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Forced and intrinsic interannual AMOC variability : an OGCM-based frequency-latitude analysis

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Two eddy-permitting (1/4°) global ocean/sea-ice simulations are used to investigate the interannual variability of the Atlantic Meridional Overturning Circulation (AMOC). The 50-year simulation, driven by a reanalyzed forcing containing the full range of atmospheric timescales, provides a realistic AMOC variability over a wide range of timescales. The 327-year simulation, only forced by a seasonal atmospheric cycle, also generates low-frequency AMOC variability, which is therefore of intrinsic origin.

The intrinsic low-frequency AMOC variance is estimated, and compared to that in the fully-forced simulation. We show that the intrinsic component is maximum at the latitude of the Gulf Stream. Its contribution to the actual AMOC standard deviation is largest (above 60%) in the Agulhas region, i.e. where inter-basin exchanges are largely modulated by a chaotic mesoscale activity (e.g. Biastoch et al., 2008; Hirschi et al., 2012).

We then investigate the spectral characteristics of the fully-forced and intrinsic AMOC variability at each latitude. The fully-forced AMOC variability clearly exhibits dominant timescales (between 3 and 8 years) depending on the latitudinal range considered. In most regions, we show that similar peaks are actually present in the intrinsic AMOC variability spectra, despite a smaller magnitude, and frequent occurences of frequency shifts between both simulations. The spectral analysis of intrinsic AMOC variability is finally extended over 256 years, and yields a description of internal, multi-decadal variability throughout the whole Atlantic.

Biastoch, A., Böning, C. W., Lutjeharms, J. R. E., 2008: Agulhas leakage dynamics affects decadal variability in Atlantic overturning circulation. Nature, 456, 489-492, doi: 10.1038/nature07426.

Hirschi, J. J.-M., Blaker, A. T., Sinha, B., Coward, A., de Cuevas, B., Alderson, S., and Madec, G.: Chaotic variability of the meridional overturning circulation on subannual to interannual timescales, Ocean Sci. Discuss., 9, 3191-3238, doi:10.5194/osd-9-3191-2012, 2012.