

Routine Reversal of the AMOC in an Ocean Model Ensemble

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Introduction

Text S1 outlines the method used in the main paper for removing the Ekman overturning streamfunction from the full AMOC overturning streamfunction.

Figure S1 shows a time series of our overturning index based on a different index than the one shown in the main text.

Text S1.

The full overturning streamfunction is given by (2) in the main body of the paper, consisting of a zonal and vertical integral of meridional velocity. A component of this overturning is in response to Ekman wind stress forcing, and high frequency variations of this forcing have been shown to result in a nearly barotropically compensated contribution. We wish to remove this to illustrate what anomalies in the overturning streamfunction remain after the Ekman effect has been accounted for. To do this, we first write at every longitude

$$v = v_e + v' \quad (S1)$$

where v is the full meridional velocity, v_e the meridional Ekman velocity and v' the residual from the Ekman velocity. The Ekman velocity is given by

$$v_e = \frac{\tau}{fh} \quad 0 > z > h \quad (S2)$$
$$v_e = 0 \text{ otherwise}$$

where τ is the wind stress, f the Coriolis parameter and h the depth of the Ekman layer. We chose a value for h corresponding to the depth of our fifth vertical gridpoint, -36.5 m, based on Jamet (2021), who showed the Ekman transport was confined to the upper few tens of meters in the North Atlantic. The Ekman mass flux is balanced with a barotropic counter flow, v_B , such that the total transport vanishes

$$v_B = \frac{-v_e h}{z_B} \quad (S3)$$

where z_B is the local depth. The results are integrated zonally over the basin and converted into a streamfunction to be removed from the full streamfunction.

References:

Jamet, Q, B Deremble, N Wienders, T Uchida and WK Dewar, On wind-driven energetics of subtropical gyres, ***Journal of Advances in Modeling Earth Systems***, 2021, doi: [10.1029/2020MS002329](https://doi.org/10.1029/2020MS002329)

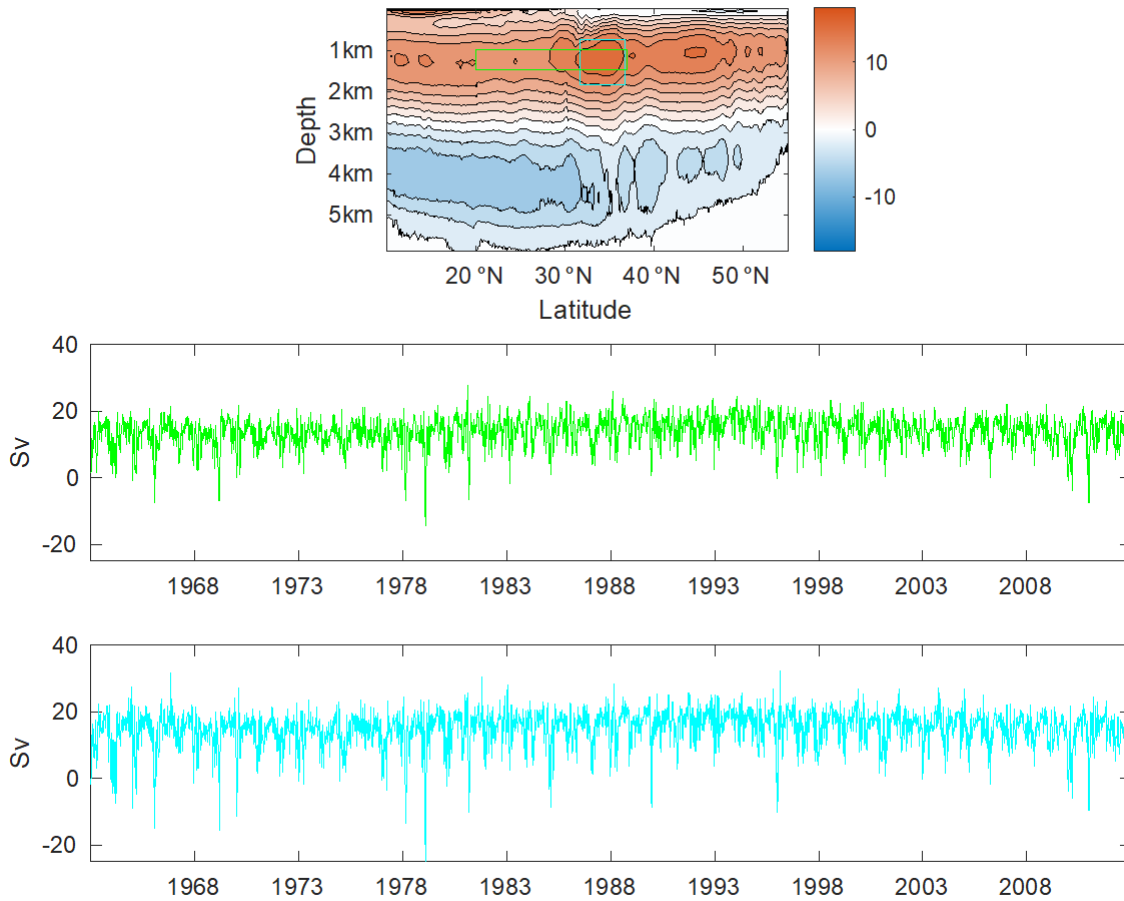


Figure S1. Comparison of AMOC indices. The top panel shows the ensemble mean and the two boxes used to develop AMOC indices. The time series from the green box appears in the middle panel and the time series from the cyan box appears in the bottom panel. The green box was chosen to span the subtropical gyre. The bottom time series is the one discussed in the main text. There are twenty-two reversals in the middle panel, as compared to 59 in the bottom panel. This is due to the greater latitudinal averaging associated with the middle panel, which incorporates areas of the gyre south of the reversal.