Abstract View

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Nonequilibrium Response of the Global Ocean to the 5-Day Rossby–Haurwitz Wave in Atmospheric Surface Pressure

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ABSTRACT

The response of the global ocean to the surface pressure signal associated with the well-known 5-day Rossby–Haurwitz atmospheric mode is explored using analytical and numerical tools. Solutions of the Laplace tidal equations for a flat-bottom, globe-covering ocean, point to a depth-independent nonequilibrium response related to the near-resonant excitation of the barotropic oceanic mode. Numerical experiments with a shallow-water model illustrate the effects of realistic continental boundaries, topography, and dissipation on the solutions. The character of the oceanic adjustment and the structure of resonances changes substantially, but a nonequilibrium response occurs in all cases studied. Besides the excitation of large-scale vorticity modes or waves, which becomes less important when topography and strong dissipation are present, basin-scale nonequilibrium signals are associated with gravity wave dynamics and the process of interbasin mass adjustment in the presence of global-scale forcing and continents that require interbasin mass fluxes to occur through the Southern Ocean. Solutions with forcing most representative of the observed atmospheric wave agree qualitatively with the results of analyses of Pacific and Atlantic tide gauge records by Luther and Woodworth et al. The observed nonequilibrium signals thus seem related to the Rossby–Haurwitz forcing mode.

top

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