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Deconstructing the subtropical AMOC variability

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Mechanisms driving the North Atlantic Meridional Overturning Circulation (AMOC) variability at low-frequency are of central interest for accurate climate predictions. However, the origin of this variability remains under debate, complicating for instance the interpretation of the observed time series provided by the RAPID-MOCHA-WBTS program. In this study, we aim at disentangling the respective contribution of the local atmospheric forcing, the signal of remote origin and the ocean intrinsic dynamics for the subtropical low-frequency AMOC variability. We analyse for this a set of four ensembles of a regional (20^{o}S - 55^{o}N), eddy-resolving (1/12^{o}) North Atlantic oceanic configuration, where surface forcing and open boundary conditions are alternatively permuted from fully varying (realistic) to yearly repeating signals.

The analysis of the four ensemble mean AMOCs reveals predominance of local, atmospherically forced signal at interannual time scales (2-10 years), while signals imposed by the boundaries imprint at decadal (10-30 years) time scales. Due to this marked time scale separation, we show that most of the subtropical AMOC forced variability can be understood as a linear superposition of these two signals. Analyzing the ensemble spread of the four ensembles, we then show that the subtropical AMOC is also characterized by an intrinsic variability, which organizes as a basin scale mode peaking at interannual time scales. This basin scale mode is found to be weakly sensitive to the surrounding forced signals, suggesting no causal relationship between the two. Its spatio-temporal pattern shares however similarities with the atmospherically forced signal, which is likely to make the attribution from a single eddy-resolving simulation, or from observations, more difficult.