Hurricane Matthew (2016)

Precipitation Accumulation — 2, 5, 10, 15 inches per day

24-hour precipitation accumulation in inches calculated from 30-minute-average precipitation rates on the 0.1° grid of GPM's Late IMERG data product.

Lightning — 10, 60, 180 Flashes per hour

Within a 50-km diameter area, the number of lightning flash during a 1-hour period. Observed by the radio-frequency ground stations of the World Wide Lightning Location Network (http://wwlln.net). Each panel shows a 24-hour period of lightning except for the lower left panel, which shows a 3-hour period.

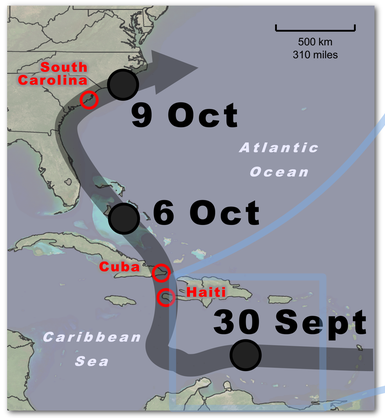
Cloud Height — 275 K / 4 km; 250 K / 8.5 km; 225 K / 11.5 km; 200 K / 14 km

Infrared temperature (K) / Approximate altitude (km)

Geosynchronous 11 micrometer infrared cloudtop temperature from the 4-km gridded GPCC file observed at the middle of the period of observation. Cloudtop altitude estimated with approximately ±1 km accuracy using the radiosonde sounding at Jacksonville, Florida, at 0000 UTC on 7 Oct 2016.

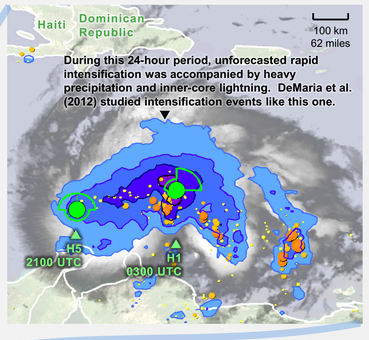
Hurricane Eye — *hhmm* UTC

The National Hurricane Center's advisories provide the location of the low-pressure center and the maximum hurricane-strength wind-speed radii in four quadrants. The annotations states the time and Saffir-Simpson intensity category (H1 through H5).



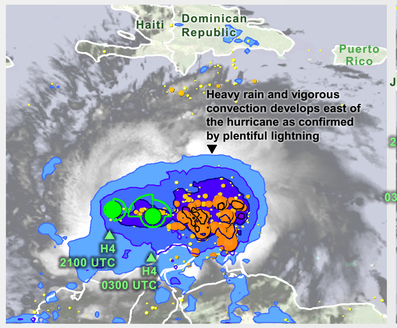
The 24-hour period ends at this time

30 Sept 8PM EDT



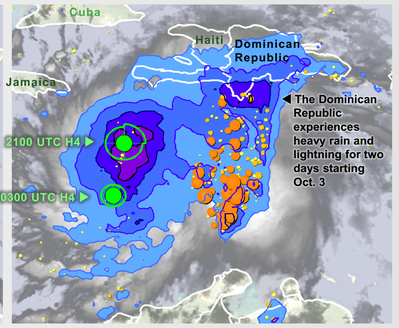
Rapid intensification from Cat 1 to Cat 5

1 Oct 8PM



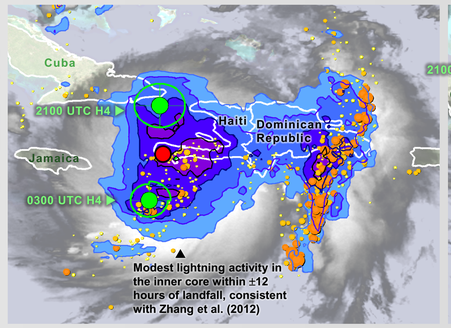
Forward motion slows to 6 mph

3 Oct 8PM



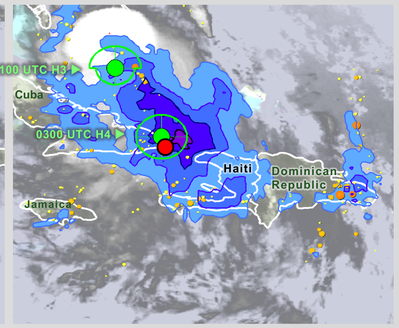
The inner core has little lightning in the two days prior to the Haiti landfall

4 Oct 8PM



Cat. 4 landfall in Haiti
0700 UTC

5 Oct 8PM



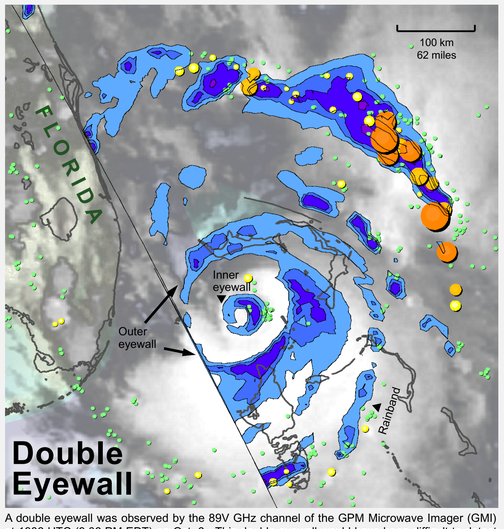
Cat. 4 landfall in Cuba
0000 UTC

Caribbean

6 Oct 3PM EDT

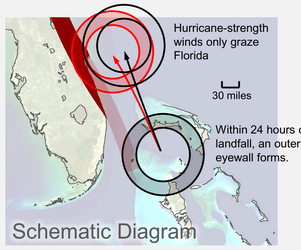
250 230 215 170 130 Tb (K)

Isolated lightning flash

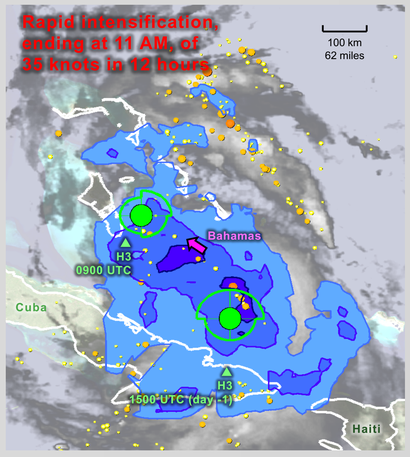


A double eyewall was observed by the 89V GHz channel of the GPM Microwave Imager (GMI) at 1906 UTC (3:06 PM EDT) on Oct. 6. This double eyewall would have been difficult to detect with a geosynchronous infrared sensor because the clouds of the north side of the outer eyewall were shallow, i.e., merely 5–6 km high. Four hours later at 23 UTC, the NOAA N43 P3 aircraft flew through the hurricane. The aircraft's doppler radar clearly showed a double wind maximum at 3 km altitude but no clear double wind maximum at 5 km altitude. When an eyewall replacement cycle begins, the radius of hurricane–force winds can increase, and the final intensity of the storm when the cycle completes becomes less certain. Any increase in forecast uncertainty was cause for concern because the hurricane was forecast to pass almost parallel to the Florida coast.

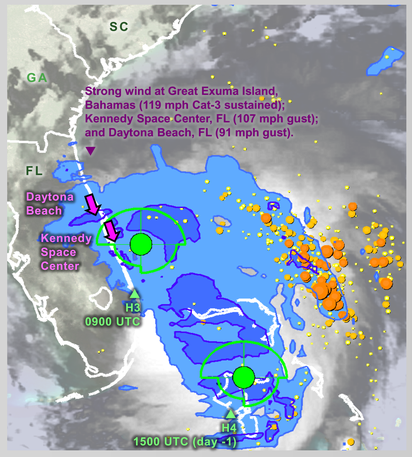
Had the hurricane passed slightly to the west (red) of the forecasted location (**black**), hurricane-force winds could have impacted a long stretch of Florida's coast (**dark red**).



Southeast United States

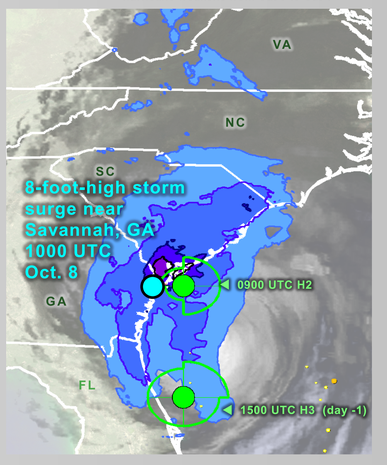


6 Oct 8AM EDT

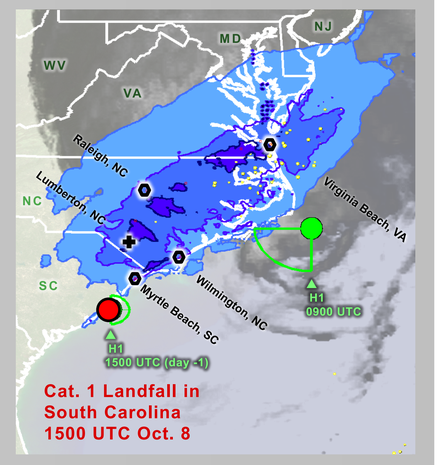


7 Oct 8AM

Very little inner-core lightning as the hurricane weakens from Cat 3 to Cat 1



8 Oct 8AM

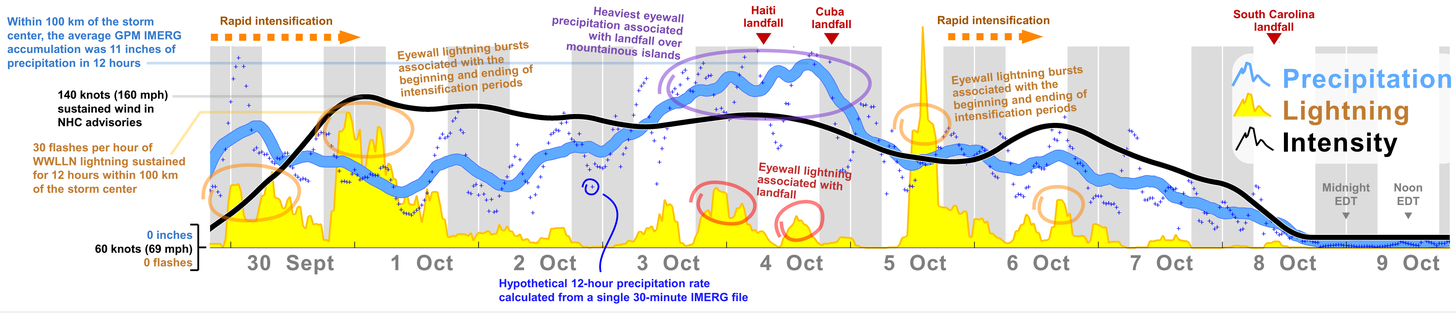


Cat. 1 Landfall in South Carolina
1500 UTC Oct. 8

9 Oct 8AM

- Three-day accumulation in excess of 12 inches: from Myrtle Beach SC to Wilmington NC; Near Raleigh, NC; in Virginia Beach, VA; and near Savannah, GA.
- River flooding in excess of 20 feet: Lumberton, NC.

Over land, GPM's IMERG precipitation estimates are less accurate than over ocean because some passive microwave channels provide limited information over land. Over the continental US, the National Weather Service (NWS) calculates a gauge-adjusted, ground-radar estimate of precipitation. For these reasons, this poster displays IMERG accumulations over ocean and NWS accumulations over the US.



Credits

GPM data provided by NASA / JAXA. WWLLN data provided by R. Holzworth (bobholz@washington.edu) at the University of Washington. Visualization and captions created in October 2016 by owen.kelley@nasa.gov at the NASA Goddard Precipitation Processing System (PPS). The NWS accumulations in the Advanced Hydrological Prediction Service (AHPS) daily "point" shapefiles were downloaded from http://water.weather.gov/precip/download .php .

References

DeMaria, M., R. T. DeMaria, J. A. Knaff, and D. Molenar, 2012: Tropical cyclone lightning and rapid intensity change. *Monthly Weather Review*, **140**, 1828–1842.

Thomas, J. N., N. N. Solorzano, S. A. Cummer, and R. H. Holzworth, 2010: Polarity and energetics of inner core lightning in three intense North Atlantic hurricanes. *Journal Geophysical Research*, **115**, doi:10.1029/2009JA014777.

Zhang, W., Y. Zhang, D. Zheng, and X. Zhou, 2012: Lightning distribution and eyewall outbreaks in tropical cyclones during landfall. *Monthly Weather Review*, **140**, 3573–3586.