Hurricane Gonzalo

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a. Synoptic History

A tropical wave moving across the tropical region in the Atlantic Ocean was being monitored during the second week of October for possible development. Figure 1 shows the wave as analyzed by the National Centers for Environmental Prediction (NCEP) at 200 am AST on Sunday, October 12, 2014, near 57°W with a lowest pressure estimated at 1010 mb and moving west at 10 mph. Well towards the north was Tropical Storm Fay, to move over Bermuda within the next several hours.

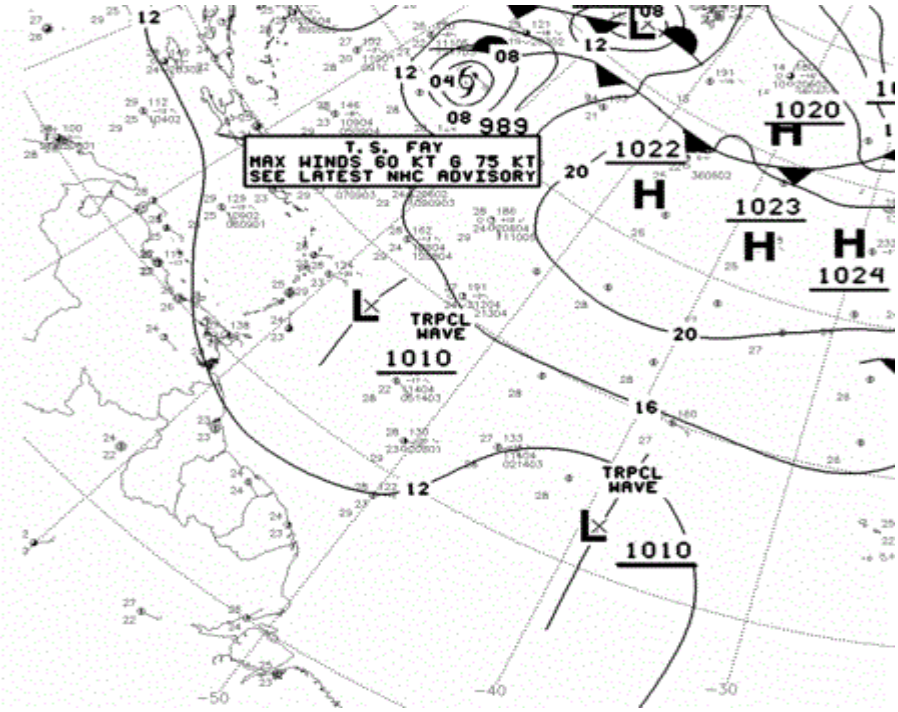


Fig. 1. Tropical surface analysis, 200 am AST on October 12, 2014.

The water vapor (MIMIC/TPC) image at 500 am AST (Fig. 2) showed the tropical wave circulating east of the Leeward Islands. Later that morning an Air Force Reserve reconnaissance aircraft was dispatched into the wave with its mission of looking for evidence of strong winds, to measure atmospheric air pressure and anything else that might indicate potential for an intensifying system. The crew on this flight used the onboard Stepped Frequency Microwave Radiometer (SFMR) to estimate surface wind speeds, and found winds at tropical storm force.

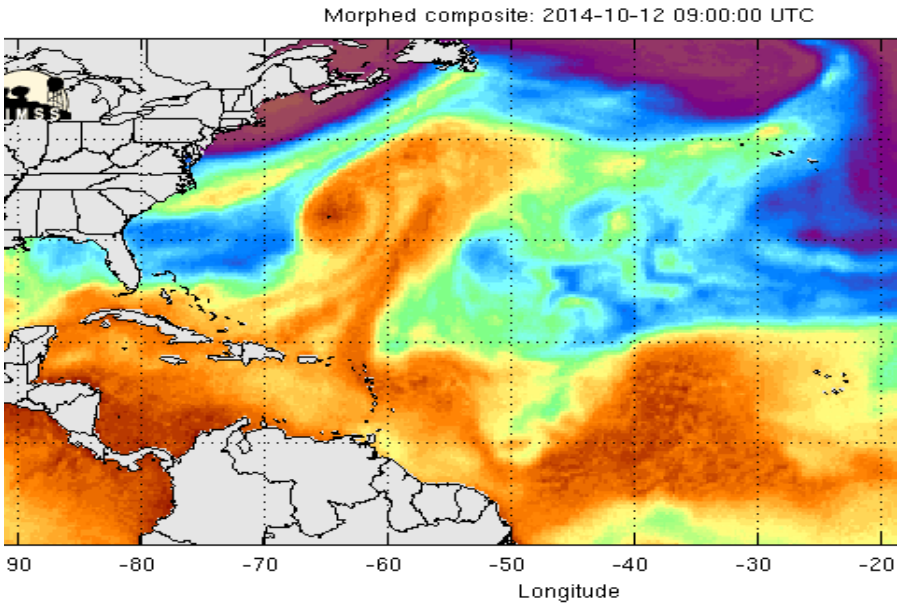


Fig. 2. Morphed Integrated Microwave Imagery at CIMSS - Total Precipitable Water (MIMIC-TPW).

By 130 pm AST on Sunday the National Hurricane Center (NHC) officially declared the system a tropical storm and local governments issued tropical storm warnings for most of the Leeward Islands. Also a tropical storm watch was issued as far west as Puerto Rico and the U.S. Virgin Islands, indicating that tropical storm conditions were possible within 48 hours on these islands. Figure 3 shows the initial forecast track for Gonzalo; reaching hurricane strength by the time it reached Fajardo, PR. However the advisory indicated that the hurricane strength winds would be slightly offshore and northeast of Fajardo at that time, a fine line that would have to be considered later.

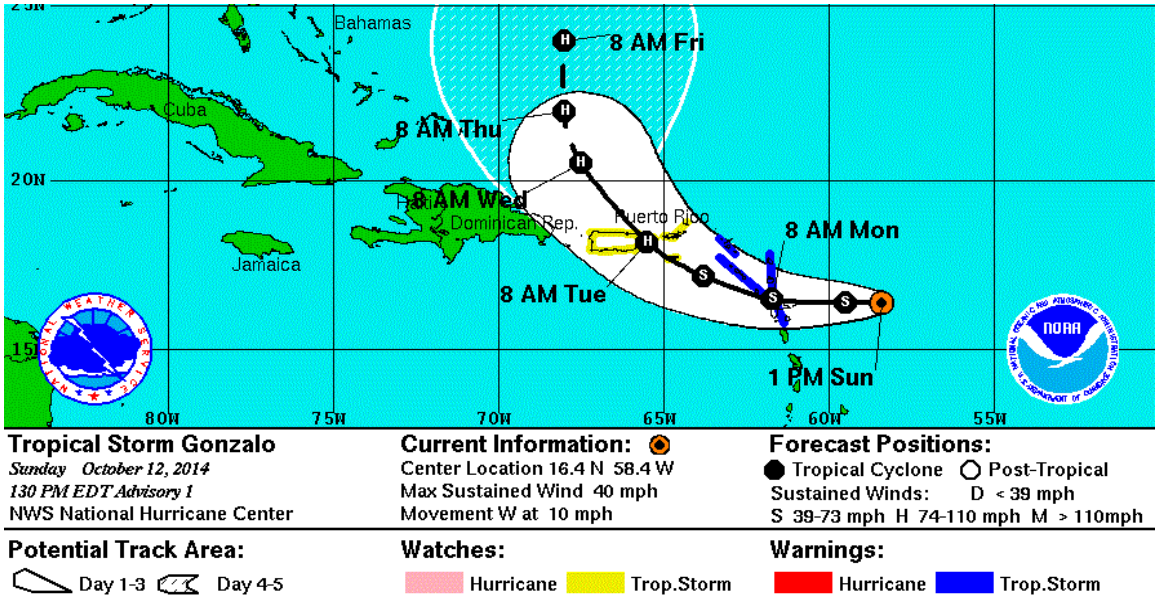


Fig. 3. Initial track forecast for Tropical Storm Gonzalo.

Later on Sunday, October 12th, the tropical storm watch for Puerto Rico and the U.S. Virgin Islands was upgraded to a tropical storm warning at 500 pm AST as the threat of storm force winds was within 36 hours of arrival. Also a hurricane watch was issued for these islands since winds of hurricane strength were also considered possible.

Early on Monday Gonzalo was still moving westward but late in the morning it began to turn more northwest. The expected track was now towards the St. Maarten and then the British Virgin Islands. Gonzalo passed over Antigua around 1000 am AST, with recorded sustained winds of 67 mph and gusts to 87 mph. As Figure 4 shows, the Advanced Scatterometer (ASCAT) indicated that storm force winds (greater than 55 mph) extended some 30 nm towards the northeast and northwest but with gales (39 mph or more) reaching only 20 nm to the southwest. Figure 5 shows the view from satellite and a weather radar image from Guadeloupe.

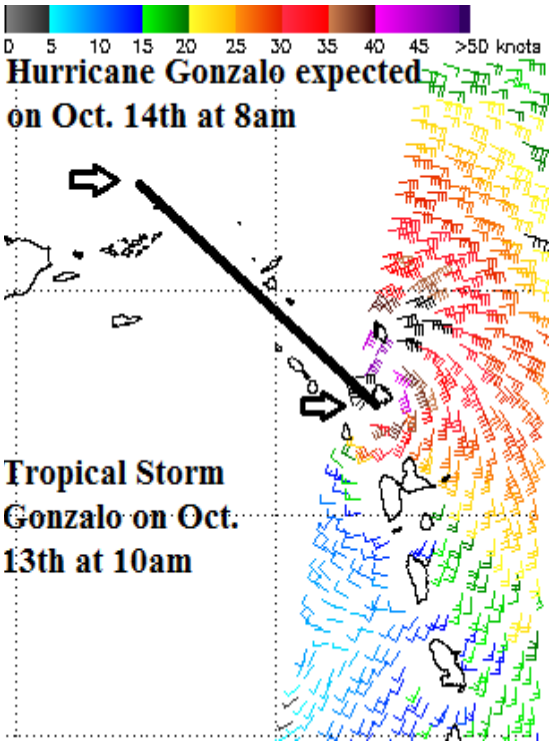


Fig. 4 (right). Advanced Scatterometer from satellite showing storm force winds northwest and northeast of the center with much weaker winds on the southwest side. The expected track over the next day is shown.

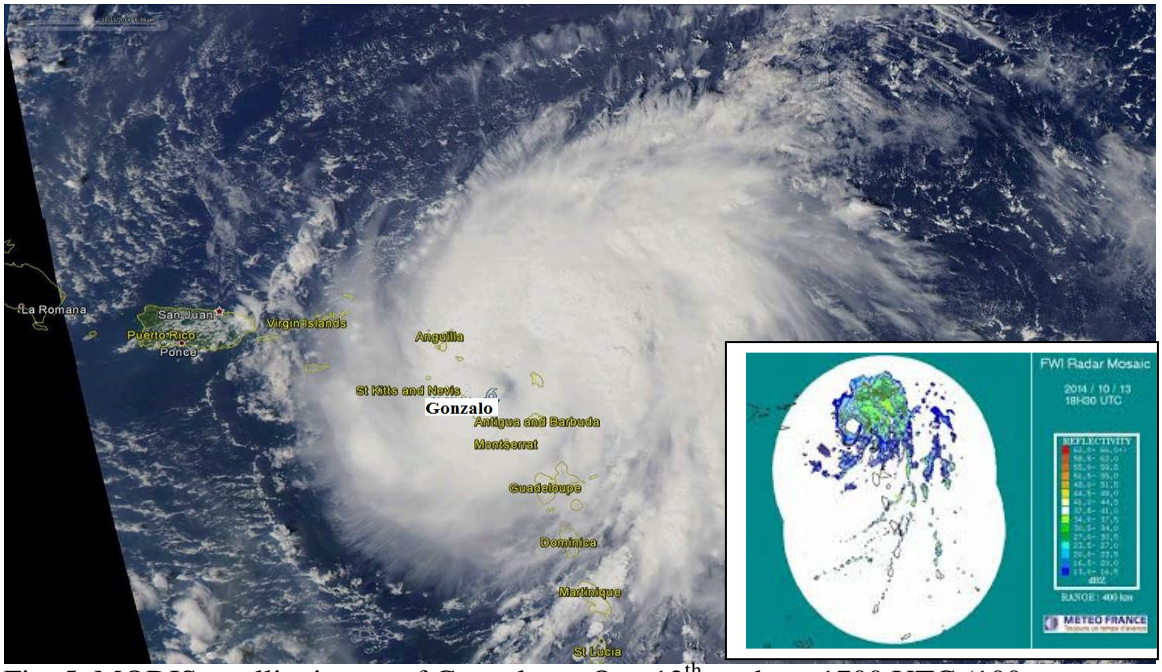
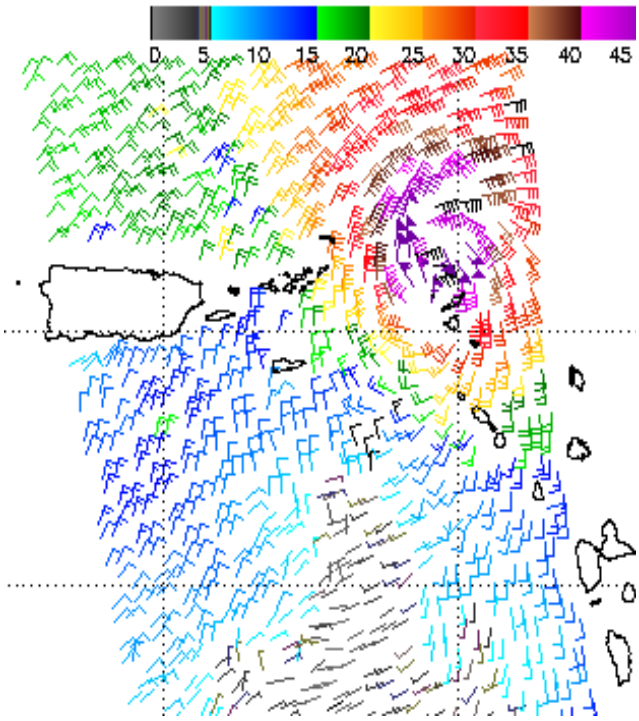


Fig. 5. MODIS satellite image of Gonzalo on Oct. 13th at about 1700 UTC (100 pm AST), inbetween St. Kitts and Barbuda. The center was at 16.4°N 62.4°W and moving northwest at 10 mph. Inset is a radar image of the storm at 1830 UTC (230 pm AST).

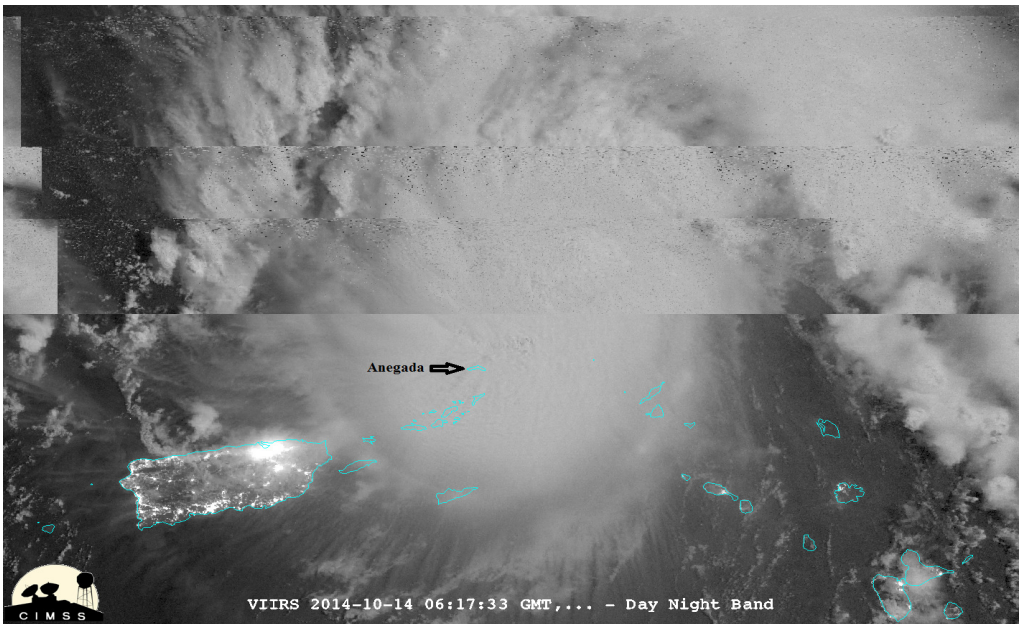
Another Air Force Reserve reconnaissance aircraft on Monday afternoon estimated 62-67 knots of wind near the surface with the SFMR in the northeast quadrant of the storm. Tropical Storm Gonzalo was upgraded to a hurricane at 500 pm, just before it arrived at St. Maarten. While passing over St. Maarten around 700 pm AST, the storm killed at least one person who was in a boat in Simpson Bay Lagoon (The Weather Channel). The airport reported sustained winds at 63 mph with a gust to 75 mph at 700 pm AST. Winds were gusting to storm force there for four hours up to that point and very likely lasted longer. The hurricane continued northwest all night while gaining strength yet winds on the southwest side remained weaker and extended to a shorter distance in other quadrants.



As the hurricane moved into the open Atlantic it continued to strengthen. ASCAT showed increasing winds on all quadrants of the developing eye, still extending to the southwest to a shorter distance (Fig. 6). Later in the night it passed just northeast of Anegada and the British Virgin Islands. Figure 7 shows the VIIRS satellite view of Gonzalo near Anegada on Oct. 14 at 0617 UTC (217 am AST).

Fig. 6 (left). Advanced Scatterometer (ASCAT) showed increasing winds around Gonzalo.

Fig 7 (below). VIIRS day-night band showing Gonzalo near Anegada, with city lights of Puerto Rico visible.



Gonzalo developed quickly during the night over the open Atlantic. It developed a well defined eye wall during this time but towards the southwest the more intense winds appeared to be nearly confined to the eye wall. The Doppler radar near Cayey, PR was able to detect wind only as low as 23,000 feet above sea level. It measured winds of at least 132 mph while in the northeast corner of San Juan's Weather Forecast Office (WFO) coastal waters (extreme northeast portion of marine zone AMZ710) at 337 am AST (Fig. 8). The NHC estimated that the hurricane's maximum sustained surface winds increased from 85 mph at 1100 pm, to 105 mph at 200 am, and then to 110 mph by 500 am AST on Tuesday. They estimated that the minimum sea level pressure had dropped to 974 mb shortly before 500 am AST while a reconnaissance flight estimated sustained surface winds at 106 mph. Later that morning the eye became more visible on satellite images (Fig. 9).

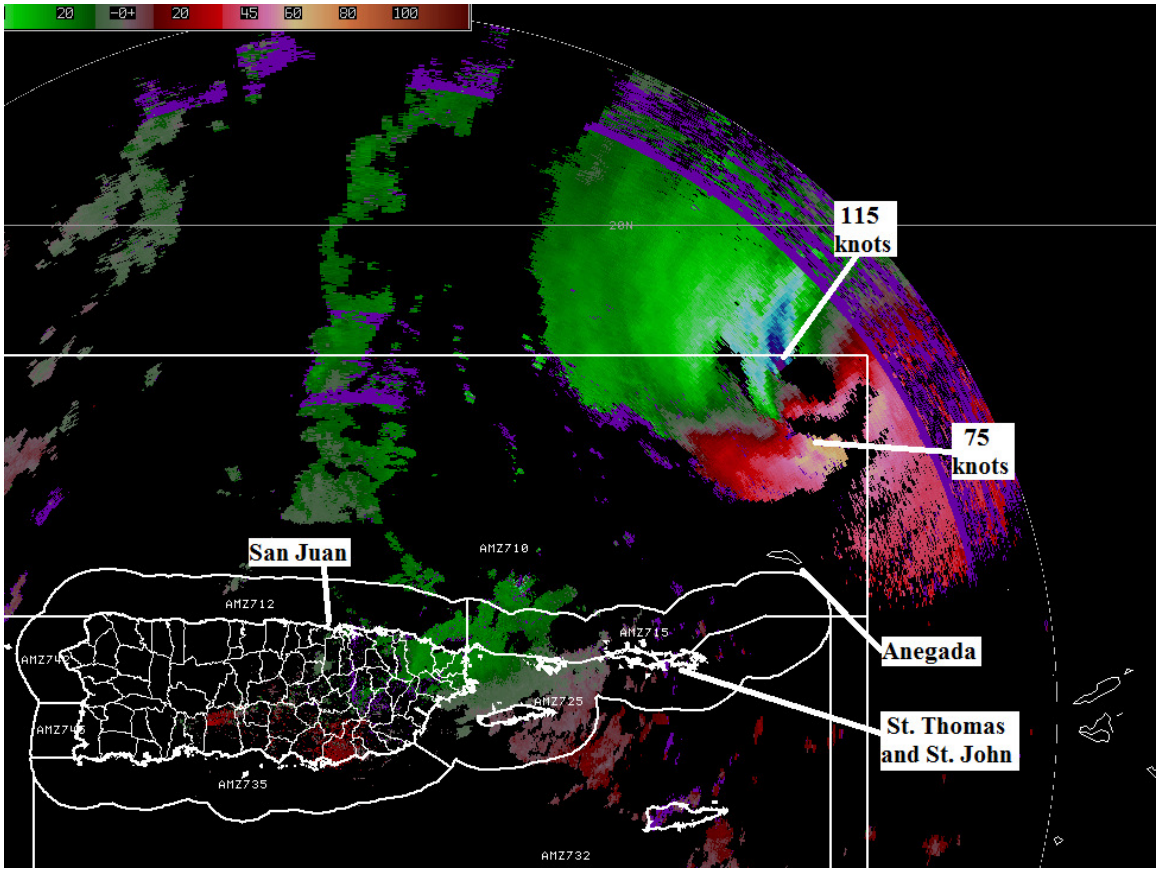


Fig. 8. Base velocity image from the Doppler radar near Cayey, PR at 0747 UTC (347 am AST) on Oct. 14. The velocities observed by the radar over the hurricane were nearly 23,000 feet MSL, measuring at least 115 knots (132 mph) inbound to the radar and 75 knots (86 mph) outbound from the radar.

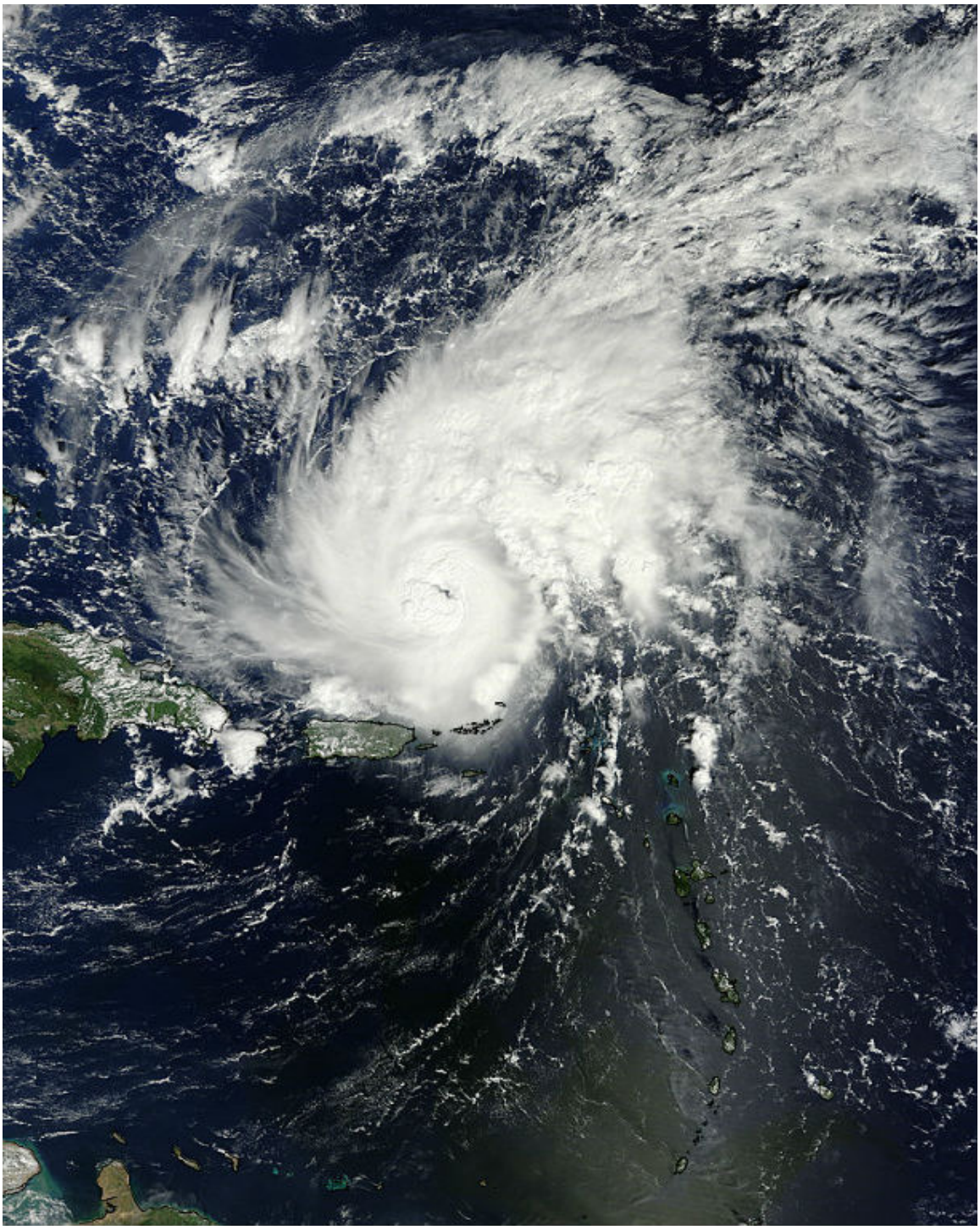


Fig. 9. MODIS satellite image on Oct. 14 at 1450 UTC (1050 am AST). Gonzalo was moving northwest with 110 mph and higher gusts. It would be a major hurricane within hours. Puerto Rico is seen at the southwest edge of the clouds with St. Thomas and St. John also on the southern periphery.

b. Meteorological Effects on Puerto Rico and the U. S. Virgin Islands

Hurricane force winds certainly crossed through the Atlantic Waters of Puerto Rico Zone 710 (coastal waters between 10 nm of Puerto Rico and U.S. Virgin Islands to 19.5^{o}N) but no measurements of strong wind were noted other than those obtained by the reconnaissance aircraft. No land areas and no coastal waters within 10 nm of shore were significantly affected by Gonzalo's passage on Tuesday night. The highest wind gust recorded in the local region was 43 mph at Buoy 41051. This was south of St. Thomas and occurred on Oct. 13 at 320 pm AST while 40 mph was recorded at the Fajardo PR NOS station at 736 pm AST.

No damage was reported from this close call with Gonzalo. No significant rainfall or flooding was reported either. Storm force winds never came closer than 25 nm of St. John, VI and no closer than 120 nm of San Juan, PR.

Gonzalo continued northward into the Atlantic Ocean and became a major hurricane later on Tuesday (minimum 111 mph sustained surface wind). It would eventually devastate Bermuda on Friday but Puerto Rico and the U.S. Virgin Islands dodged this bullet. It was a near miss for these islands that surely no one regrets.

c. Damage, Watches and Warnings

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Type of Issuance	Location	Date/Time (AST)
Flash Flood Watch issued	U.S. Virgin Islands	Oct. 12 / 359 am
Tropical Storm Watch issued	Puerto Rico, Vieques, Culebra, U.S. Virgin Islands	Oct. 12 / 130 pm
Tropical Storm Warning issued	Puerto Rico, Vieques, Culebra, U.S. Virgin Islands	Oct. 12 / 500 pm
Hurricane Watch issued	Puerto Rico, Vieques, Culebra, U.S. Virgin Islands	Oct. 12 / 500 pm
Flood Watch issued	Puerto Rico, Vieques, Culebra, U.S. Virgin Islands	Oct. 12 / 558 pm
Hurricane Warning issued	St. Thomas, St. John	Oct. 13 / 1100 am
Hurricane Watch discontinued	Puerto Rico, Vieques, Culebra, St. Croix	Oct. 13 / 1100 pm
Tropical Storm Warning discontinued	Puerto Rico, Vieques, Culebra, St. Croix	Oct. 14 / 500 am
Hurricane Warning downgraded to Tropical Storm Warning	St. Thomas, St. John	Oct. 14 / 500 am
Tropical Storm Warning Ended	St. Thomas, St. John	Oct. 14 / 800 am
Flood Watch Ended	Puerto Rico, Vieques, Culebra, U.S. Virgin Islands	Oct. 14 / noon

Table 1. Historical timeline of watches and warnings issued by NHC and the San Juan Weather Forecast Office.