Oceanic and Atmospheric Forcings of Tropical Cyclone Rapid Intensification in the Gulf of Mexico During the 2005 Atlantic Hurricane Season

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Abstract

Skill in forecasting tropical cyclone intensity has not made the same progress as track forecast skill since the National Hurricane Center (NHC) made those products available to the public. The NHC has identified predicting the onset, duration and magnitude of tropical cyclone rapid intensification (RI) events as their number one forecast priority. RI events are defined as intensification periods where the maximum sustained surface winds increase 30 kt. or more over a 24-hour period. Since current full-physics operational tropical cyclone intensity forecast models have not yet demonstrated the ability to predict RI events adequately, forecasters have relied upon statistical forecast techniques that employ larger-scale predictors in the atmosphere. This study evaluates those predictors for three hurricanes that underwent RI during the 2005 Atlantic hurricane season: Katrina, Rita, and Wilma. In addition to the statistical predictors, the interaction of deep warm waters associated with the Gulf Loop Current, as well as ocean heat content (OHC), were included to investigate the viability of including ocean predictors to increase the forecast skill for RI events..

Five predictors of RI were calculated for this study: relative humidity, vertical wind shear, sea surface temperature (SST), OHC, and 12-hour intensity change. To capture the storm environment, only data within a 200 km annulus of the storm center were included in the calculations. Results revealed that each storm underwent RI embedded in ideal conditions in the atmosphere, while interaction with the Gulf Loop Current provided additional energy to further enhance RI as the storm moved across the extremely warm waters of the Gulf of Mexico. In order to further support these findings, it is emphasized that more case studies of RI and non-RI events in the Gulf of Mexico are needed to validate these results.