Abstract View

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The Resonant Response of Interannual Baroclinic Rossby Waves to Wind Forcing in the Eastern Midlatitude North Pacific

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ABSTRACT

During the four year period 1976–80, mesoscale anomalies of 300 m temperature in the eastern midlatitude North Pacific were observed propagating westward from the coast of North America to 165°W at approximately 2 cm s^{-1}, with characteristics similar to baroclinic, nondispersive Rossby waves. These mesoscale anomalies had a dominant period scale of approximately two years and a dominant wavelength scale of approximately 1000 km. In this study, a baroclinic, nondispersive Rossby wave model is driven by the observed wind stress curl in an attempt to simulate the amplitude and phase of these observed mesoscale anomalies over this period of time. Model/data intercomparison finds the frequency/zonal wavenumber spectra of model 300 m temperature to be similar in pattern to that observed for waves of periods greater than one year, with peak spectral energy density in both occurring at zonal wavelengths of 1000–1200 km and periods of 2–3 years. These spectral peaks occur on the Rossby wave dispersion curve at the frequency/wavenumber location where peak spectral energy density occurs in the wind-stress curl spectrum. Coherence between model and observed mesoscale anomalies is maximum at the frequency/wavenumber location of these spectral peaks, significant at the 70% confidence level, with approximately 0° phase difference. The response functions in frequency/wavenumber space of both model ocean and real ocean are nearly identical in pattern for periods greater than one year, with maximum values located along the Rossby wave dispersion curve. Therefore, a resonant response of the baroclinic, nondispersive, Rossby waves to the wind stress curl is indicated. These resonant waves begin at the coast of North America and propagate westward with amplitude increasing linearly. The zonal profile of rms differences of observed mesoscale anomalies from 125–165°W is very similar to the model profile, the latter dominated by the resonant response which explains 60–90% of the total model response. The off-resonant model response is small, even though the wind strew curl variability is largest at off-resonant frequencies and wavenumbers. In the real ocean the off-resonant response is much larger than in the model, with the largest off-resonant response occurring in the dispersive portion of the spectral domain where the model is not applicable. This, together with white noise in both model and observed data, accounts for the model's inability to explain more than 20% of the total observed mesoscale variance.

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