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Frequency-domain analysis of forced versus intrinsic variability in a quasi-geostrophic coupled ocean-atmosphere model

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Currently there is great interest in diagnosing intrinsic versus forced contributions to low-frequency variability in the climate system. In this study, we investigate variability in the ocean-atmosphere system in the frequency domain, using the Quasi-Geostrophic Coupled Model (QGCM). The model is a simplified box ocean coupled to a channel atmosphere via mixed layers that allow for the vertical exchange of heat and momentum across the ocean-atmosphere boundary. In the frequency domain, we compute spectra and spectral transfers, the latter indicating the relative importance of forced versus intrinsic contributions to the maintenance of low-frequency variability. We run the model in three different cases: a variable ocean under a fixed atmospheric wind stress, a variable atmosphere subject to fixed ocean surface temperatures, and the fully coupled regime. This analysis on a simplified model provides useful insight into the source of nonlinearities within the climate system, and will be a helpful tool in future studies using more complex models.