Tropical Cyclone Induced Tornados Associated With The Formation of Tropical Storm Barry

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On 1 June 2007, Tropical Storm Barry formed in the southeastern Gulf of Mexico. The Florida Keys and South Florida were located in the northeast quadrant at a range of 200 to 400 km from the center of the storm. As the tropical storm was developing, a quasi-stationary weak convergence boundary, with baroclinic characteristics, formed across the waters of the Florida Straits, the islands of the Florida Keys, and South Florida. Analysis showed steep instability and wind shear gradients along this convergence zone. During the day and into the evening hours, convective rain bands developed across the Florida Straits and moved northwest into the Florida Keys and the South Florida Peninsula. These convective bands moved across the convergence boundary in an environment of low CAPE and very high helicities, with most of the shear concentrated below 1 km. The result was mini supercell activity during the afternoon and evening along the Florida Keys and coastal waters, and into the extreme southern sections of the South Florida peninsula. Two tornado touchdowns were confirmed, with an EF-0 on Sugarloaf Key in the Florida Keys, and an EF-1 in the city of Cutler Ridge in southeastern Miami Dade County in South Florida. Other mini supercells were identified on radar but moved through unpopulated areas or over the open waters.

This paper presents an analysis of the pre-storm as well as storm environment in the context of past research. In addition to the aforementioned boundary, the analysis revealed a near-storm environment with helicities in excess of 300 m^2 sec^{-2}, and CAPE values in the 500 J kg^{-1} range; typical of mini supercell environments associated with tropical storms. In the storm scale, mini supercells exhibited classical comma head, or "kidney bean" shaped signatures, with the mesocyclones persisting over an hour in some instances. The mesocyclones extended vertically to near 3.5 km, with rotational velocities fluctuating near 15 knots and shear values exhibiting the same behavior around 7 x 10^{-3} sec^{-1}. Their horizontal scales were typically no more than 1.5 nautical miles which challenged the WSR-88D detection algorithms. The analysis also showed a correlation between increasing spectrum width values of 15-20 knots or greater at the lowest elevation, and the other elements associated with the core of the small circulations. This event and the analysis presented here highlight the importance of using manual mesocyclone detection techniques and multilevel base data to conduct proper storm scale analysis, as well as the importance of conducting near storm environment analysis with the aim of increasing situational awareness.