

# TIPMIP-Ocean: Tipping dynamics of the AMOC

*Domian leads: Didier Swingedouw, Aixue Hu, Laura Jackson, Anastasia Romanou*  
*Liaison: Nicole Laureanti*



Feb. 12, 2026



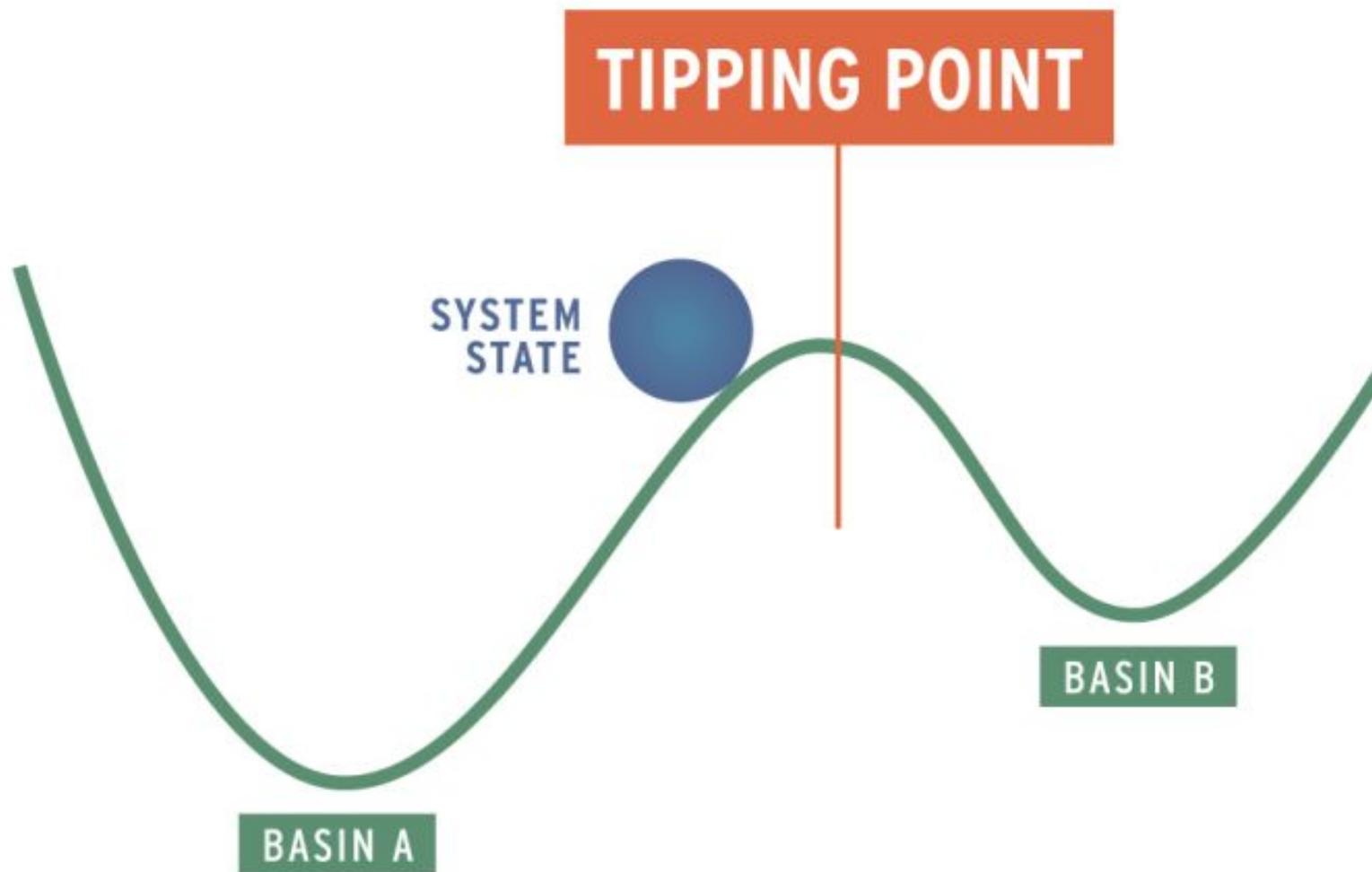


Illustration by Andrew Bernier, adapted from Walker, B. & Salt, D. (2006) Resilience Thinking: Sustaining Ecosystems and People in a Changing World. Island Press: Washington, DC.

# Tipping Points Modelling Intercomparison Project (TIPMIP)

Project Leader: Ricarda Winkelmann

More information: <https://tipmip.org/>

**General Assembly 2026:** March 3-6, 2026, Tokyo, Japan

Abstracts are open for submission (deadline: Nov. 23, 2025 at 23:59 CET)

**Headquarter: Potsdam Institute for Climate Impact Research**

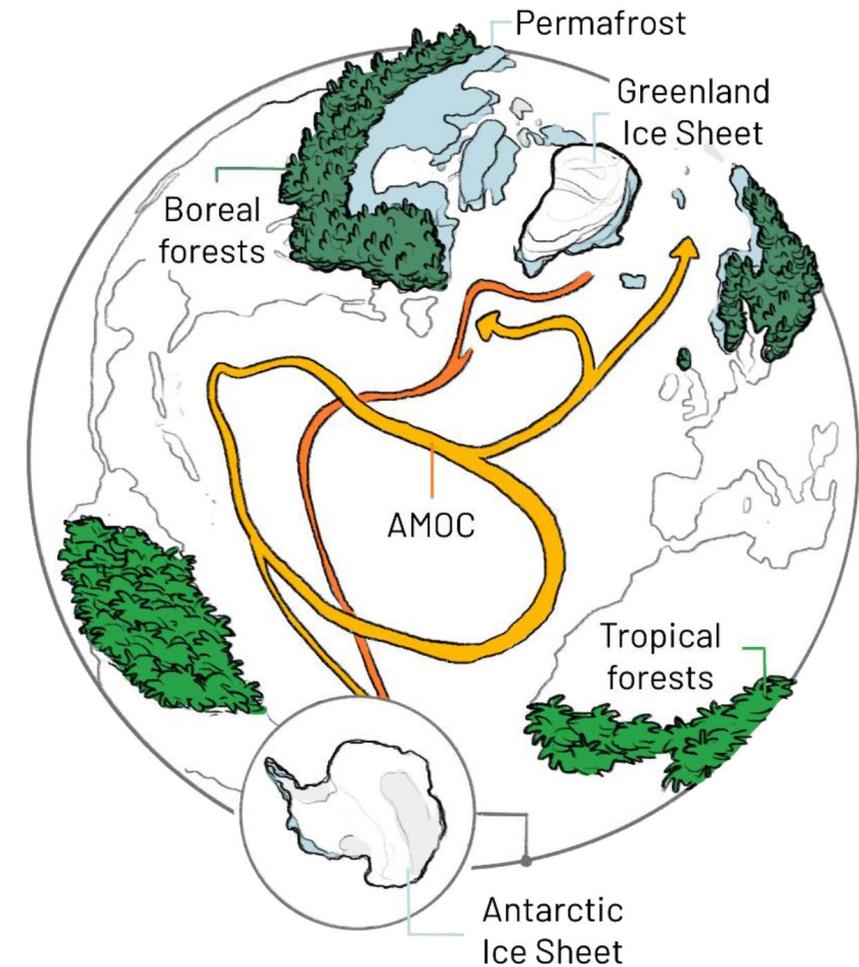
**Kick start:** 800. WE Heraeus Seminar “Addressing Key Uncertainties in Modelling Physical and Ecological Tipping Dynamics in the Earth System (Towards TIPMIP) (Nov. 5-8, 2023)

**General Assembly 2024:** Dec. 4-7, 2024 Baltimore, Maryland

*TIPMIP project paper: Winkelmann et al. (2025, Earth Sys. Dyn., under revision)*

*TIPMIP-ESM protocol paper: Collin et al., (2025, Earth Sys. Dyn., under revision)*

*TIPMIP-OCEAN protocol paper: Swingedouw et al. to be submitted.*

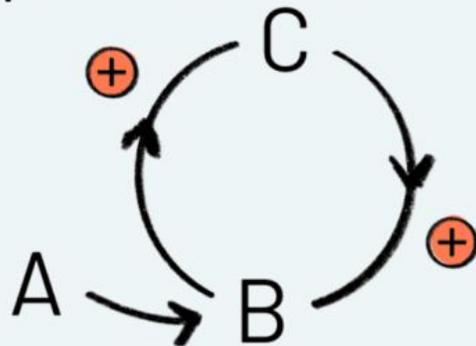


# Research questions

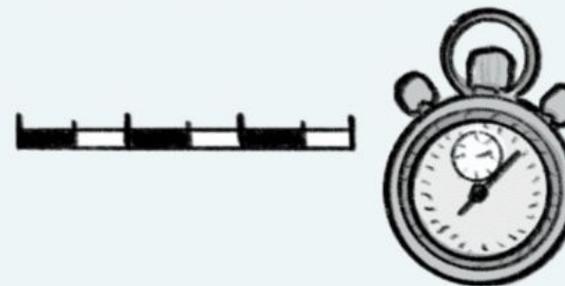
Risk of crossing  
TPs?



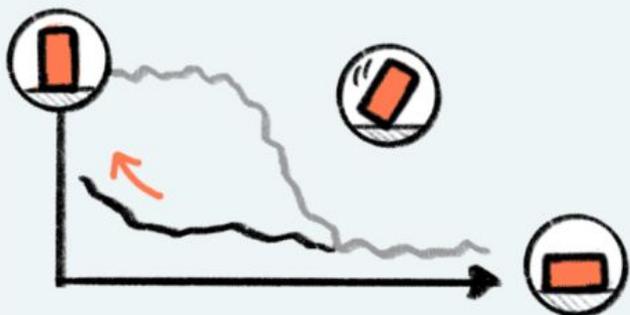
Key feedback  
processes?



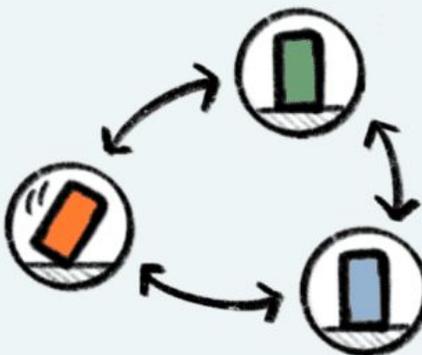
Characteristics  
and scales?



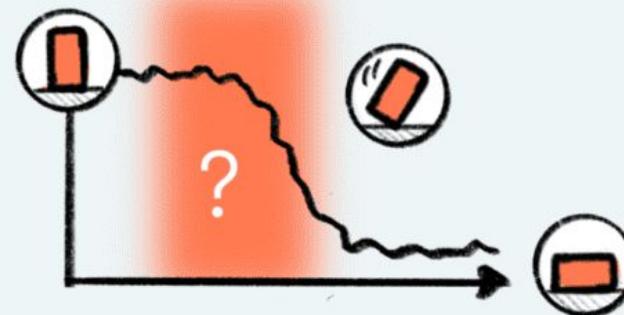
Reversibility?

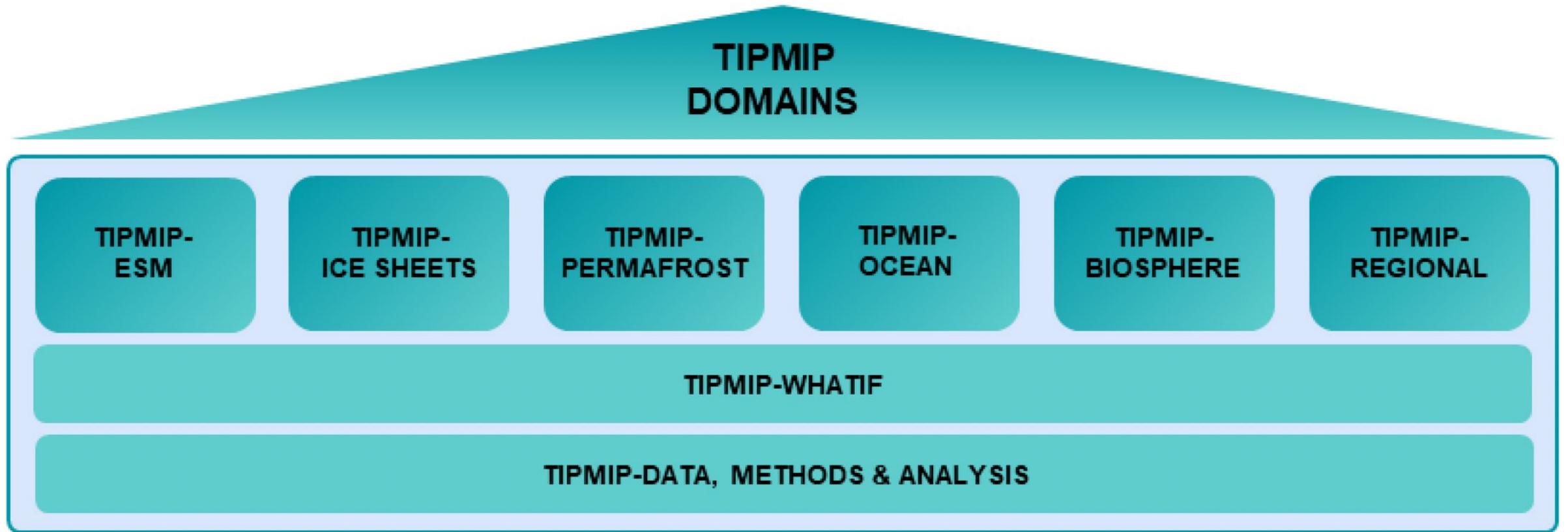


Interactions?



Uncertainties?





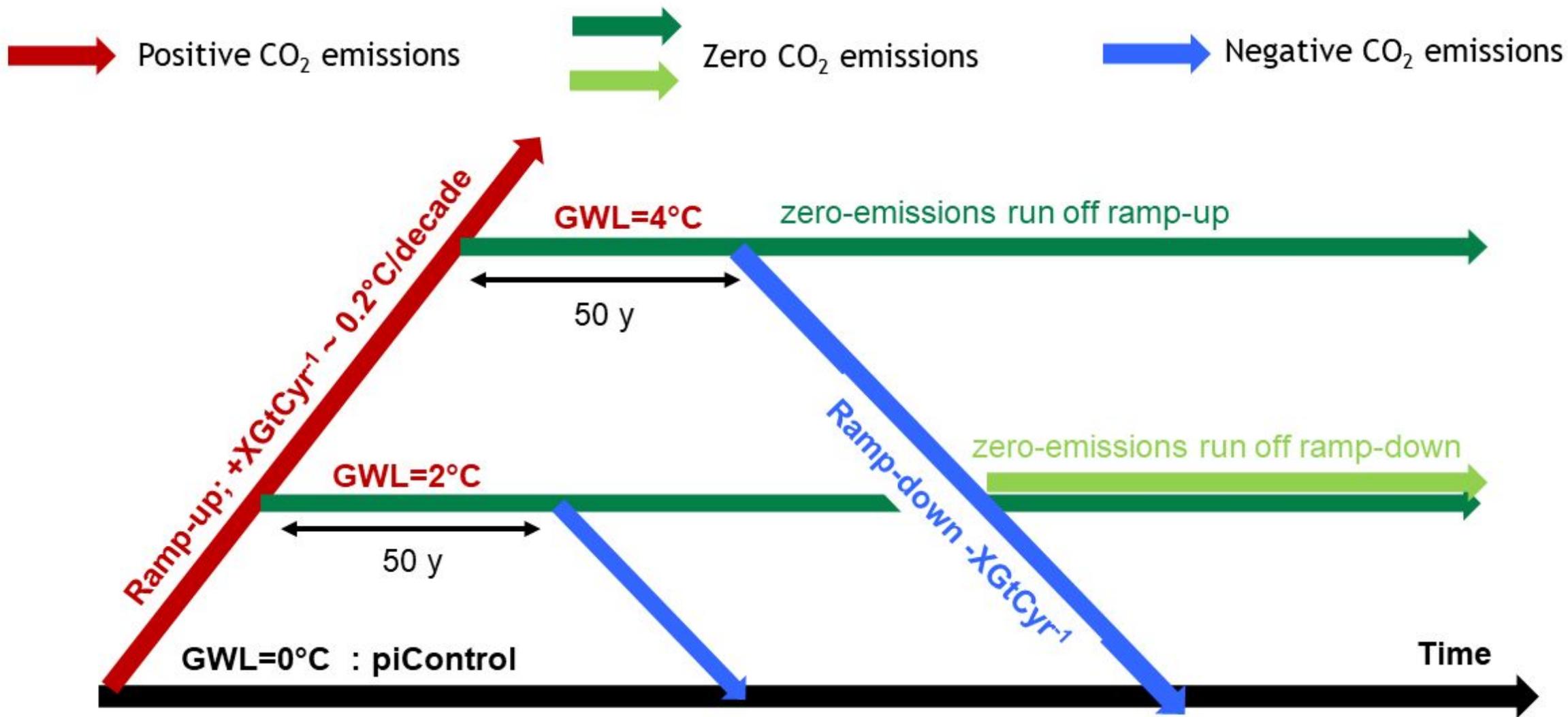
## TIP-ESM, ClimTIP, etc.

*Winkelmann et al. (2025, Earth Sys. Dyn., under revision)*

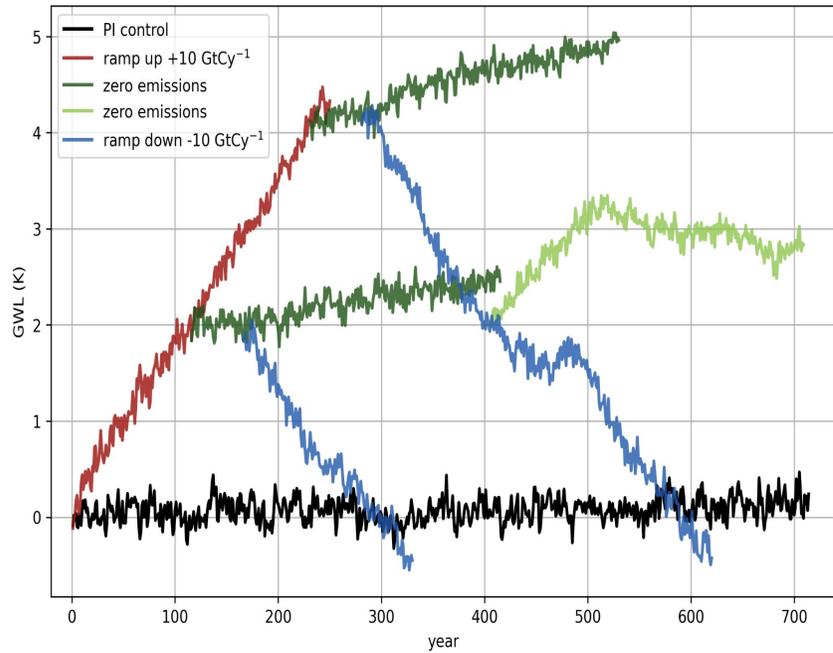
NCAR participants: Gokhan Danabasoglu, Fred Castruccio, Aixue Hu, Peter Lawrence, & Bette Otto-Bliesner, Yaru Guo, Nan Rosenbloom



# TIPMIP ESM Tier 1 experiment protocol: All experiments in CO<sub>2</sub>-emission mode

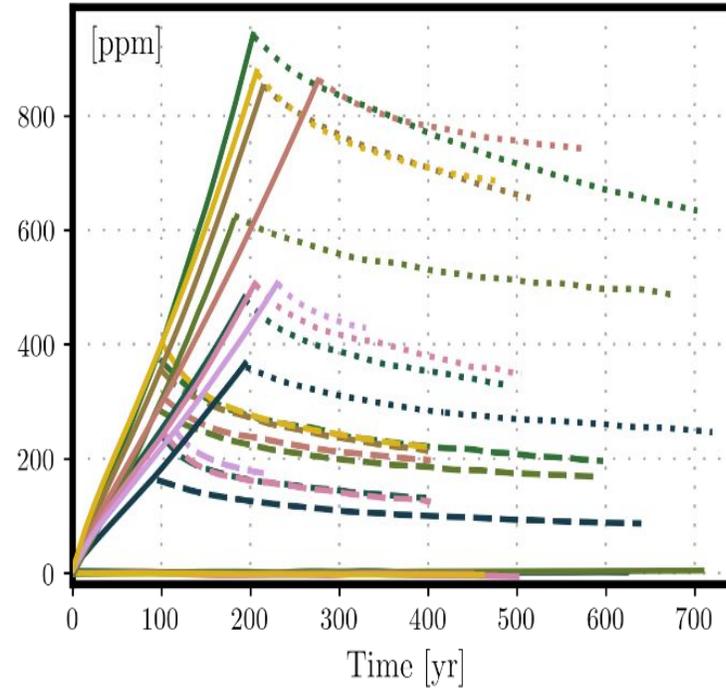


# CESM2



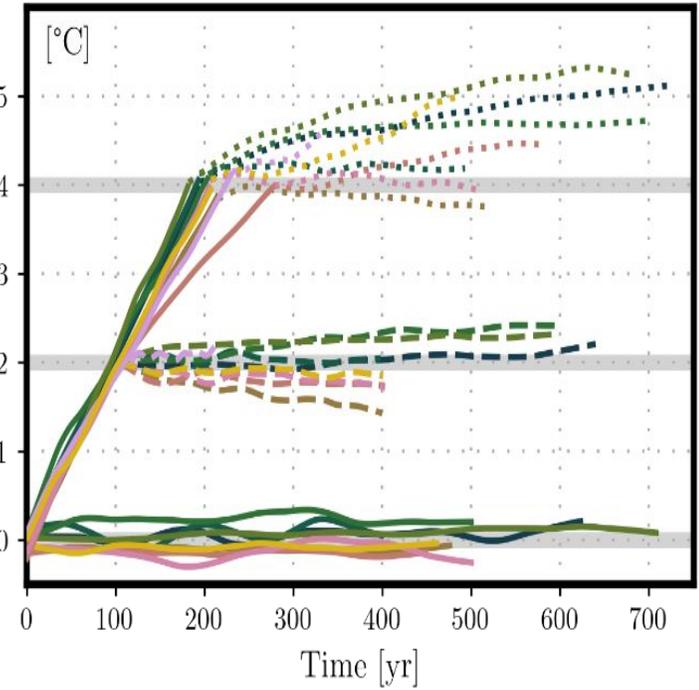
Credit to: Fred and Gokhan

a. GMCO2 anomaly



- NorESM
- CESM2
- EC-Earth
- NASA-GISS
- MIROC-ES2L
- ACCESS-ESM1-5
- GFDL-ESM2M
- CNRM-ESM2-2
- UKESM1-2

b. GMSAT anomaly



- Ramp-up and PI-control runs
- - - +2°C zero-emission run
- ..... +4°C zero-emission run

Jones et al., GMD, 2026

# TIPMIP-Ocean domain experiments

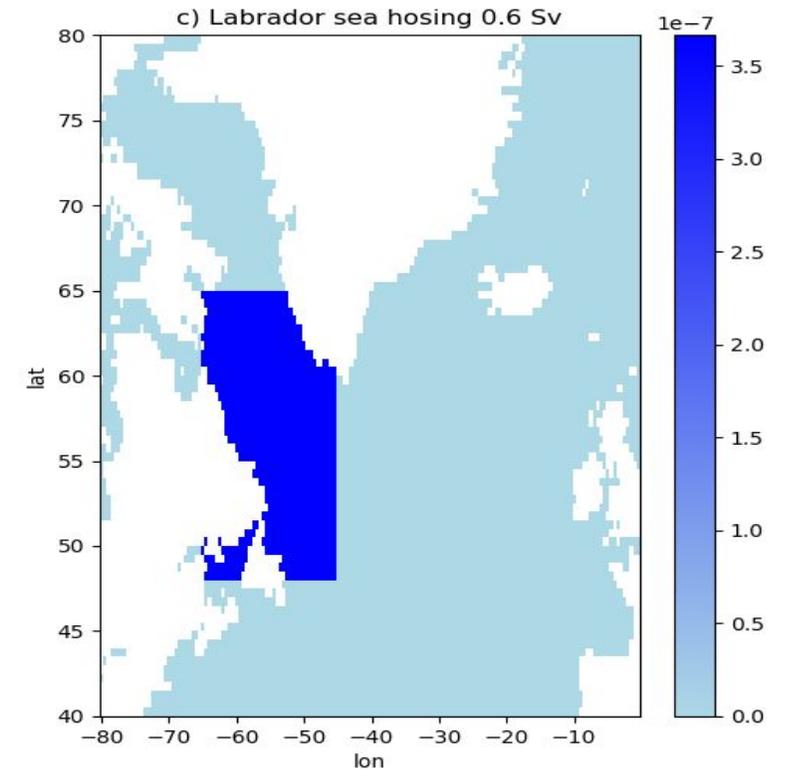
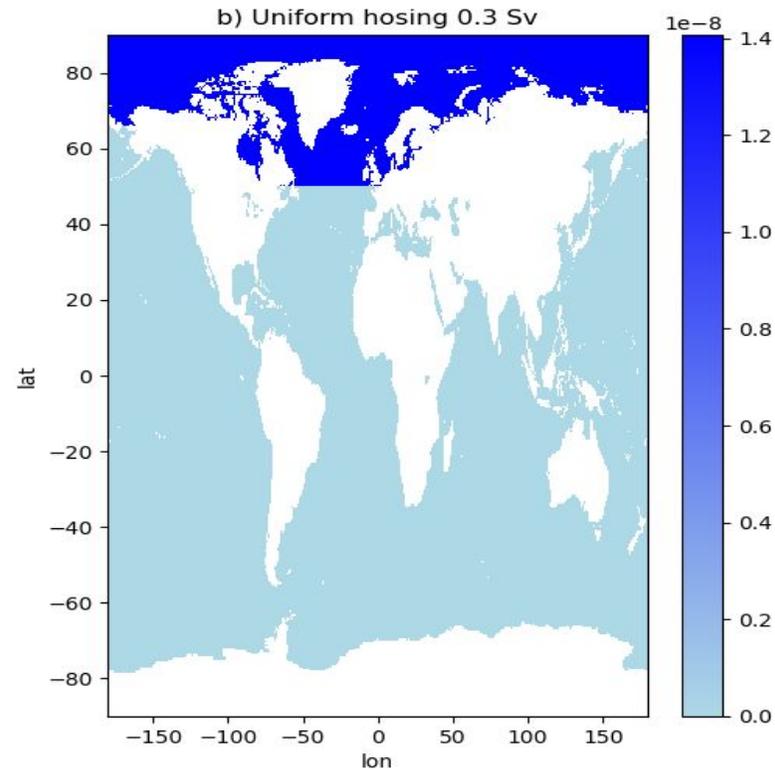
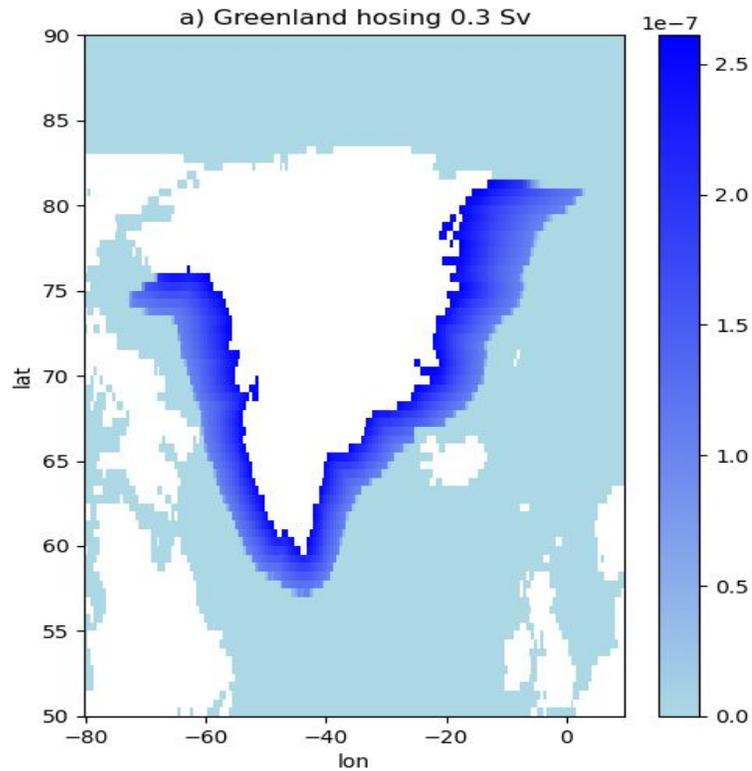
*Domian leads: Didier Swingedouw, Aixue Hu, Laura Jackson, Anastasia Romanou*

*Liaison: Nicole Laureanti*

*Acknowledgement: previous domain lead Wilbert Weijer*

- **Experiment A:** CO<sub>2</sub> + hosing
- **Experiment B:** GrIS melt past and future
- **Experiment C:** NAHosMIP
- **Experiment D:** 8.2k event

# REGIONS WHERE FRESHWATER FLUX IS ADDED

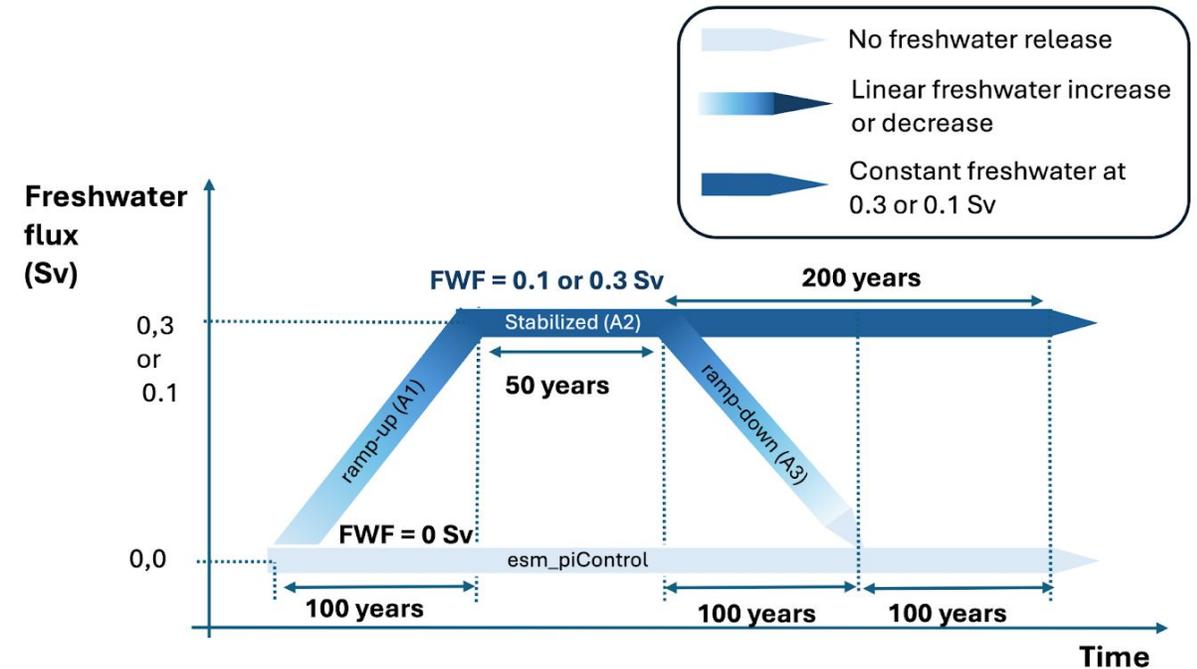
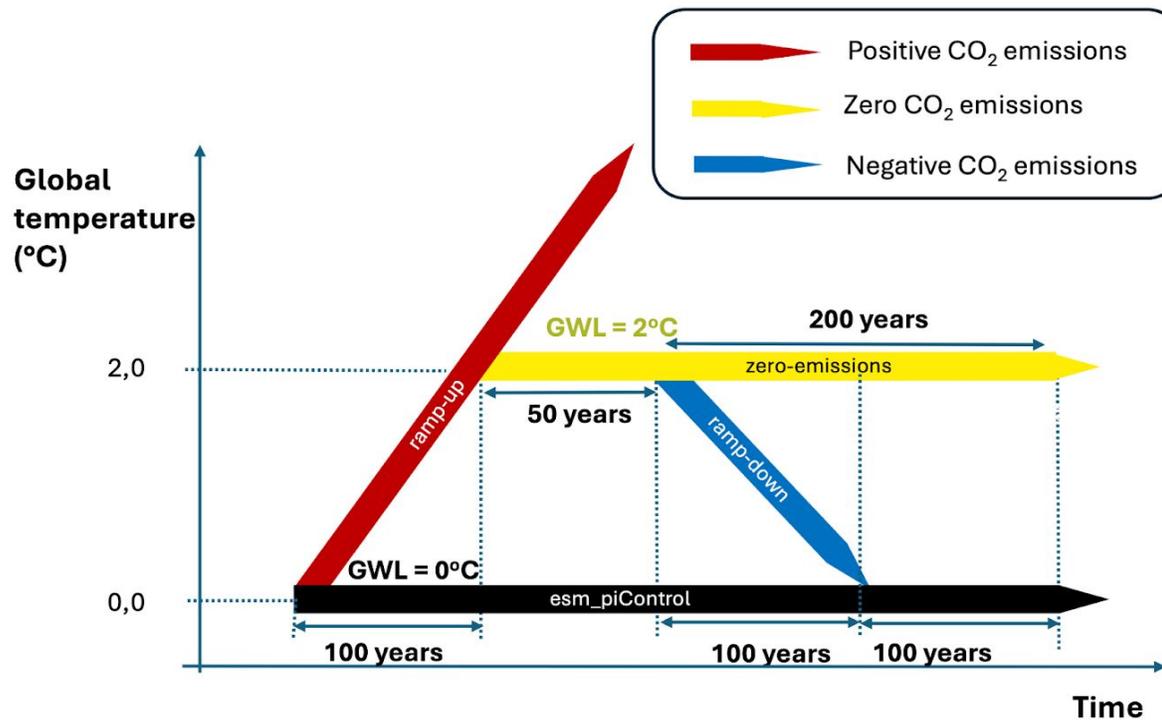


**Experiments A and B**

**Experiment C**

**Experiment D**

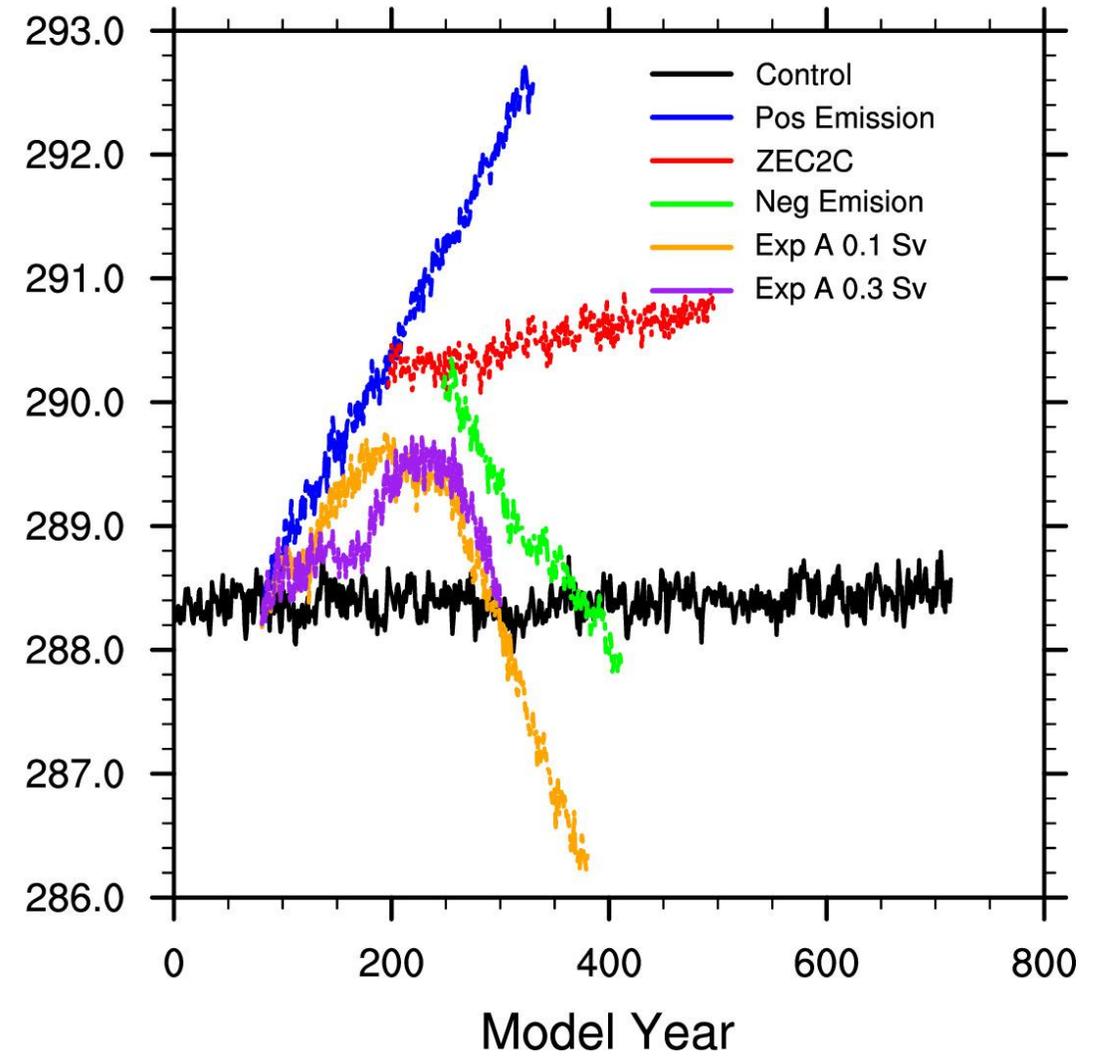
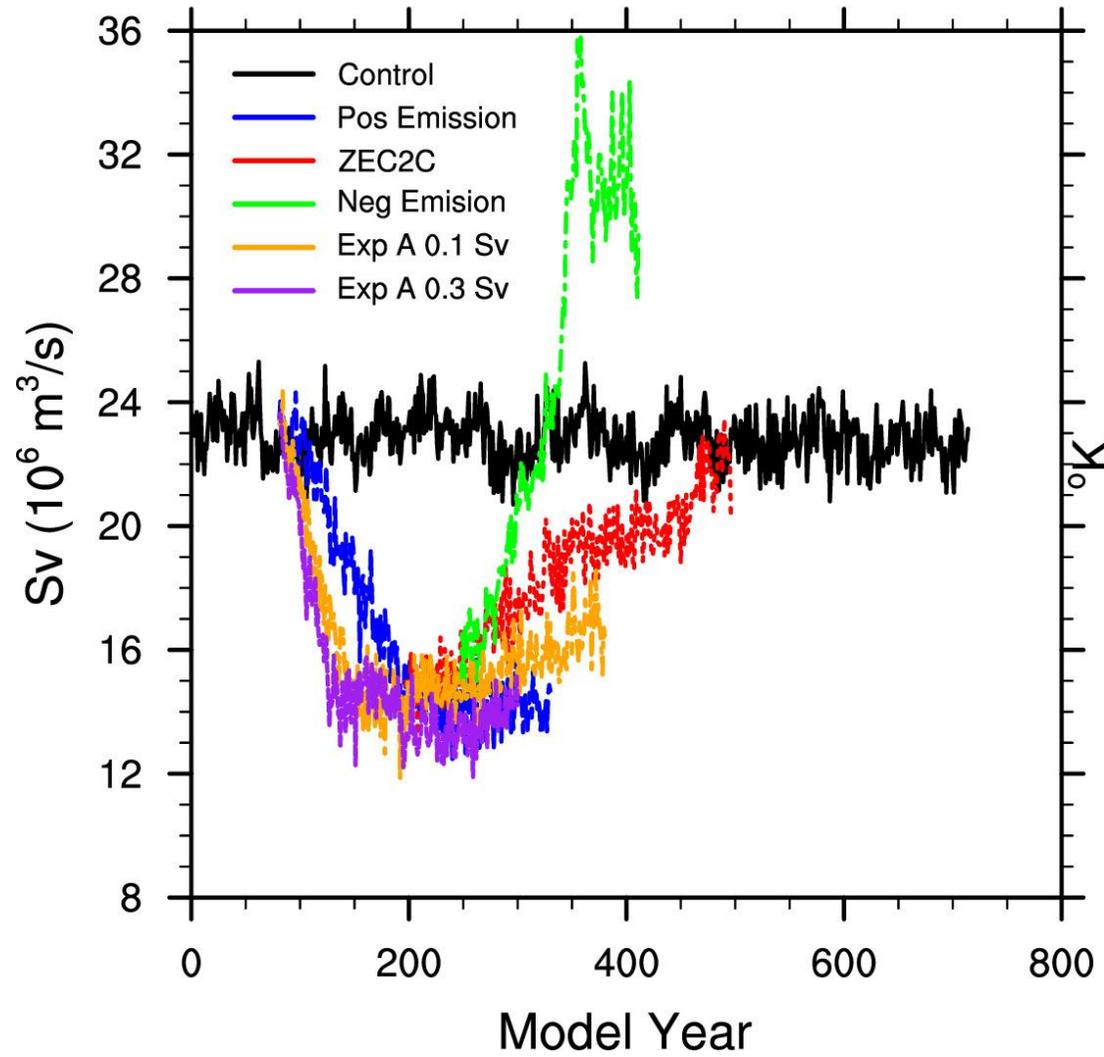
# Experimental Design: Experiment A



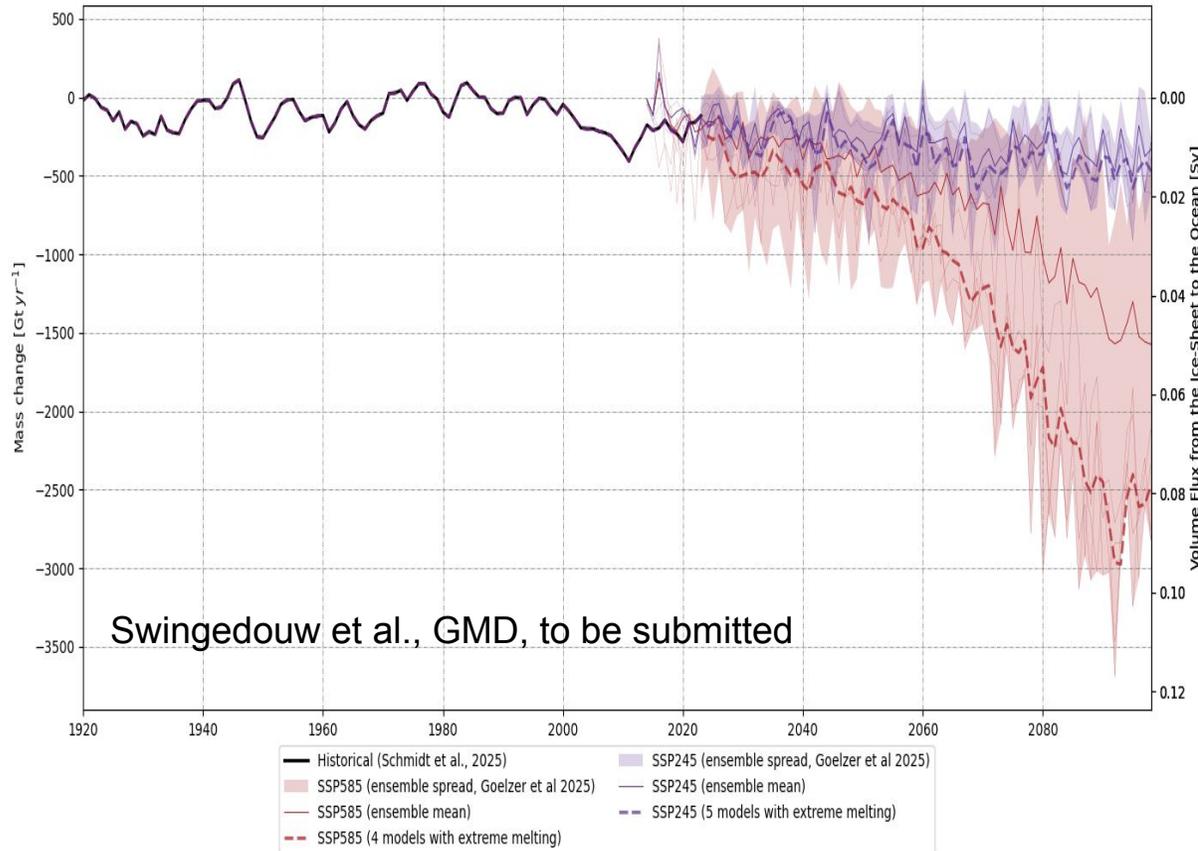
# CESM2

## AMOC

## Global Mean TS



# Experimental Design: Experiment B



## Experiments: Tier 1

### B1:

- Climate Forcing: historical (1900-2014)
- 115 years at H1(t)

**B2:** (can be the only one from HR run, coordination with High ResMIP?)

- Starting from the end of B1
- Climate forcing: SSP5-8.5
- 80 years at H2(t)

## Experiments: Tier 2

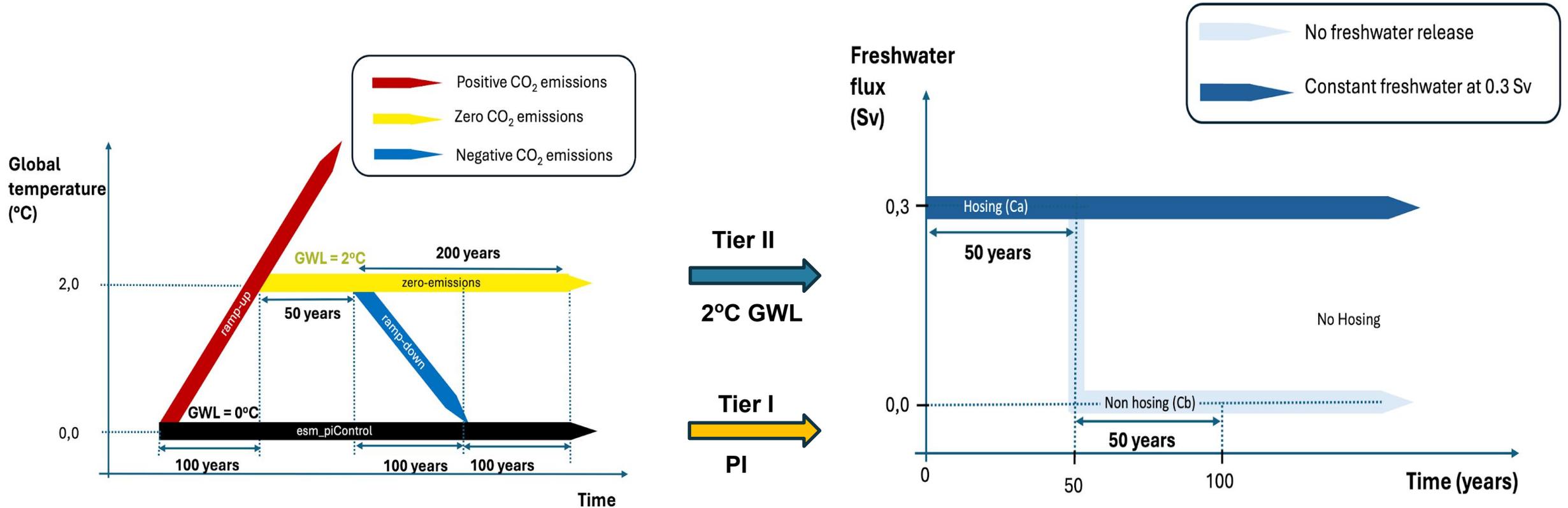
**B3 :** Same as B2 but with SSP2-4.5 and H3(t)

**B4 :** Same as B2 but with SSP1-2.6 and H4(t)

**B1bis:** different members of B1

**Extension of Bk** beyond 2100 for  $k > 1$

# Experimental Design: Experiment C



North of 50N include Arctic

# Experimental Design: Experiment D

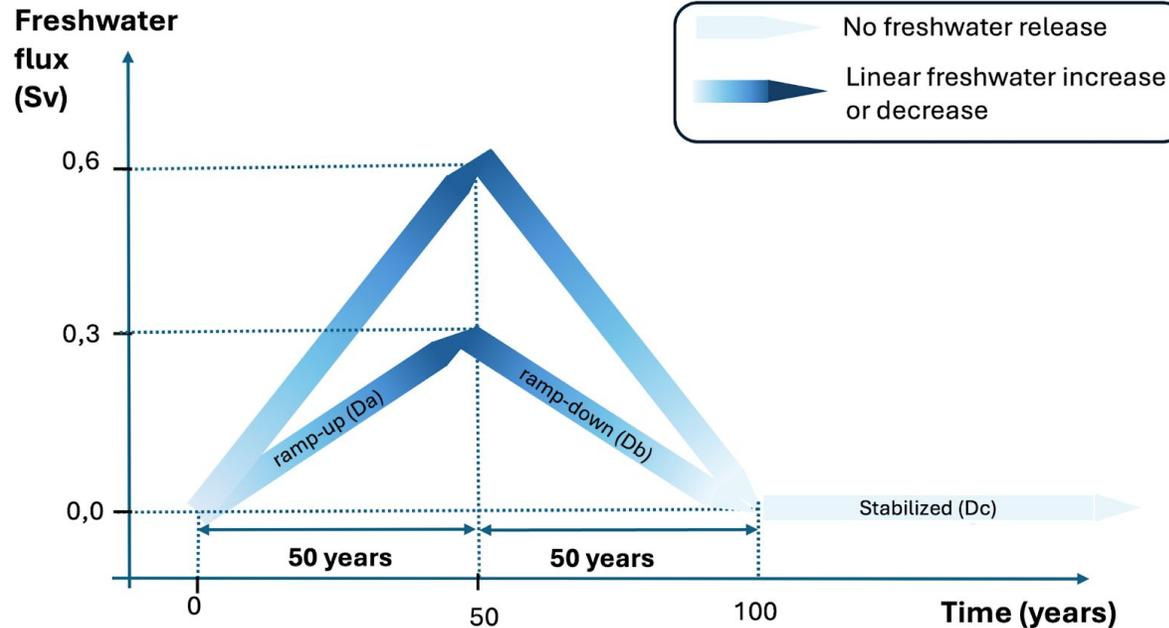
## Experiments:

### E1:

- E1a: 50 years at R1-up
- E1b: 50 years at R1-down
- E1c: 100 years of H0 stabilisation

### E2:

- E2a: 50 yrs at R2-up
- E2b: 50 years at R2-down
- E2c: 100 years of H0 stabilisation



65°W-45°W, 48°N-65°N

PMIP: hol9.5k, hol8.2k\_0.3, hol8.2k\_0.6

# Participating Models

## Europe:

HadGEM3	<a href="#">Laura Jackson, Richard Wood</a>	Met Office
EC-Earth3	<a href="#">Shuting Yang</a>	
IPSL-CM	<a href="#">Didier Swingedouw</a>	
Bern3D	<a href="#">Ferk Pöppelmeier</a>	
PlaSim-LSG, Climber-X	<a href="#">Reyk Börner (with V. Lucarini)</a>	
CLIMBER-X-Yelmo	<a href="#">Alexander Robinson</a>	
EC-Earth3	Valeria Lambo	
CLIMBER-X	Matteo Willeit	Potsdam Institute for Climate Impact Research
PlaSim-LSG, Climber-X	Reyk Börner	Utrecht University

## North America:

GFDL ESM2M, GFDL-CM4?	<a href="#">Thomas Frölicher</a>	University of Bern
CESM	<a href="#">Aixue Hu</a>	
NASA-GISS	<a href="#">Anastasia Romanou</a>	
Vitoria Earth System Climate Model	<a href="#">Geoffrey Harper (Kirsten Zickfeld)</a>	

## Asia:

COSMOS-wiso	Xu Zhang	
IITM-ESM	Ayantika Dey Choudhury (Swapna Panickal)	
CAS-ESM2	<a href="#">Zhaohui Lin, Jiangbo Jin</a>	Institution of Atmospheric Physics, Chinese Academy of Science
BCC-ESM2	<a href="#">Fanghua Wu</a>	CMA Earth System Modeling and Prediction Centre (CEMC), China Meteorological Administration (CMA)

## Australia:

ACCESS-ESM1.5 [Laurie Menviel](#)

## South America:

BESM Paulo Nobre (with E.Giarolla)

**PAGES SSC co-chairs:**

Shiling Yang  
Martin Grosjean

**PAGES IPO director:**

Marie-France Loutre

# PAGES

## PAST GLOBAL CHANGES

*Coordinating Paleoscience for a Sustainable Future*



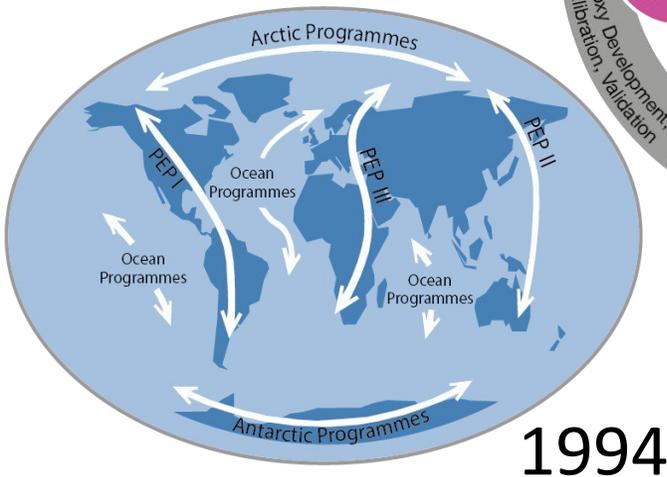
中国科学院  
CHINESE ACADEMY OF SCIENCES

futureear  
Research. Innovation. Sust

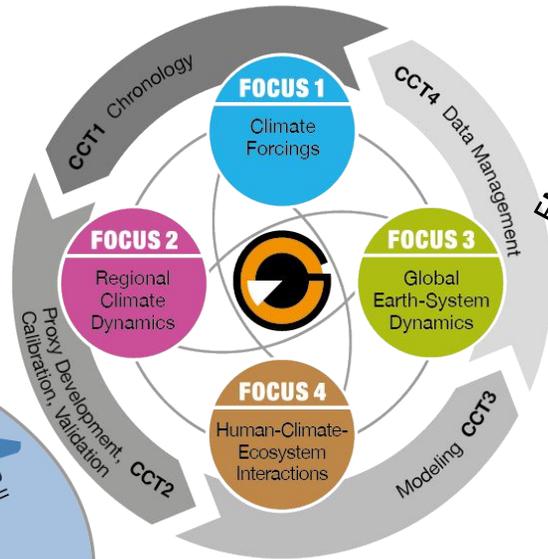
**WCRP**  
World Climate  
Research Programme



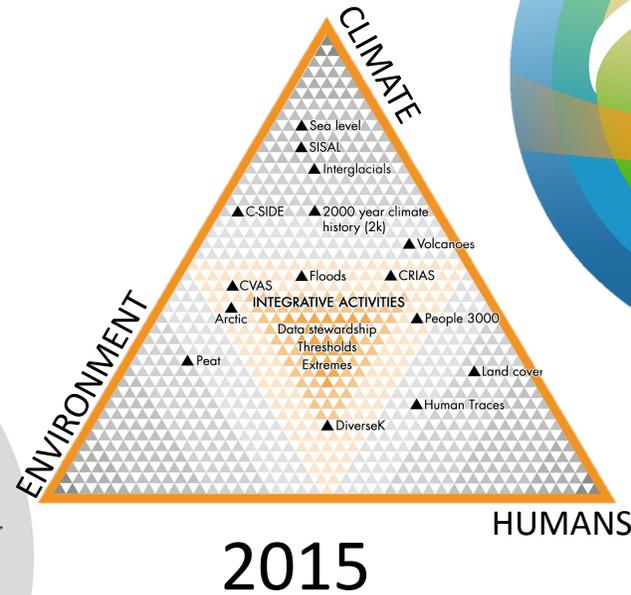
# The PAGES Project



1994



2009



2015



2021

PAGES  
EARLY-CAREER NETWORK

IMPACT

ATRAN

FLOODS

ACME

2K NETWORK

CVAS

VTCS

SISAL

PO2

PLANETARY BOUNDARIES

PALSEA

MARDI

HUMAN TRACES





# The Scientific Steering Committee

A mirror of PAGES community



**15 members** from **11 countries**

International Project Office in Bern

Switzerland with **6 staff members**

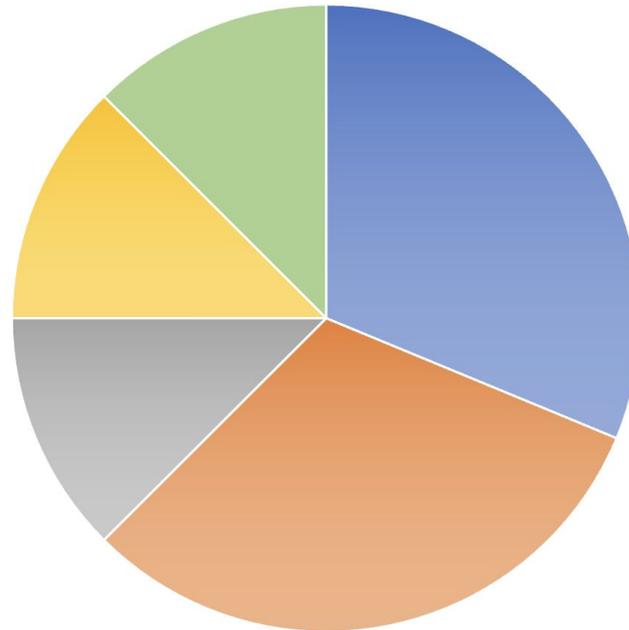
from

**5 countries**

**SSC member application:**

<https://pastglobalchanges.org/be-involved/ssc/apply>

Deadline: March 11, 2026



- Europe
- Asia
- NAmerica
- SAmerica
- SPacific
- Africa

# PAGES new working group

## Investigating Modes of Past Abrupt Climate change and Tipping points (IMPACT)

While most existing initiatives emphasize the potential future crossing of tipping points and their associated impacts, our focus is to deliver critical insights into tipping elements and abrupt climate change based on evidence from past abrupt climate transitions. By characterizing the scale, triggers, bi-stability, and feedbacks of past tipping behavior, we aim to improve their representation in Earth system models, thereby enhancing the reliability of future climate projections.

### **PAGES IMPACT workshop 2026**

**Past abrupt changes, thresholds and tipping points: Definitions, Identification, and Context**

11<sup>th</sup> – 13<sup>th</sup> May 2026, University of Bern, Bern, Switzerland



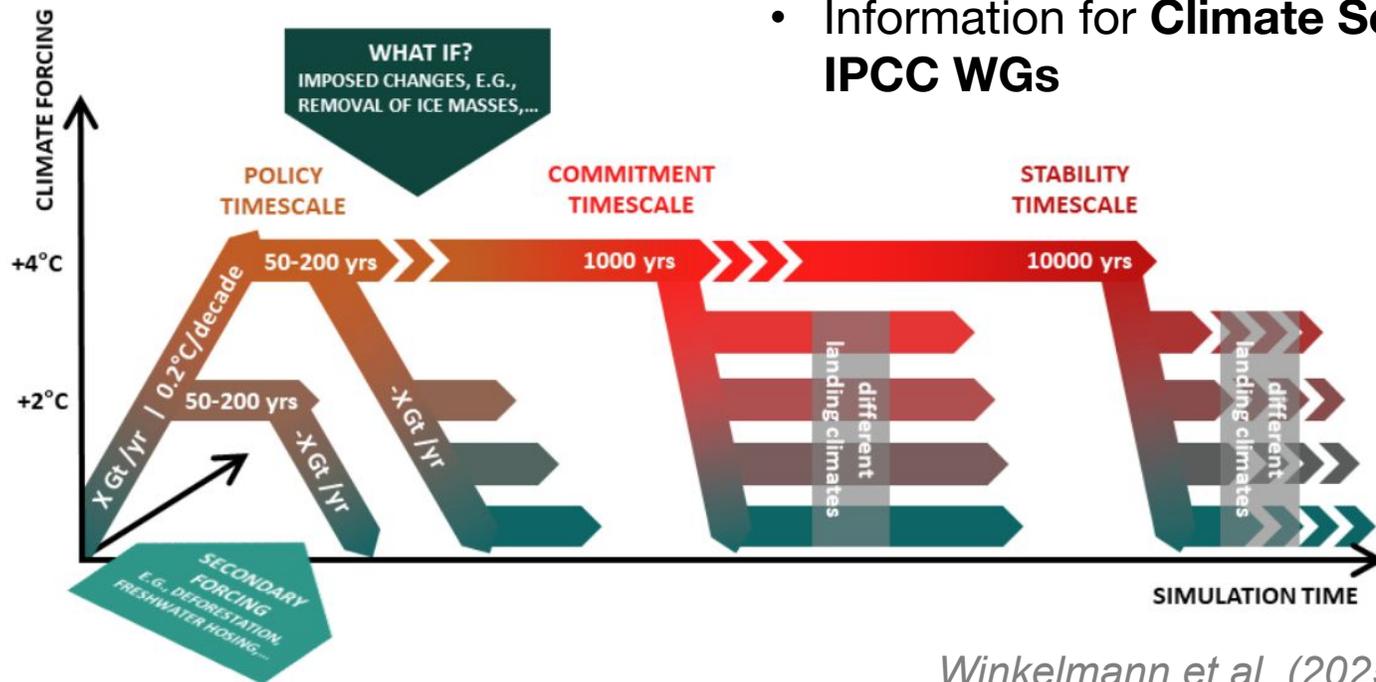
# Thank you!



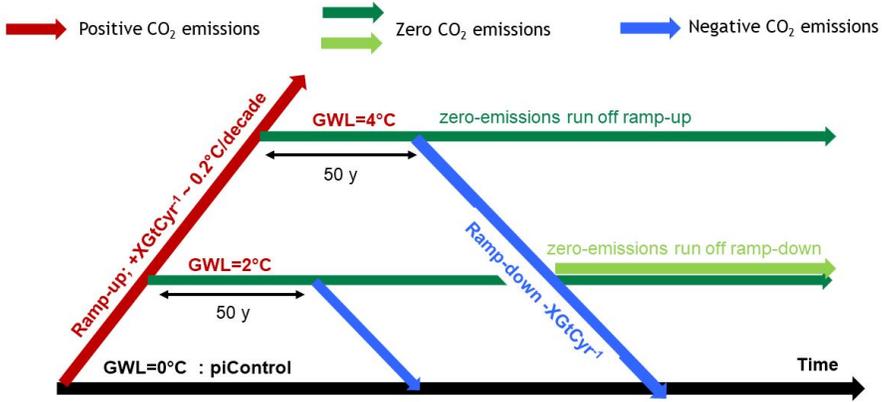
# TIPMIP – WhatIf

- **Doable by any AOGCM**
- These components do not need to be interactive
- **Multi-model estimates of uncertainties in CONSEQUENCES**

- Potential **far-field impacts** (e.g. ENSO) and **global risks** (e.g. carbon cycle, wildfire aerosols)
- Policy relevant for assessing **local, regional adaptation and vulnerability**
- Information for **Climate Services & all 3 IPCC WGs**

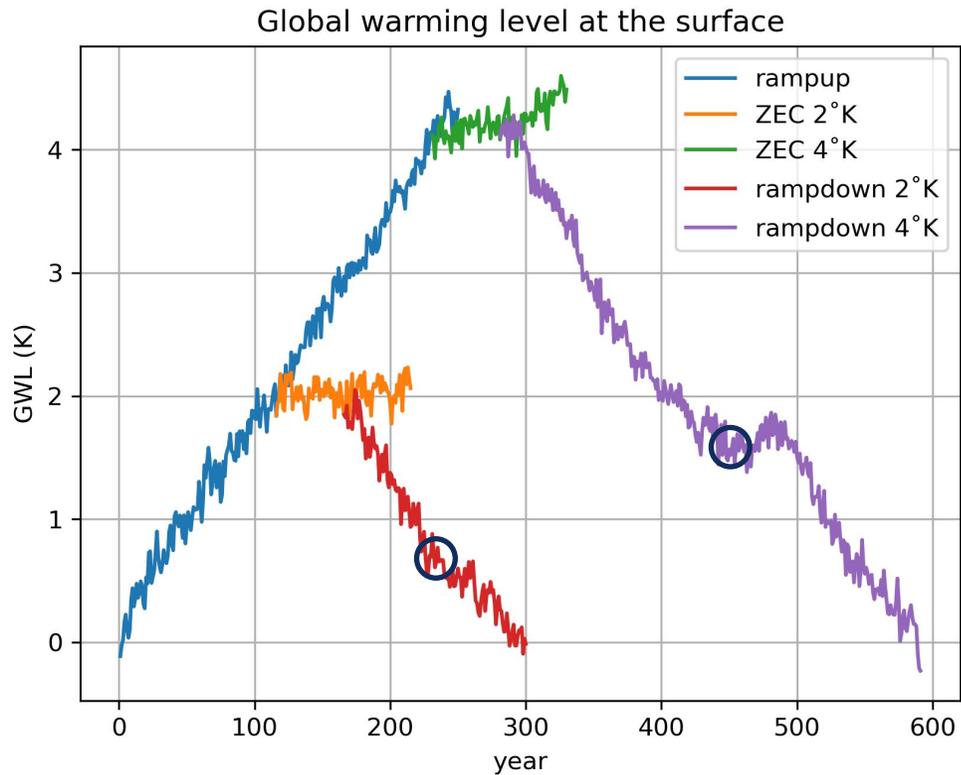


Winkelmann et al. (2025, Earth Sys. Dyn., submitted)



# CESM2 Nominal 1°, Emissions-Driven Simulations

Ramp up: 10 GtC / year



Atmospheric carbon dioxide concentrations at the surface

