Frequency-domain analysis of forced versus intrinsic ocean surface kinetic energy variability in GFDL's CM2-O Model Hierarchy

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Abstract

Low-frequency variability at the ocean surface can be excited by both external forcing, such as atmospheric exchanges of heat and momentum, and through the intrinsic nonlinear transfer of energy between ocean eddies. Recent studies have shown that nonlinear eddy interactions at short timescales can excite an energy transfer from high to low frequencies similar to the transfer of energy from smaller to larger spatial scales in two-dimensional urbulence. Because the spatial inverse cascade is driven by oceanic eddies, the process of energy exchange across frequencies may be sensitive to ocean model resolution. We use a cross-spectrum diagnostic applied to GFDL's CM2-O hierarchy of fully coupled ocean-atmosphere models to address the transfer of ocean surface kinetic energy between high and low frequencies. The cross-spectral diagnostic informs us about the relative contributions of external forces (such as wind stress) and the intrinsic advection to low-frequency ocean surface kinetic energy. Diagnostics of energy flux and transfer within the frequency domain are compared between three coupled models with horizontal ocean resolutions of 1, 1/4th, and 1/10th degree to address the importance of resolving eddies in the driving of energy to low frequencies in coupled models. Preliminary results on the signature of coupled atmosphere-ocean heat budgets in the frequency domain may also be discussed.

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