



u<sup>b</sup>

UNIVERSITÄT  
BERN

OESCHGER CENTRE  
CLIMATE CHANGE RESEARCH

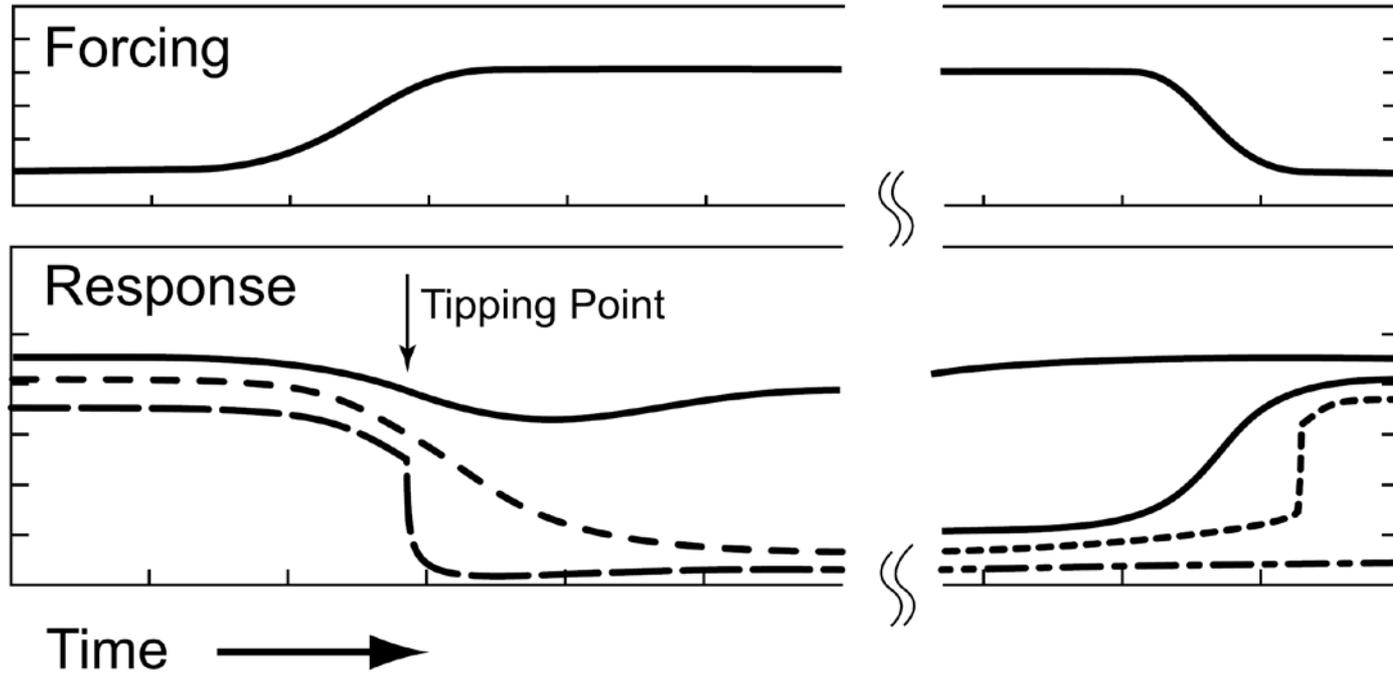
University of Bern, Institute of Philosophy, Epistemology of Climate Change

# Climate tipping points: From paleoclimate insights to policymaking

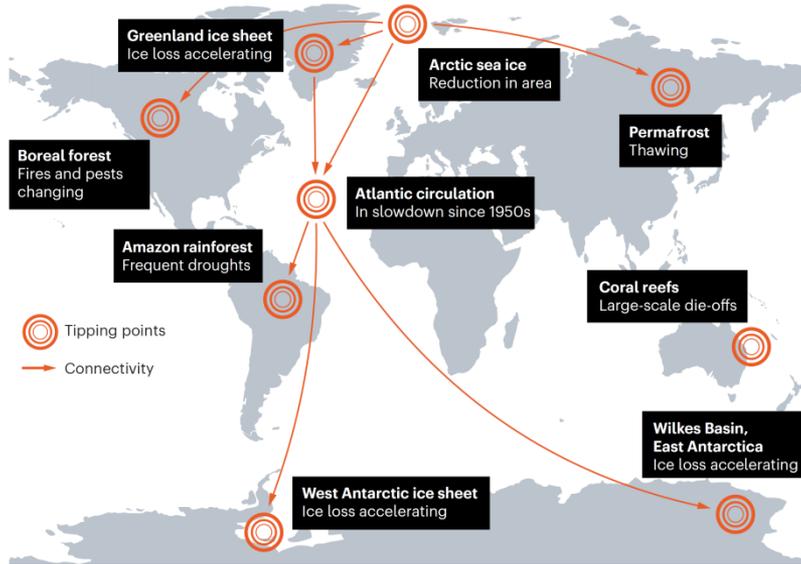
**Thomas Stocker**

Physics Institute  
Oeschger Centre for Climate Change Research  
University of Bern, Switzerland

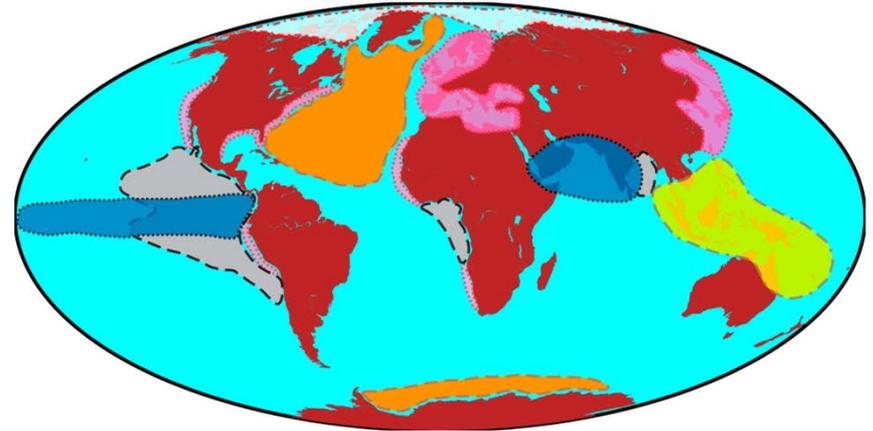
# Tipping points: First emergence in IPCC Assessment Reports



# Tipping points: EVERYWHERE ?



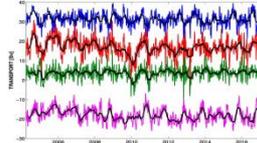
Lenton et al 2019, Nature



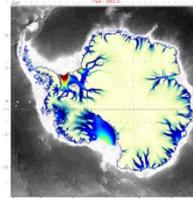
Heinze et al 2021, PNAS

# Tipping points: Four elements for progress

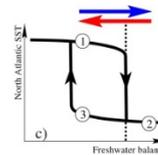
❖ Observations



❖ Modelling



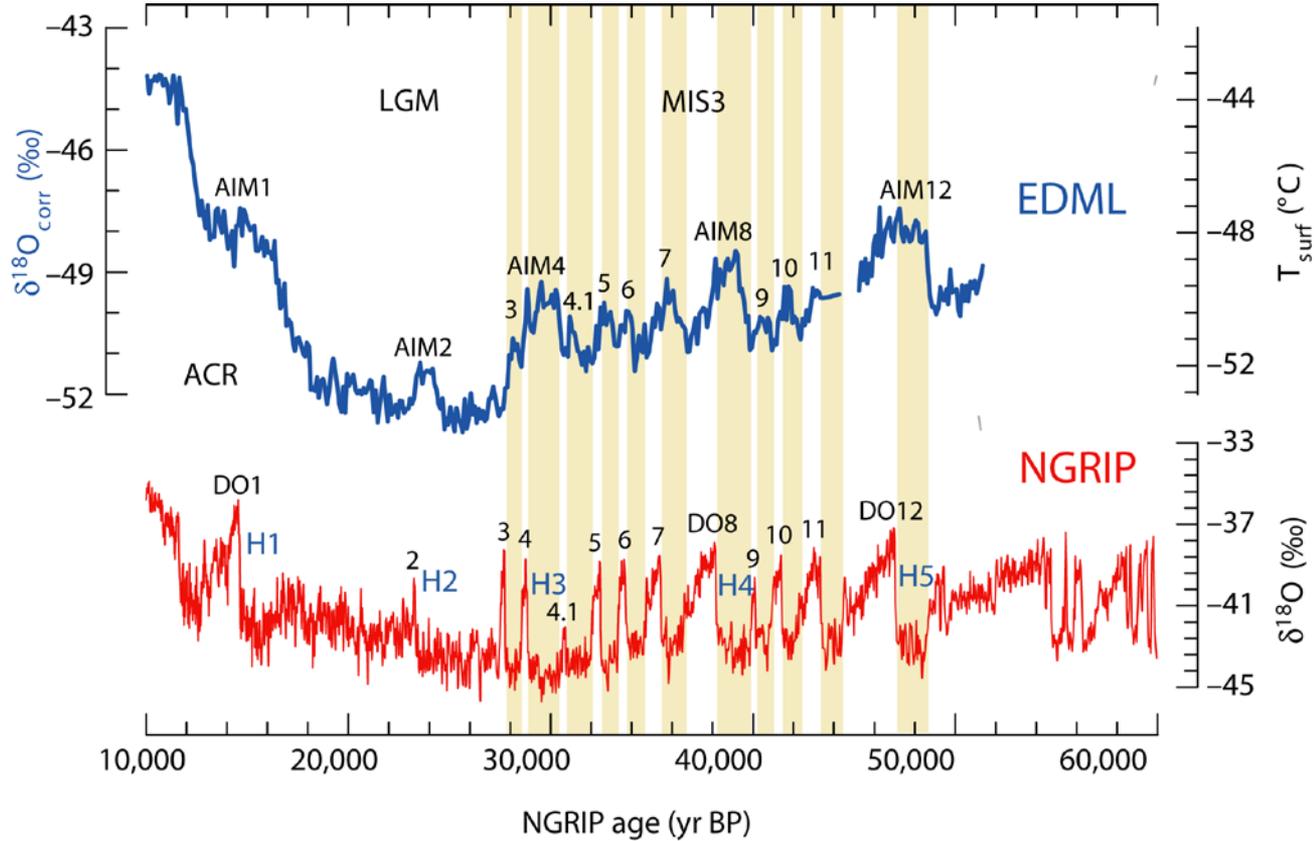
❖ Theory



❖ Communication



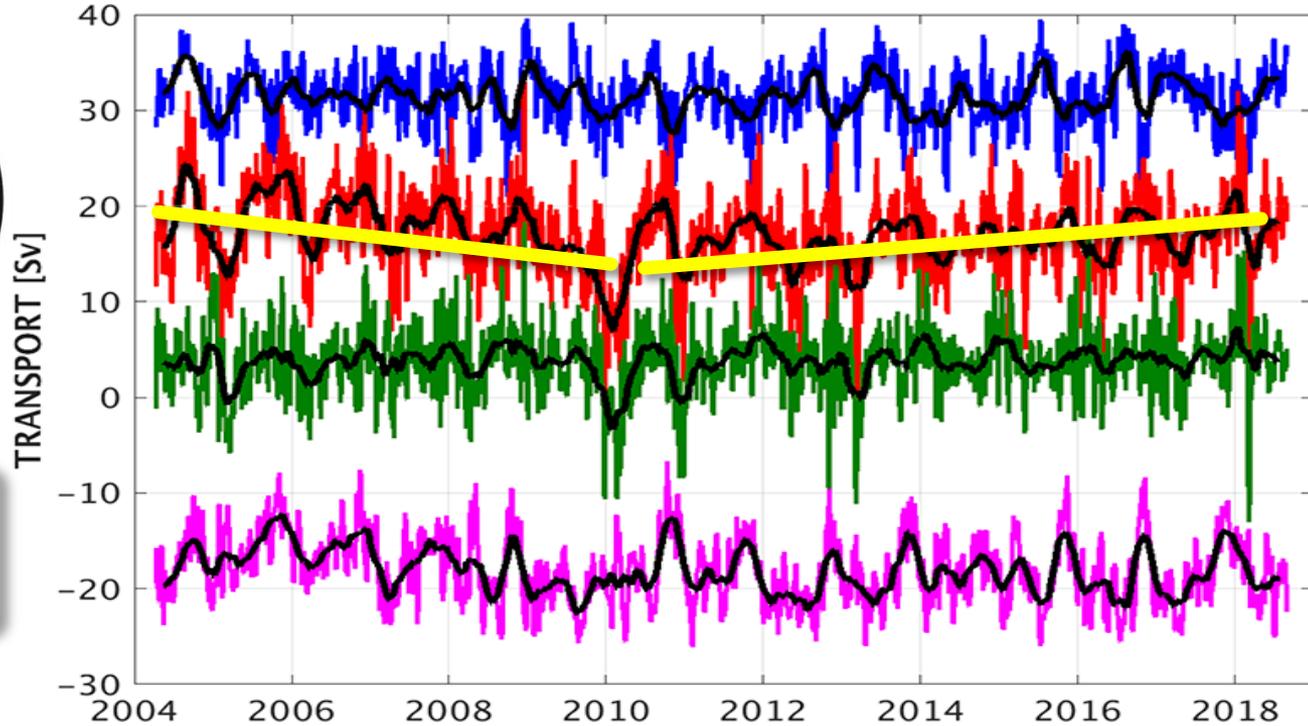
# Observations: Tipping points in the past



# Observations: Tipping points approaching ?



— Gulf Stream — MOC — Ekman — Upper Mid-Ocean

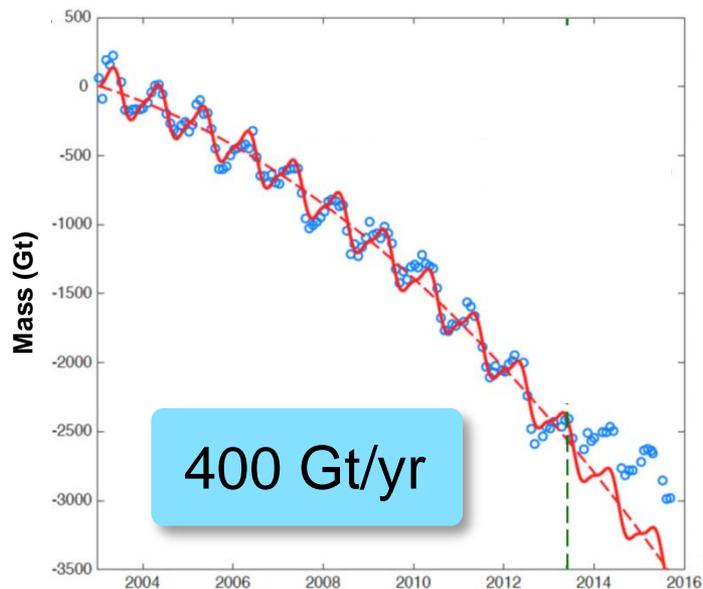


Trend or no trend ?

RAPID-AMOC, 2021

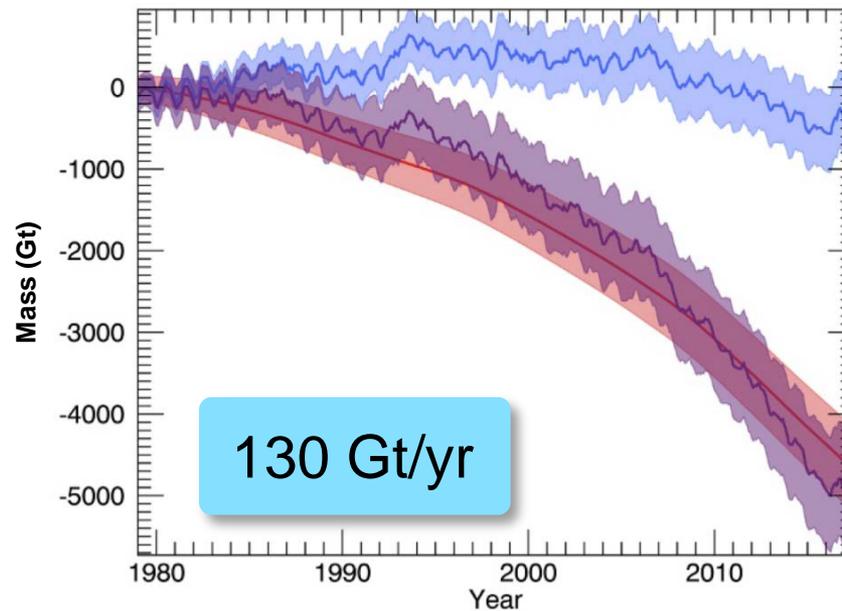
# Observations: Tipping points approaching ?

## Greenland (GRACE)



Bevis et al., 2019

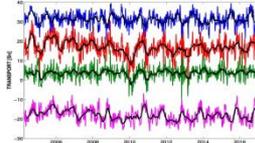
## Antarctica (various)



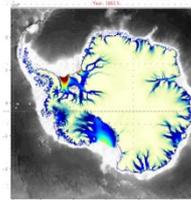
Rignot et al., 2019

# Observations: Tipping points approaching ?

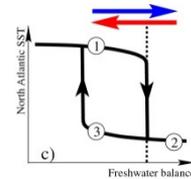
❖ Observations



❖ Modelling



❖ Theory

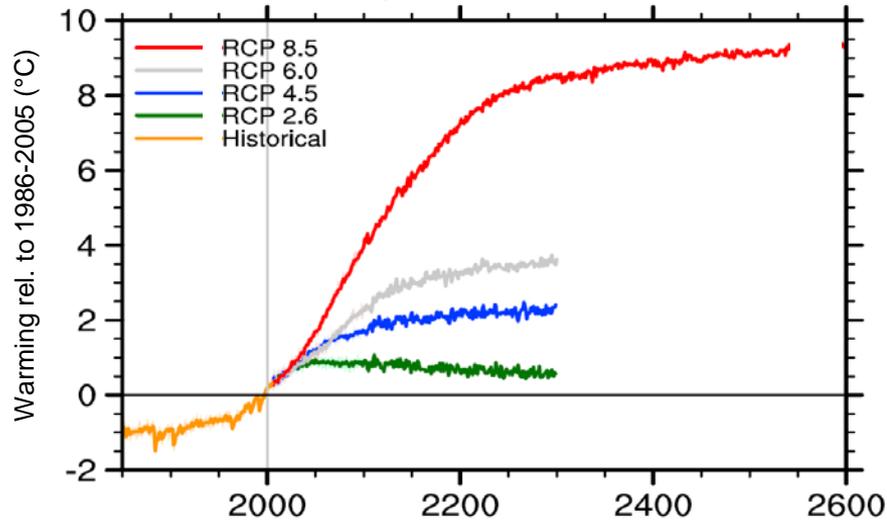


❖ Communication

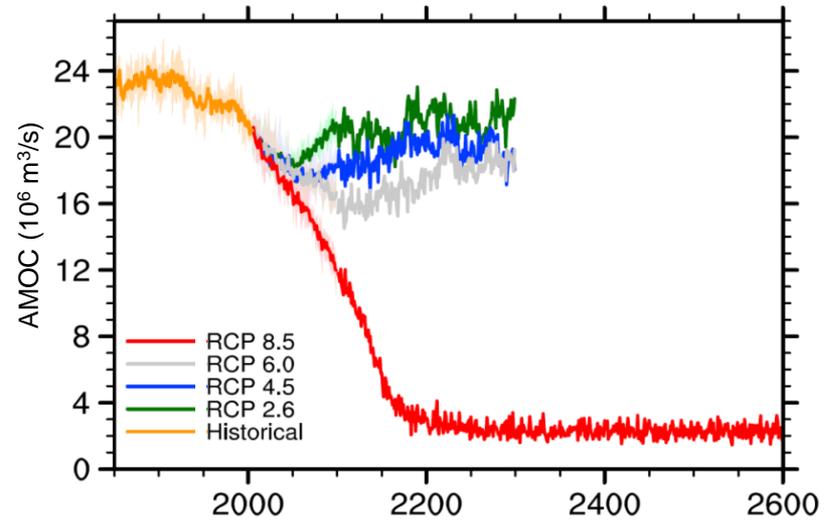


# Modelling: Tipping points as a consequence of the climate crisis

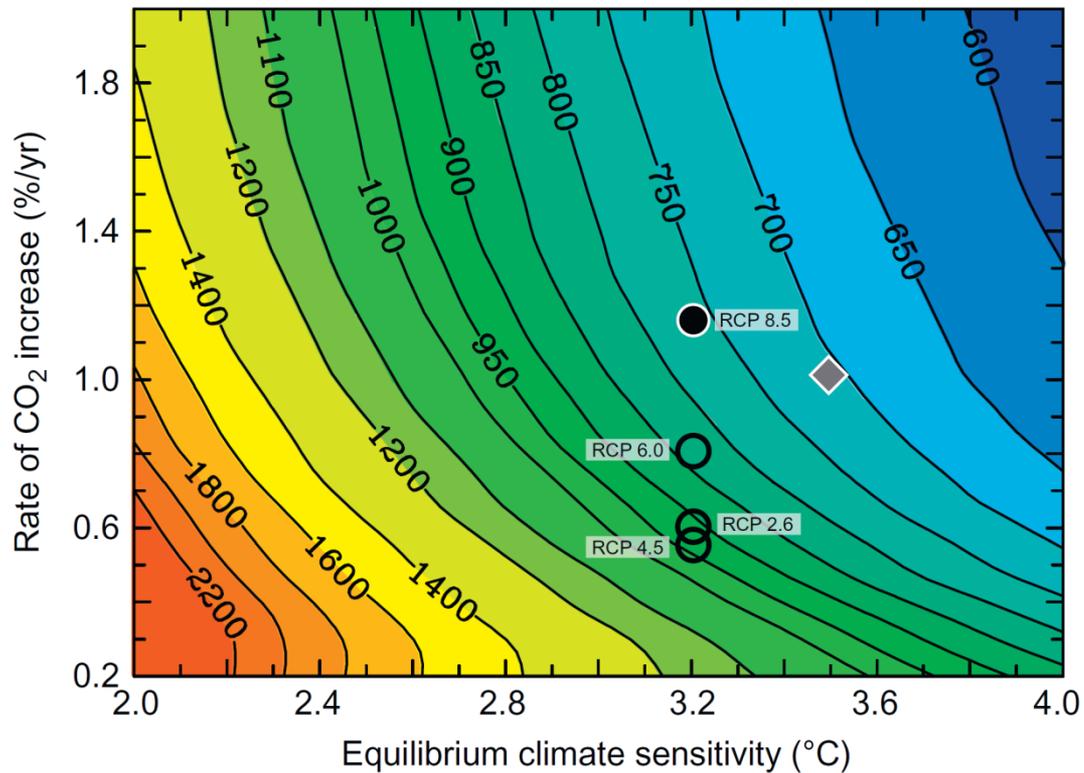
### Global mean surface temperature change



### Maximum Atlantic Overturning

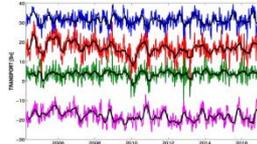


# Modelling: Tipping points as a consequence of the climate crisis

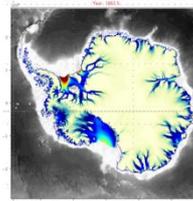


# Tipping points: Four elements for progress

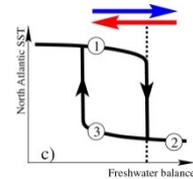
❖ Observations



❖ Modelling



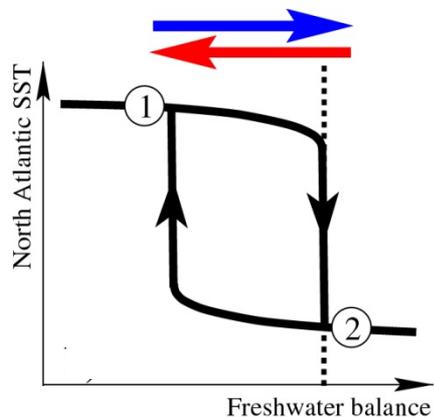
❖ Theory



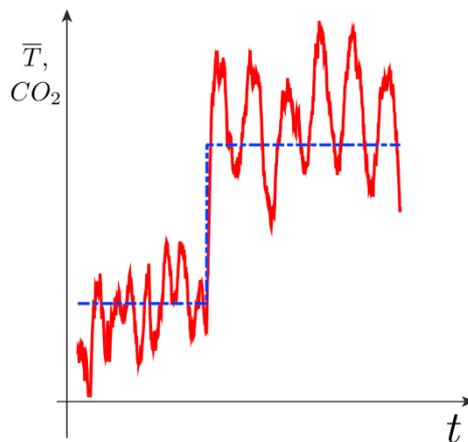
❖ Communication



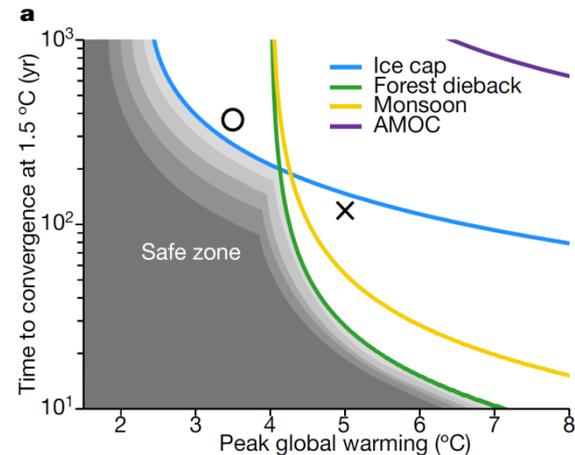
*abrupt, reversible*



*change in variability*



*overshooting risk*

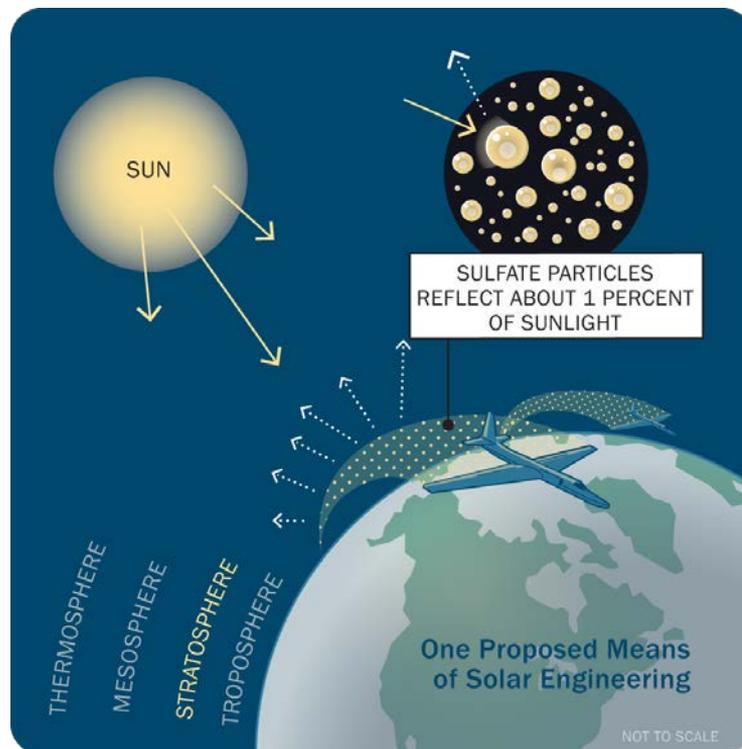


Stocker & Marchal 2000, PNAS

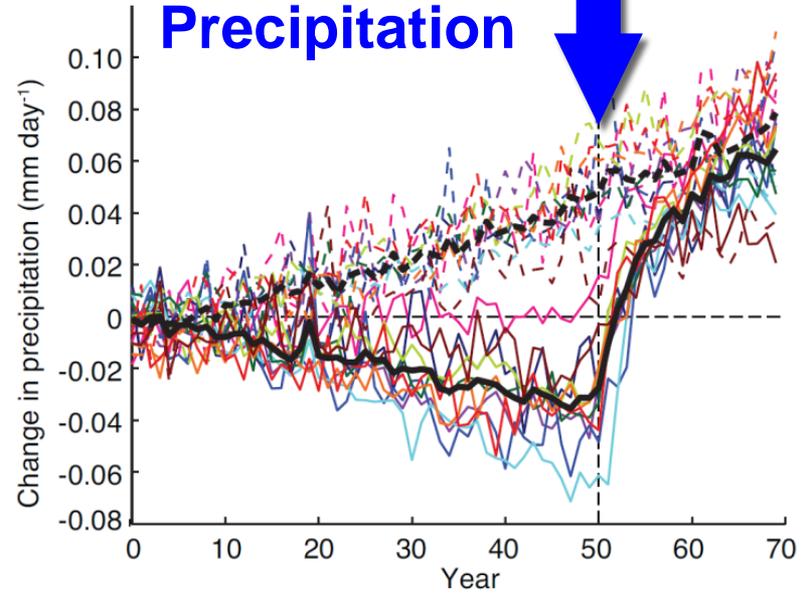
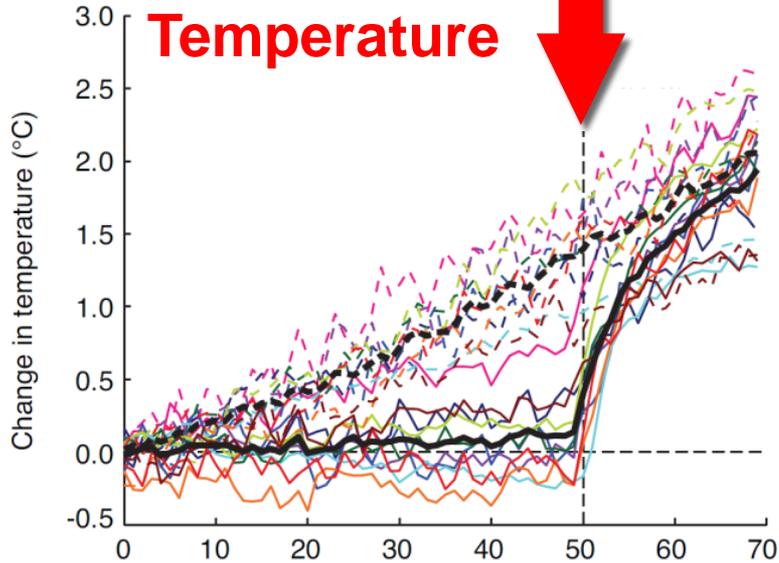
Ghil 2019, ESS

Ritchie et al., 2021, Nature

# Geoengineering: A dangerous driver of tipping points

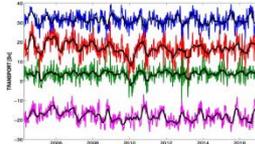


## The Termination Problem

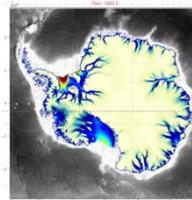


# Tipping points: Four elements for progress

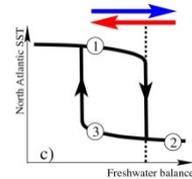
❖ Observations



❖ Modelling



❖ Theory

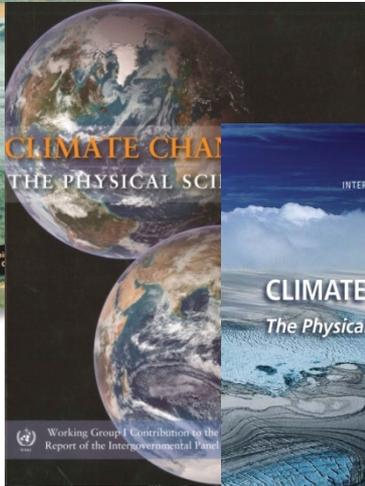
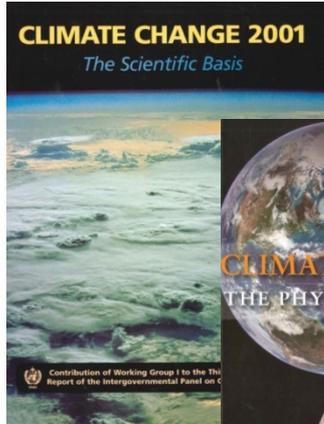


❖ Communication



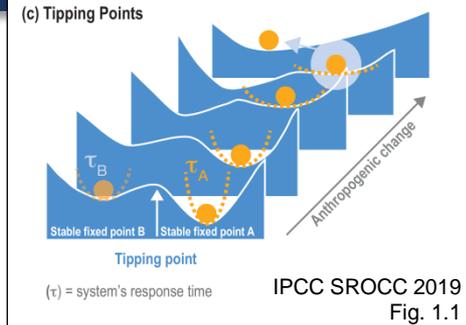
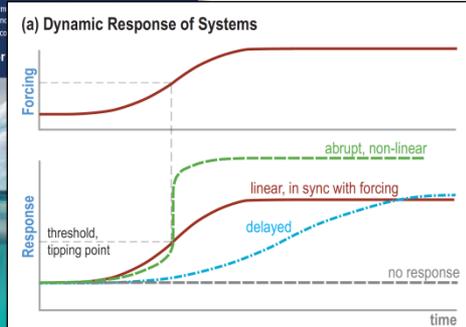
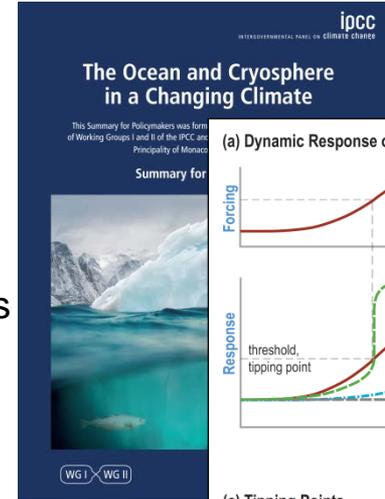
# Tipping points: Confusing in the public, scattered in assessments

Surprises in the climate system  
Emerging science

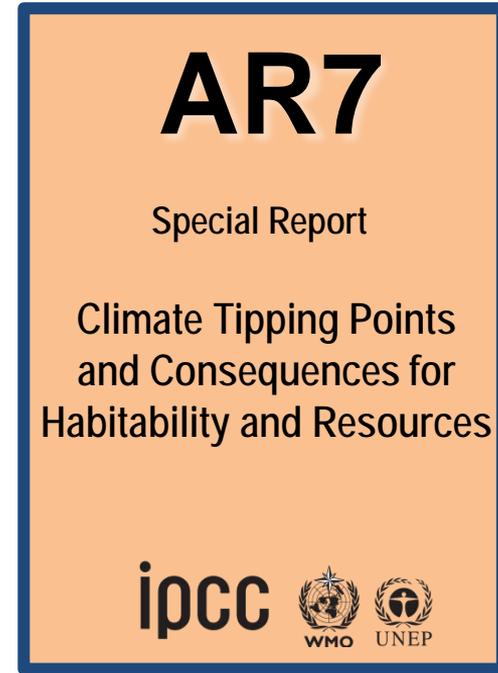
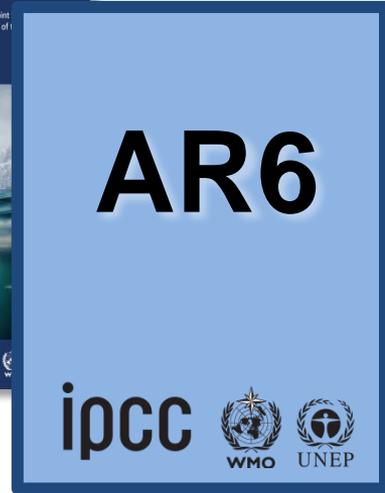
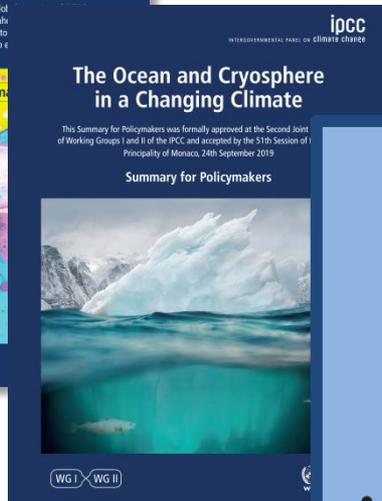
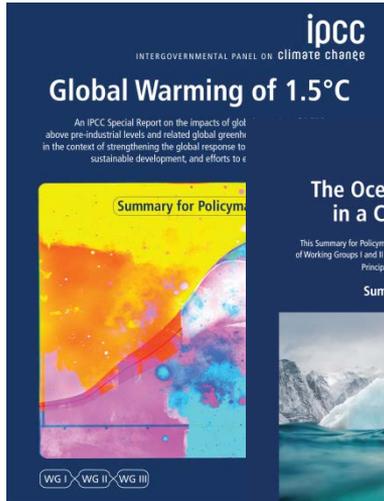


Atlantic meridional overturning  
Polar ice sheets

Tipping points  
Irreversible changes  
in all components  
Impacts



# Tipping points: Confusing in the public, scattered in assessments





University of Bern, Institute of Philosophy, Epistemology of Climate Change

## Summary

- ❖ Tipping points were a reality in the past. They are a **serious possibility in the future.**
- ❖ Understanding of tipping points has increased, but remains fragmented, confusing, or incomplete. **This hampers policymaking.**
- ❖ A scientific consensus on tipping points and their regional impacts is missing. **Tipping points events are not yet part of IPCC scenarios.**
- ❖ This calls for an **IPCC Special Report** on *Climate Tipping points and Consequences for Habitability and Resources* in the IPCC's 7<sup>th</sup> cycle.