Abstract View

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Instability Waves in the Equatorial Atlantic Ocean

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ABSTRACT

Evidence is presented for the generation of planetary waves by barotropic instability within the cyclonic shear region of the Atlantic Ocean's South Equatorial Current (SEC). Immediately following the springtime intensification of the southeast trade wind, which accelerates the SEC westward, a packet of waves with central periodicity of around 25 days is observed lasting for about three cycles. Independent wavenumber analyses on 1983 and 1984 data give newly identical zonal wavelengths and phase speed estimates of around 1100 km and −50 cm s^{-1}. The waves are anisotropic and spatially inhomogeneous with generation confined primarily to the mixed layer.

An energetics analysis using 1983 data centered upon the equator at 28°W shows a rapid increase in total perturbation energy (TPE) reaching values of 2000 erg cm^{-3} within two weeks. The subsequent decrease in TPE at this location is due primarily to meridional pressure-work divergence. Baroclinic instability is negligible because both the meridional and zonal components are small and cancelling.

Thermodynamically, the waves effect a southward heat transport during the period when the North Equatorial Countercurrent (NECC) is most rapidly gaining heat, suggesting that the waves act to regulate the heat stored in the NECC. Also the Reynolds' heat flux convergence upon the equator appears to halt the upwelling induced cooling and to increase sea surface temperature. In 1983 this convergence was equal to the climatological atmosphere-ocean net heat flux.

Dynamically, the waves decelerate the SEC north of the equator and reduce its shear. This occur simultaneously with a deceleration of the SEC by the basinwide adjustment of the zonal pressure gradient (ZPG). The seasonal modulation of the waves is therefore a consequence of both the ZPG response to seasonally varying wind stress as well as the instability itself since both are stabilizing. The basin size and hence the ZPG adjustment time differences between the Atlantic and Pacific Oceans would thus account for the observed differences in wave season durations between these two oceans.

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