Pacific Northwest
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The role of oceanic and atmospheric feedbacks in the response of the Atlantic Meridional Overturning Circulation to a CO2 increase

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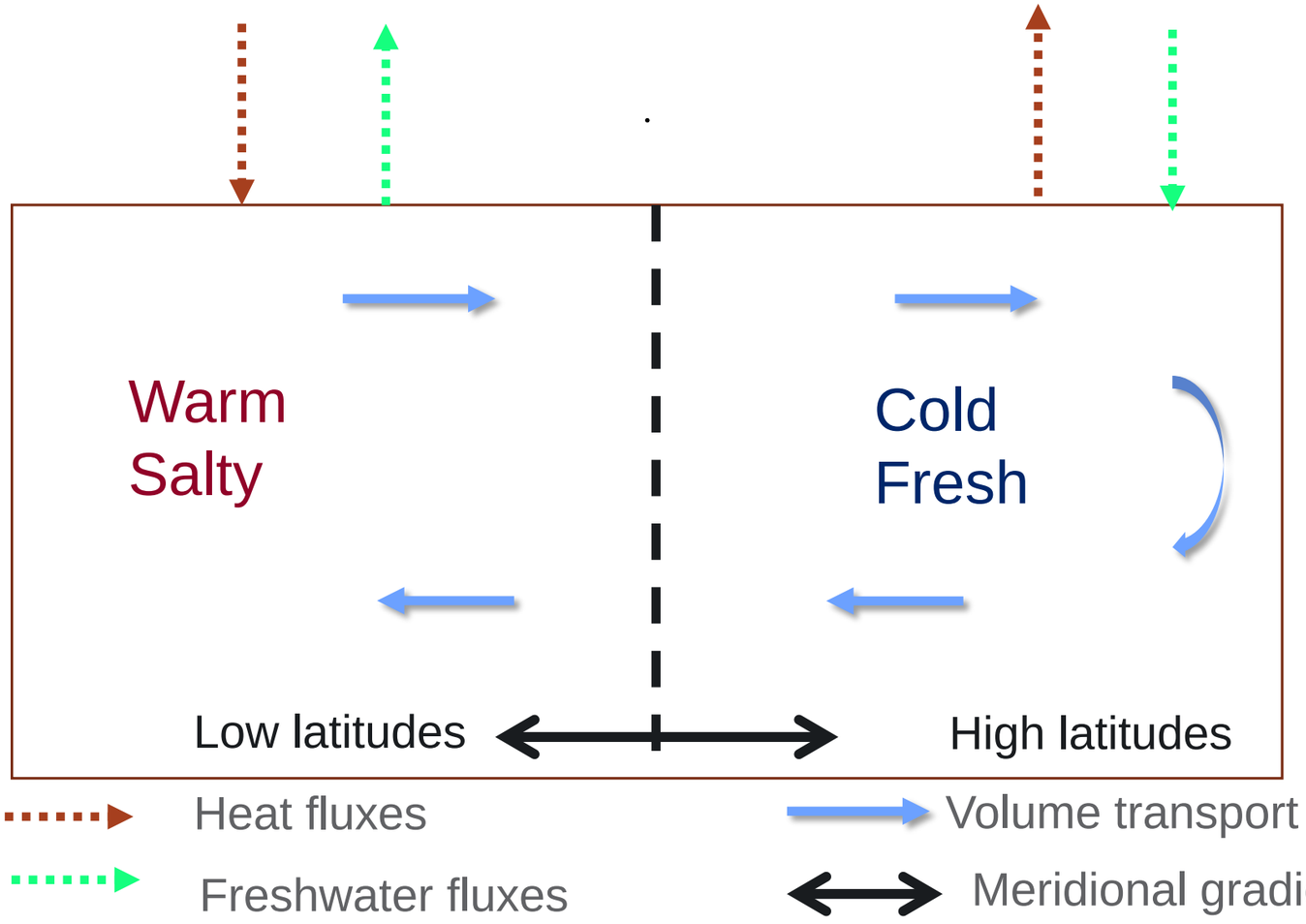
Feedbacks on AMOC response



- Oceanic (advective) feedbacks
  - o Temperature ⇨ stabilizing
  - o Salt ⇨ destabilizing
- Atmospheric (surface flux) feedbacks?

Goal: Understand the relative impacts of temperature and salt advective feedbacks and atmospheric feedback on the AMOC response to CO_2 quadrupling

Tools for isolating feedbacks

- Passive tracer decomposition method is used to isolate the impacts of temperature and salt advective feedbacks on AMOC weakening.

- Partial coupling suppresses atmospheric feedbacks on the AMOC weakening

Passive tracer decomposition of anomalous temperature and salinity

$$T = \bar{T} + T'$$

$$\frac{\partial T'}{\partial t} = F'_{OA} - v' \cdot \nabla \bar{T} - v \cdot \nabla T'$$

$$\frac{\partial T'_S}{\partial t} = F'_{OA} - v \cdot \nabla T'_S$$

(Surface-driven)

$$\frac{\partial T'_C}{\partial t} = -v' \cdot \nabla \bar{T} - v \cdot \nabla T'_C$$

(Circulation-driven)

$$T' = T'_S + T'_C$$

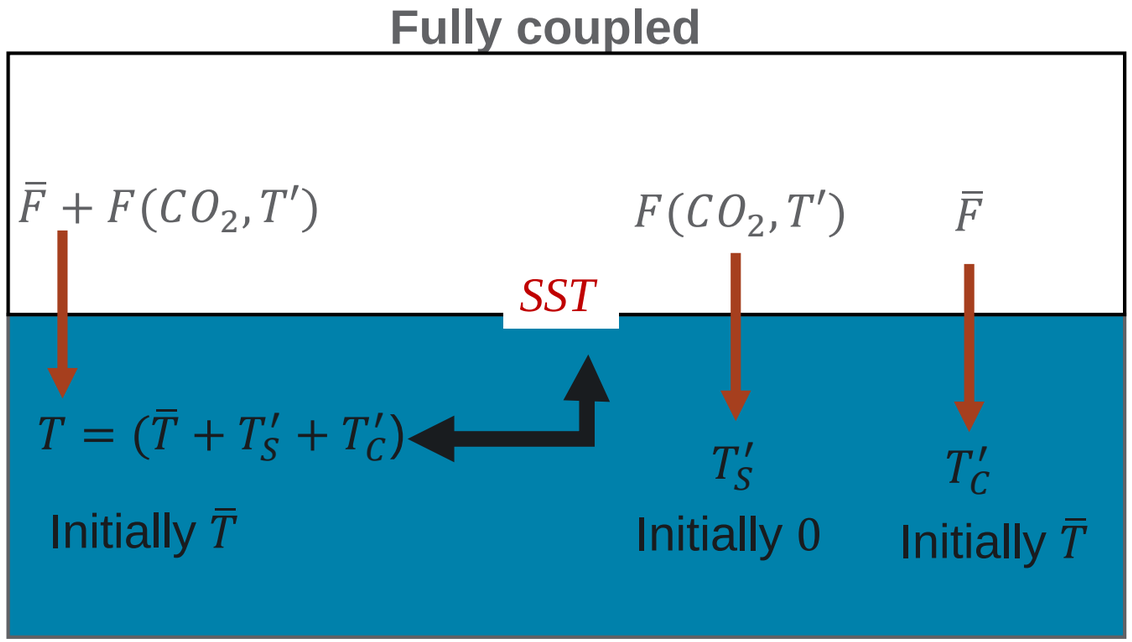
Atmospheric feedbacks

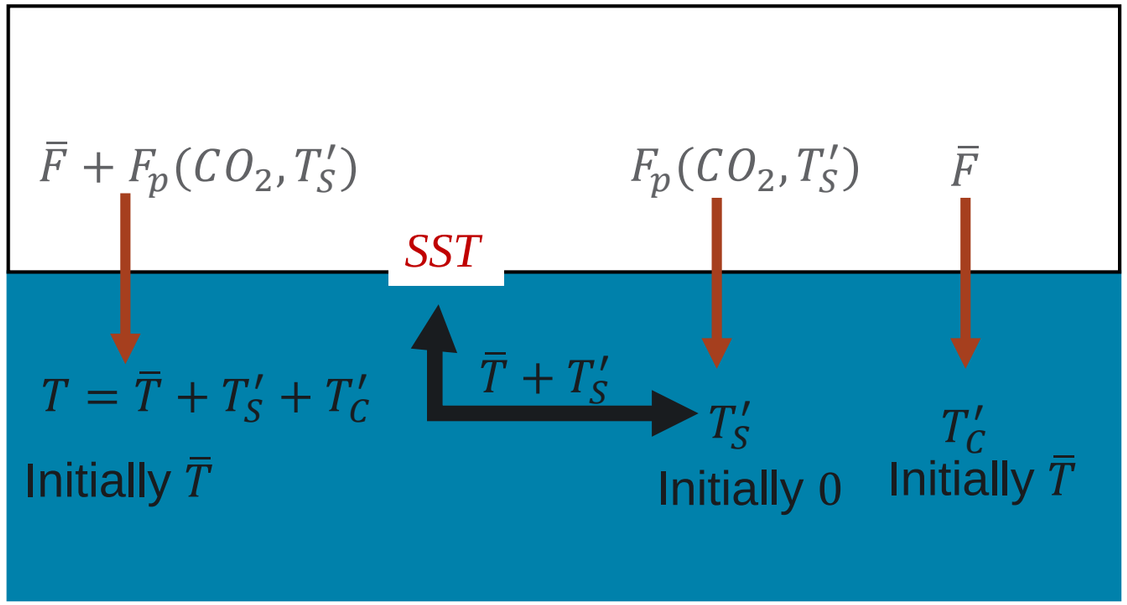
Advective feedbacks

(Banks and Gregory 2006, Xie and Vallis 2011)

Partial coupling method

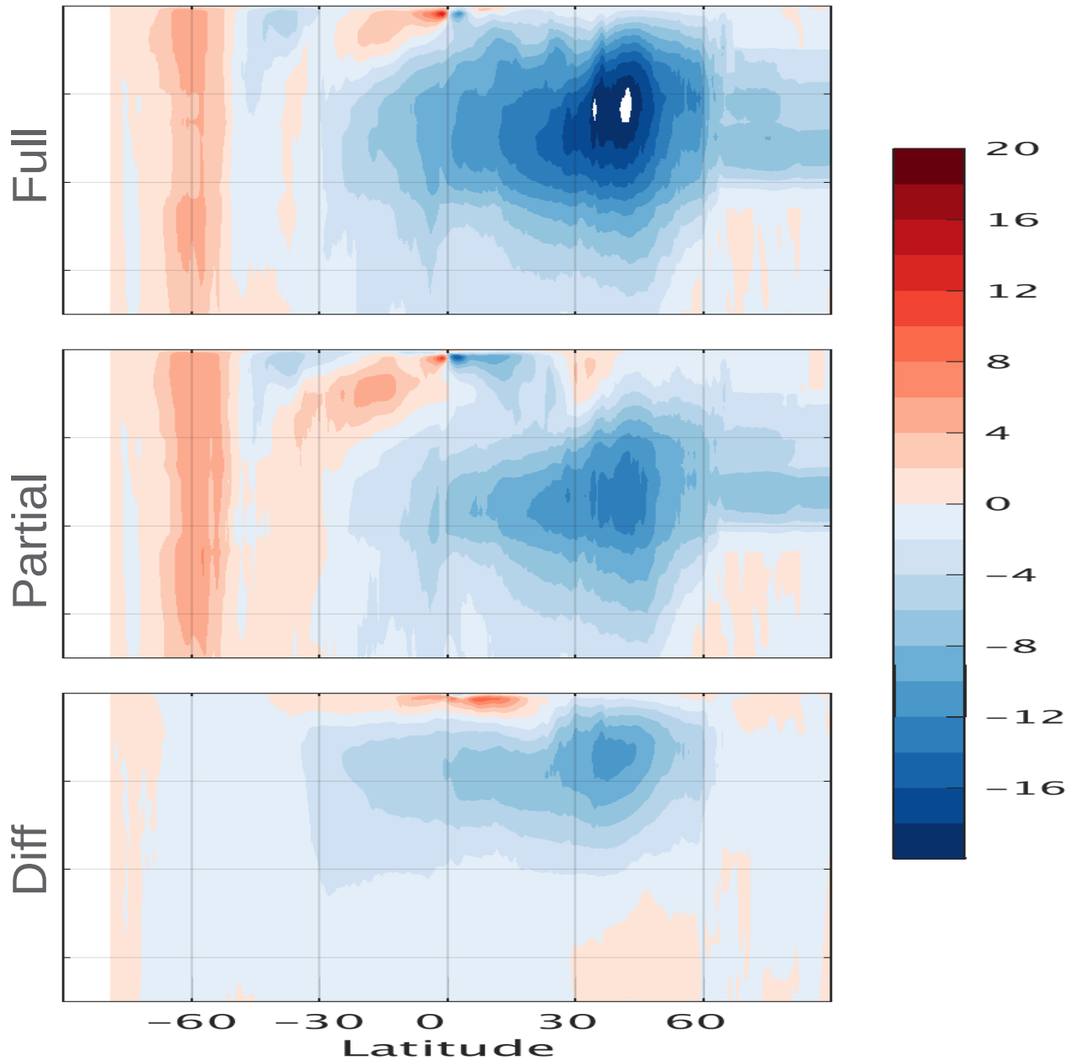
- Suppresses atmospheric feedbacks on the ocean circulation response by removing circulation-driven anomalous ocean surface temperature from coupling with the atmosphere

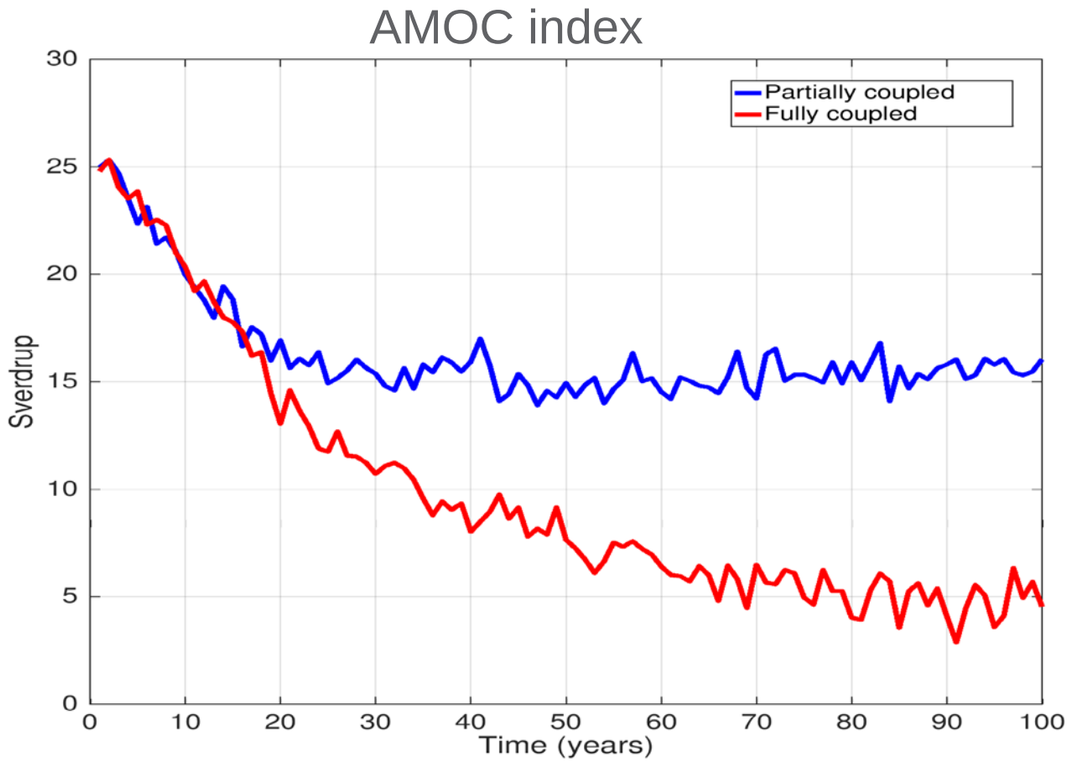




(Garuba et al 2018; Garuba and Rasch 2020)

Atmospheric feedback impact on the AMOC response





- Atmospheric feedbacks destabilize the AMOC
- Oceanic feedbacks stabilize the AMOC after 20 years