

Frequency domain analysis of AMOC variability mechanisms

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The dynamics of AMOC vary considerably between different climate models; for example, some models show clear peaks in their power spectra at multi-decadal frequencies, while others do not, with various mechanisms having been proposed to explain these differences. In order to better understand these frequency-dependent differences between different GCMs, we use transfer functions to look at individual process representations in the frequency domain. We explore two particular proposed mechanisms for explaining inter-model differences in AMOC variability: differences in Labrador sea stratification, and excitation by westward propagating subsurface Rossby waves. Increased Labrador sea stratification reduces the penetration of surface forcing to depth; however, by resolving this process in the frequency domain, we do not see evidence that suggests that differences in the stratification are responsible for the presence or absence of spectral peaks in AMOC variability. The Rossby-wave mechanism has been suggested for explaining spectral peaks in AMOC. We find that an east-west subsurface temperature gradient related to such propagating waves is not more effective at exciting AMOC variability than a comparable unrelated temperature anomaly, nor more effective at exciting AMOC in GFDL CM2.1 (which has a spectral peak in AMOC variability) than in CCSM4 (which does not). However, the power spectrum of this subsurface temperature gradient indicates that it is itself preferentially excited at a 20-year period in GFDL CM2.1 relative to CCSM4, indicating that this mechanism may indeed play a role.