# Initial response of reduced ice albedo in coupled atmosphere-ocean-sea ice ECHAM-FESOM simulations

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# Outline

1. Motivation
2. Set-up of experiments
3. Results
    a. Ice volume
    b. Atmosphere
    c. Ocean
4. Summary and conclusions

# 1. Motivation

AWI

Starting point:

Semmler et al. (2012): Mean atmospheric response to reduced Arctic sea ice extent and thickness in a continuous 40-year atmosphere-only simulation.

One result: In winter weaker westerly flow in Northern midlatitudes. In coupled atmosphere-ocean simulations with increased greenhouse gas concentrations intensified westerly flow in Northern and Southern midlatitudes.

# 1. Motivation

AWI

This study:

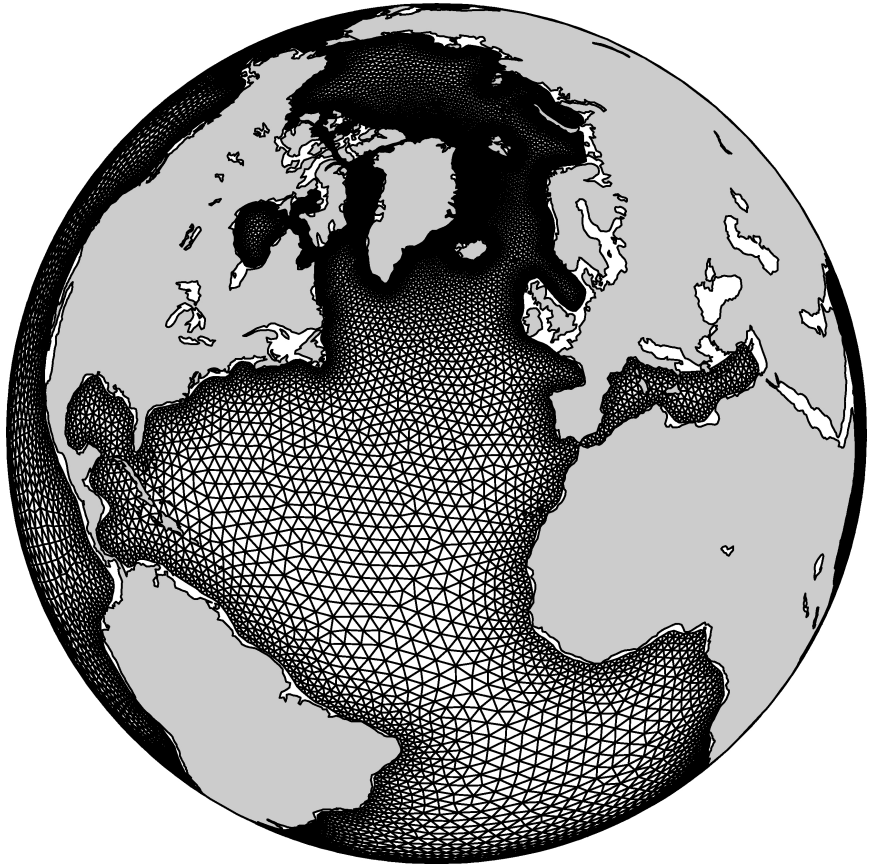
Use of a coupled atmosphere-ocean model

How is the initial reaction of the atmosphere and the ocean to rapid changes in the sea ice extent before an equilibrium is reached?

# 2. Setup of experiments

AWI

**50,000 2D nodes**

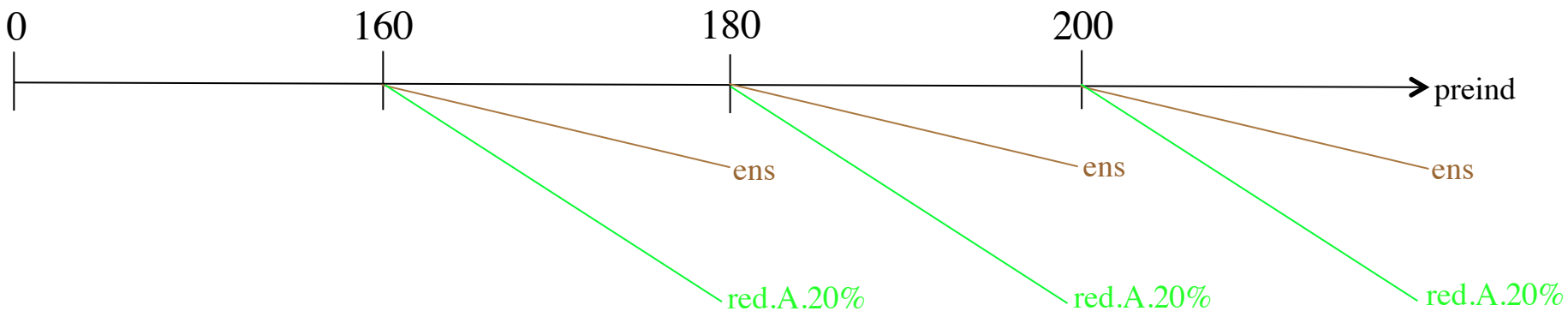


**T63**

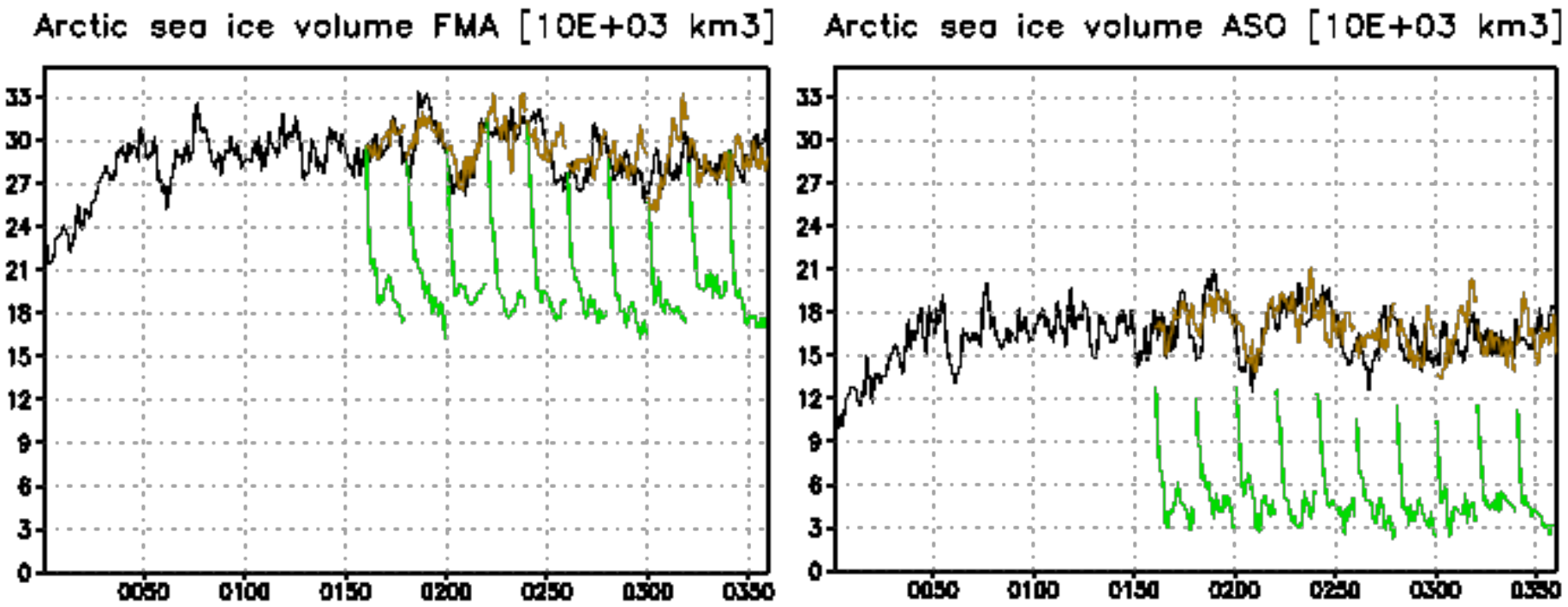
**FESOM** **exchange grid** **ECHAM**

HELMHOLTZ GEMEINSCHAFT

# 2. Setup of experiments



# 3a. Results: Ice volume

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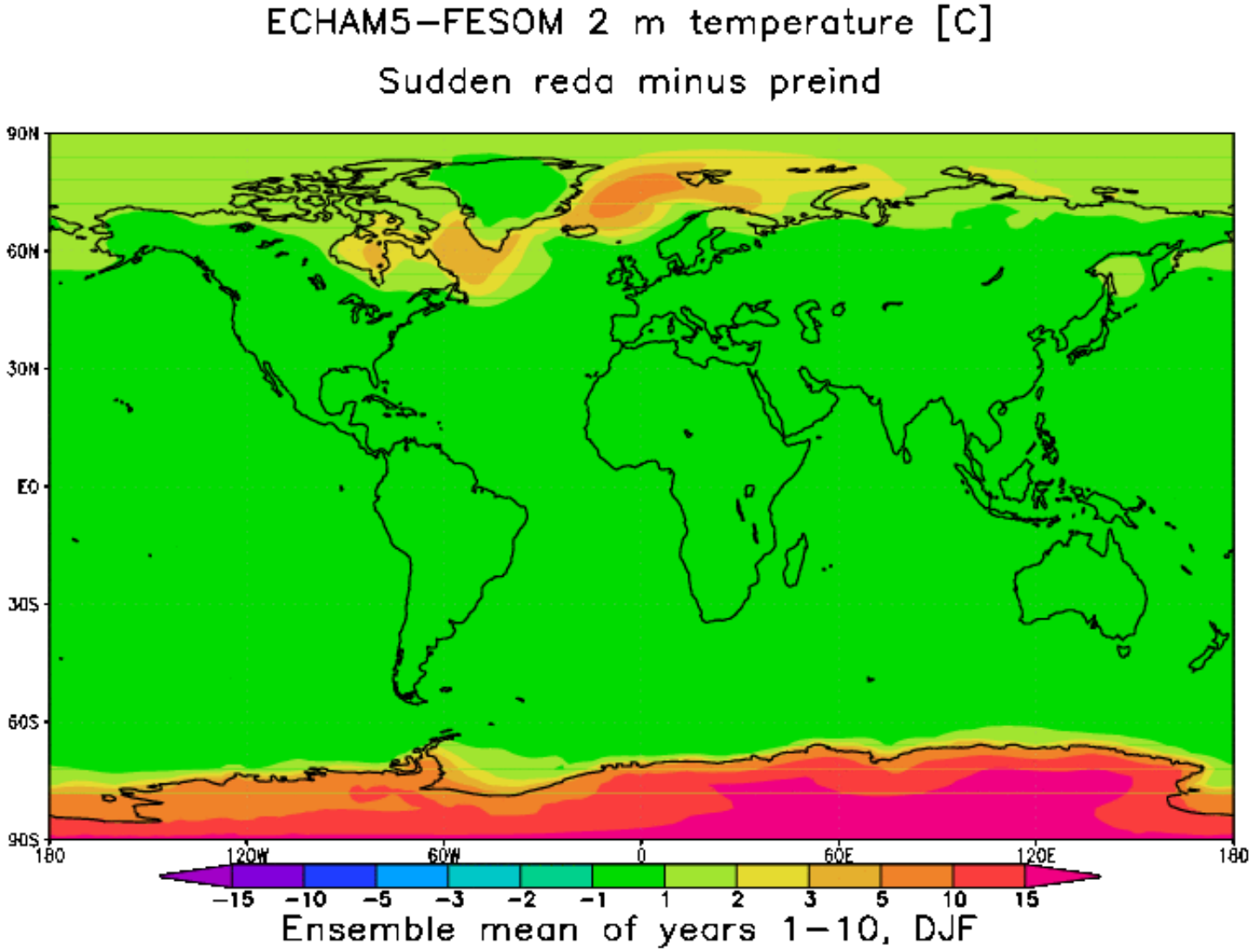
**ens**

# 3b. Results: Atmosphere



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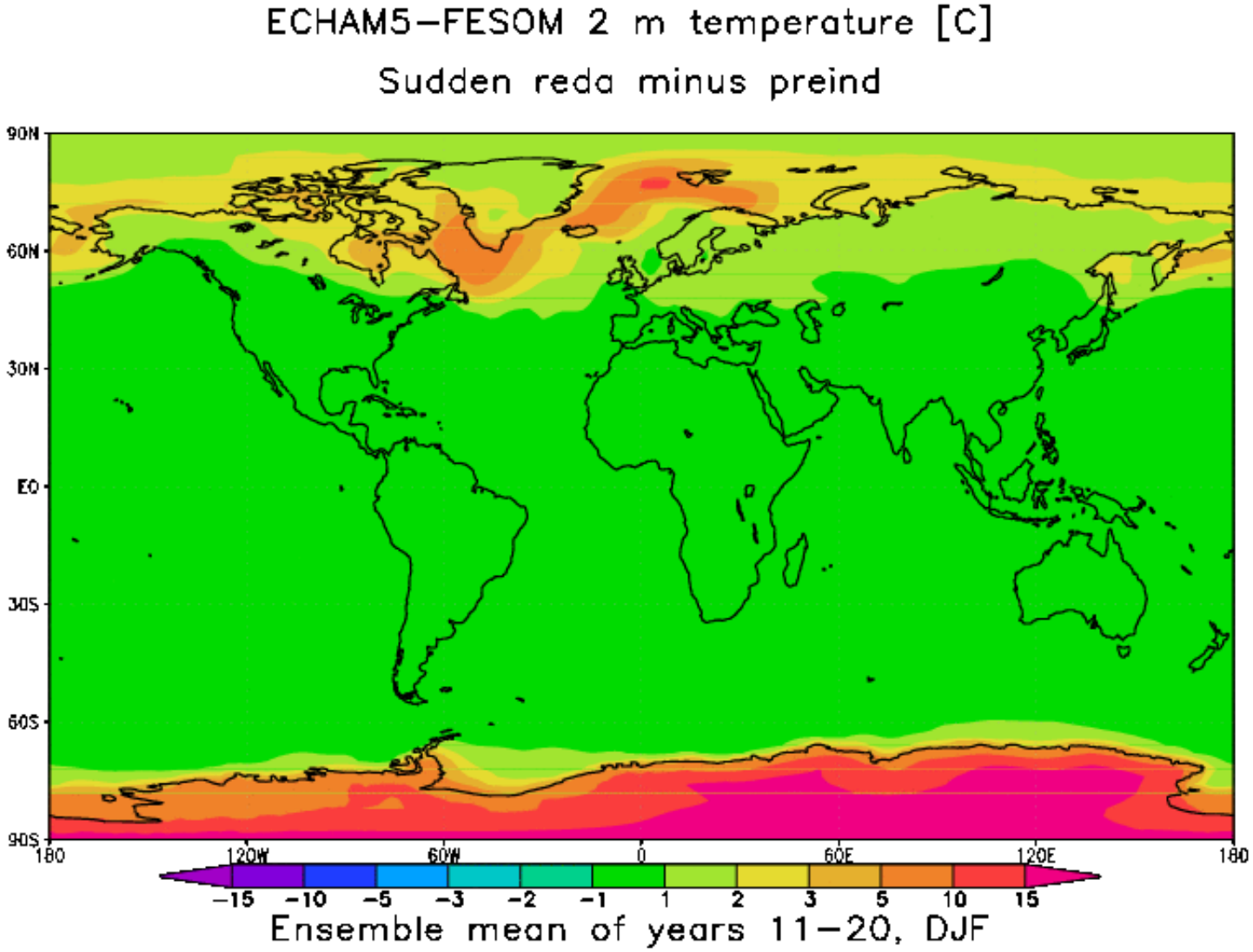

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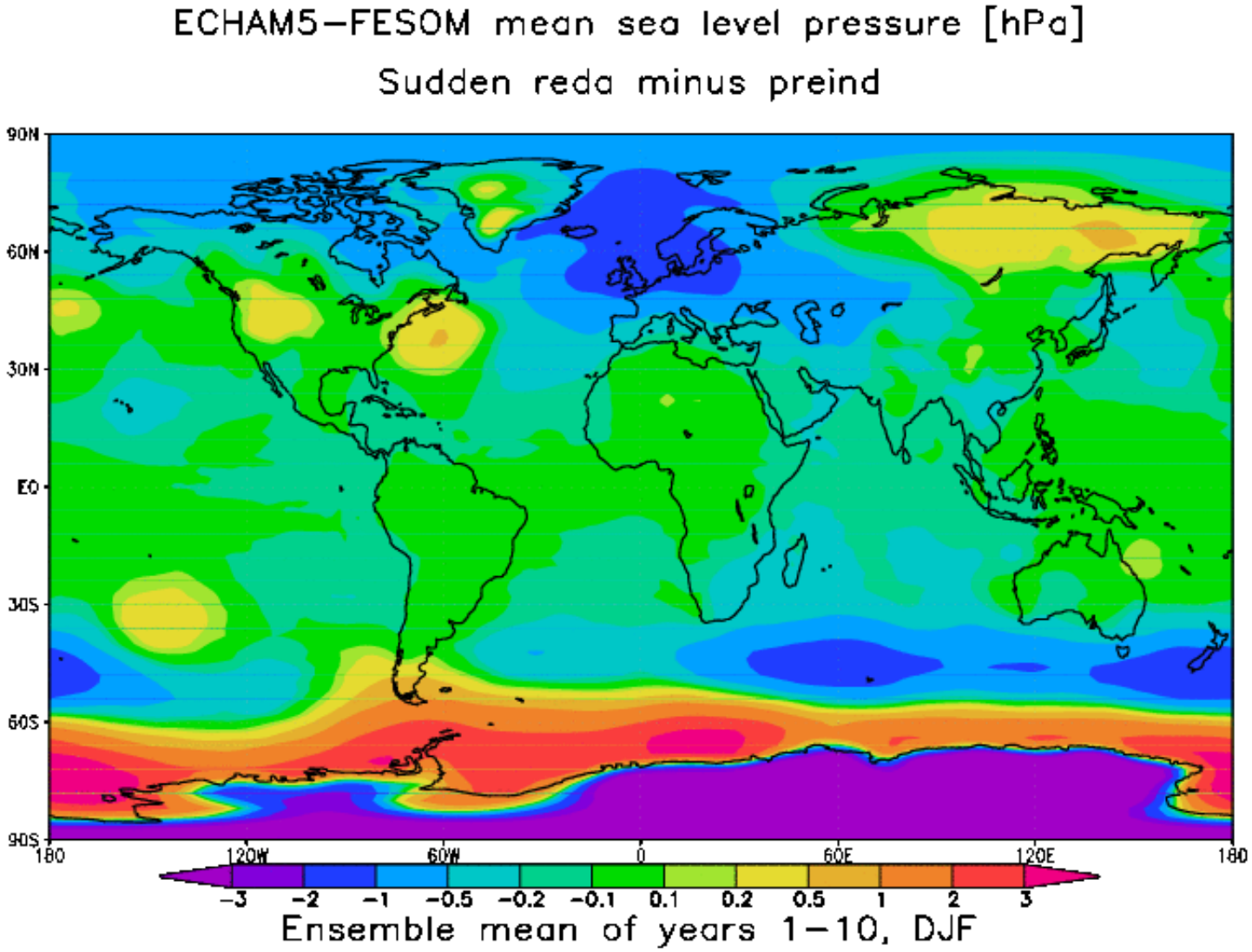

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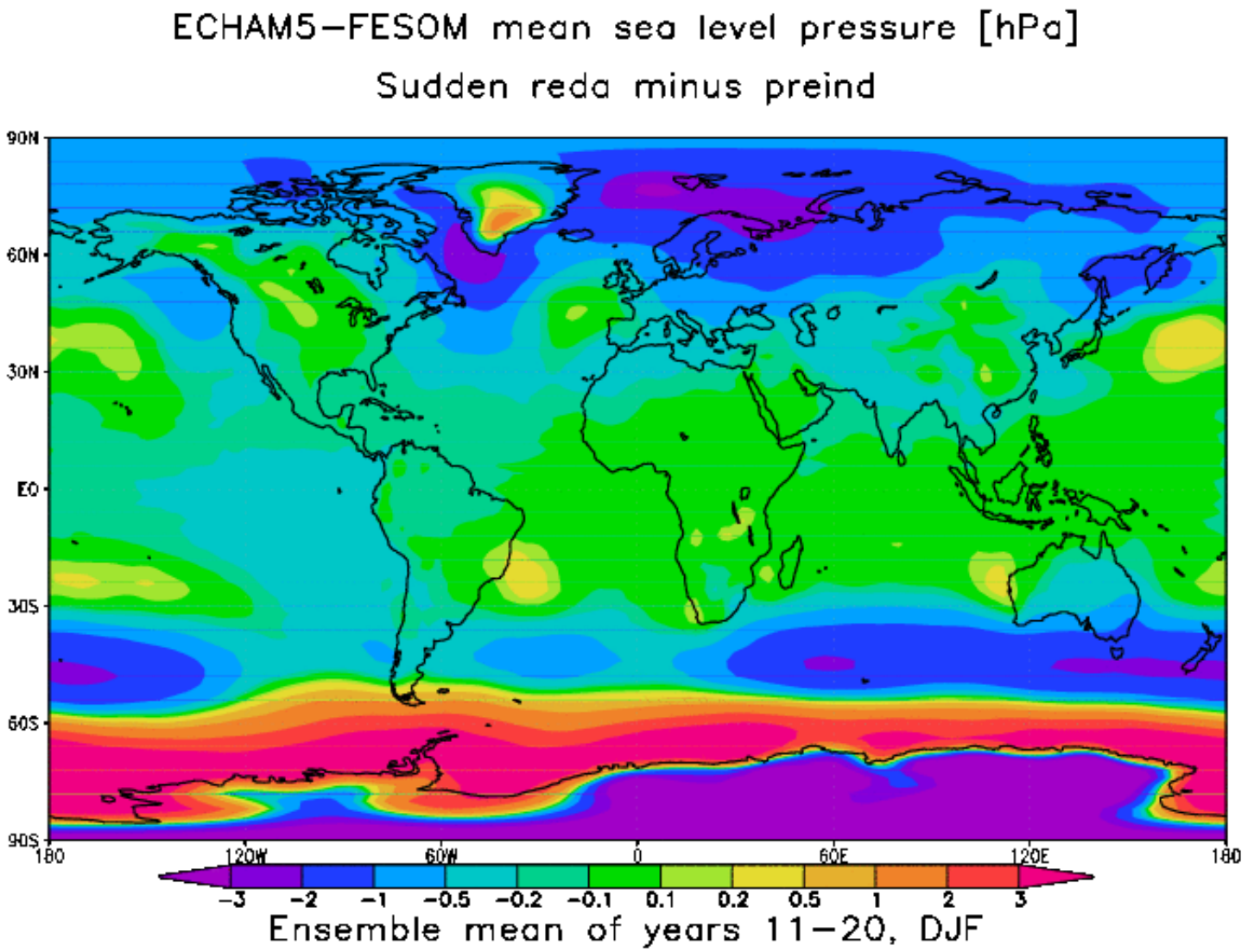

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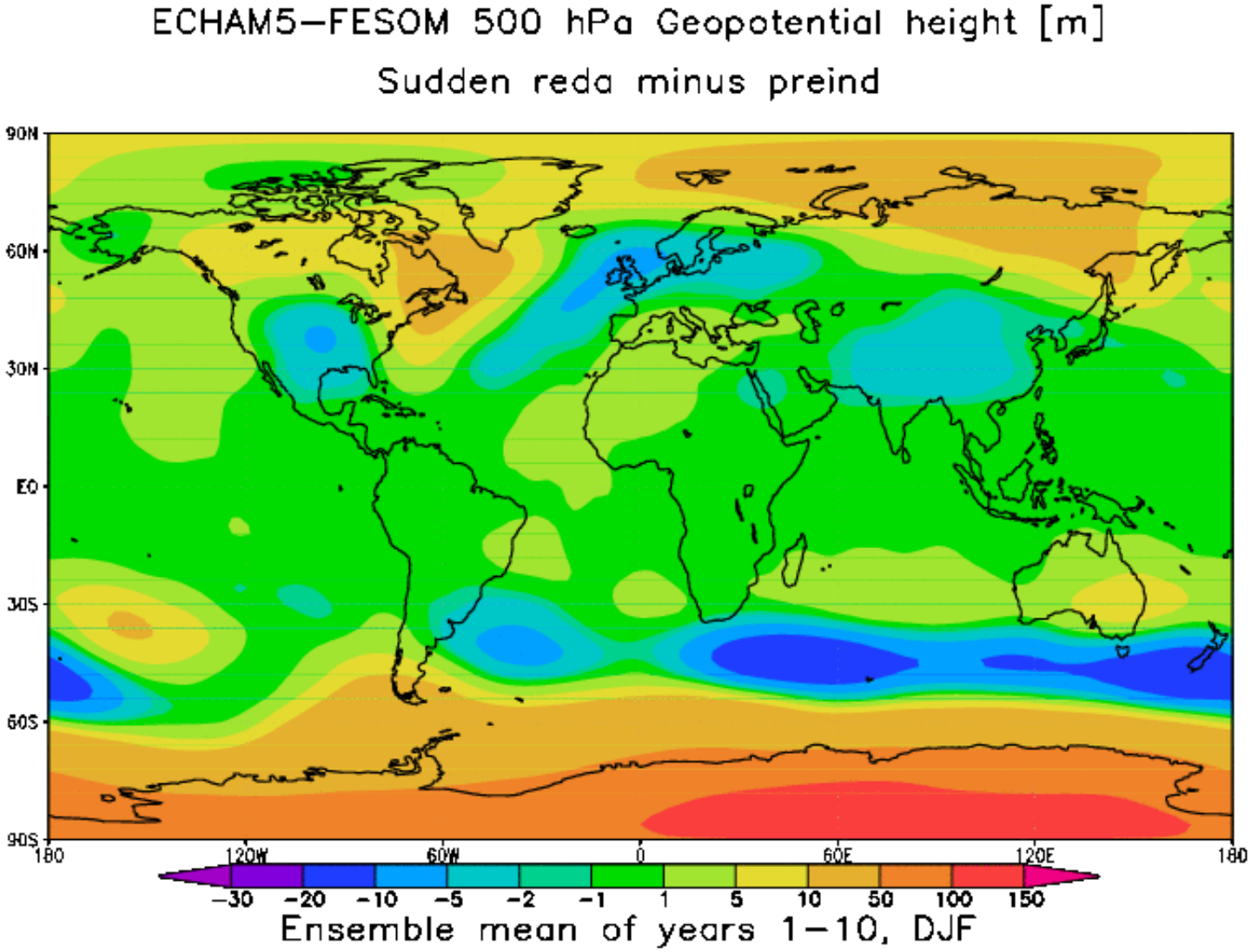

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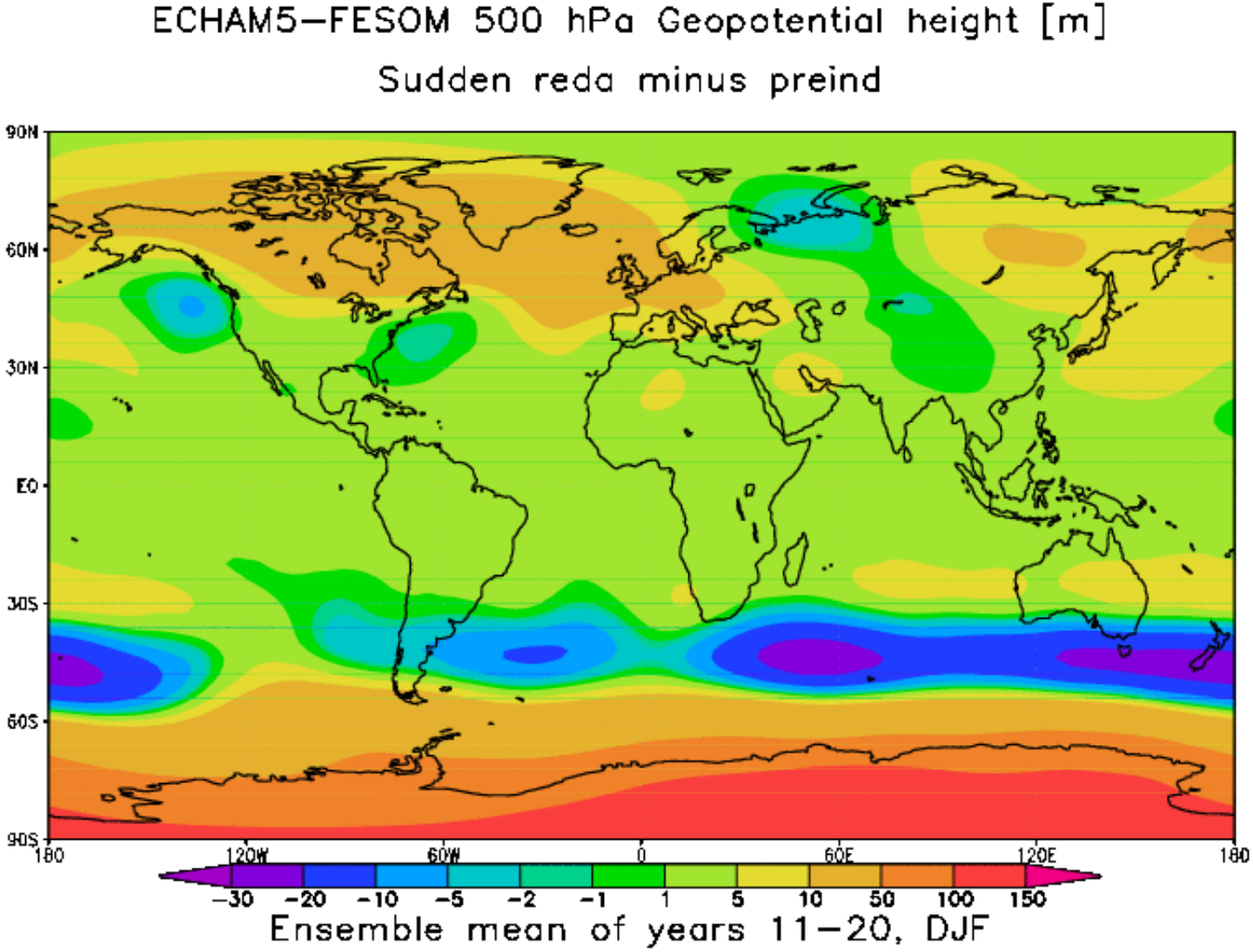

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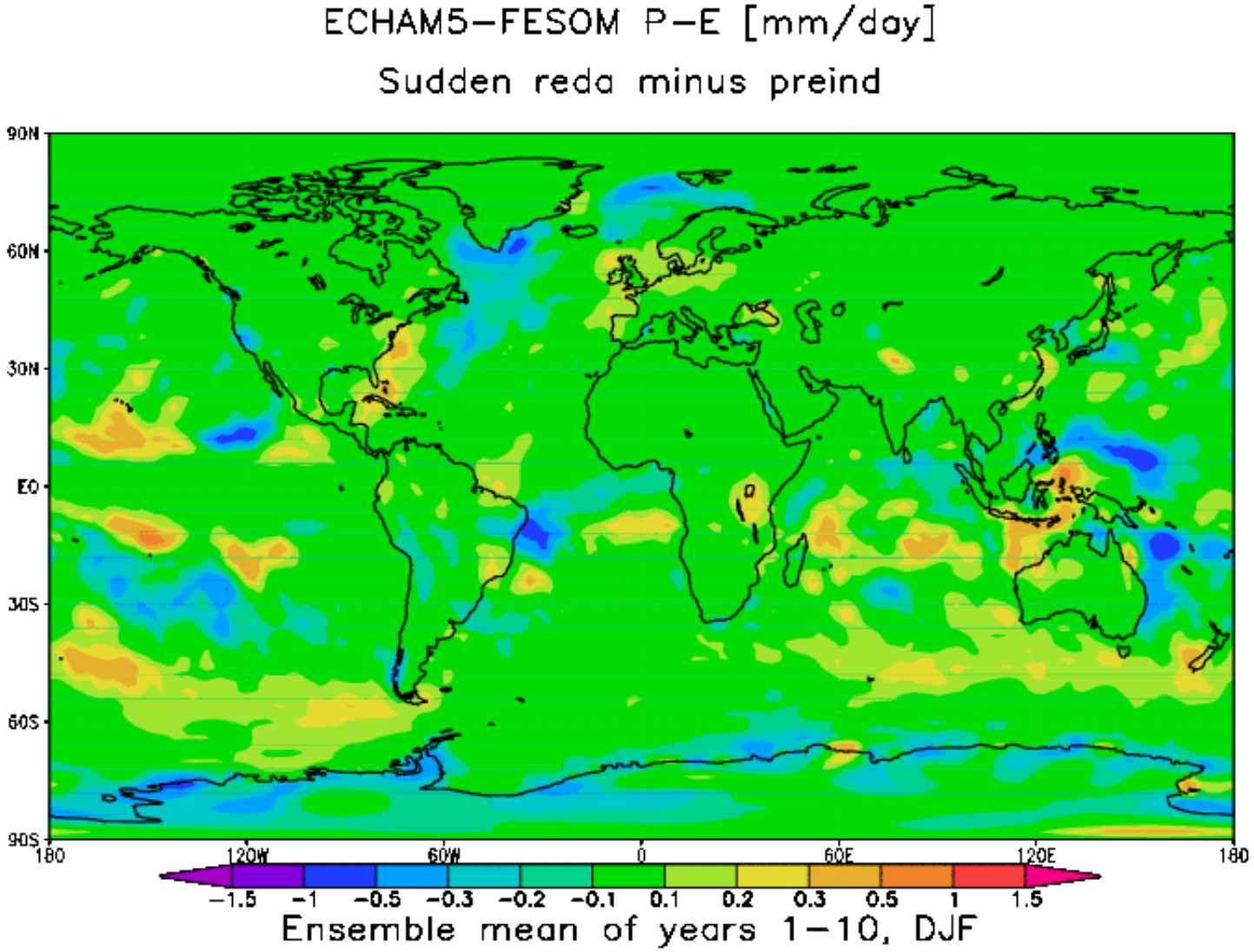

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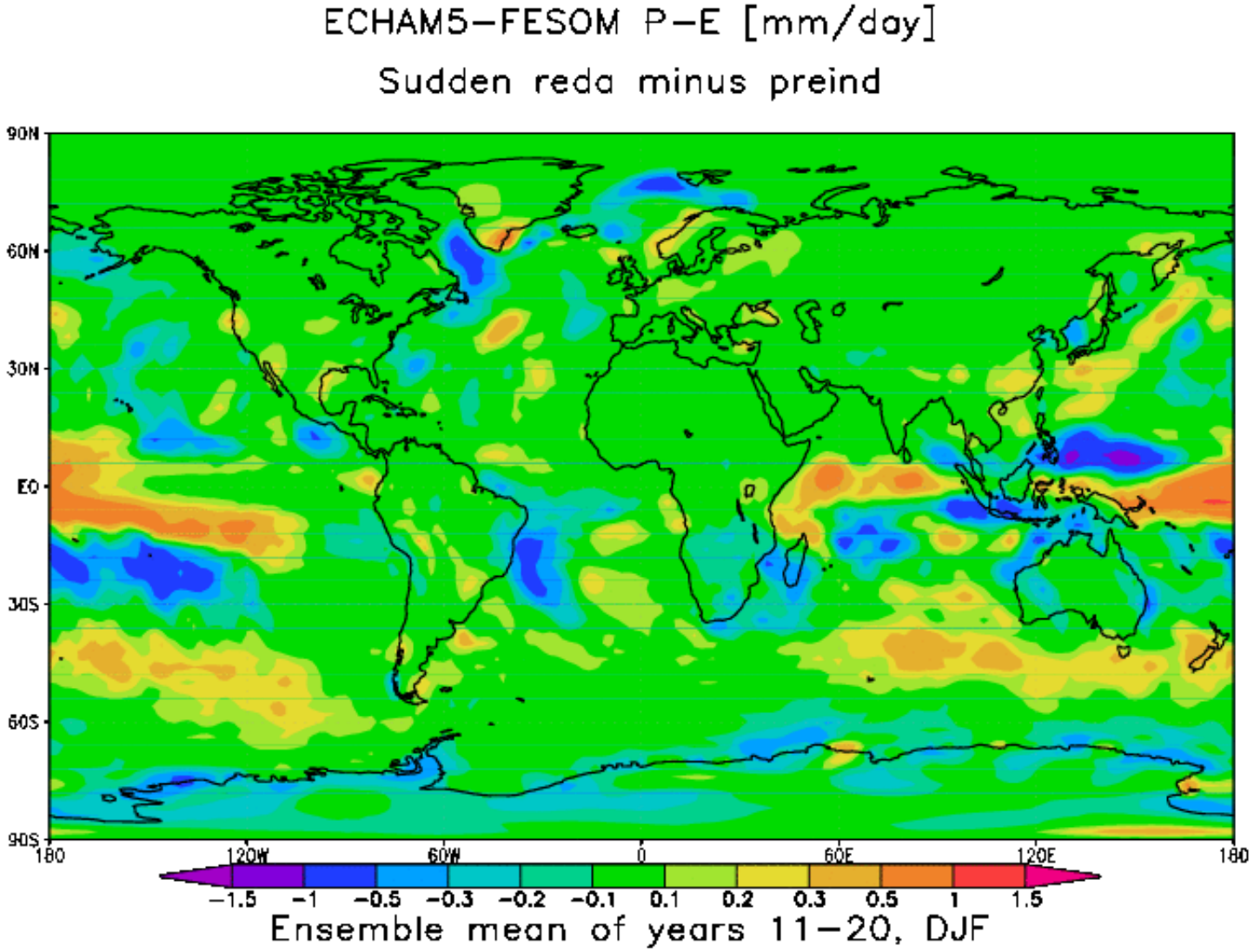
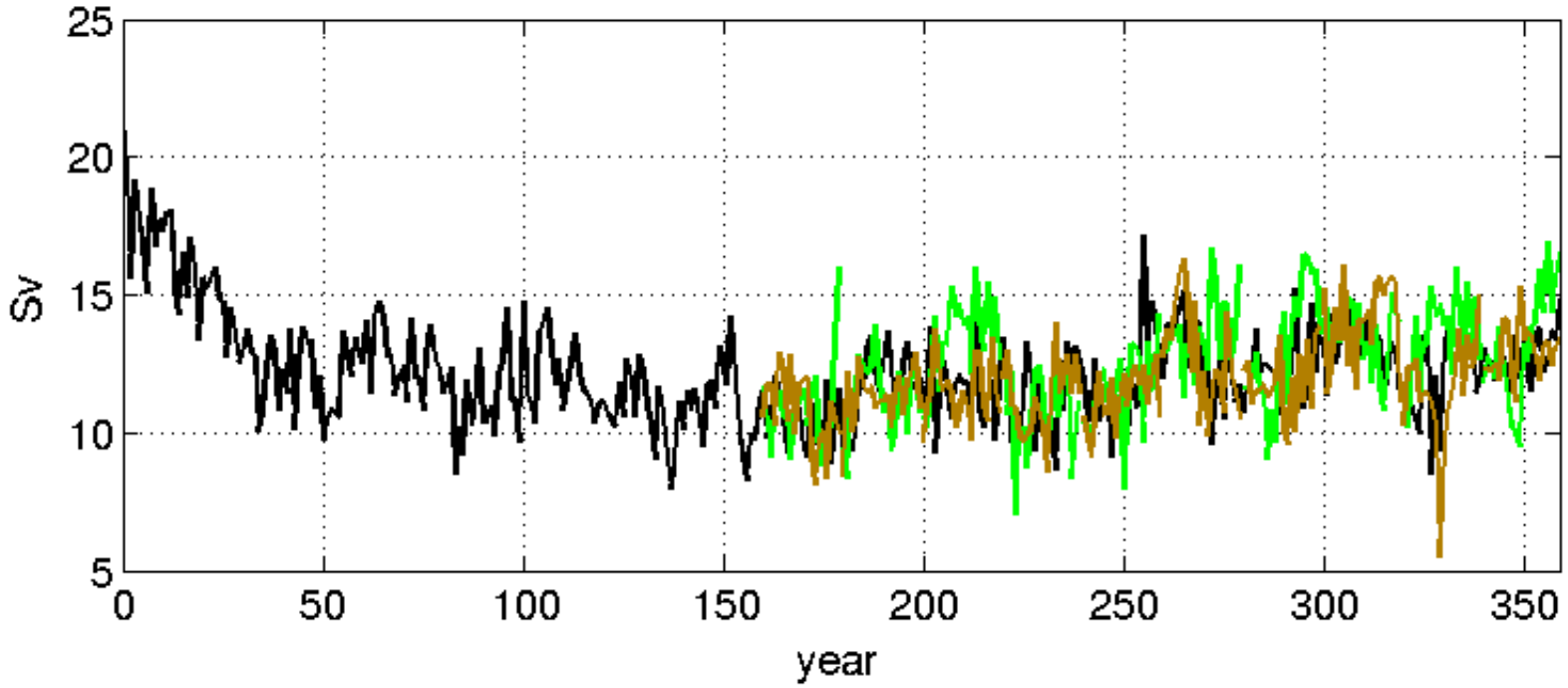


# 3c. Results: Ocean

Maximum Atlantic Meridional Overturning Circulation
43 N to 46 N

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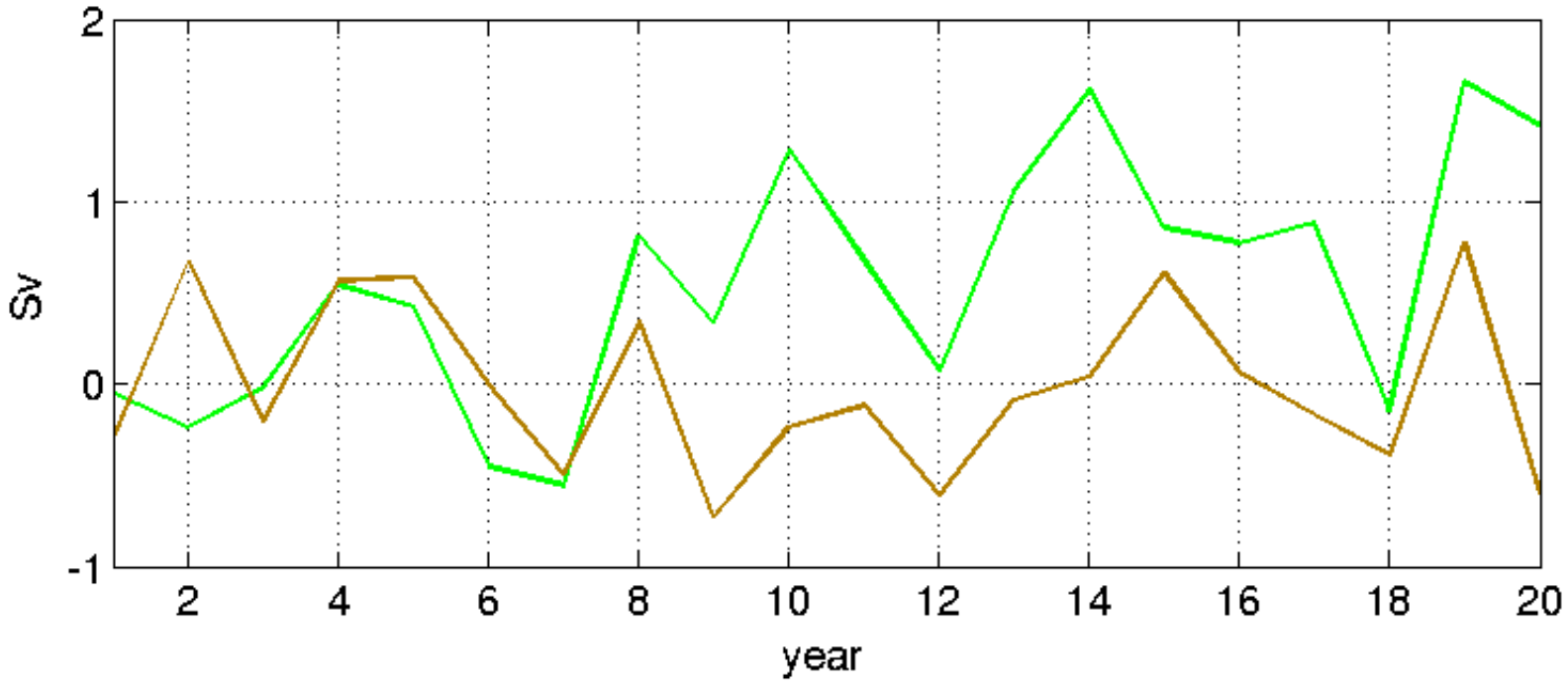


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**red.A.20%**

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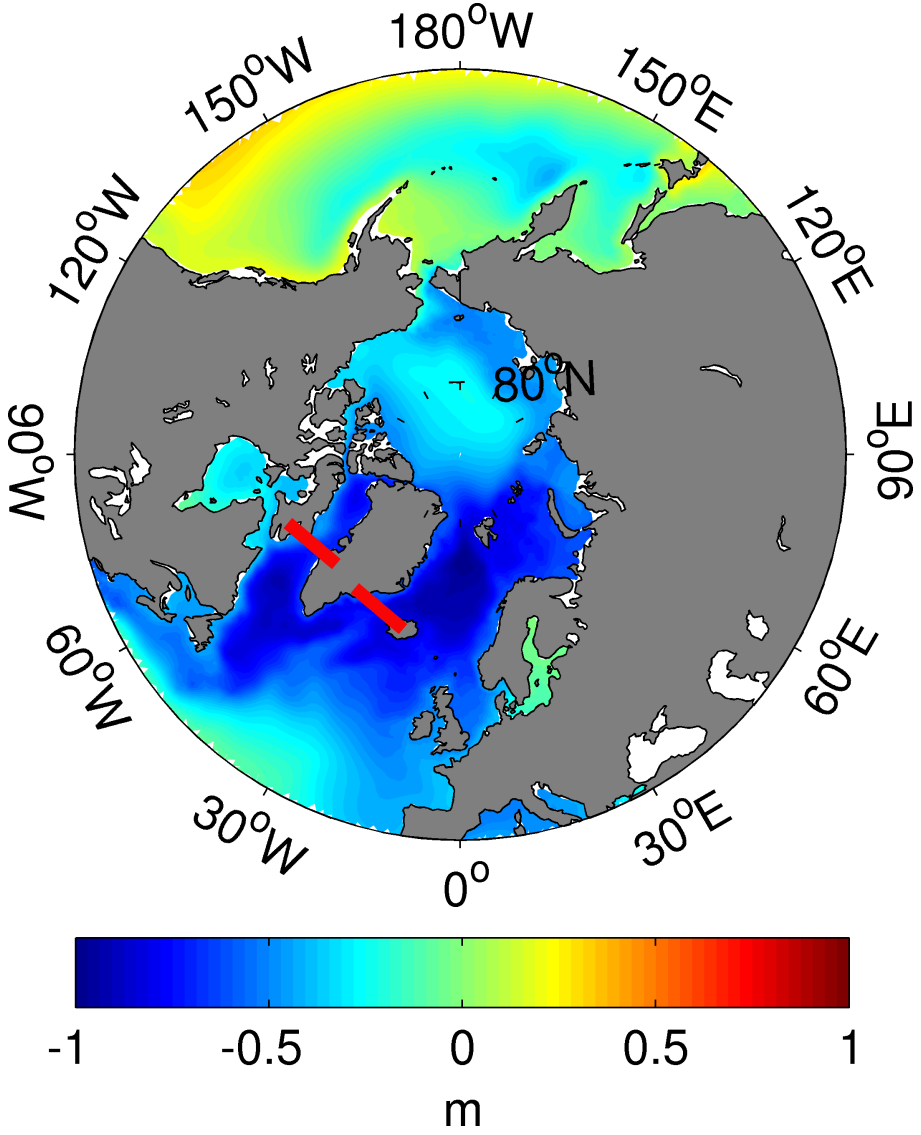
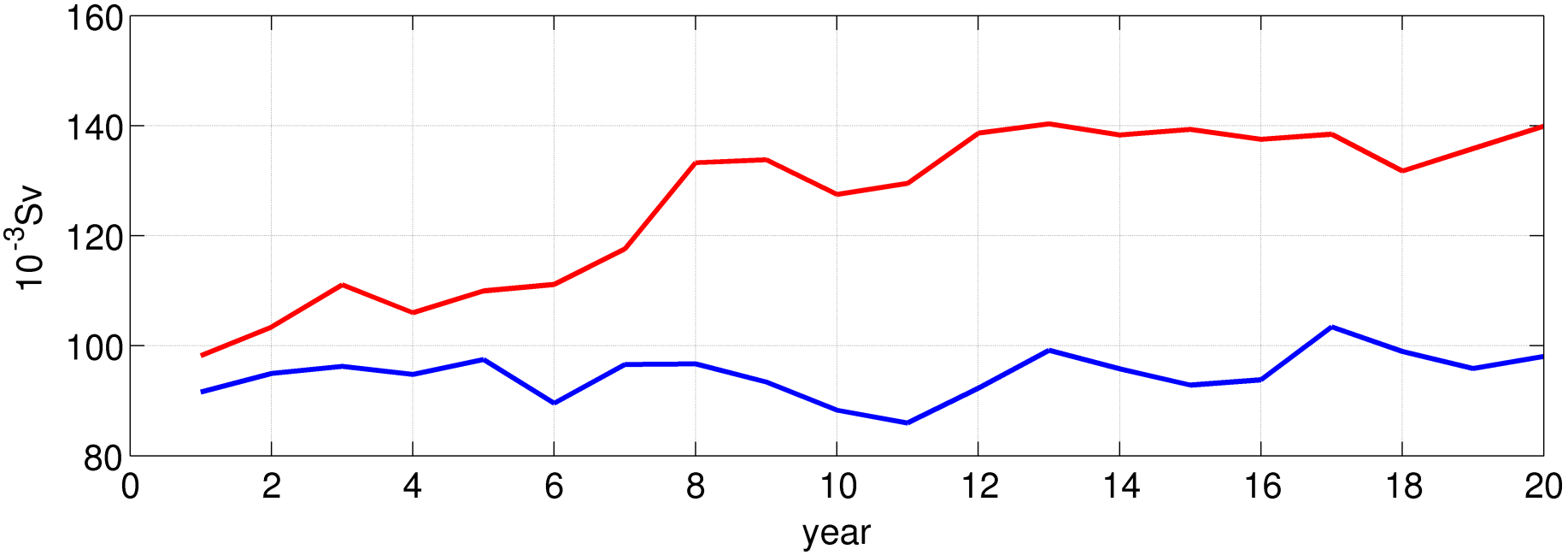



Calculation of fresh water transport through Davis Strait and Denmark Strait (red lines)

Background: mean SSH

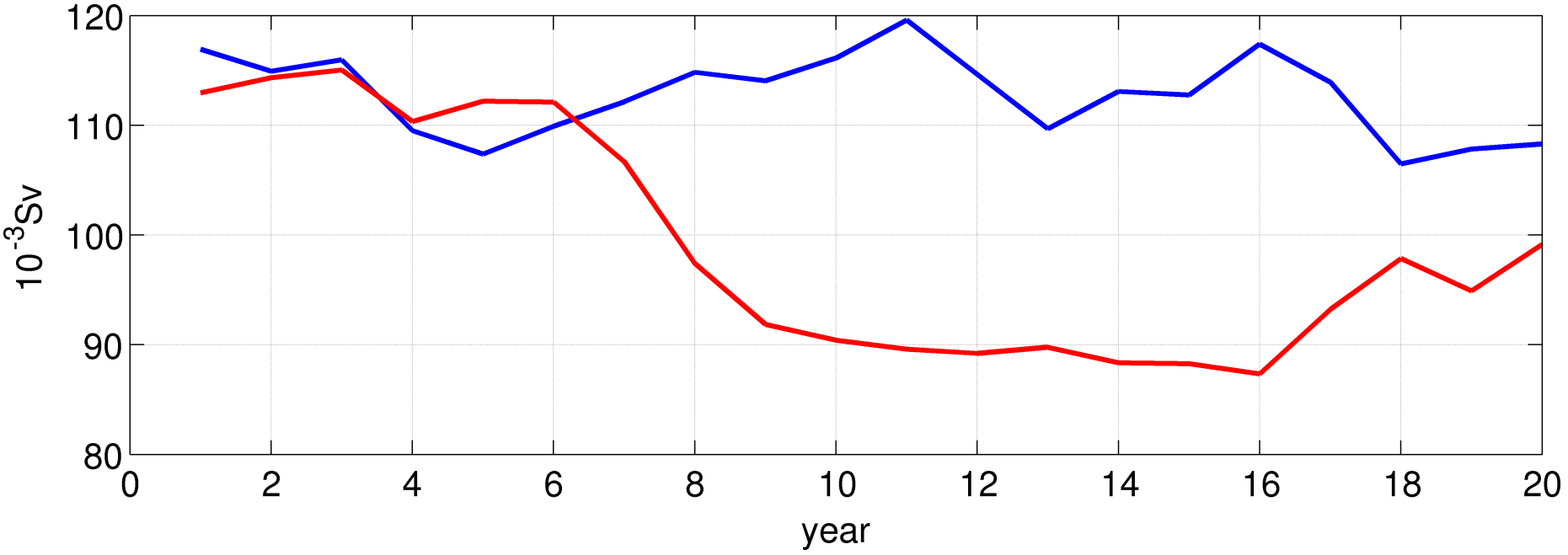
# 3c. Results: Ocean

Southward fresh water transport through Davis Strait averaged over 10 ensemble members (blue: reference, red: red.A. 20%)



# 3c. Results: Ocean

Southward fresh water transport through Denmark Strait averaged over 10 ensemble members (blue: reference, red: red.A. 20%)



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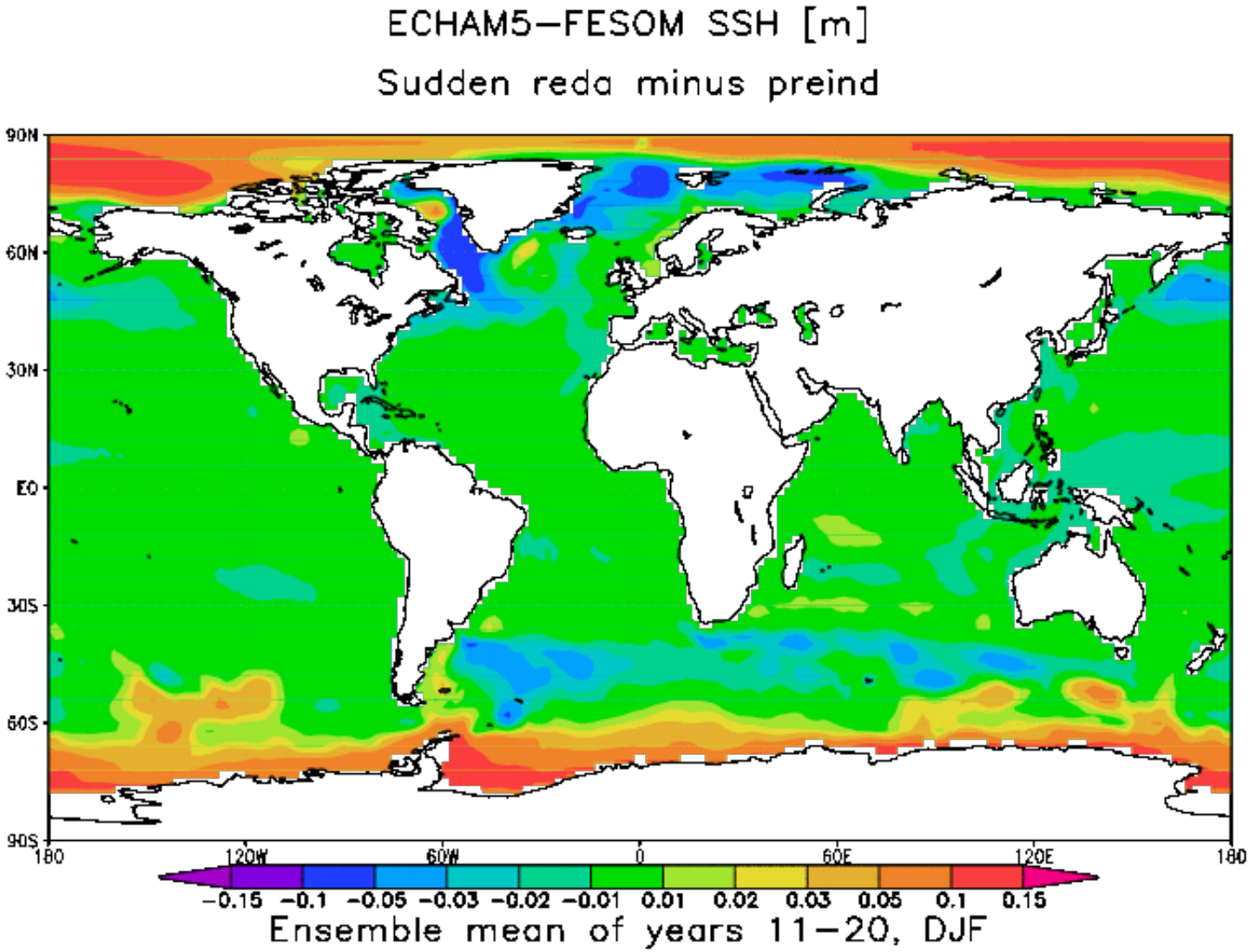
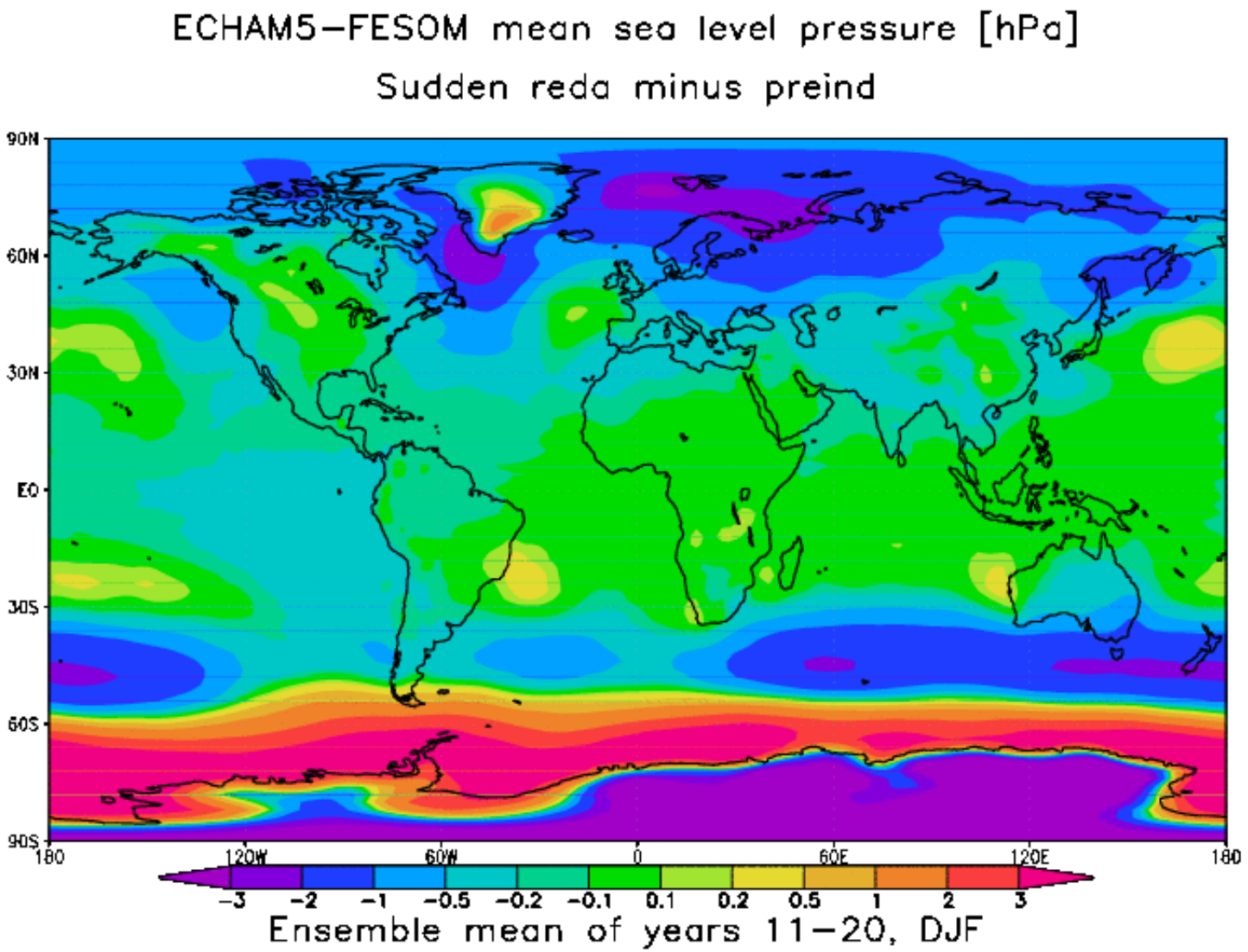


# 3b. Results: Atmosphere



# 4. Summary and conclusions

In reduced ice albedo experiments atmospheric circulation especially at 500 hPa weakened – contrasting to increased greenhouse gas experiments – counteracting influence through upper tropospheric warming in tropics

Arctic sea ice melts faster than predicted -> implications for atmospheric large scale circulation?

Southward freshwater transport through Davis Strait increased, through Denmark Strait decreased (due to atmospheric circulation changes)

# 4. Summary and conclusions

No deep water formation area in Labrador Sea in our model experiments (pre-industrial times!) -> only decreased transport through Denmark Strait has impact on MOC -> slight increase of MOC

Decrease of P-E over deep water formation areas -> Increase of SSS -> slight increase of MOC

Again contrasting results compared to increased greenhouse gas experiments

Thank you!