Post Storm Data Acquisition
Aerial Wind Mapping Mission
Hurricane Isabel - 2003

November 16th , 2003

Overview

On September 18th, 2003, Hurricane Isabel, a category two tropical cyclone on the Saffir-Simpson Scale, moved northwest from the Atlantic Ocean, across eastern North Carolina, and into Virginia . Convection within the inner core of Isabel was limited as the eye approached the coast; however, two bursts of convection occurred as Isabel's eye came ashore, the second of which was closely associated with the visual evidence of the most significant winds.

A Post Storm Data Acquisition (PSDA) Aerial Wind Mapping Mission was flown by the National Weather Service (NWS) on September 20th, 2003 to investigate the suspected area of maximum winds. Analysis of photographs and video taken during the mission were integrated with subsequent ground surveys undertaken by staff from the NWS Weather Forecast Offices (WFOs) in Newport, NC and Wakefield, VA to produce a final gust analysis.

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 (F) 0 and low-end F1 damage occurs, this PSDA Wind Mapping Mission focused on the areas most likely to have received winds at or above 90 mph.

The PSDA mission was flown from Frederick, Maryland in a Piper Seminole aircraft with 3 NWS meteorologists onboard. Two of the meteorologists flew the aircraft, while the third recorded images and flight position information. The seven hour mission covered the outer banks of North Carolina and interior sections of North Carolina where the most significant convection occurred in the cyclone's core.

Digital video imagery was taken to maximize the area covered for later analysis, with higher resolution digital photographs taken at important locations when possible.

Data Collection

Correlation of imagery to aircraft location was key to the subsequent wind analysis. Global Positioning System (GPS) data was logged in a laptop computer, with the clocks of the GPS, laptop, video camera, and still image camera synchronized. However, data collection during this mission was hampered by the failure of extended life battery system, so only a fraction of the imagery was cataloged with the best possible precision. Manual logging in combination with track information stored in the GPS unit was used in leu of the primary logging system. The power failure did not prevent the PSDA team from creating a useful analysis.

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. The initial gust estimates from the imagery were based on observed damage, measured wind speeds, and the subjective correlation of similar damage at sites with measured wind gusts. The accuracy of such estimates are inherently limited due a lack of first-hand knowledge of the affected building construction quality, soil types, and vegetation characteristics. Information from the NWS ground surveys performed by WFOs Newport and Wakefield addressed these issues and greatly enhanced the process of creating a final product. While combining the information from the two processes results in a better final analysis, much of the entire process is based on subjective conclusions, and a margin of error remains.

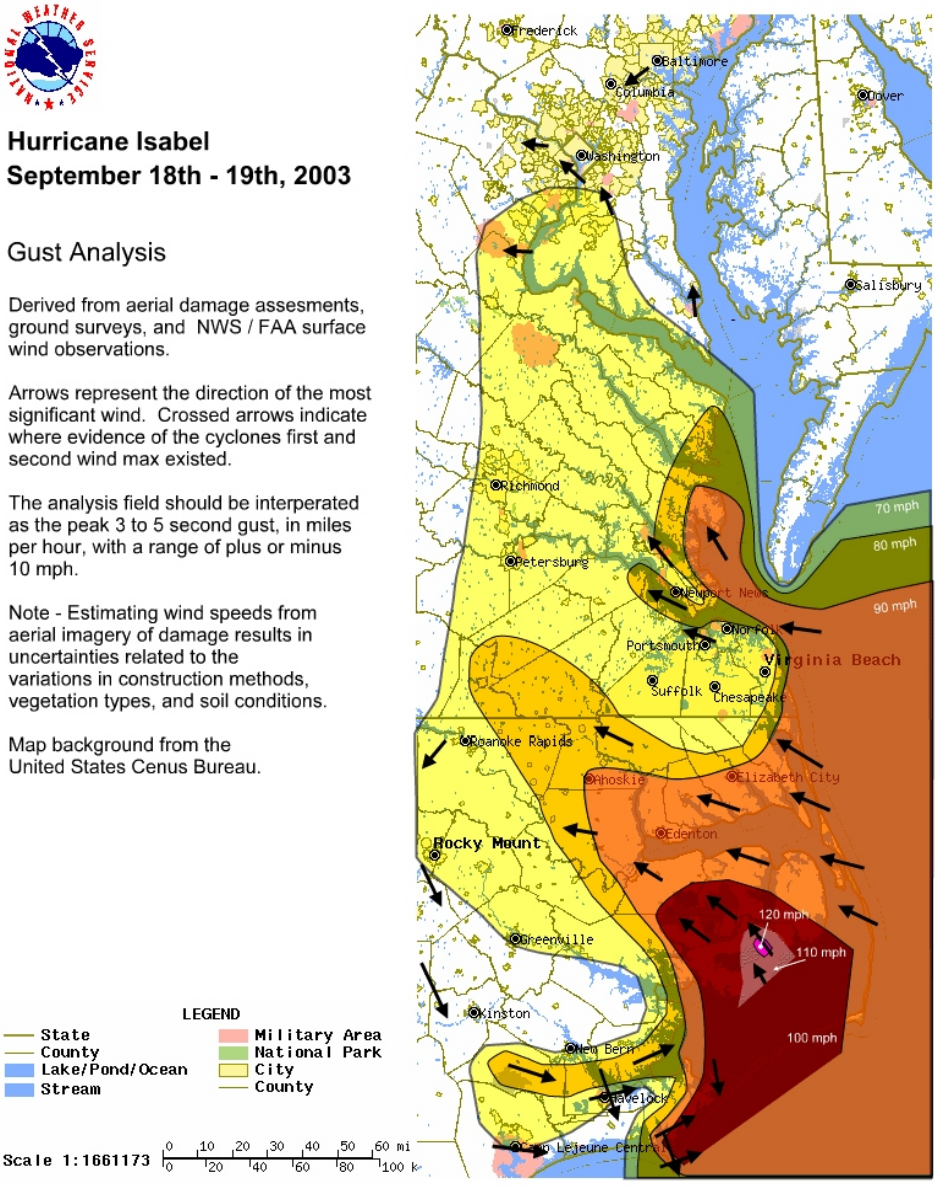

Figure 1 - Hurricane Isabel Peak Gust Analysis

The Peak Gusts

The Hurricane Isabel PSDA Wind Mapping Mission found the maximum wind gusts associated with the cyclone were within a small area located in Hyde County, North Carolina just to the east of Lake Mattamuskeet. Evidence in the tree damage is indicative of a wet microbusrt (Figure 2). The initial peak gust estimate at this location of 120 mph was found to be reasonable by the staff of WFO Newport who performed the ground survey in Hyde County. Therefore this estimate remains in the final analysis. The extent of this extreme wind gust was quite limited, well below the scale typically addressed by the National Hurricane Center.

Figure 2 - Video frame of tree damage indicative of a wet microburst.

The type of tree damage seen in Figure 2 is commonly associated with F2 tornado damage (113 to 157 mph). Engineers continue to debate the importance of wind duration and its contribution to wind damage, so it is not clear if the estimated gust speed at this location should be reduced slightly because of the extended duration of damaging winds in a hurricane, or if the estimated gust should be more toward the middle of the F2 range given the transitory nature of a microburst.

Data from the NHC indicated flight-level winds in the cyclone at 10,000 feet were near 135 mph near landfall. This would likely be the upper-most limit of any estimate given to a microburst in Isabel's eyewall near this time.

Overall the maximum winds swath, as depicted in Figure 1, matches well with the second convective burst noted in hurricane's eyewall at landfall. The first burst of convection was noted in satellite images prior to 1600 UTC on the 18th off of Ocracoke Island. This burst of convection rotated around the northern semi-circle of the eye and its affects may have been felt mostly offshore. Figure 3 shows the colder cloud tops associated with the convection over Pamlico Sound.

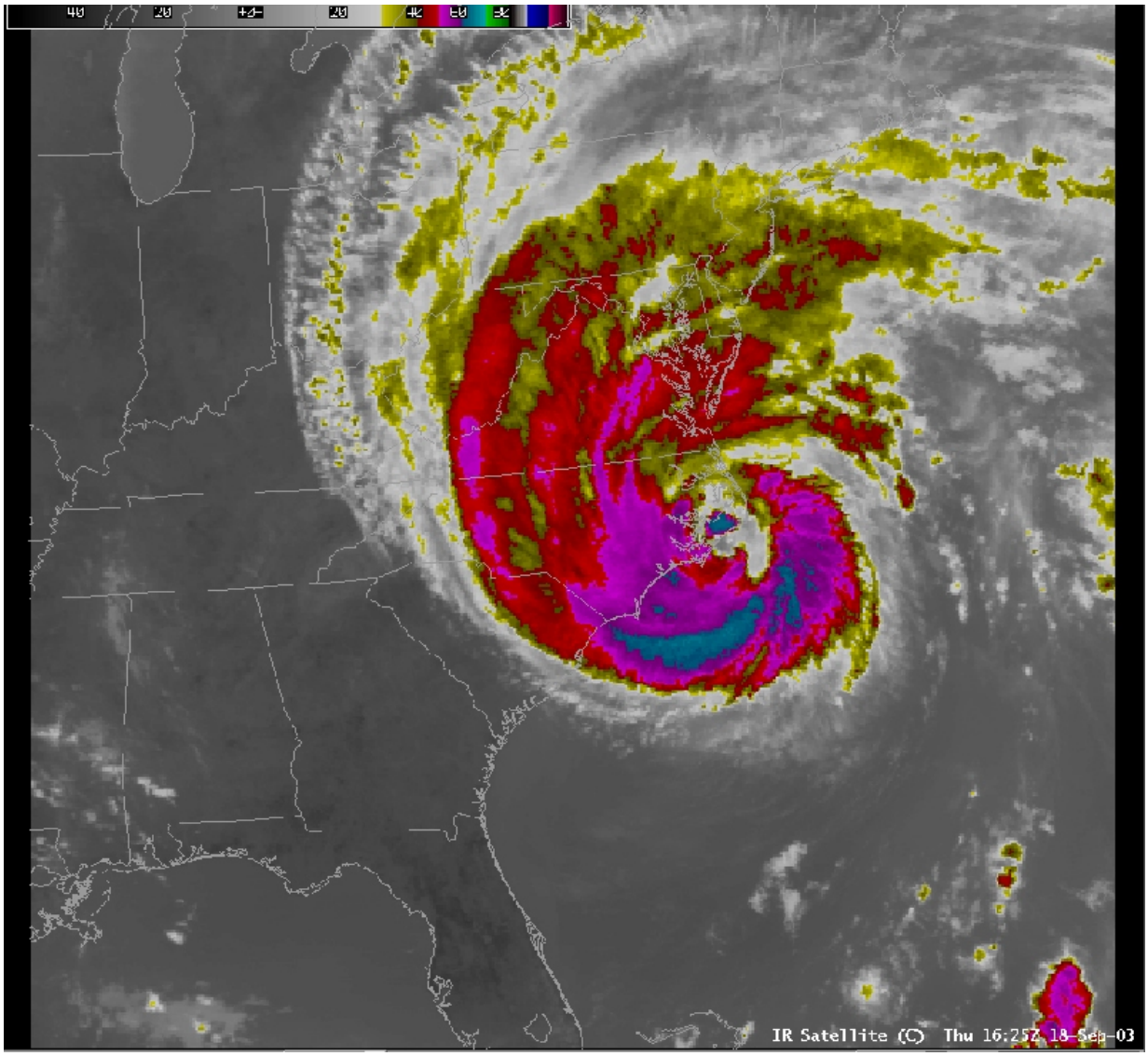

Figure 3 - Infrared Satellite Image of Isabel near landfall.

A second and more persistent burst of convection began around 1800 UTC in the southern eyewall over Pamlico Sound. This convection rotated around the eastern semi-circle of Isabel's core and weakened over northeast North Carolina as the cyclone's inner core appeared to collapse in infrared satellite imagery. The second burst of convection can be seen in composited NWS Weather Surveillance Doppler Radar (WSR-88D) imagery (Figure 4).

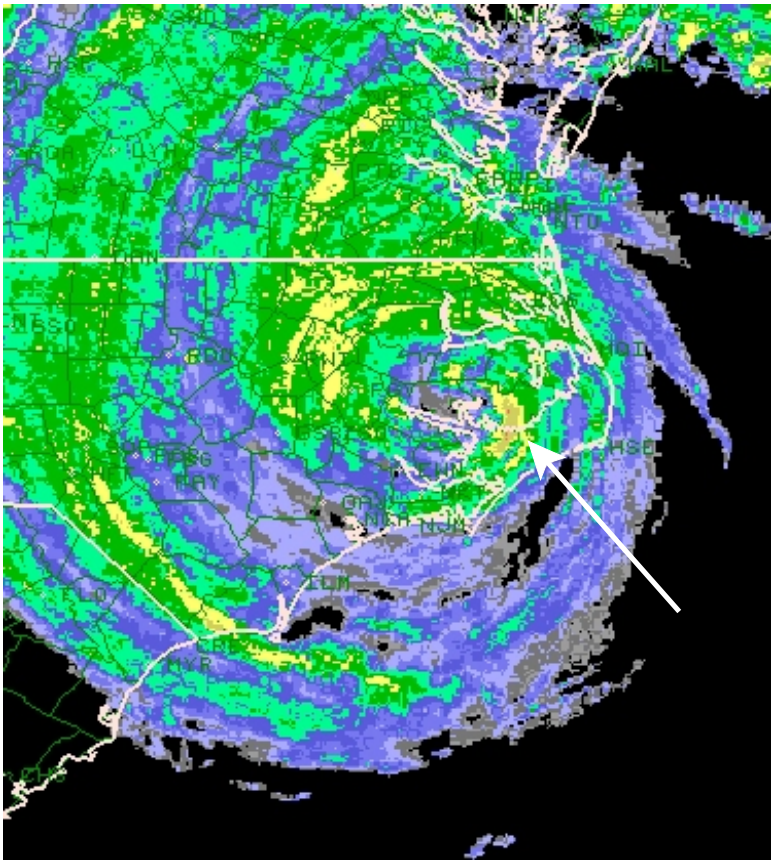

Figure 4 - Composite WSR-88D image of Hurricane Isabel just after landfall. Arrow notes the convective burst most closely associated with the peak inland wind gusts.

Evidence of the cyclone's first and second wind maximum were only noted in the damage and wind reports along the North Carolina coast near and immediately southwest of where the center made landfall. This was likely due to the transitory nature of the convection in the central core of Isabel.

Ackowledgements

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