Post Storm Data Acquisition
Aerial Wind Mapping Mission
Hurricane Jeanne

October 18, 2004

Overview

Hurricane Jeanne was born as a tropical depression over the northern Caribbean islands on September 13, 2004. The depression became a tropical storm as it moved across Puerto Rico on September 15th. The storm continued to move slowly westward along the northern coast of the Dominican Republic and Haiti. The tropical cyclone weakened considerably but eventually emerged over the warm Atlantic waters once again. Jeanne then slowly intensified again as it made a loop over the western Atlantic before moving westward through the northern Bahamas. Hurricane Jeanne made landfall on the southeast Florida coast, near Stuart, during the late evening of September 25, 2004. The hurricane was a category three storm on the Saffir-Simpson Scale when it made landfall.

Hurricane Jeanne was a relatively large storm and had a well defined 25+ mile wide eye at landfall. The most significant damage associated with the hurricane was confined to the eyewall where several instances of deep convection resulted in enhanced surface winds. Most of the central Florida peninsula experienced hurricane force wind gusts. Nearly the entire state had wind gusts to at least tropical storm force.

Hurricane Jeanne was the fourth hurricane to impact Florida since the middle of August 2004. Figure 1 shows the tracks of the hurricanes across the Florida peninsula. Hurricane Jeanne made landfall on September 25th very close to where hurricane Frances made landfall just three weeks earlier.

A Post Storm Data Acquisition (PSDA) Aerial Wind Mapping Mission was flown by NOAA's National Weather Service (NWS) on September 29, 2004 to investigate the area of maximum wind damage. Analysis of photographs and video taken during the mission were integrated with subsequent ground surveys and additional information received from the Florida NWS Weather Forecast Offices (WFOs) in Melbourne, Miami, Tampa, Tallahassee, and Jacksonville to produce a final peak gust analysis map.

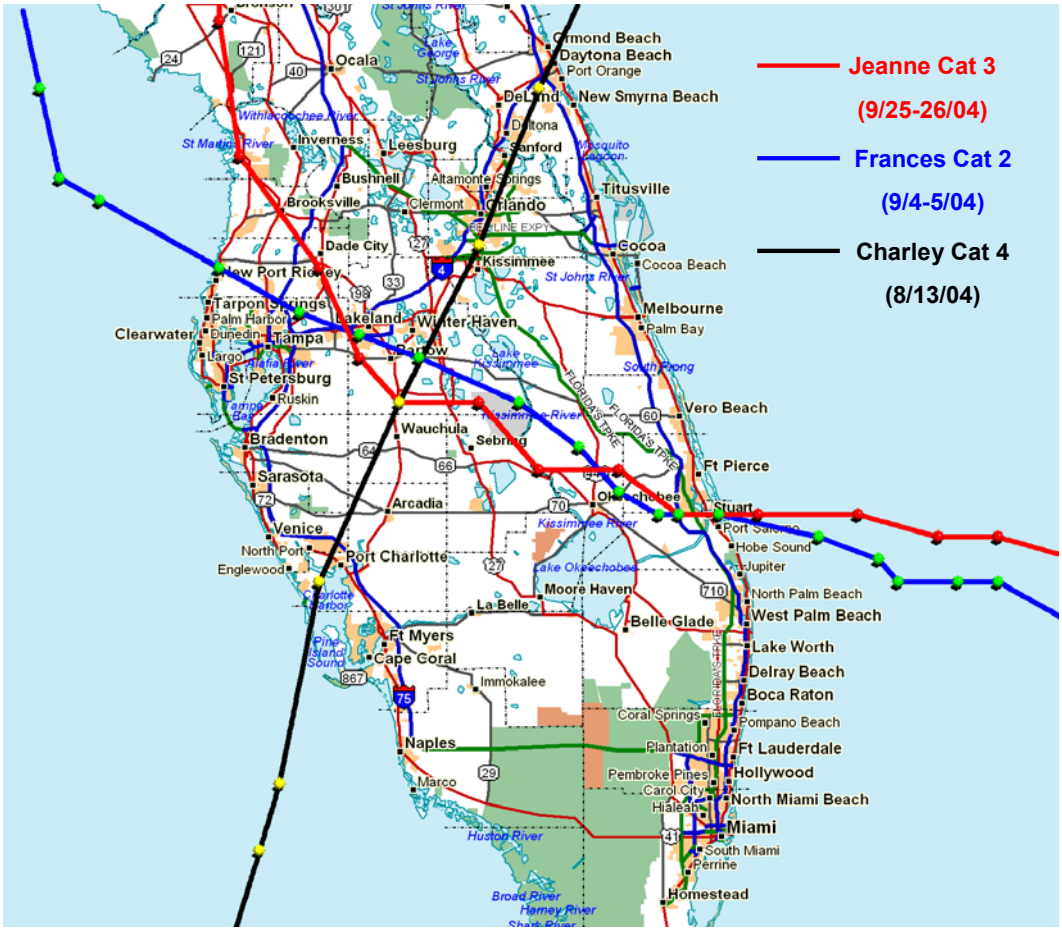


Figure 1. Hurricane tracks across Florida peninsula (August and September)

Flight Tactics and Mission Objective

Given the inherent difficulties associated with estimating wind gusts from damage observations in fixed-wing aircraft over areas where Fujita Scale F0 (40 – 72mph) and low-end F1 (73-112mph) damage occurs, this PSDA Wind Mapping Mission focused on the areas most likely to have received winds at or above 90 mph (F1). The repetitive tropical activity that affected Florida during the summer of 2004 was another obstacle as determining which damage occurred from which storm, especially between Hurricanes Frances and Jeanne.

The PSDA mission was flown from Tamiami Airport in southwest Miami in a Cessna 172 aircraft with 2 NWS meteorologists onboard. The two meteorologists recorded images and flight position information. The four hour mission covered areas of south Florida between Lake Okeechobee and the coast and along the coastline between Stuart and Melbourne where the eyewall came onshore (Figure 2). Digital video imagery was taken to maximize the area covered for later analysis, with digital photographs taken at important locations.

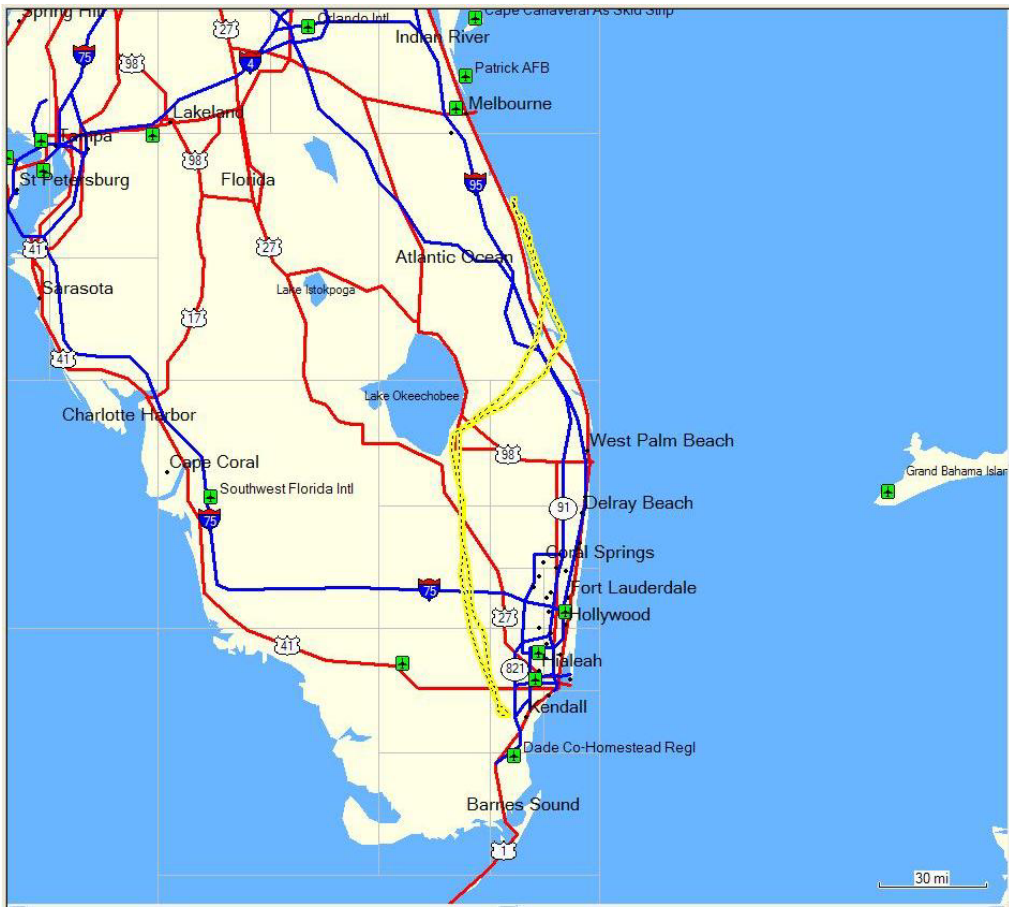


Figure 2. Flight path (yellow) of Hurricane Jeanne PSDA mission

Data Collection

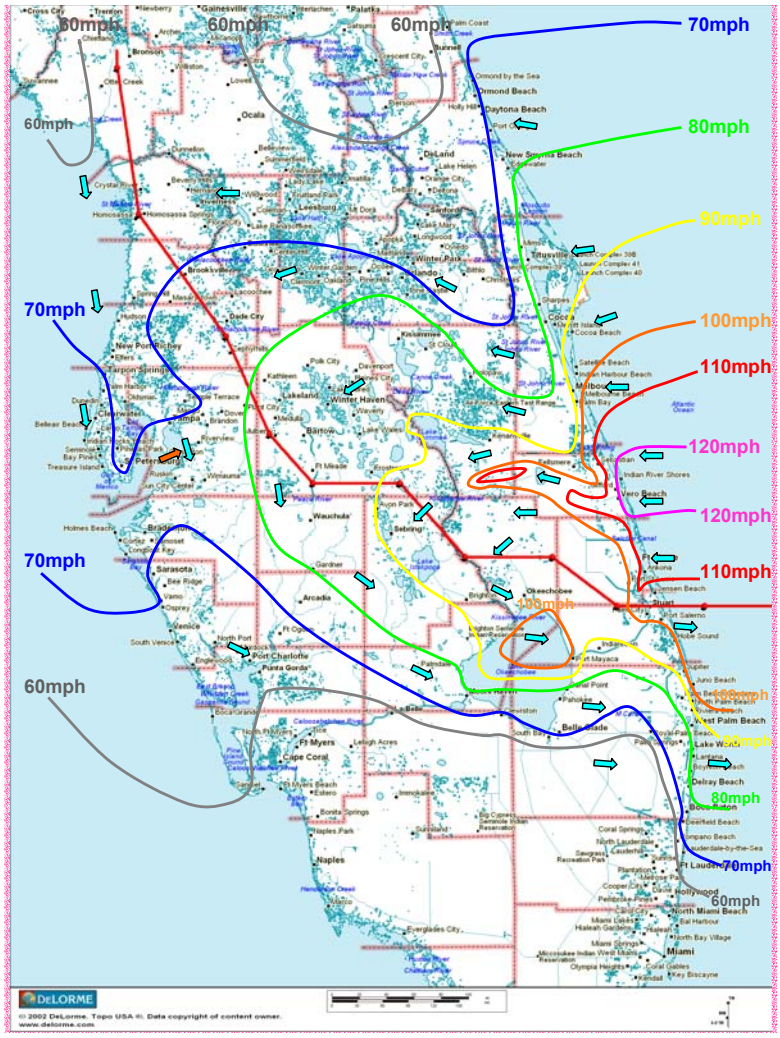
Correlation of imagery to aircraft location was key to the subsequent peak wind analysis. Global Positioning System (GPS) data was logged and transferred to a laptop computer, with the clocks of the GPS, laptop, video camera, and still image camera synchronized. However, data collection during this mission was limited due to a relatively short flight time due to convective activity in the area, and Temporary Flight Restrictions due to the arrival of President Bush.

Image Analysis

Digital video and still images were reviewed subsequent to the flight in an effort to produce a best estimate of the maximum 3 to 5 second wind gust, and wind direction during the peak speed. Initial wind gust estimates were based on observed damage, measured wind speeds form observing equipment, and additional wind estimates. Where applicable, correlations developed between wind speed reports and damage were used to develop wind estimates at other locations (Figure 3).

The accuracy of aerial wind speed estimates is inherently limited due a lack of first-hand knowledge of the affected building construction quality, soil types, vegetation characteristics, and possibly most importantly the duration of the strong wind speeds. In addition, in this instance it was made even more difficult due to the problems in delineating damage that occurred from the previous land falling tropical cyclones just a few weeks earlier. Information received from the Florida WFOs greatly enhanced the final

wind estimate product. Much of the entire wind estimate process is based on subjective conclusions, and a margin of error remains.



NWS PSDA Peak Wind Gust Analysis for Hurricane Jeanne

September 25-26, 2004

Derived from aerial damage assessments, ground surveys, and NWS/FAA surface wind observations

Arrows (blue) represent the direction of the most significant first wind. Second wind maximums are indicated with red arrows.

The analysis should be interpreted as the peak 3 to 5 second wind gust, in miles per hour, with a range of plus or minus 10 mph.

Note – Estimating wind speeds from aerial imagery of damage results in uncertainties related to the variations in construction methods, vegetation types, and soil conditions.

Figure 3 – Preliminary Peak Wind Gust Analysis for Hurricane Jeanne. (map background courtesy of DeLorme)

Peak Wind Gusts

As would be typically expected, the maximum wind gusts associated with the cyclone occurred along the immediate coast line north of where the center made landfall (Figure 4), mainly between Melbourne and Stuart. Based on wind observations and the extent of widespread roof damage, a small area where the wind gusts were between 115 mph and 125 mph (F2) occurred along the coast near Vero Beach and Indian River Shores (Figures 6 and 7). A wind gust maximum then extended inland within the northern eyewall across Indian River County and southern Osceloa County. Within this corridor, wind gusts exceeded 100 mph (F1). Based on radar imagery, it appears that strong convective bursts within the eyewall, similar to the one seen in Figure 5, played a significant role in the higher wind maxes in this zone. The westerly wind maxes to the south of the hurricane center occurred over a smaller area. One maximum was evident across the northern half of Lake Okeechobee and along the eastern shoreline where based on wind observing equipment winds gusted to around 100 mph. Another area where westerly wind were in excess of 100 mph occurred

was just south of where the center made landfall and extended southward, mainly just along and offshore, to just north of West Palm Beach.

Velocity data from the NWS Melbourne Radar indicated winds of around 125 mph several thousand feet off the surface which further supports maximum wind gust estimates in the 110 mph to 120 mph range.

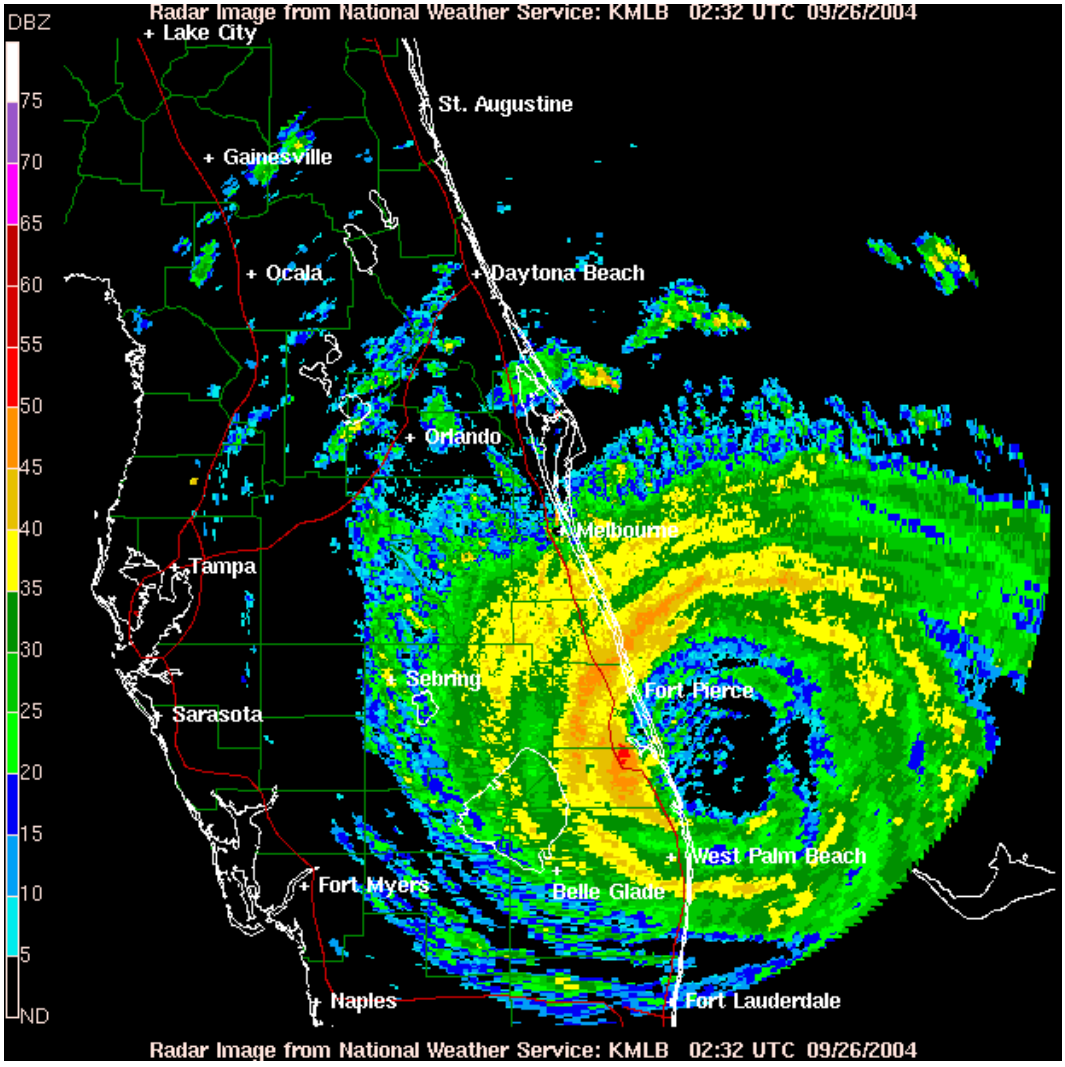
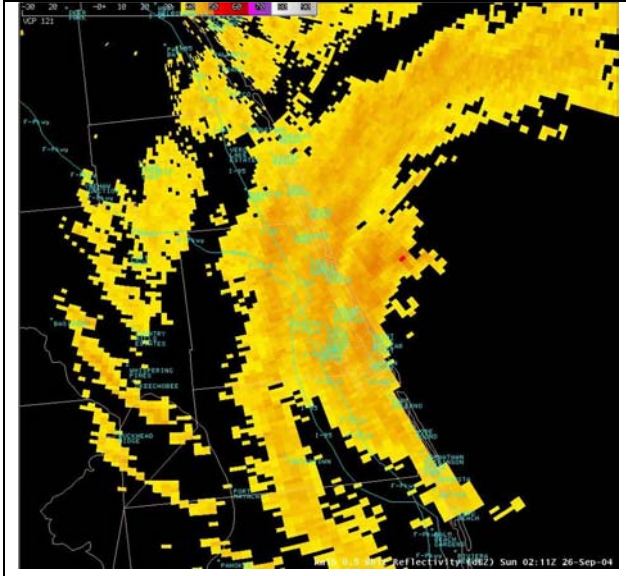
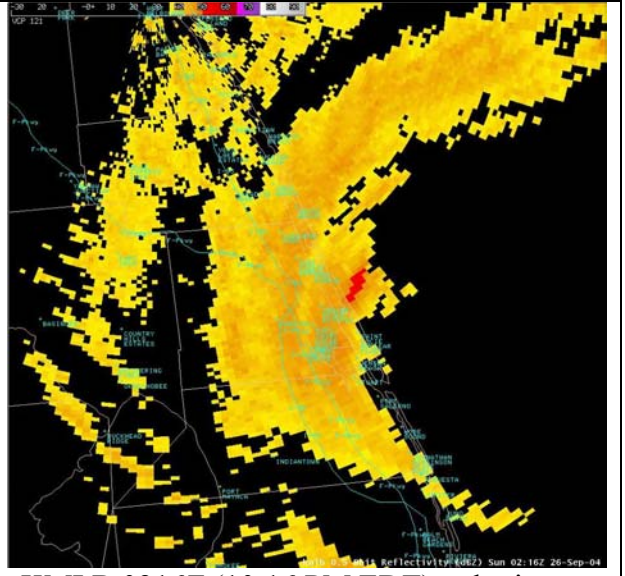


Figure 4 – Base Reflectivity NWS Melbourne (KMLB) WSR-88D image of Hurricane Jeanne as it made landfall 0232Z (10:32 PM EDT).



KMLB 0211 Z (10:11PM EDT) radar image



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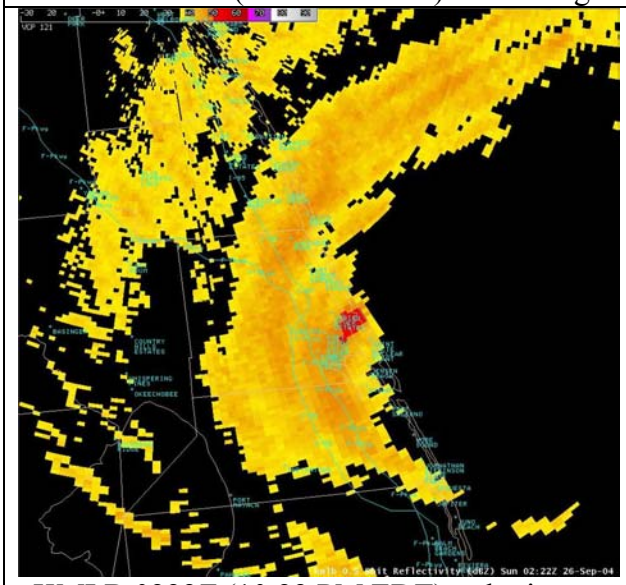
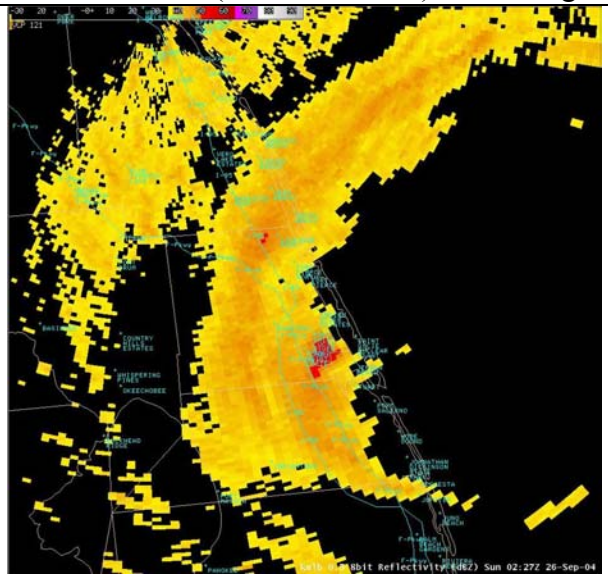


KMLB 0222Z (10:22 PM EDT) radar image



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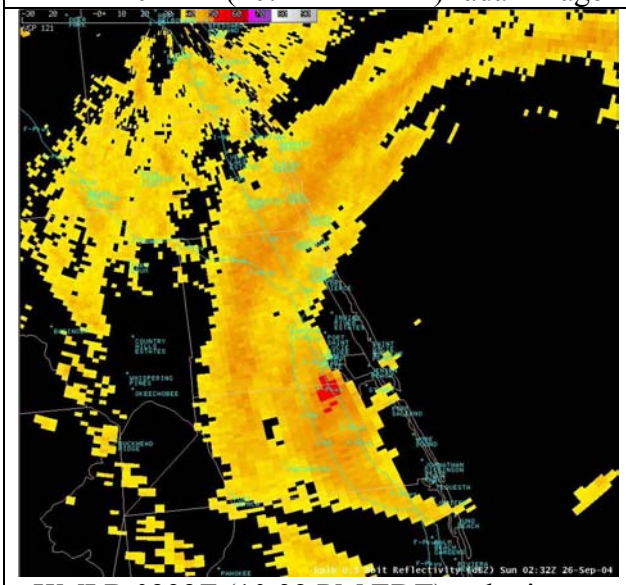
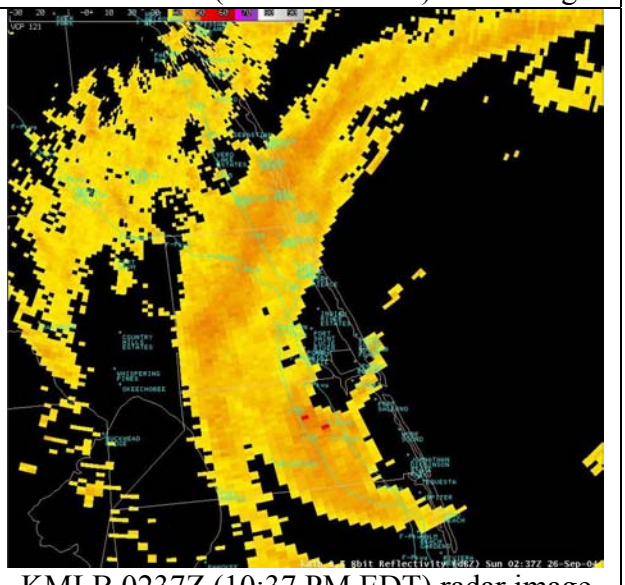


KMLB 0232Z (10:32 PM EDT) radar image



KMLB 0237Z (10:37 PM EDT) radar image

Figure 5 – Radar imagery showing evolution of intense convection within the eyewall. These convective bursts corresponded with increased wind damage along their paths.

Figure 6 –Most common damage encountered, mainly scattered significant roof damage. (September 26, 2004 10:17 AM EDT)

Figure 7 – Damage to oceanfront buildings where many of the windows were blown out and roof damage occurred. (September 26, 2004 10:50 AM EDT)

Acknowledgements

The Hurricane Jeanne PSDA Wind Mapping Mission would like to thank the NWS Offices in Miami, Tampa, Tallahassee, Jacksonville, the National Hurricane Center, and the Civil Air Patrol for assisting with the development of this report.

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