OCEAN:ICE

Ocean-Cryosphere Exchange in Antarctica: Impacts on Climate and the Earth System

Impacts of ocean-ice interactions on climate

Speakers:
Dr Ruth Mottram, Senior Scientist, Danish Meteorological Institute
Dr Andrew Meijers, Polar Oceans Science Leader, British Antarctic Survey
Event: The Changing Poles: how Antarctic and Arctic science helps inform and prepare the EU for changes in sea level rise and global climate
Date: 24/1/2024

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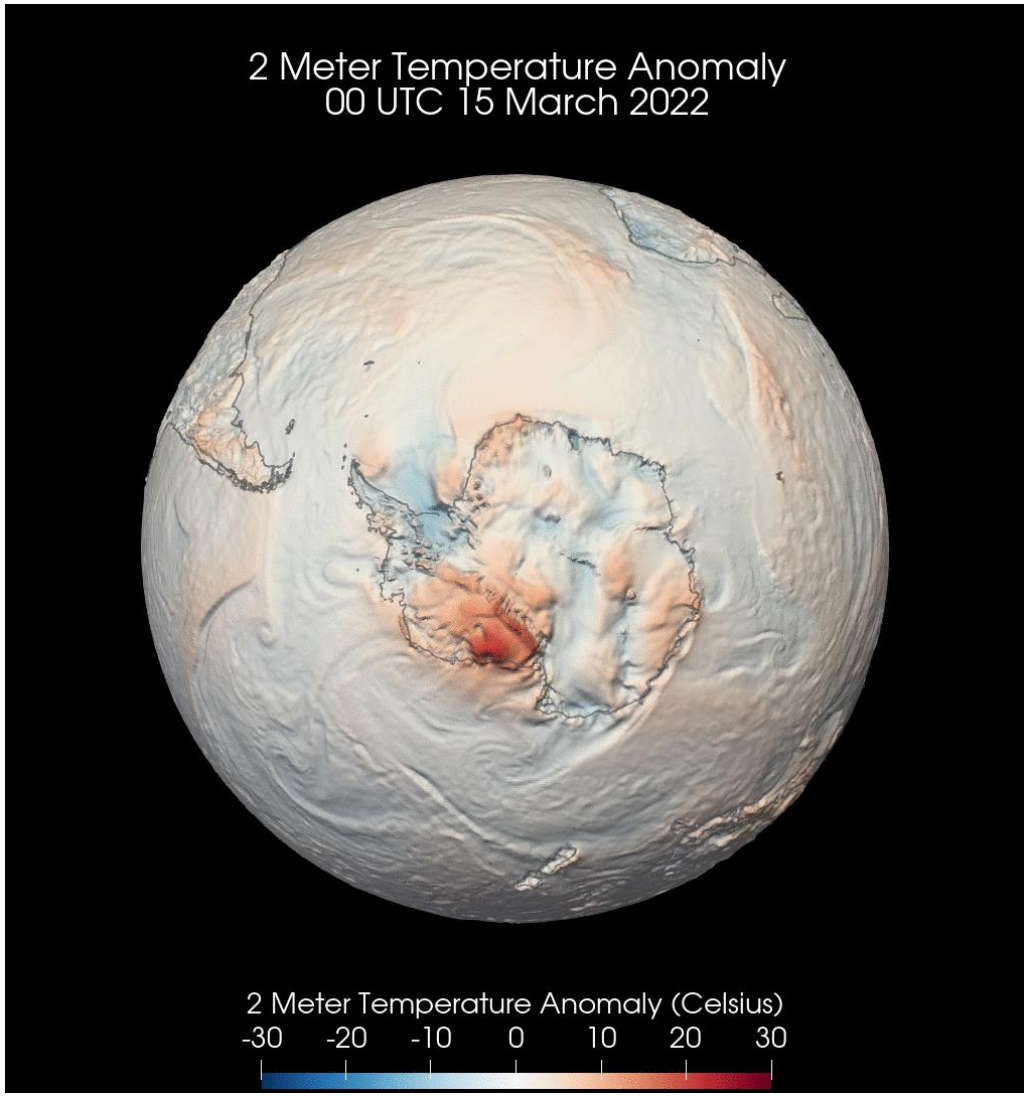
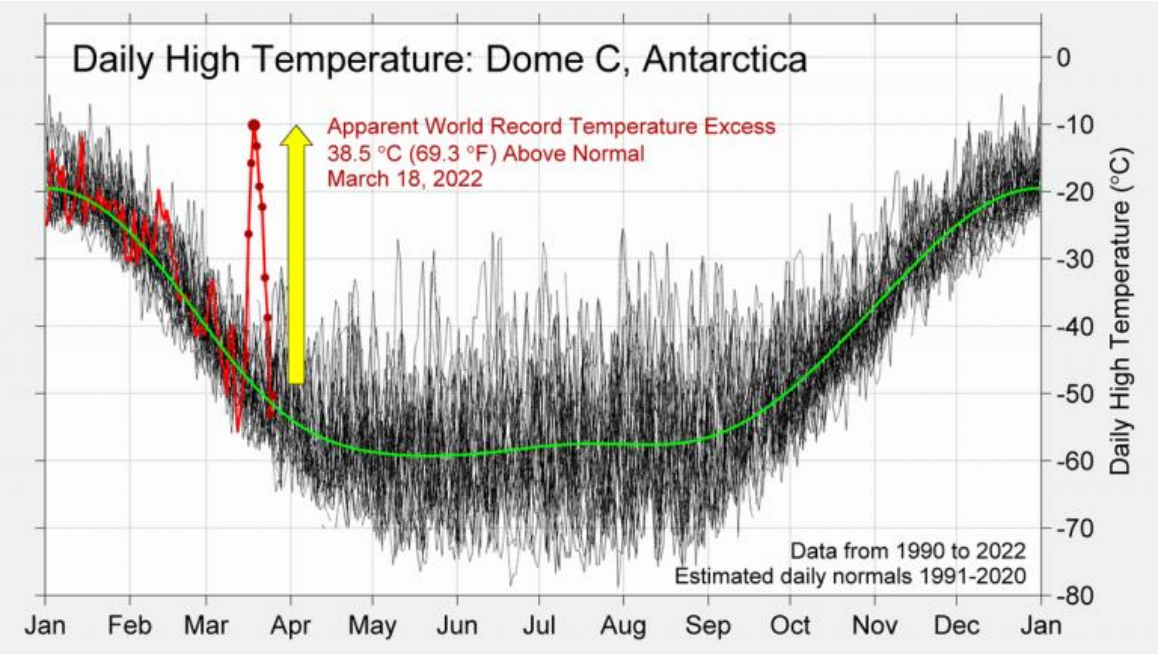
Climate Extremes in Antarctica



Data visualisation: Prof Mathew Barlow, ERA5 via Copernicus climate change service

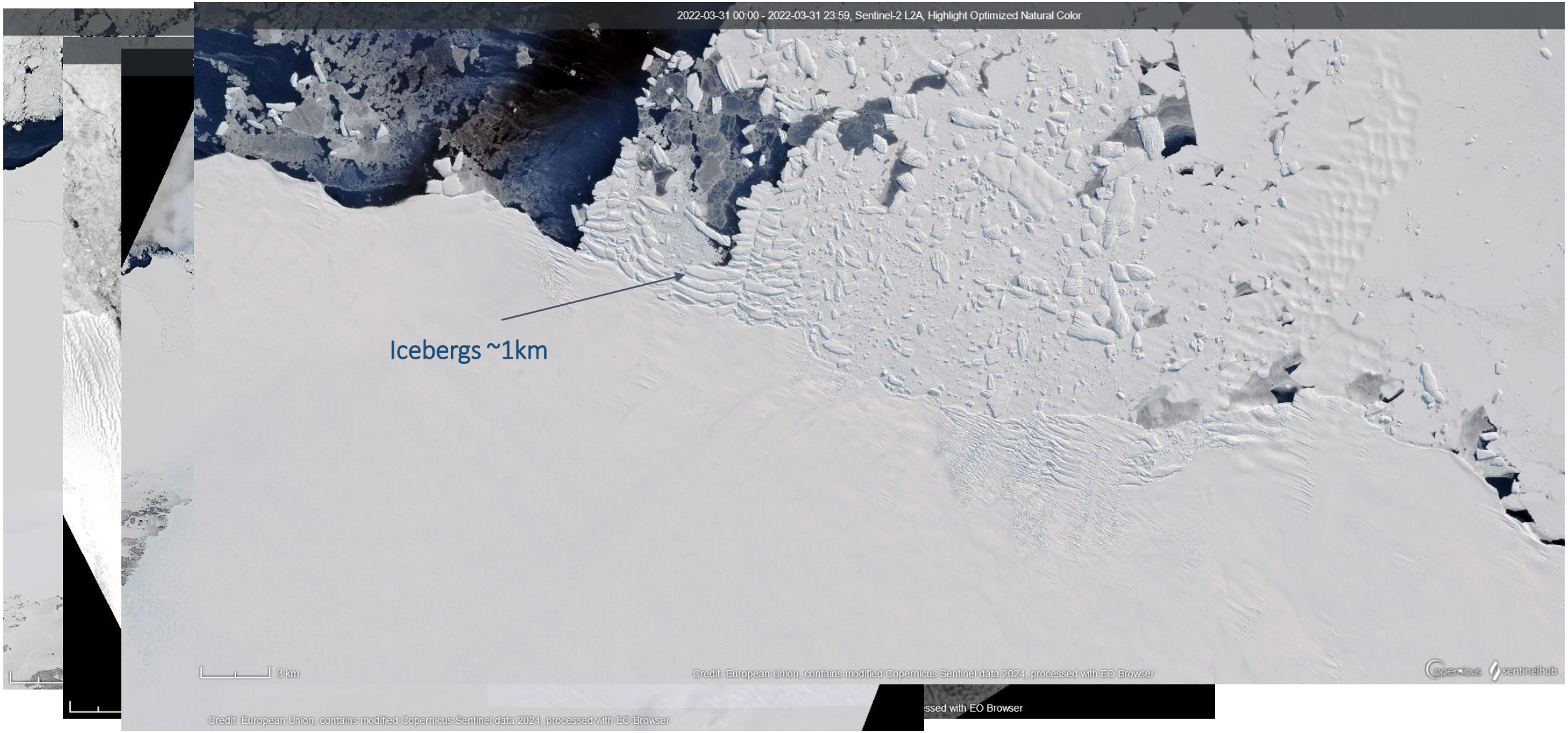


Data visualisation: Dr Robert Rohde, Berkeley Earth

Temperatures at the French-Italian Concordia station were 38.5°C above normal in March 2022 – a new world record.

Climate model simulation with data assimilation

Death of an ice shelf



Climate projections and downstream effects

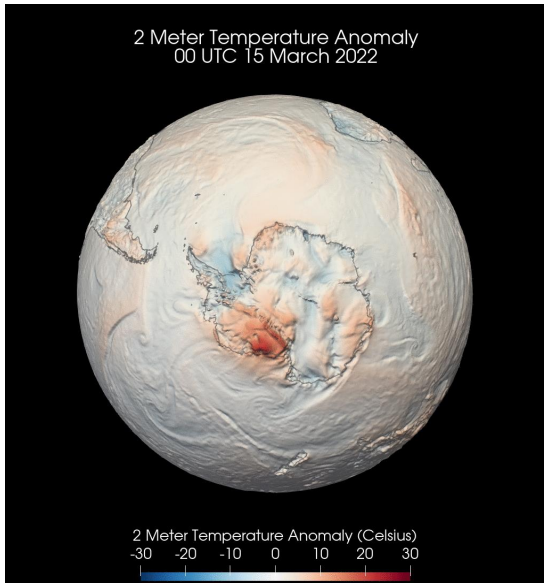
Climate extremes can lead to rapid and irreversible changes in the Polar environment

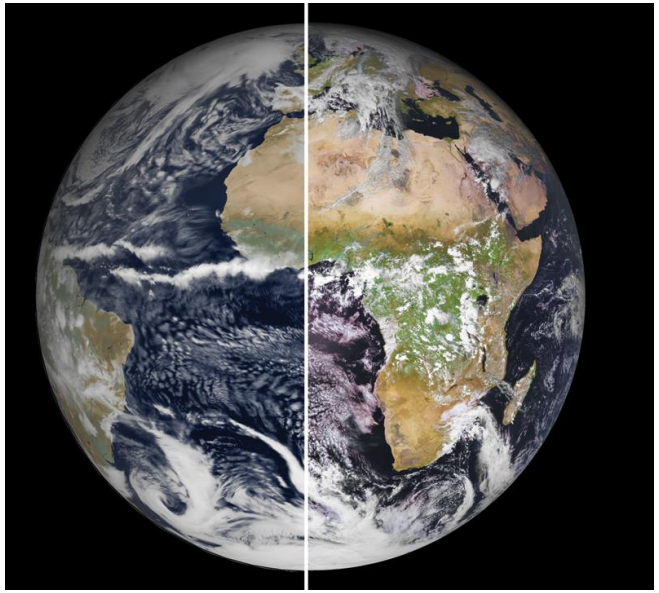
Models

Satellite data

In-situ observations

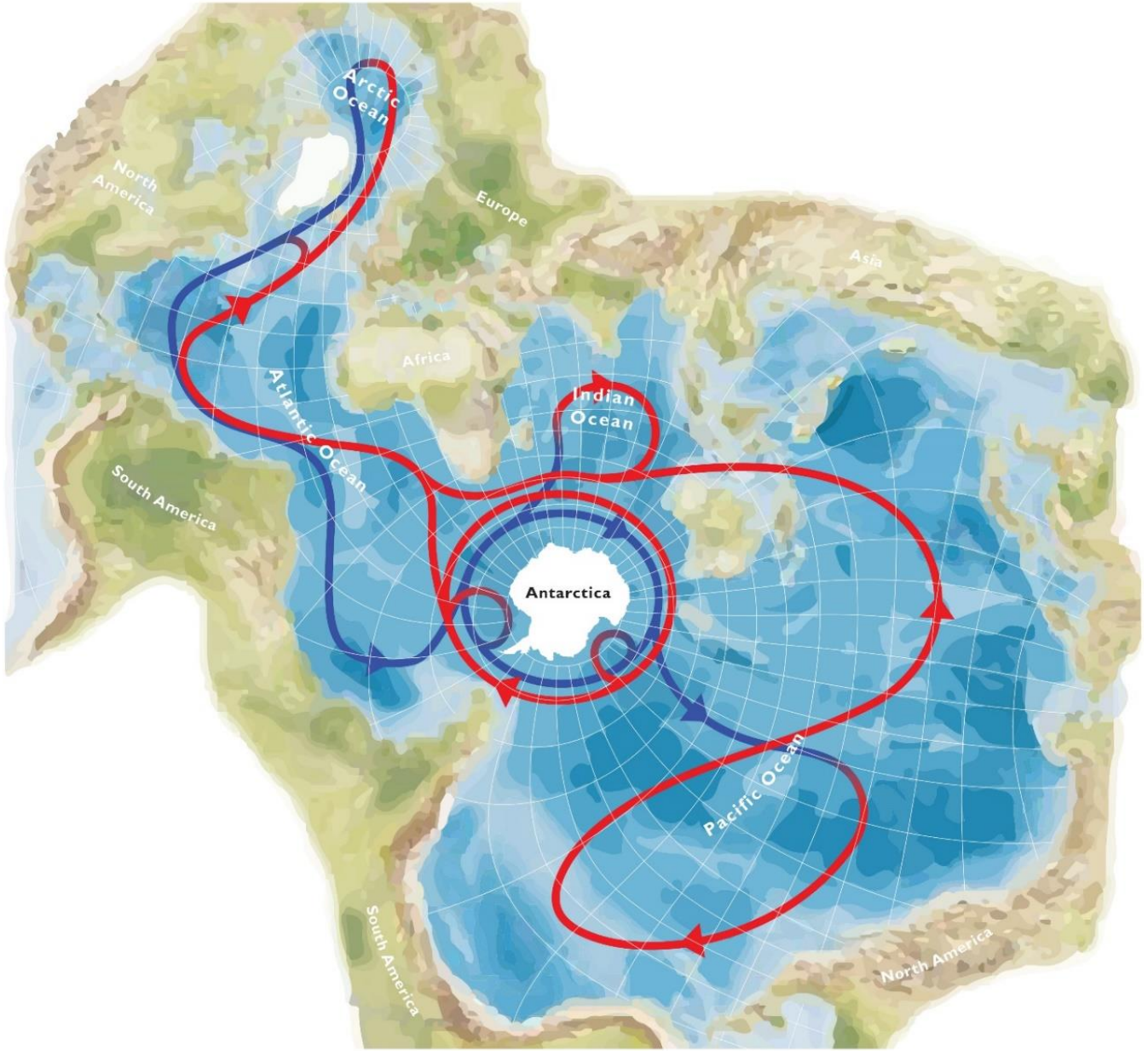
Going towards a digital twin of the Earth



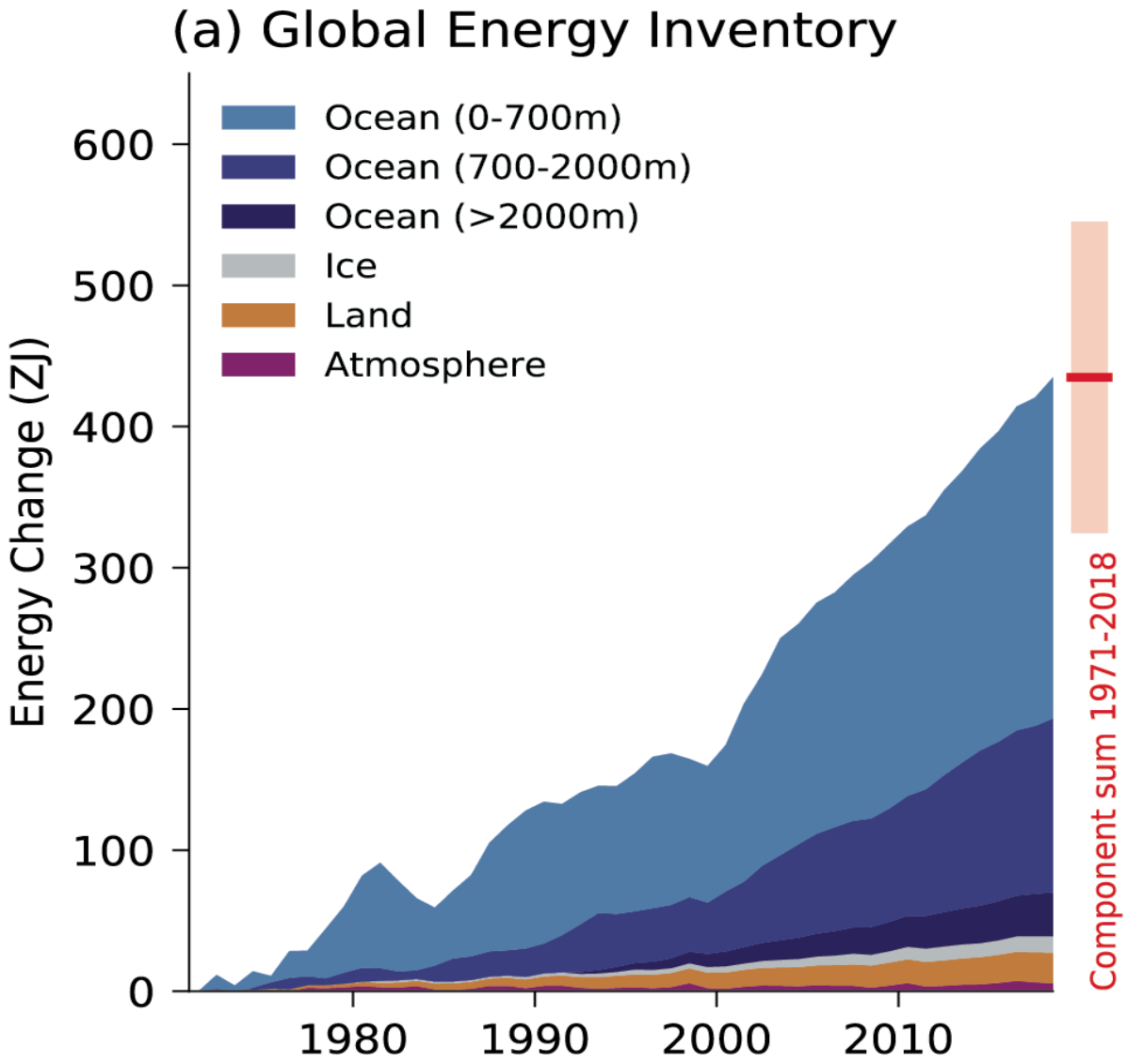


1-kilometre resolution, European climate model (left) is nearly indistinguishable from reality (right).(LEFT TO RIGHT) ECMWF; © EUMETSAT

The continent at the centre of the world



Global warming is ocean warming

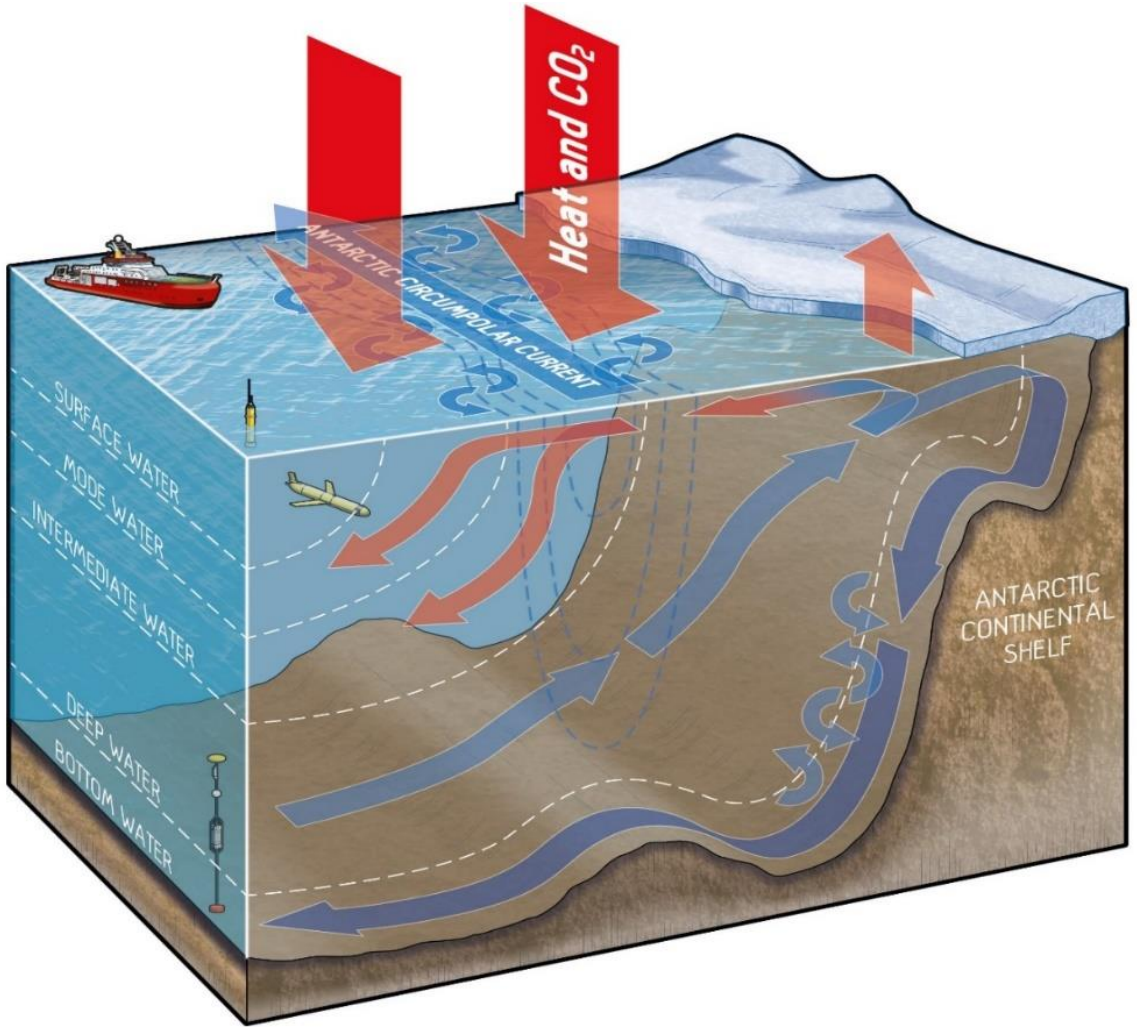


IPCC AR6 (2021)

>90% of all human generated heat goes into the ocean (blue)

Global warming is ocean warming – mostly via the Southern Ocean

75% global ocean heat uptake



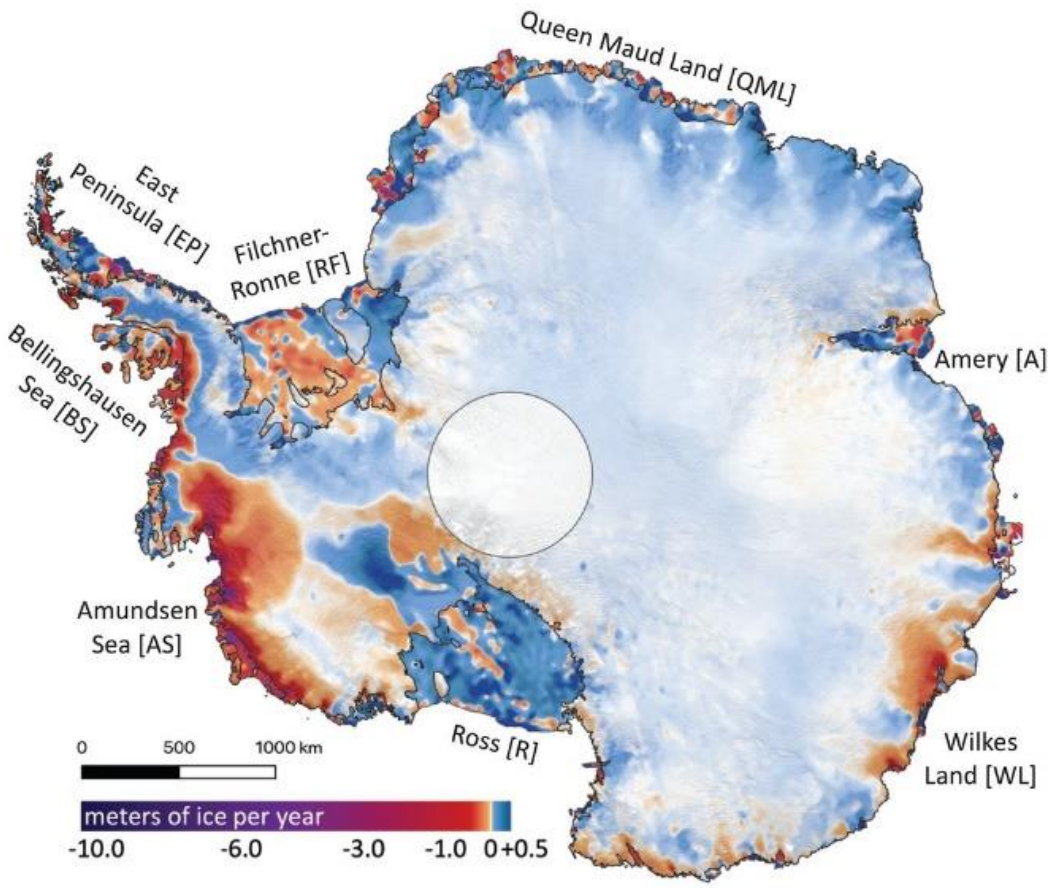
40% global ocean CO2 uptake

Frolicher et al., 2015
Williams et al., in rev.

Climate service value ~ 80 billion €/y

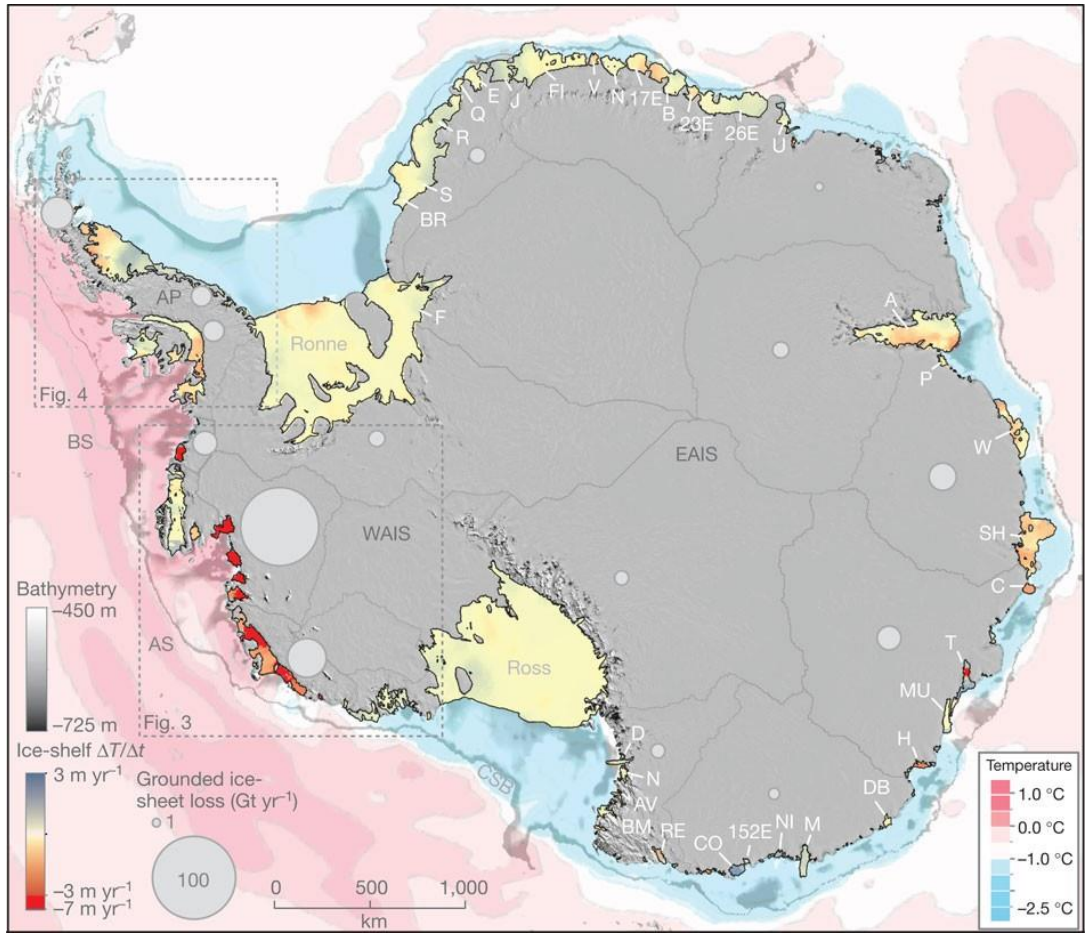
Based on carbon price 80€/tCO2 (N.Gruber)

The Antarctic Ice Sheet is melting – largely due to extra ocean heat delivery



IceSat(-2) Mass loss (2003-19)

Smith et al., 2020



Average sea floor temperature

Pritchard et al., 2012

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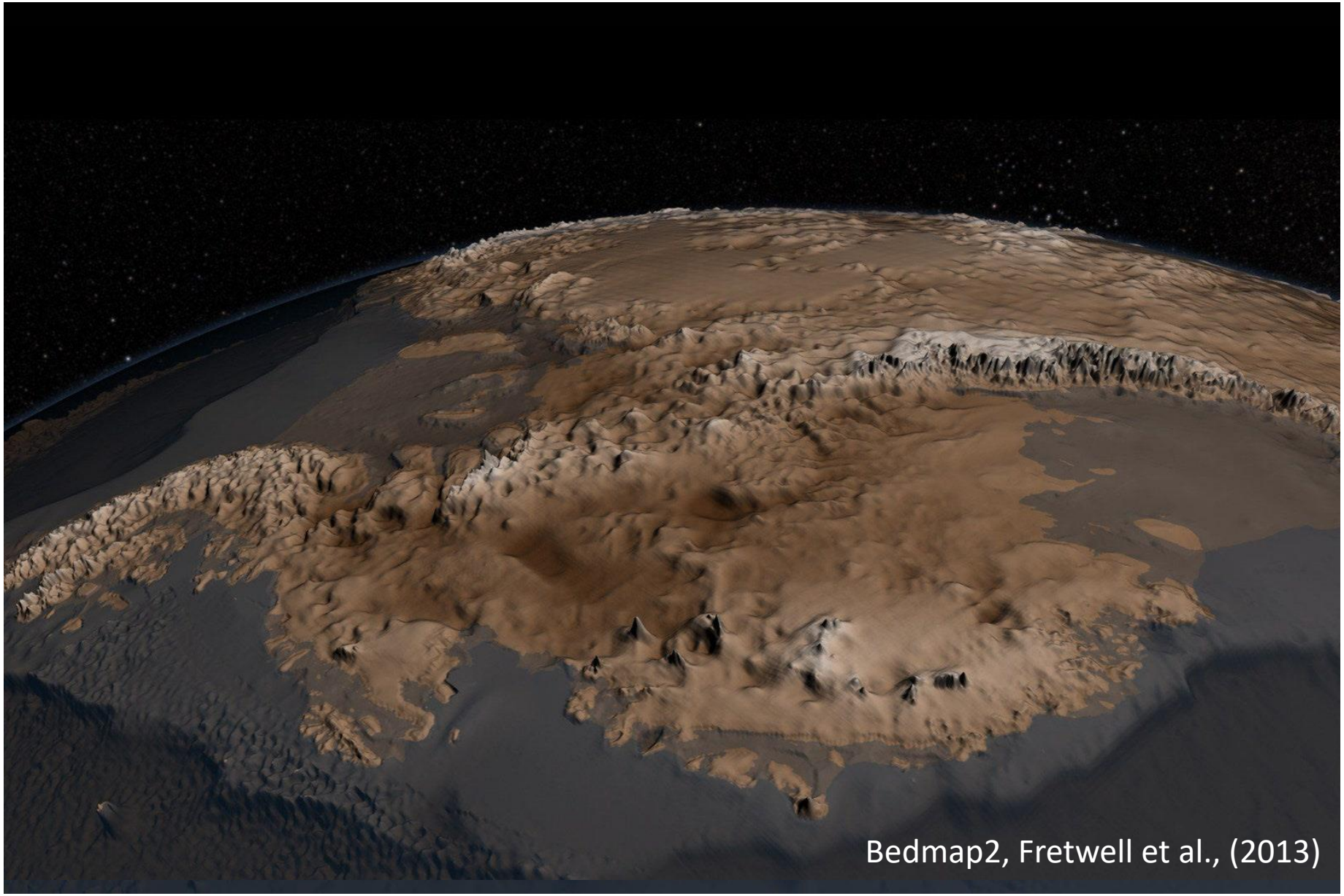
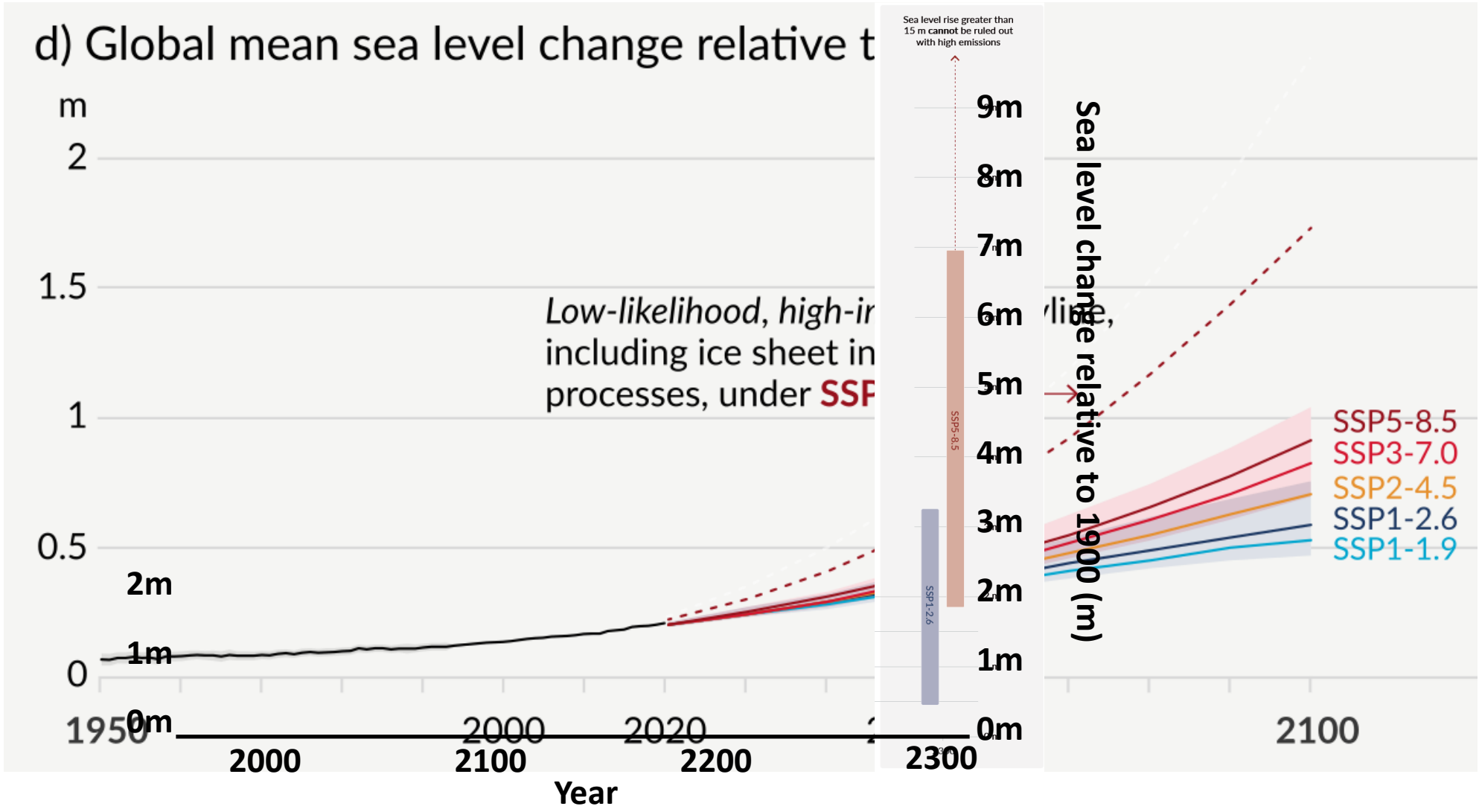


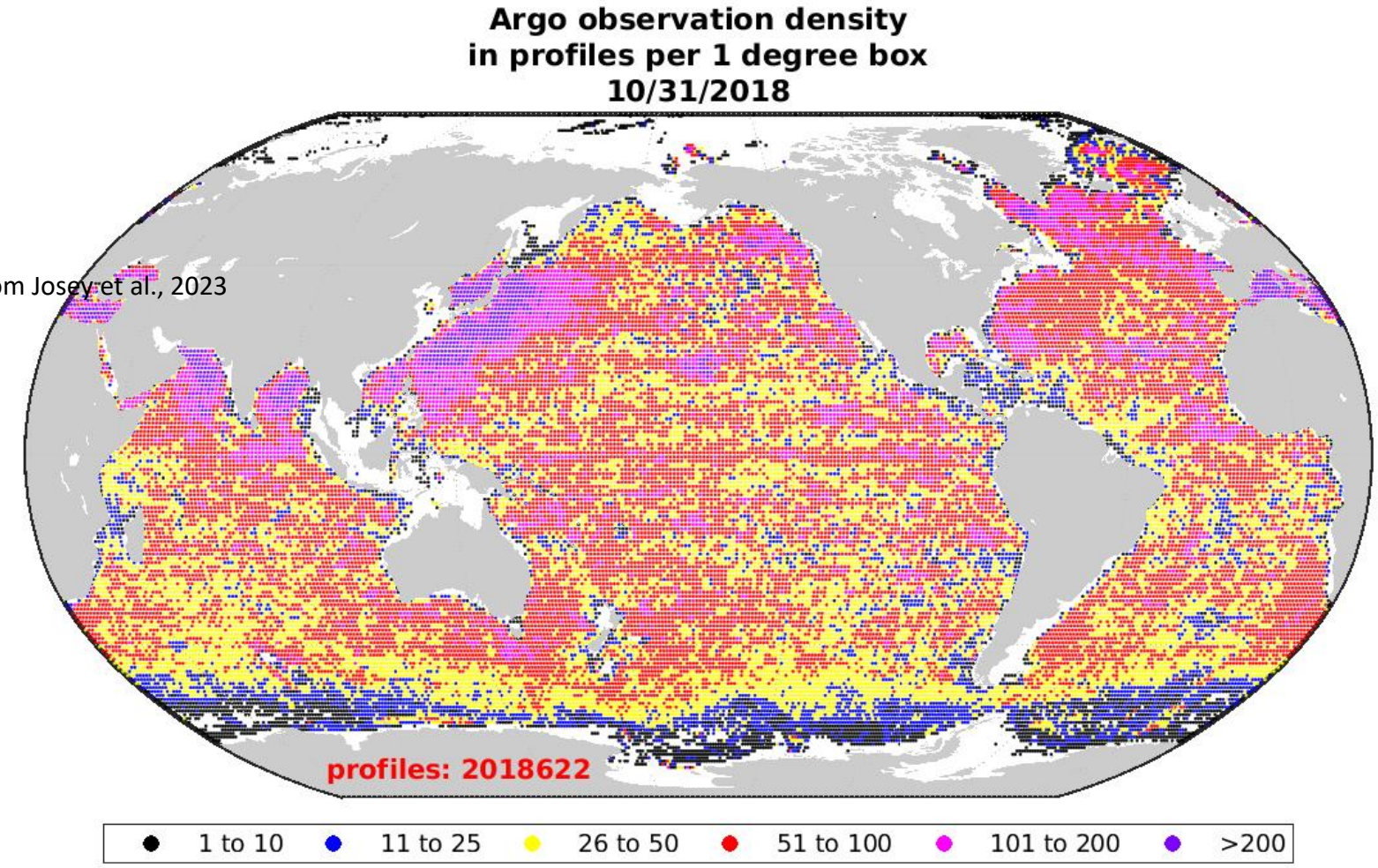
Future ice sheet mass loss is one of the greatest climate uncertainties



IPCC AR6 (2021), Summary for policy makers high impact storyline from an expert survey and structured expert judgement (i.e. not modelled)

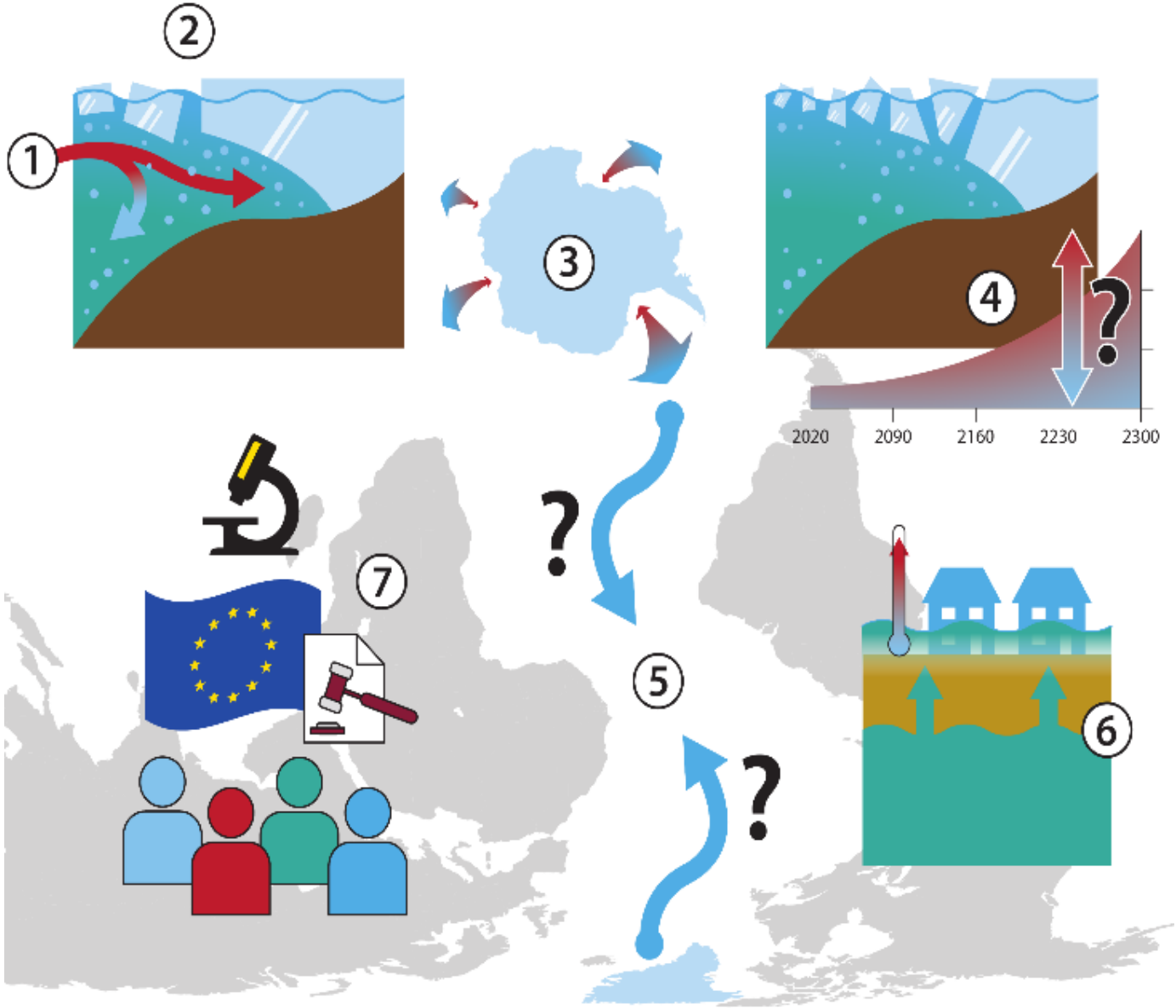
Yet the Southern Ocean and Antarctic is (still) a huge hole in our observing network

From Josey et al., 2023



Observations of top 2km of ocean by Argo floats since 2004 (>2 million)

Impact of Antarctic and Southern Ocean processes and feedbacks on planet Earth



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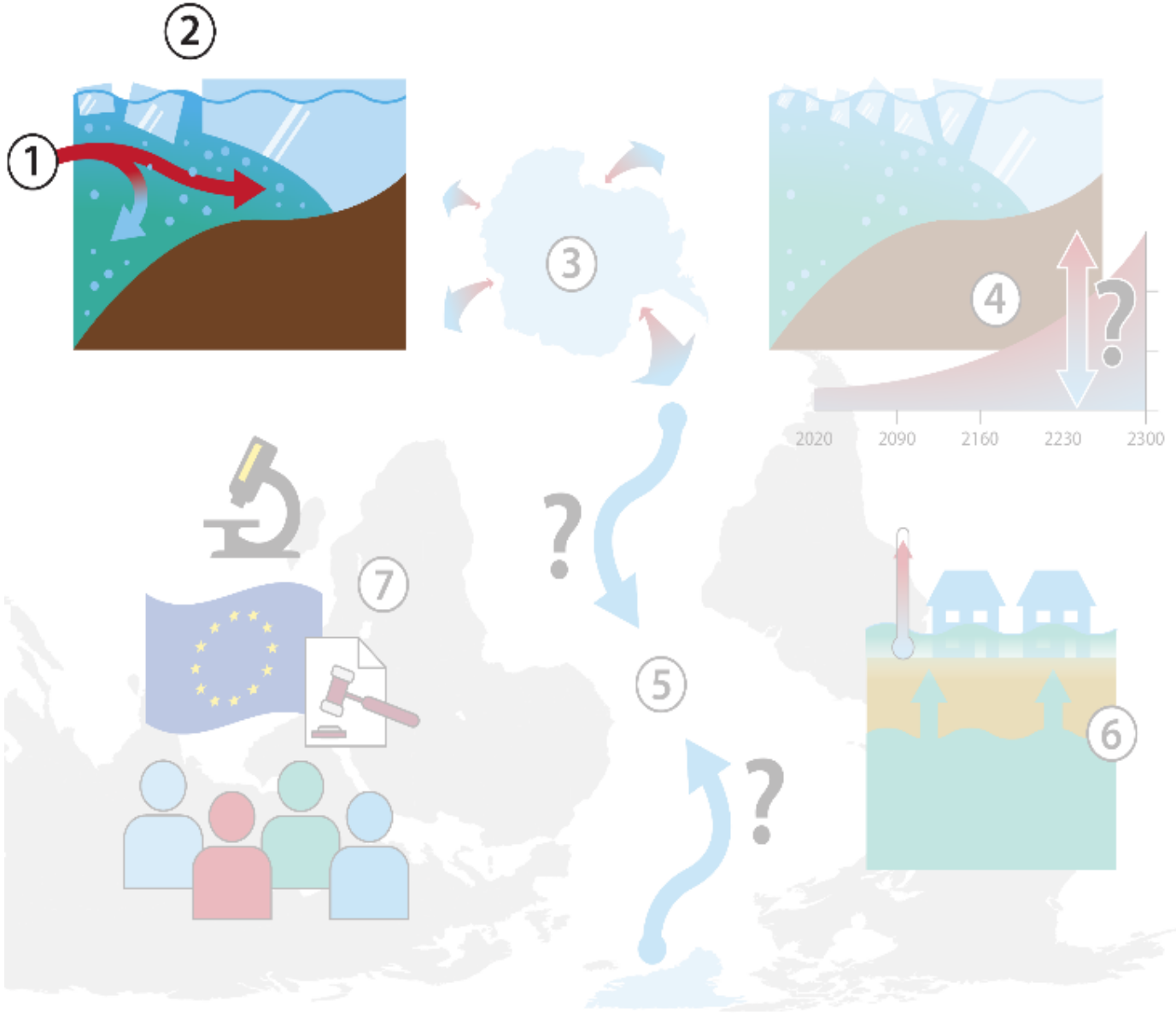

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- 2: Ice shelf dynamics, supporting;

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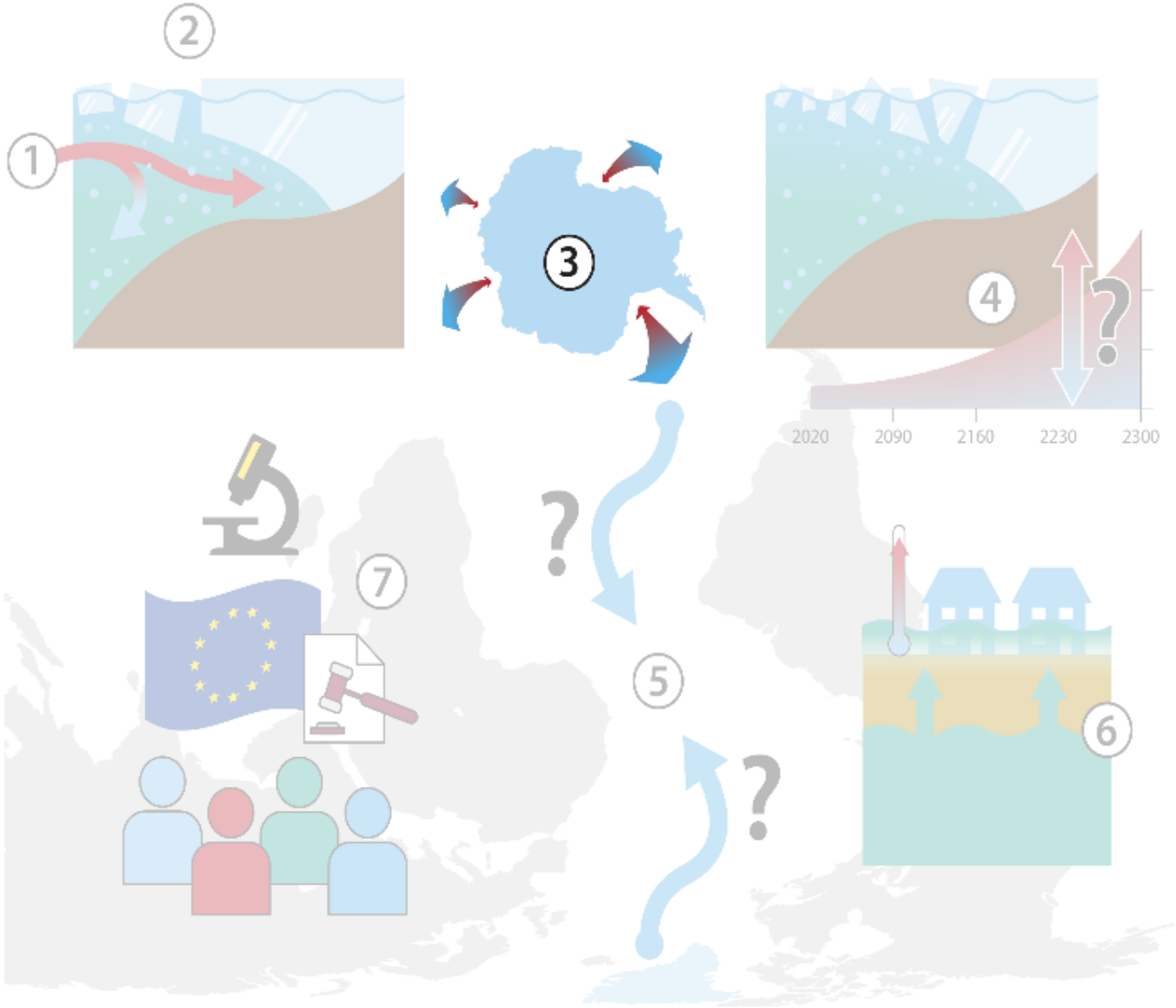

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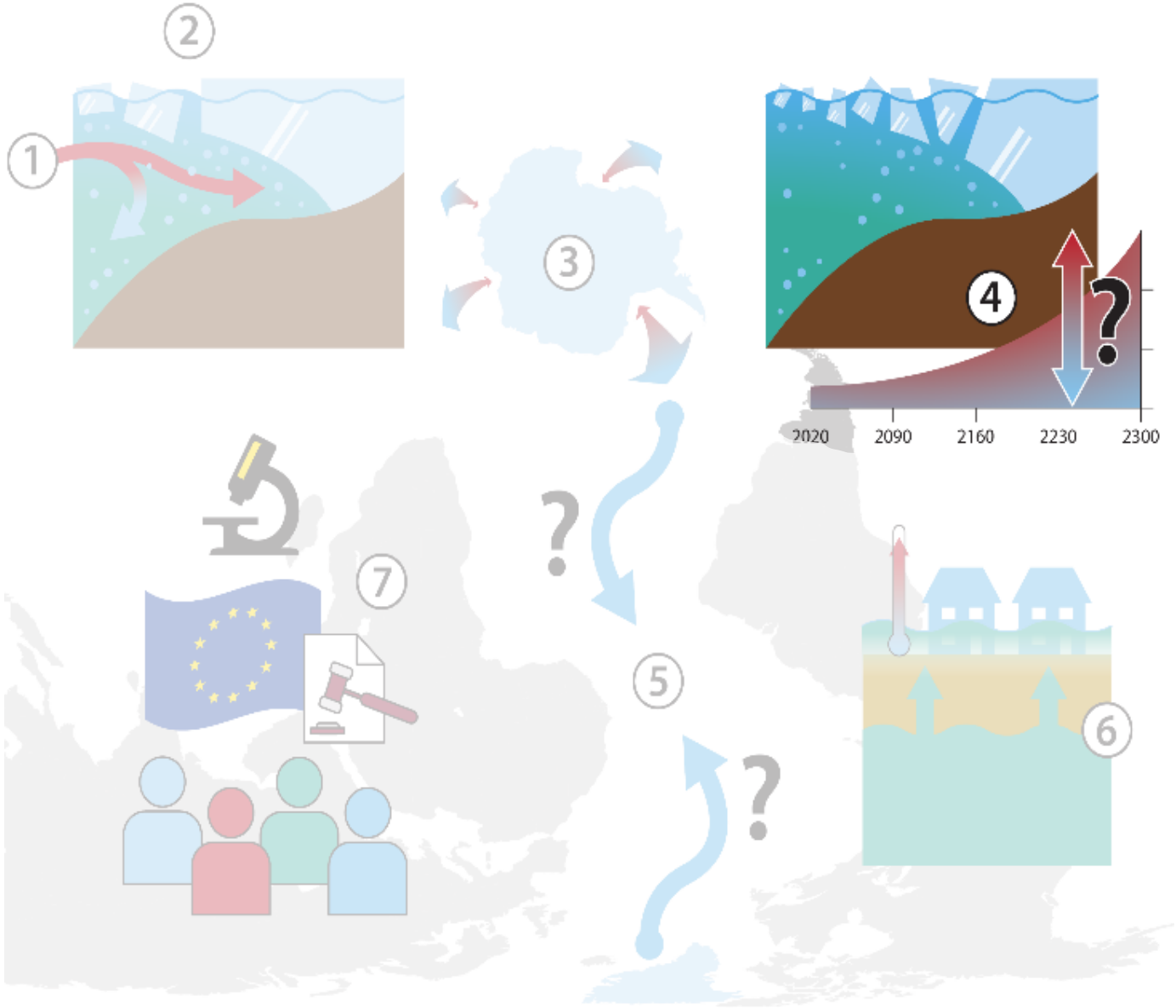

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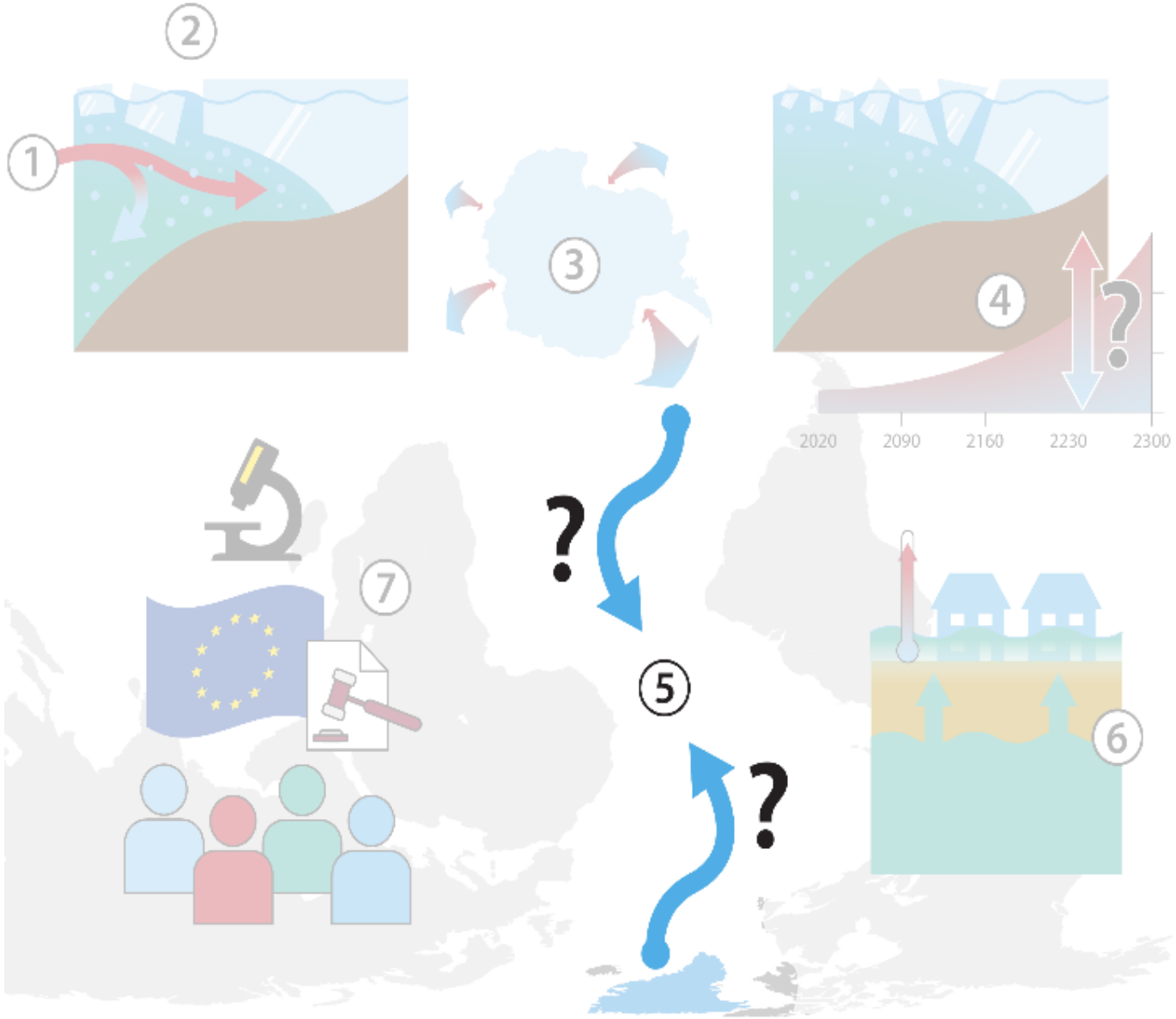

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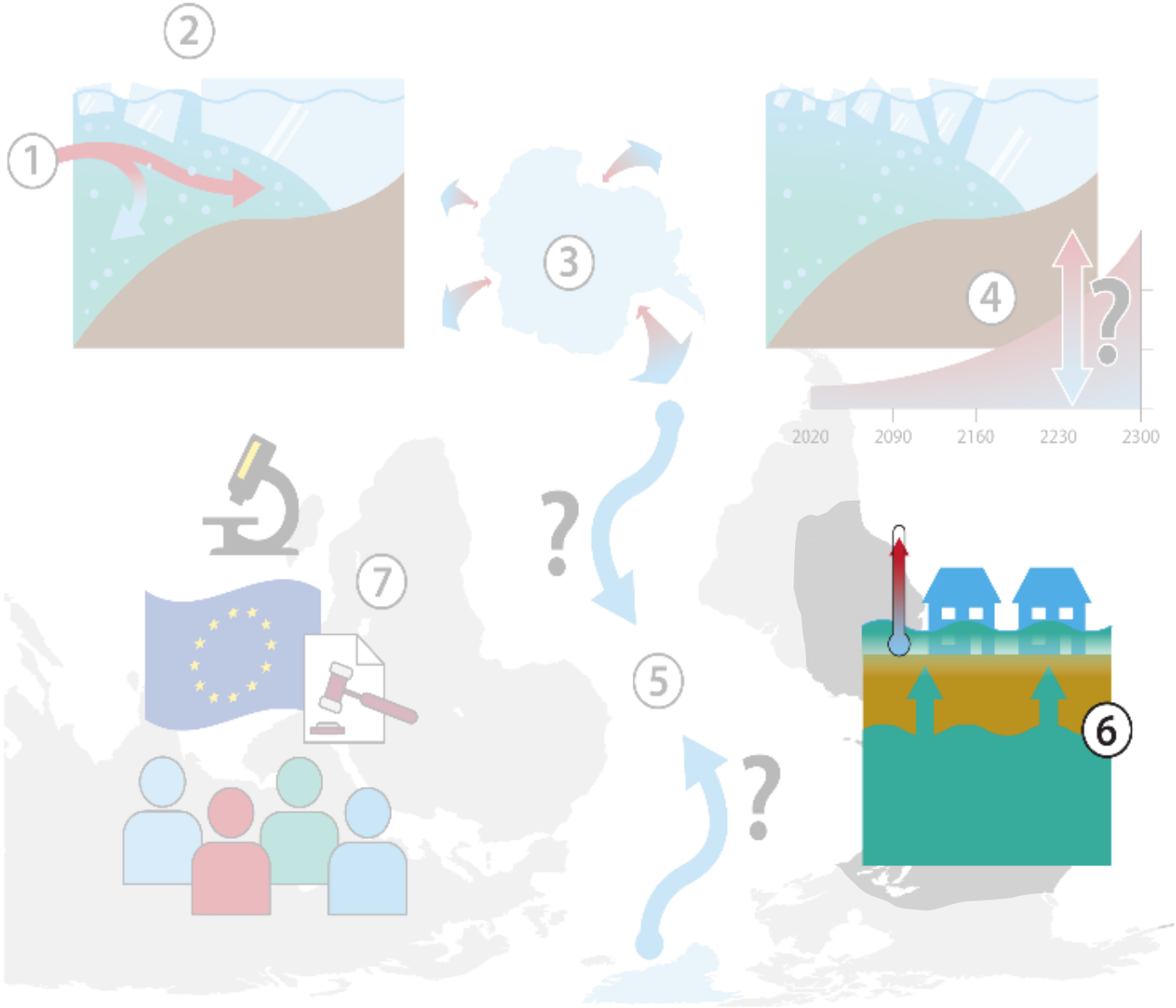

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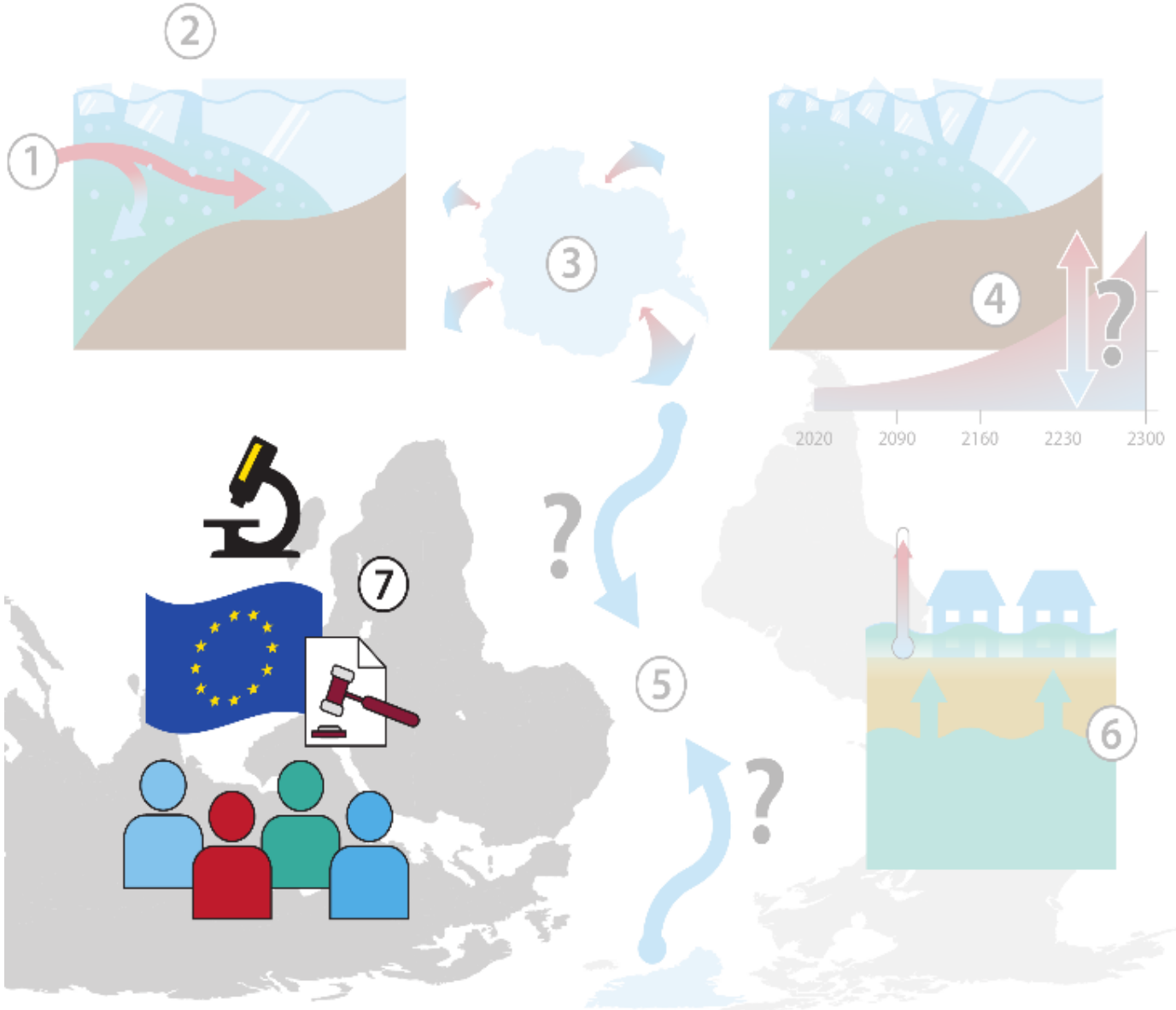

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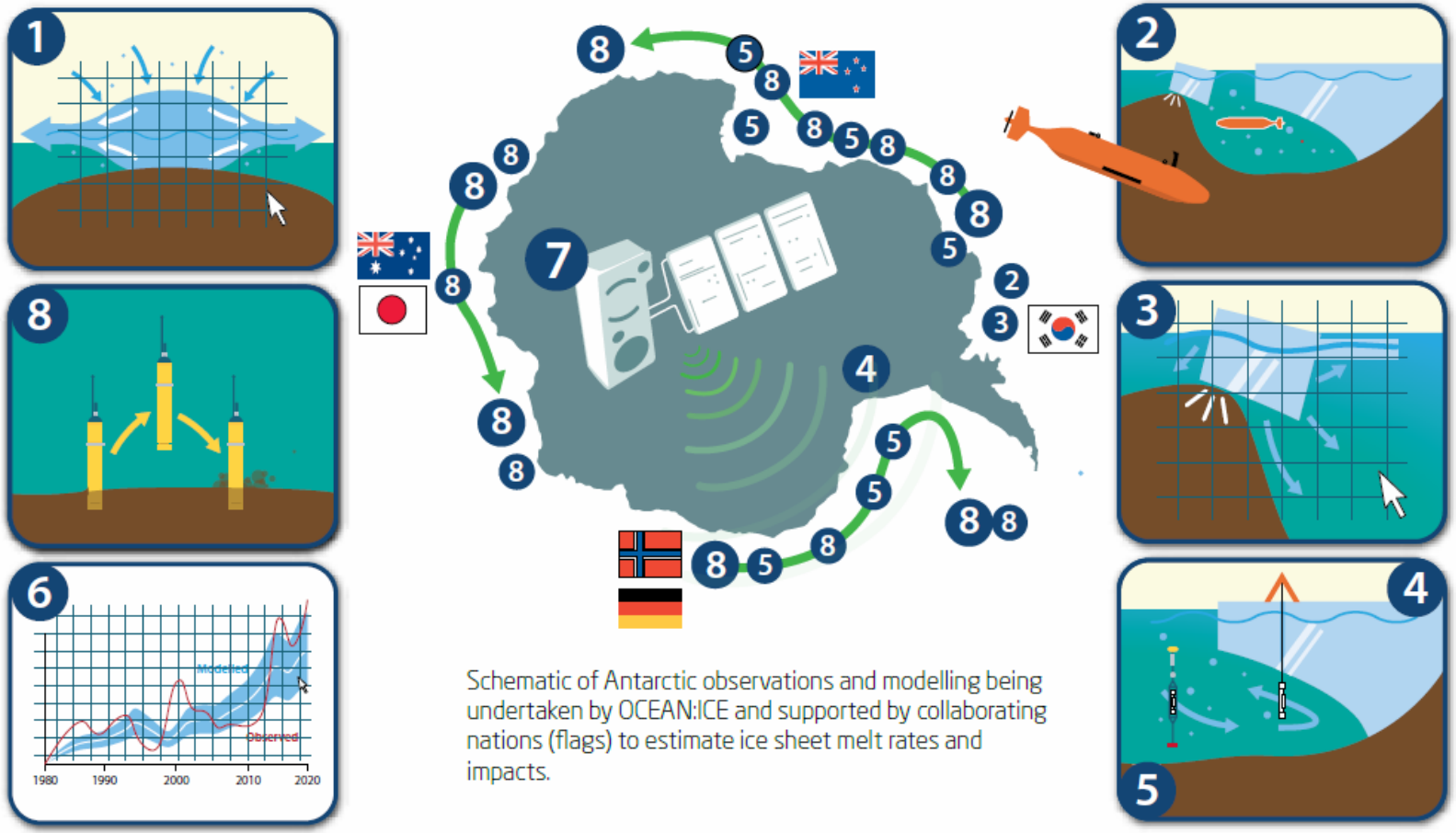
- 6: Modelling of ocean-ice feedbacks and impact on climate; which informs;
- 7: Climate assessments and advice to policymakers and public

Antarctic research elements



Schematic of Antarctic observations and modelling being undertaken by OCEAN:ICE and supported by collaborating nations (flags) to estimate ice sheet melt rates and impacts.

Copernicus Europe's eyes on Earth

SOOS SOUTHERN OCEAN OBSERVING SYSTEM

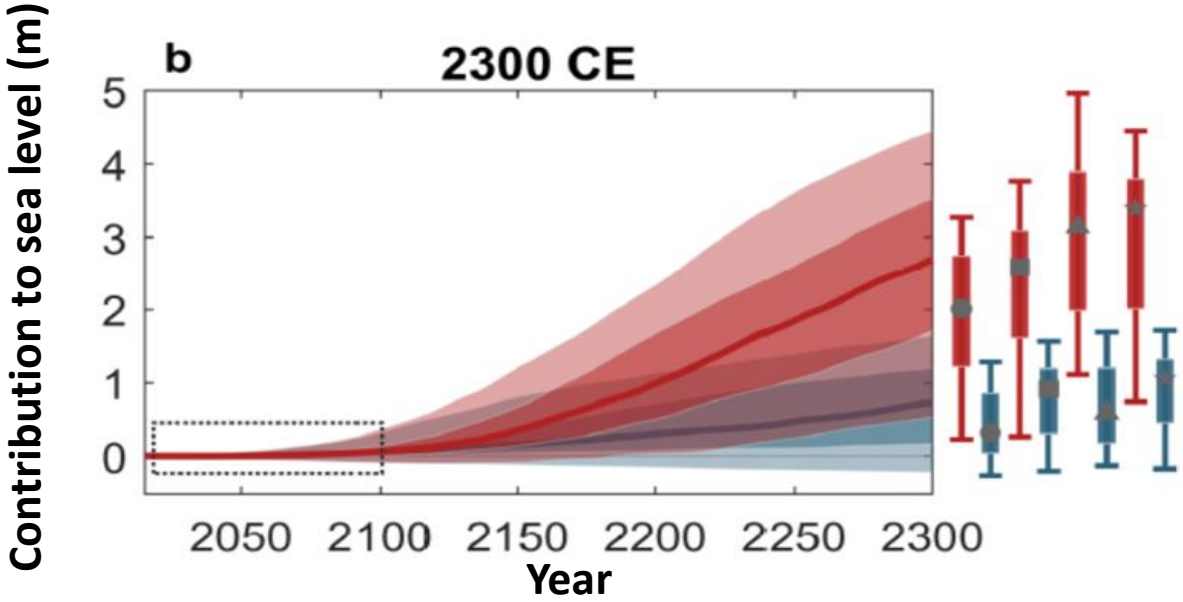
esa

ALL-ATLANTIC OCEAN RESEARCH ALLIANCE

Creating an Atlantic Ocean Community by implementing the Galway and Belém Statements

What OCEAN:ICE will produce

- New projections of sea level rise
- New assessments polar tipping point risk
- New observations under different types of ice shelves
- Improved data management and data sharing
- Improvements to regional and global climate models
- The first projections of global climate indicators with active ice sheets
- Direct collaboration with regional modellers and policy makers for long term planning



Preliminary projections of Antarctic melt contribution sea level (m) to 2300, including climate forcing uncertainty. Coulon et al., (in prep)

OCEAN:ICE takeaways

The Southern Ocean, Antarctic and their interaction are disproportionally important for future climate and sea level rise.

Both are critically under-observed and lack structured observing systems.

Need for observations and model improvements to:

- **Reduce uncertainty in future global climate projections and impacts**
- **Deliver results to climate assessments and society**

OCEAN:ICE

oceanice.eu@gmail.com

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@OCEANICE_EU

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