Abstract View

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Internal Wave Wake of a Moving Storm. Part I. Scales, Energy Budget and Observations

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ABSTRACT

The ocean's baroclinic response to a steadily moving storm is analyzed using a numerical model for an inviscid, multi-layered fluid. This first part of a two-part study gives a detailed account of the response to a rapidly moving hurricane, while parameter dependence is examined in the second part. A central theme of both parts is the coupling between wind-forcing, the surface mixed layer, and the thermocline.

The baroclinic response is made up of a geostrophic component and a three-dimensional wake of inertial-internal waves which is emphasized. These waves initially have large horizontal spatial scales set directly by the storm. Their along-storm track wavelength is the storm translation speed times the wave period, which is typically five percent less than the local inertial period. Their cross-track scale is the storm scale. If the storm is intense as it is here, finite amplitude effects soon produce a double inertial frequency wave and smaller spatial scales.

An important qualitative result is that the vertical penetration scale is large compared to the thermocline thickness. The initial isopycnal displacement is almost uniform through the thermocline, and the associated pressure field couples the mixed layer to the entire thermocline. Vertical energy propagation is thus very rapid new the storm track, O(100 m day^{-1}), and largely responsible for a rapid post-storm decay of mixed-layer inertial motion (*e*-folding in $\sim$5 inertial periods).

Measurements made by buoy EB-10 in the wake of Hurricane Eloise provide a semi-quantitative check on the model results. The model-computed decay of mixed-layer inertial motion and its blue shift are roughly consistent with the EB-10 measurements. A large vertical penetration scale is evident in both the measured velocity and the isopycnal displacement.

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