Observed variability of AMOC transport components at 11°S

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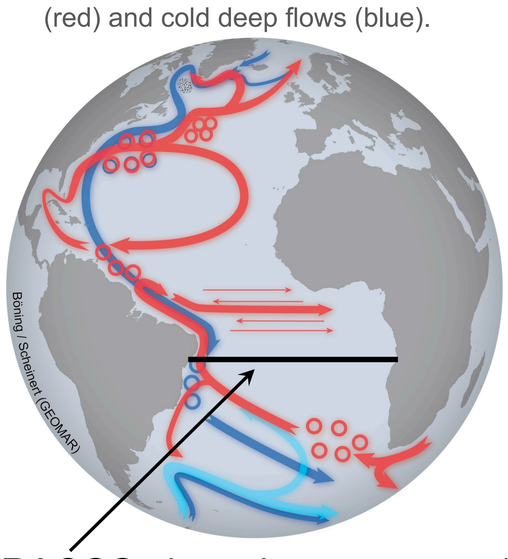
1. Introduction

Figure 1. Sketch of the Atlantic current system with the warm surface flows (red) and cold deep flows (blue).



TRACOS observing system at 11°S

- Western Boundary moorings
- Eastern Boundary mooring
- Bottom pressure recorders (BPR)
- Ship-based measurements
- Argo, Satellite SLA and wind

The zonally and vertically integrated upper-ocean meridional flow in the tropical Atlantic is associated with the upper branch of the Atlantic Meridional Overturning Circulation (AMOC),

- a key feature of the oceanic circulation which has a big impact on regional weather and global climate.
- whose characteristics and variability are crucial for deep water formation at high latitudes in the North Atlantic.

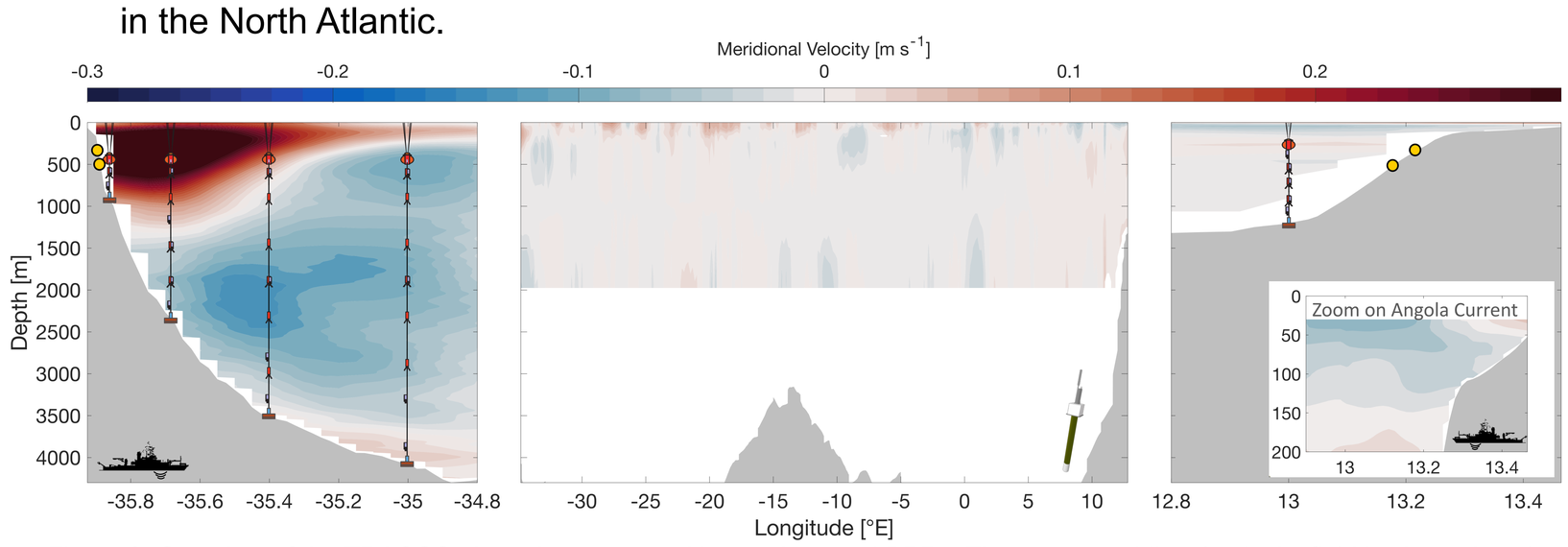


Figure 2. Overview of the TRACOS observing system with moorings and BPRs. The mean meridional velocity field is shown in colour.

2. Western Boundary (WB)

North Brazil Undercurrent Transport

- Crossroad for meridional property transfer between hemispheres
- Stable flow of 25.0 ± 0.8 Sv

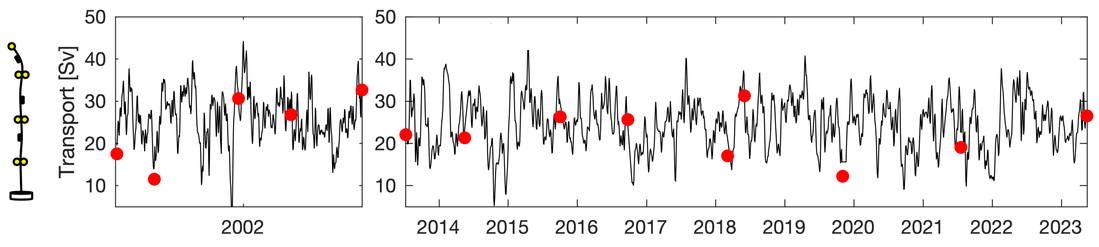


Figure 3. NBUC meridional transport time series. Ship section transports are indicated by red dots. Update from [1].

3. Eastern Boundary (EB)

Angola Current Transport

- Gateway for equatorial variability in the Benguela upwelling system
- Weak mean and variable flow [2] of -0.15 ± 0.02 Sv

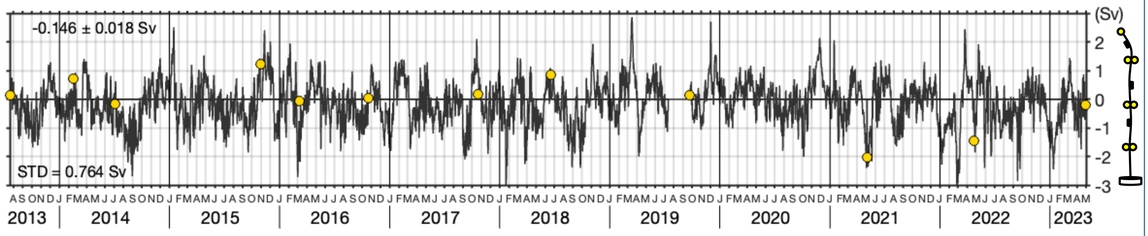


Figure 4. Angola current meridional transport time series for the upper 200 m depth. Ship section transports are indicated by yellow dots. Update from [2].

4. Basin-wide Transport (upper 1200 m)

Net transport = Geostrophic (seasonal variability + mean) + Ekman

$$T'_g(z_{BPR},t) = \frac{P'_{EB}(z_{BPR},t) - P'_{WB}(z_{BPR},t)}{\rho_0 \cdot f}$$

$$T'_g(0\,m,t) = \frac{g}{f}[\eta'_{EB}(t) - \eta'_{WB}(t)]$$

- Linear interpolation in the vertical

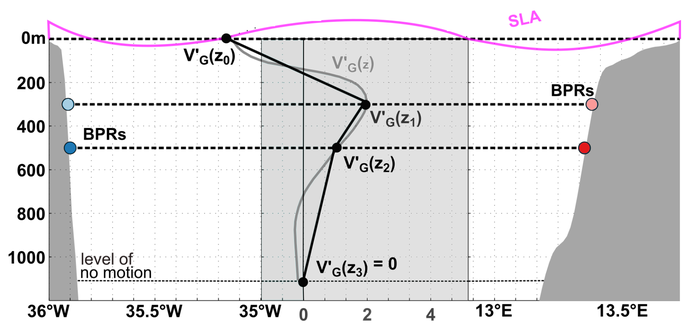


Figure 5. Sketch of the method to derive the basin-wide upper ocean geostrophic transport variability. Taken from [3].

$$\overline{T_g}(z) = \frac{1}{f}[\Phi_{EB}(z) - \Phi_{EB}(z)]$$

- Argo Römmich-Gilson Climatology 2004 – 2018, taken from [4]
- Level of no motion at 1200 m

$$T_{Ek}(t) = -\int_{WB}^{EB} \frac{\tau_x(x,t)}{\rho_0 f}\,dx$$

- ERA5 wind stress

- Ekman and geostrophic transport time series are dominated by seasonal variability [3].

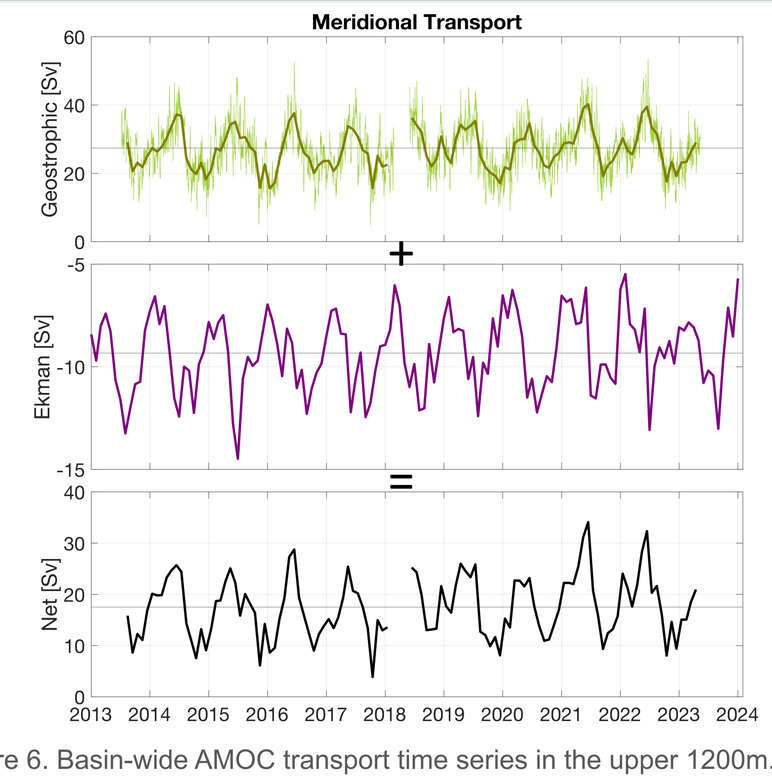


Figure 6. Basin-wide AMOC transport time series in the upper 1200m.

References

[1] Hummels et al. (2015). Interannual to decadal changes in the western boundary circulation in t he Atlantic at 11°S, *Geophysical Research Letters*, 42(18), 7615-7622, doi: 10.1002/2015GL065254.

[2] Kopte et al. (2017). The Angola Current: Flow and hydrographic characteristics as observed at 11°S, *J. Geophys. Res. Oceans*, 122, 1177– 1189, doi: 10.1002/2016JC012374.

[3] Herrford et al. (2021). Seasonal variability of the Atlantic Meridional Overturning Circulation at 11°S inferred from bottom pressure measurements, *Ocean Sci.*, 17(1), 265-284, doi: 10.5194/os-17-265-2021.

[4] Tuchen et al. (2022). Transports and Pathways of the Tropical AMOC Return Flow From Argo Data and Shipboard Velocity Measurements, *J. Geophys. Res. Oceans*, 127(2), e2021JC018115, doi: 10.1029/2021JC018115.

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5. Future work

- Comparison of AMOC transport estimates at 11°S and associated uncertainties based on different methodological approaches and data sets
- Method testing by subsampling a numerical model
- Combination of all available data sets to obtain a ‘best AMOC’ transport time series
- Analysis of AMOC variability at 11°S on different time scales and comparison to other latitudes