Tipping Points in Antarctic Climate Components

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TipESM kick-off meeting, January 2024

Photo: Svein Østerhus

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Links between TipESM and TiPACCs

TipESM

(All?) Tipping points & elements

Physical, biogeochemical & societal TPs

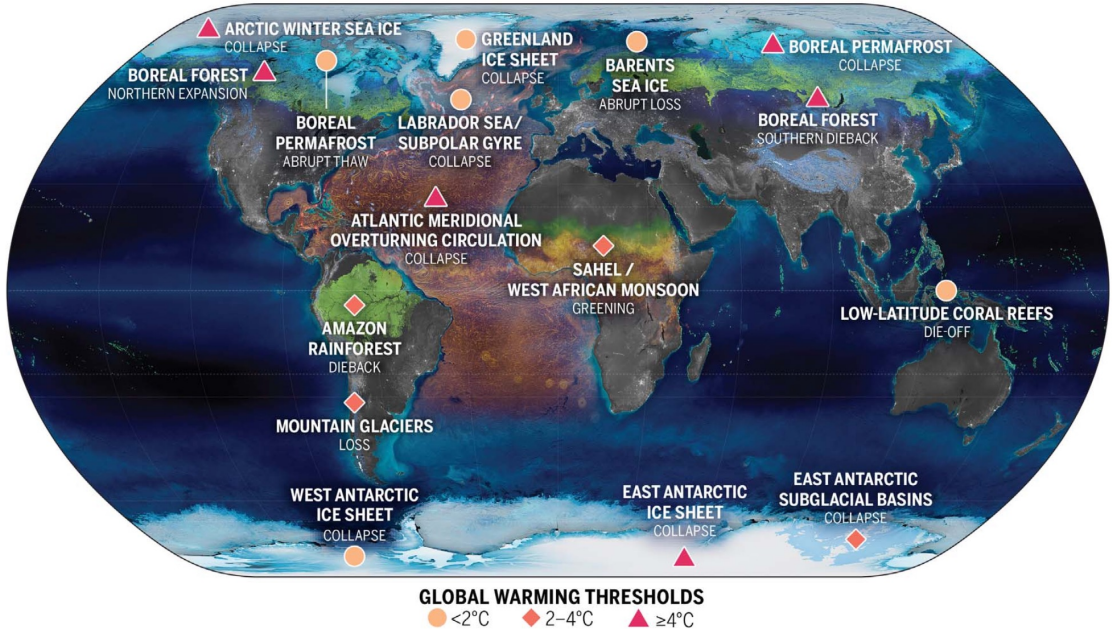
6 ESMs

TiPACCs

Tipping points in Antarctica

Physical system

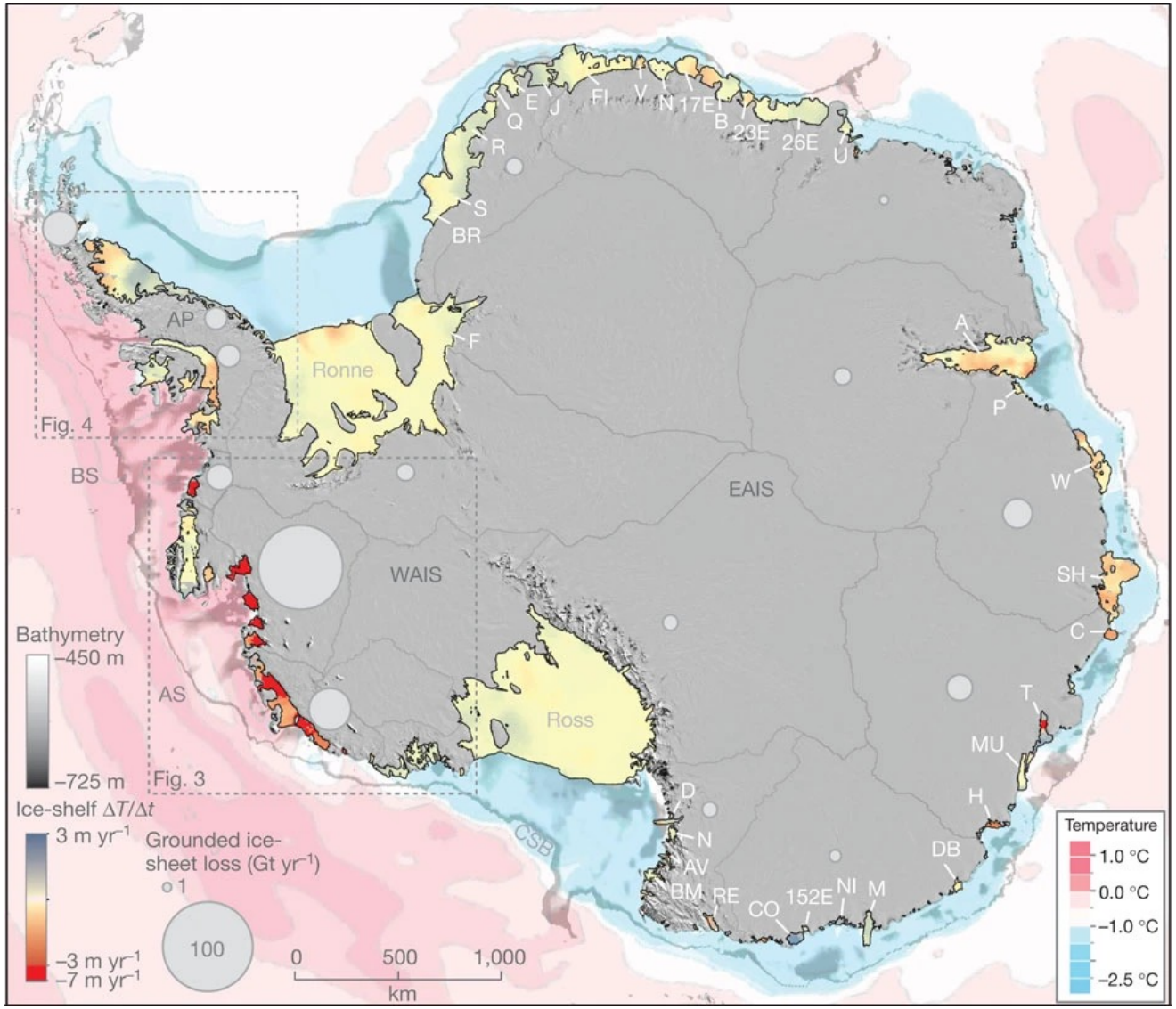
3 (Coupled) ocean and ice sheet models



Armstrong McKay et al., 2022

Photo: Svein Østerhus

What's happening in Antarctica today ?

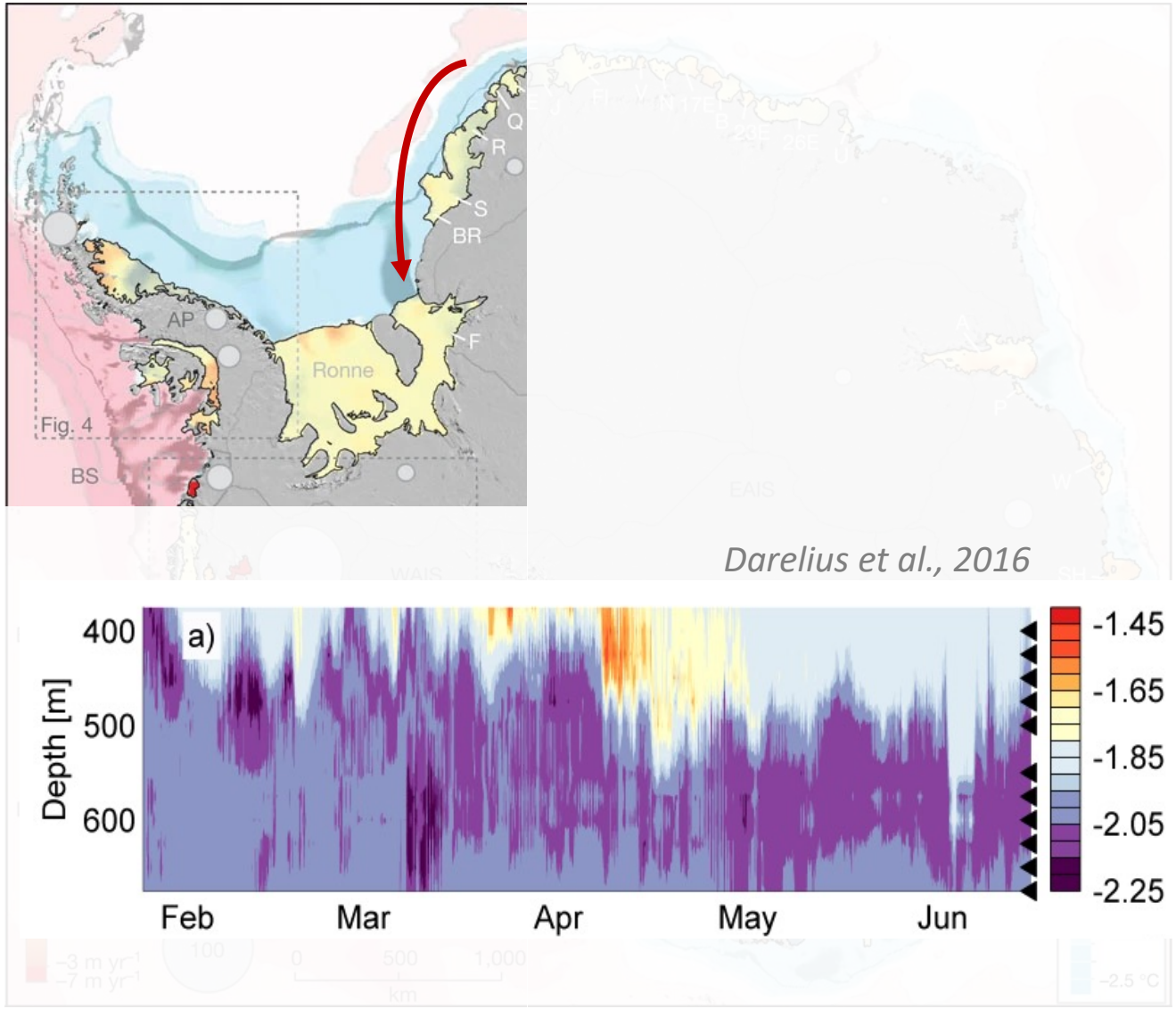


Ice sheet is losing mass especially in West Antarctica

Ice shelves are thinning

Pritchard et al., 2012

What's happening in Antarctica today ?



Darelius et al., 2016

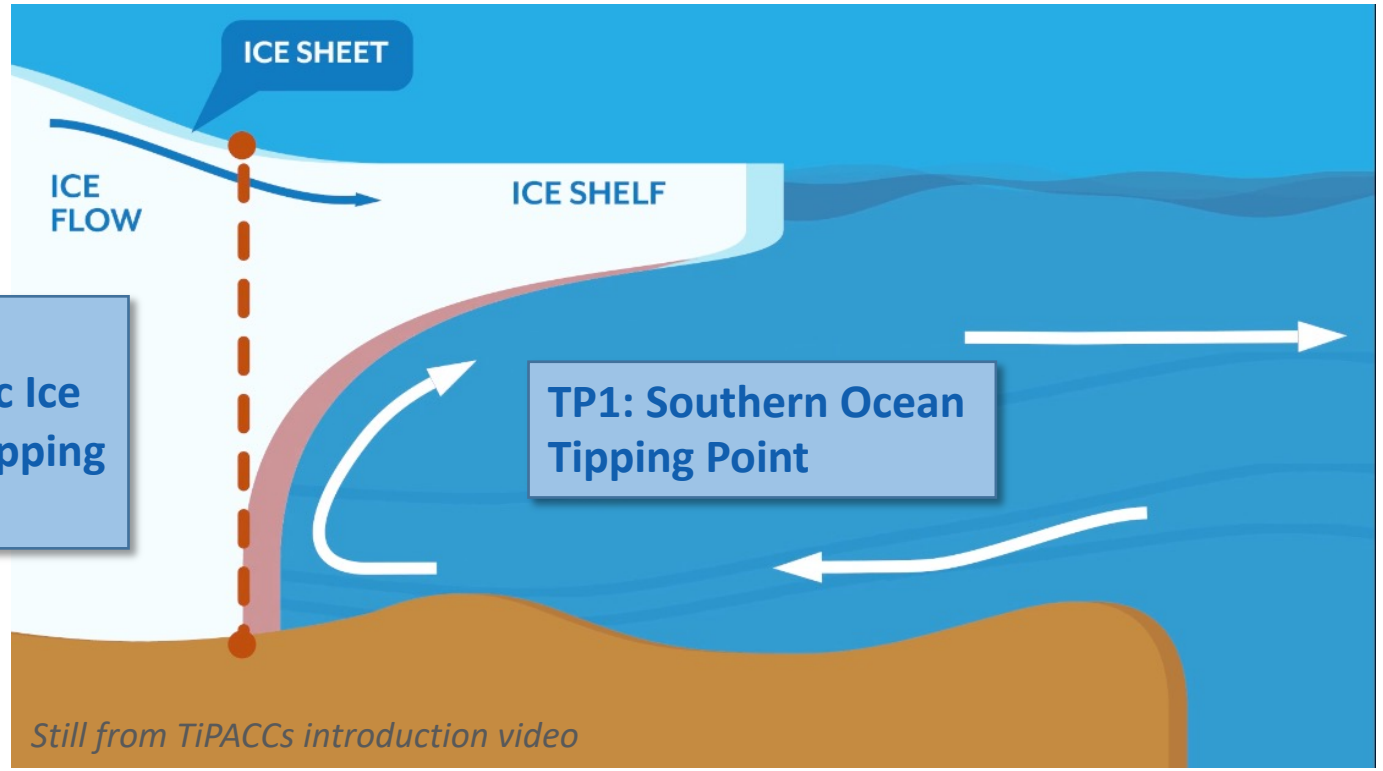
Ice sheet is losing mass especially in West Antarctica

Ice shelves are thinning

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



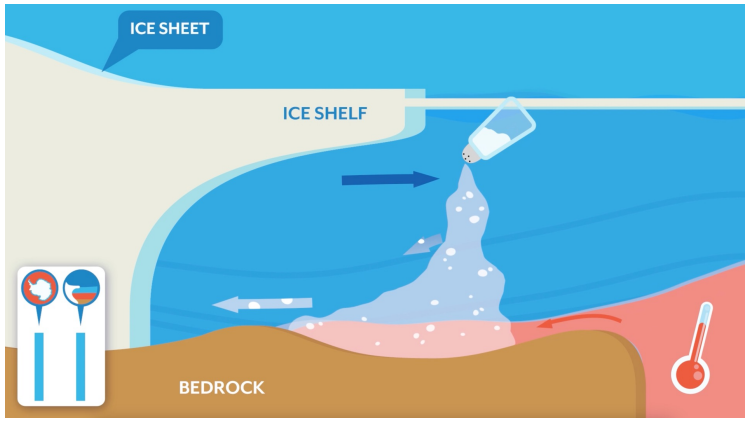
TP1: Southern Ocean TP
A switch from a cold to a warm ocean (ice shelf cavity)

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

TP1+TP2
Coupled ocean – ice sheet system

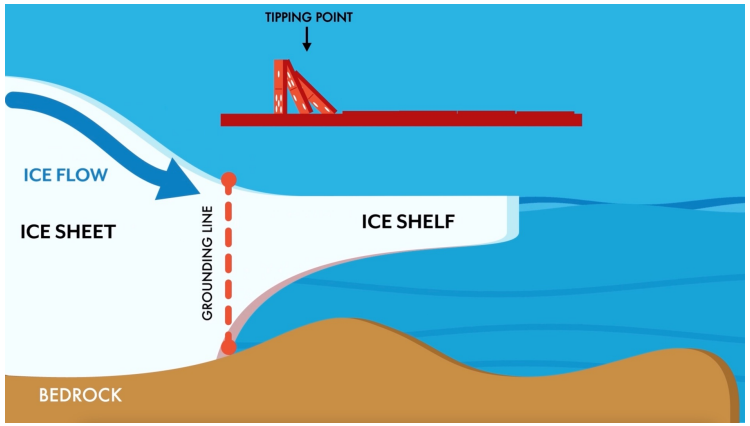
TiPACCs: Tipping points in Antarctic Climate Components

TP1: Southern Ocean



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

TP2: Antarctic Ice Sheet



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

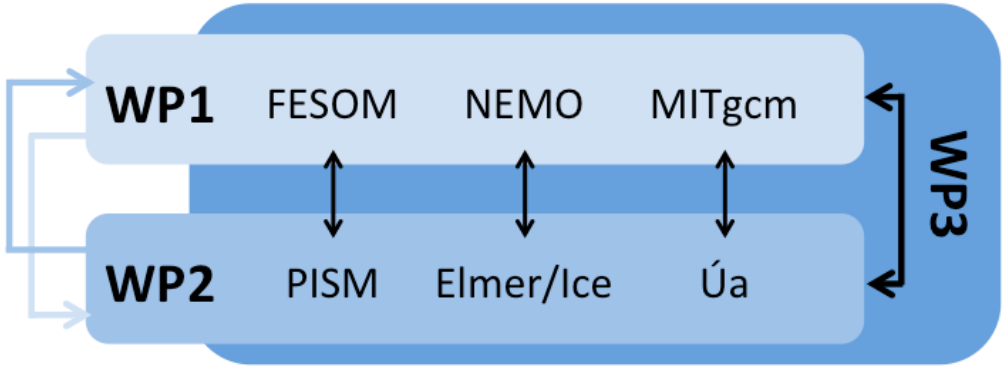
Scientific Methodology

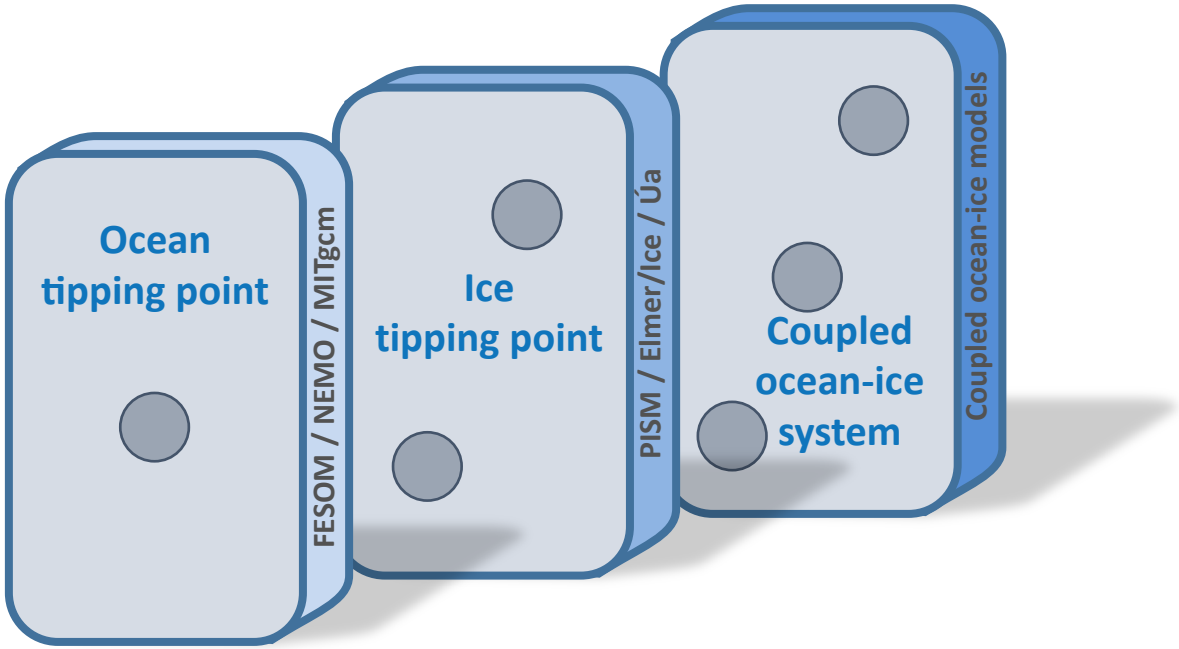
Numerical Models:

- ocean-circulation models (WP1; TP1)
- ice-flow models (WP2; TP2)
- coupled ocean-ice models (WP3; TP1&TP2)

Observations and (paleo) data:

To define proximity of simulated tipping points





TiPACCs team

Around 35 scientists from:

NORCE

Northumbria University NEWCASTLE

AWI

PIK

UGA Université Grenoble Alpes

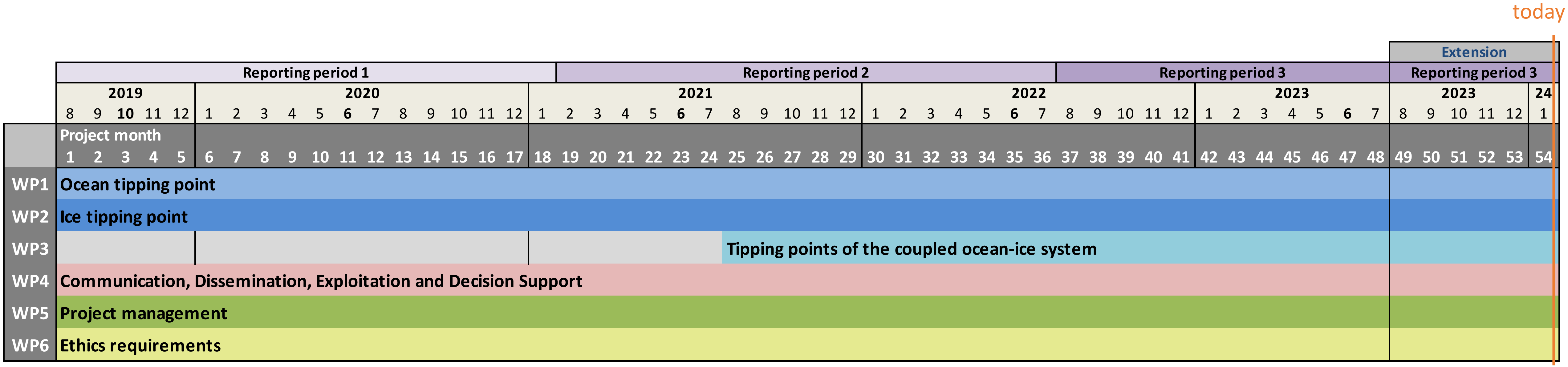
Advisory Board:

Rupert Gladstone
Arctic Centre, University of Lapland

Guðfinna Aðalgeirsdóttir
University of Iceland

Jean-Baptiste Sallée
Sorbonne Université

Project overview and timeline



In 4.5 years:
Successfully finished two reporting periods
Submitted ~40 Deliverables & 8 Milestones, 50+ publications, 4 videos, 1 interactive map, school materials, policy events, …

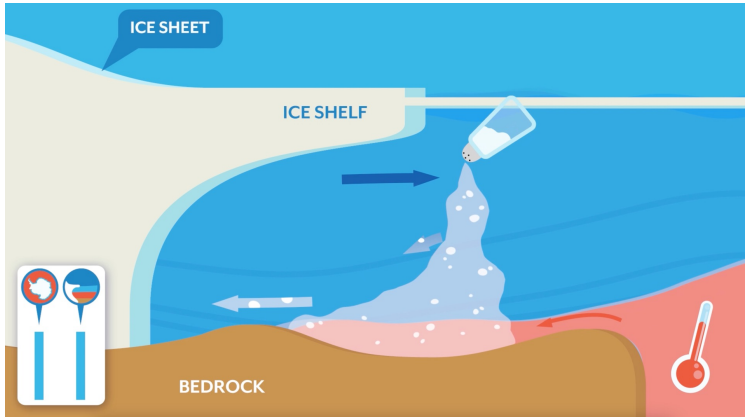
Now: Last 8 days of the TiPACCs project

After January 2024: final reporting

Check out our website:
www.tipaccs.eu

Summary of (some) results

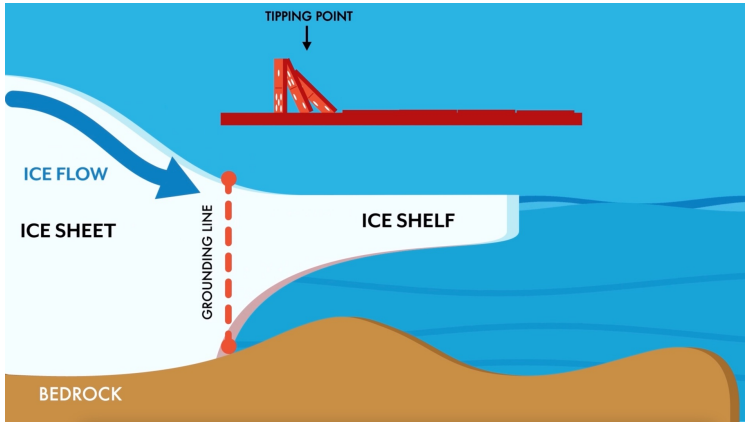
TP1: Southern Ocean



*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

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)

TP1+TP2

Enormous progress in coupled ocean – ice sheet modelling !

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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