Response of AMOC Variability under $4{\times}CO_2$ conditions

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The variability of the Atlantic Meridional Overturning Circulation (AMOC) not only differs between different models, but can be considerably different in the same model under different CO_2 scenarios. We look at AMOC decadal variability in GFDL ESM2M in both the preindustrial control and $4{\times}CO_2$ conditions. In the former, there is a strong peak in the power spectrum of variability at both 26°N and 45°N. However, in the high-CO_2 case, there is no spectral peak at 26°N, and a much reduced spectral peak at 45°N (see Figure 1 below), while at 60°N there is a spectral peak that was not present in the pre-industrial control case. Understanding these differences is important for understanding the impact of AMOC on the atmospheric state under future climate change, as well as giving more insight into the physics underlying AMOC variability. A key question is whether the difference in characteristics of variability is due to a shift in the internal ocean dynamics due to the change in the mean state, or due to a change in the stochastic forcing of the AMOC. We use frequency-domain transfer function analysis to evaluate individual processes relevant to AMOC variability and distinguish between shifts in the dynamics and shifts in the forcing.

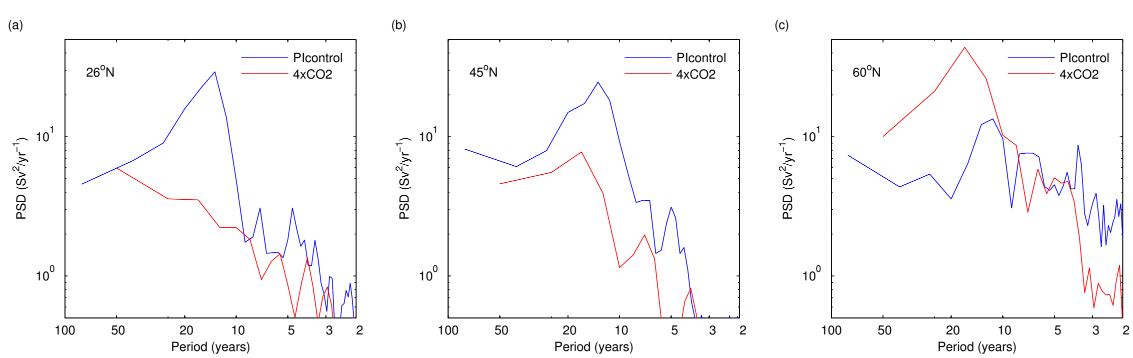

Figure 1: Power spectrum of AMOC variability in GFDL ESM2M at (a) 26°N, (b) 45°N, and (c) 60°N, for pre-industrial control run, and $4{\times}CO_2$.