Comparison of Tornado Outbreaks Associated with Frances (2004) and Jeanne (2004) over Southeast Georgia and Southern South Carolina

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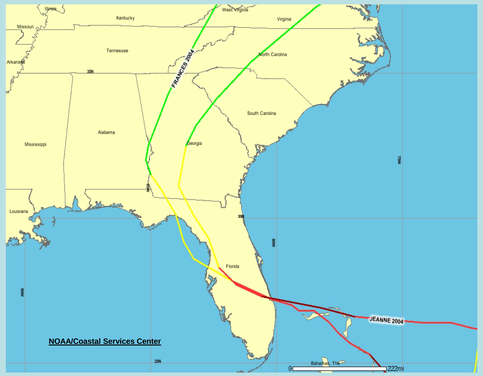
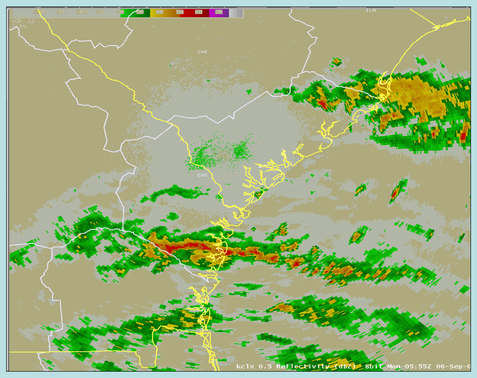
During the 2004 hurricane season, the Charleston, South Carolina National Weather Service (CHS) County Warning Area (CWA) verified tornado touchdowns with the remnants of Hurricanes Frances and Jeanne. Both hurricanes crossed central Florida peninsula from southeast to northwest, then turned north and moved into southwest Georgia. The storms produced a combined 26 tornadoes across northeast coastal Georgia and southern South Carolina. While both hurricanes were similar in strength and size at landfall, and took similar tracks across Florida and southwest Georgia, Frances produced over 3 times more tornadoes (20) than Jeanne (6) across the Charleston CWA.

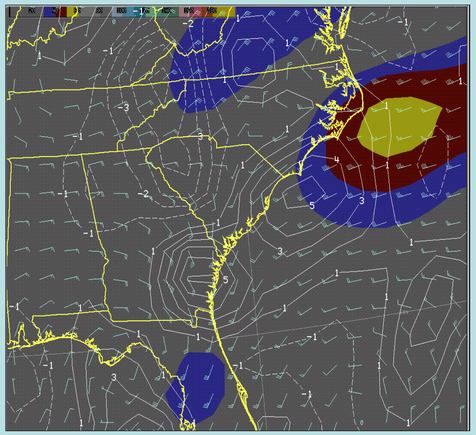


With both Frances and Jeanne, the tornadoes formed from convective cells within outer bands of the storm, several hundred kilometers removed from the center. A typical band from Frances can be seen in the 88D image below.

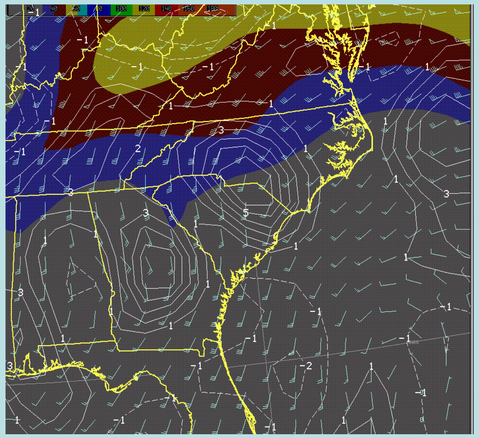


Charleston South Carolina KCLX 0.5 degree base reflectivity at 0555 UTC 6 September 2004.

Contributing factors to the larger number of tornadoes associated with Frances appear to be a more favorable position of an upper level jet to the northeast of the storm, deeper moisture profiles, and slower forward speed maintaining favorable wind profiles over the CWA for a longer period of time. The images below show the 250 hPa winds and divergence near the peak of the tornado outbreaks associated with each storm. Notice that the divergence associated with the right entrance region of the upper jet off the North Carolina Coast in Frances (top) was in a more favorable location across coastal South Carolina and Georgia than with Jeanne (bottom).

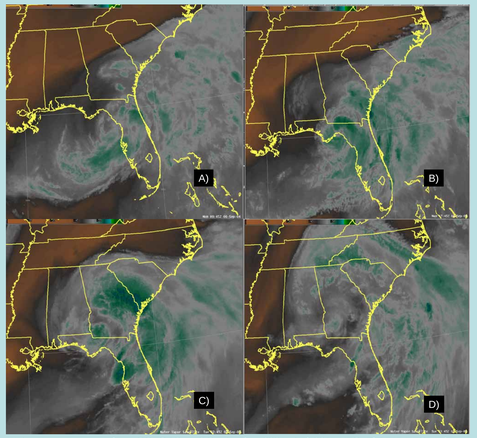


Rapid Update Cycle (RUC) model 250 hPa 1500 UTC 6 September 2004 isotachs [(shaded 30 kt (blue) 40 kt (red) 50 kt (yellow)], wind barbs and divergence (positive-solid white contour).

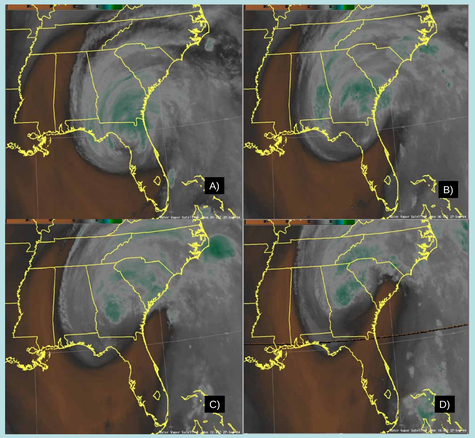


RUC 250 hPa 1500 UTC 27 September isotachs 2004 [shaded 30 kt (blue), 40 kt (red), 50 kt (yellow)], wind barbs and divergence (positive-solid white contour).

During Frances (top), The CHS CWA remained under a strong gradient of mid level relative humidity with plentiful deep moisture for an extended period of time. For Jeanne (bottom), the gradient was overhead only for a few hours, then significant mid level drying wrapped around the circulation and moved over the Charleston CWA. The images also show a flat cirrus shield to the northeast of Frances due to the weak upper disturbance and associated jet streak off the North Carolina coast, while the cirrus shield is strongly anticyclonic to the northeast of Jeanne under the influence of a strong ridge.

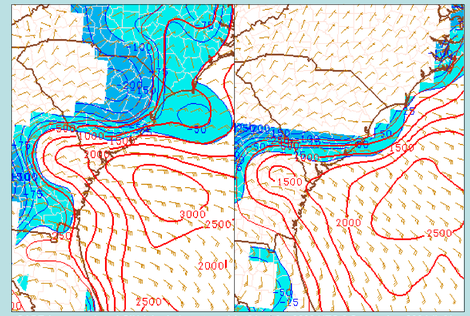


Water Vapor Imagery from GOES 12 on 6 September 2004 at A) 0945 UTC, B) 1745 UTC and 7 September at C) 0245 UTC and D) 1145 UTC.

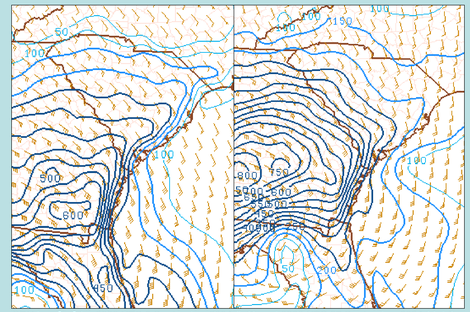


Water Vapor Imagery from GOES 12 on 27 September 2004 at A) 0045 UTC, B) 0645 UTC, C) 1245 UTC and D) 1845 UTC.

Mesoanalyses obtained from the Storm Prediction Center showed little difference in the orientation of Convective Available Potential Energy (CAPE) and Convective Inhibition (CIN) during peak times of both outbreaks. Storm Relative Helicity (SRH) fields were similar as well, although values were a bit higher during Jeanne over southeast Georgia.



CAPE (contours) and CIN (shaded contours) in J kg^{-1} for 0600 UTC 6 September 2004 (left) and 0900 UTC 27 September 2004 (right). Images courtesy Storm Prediction Center



SRH in m^2 s^{-2} for 0600 UTC 6 September 2004 (left) and 0900 UTC 27 September 2004 (right). Images courtesy Storm Prediction Center

Tornado on 6 September 2004 near Savannah, GA. Image courtesy of WTOC.