BJERKNES CENTRE for Climate Research

iC3 Centre for ice, Cryosphere, Carbon and Climate

Antarctic Ice Sheet modelling – the needs, challenges, and opportunities for Norwegian Antarctic research

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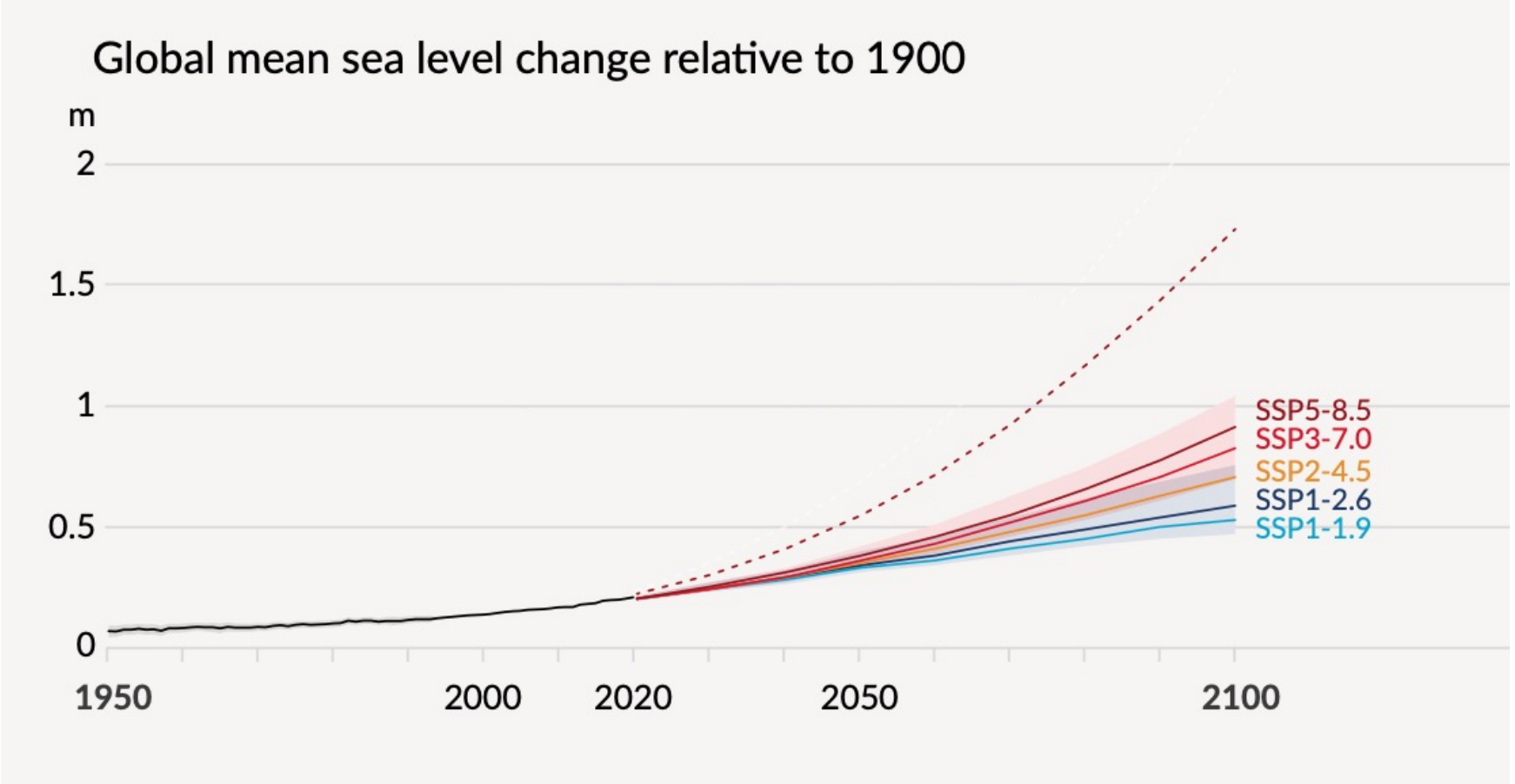
UNIVERSITY OF BERGEN NORCE NERSC HAVFORSKNINGSINSTITUTTET INSTITUTE OF MARINE RESEARCH

Need: reduce uncertainties in sea level projections



Sea level rise:

thermal expansion ocean
+
ice loss from glaciers,
Greenland and Antarctica

IPCC Report, 2021, Summary for policy makers

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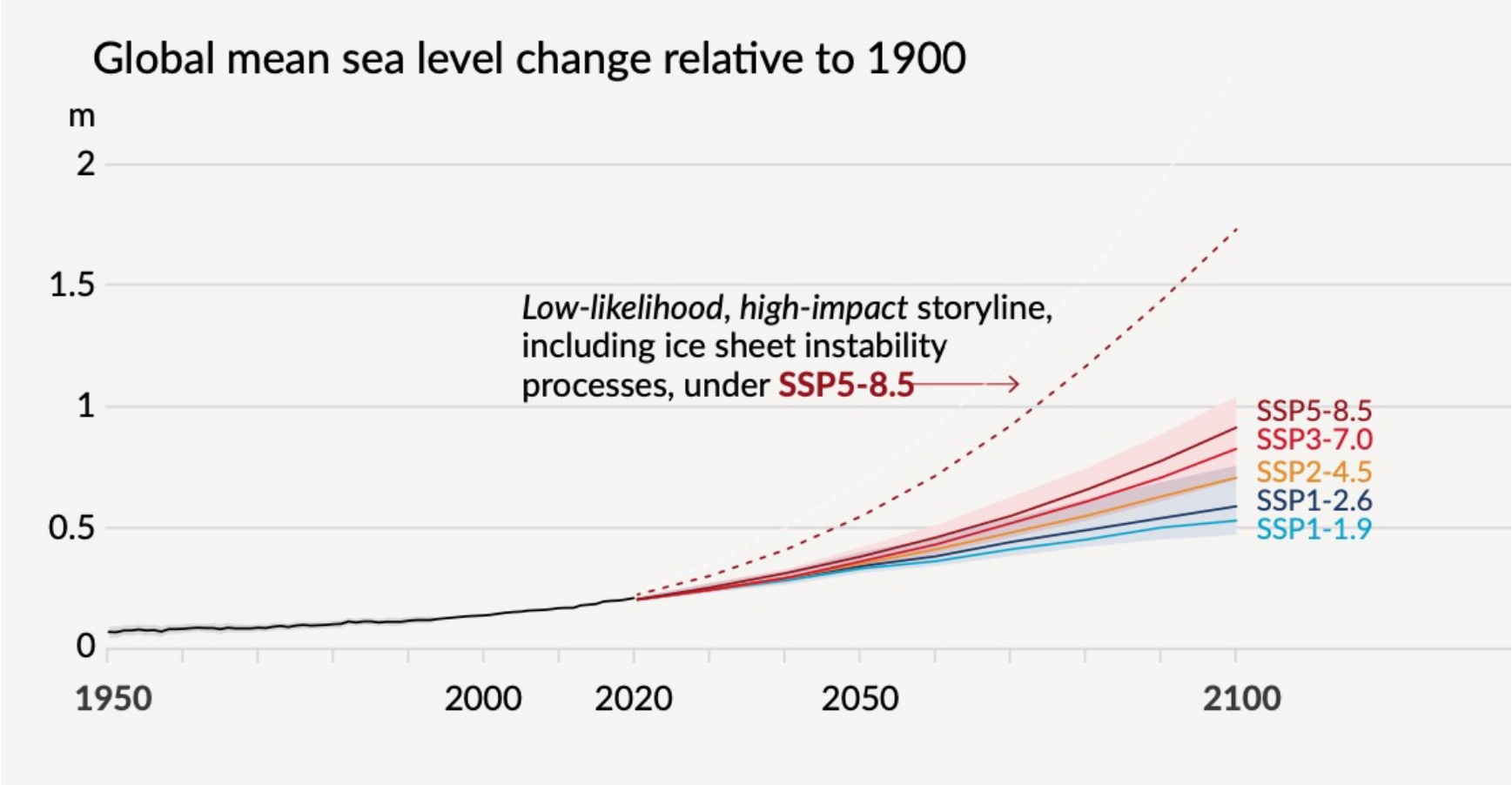

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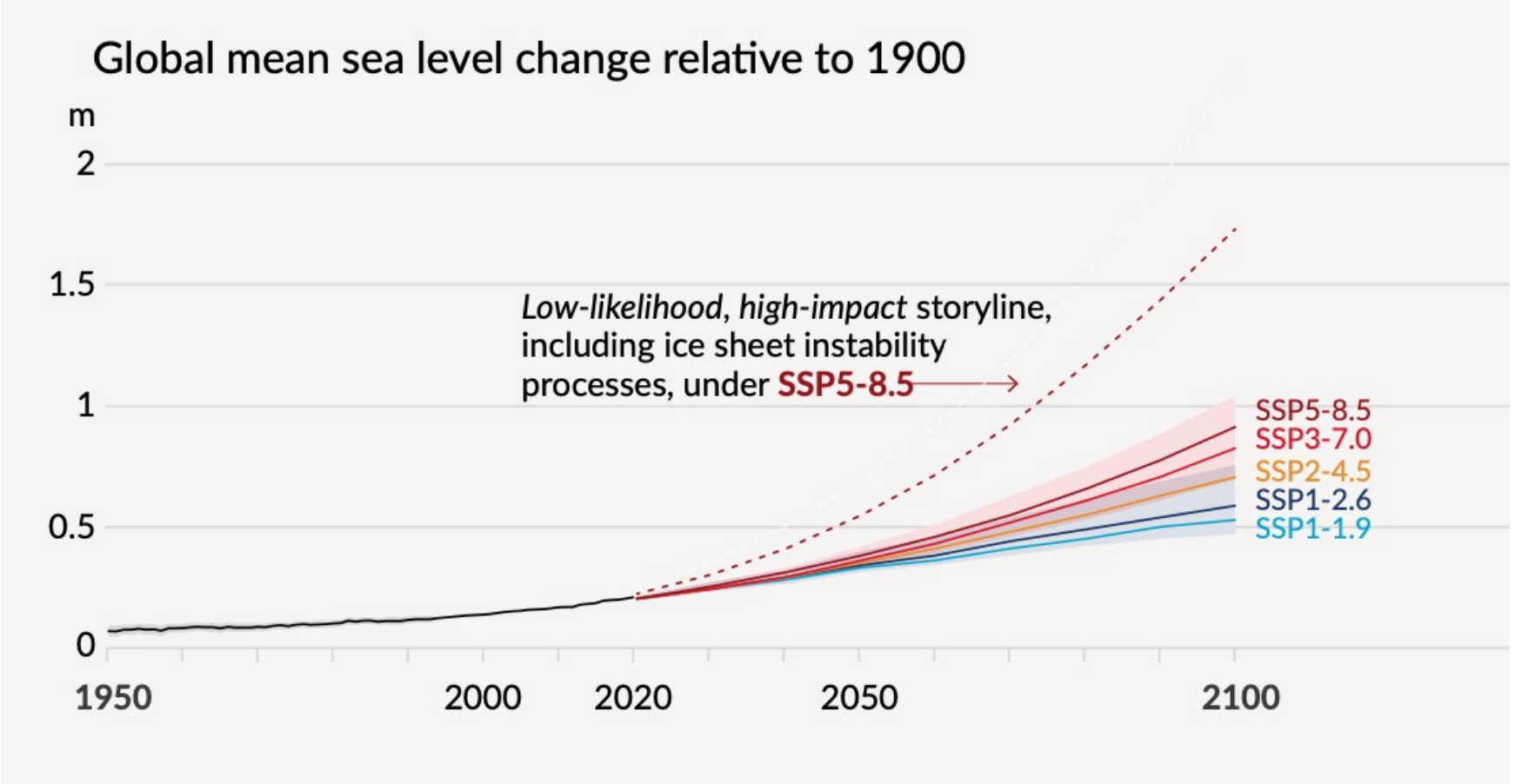

Sea level rise:

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ice loss from glaciers, Greenland and Antarctica

Sea level rise in 2300:

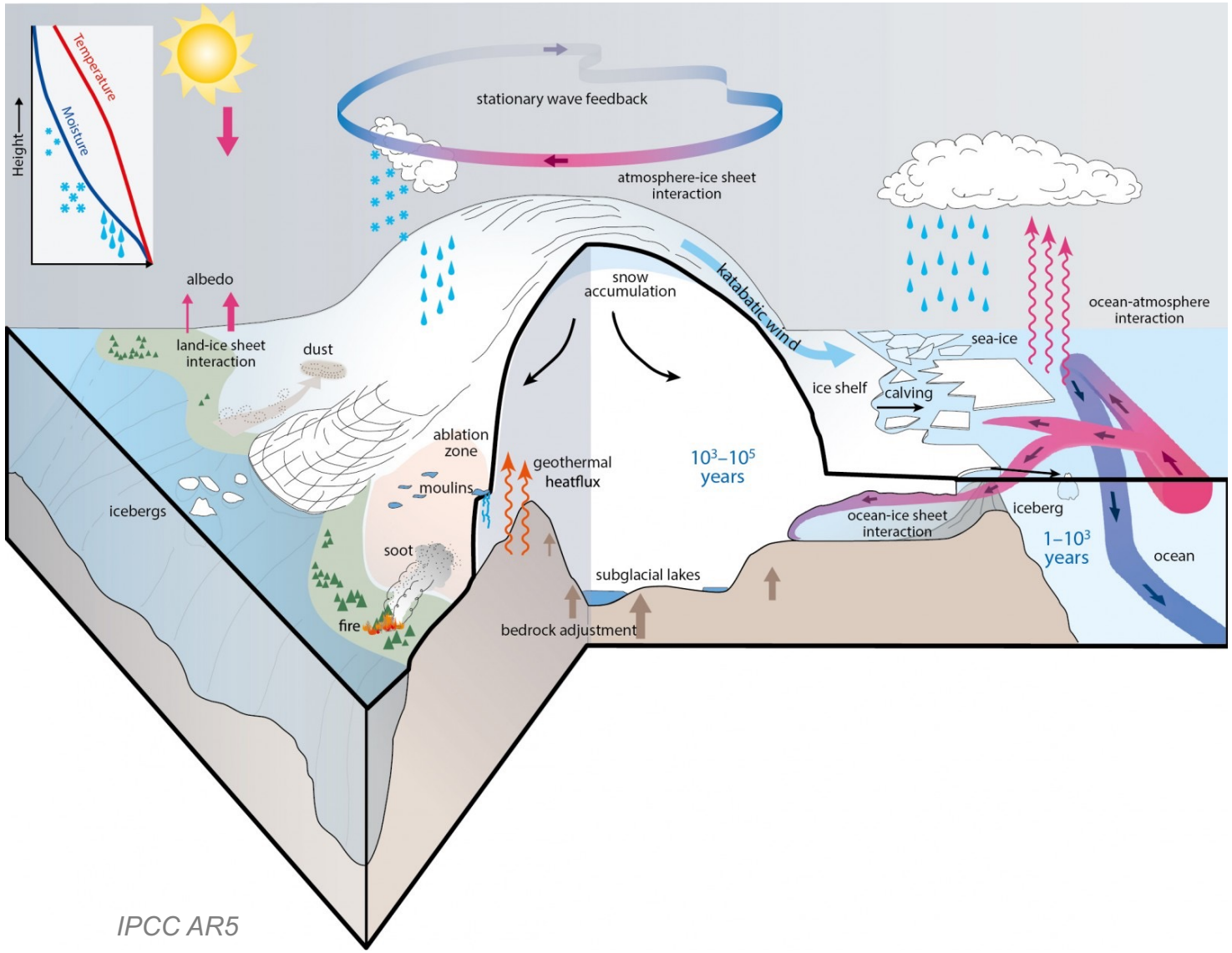
1-3 m (low emission scenario)

2-7 m (high emission scenario)

more than 15 m cannot be ruled out

IPCC Report, 2021, Summary for policy makers

Challenge: Antarctic Ice Sheet

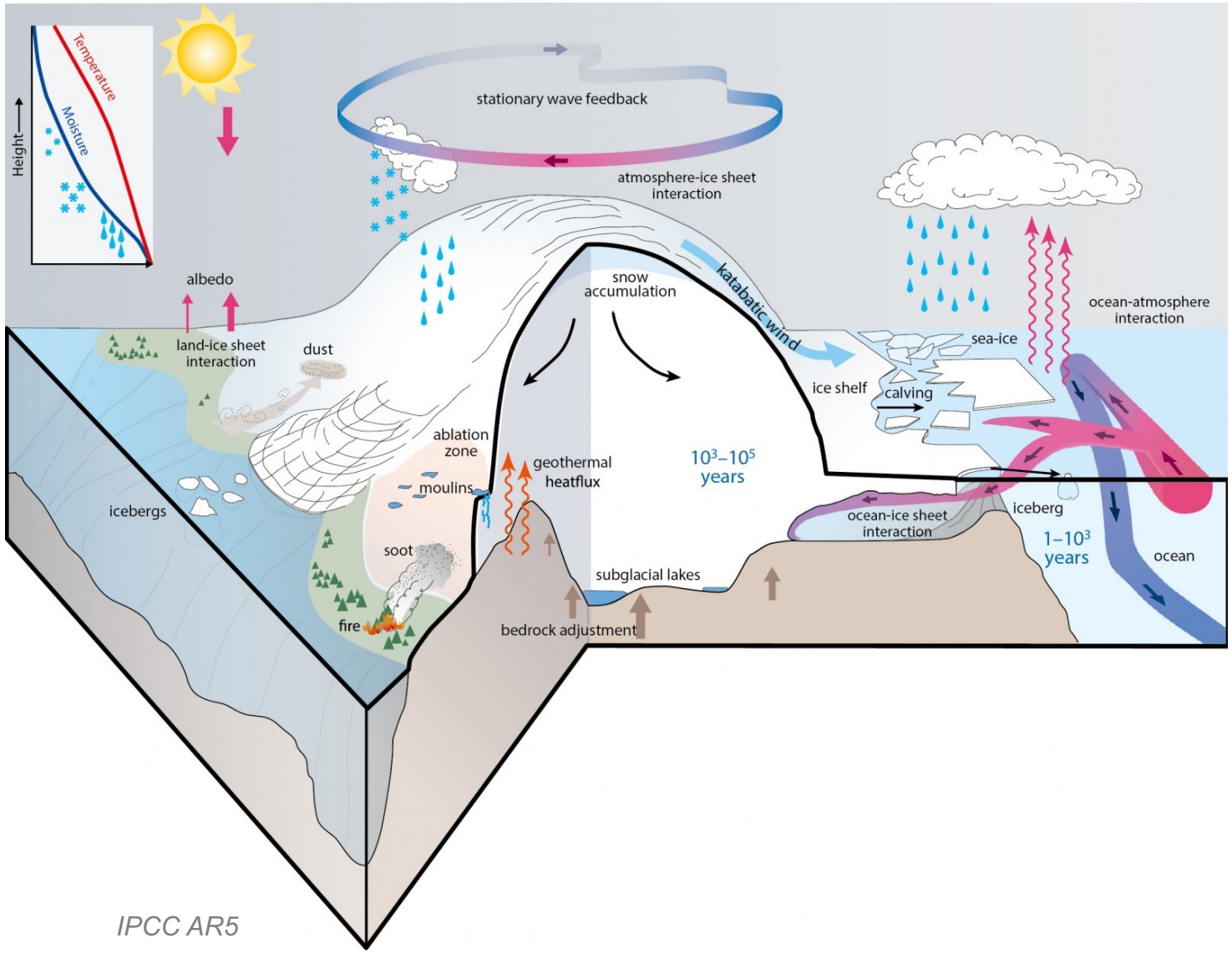


IPCC AR5

Ice sheets interact with all other parts of the Earth system

Diverse spatial and temporal scales

Opportunity: research!



IPCC AR5

Impact of climate change on ice sheet stability (hence sea level)?

- How much & fast can ice sheets change?
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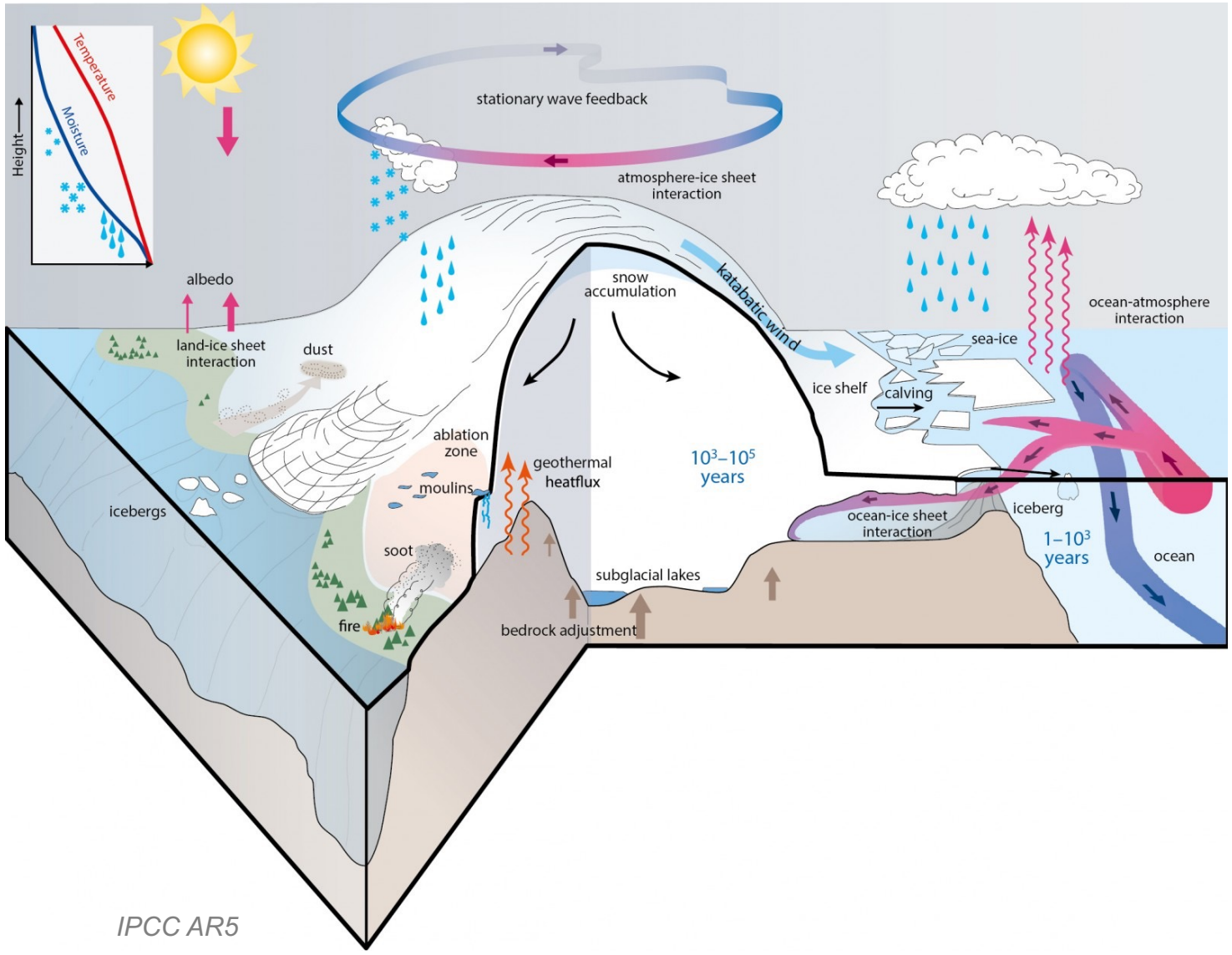
Opportunity: research!



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Impact of ice sheet change on climate?

- Through freshwater fluxes on ocean circulation?
- Through heat budgets and carbon cycle?
- Impact on ecosystems?

Opportunity: research & collaboration!

Tipping Points in Antarctic Climate Components

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The TiPACCs project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 820575

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Some highlights from TiPACCs

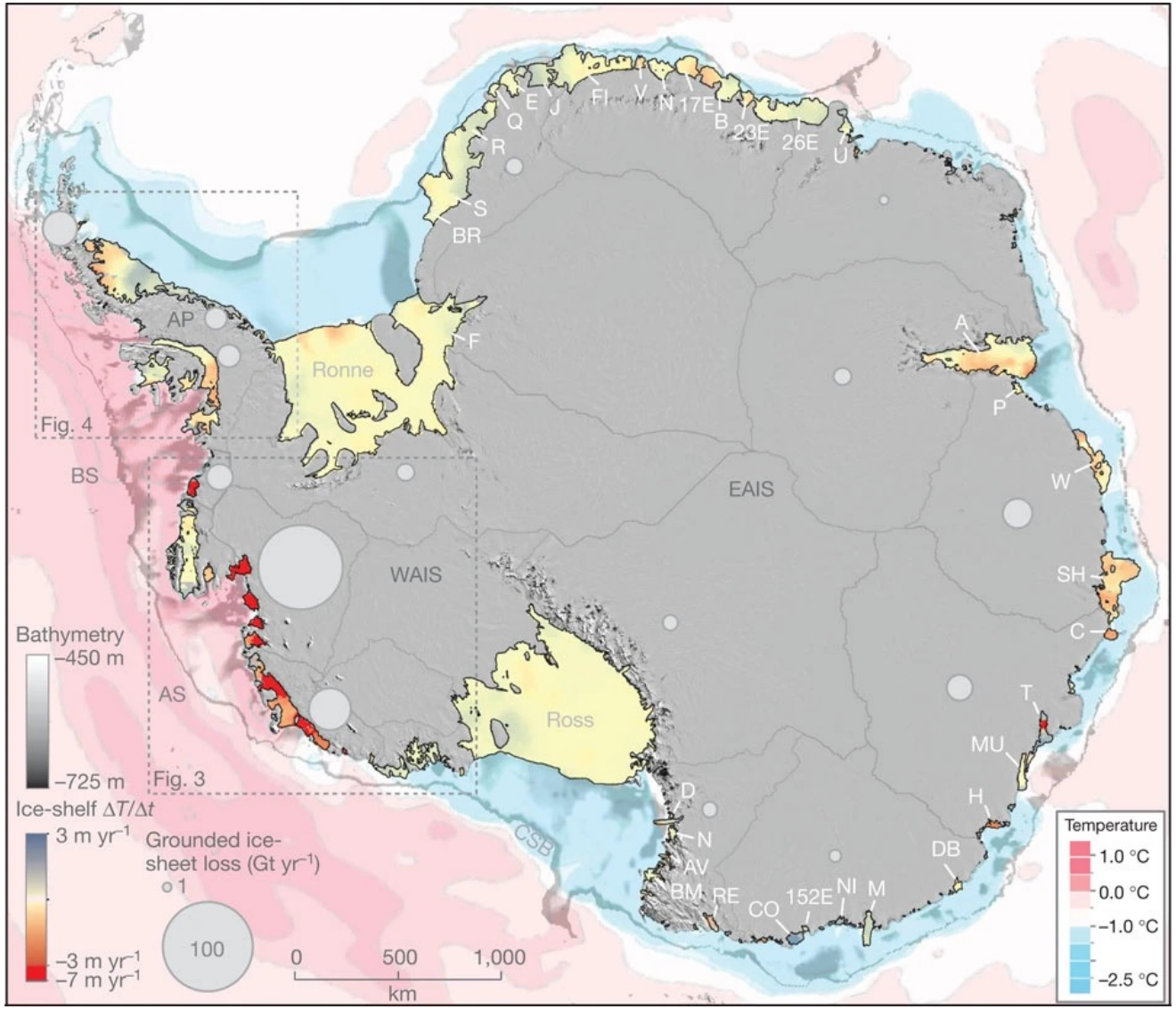
Tipping Points in Antarctic Climate Components

EU Horizon 2020 project
August 2019 – January 2024 (4.5 years)
Led by NORCE (Norway)
Partners in Germany, UK and France
Total budget: 4.6 mEUR

Photo: Svein Østerhus

NORCE
Northumbria University NEWCASTLE
PIK
AWI ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG
UGA Université Grenoble Alpes

What's happening in Antarctica today ?

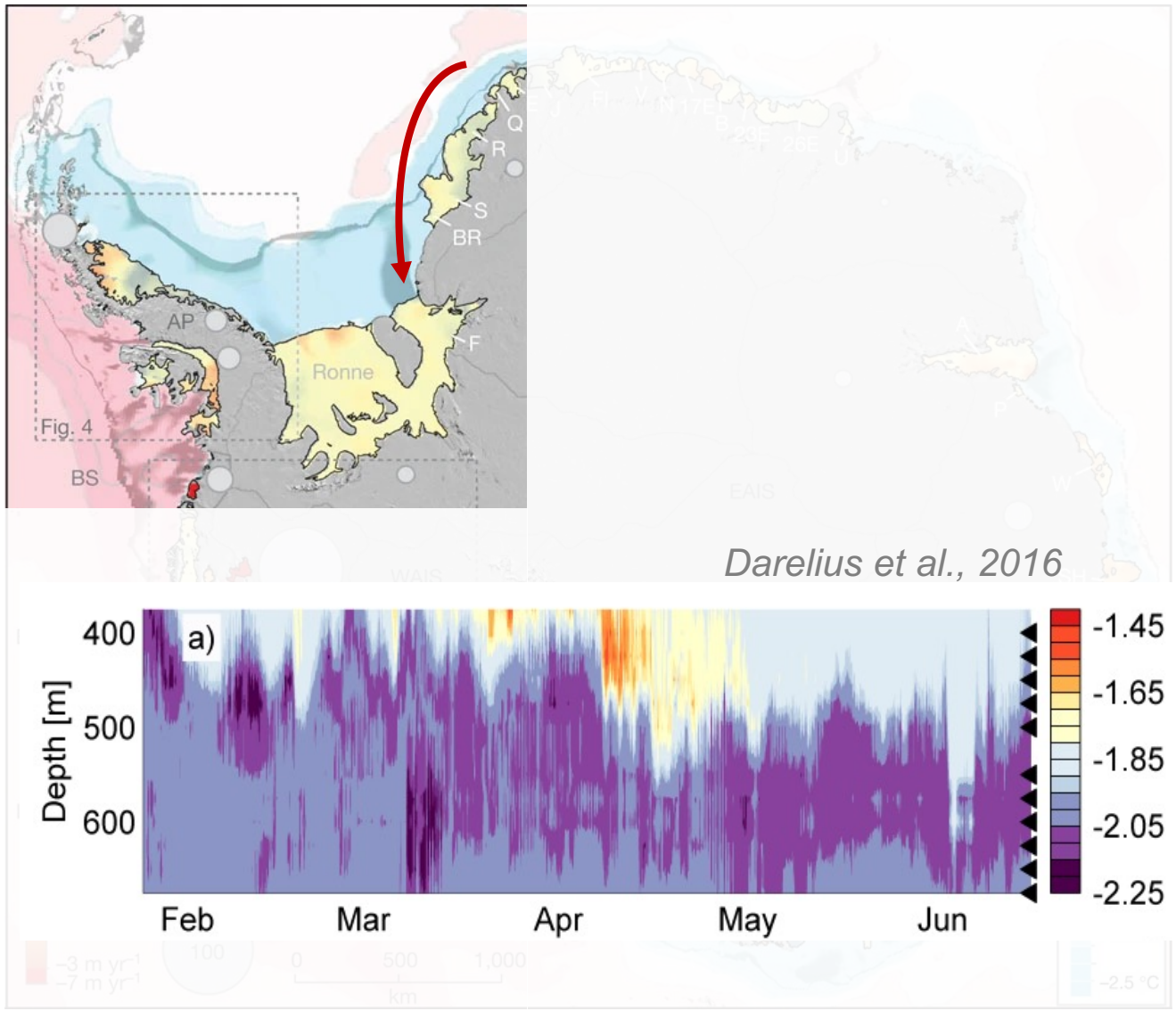


Ice sheet is losing mass especially in West Antarctica

Ice shelves are thinning

Pritchard et al., 2012

What's happening in Antarctica today ?



Darelius et al., 2016

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Observations of "warm" waters reaching "cold" ice shelf cavities, such as Filchner in 2013

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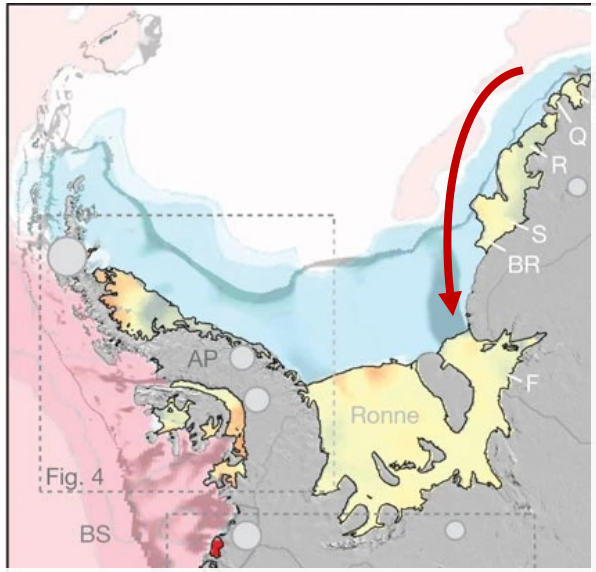

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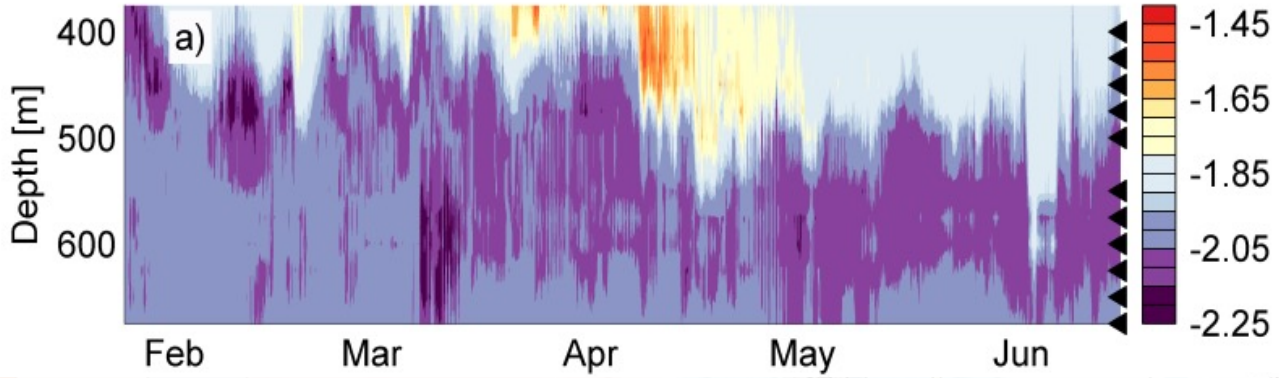

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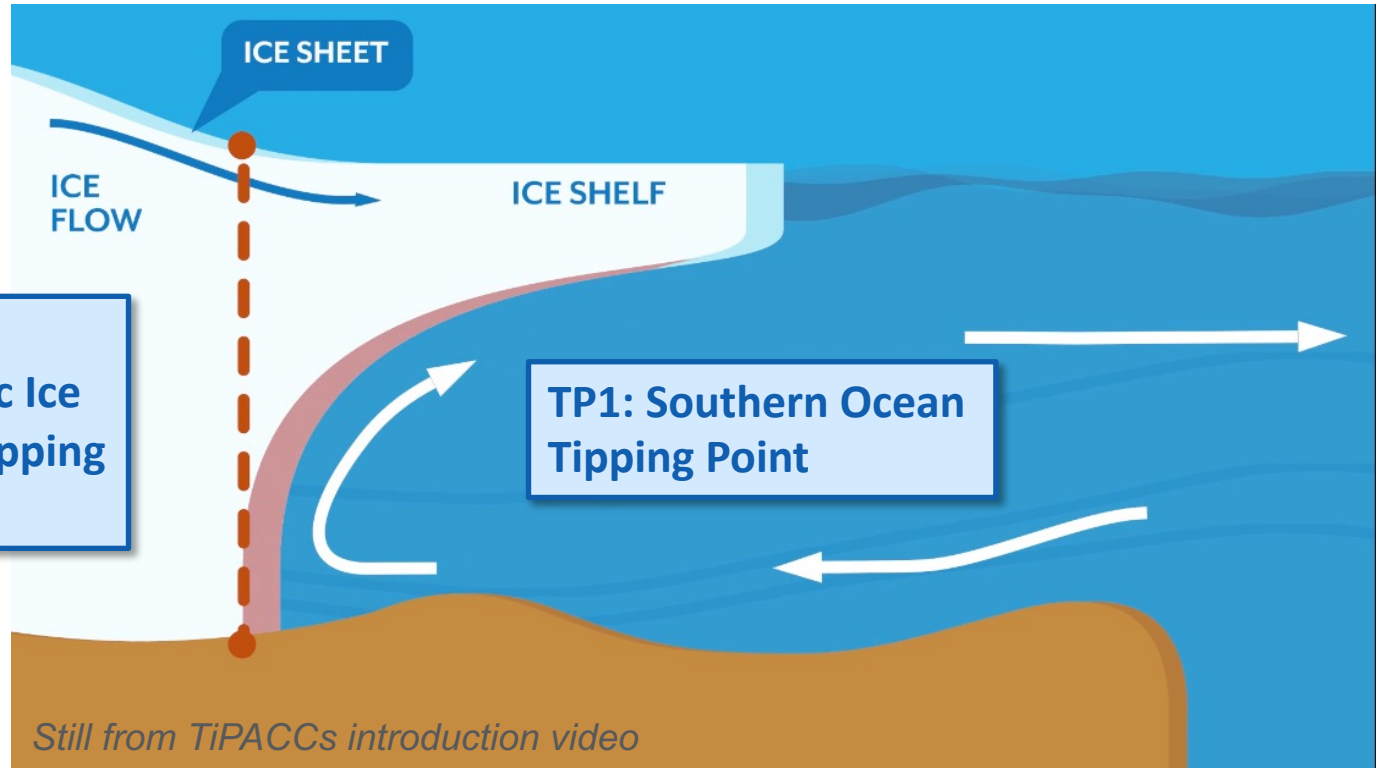
Observations of "warm" waters reaching "cold" ice shelf cavities, such as Filchner in 2013

What will happen with the large ice shelves?
Did we already cross tipping points in Antarctica?
Is ice retreat irreversible?

TiPACCs: Tipping points in Antarctic Climate Components



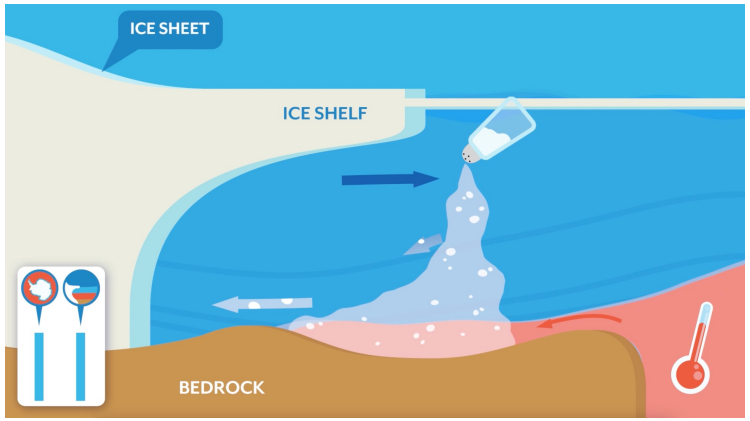
TP1: Southern Ocean
A switch from a cold to a warm ocean (ice shelf cavity)

TP2: Antarctic Ice Sheet
A switch from stable to unstable grounding lines

TP1+TP2
Coupled ocean – ice sheet system

Summary of (some) TiPACCs results

TP1: Southern Ocean



*Under **which conditions** do the **Antarctic continental shelf seas switch from a "cold" to "warm" state** ?*

- All ocean models (FESOM, NEMO, MITgcm) show abrupt transitions under some future climate forcing
- Response varies per model, region, timescale and forcing
- Looks to be reversible, so maybe rather an abrupt transition than a tipping point

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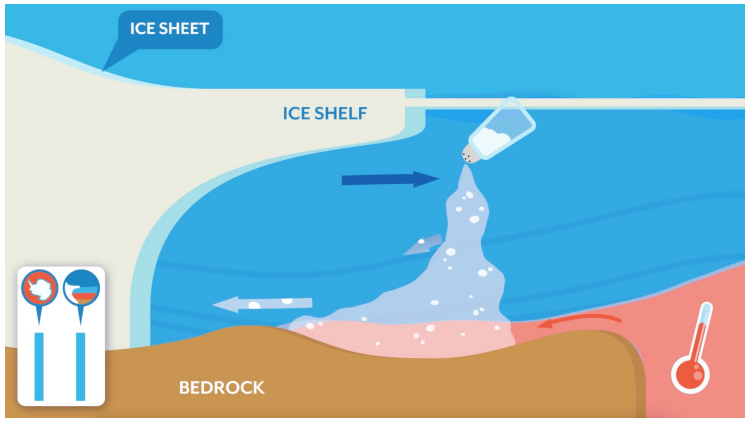

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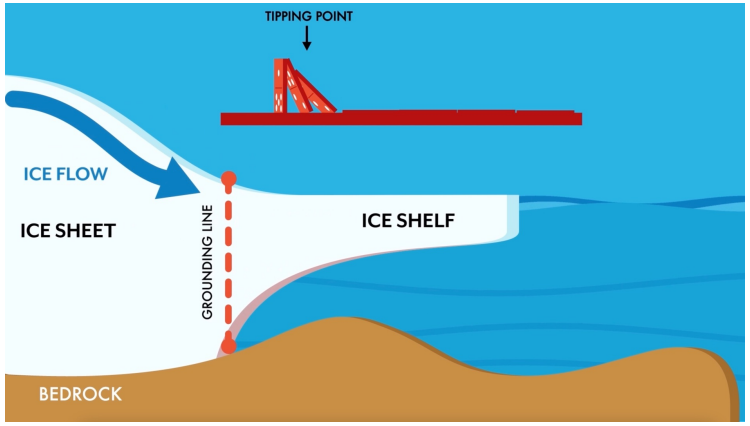
TP2: Antarctic Ice Sheet



*How **stable** are the grounding lines of the Antarctic ice sheet, now and after **enhanced ice-shelf melting** ?*

- All ice sheet models (PISM, Elmer/Ice, Úa) show the same result:
- Grounding lines are stable in their current configuration
  Current ongoing retreat not due to crossed tipping point (no MISI yet)
- Some grounding lines will tip (irreversibly) under sustained climate forcing (PISM)

Summary of (some) TiPACCs results

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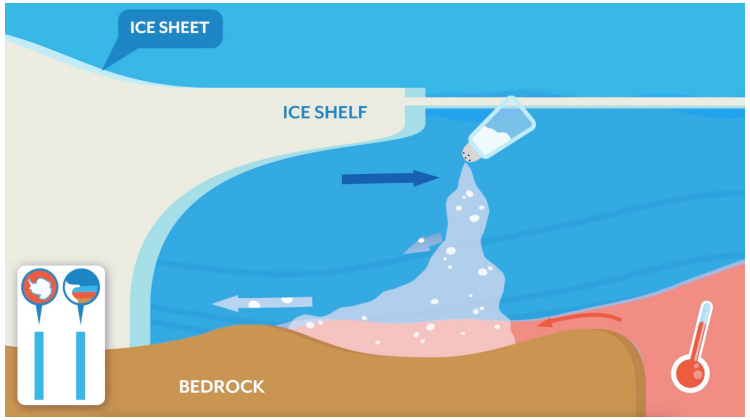

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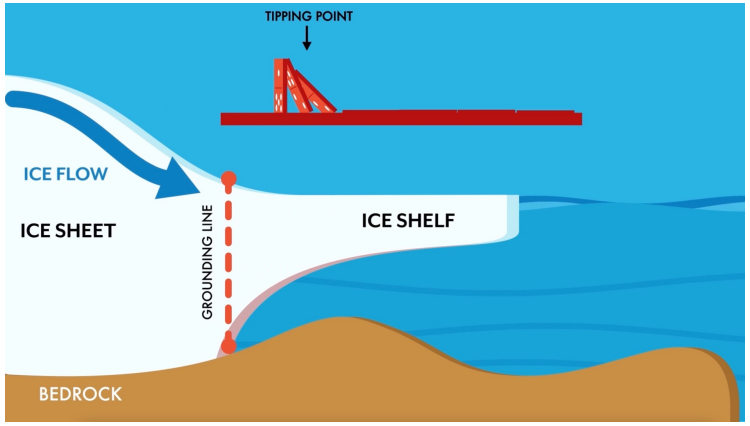

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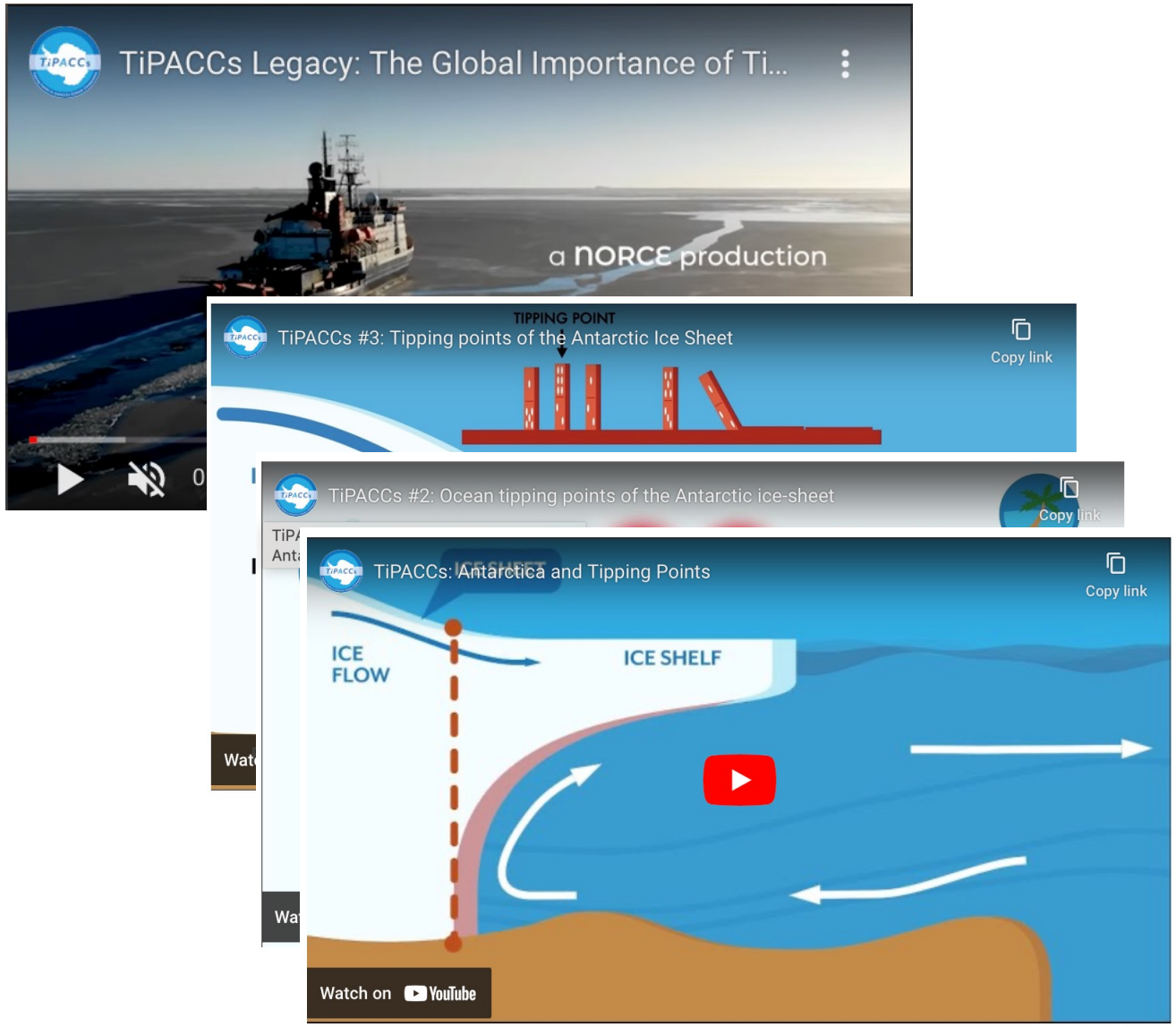
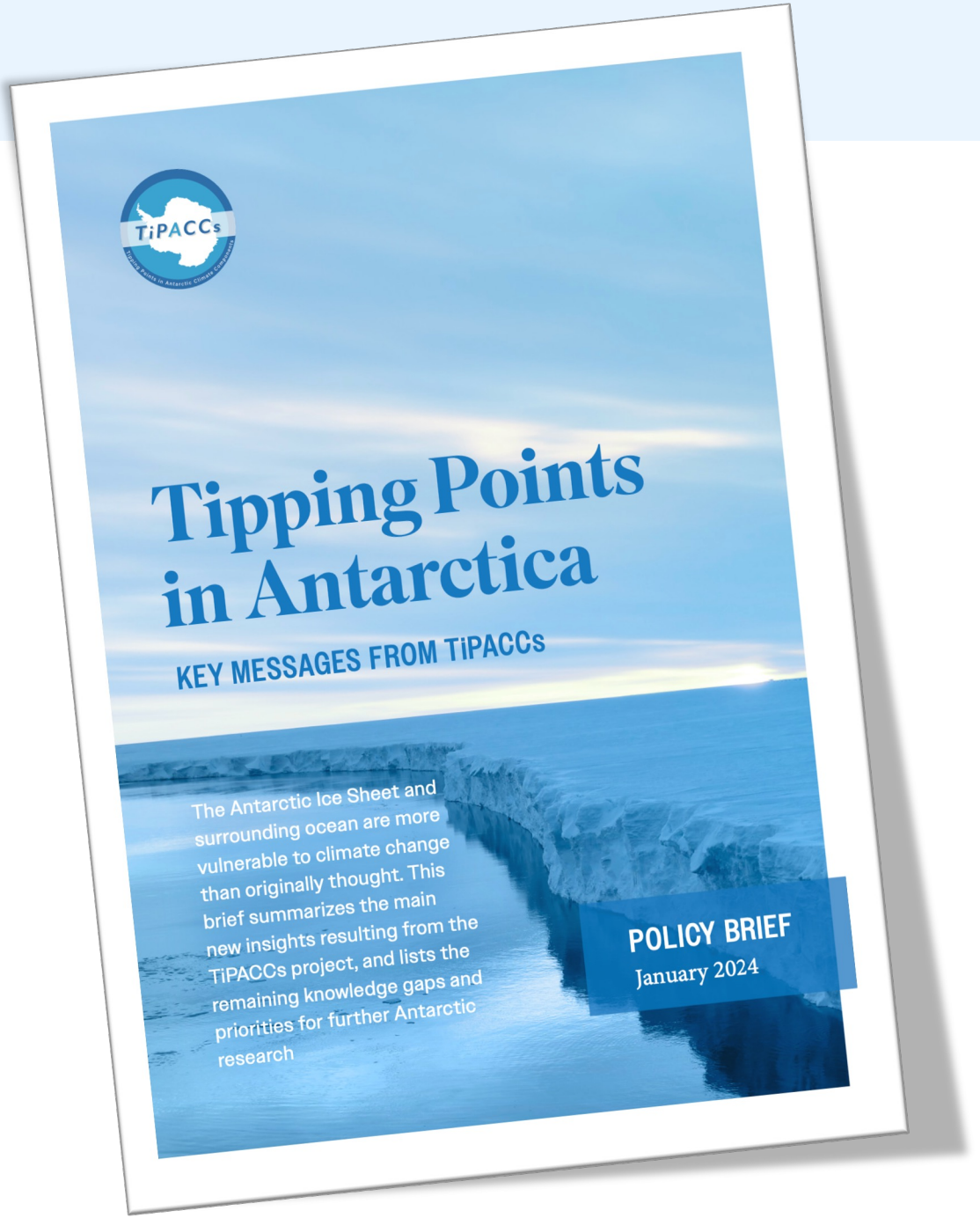
TP1+TP2

Enormous progress in coupled ocean – ice sheet modelling !

TiPACCs outreach





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OCEAN:ICE is co-funded by the European Union, Horizon Europe Funding Programme for research and innovation under grant agreement Nr. 101060452 and by UK Research and Innovation

OCEAN:ICE

iC3 Centre for ice, Cryosphere, Carbon and Climate

INES KeyCLIM CLIM2Ant, and many more RCN and EU projects…

Modelling: a tool for research & collaboration!

+ CISM

Working on implementing a model for the Antarctic Ice Sheet (CISM) into the Norwegian Earth System Model (NorESM)

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My suggestions for a strong(er) Norwegian Antarctic research community:

Encourage scientific collaboration
International and national, build on our networks

Expand and share our scientific knowledge
Seminars, workshops, training of (ECR) researchers, being inclusive, promote our Norwegian research

Tools and infrastructure
Not only research stations and ships, but also support for ice sheet and climate model infrastructure and development

Support scientific work
Support tools and infrastructure, but also research time & projects