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Further influence of the eastern boundary on the seasonal variability of the Atlantic Meridional Overturning Circulation at 26N

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The seasonal cycle of the Atlantic Meridional Overturning Circulation (AMOC) at 26.5 N has been shown to arise predominantly from sub-surface density variations at the Eastern boundary. Here, we suggest that these sub-surface density variations have their origin in the seasonal variability of the Canary Current system, in particular the Poleward Undercurrent (PUC). We use a high-resolution ocean model (STORM) for which we show that the seasonal variability resembles observations for both sub-surface density variability and meridional transports. In particular, the STORM model simulation density variations at the eastern boundary show seasonal variations reaching down to well over 1000m, a pattern that most model simulations systematically underestimate.

We find that positive wind stress curl anomalies in late summer and already within one degree off the eastern boundary result -through water column stretching- in strong transport anomlies in PUC in fall, coherent down to 1000m depth. Simultaneously with a westward propagation of these transport anomalies, we find in winter a weak PUC between 200 m and 500m, and southward transports between 600m and 1300m. This variability is in agreement with the observationally-based suggestion of a seasonal reversal of the meridional transports at intermediate depths. Our findings extend earlier studies which suggested that the seasonal variability at of the meridional transports across 26N is created by changes in the basin-wide thermocline through wind-driven upwelling at the eastern boundary analyzing wind stress curl anomalies 2 degrees off the eastern boundary.

Our results suggest that the investigation of AMOC variability and particular its seasonal cycle modulations require the analysis of boundary wind stress curl and the upper ocean transports within 1 degree off the eastern boundary. These findings also implicate that without high-resolution coverage of the eastern boundary, coarser model simulation might not fully represent the AMOC's seasonal variability.