Abstract View

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On the Response of the Ocean to a Moving Storm: Parameters and Scales

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ABSTRACT

This paper has two purposes: One is to present a new and efficient multilevel numerical model for calculating the response of the ocean to a moving storm; the second is to show how, on a time scale of a few inertial periods following the arrival of the storm, the maximum horizontal and vertical velocities found in the wake can be calculated using a linear Ekman model and a knowledge of that part of the change in the depth of the wind mixed layer due to entrainment. This is demonstrated over a range of experiments with the multilevel numerical model. These integrate the full nonlinear equations of motion with realistic ocean stratification and involve substantial entrainment of water into the wind mixed layer.

It is also shown that on this time scale, the horizontal currents are confined near the surface but that the vertical velocity field extends throughout the depth of the ocean. It is shown in Appendix B that the wind forcing need only be "large" or "fast" for the forced response not to feel the effect of the ocean stratification and to extend through the depth of the ocean in this way.

The parameter which determines the horizontal structure of the response, in coordinates scaled with respect to the scale L of the storm, is $k = U/Lf$. Here U is the storm translation speed and f the Coriolis parameter. This parameter also determines the magnitude of the response, after suitable nondimensionalization.

Finally, it is shown how to apply these results to an interpretation of observations and other model results.

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