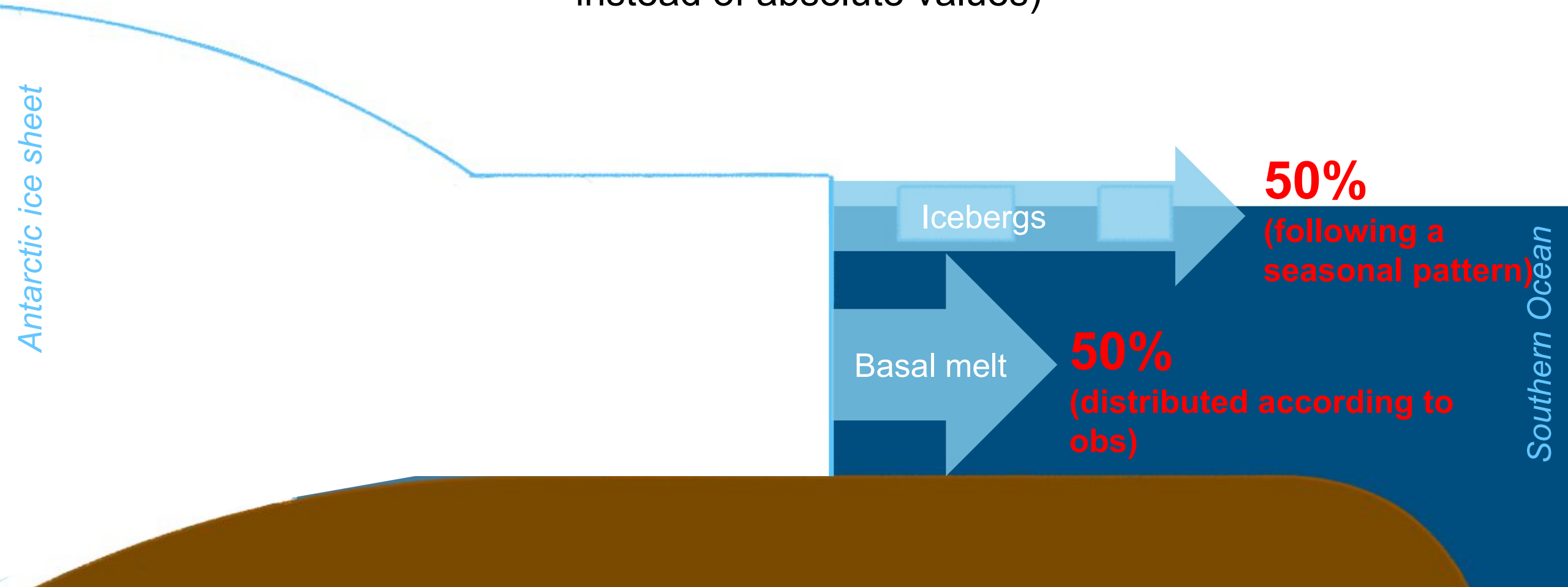
Now in progress (for tests and potential use in CMIP7 fast track)

Precipitation falling on Antarctica

100%

For all other ice shelves

> Melt assigned from observational estimates (ratio instead of absolute values)



On the longer term (for CMIP7)

- Allow interactive melt under ice shelves
- Implement an interactive parameterisation in NEMO for unresolved ice shelves and unresolved parts of larger ice shelves
- Work on a satisfying „bucket“ method to allow more melt than incoming precipitation and still keeping the water cycle closed

BONUS

Genci-CEA's Joliot-Curie @TGCC

Préparation des modèles et outils

Calibration et Equilibration

Production et Publication

FAST TRACK

2024 2025 2026 2027

CMIP7 (la suite)

Préparation des modèles et outils

Calibration et Equilibration

Production et Publica

EUROHPC Jules-Verne @TGCC (exascale)

Préparation des **modèles** et outils

FAST TRACK

EU projects : 4C, OPTIMESM, TIPESM
GCB, WMO

PLAN A : IPSLCM7 [ed]

PLAN B : IPSLCM7 [cd] & IPSLCM6.2-ESM-CO2 [ed]

PLAN B' : IPSLCM7 [cd] & IPSLCM6.3 + CO2 [ed]

EU project : ESM2025

IPSLCM7 = LMDZico + NEMOv4 + ORCHIDEE 4

eORCA1 - resolution spatiale dans LMDZico ?

IPSLCM6.2-ESM-CO2 (LR) = LMDZreg + NEMOv3.6 + ORCHIDEE 2 avec cycle CO2

IPSLCM6.3 (LR) = LMDZreg + NEMOv3.6 + ORCHIDEE 3 avec cycle azote => ajouter cycle CO2

[ed] = emission driven, [cd] = concentration driven,

CMIP7 (la suite)

IPSLCM7 [ed]

IPSLCM7 = LMDZico + NEMOv4(5) + ORCHIDEE 4

[LR] = eORCA1 - res. spatiale dans LMDZico ?

+ [VLR] ? [MR] ? [HR] ?

Préparation des modèles et outils

Calibration et Equilibration

Production et Publica

EUROHPC Jules-Verne @TGCC (exascale)

↗ processus surfaces continentales

↗ cycles BGC

+ calottes continentales (explicites ou émulées)

=> Adaptation de nos codes aux infrastructures hybrides

+ hybridation des modèles (inclusion d'émulateurs de composantes ou de modules spécifiques, par exemple les paramétrisations…)