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Interaction of tropical cyclone and warm ocean eddy

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Understanding the interaction of ocean eddies with tropical cyclones is critical for improving the understanding and prediction of the tropical cyclone intensity change. Here we present an investigation of the interaction between Supertyphoon Maemi (2003) and a warm ocean eddy in the Northwest Pacific Ocean based on the satellite observations, the Coupled Hurricane Intensity Prediction System, and the ocean-coupled GFDL hurricane model.

In September 2003, Maemi passed directly over a prominent (700 km × 500km) warm ocean eddy when transgressing through the 22°N-eddy-rich zone in the Northwest Pacific Ocean. Analyses of satellite altimetry and the best-track data from the Joint Typhoon Warning Center show that during the 36 h of the Maemi-eddy encounter, Maemi's intensity (in 1-minute sustained wind) shot up from 41 m s^{-1} to its peak of 77 m s^{-1}.

Based on results from the Coupled Hurricane Intensity Prediction System and satellite microwave sea surface temperature observations, we suggest that the warm eddy acts as an effective insulator between typhoon and the deeper ocean cold water. The typhoon's self-induced sea surface temperature cooling is suppressed owing to the presence of the thicker upper ocean mixed-layer in the warm eddy, which prevents the deeper cold water from being entrained into the upper ocean mixed-layer. This helped to increase Maemi's peak intensity by 1 category and to maintain Maemi's peak intensity at category-5 strength for a longer period (36-h) of time. The Coupled Hurricane Intensity Prediction System successfully captures both the 1 category increase of peak intensity and intensity sustention. When running a hindcast using the Coupled Hurricane Intensity Prediction System with the incorporation of the eddy information, an evident improvement on Maemi's intensity evolution is achieved. Without the presence of warm ocean eddies, rapid intensification still takes place, though of less magnitude. This study can serve as a starting point in the largely speculative and unexplored field of typhoon-warm ocean eddy interaction in the Northwest Pacific Ocean. Given the abundance of ocean eddies and intense typhoons in the Northwest Pacific Ocean, these results highlight the importance of a systematic and in-depth investigation of the interaction between typhoons and Northwest Pacific Ocean eddies. The new results based on the ocean coupled GFDL hurricane model will also be shown in the conference.