Colocation Day 1 PISCO – Polar ice sheets in Climate Models and Earth Observation

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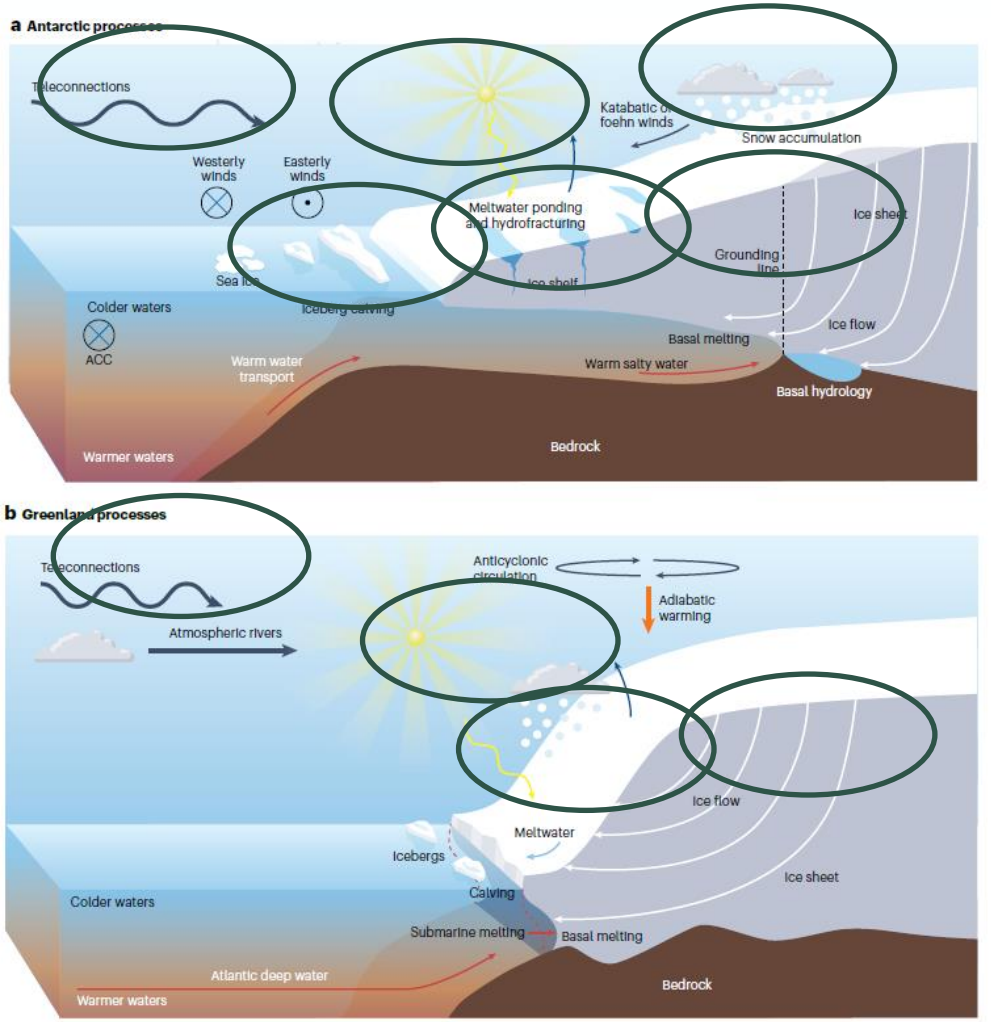
24/03/2026

Project Objectives:

Bringing together climate models and Earth Observation to build better polar ice sheet projections for Greenland and Antarctica

Focused on drivers of ice sheet surface mass budget:

- Accumulation and atmospheric extreme events
- Regional teleconnections
- Water vapour transport
- Surface energy budget and ice surface temperature
- Clouds, aerosols and turbulent heat fluxes
- Earth system feedbacks between sea ice and SMB
- Ice sheet velocity and discharge



The key details

ESA AO/1-12469/24/I-LR

Interfacing the Climate Observations and Modelling Communities

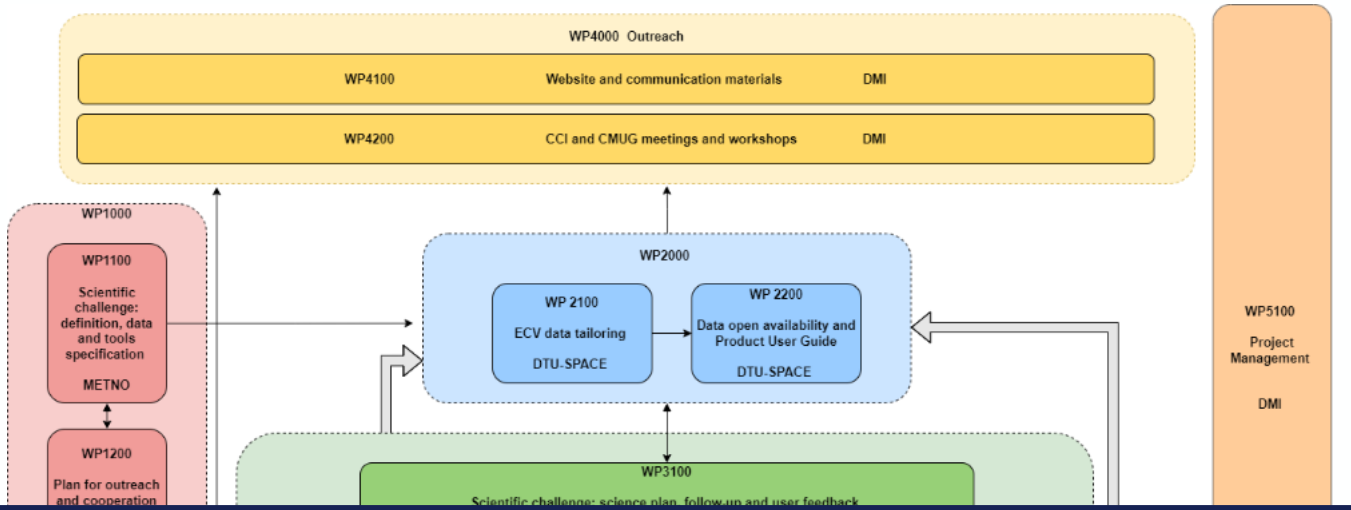
- Started May 2025 for 2 years
- 1 user workshop planned, 2 early career hackathons.
- Strong connections with CCI **Greenland ice sheet**, **Antarctic ice sheet**, **land (ice) surface temperature** and **sea ice** but also

Ensemble of high resolution polar RCMs

ERA5 as driving model for hindcast

Historical and SSP 3-7.0 projections

1985 – 2100 for 2 storylines in each region



Ensemble of RCMs (11km) for high resolution future projections and impacts

Model	HCLIM	MetUM	ICON	MAR	RACMO2	WRF
Atmosphere	ALARO/ ALADIN	UM	ICON	MAR	RACMO2	WRF
Sea-ice	SICE	-	-	-	-	
Region	Arctic	Both	Arctic	Both	Both	Arctic
Partner	METNO, DMI	BAS	AWI	ULiége	UUtrecht	NORCE

Facilitating Collaboration with the Open Science Toolkit

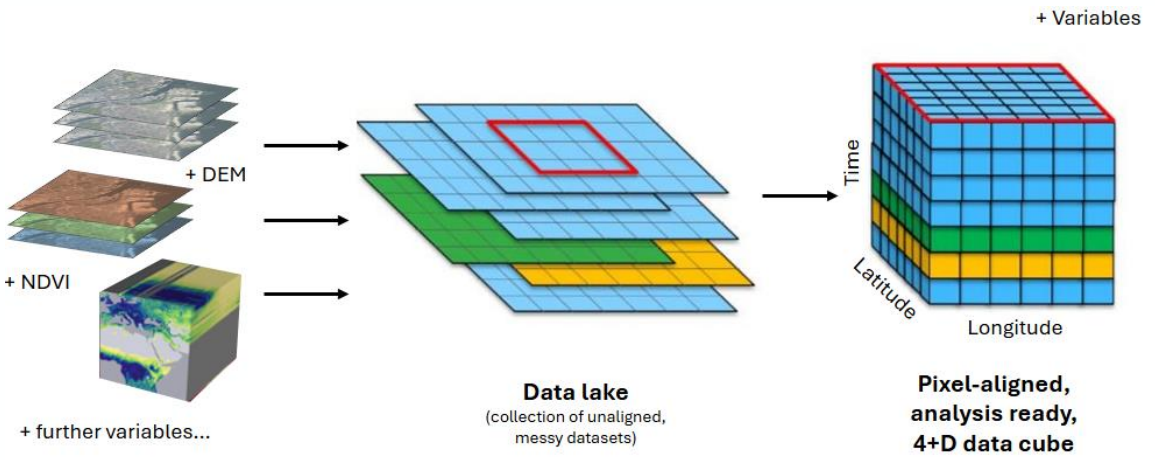
PISCO open science notebooks:

To facilitate handling of model and satellite data together, ranging from the simple (data imports, regridding scripts) to the more complex (e.g. deep learning algorithms to identify patterns in melt extent).

Interface also with ESA CCI toolbox

Final workshop to present the toolkit in spring 2027

Close collaboration between EO + RCM groups has already proved essential with development of datacubes.



From Tabea Rettelsbach, DTU

Cherblanc C, Grejs Petersen JP, Bunt F et al. On solving coordinate problems in climate model output and other geospatial datasets

Open Res Europe 2025, 5:269 (https://doi.org/10.12688/openreseurope.20467.2)

…and CCI ECVs to assess drivers of surface mass budget

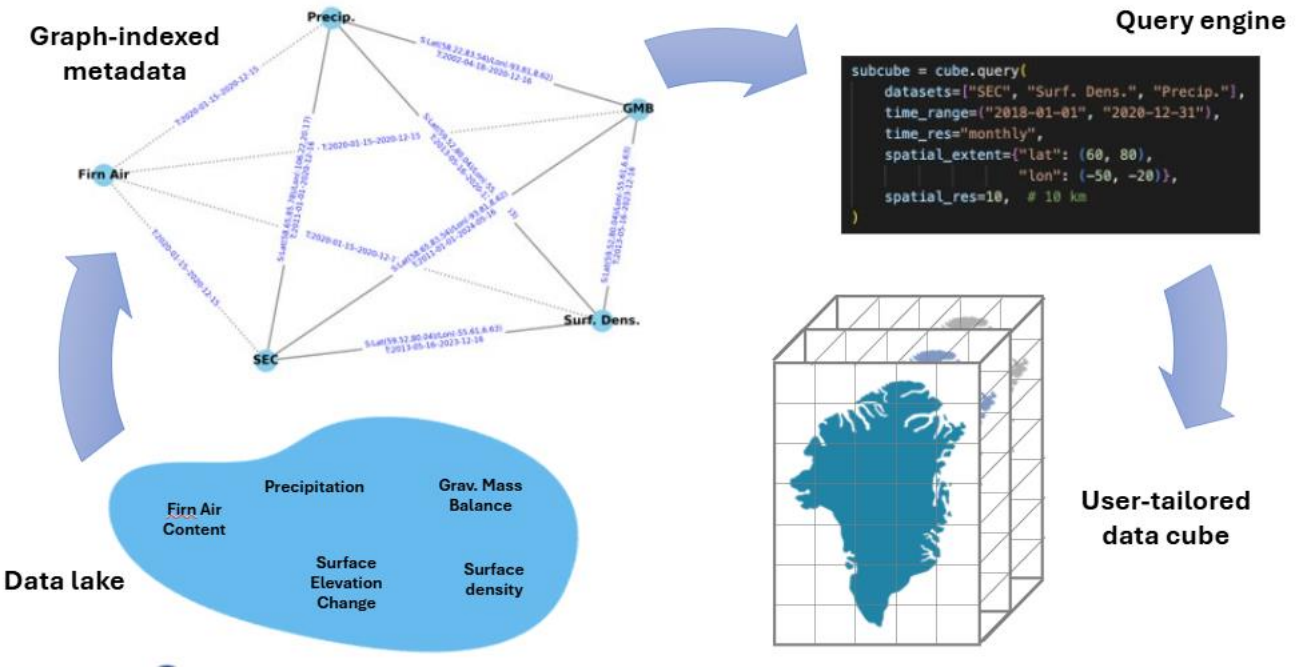
- Different conventions on grids, coordinates etc take a surprising amount of time to resolve!
- We focus on tailoring targeted ECVs, other ECVs are used as available:

- SEC, GMB, IV, SICCI, IST/LST
- Clouds, IWV

- Our big headache: SNOW
- albedo
- Density
- Clouds
- SWE

Dataset	"months"	Temp. coverage	Time format	Spat. res
SEC	Year/12, label: first day	2011-01 to 2025-04	Datetime in metadata	~ 5 km
Surf. dens	Calendar months	2013-05 to 2023-12	MM_YYYY from filename	25/40/50 km
GRACE	Irregular, label: bounds + mid-point	2002-02 to 2024-05	Decimal years	~50 km disc / 250-300 km
Precipitation	Calendar months, label: mid-point	2000-01 to 2020-12	Days since 1999-09-01	11 km
PISCO cube	Year/12, label: bounds + mid-point	2013-05 to 2020-12	Days since 2000-01-01	250-300 km

Smallest Common Denominator



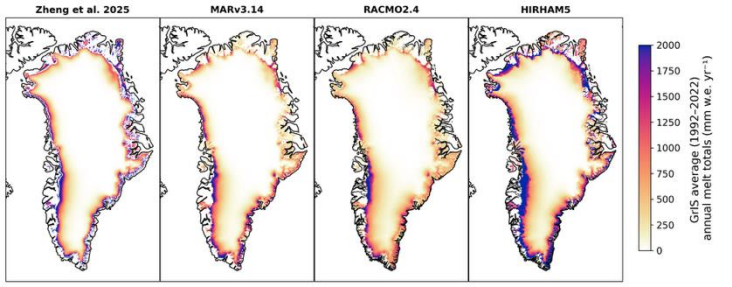
From Tabea Rettelsbach, DTU

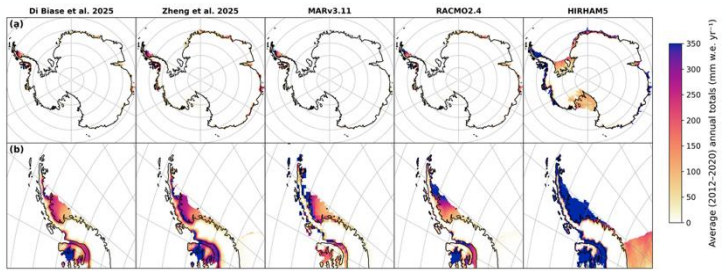
Bringing together EO and RCM data: IST

The L4 LST/IST datasets enable monitoring of the two major polar ice sheets of mainly daily surface temperatures and surface temperature trends

Can RCMs reproduce this trend?

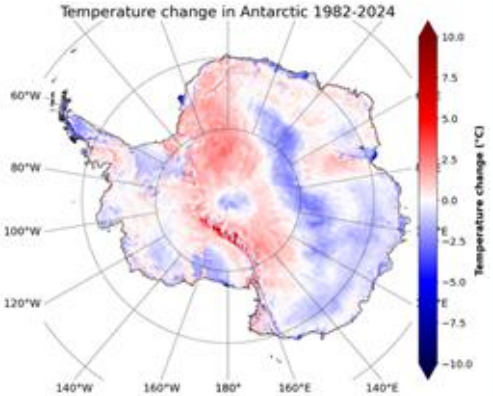
Some important biases in melt extent

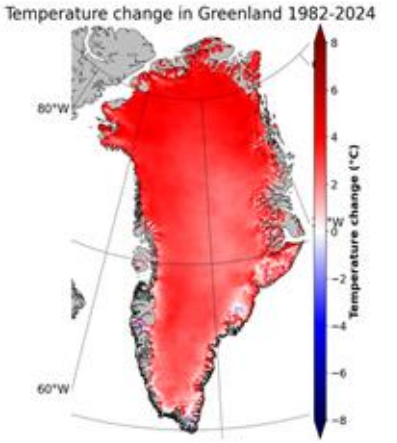


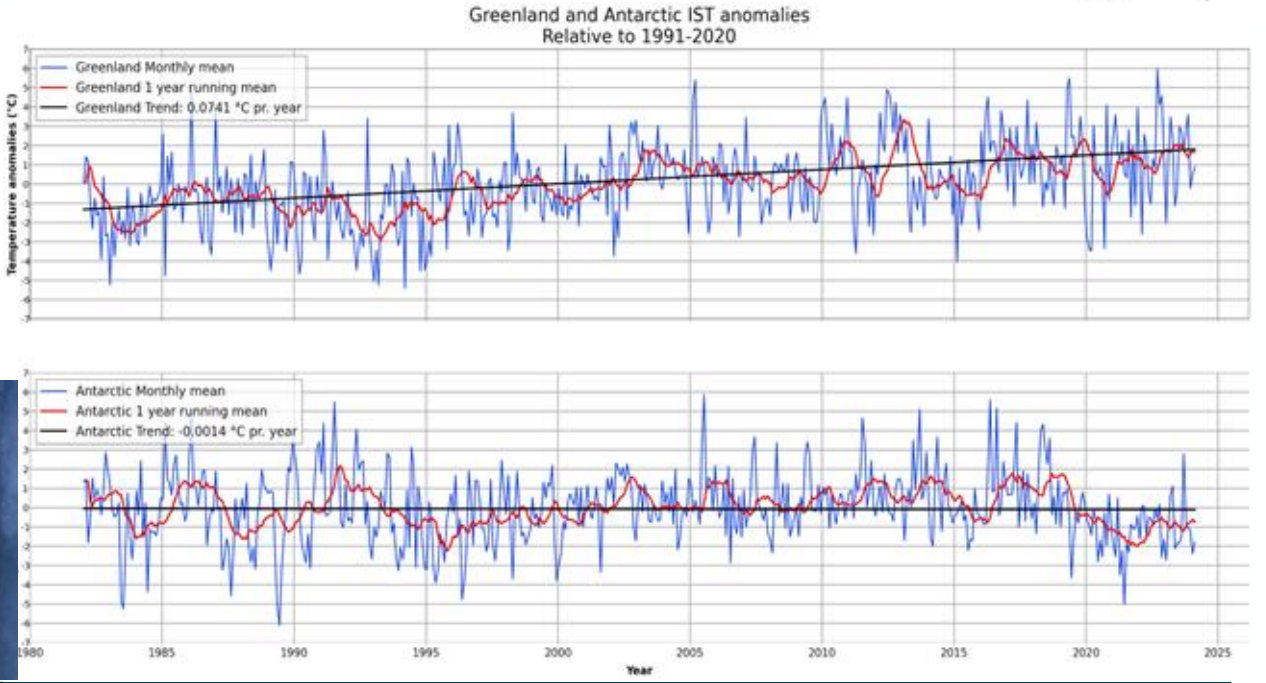


From Kristiina Verro, DMI

From Magnus Suhr Barfod, DMI





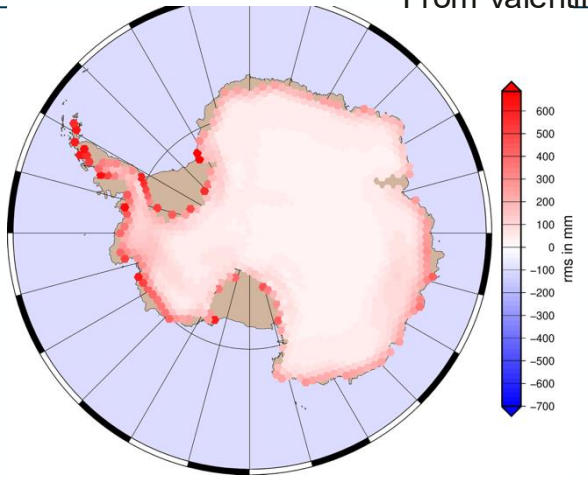


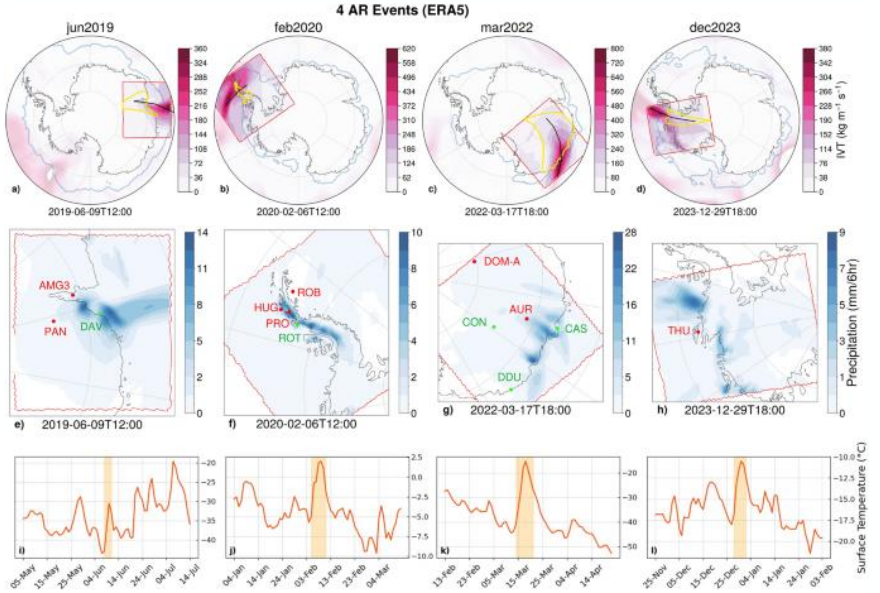
Precipitation, Accumulation and Mass change

Going beyond state-of-the-art for RCM evaluation, can we quantify how much snow falls during different kinds of extreme events?

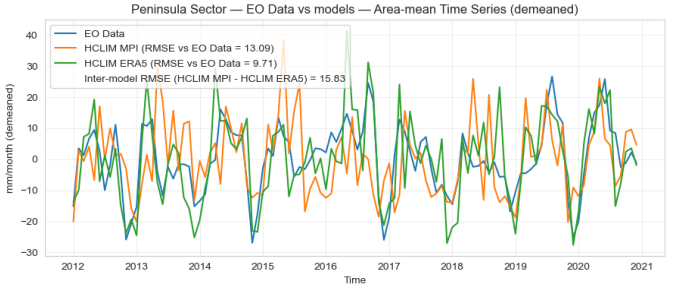
GRACE GMB RMS on a monthly resolution cross-compared with SEC from cryosat and RCM outputs for 4 different atmospheric river events.

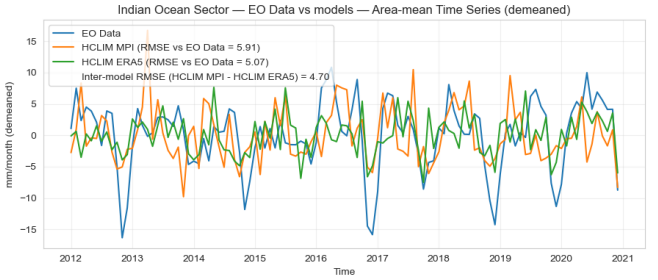
From Valentina Barletta and Rasmus Arildsen, DTU

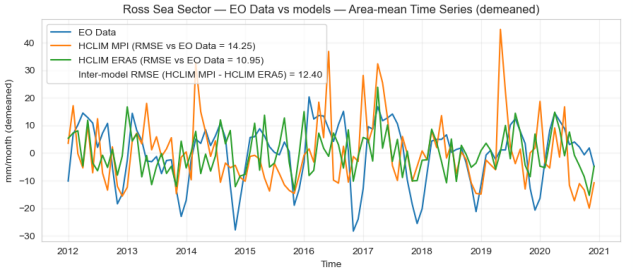


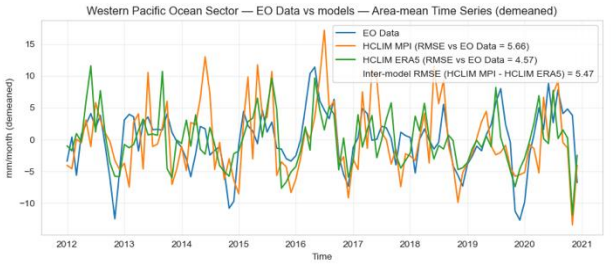


From Kolbe et al., 2025, DMI







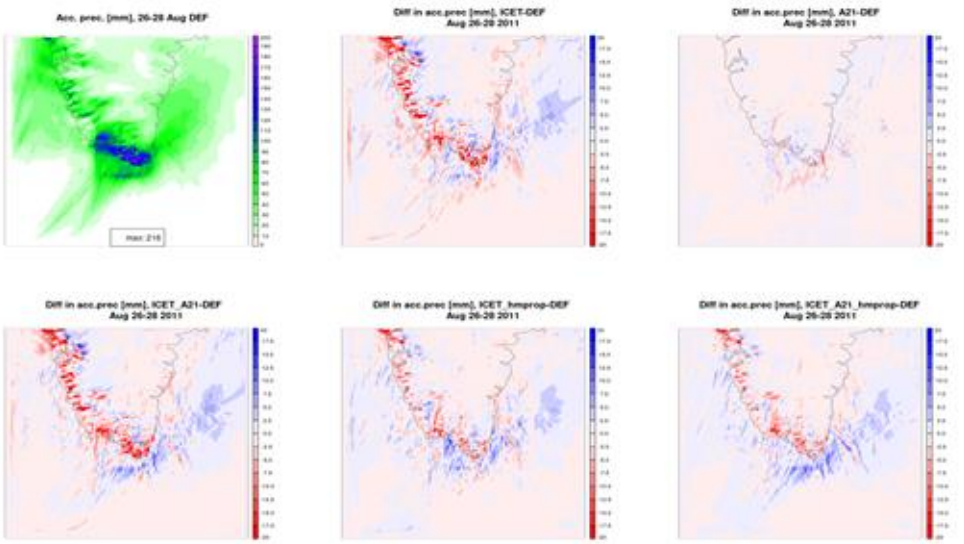


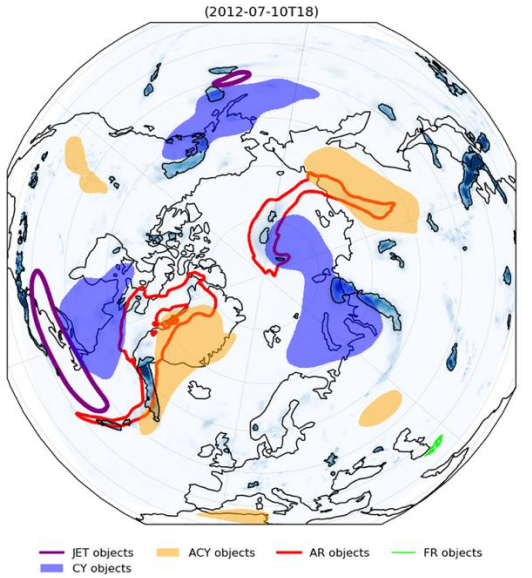
Extreme events, clouds and surface energy budgets

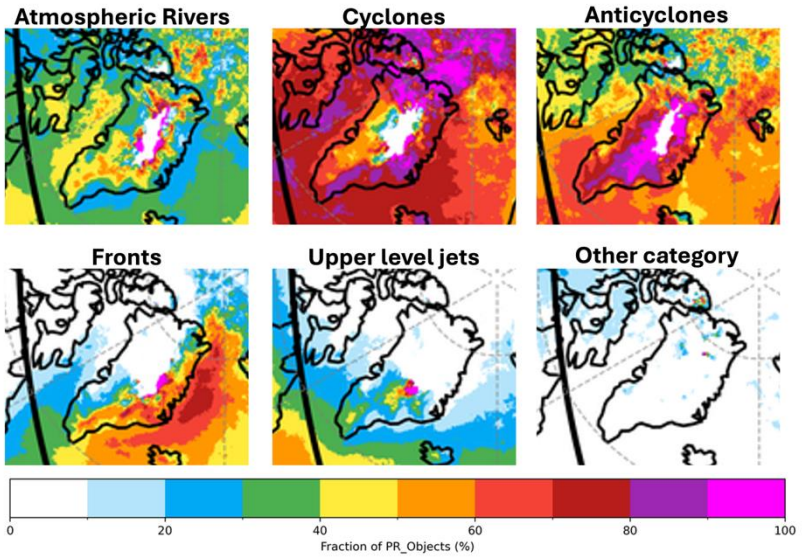
Use of MOAPP tool (Prein et al., 2019) Attribution of different extreme events to different atmospheric processes allows us to choose different parameterisation schemes and assess model outputs against:

- cloud CCI
- Water vapour CCI (IVT)
- LST (IST) CCI
- GrIS CCI SEC

e.g. 2011 extreme precipitation and 2012 extreme melt events





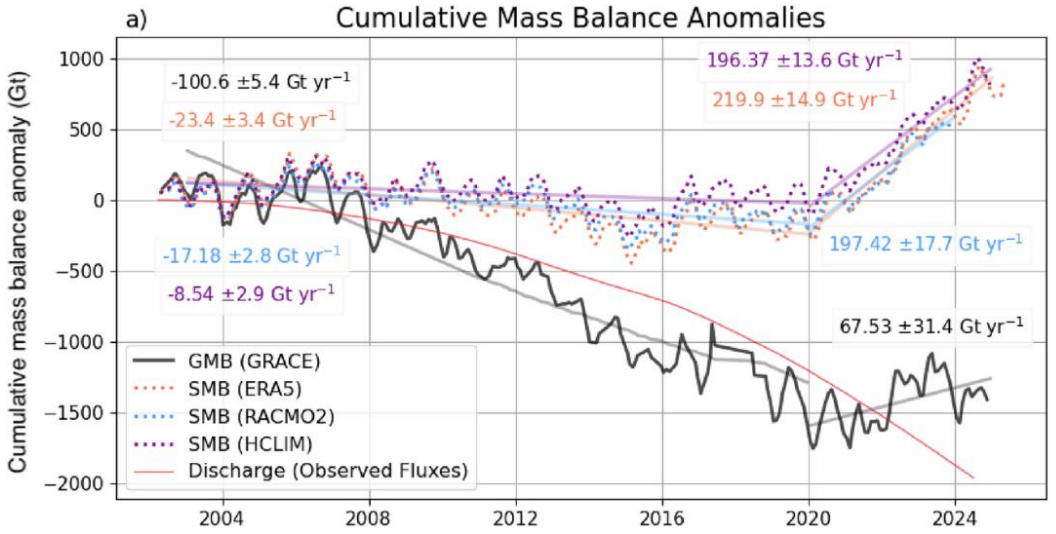


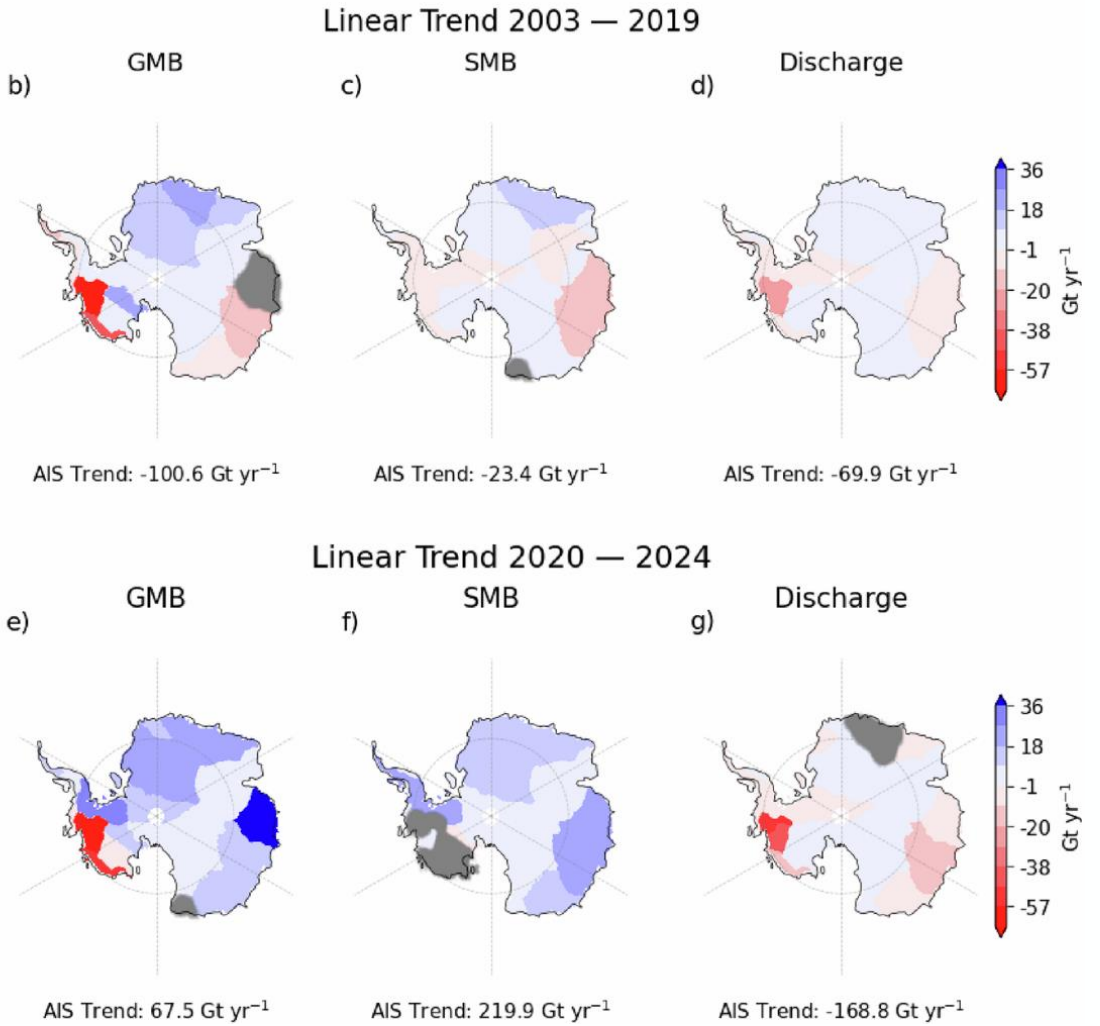
Top: Different precipitation simulations from Bjørg Jenny Engdahl, MetNo

Right top and bottom, Andrea Vang, Copenhagen University and Priscilla Mooney, Norce

What is the Antarctic mass budget trend ?

How to explain GRACE observations of changing trend in AIS mass budget?





communications earth & environment

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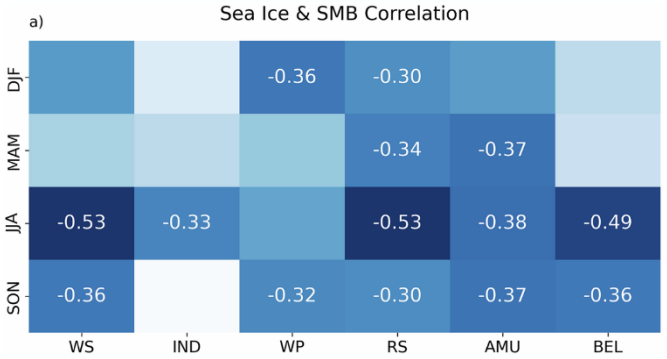
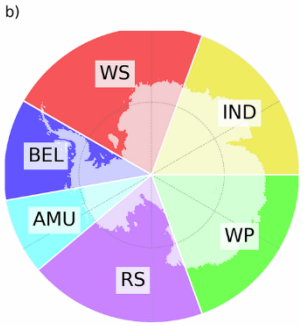
Atmospheric rivers and winter sea ice drive recent reversal in Antarctic ice mass loss

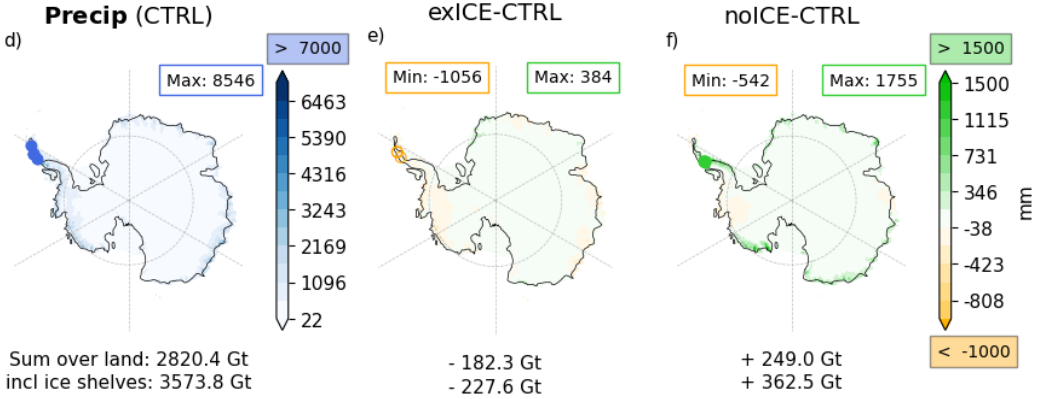
Marlen Kolbe ✉, Jose Abraham Torres Alavez, Ruth Mottram, Marwan Katurji, Richard Bintanja & Eveline C. van der Linden

Sea ice and SMB…

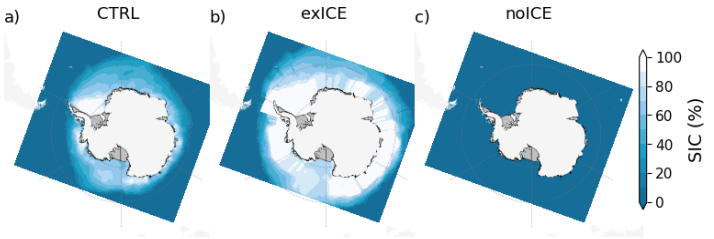
Experimental simulations with and without sea ice show that around a 10% increase in SMB maybe attributed to winter sea ice (SIC) decline since 2016 and 3% in summer

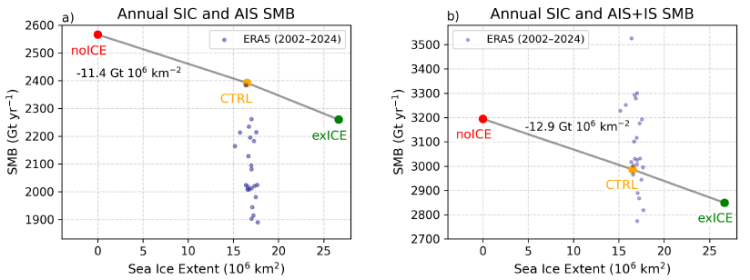


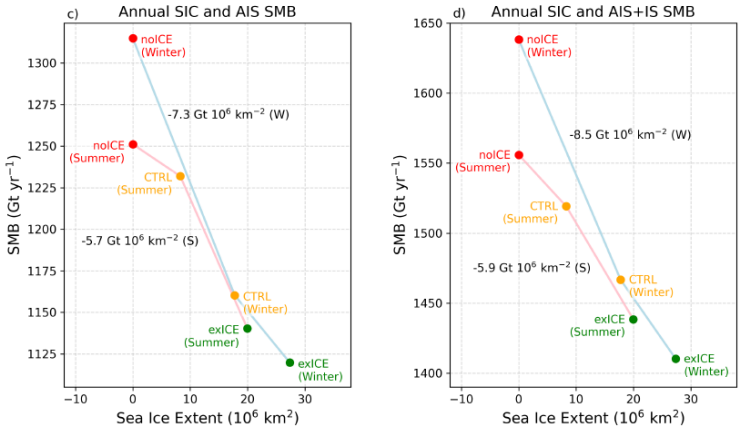




From Kolbe et al., 2026



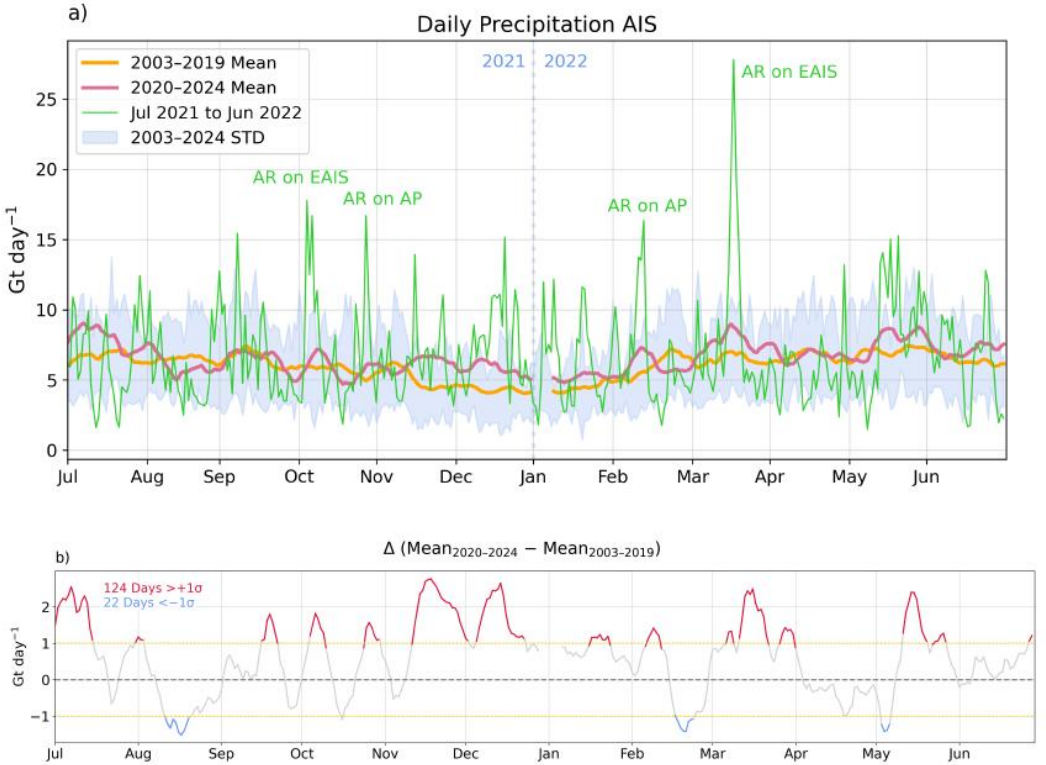


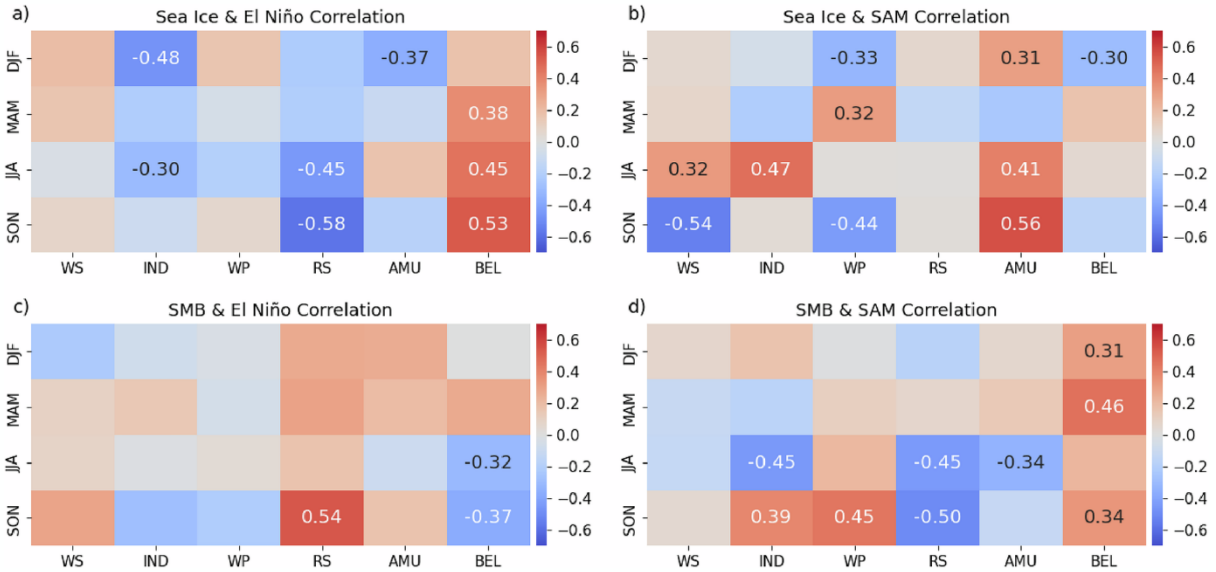


Atmospheric rivers drive SMB increase

Increase in total number and intensity of atmospheric rivers is primarily responsible for change in trend of AIS mass budget.

But will it continue?



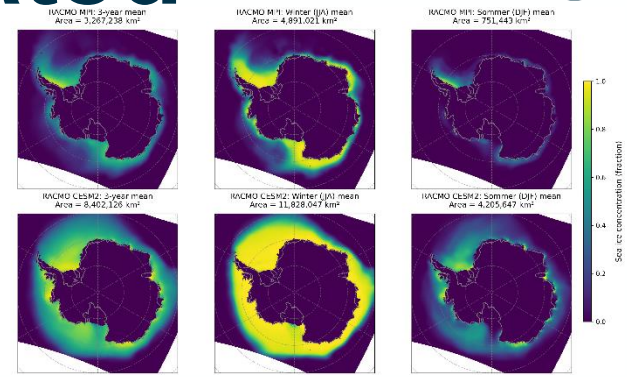


From Kolbe et al., 2026

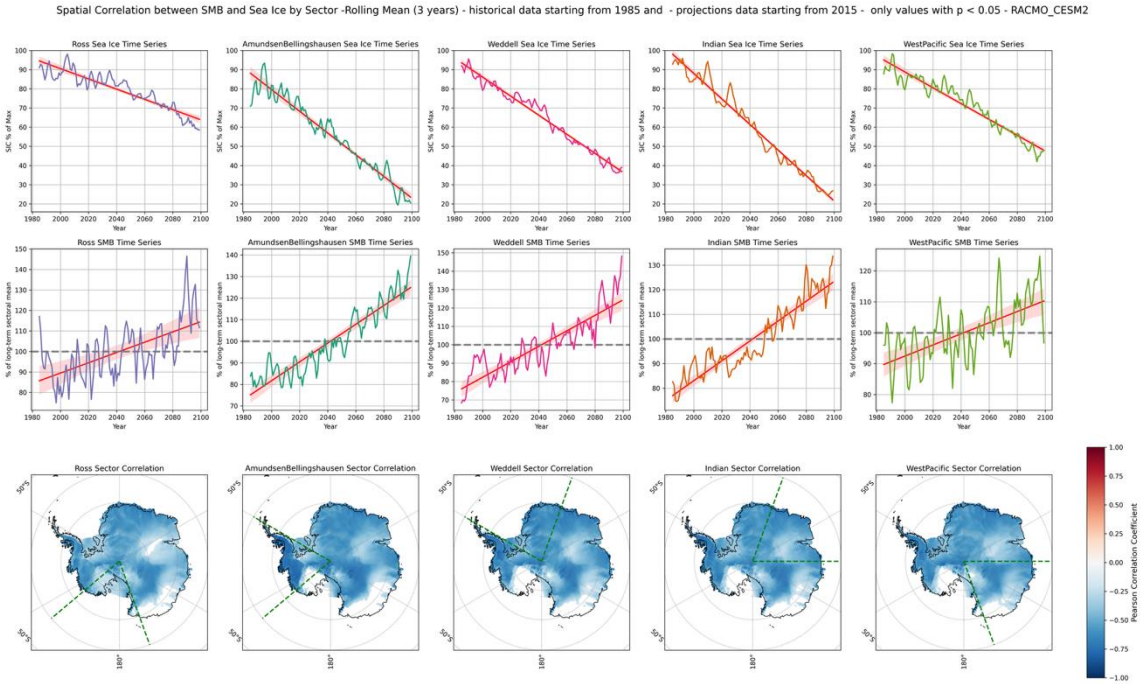
Future projections? It's complicated

Similar SMB/sea ice correlation by sector but very different gradients and variability: representaton of ENSO by models turns out to be important to AIS mass budget

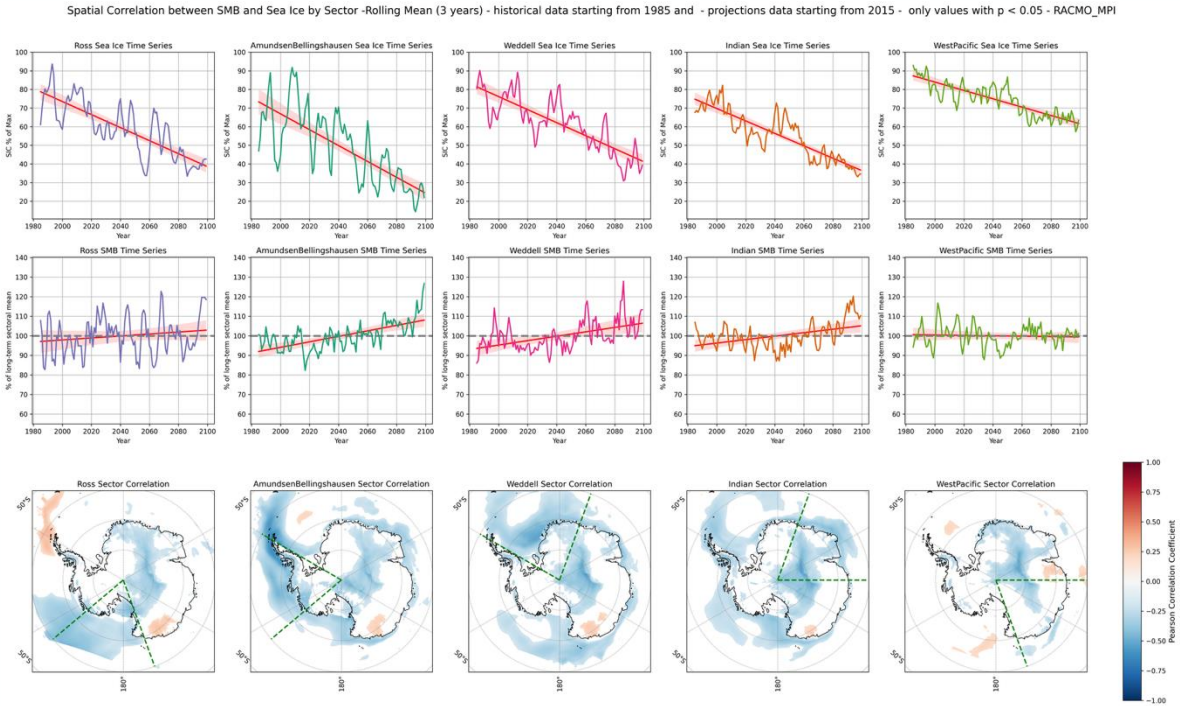
Work from first PISCO/PolarRES hackathon



Storyline 1: CESM2



Storyline 2: MPI-ESM



The ClimateSpace: Polar climate hackathon

24th – 30th August 2026, Åh Stiftegard, Sweden

Pre-registration now open!

Open to all ECRs working across the range of polar climate and crysophere processes with different backgrounds

Also looking for senior scientists who would like to mentor hackathon groups or to run projects

Free participation and some funding available to support travel

Scan here to find out more.
Deadline for registration
30th April

2025 PISCO/PolarRES hackathon, Budapest