Abstract View

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Numerical Simulations of Hurricane-Generated Currents

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ABSTRACT

The work described here involves the application of a three-dimensional numerical circulation model to the hindcasting of currents generated during two storms—Tropical Storm Delia and Hurricane Anita. Reasonably high-quality current and other data were collected during these two storms and are reported in the literature. The hindcasted results of the two storms are used to assess the accuracy of the model and to explore the relative importance of the forcing mechanisms which affect water circulation during a tropical storm event. The observed currents from both data sets indicate that the bottom shear stress is much larger than the surface shear stress during the storms, implying that a forcing mechanism other than the local wind is important in driving flow during the storm. Two possible mechanisms have been suggested in the literature—flow driven by pressure gradients and unsteady flow effects created by wind waves. The circulation model is used to study the first mechanism and the results indicate that the pressure gradient is not the primary reason for the large bottom shear stress for either storm. The absence of other explanations would strongly suggest that waves are the dominant reason for the large bottom shear stress displayed in the data. Further evidence supporting this hypothesis is found by successfully using a bottom-layer wave/current model by Grant and Madsen (1980) to predict the maximum bottom shear stress that occurred during both storms. The boundary-layer model is also used to explain the difference between the bottom-friction coefficients deemed most appropriate for the two hindcasts. This latter finding suggests that including wave effects in the bottom-boundary-layer dynamics can improve current forecasts and hindcasts with the circulation model by a factor of more than 2 in shallower waters. The findings are also relevant to the majority of finite-depth circulation models.

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