15A.6 REGIONS OF INTENSE CONVECTION IN THE CORE OF MINIMAL TROPICAL CYCLONES

Daniel E. Lipper*
State University of New York at Albany
Albany, New York

1. INTRODUCTION

Gentry (1970), in his study of Hurricane Gladys (1968), became one of the first to research an intense convective burst within the core of a minimal tropical cyclone. He referred to the feature as a Circular Exhaust Cloud (CEC), and hypothesized that convergence near the storm center associated with this feature, was important in the strengthening of Gladys. Black (1983) researched similar events, calling them supercells. He generally found them to occur anywhere from 25 to 150 km from the center of circulation.

This research has goals of identifying what determines the quadrant in which these outbreaks occur, and why they develop when they do.

2. DATA AND METHODOLOGY

Cloud to ground lightning flash data from the National Lightning Detection Network (NLDN) were used to pinpoint convective outbreaks within the cores of four tropical cyclones: Bob (1985), Dean (1995), Bertha (1996), and Harvey (1999). Gridded analyses from the European Centre for Medium Range Weather Forecasts (ECMWF) were used to calculate vertical wind shear values in these same storms. Best track data were obtained from the National Hurricane Center (NHC) for determining the proximity of lightning flashes to the positioned storm centers.

Each storm studied contained an intense period of convection within its core (r < 100km). At the time of the outbreak, only Bertha was of hurricane status, while the other three were tropical storms. For the purposes of this research, an outbreak was defined as the occurrence of 100 or more core flashes in an hour, for at least two consecutive hours. If an hour with fewer than 100 strikes existed between outbreaks, the entire time period was considered.

3. RESULTS

Figure 1 shows the lightning outbreak in Tropical Storm Bob, along with NHC positioned storm centers during the outbreak. The vertical wind shear vector is plotted, as well as the locations of Naples and Everglades City. Respectively, these cities received rainfall rates of 30cm and 55 cm during the time of the outbreak, which featured 200 or more core strikes in eleven consecutive hours. Figure 2 displays Tropical Storm Harvey's lightning outbreak, along with storm center locations and vertical shear vectors. Higher time resolution ECMWF grids allowed for 6-hourly shear calculations during Harvey. A more sensitive NLDN is partly responsible for the significantly higher count of positive strikes, some of which are thought to be intracloud flashes. Although Harvey's outbreak did not last as long as the one in Bob, it did peak with over 1,900 strikes confined to a relatively small area in one hour.

The main convective episodes exhibited a strong downshear preference. This is consistent with Corbosiero and Molinari (2001), who for the storms they studied, found that over 90% of the lightning strikes occurred in the downshear quadrants, provided a wind shear magnitude of 5 m/s or greater. In the cases studied here, the storm motion vector was directed to the left of the shear vector, with a separation of typically between 45 and 90 degrees. This orientation sets up a preferred area for ascent in the right front quadrant with respect to storm motion (Shapiro, 1983) and downshear or downshear left.

In the talk, the conditions that favor intense convective cells in the core of tropical cyclones will be examined. The role of such outbreaks in tropical cyclone intensity change will be discussed.

4. ACKNOWLEDGEMENTS

This work was supported by National Science Foundation Grant ATM0000673, Office of Naval Research Grant N00014-98-1-0599, and under the advisement of Dr. John Molinari. Programs used to plot lightning data and calculate ECMWF data were provided by Dave Vollaro, Paul K. Moore, and Steven Skubis.

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**Corresponding author address*: Daniel E. Lipper, Department of Earth and Atmospheric Sciences, State University of New York at Albany, Albany, NY 12222. e-mail:lipper@atmos.albany.edu

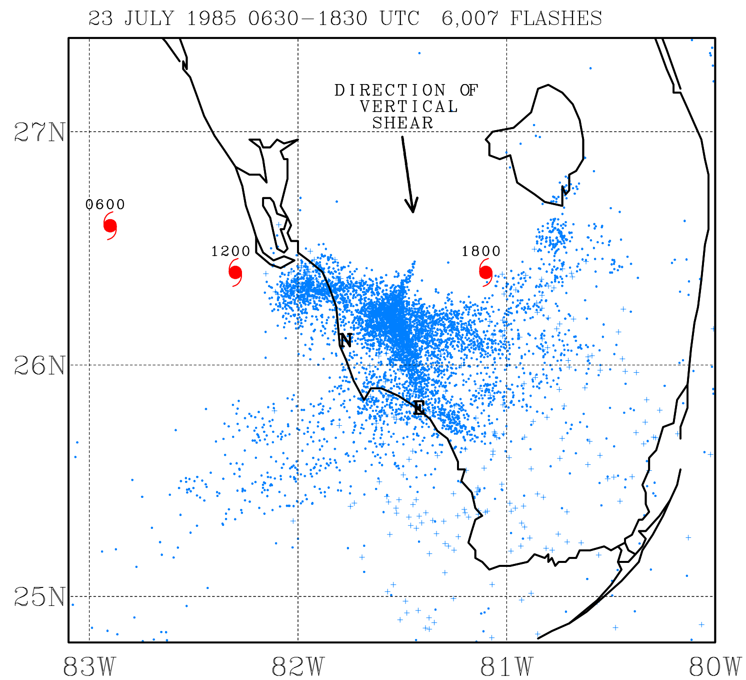

Figure 1. Positive (+) and negative (dots) lightning flashes for tropical storm Bob are plotted along with storm center locations at 0600, 1200, and 1800 UTC 23 July 1985. Also included are the vertical wind shear vector at 1200 UTC, and the locations of Naples (N) and Everglades City (E).

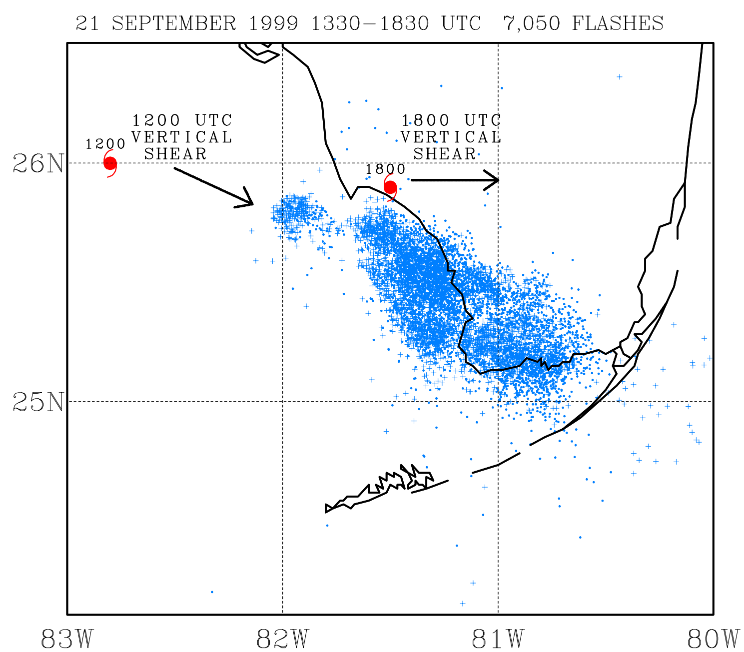

Figure 2. Same as in Figure 1, for Tropical Storm Harvey.