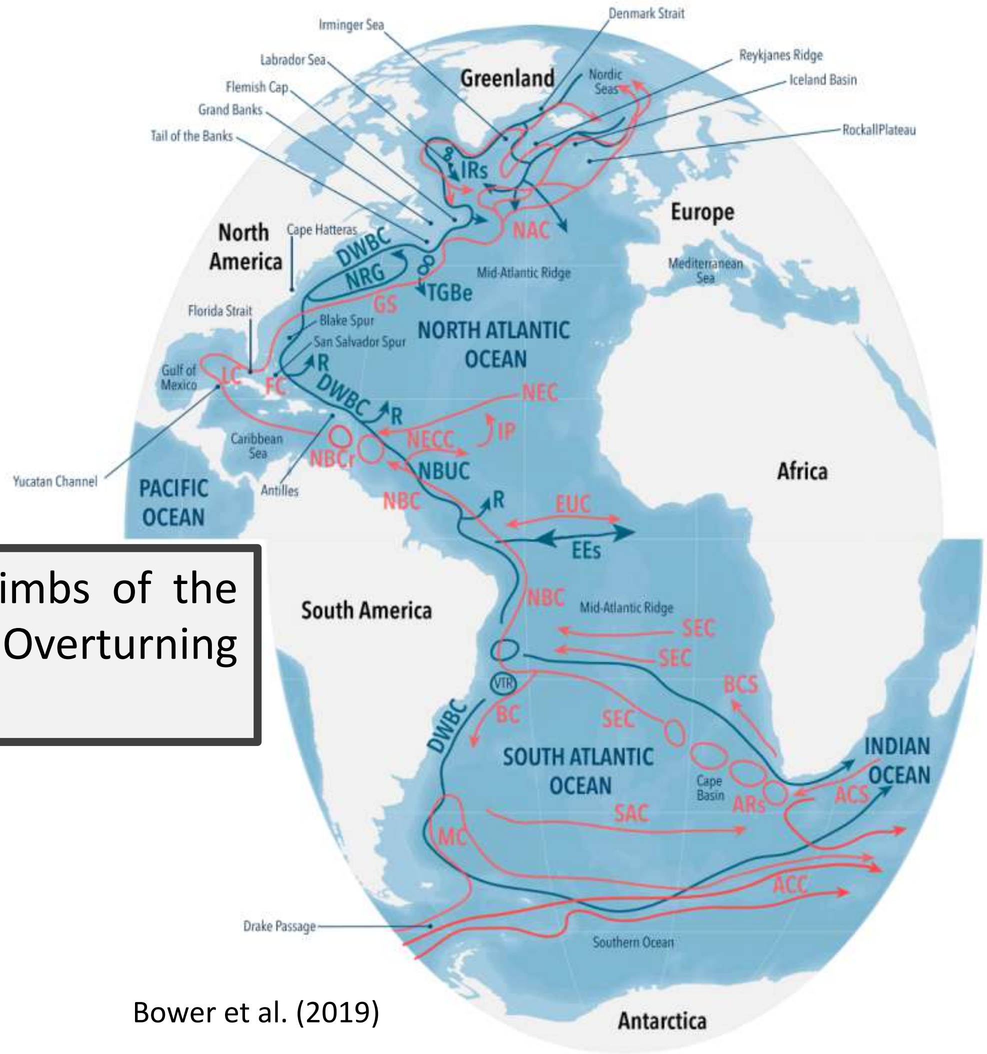
GEOMAR Helmholtz Centre for Ocean Research Kiel

Tropical pathways and water mass transformation of the Atlantic Ocean upper circulation

Franz Philip Tuchen, Peter Brandt, Joke F. Lübbecke, Rebecca Hummels

Atlantic Meridional Overturning Circulation pathways



Bower et al. (2019)

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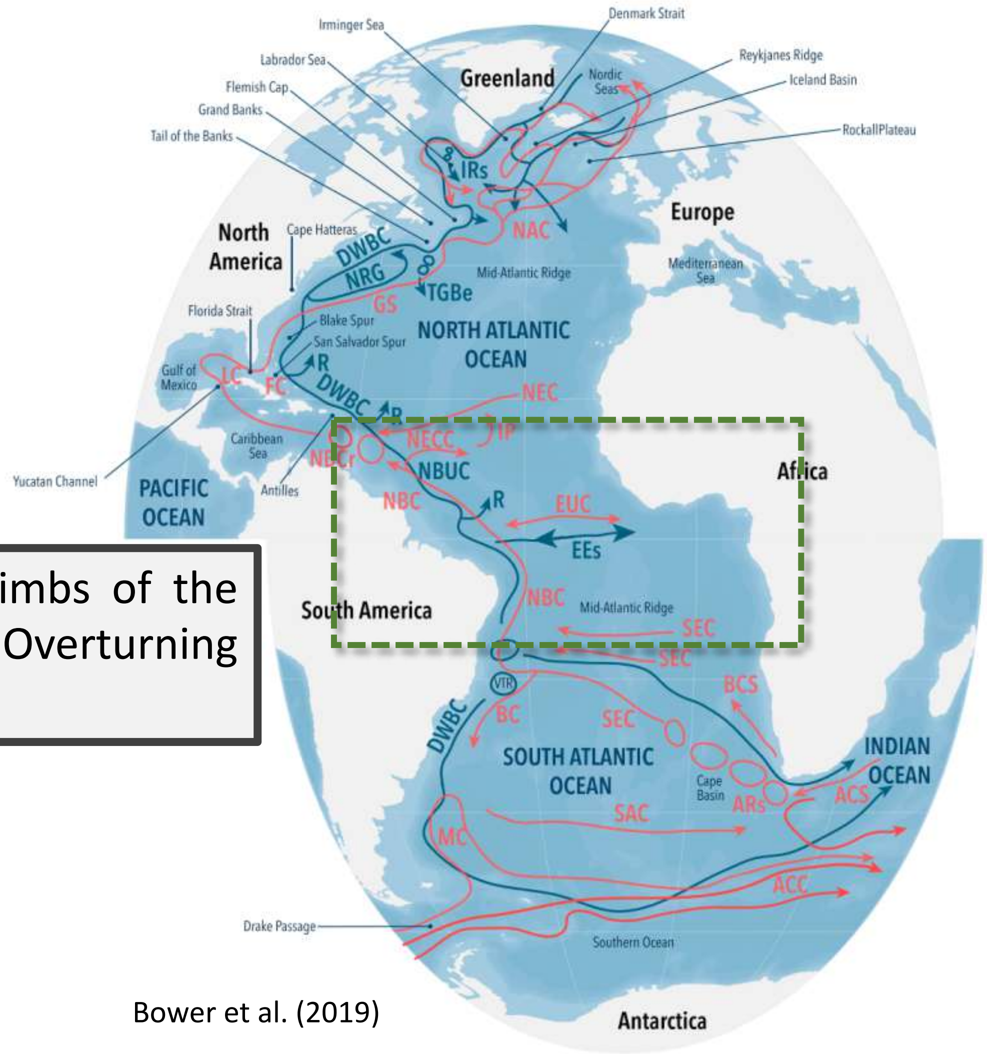

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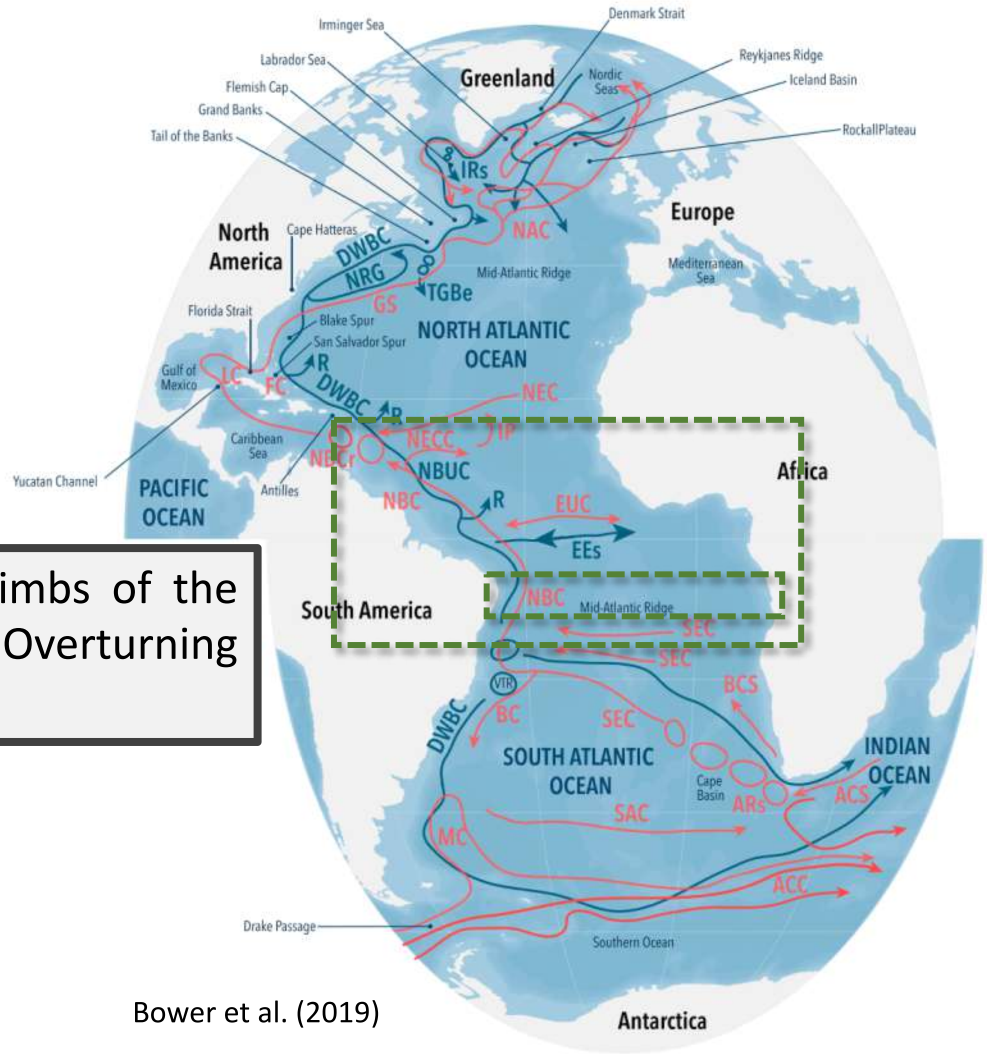

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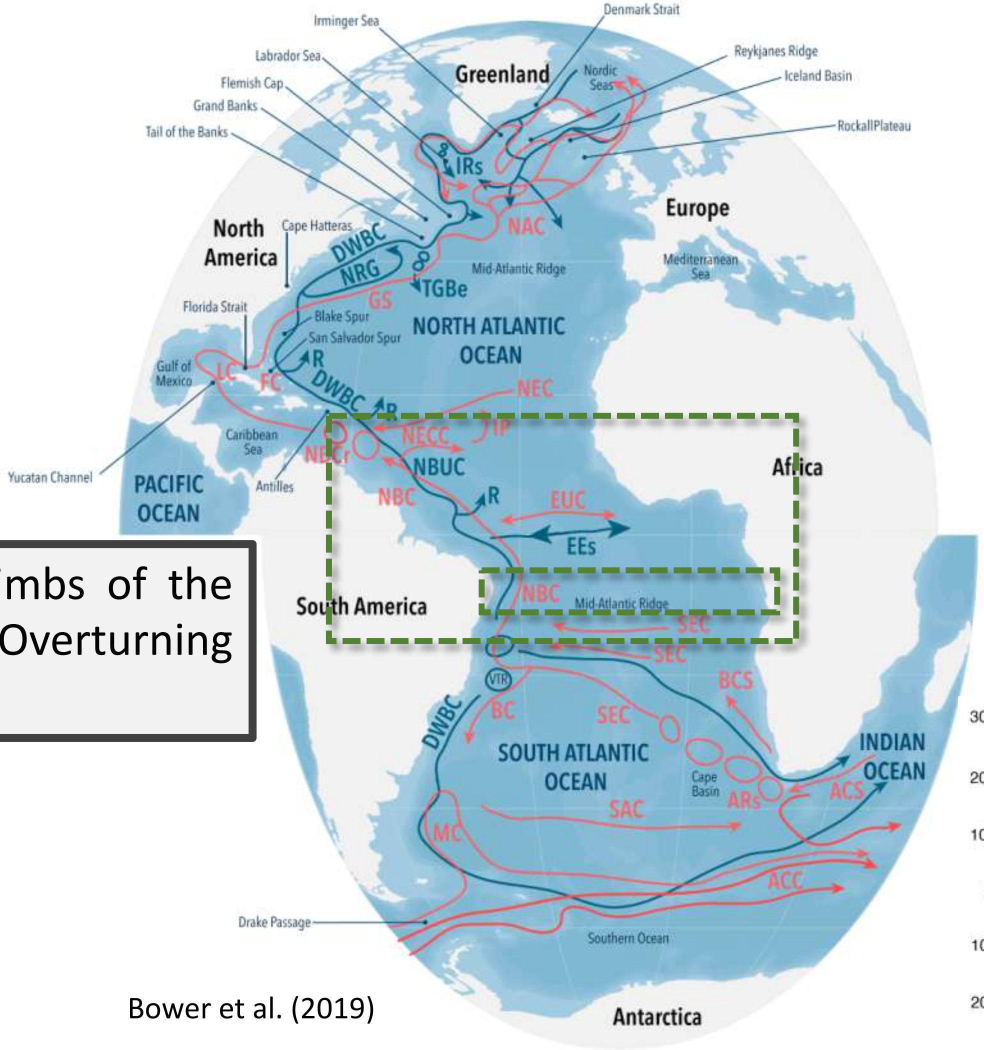

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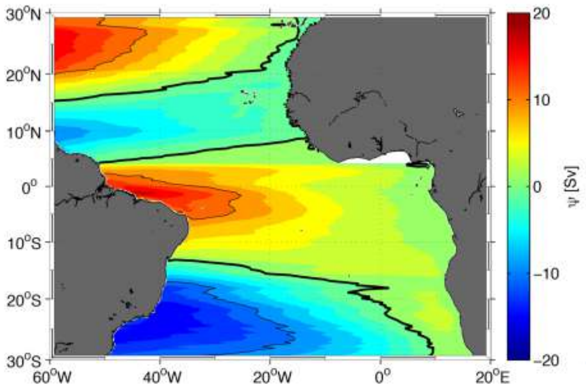

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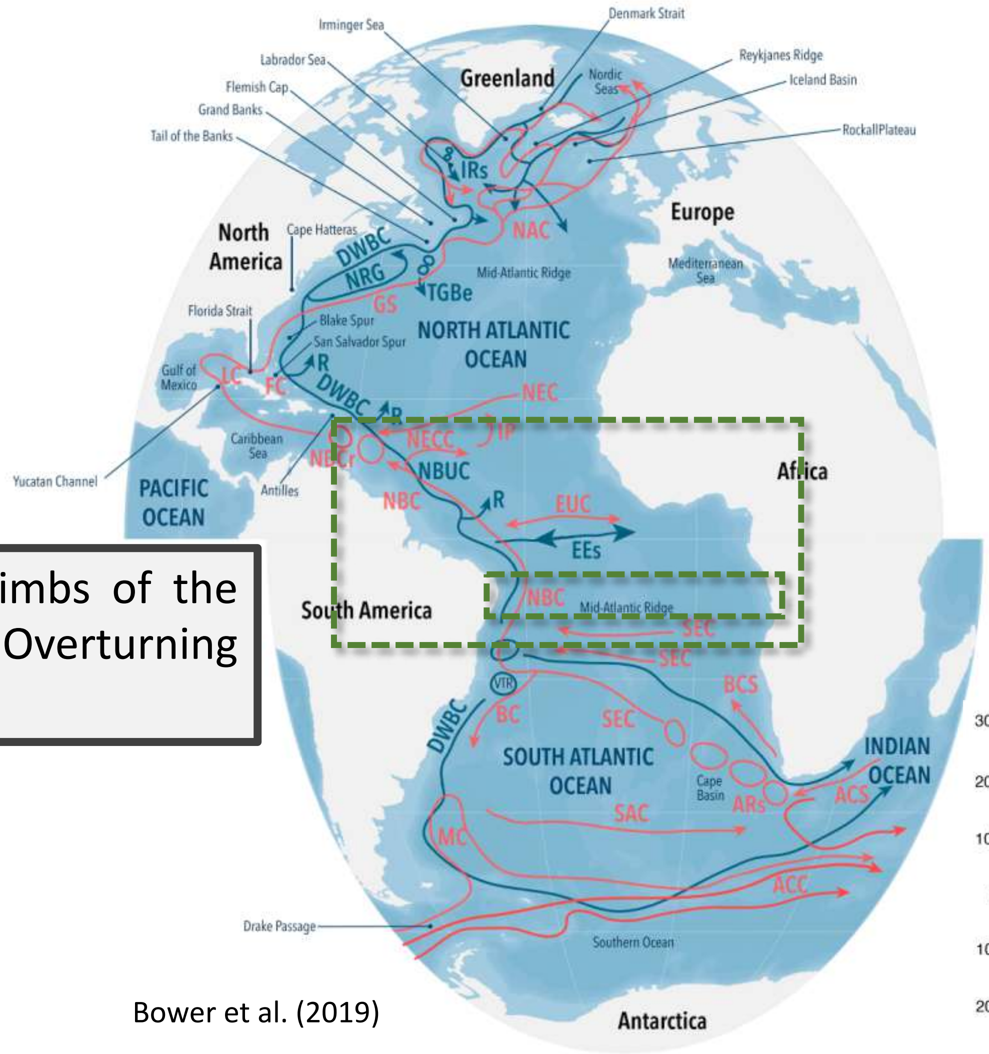

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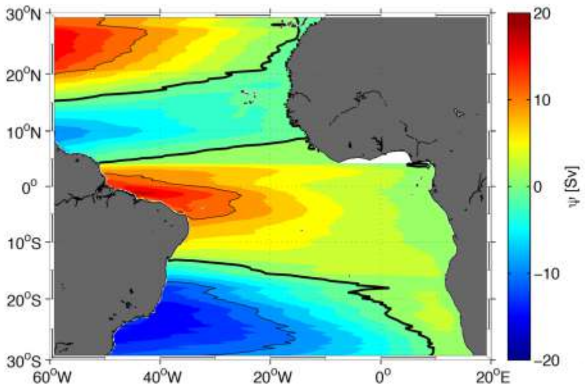

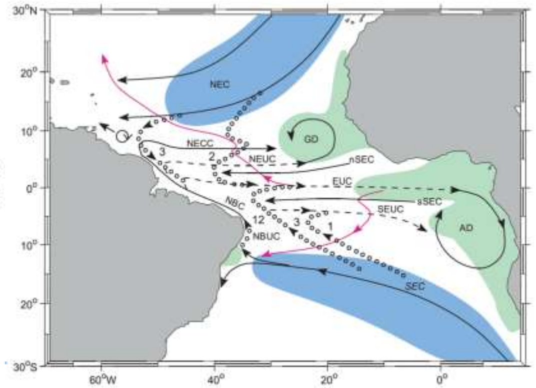

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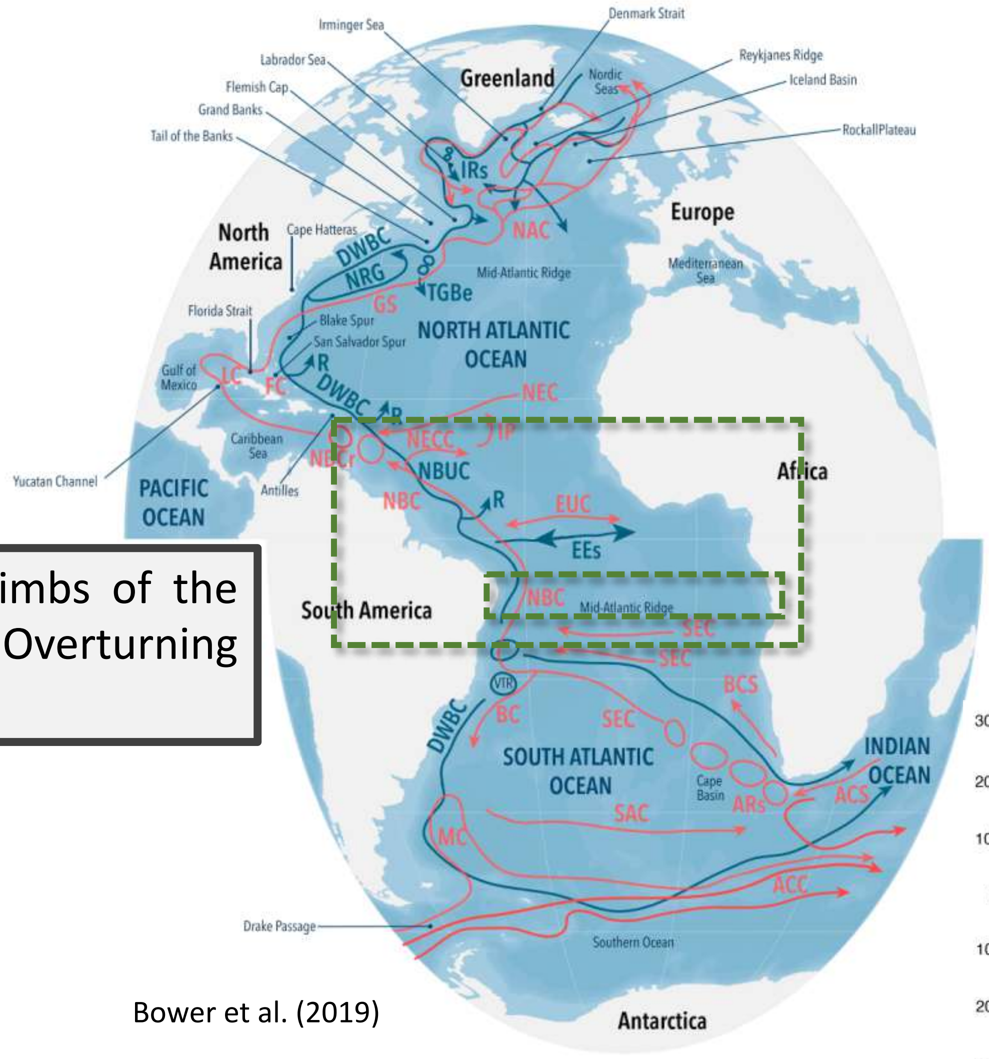

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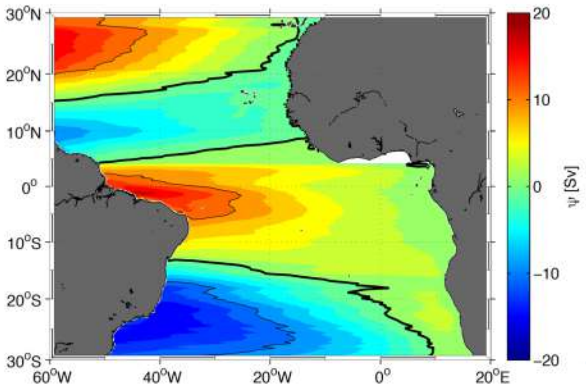
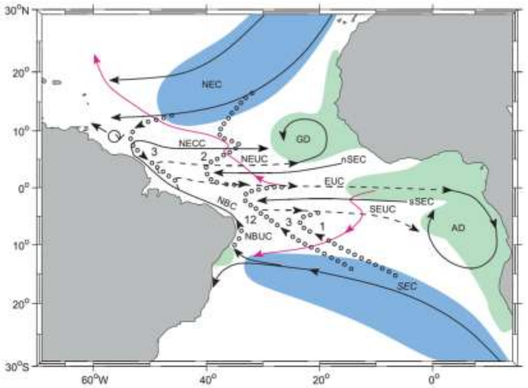
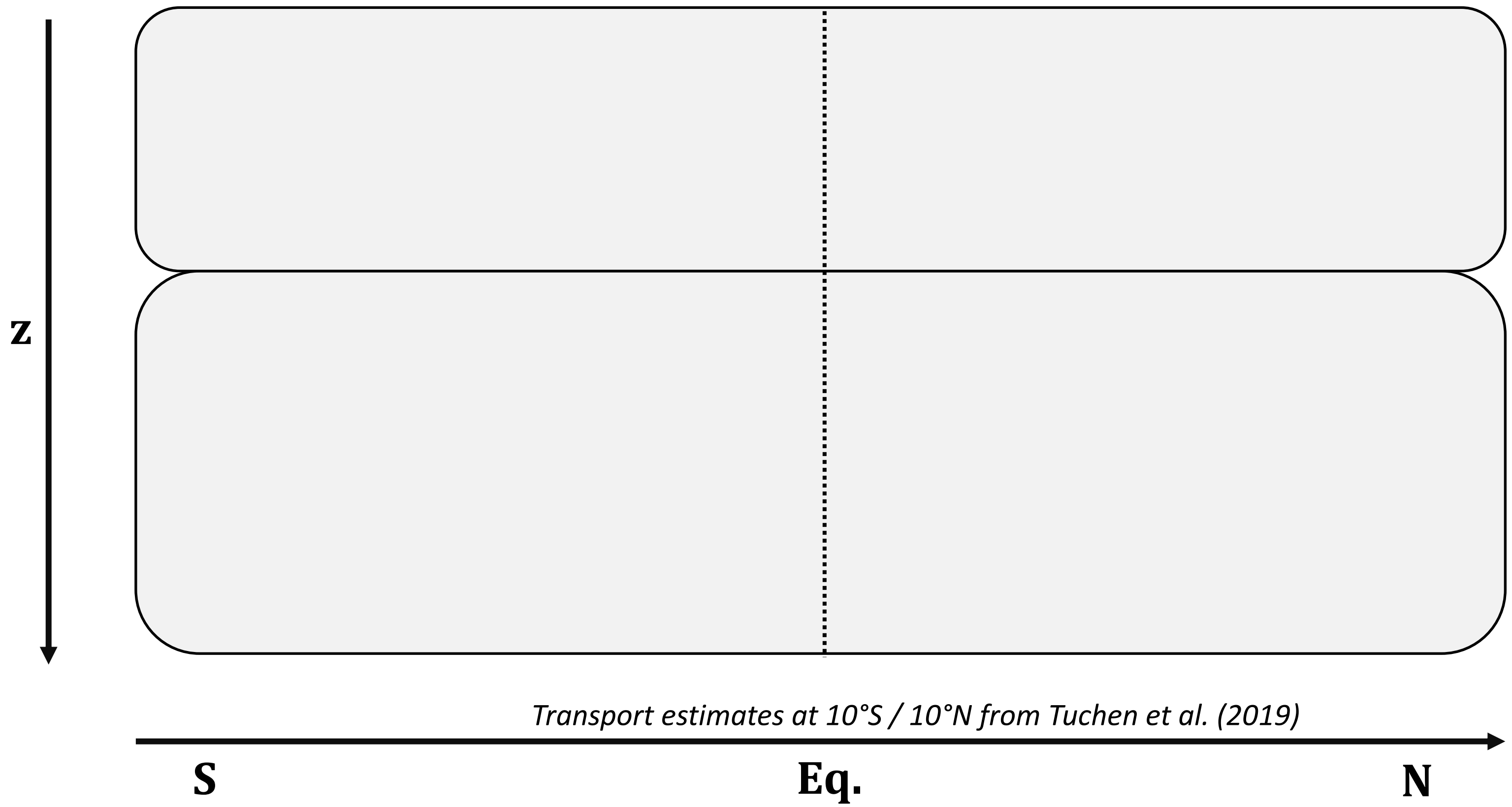




Atlantic Subtropical Cells and upper AMOC

Zonally averaged view:



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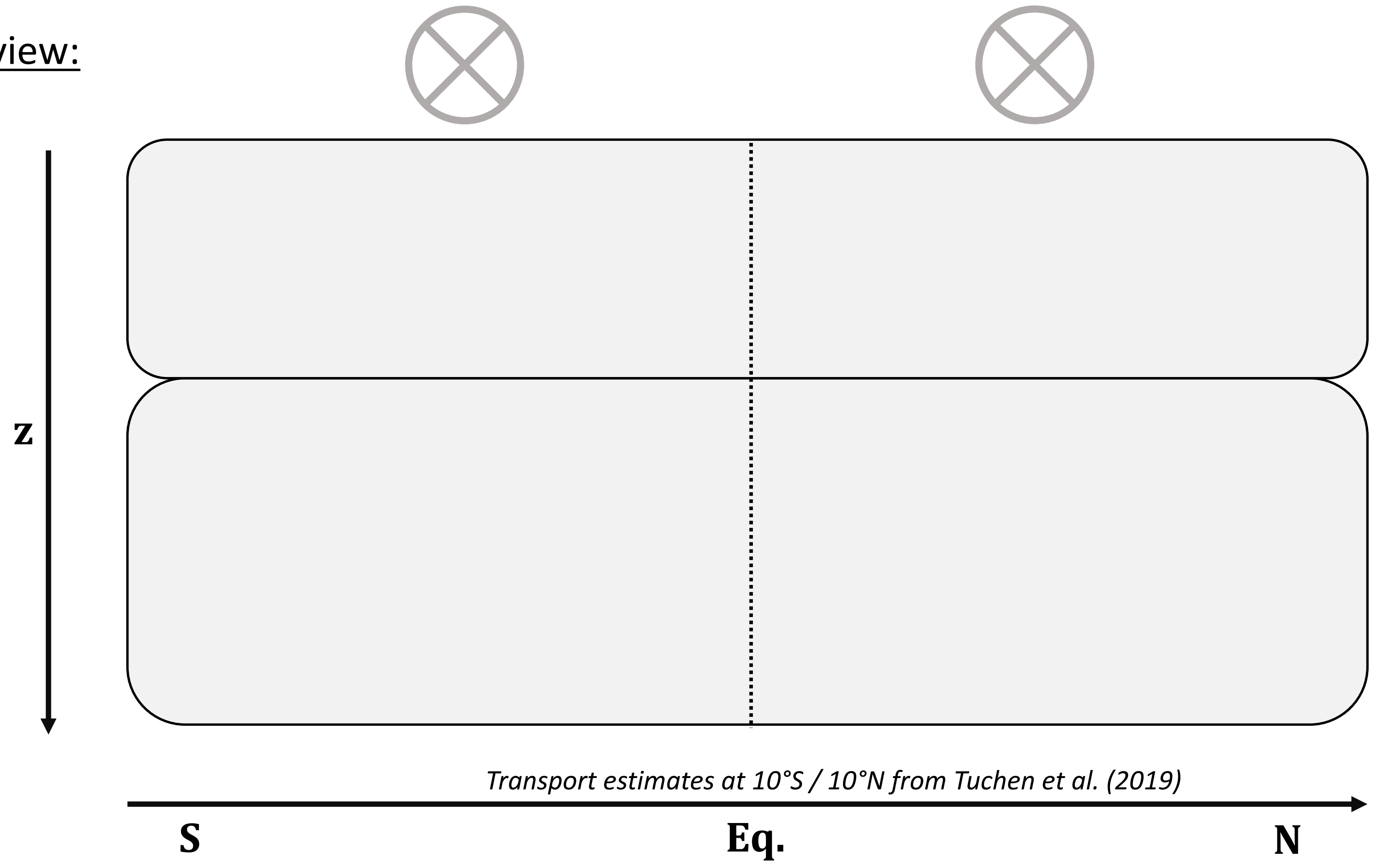

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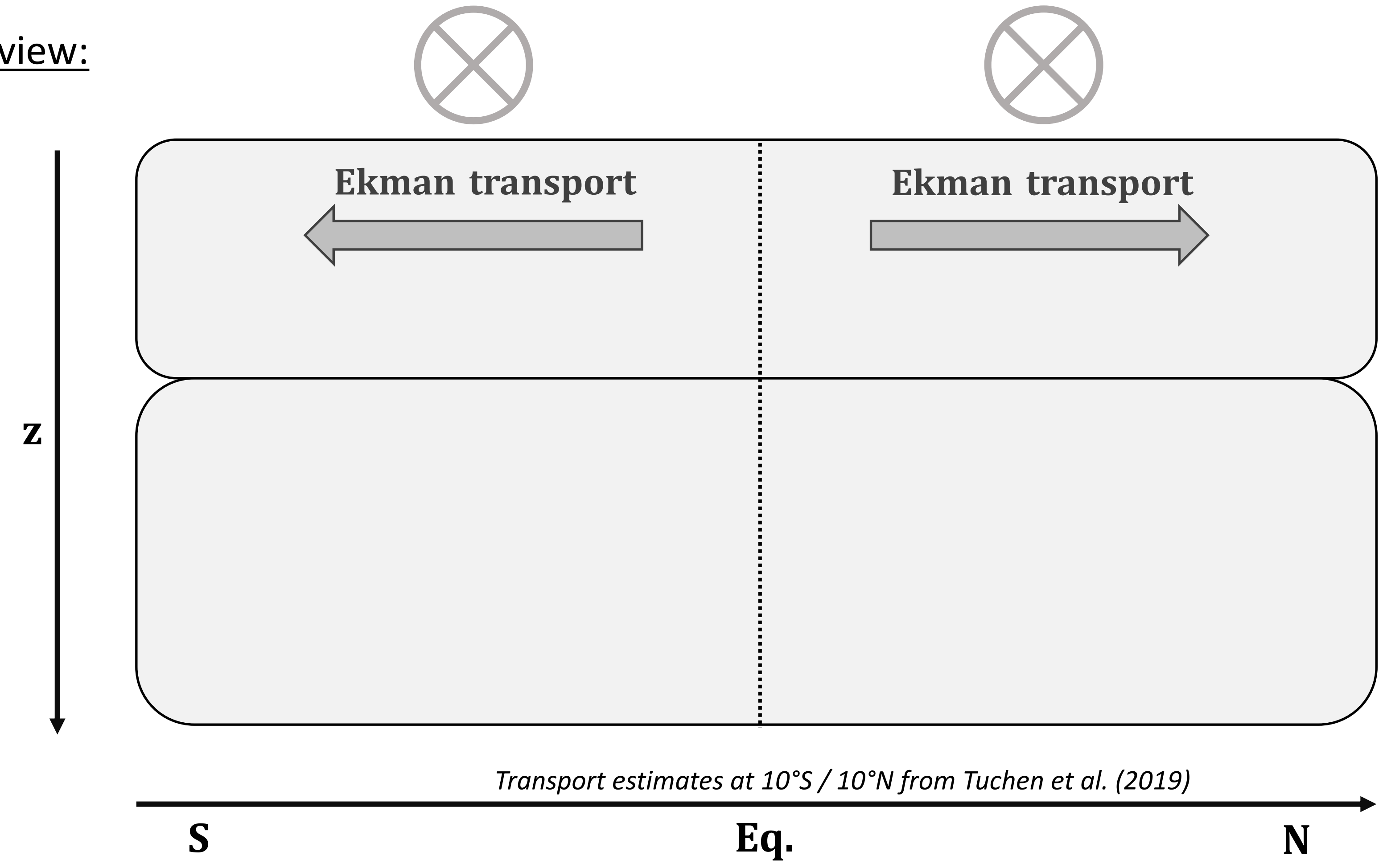

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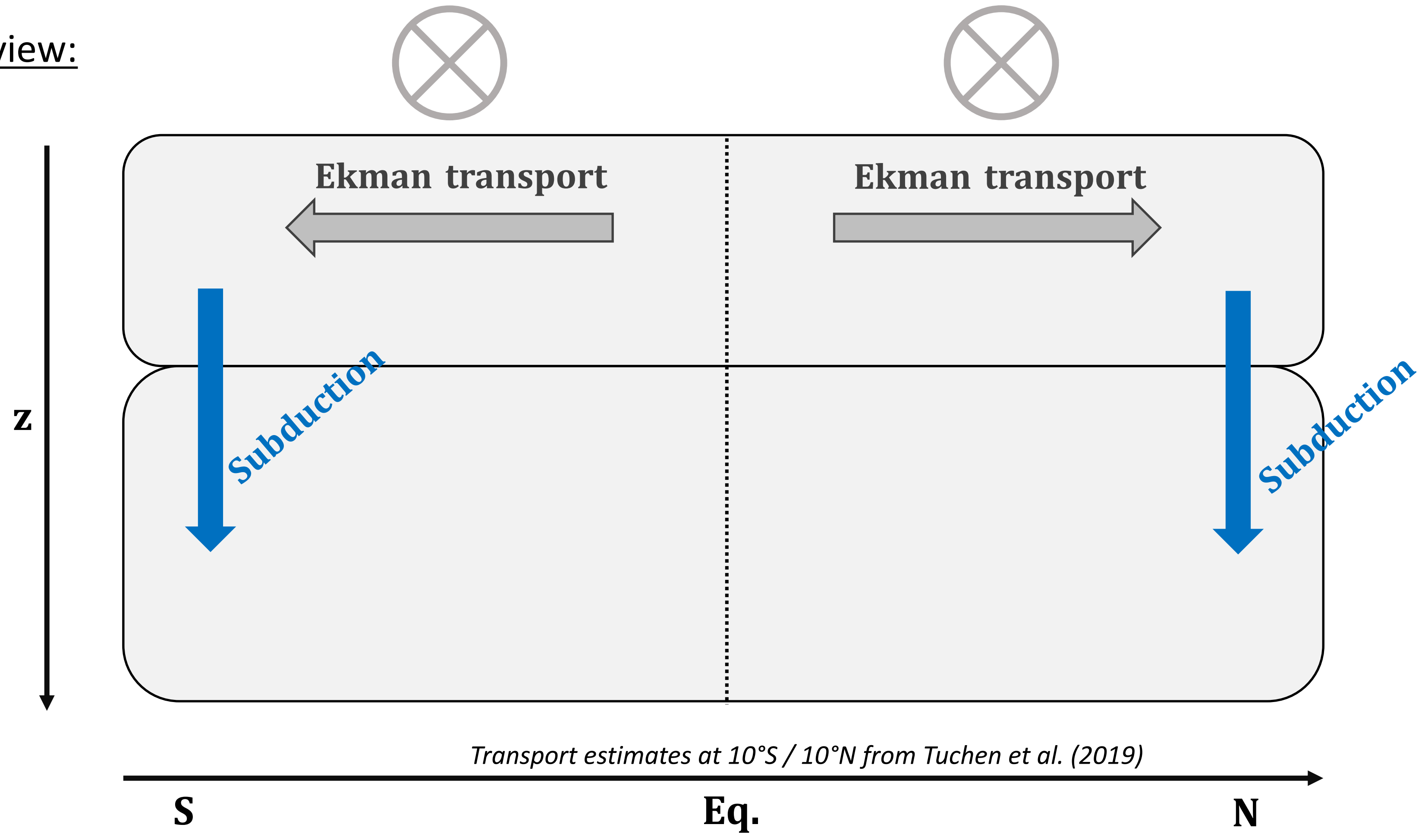

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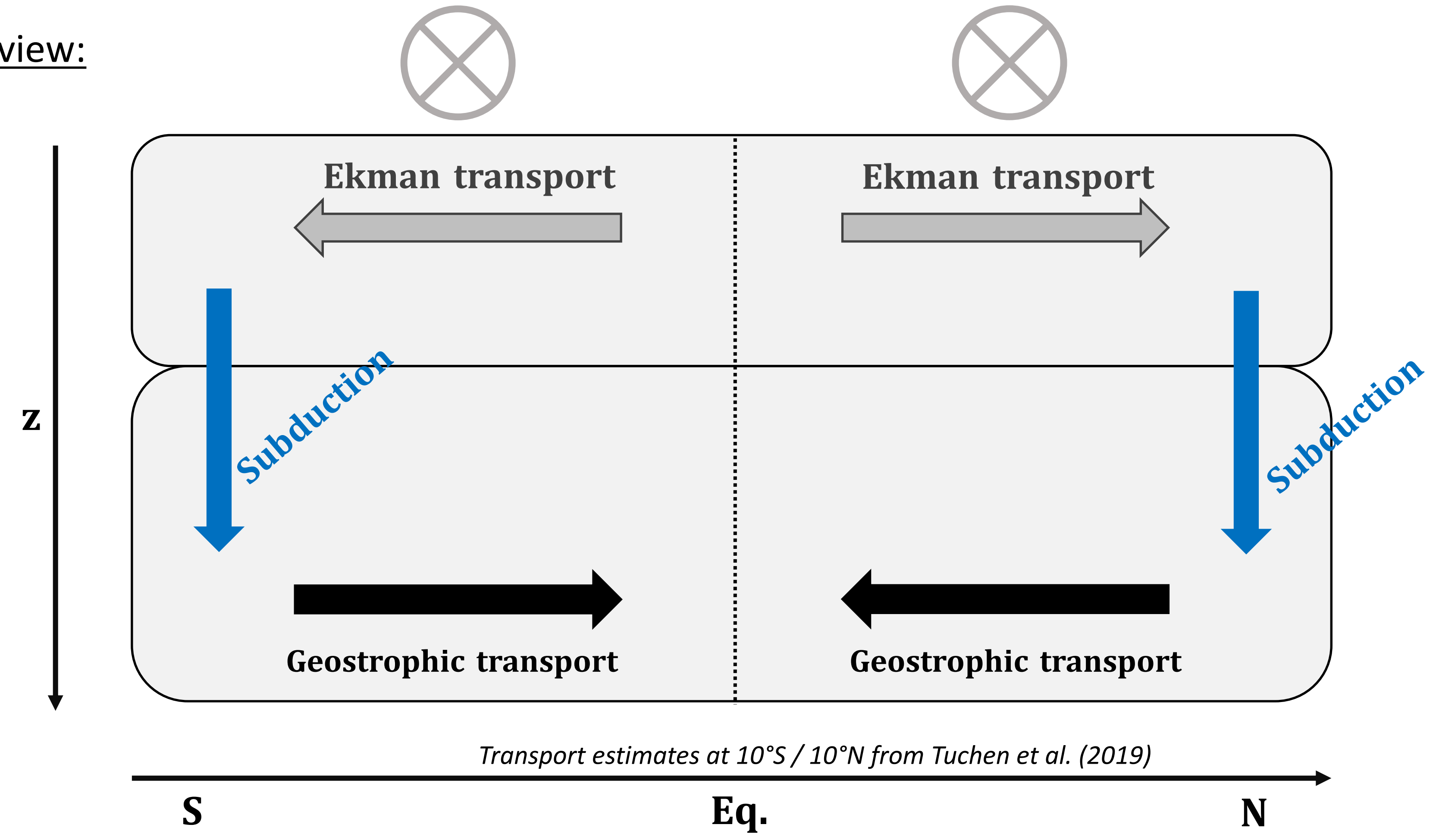

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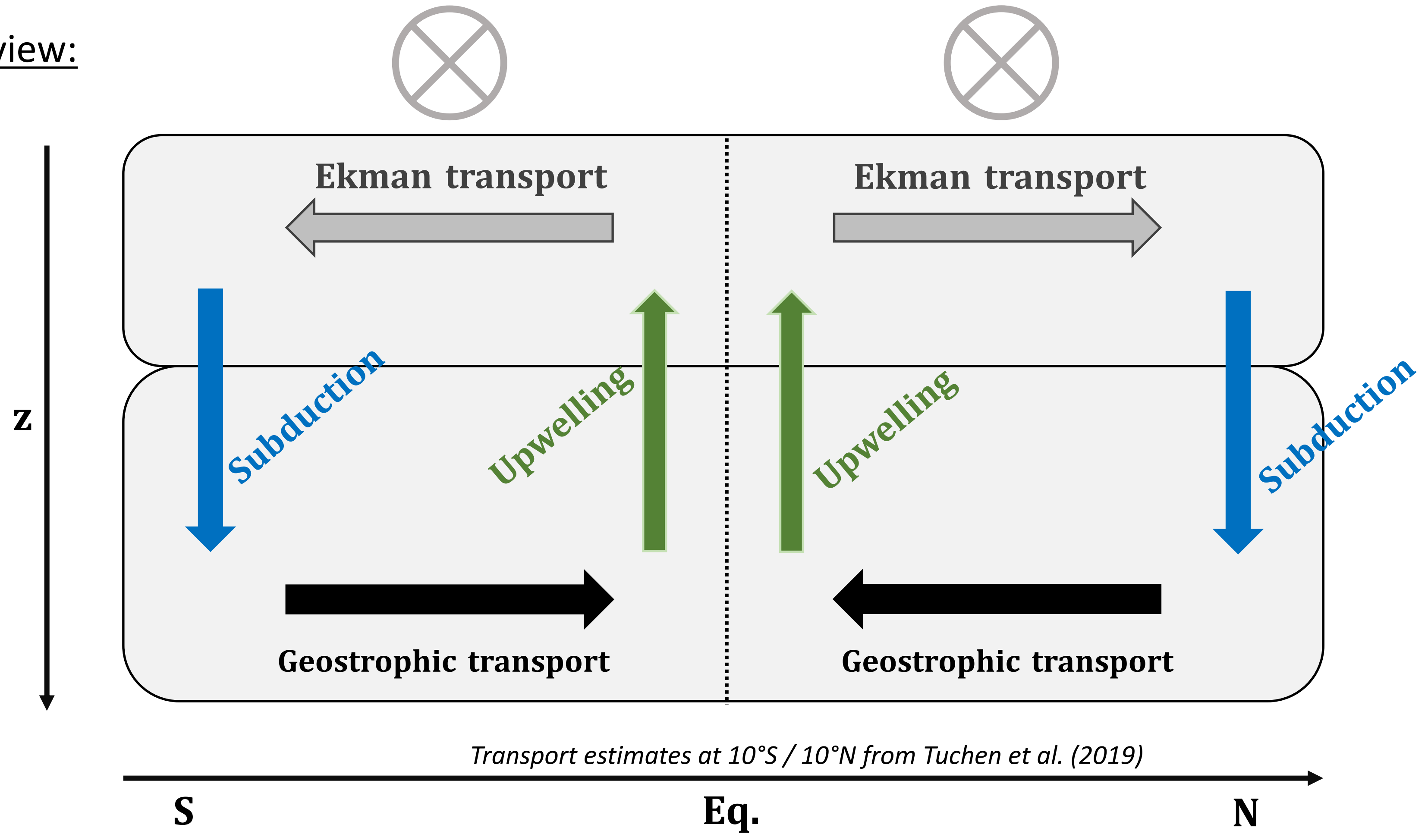

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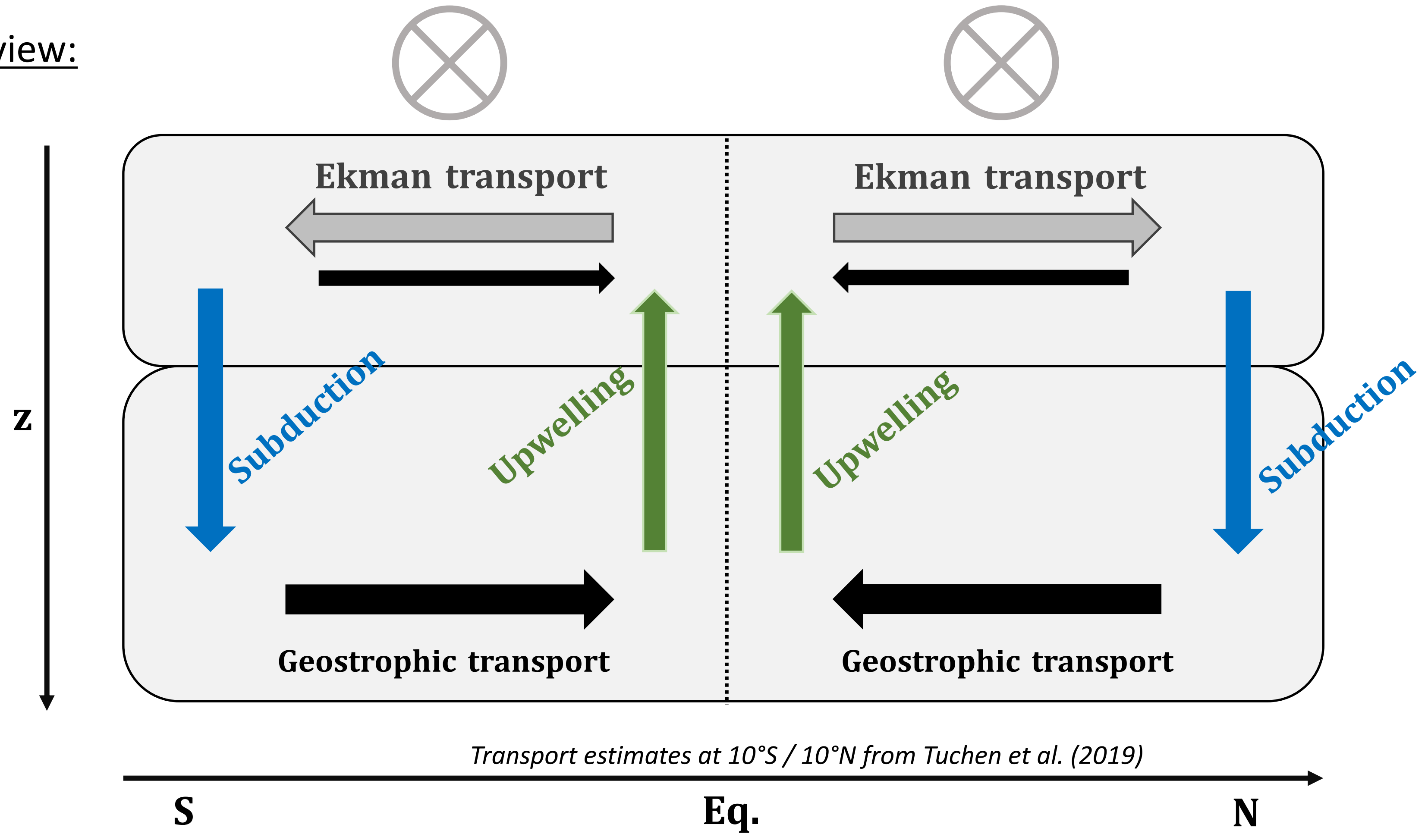

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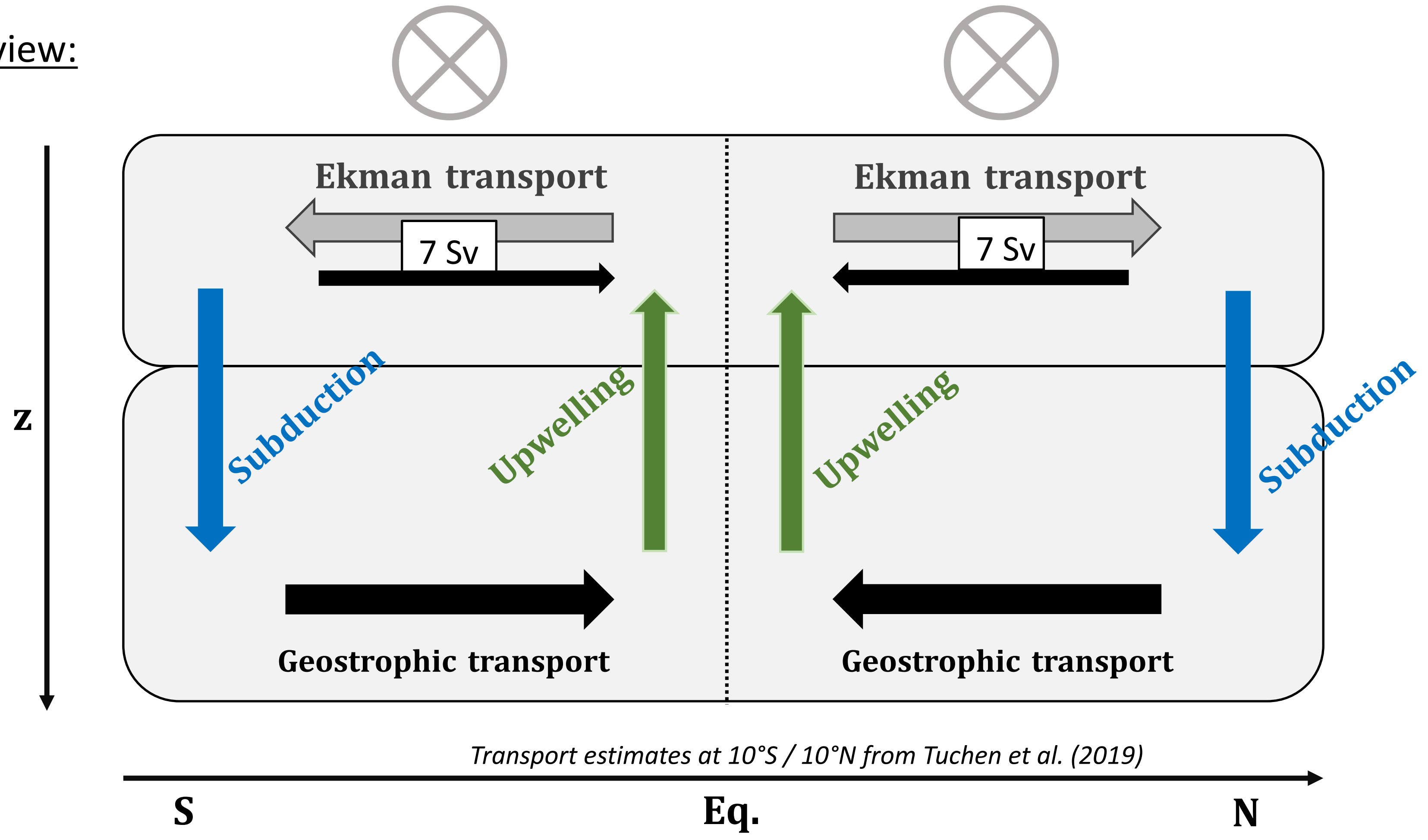

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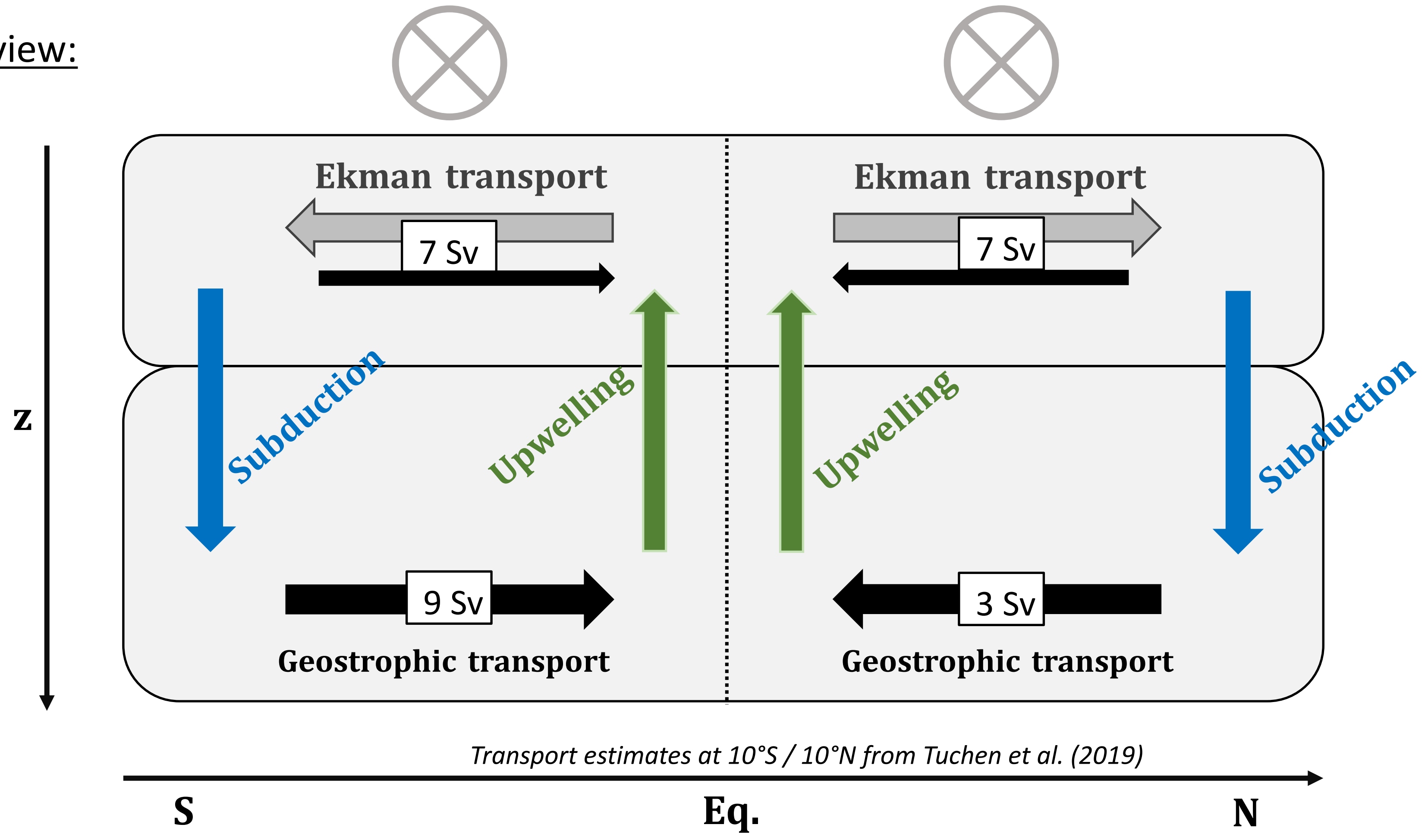

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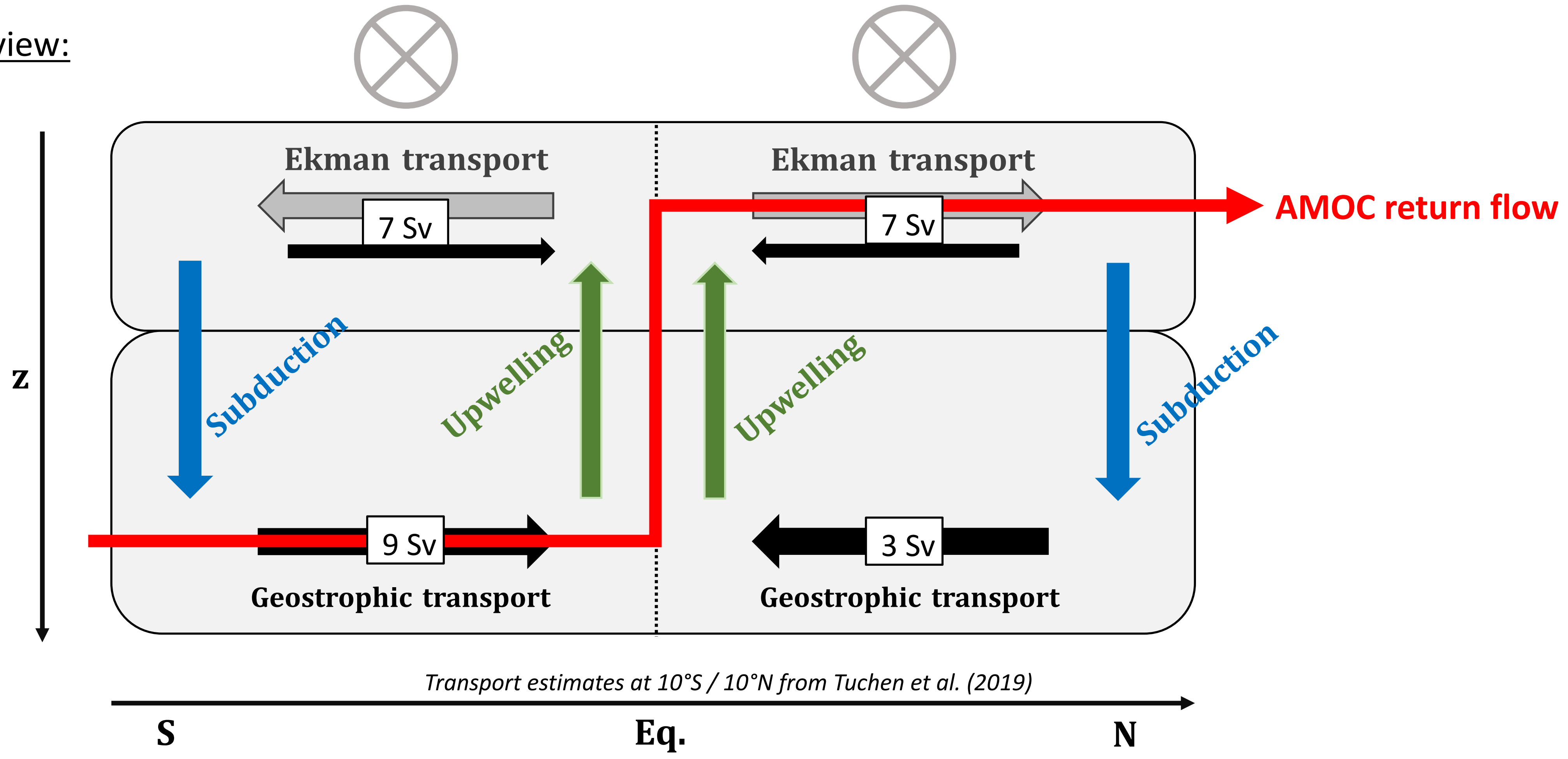

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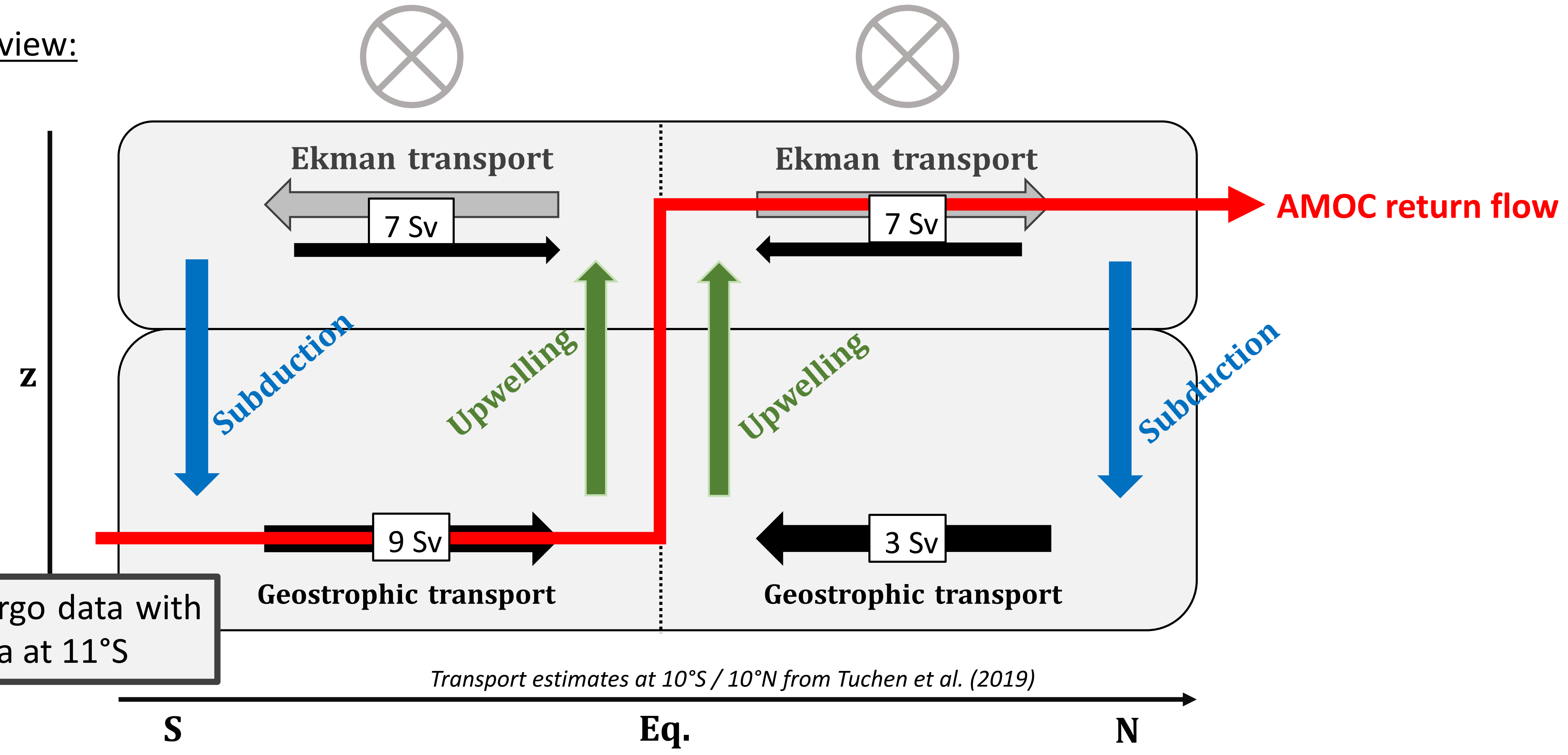

1. Comparing Argo data with ship section data at 11°S

Atlantic Subtropical Cells and upper AMOC

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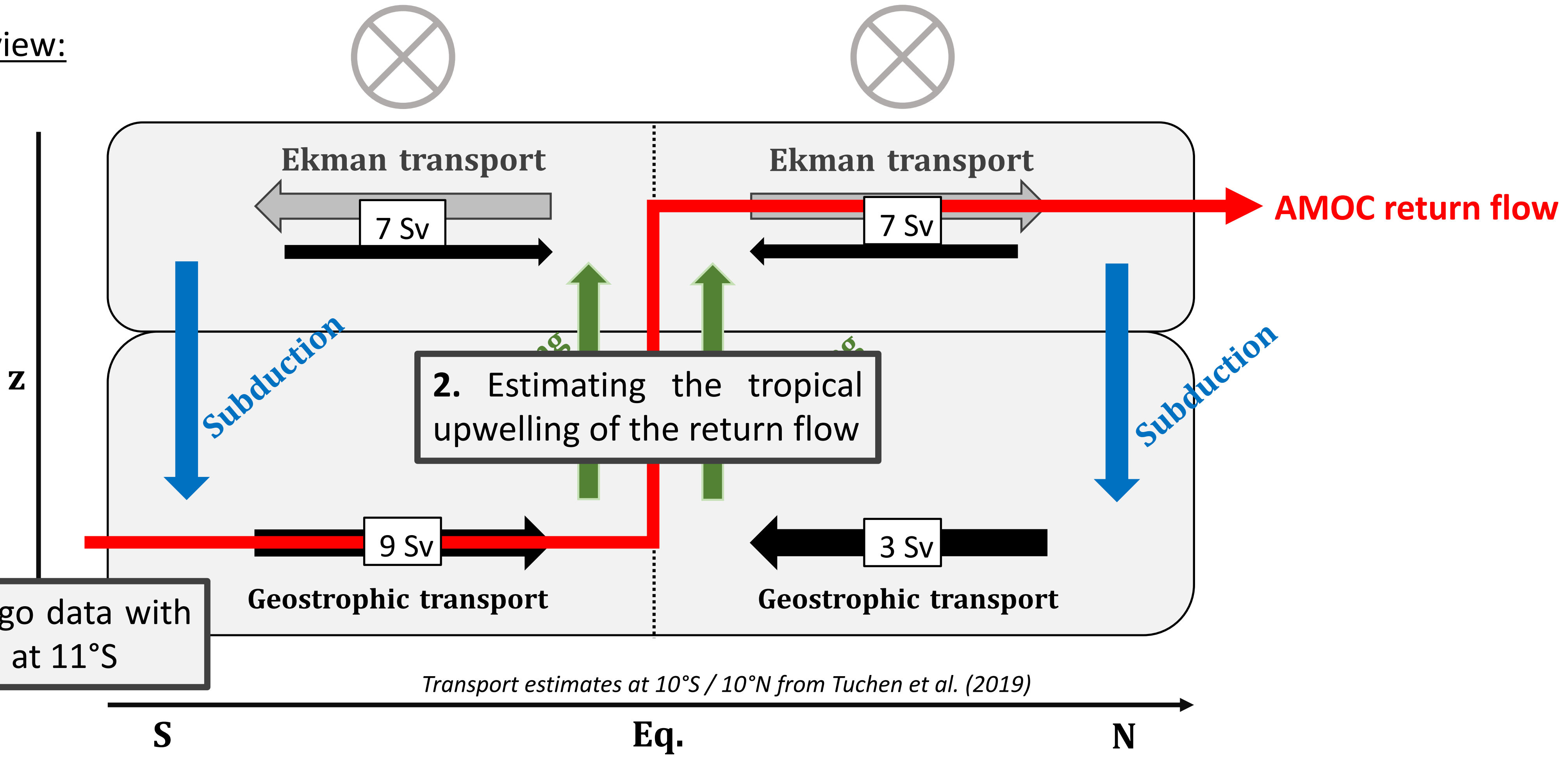

2. Estimating the tropical upwelling of the return flow

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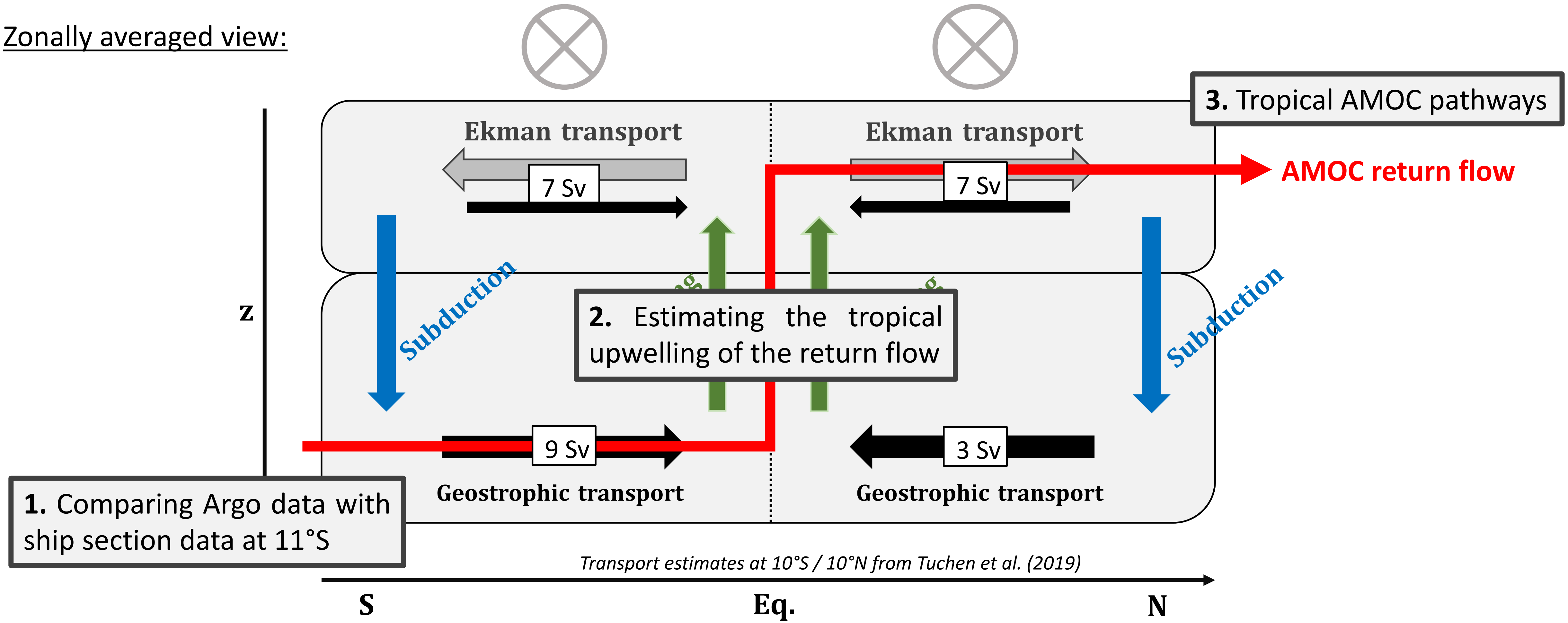
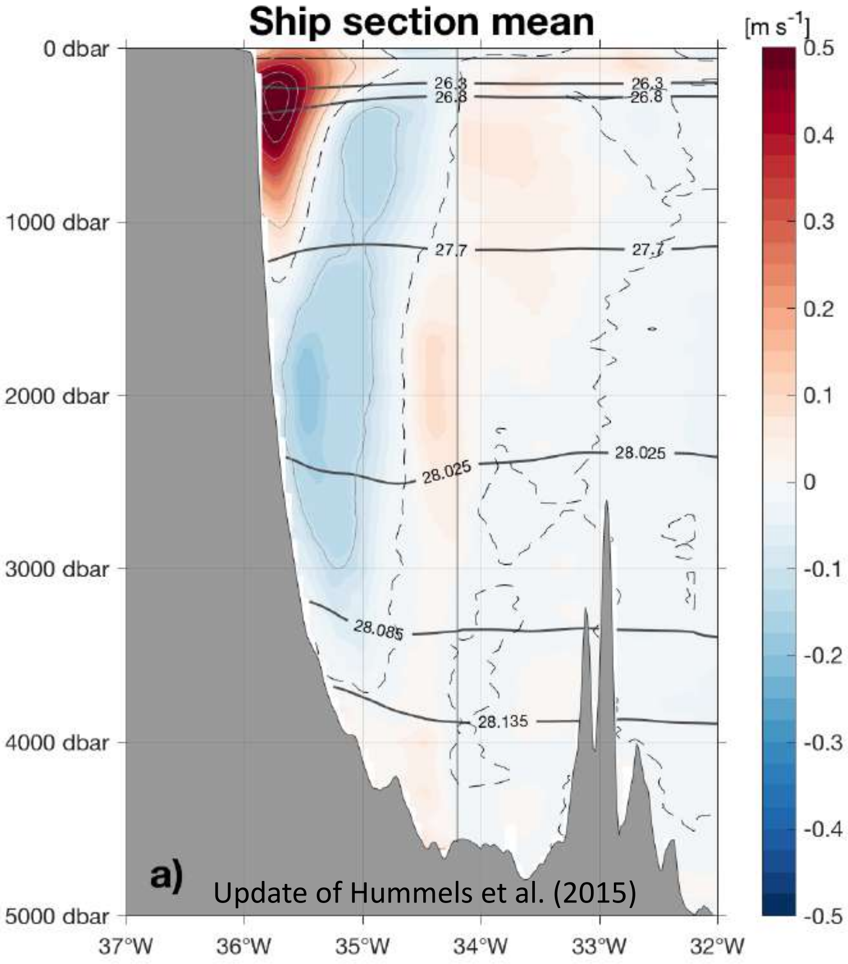


Validating Argo data: case study at 11°S



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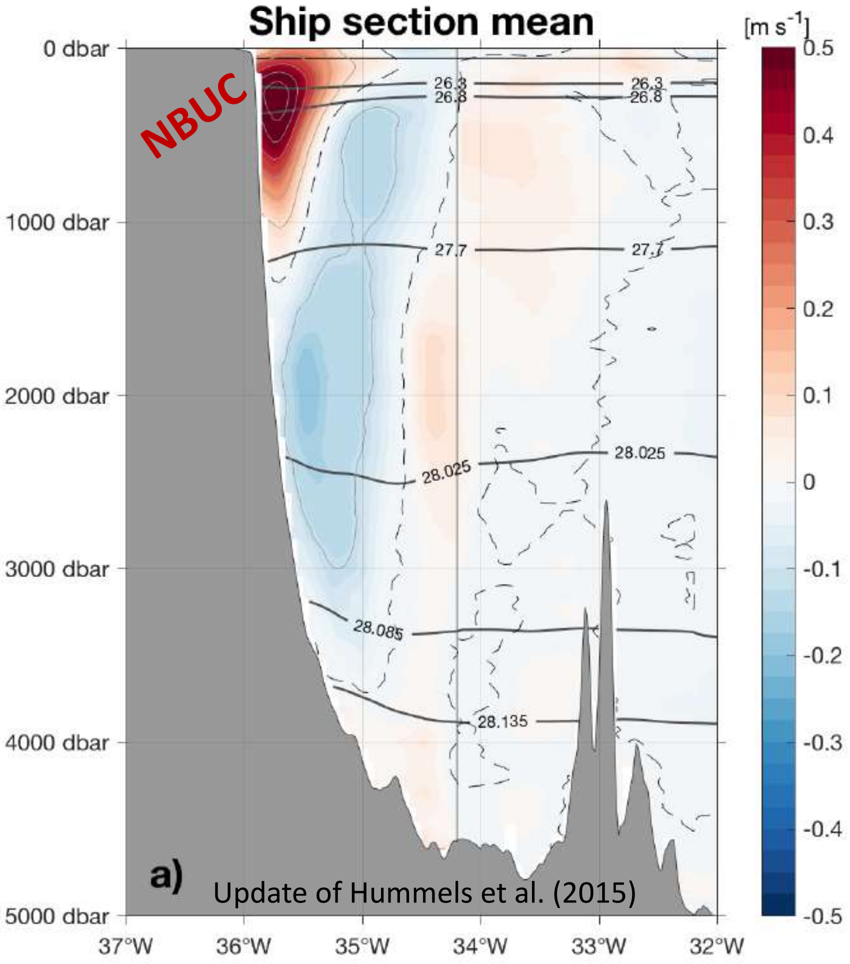

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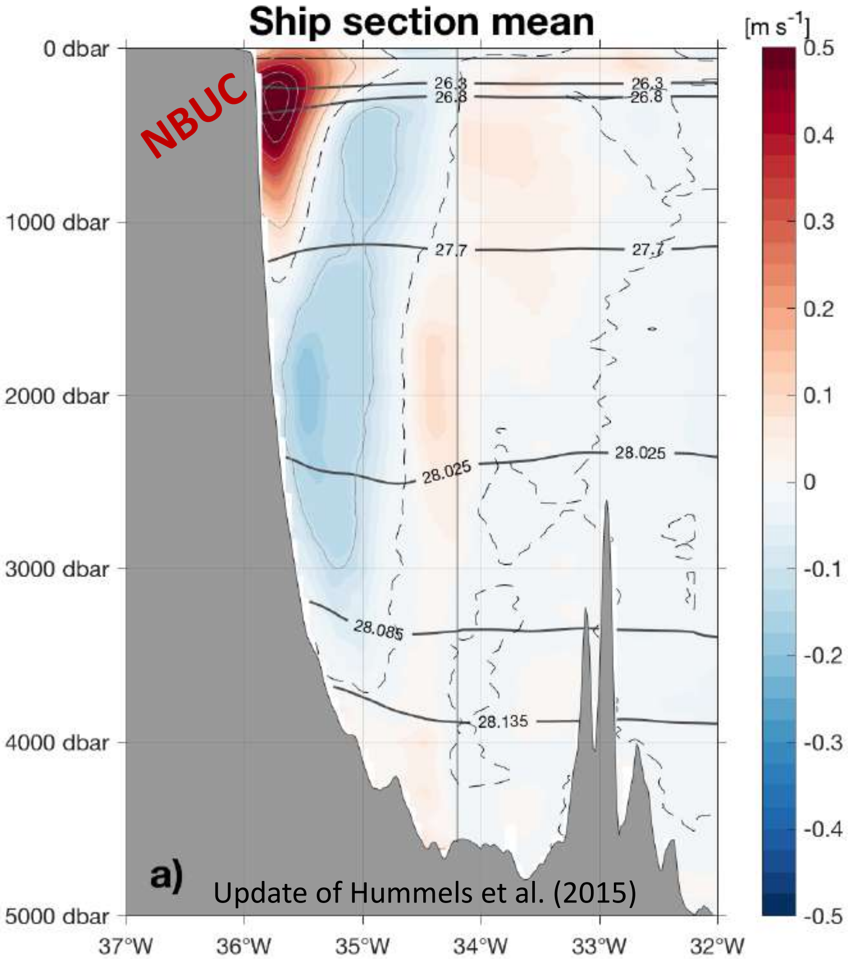

Update of Hummels et al. (2015)

Water Mass	Layer boundaries (γ_n)
Surface layer	Surface - Ekman depth
Thermocline/STC layer	Ekman depth – 26.3
Lower Central Water	26.3 - 26.8
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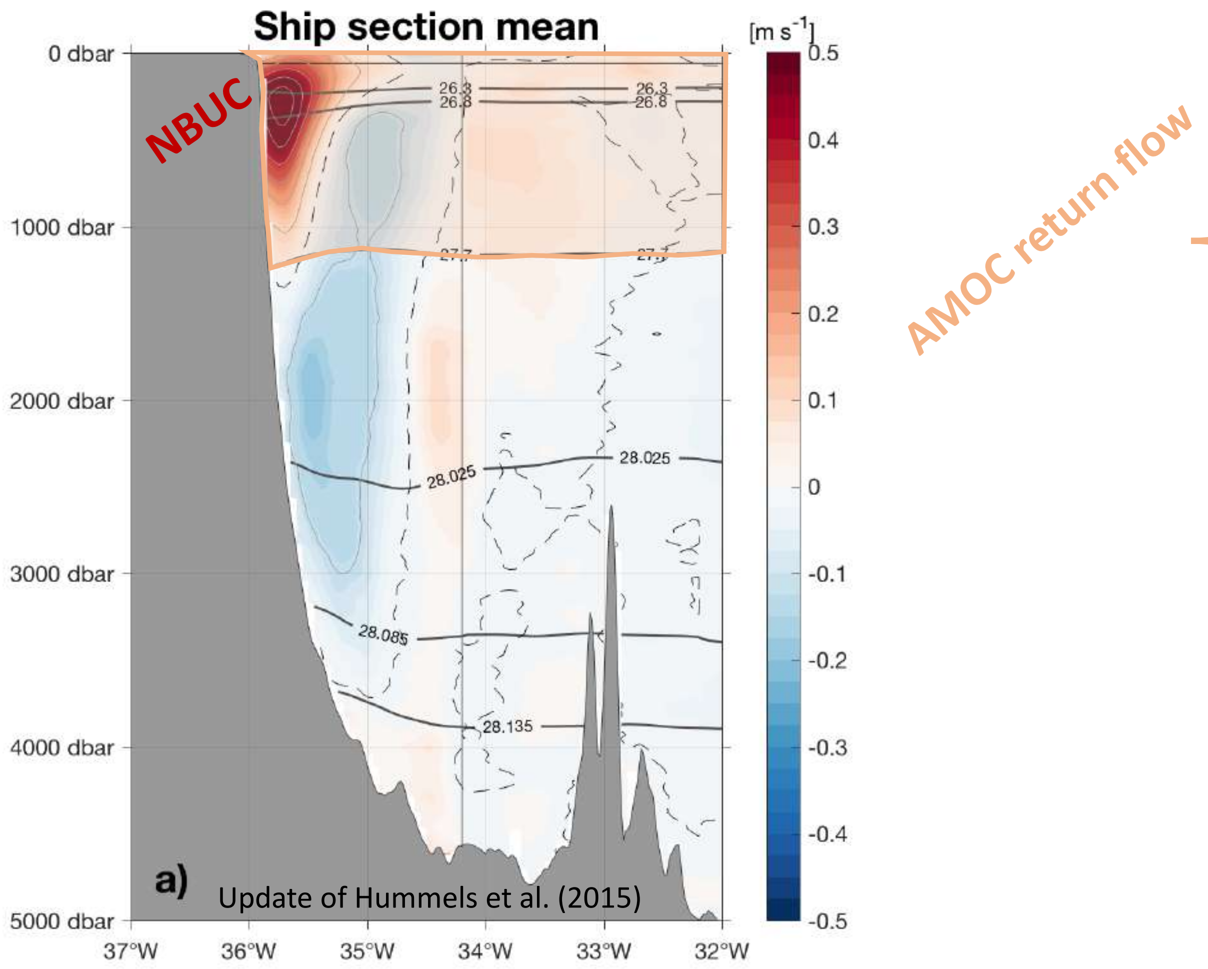

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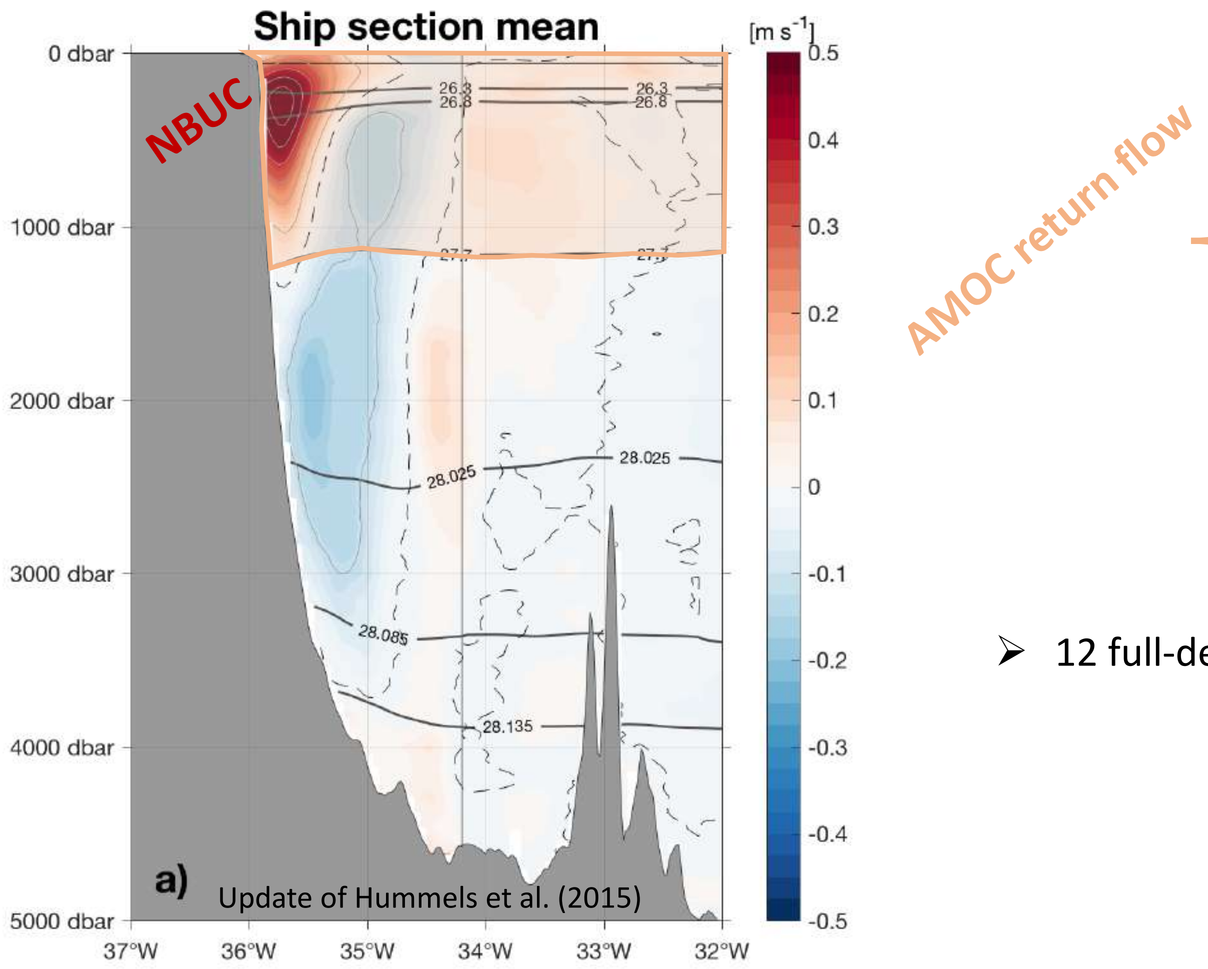

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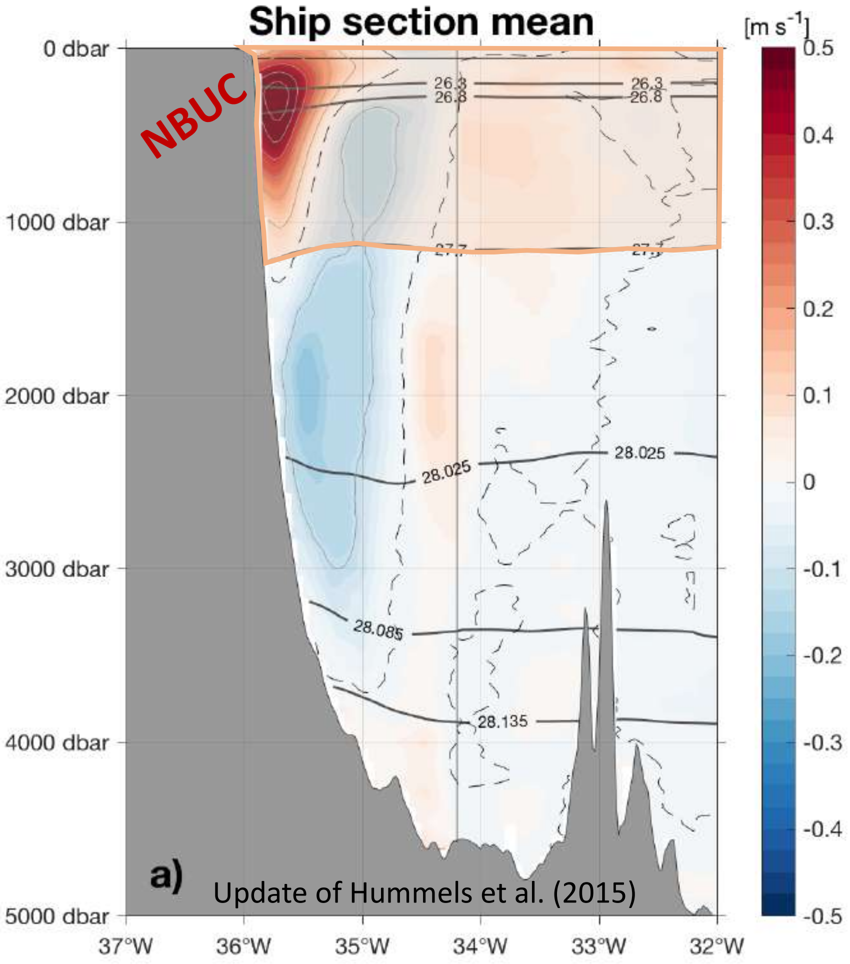

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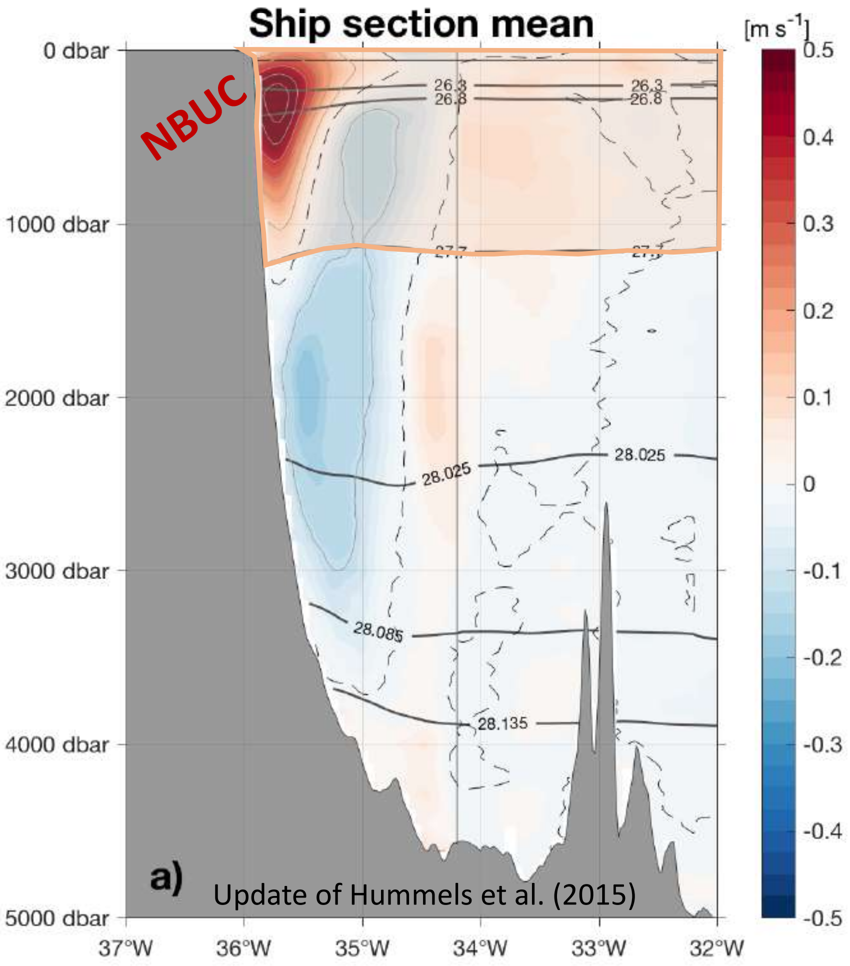

AMOC return flow

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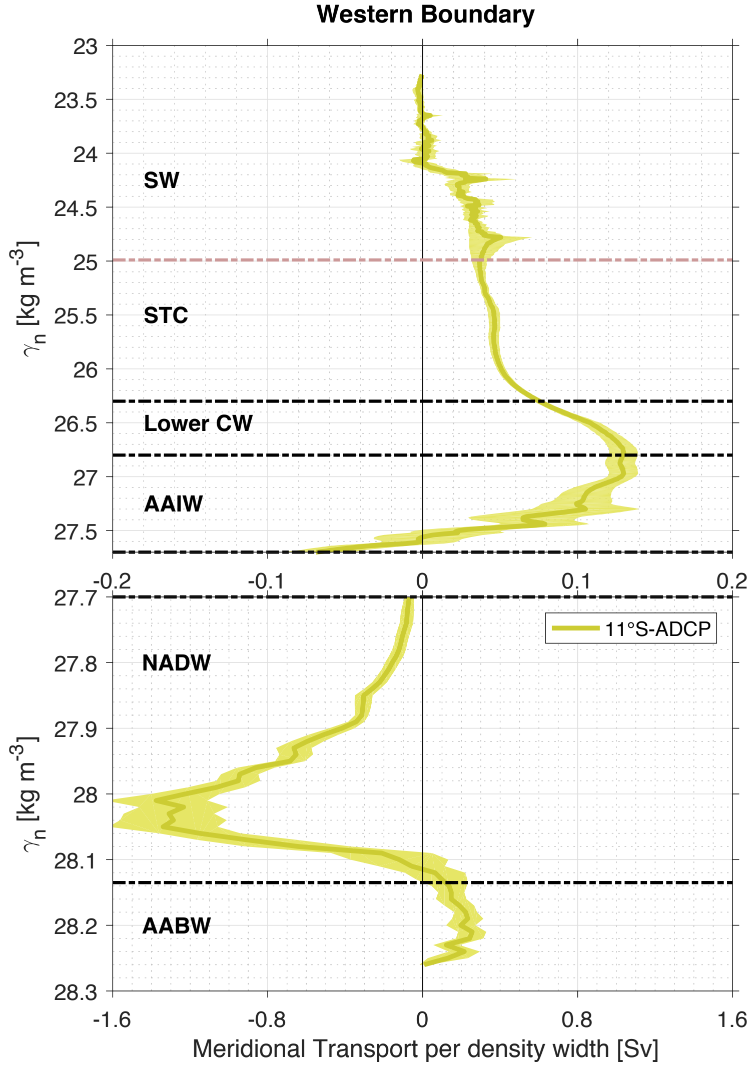
Water Mass Layer Transports



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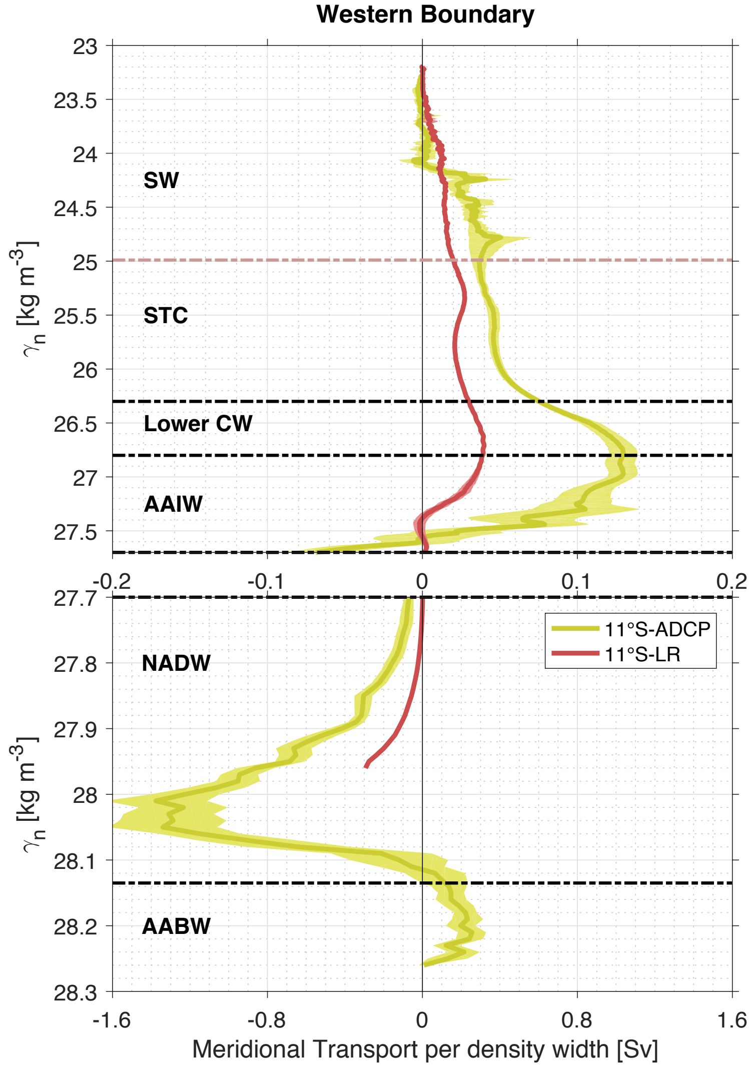

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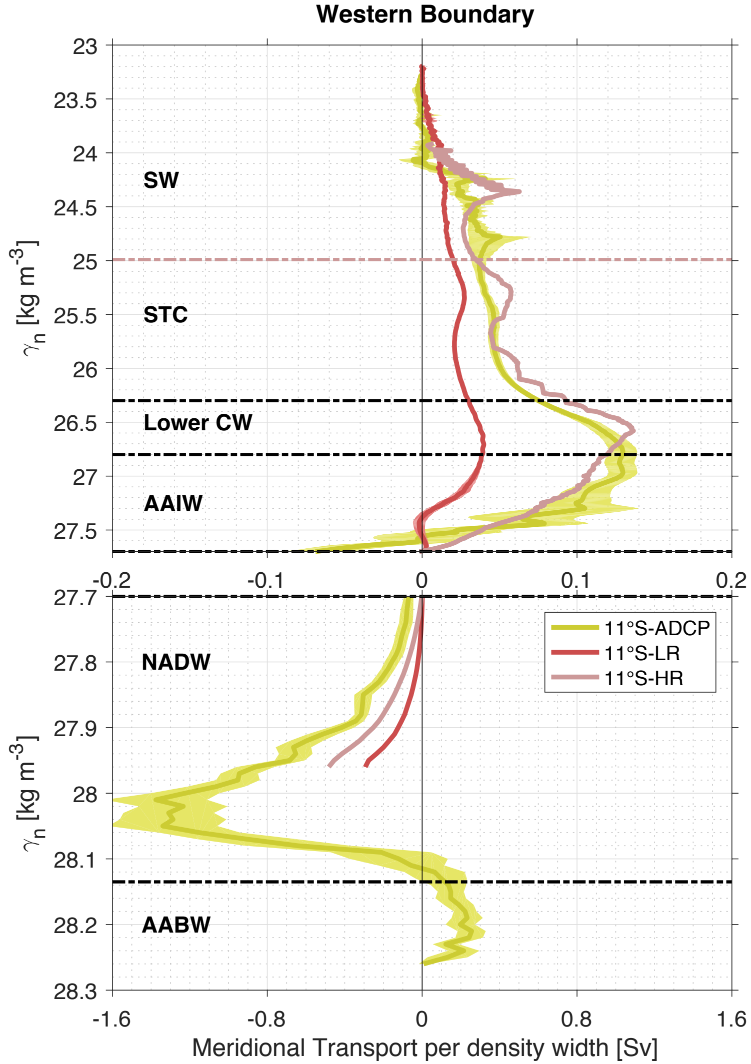

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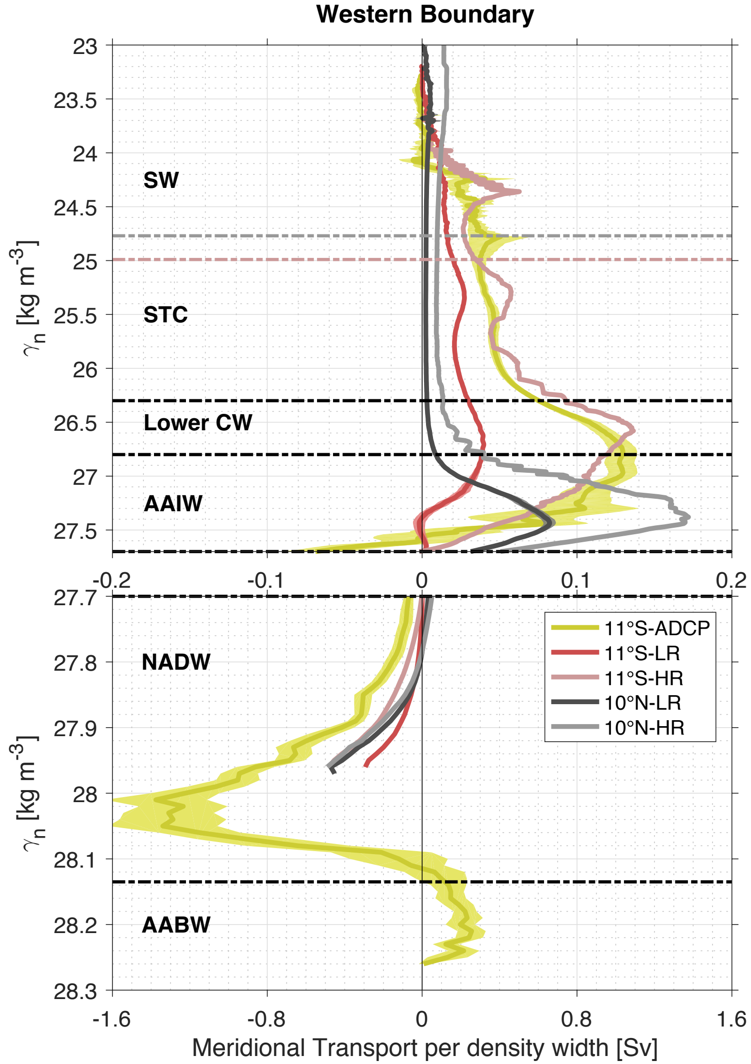

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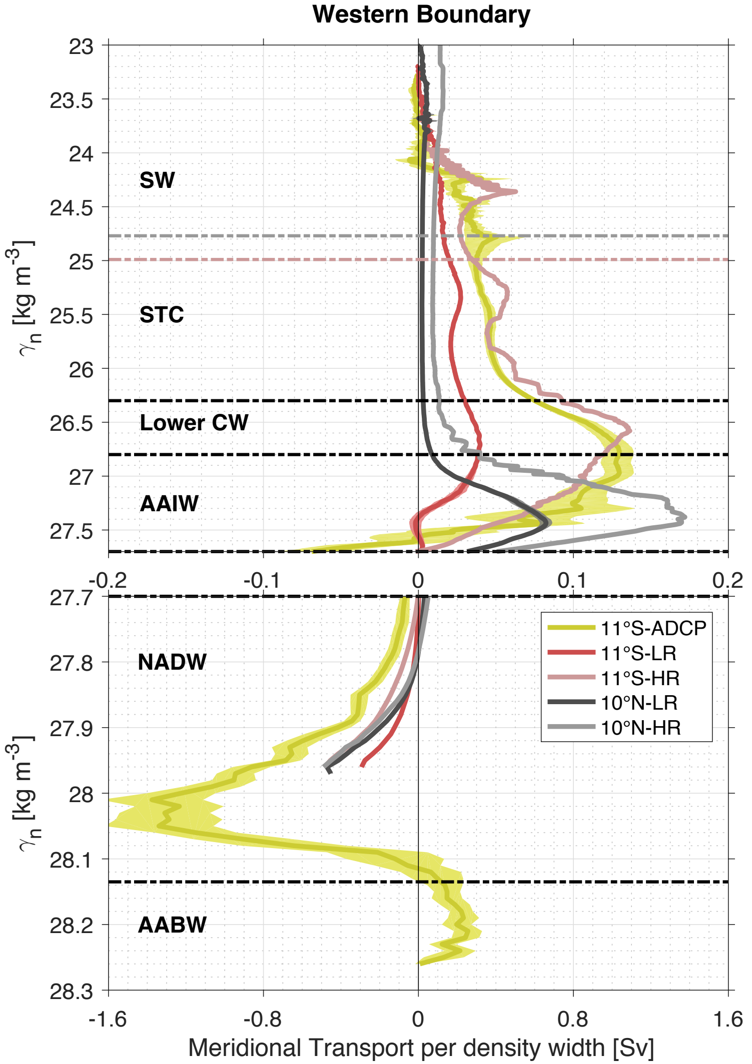

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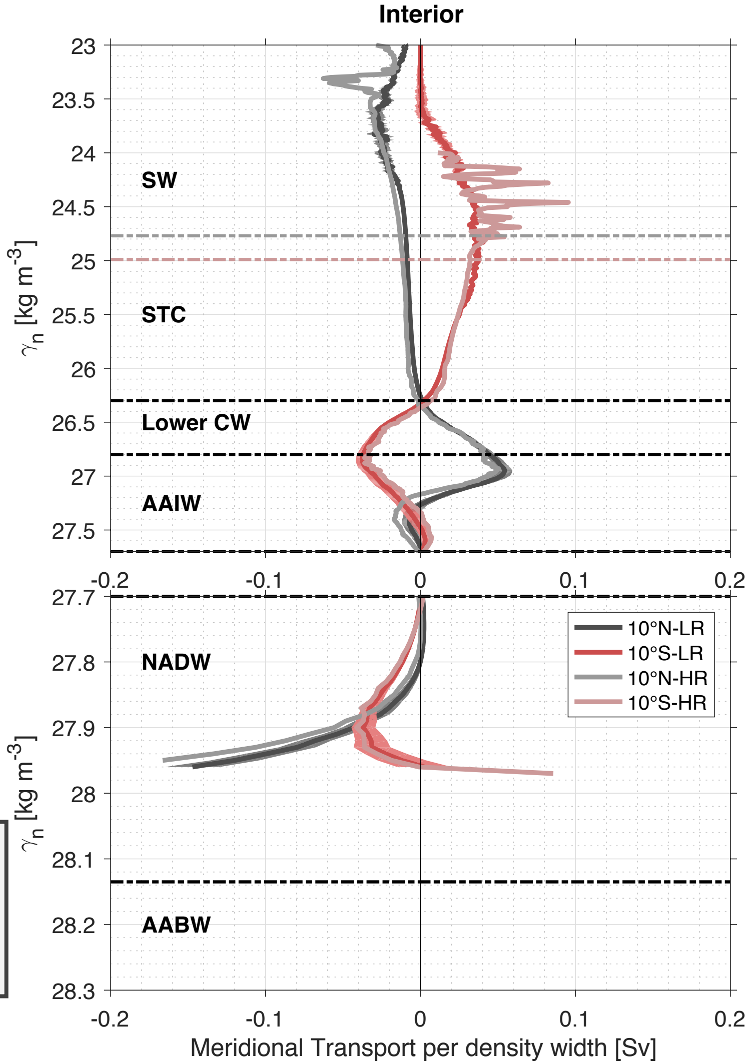
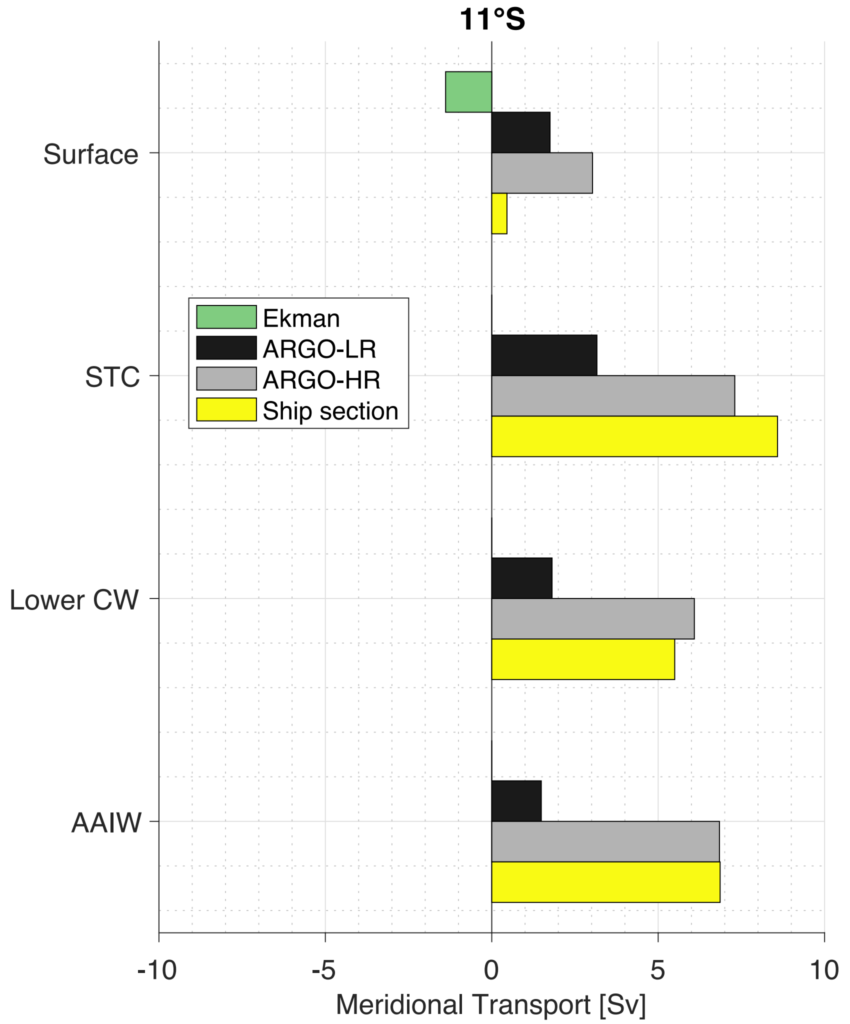


Mean AMOC return flow at the western boundary



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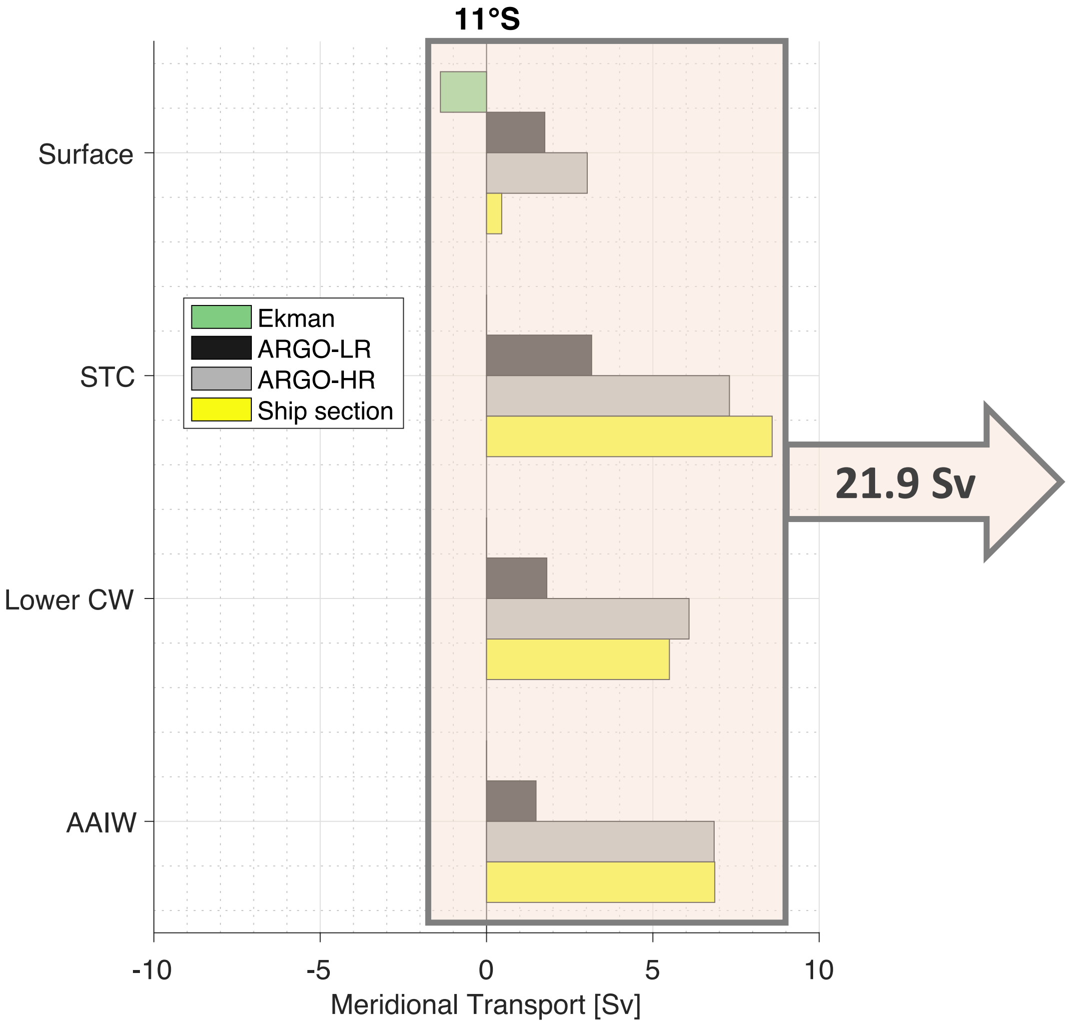

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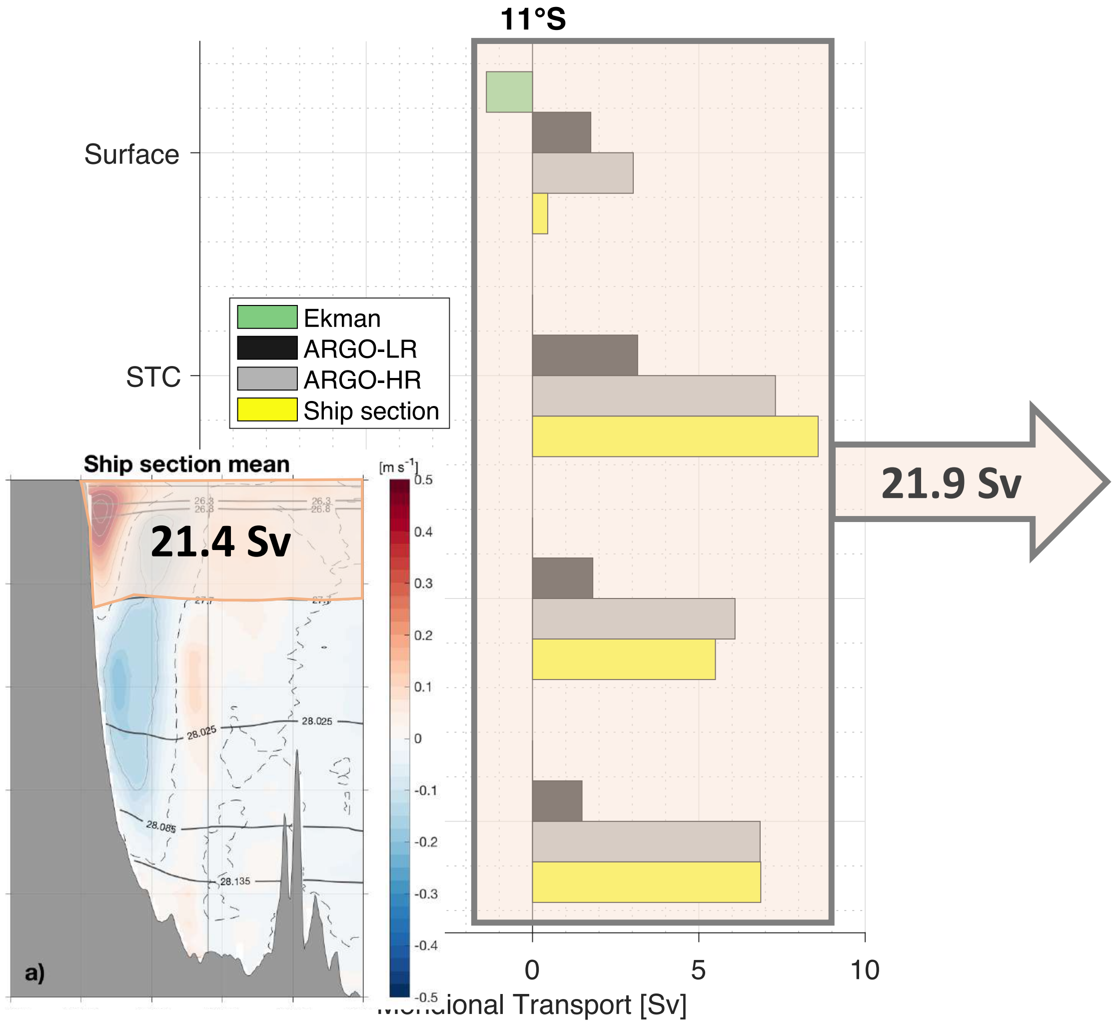

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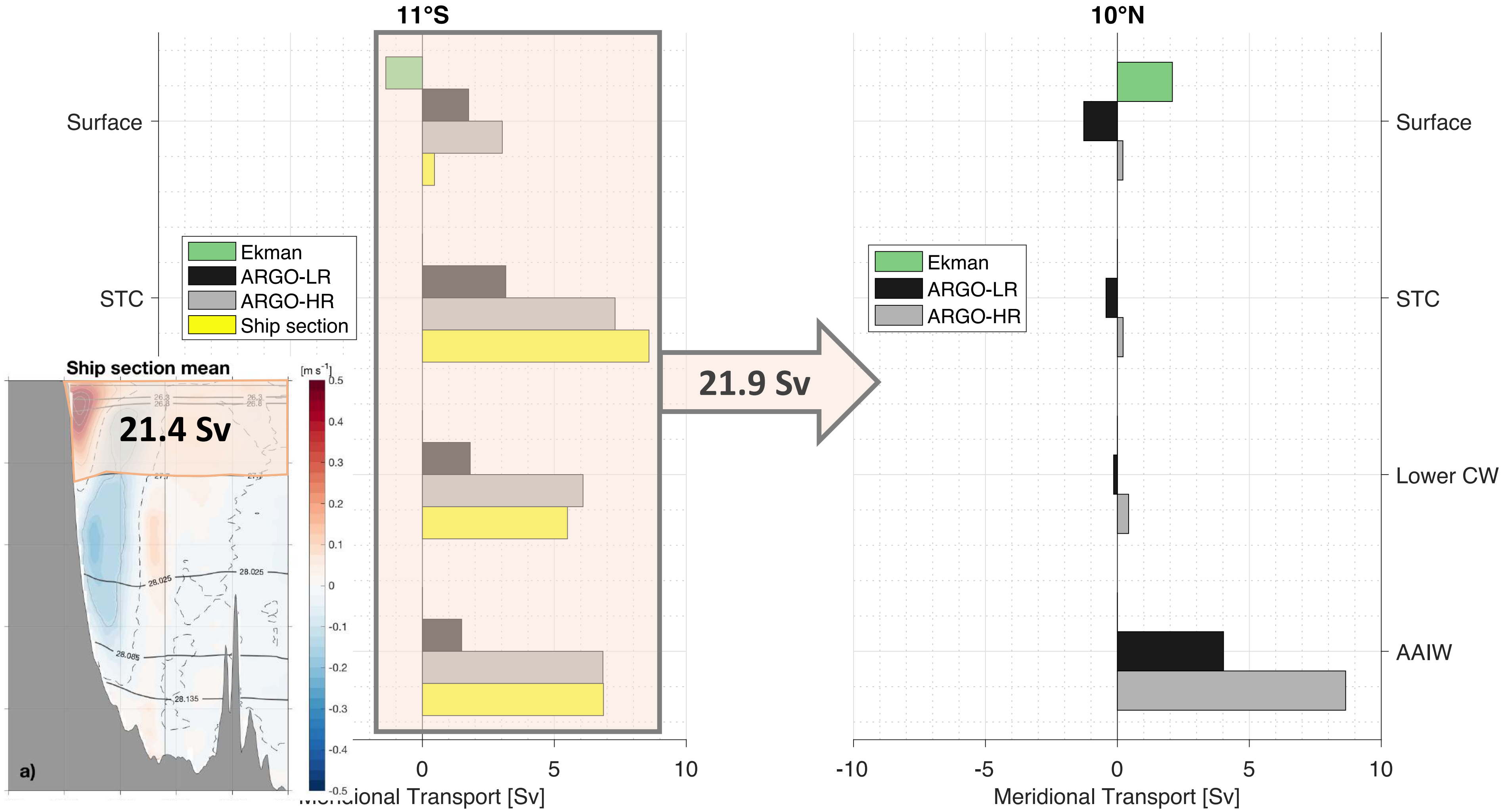

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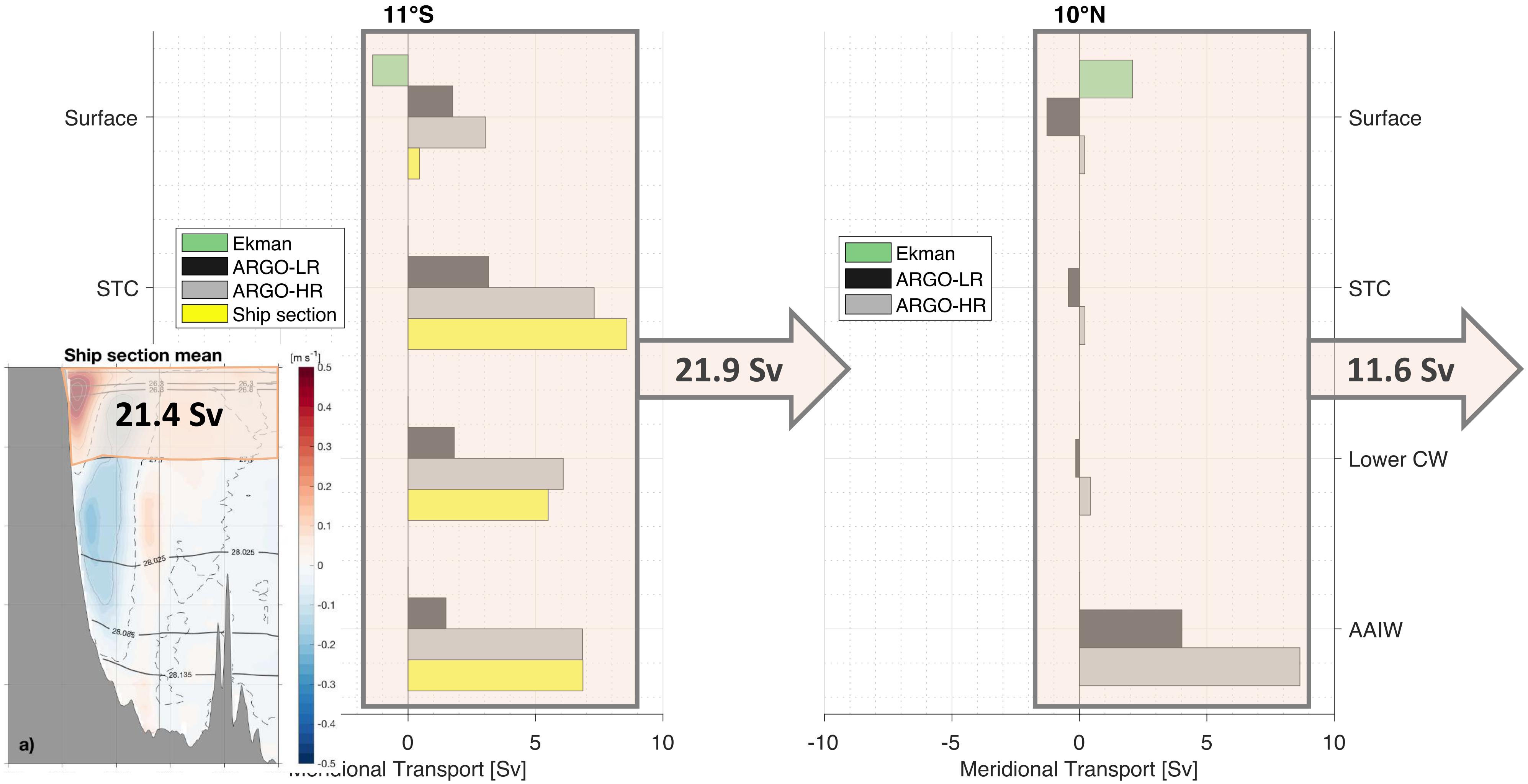
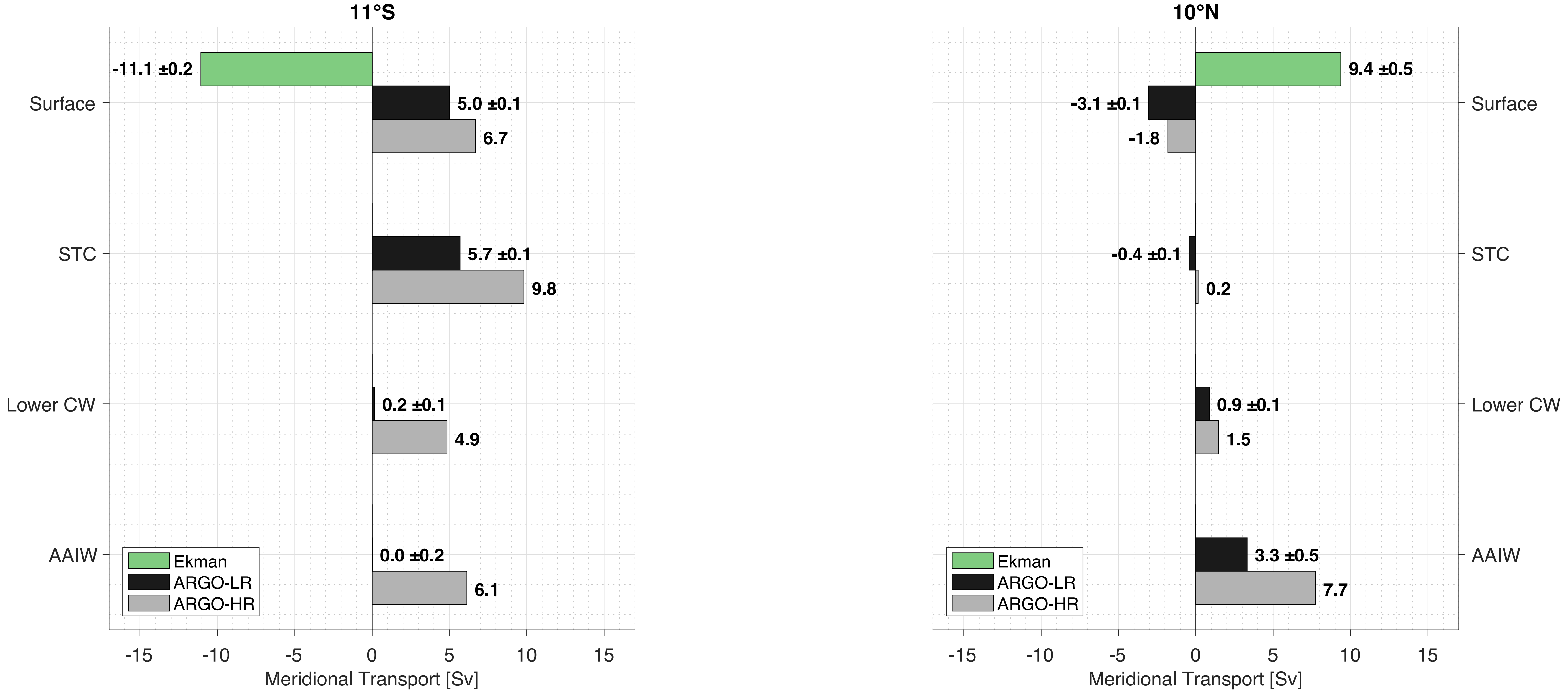


Water Mass Transformation within the AMOC return flow



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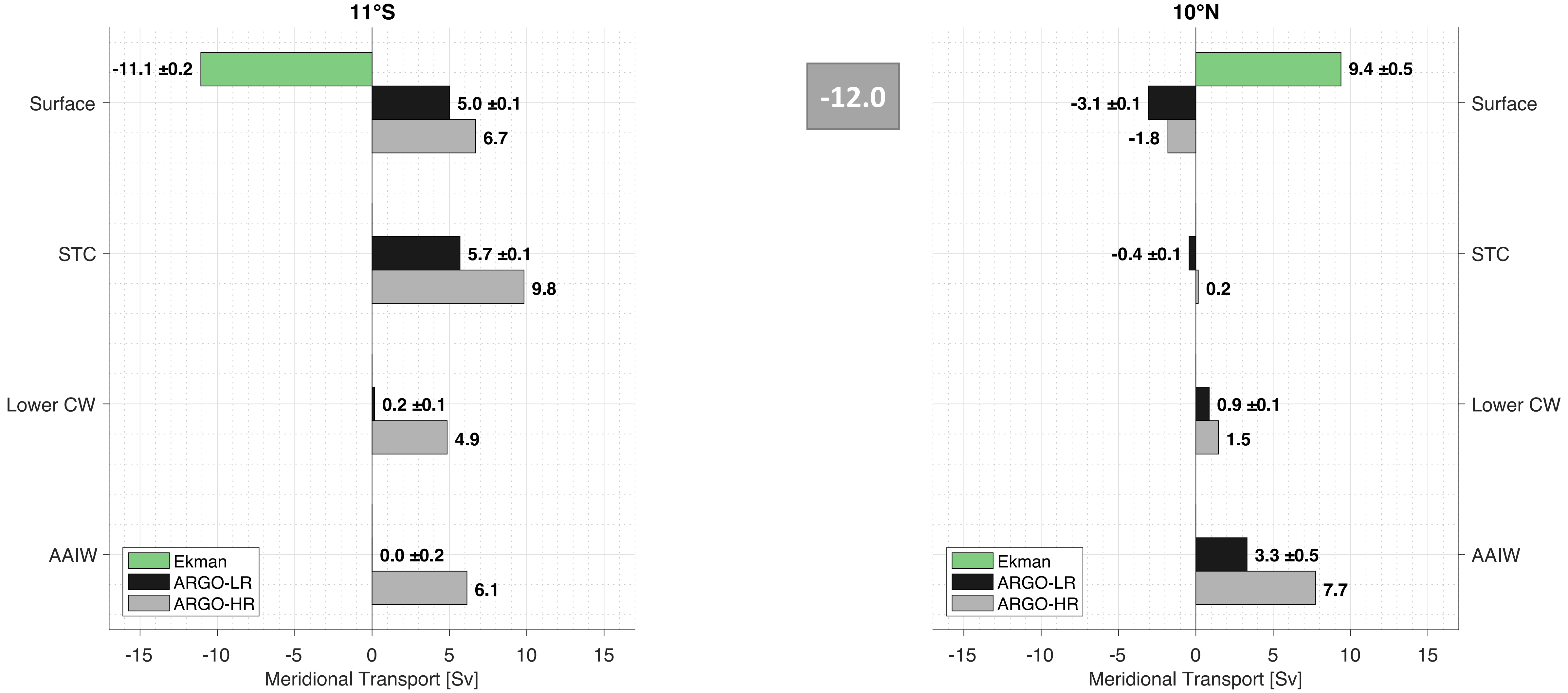

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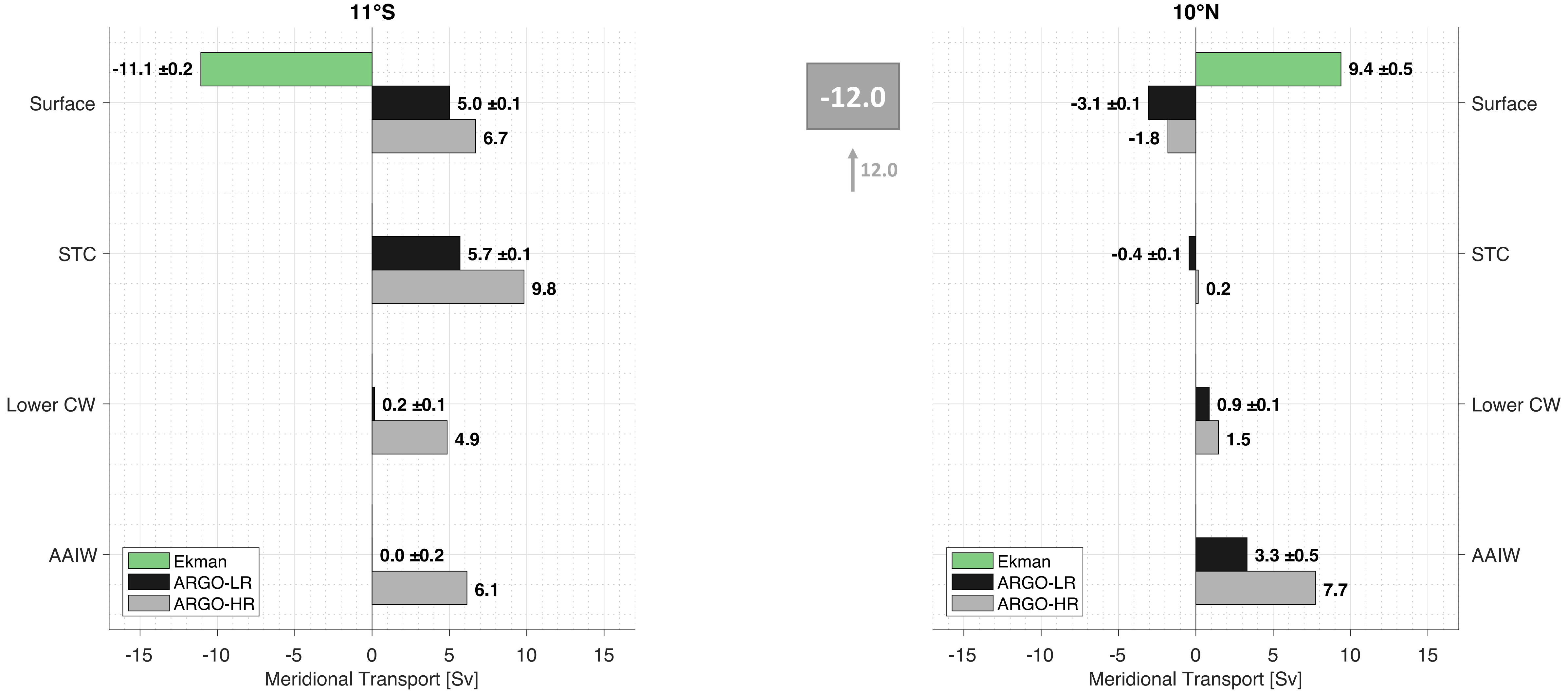

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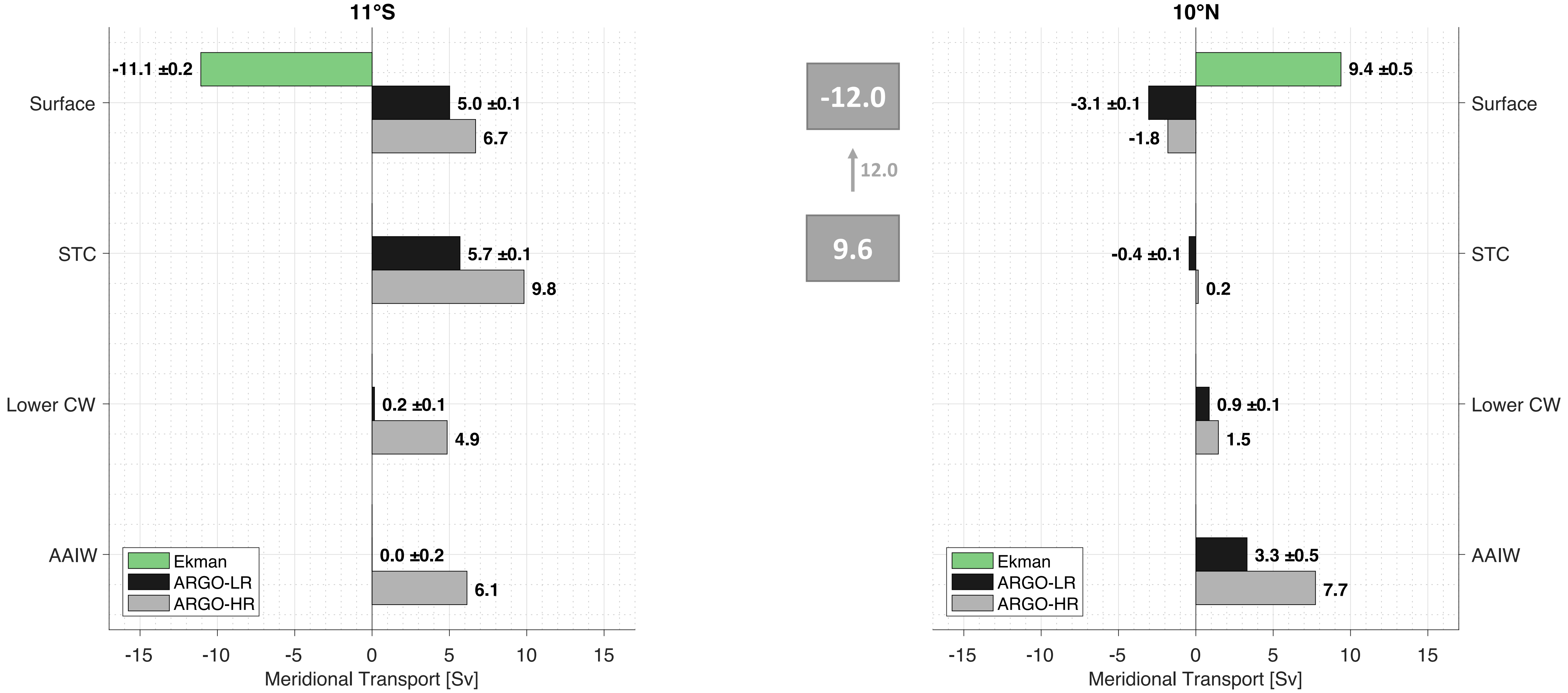

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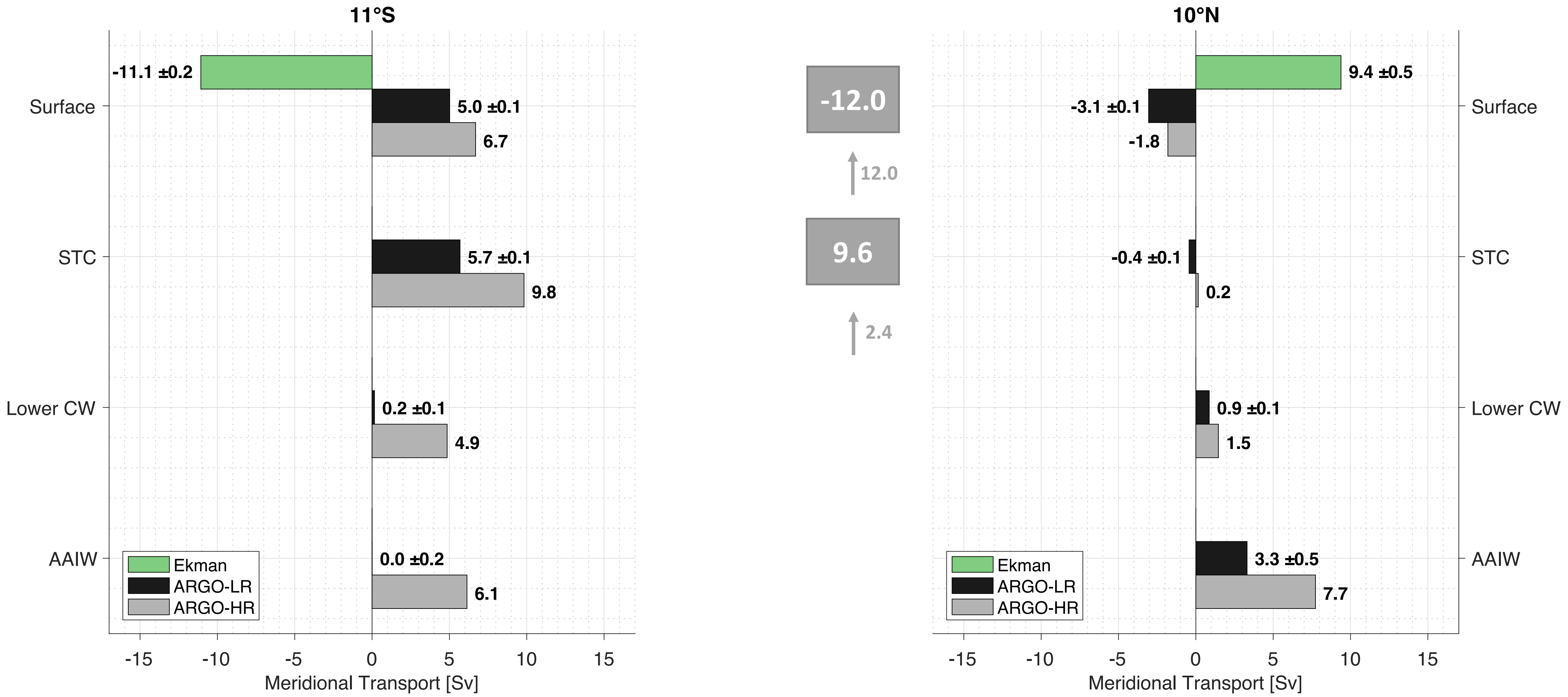

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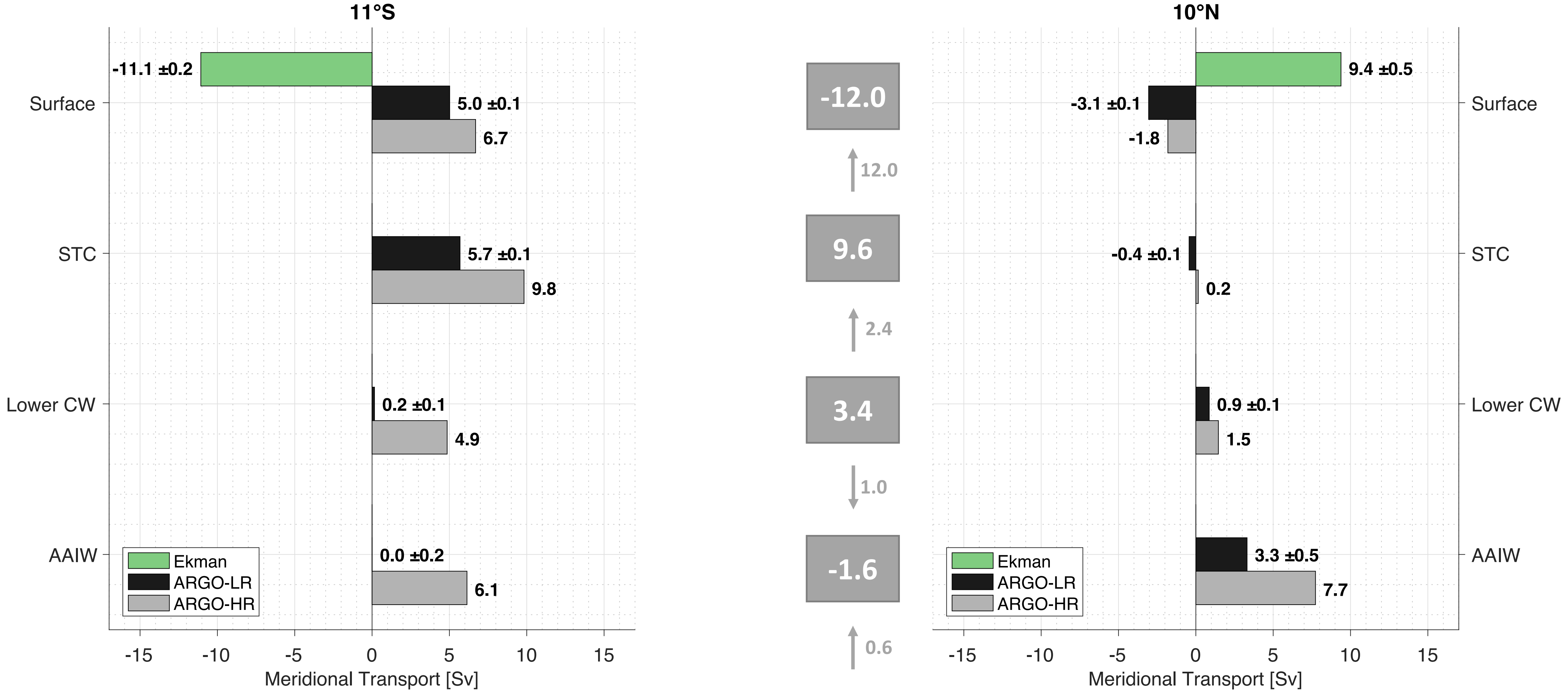

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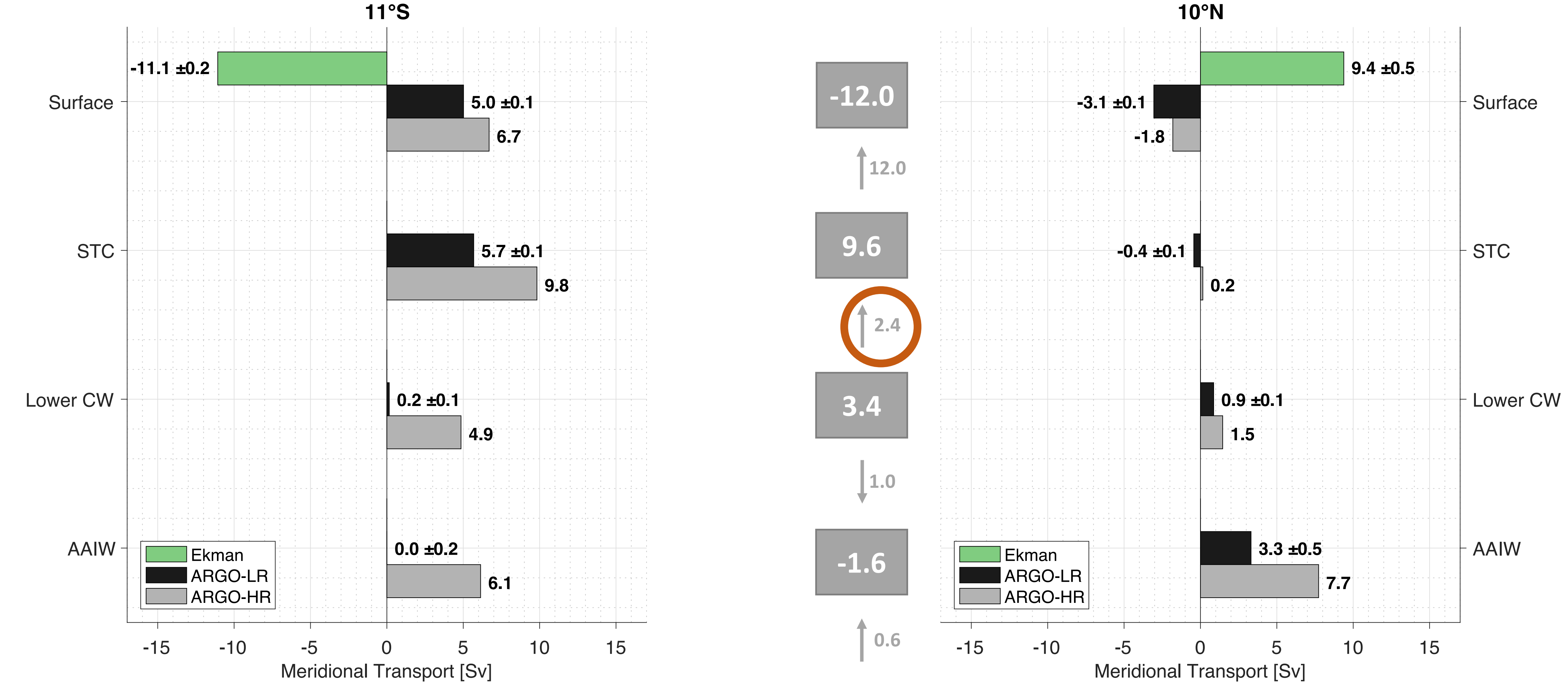

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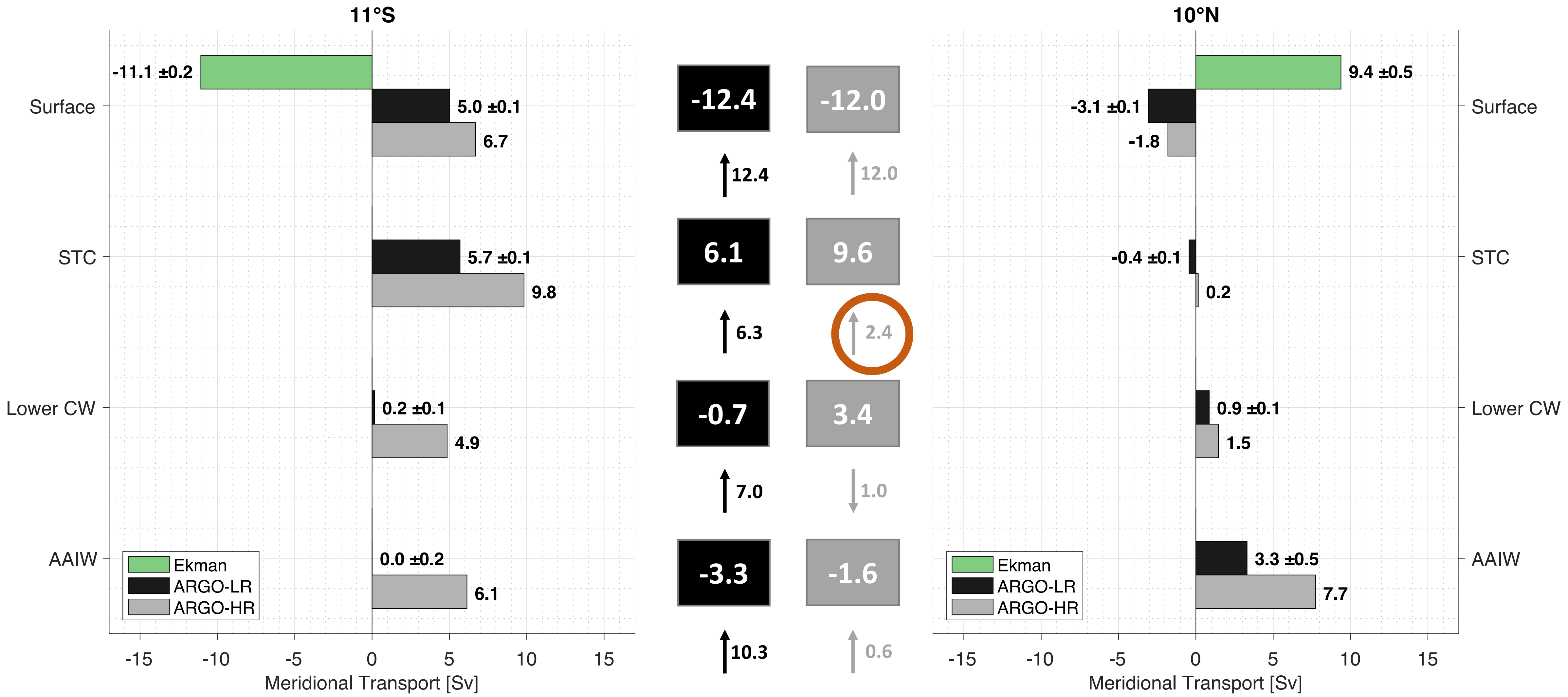

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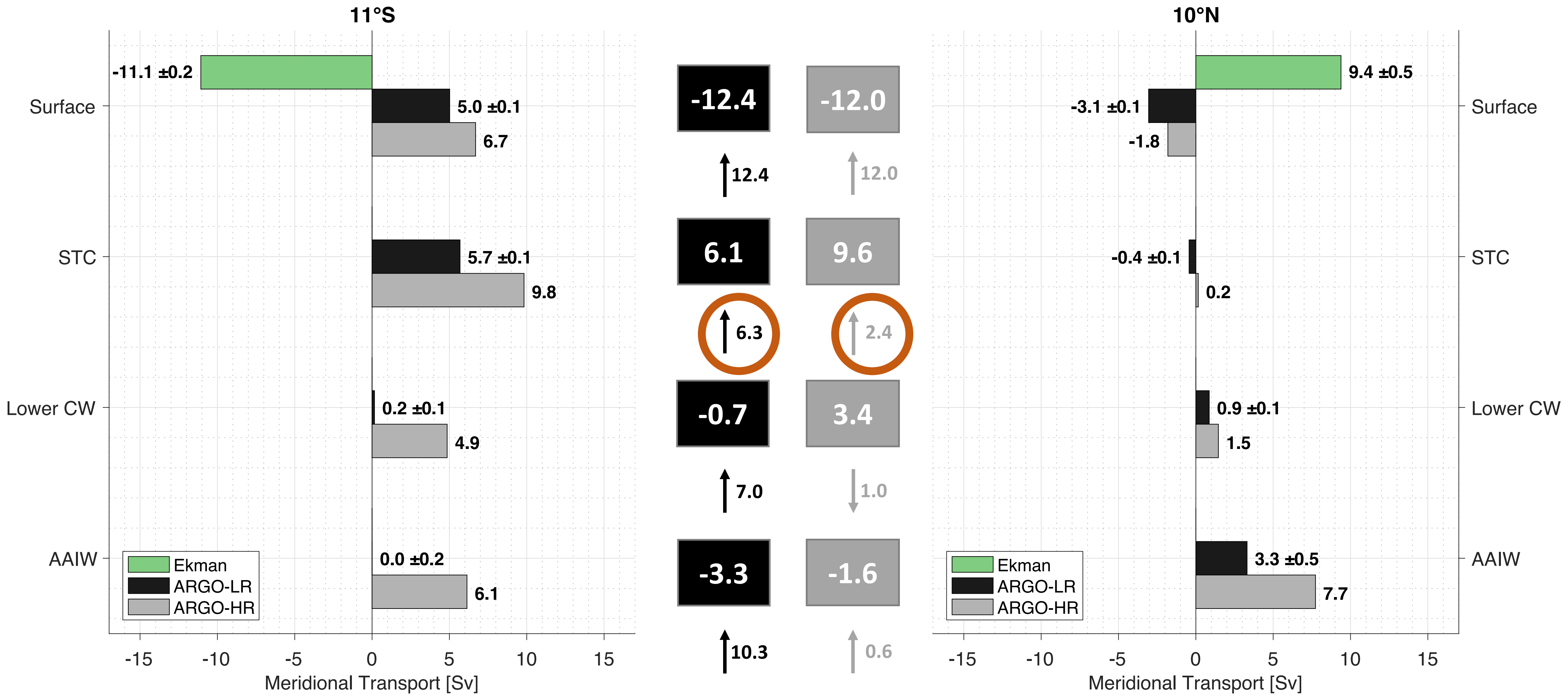

Tropical Pathways of the AMOC return flow

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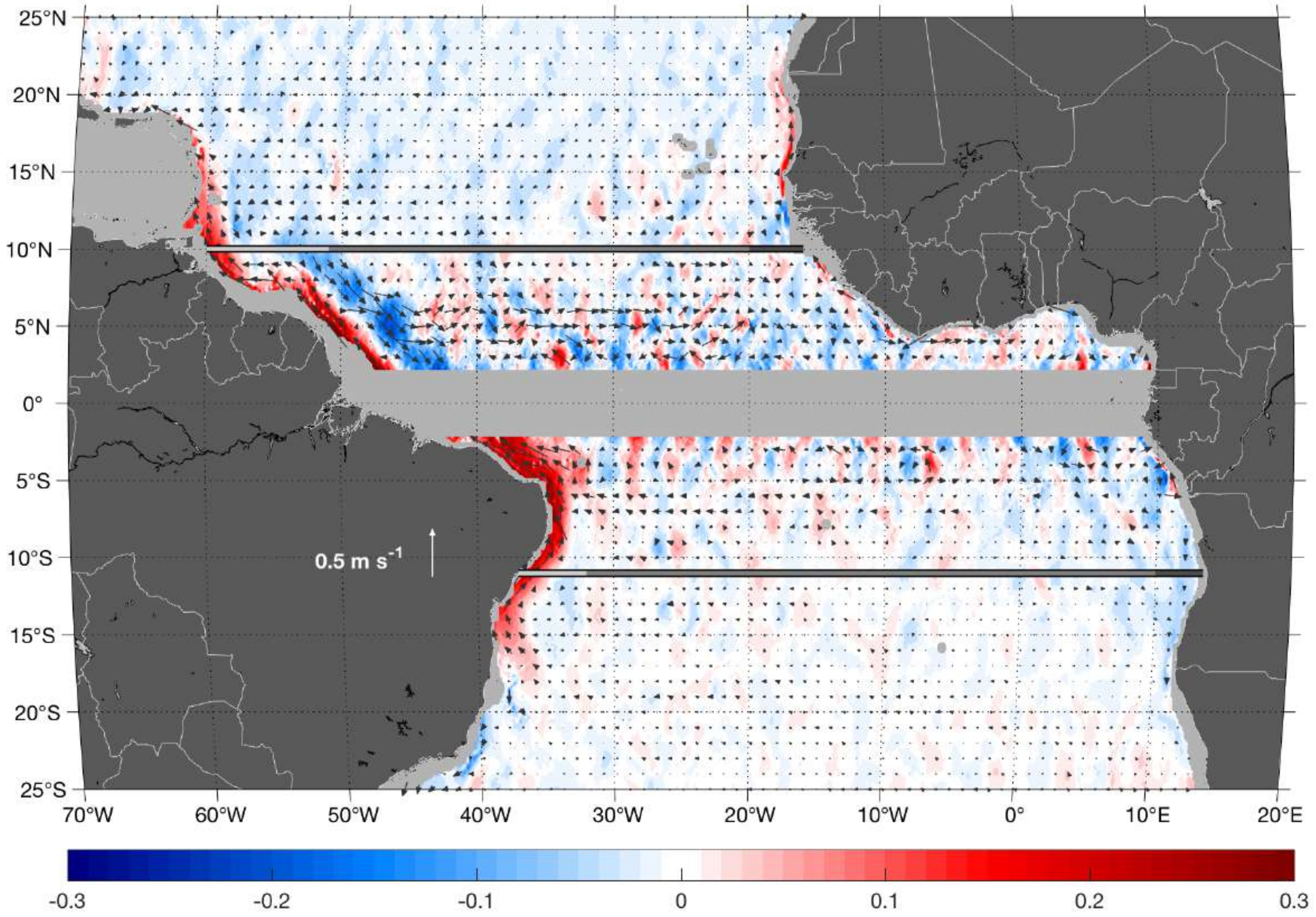

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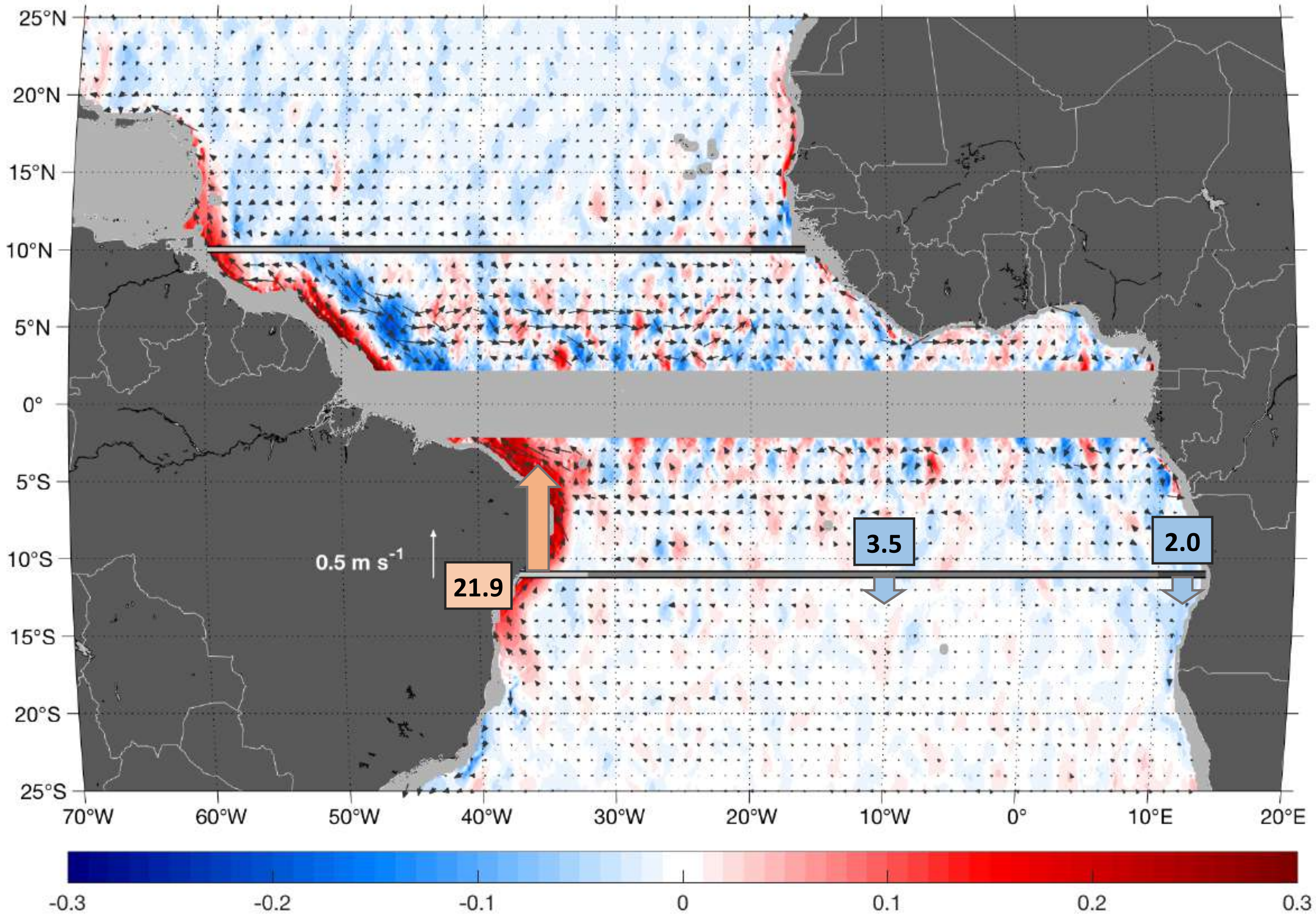

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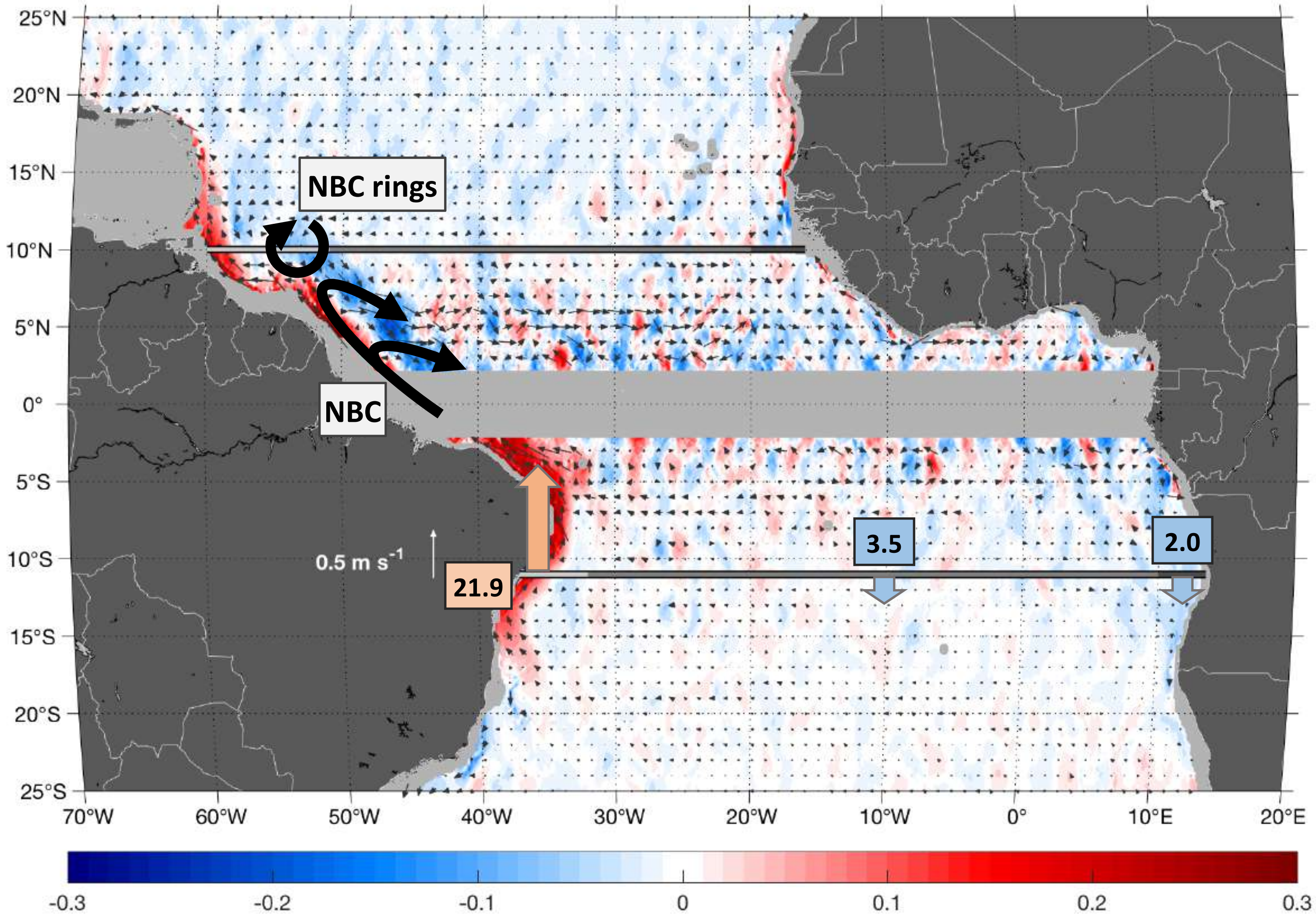

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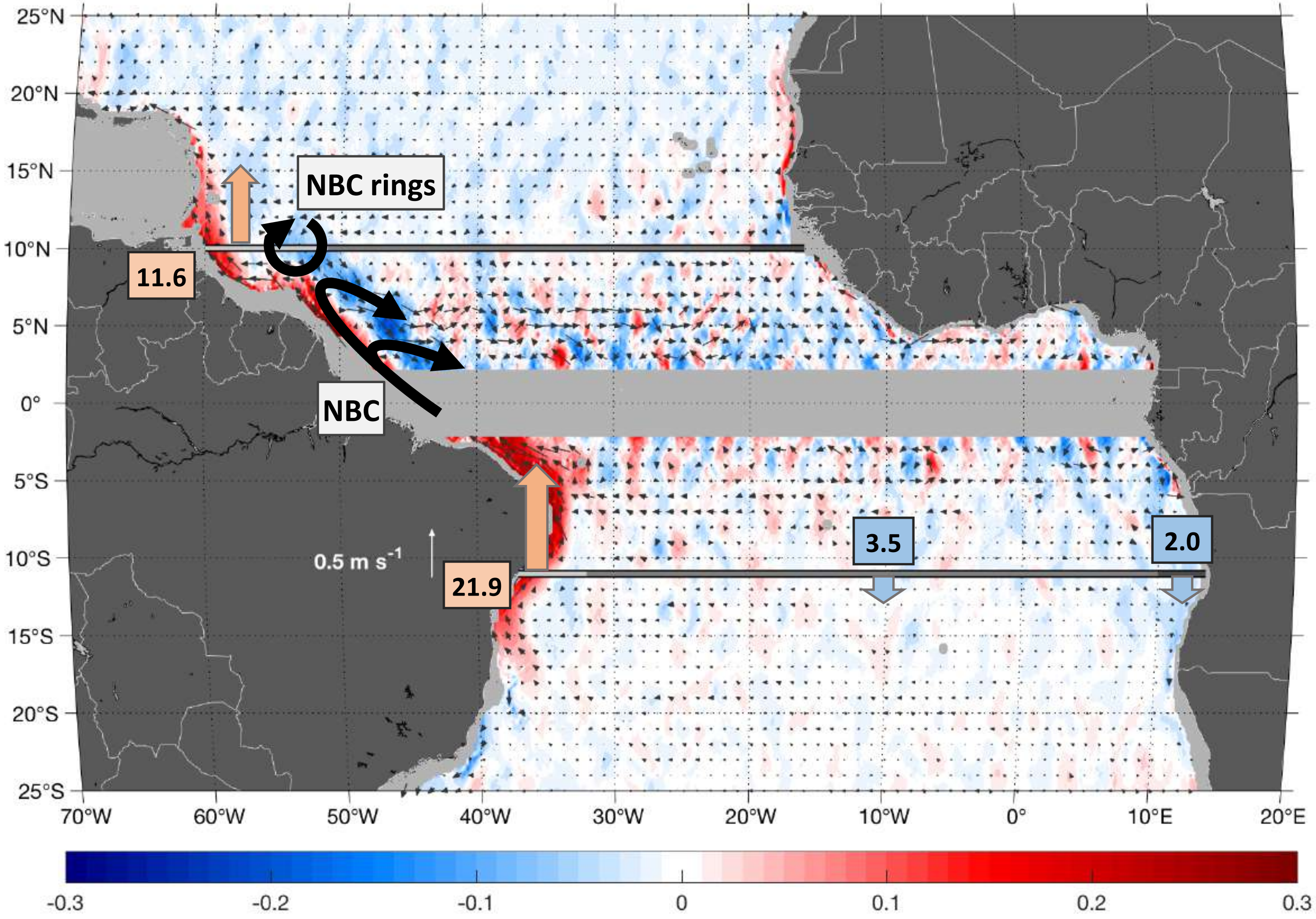

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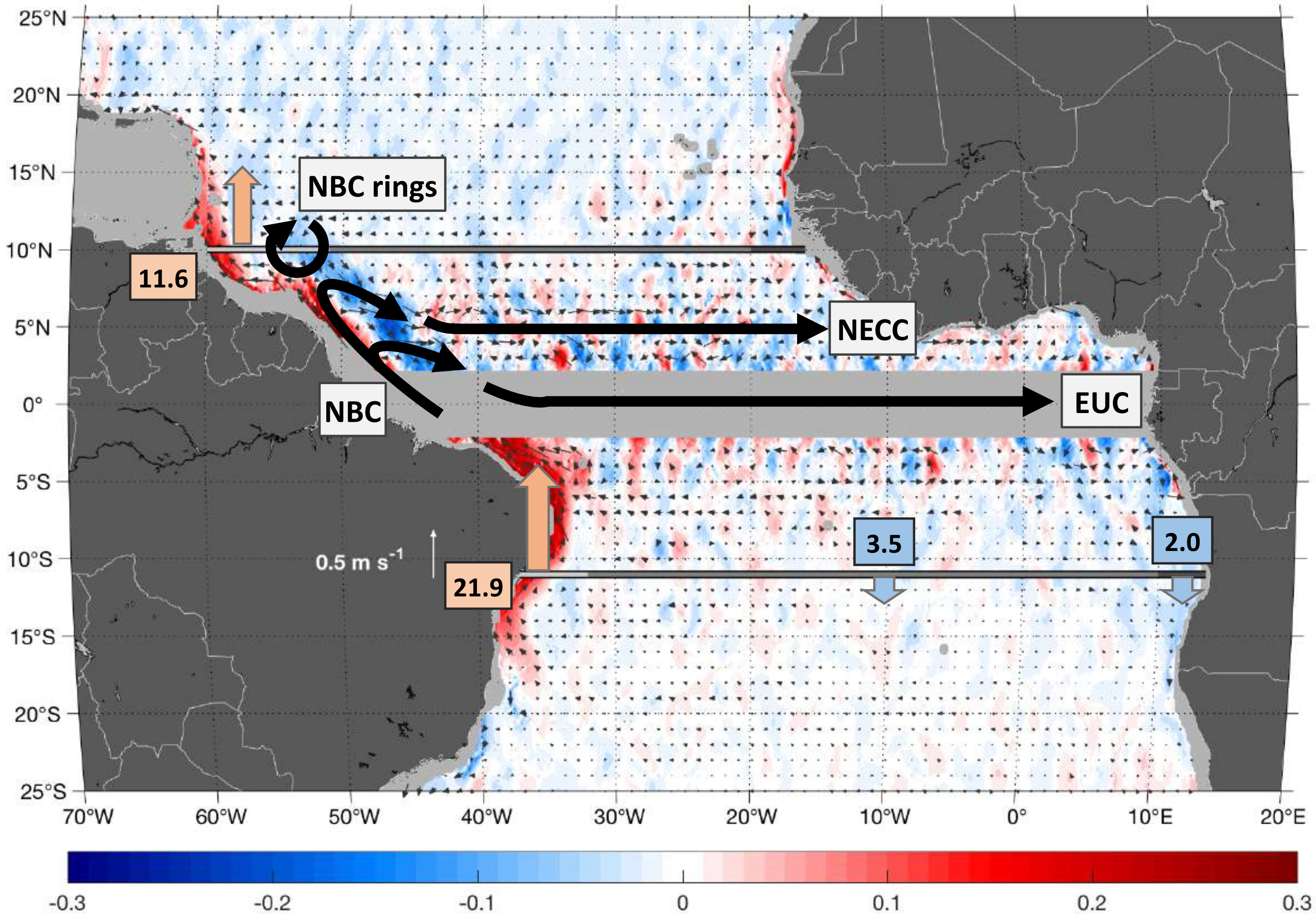
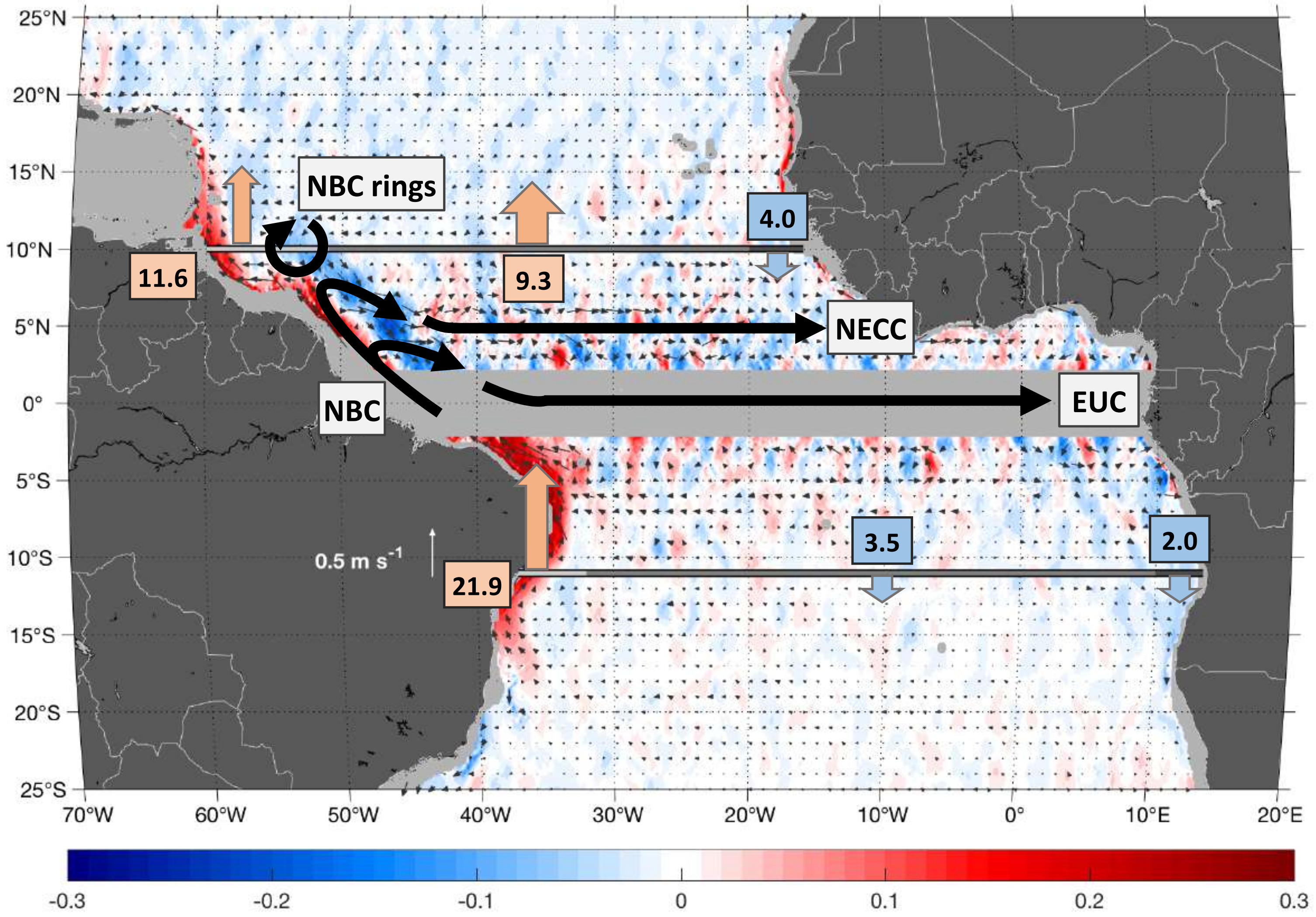


Tropical Pathways of the AMOC return flow

- Meridional flow averaged for water mass layers of the AMOC return flow:

- ~50% via western boundary
- ~40% through interior basin



Tropical Pathways of the AMOC return flow

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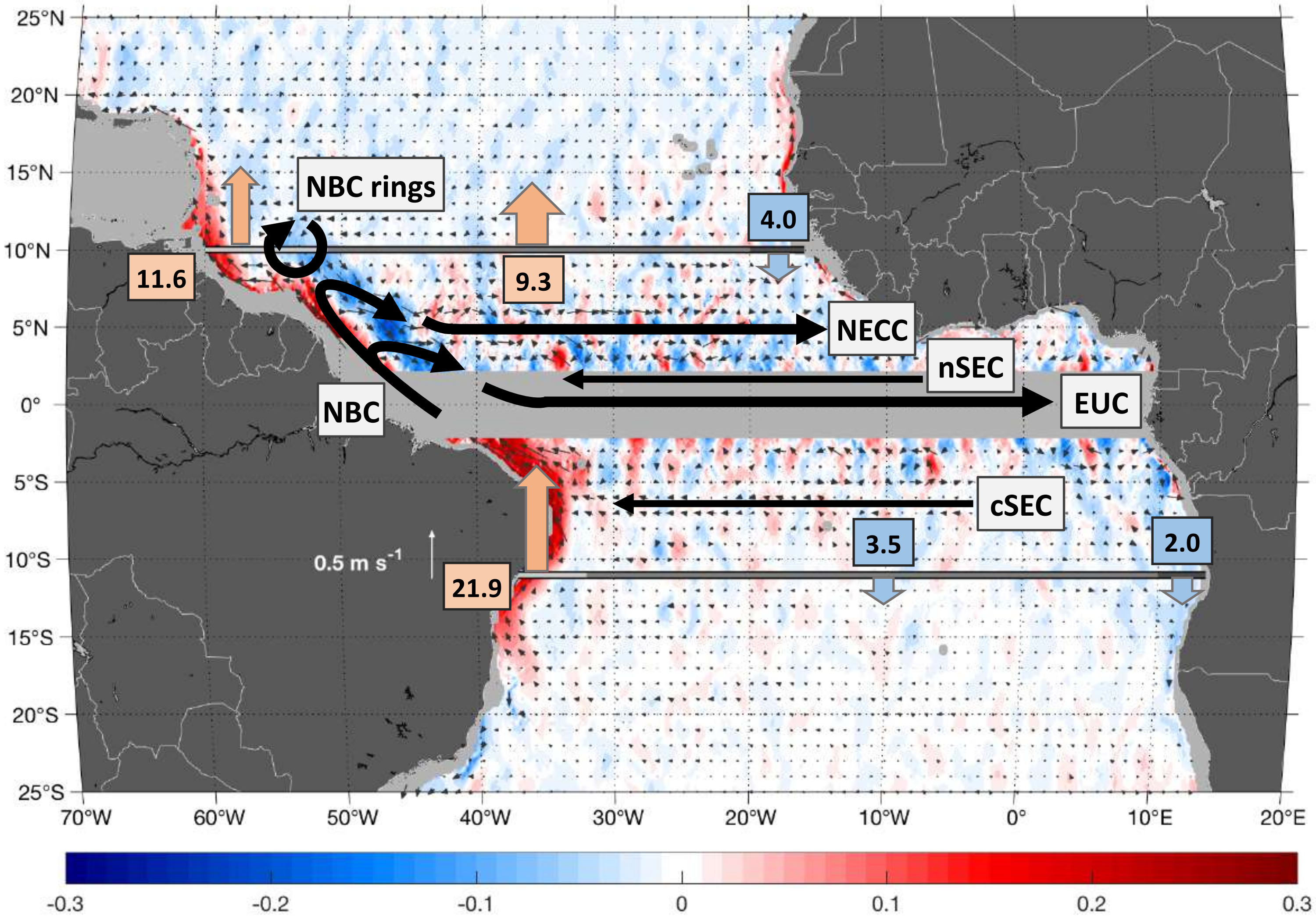
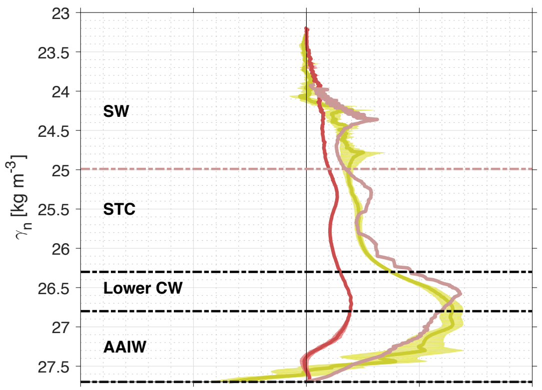
- Role of recirculation and zonal current system: Analyzing additional section data at 5°S, 35°W and 23°W



Key points

Observed Atlantic Ocean western boundary current mean transport at 11°S is realistically reproduced by high-resolution Argo float data



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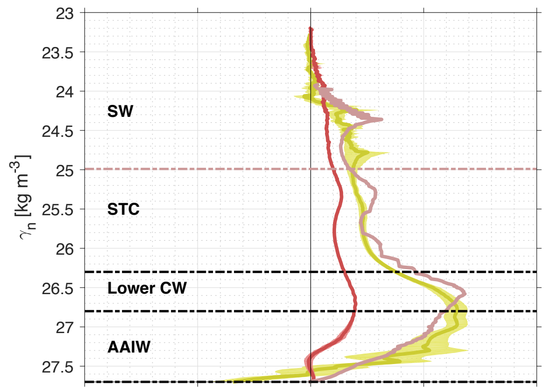

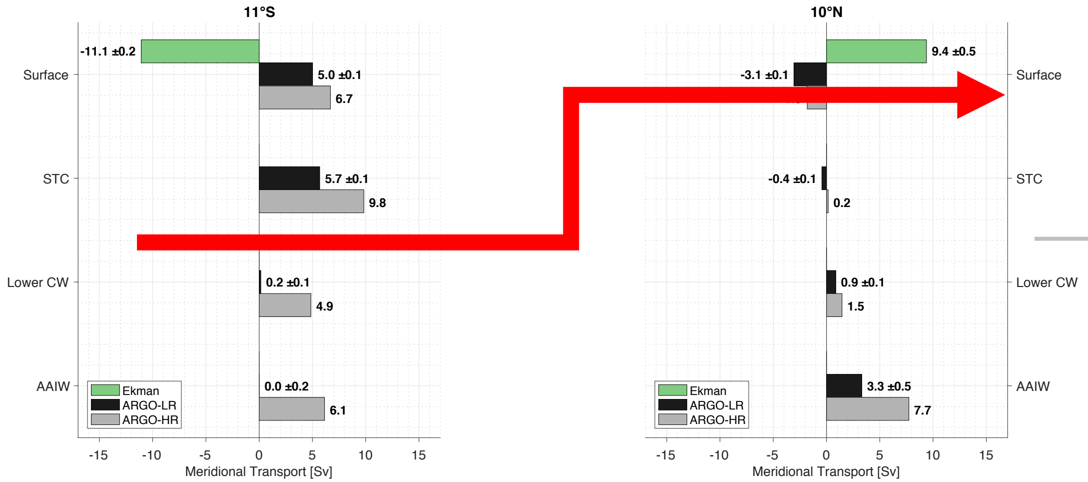

Within the tropical AMOC return flow, diapycnal upwelling into the thermocline layer (2-3 Sv) is smaller than previously estimated

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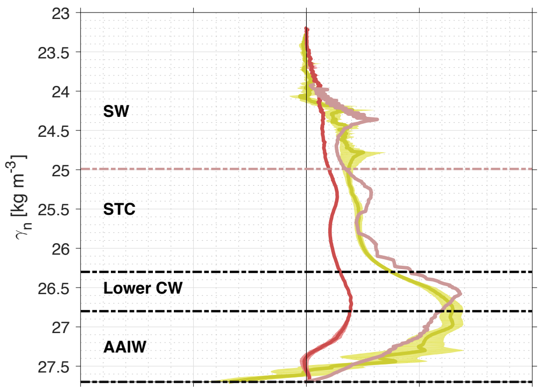
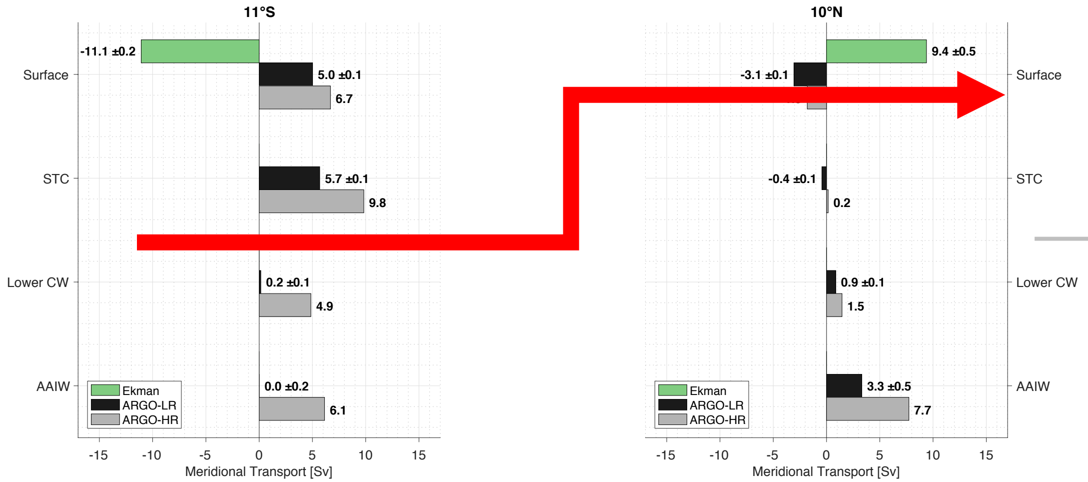
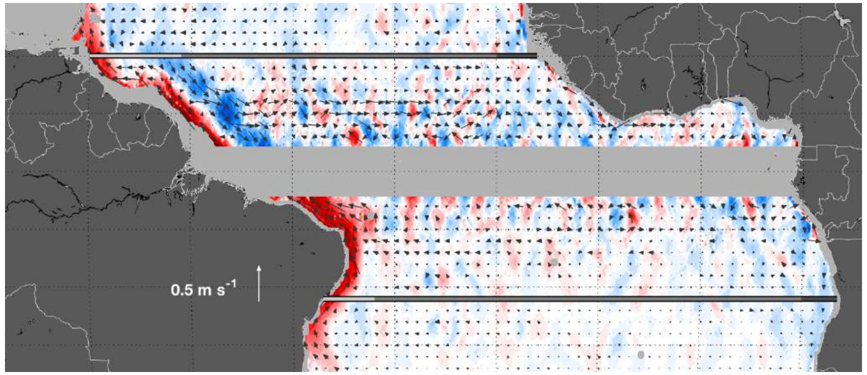




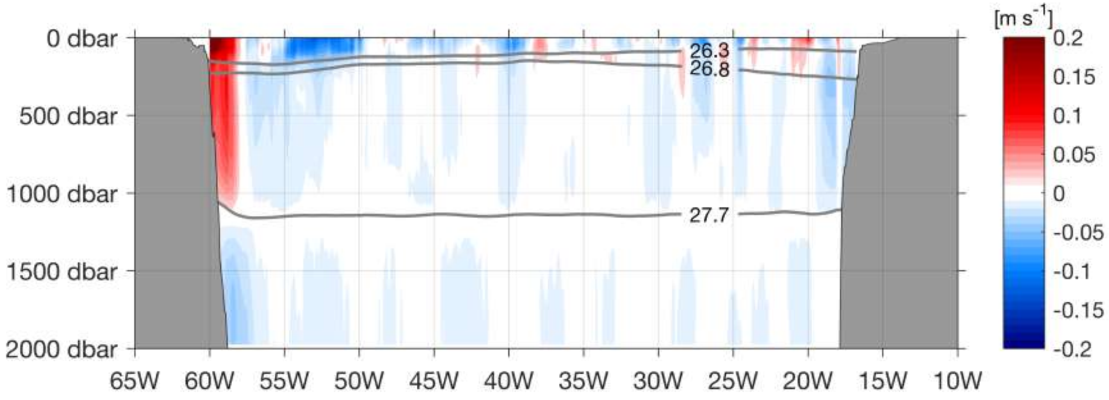
Within the tropical AMOC return flow, diapycnal upwelling into the thermocline layer (2-3 Sv) is smaller than previously estimated

At 10°N, the AMOC return flow is largely recirculated and about 50% exit the tropics at the western boundary, while 40% exit through the interior part of the basin



Appendix: Argo sections

10°N



10°S