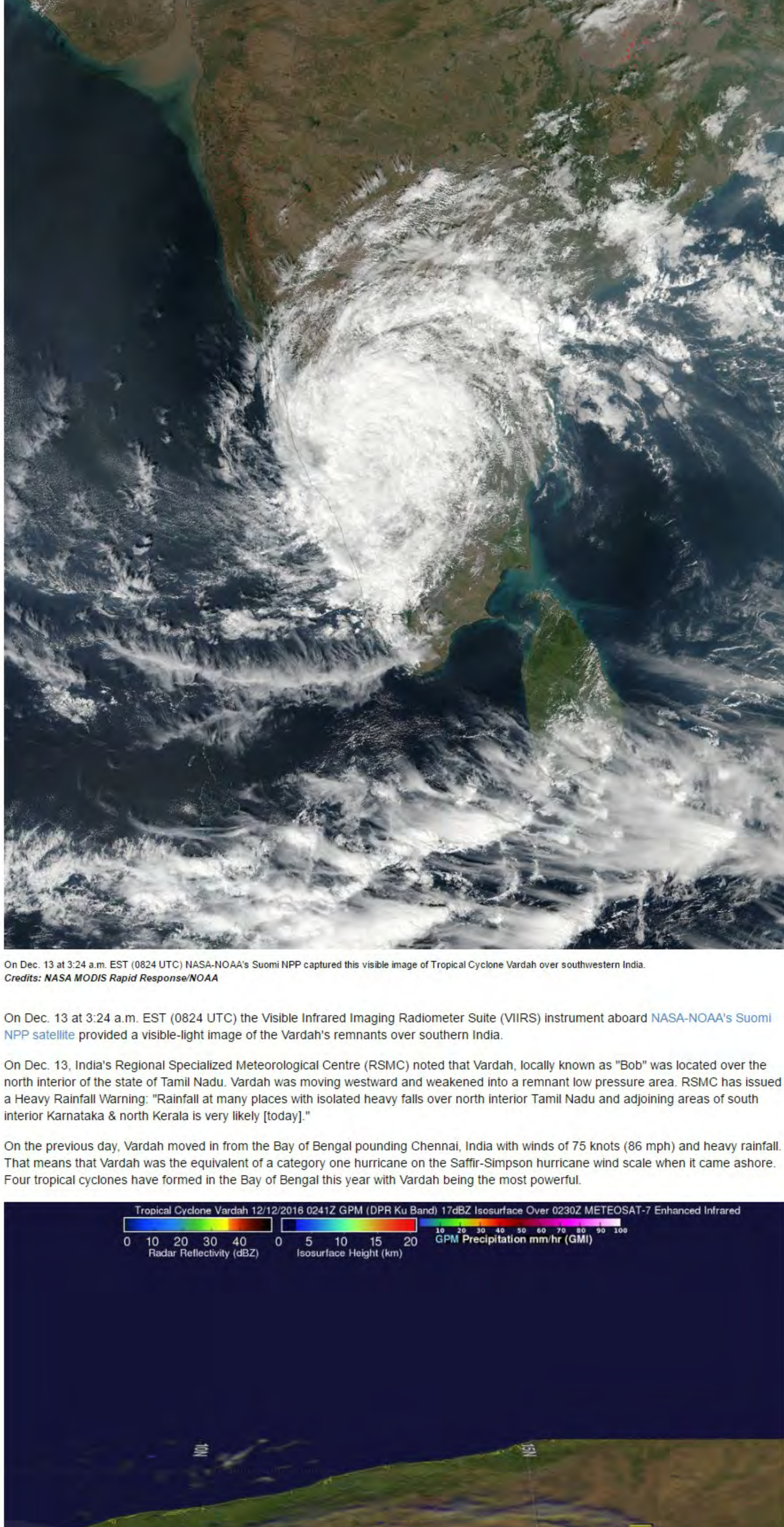


Vardah (was 05B - Northern Indian Ocean)

NASA Provides 2 Views of Former Tropical Cyclone Vardah

NASA satellite data provided a look at the cloud cover and rainfall rates within Tropical Cyclone Vardah. The Global Precipitation Measurement mission or GPM core satellite measured rainfall rates as Vardah was headed for landfall. After landfall, NASA-NOAA's Suomi NPP satellite captured an image of the storm's cloud cover as it weakened to a remnant low pressure area over southern India.

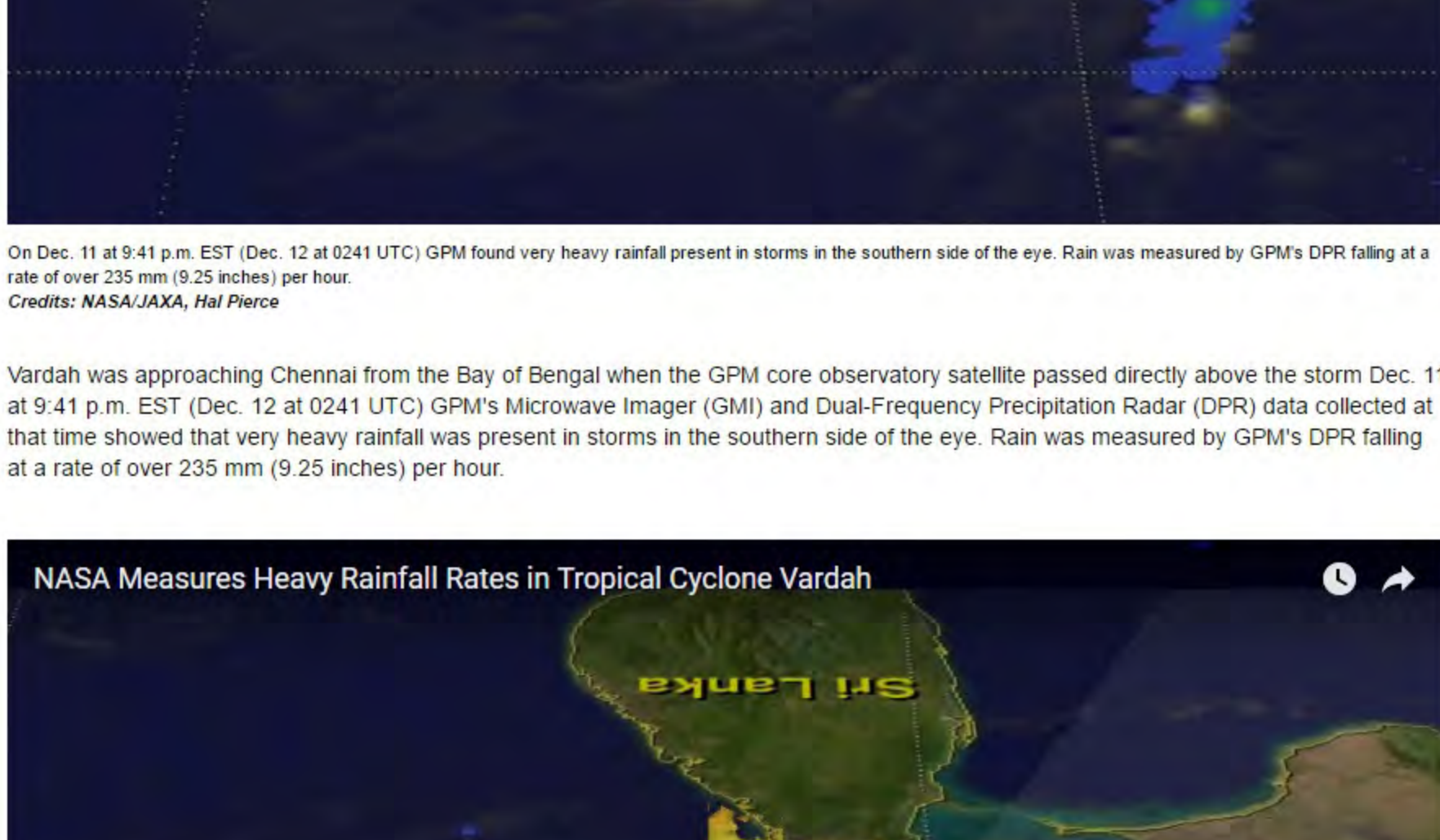


On Dec. 13 at 3:24 a.m. EST (0824 UTC) NASA-NOAA's Suomi NPP captured this visible image of Tropical Cyclone Vardah over southwestern India.
Credits: NASA MODIS Rapid Response/NOAA

On Dec. 13 at 3:24 a.m. EST (0824 UTC) the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument aboard NASA-NOAA's Suomi NPP satellite provided a visible-light image of the Vardah's remnants over southern India.

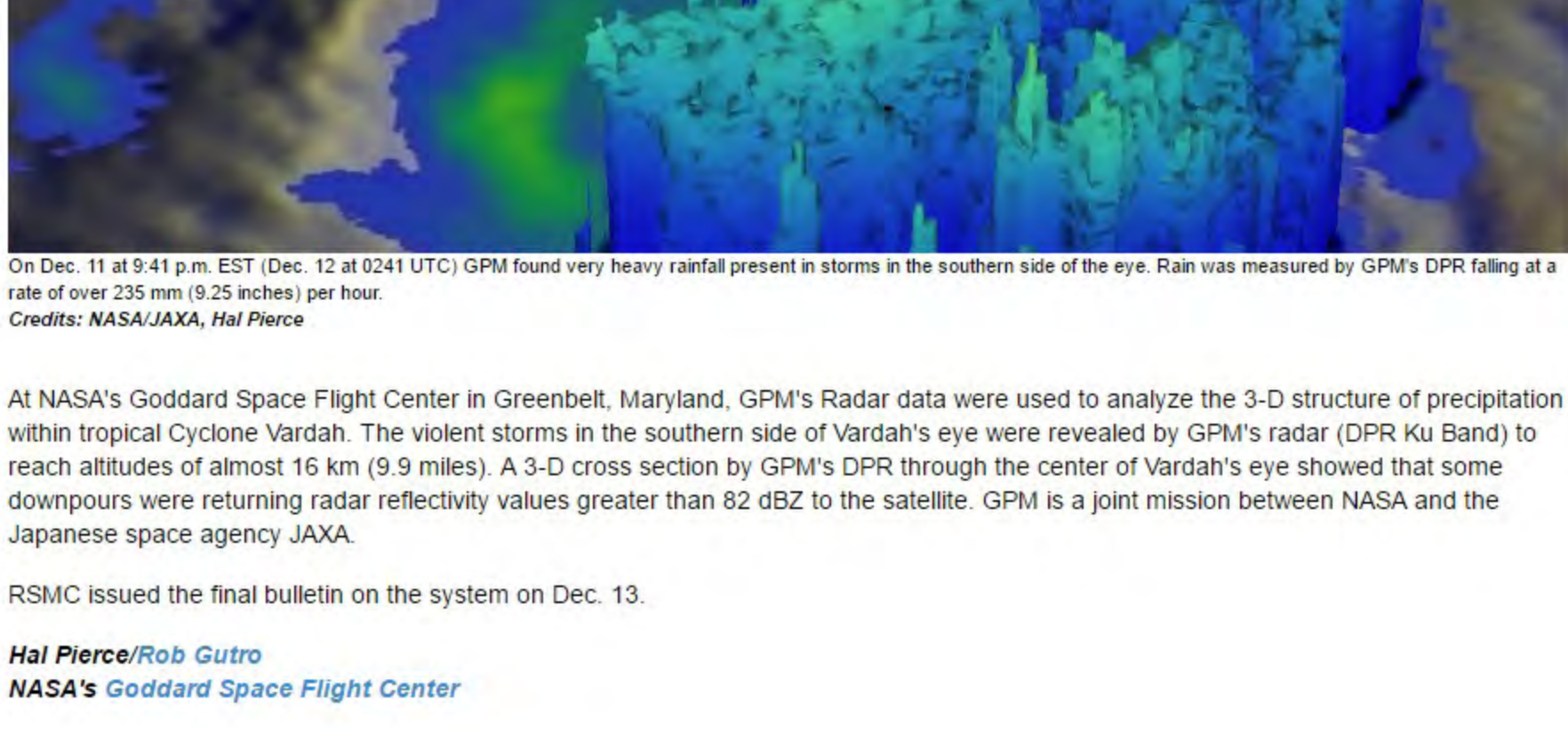
On Dec. 13, India's Regional Specialized Meteorological Centre (RSMC) noted that Vardah, locally known as "Bob" was located over the north interior of the state of Tamil Nadu. Vardah was moving westward and weakened into a remnant low pressure area. RSMC has issued a Heavy Rainfall Warning: "Rainfall at many places with isolated heavy falls over north interior Tamil Nadu and adjoining areas of south interior Karnataka & north Kerala is very likely [today]."

On the previous day, Vardah moved in from the Bay of Bengal heading Chennai, India with winds of 75 knots (86 mph) and heavy rainfall. That means that Vardah was the equivalent of a category one hurricane on the Saffir-Simpson hurricane wind scale when it came ashore. Four tropical cyclones have formed in the Bay of Bengal this year with Vardah being the most powerful.



On Dec. 11 at 9:41 p.m. EST (Dec. 12 at 0241 UTC) GPM found very heavy rainfall present in storms in the southern side of the eye. Rain was measured by GPM's DPR falling at a rate of over 235 mm (9.25 inches) per hour.
Credits: NASA/JAXA, Hal Pierce

Vardah was approaching Chennai from the Bay of Bengal when the GPM core observatory satellite passed directly above the storm Dec. 11 at 9:41 p.m. EST (Dec. 12 at 0241 UTC) GPM's Microwave Imager (GMI) and Dual-Frequency Precipitation Radar (DPR) data collected at that time showed that very heavy rainfall was present in storms in the southern side of the eye. Rain was measured by GPM's DPR falling at a rate of over 235 mm (9.25 inches) per hour.



On Dec. 11 at 9:41 p.m. EST (Dec. 12 at 0241 UTC) GPM found very heavy rainfall present in storms in the southern side of the eye. Rain was measured by GPM's DPR falling at a rate of over 235 mm (9.25 inches) per hour.
Credits: NASA/JAXA, Hal Pierce

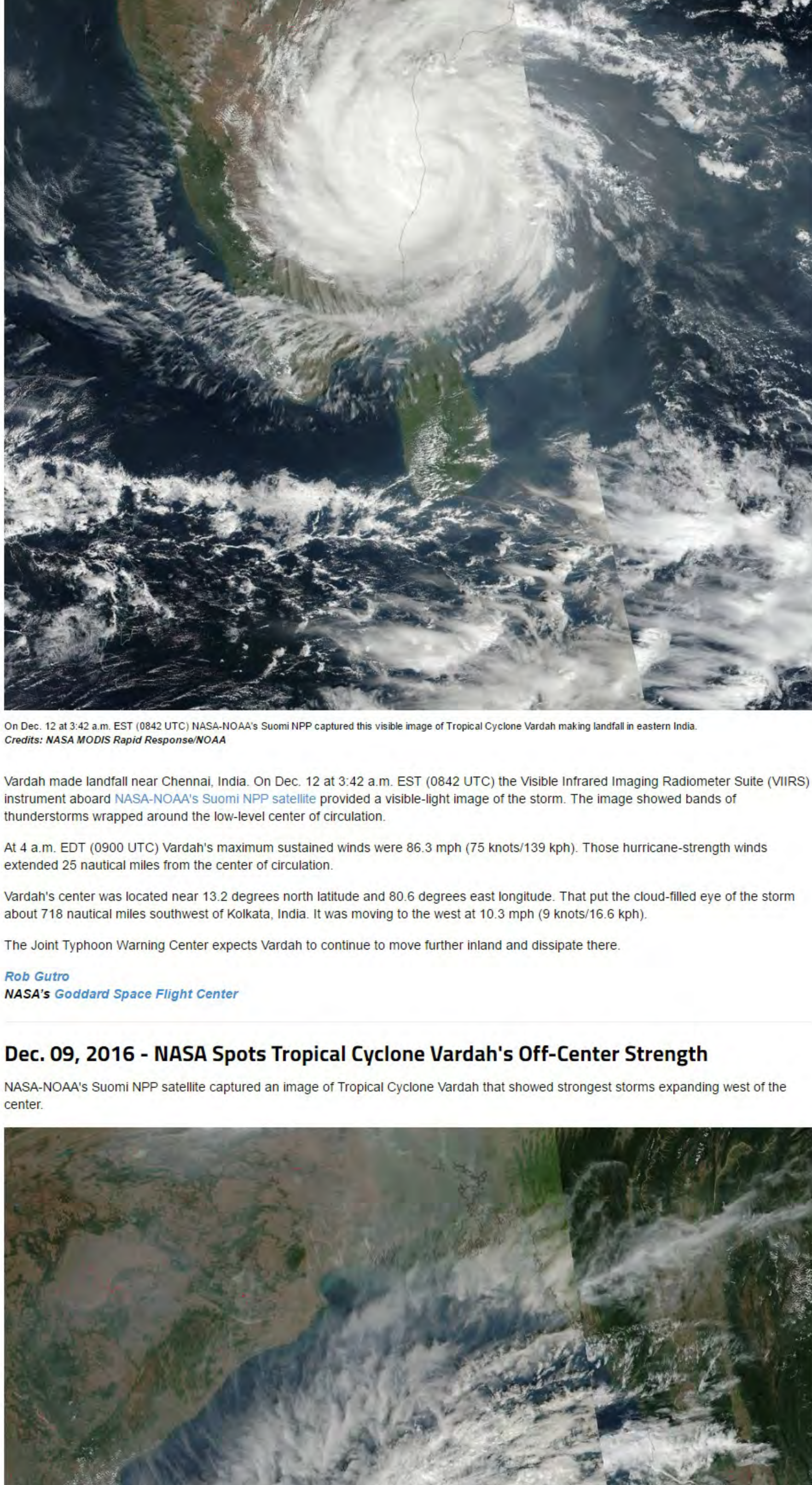
At NASA's Goddard Space Flight Center in Greenbelt, Maryland, GPM's Radar data were used to analyze the 3-D structure of precipitation within tropical Cyclone Vardah. The violent storms in the southern side of Vardah's eye were revealed by GPM's radar (DPR Ku Band) to reach altitudes of almost 16 km (9.9 miles). A 3-D cross section by GPM's DPR through the center of Vardah's eye showed that some downpours were returning radar reflectivity values greater than 82 dBZ to the satellite. GPM is a joint mission between NASA and the Japanese space agency JAXA.

RSMC issued the final bulletin on the system on Dec. 13.

Hal Pierce/Rob Gutro
NASA's Goddard Space Flight Center

Dec. 12, 2016 - NASA Sees Tropical Cyclone Vardah Make Landfall

Tropical Cyclone Vardah made landfall in eastern India as the NASA-NOAA Suomi NPP satellite passed over it from space. Vardah was hurricane-strength at the time of landfall and brought heavy rainfall and strong winds to areas of the India states of Tamil Nadu and Andhra Pradesh.



On Dec. 12 at 3:42 a.m. EST (0842 UTC) NASA-NOAA's Suomi NPP captured this visible image of Tropical Cyclone Vardah making landfall in eastern India.
Credits: NASA MODIS Rapid Response/NOAA

Vardah made landfall near Chennai, India. On Dec. 12 at 3:42 a.m. EST (0842 UTC) the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument aboard NASA-NOAA's Suomi NPP satellite provided a visible-light image of the storm. The image showed bands of thunderstorms wrapped around the low-level center of circulation.

At 4 a.m. EDT (0900 UTC) Vardah's maximum sustained winds were 86.3 mph (75 knots/139 kph). Those hurricane-strength winds extended 25 nautical miles from the center of circulation.

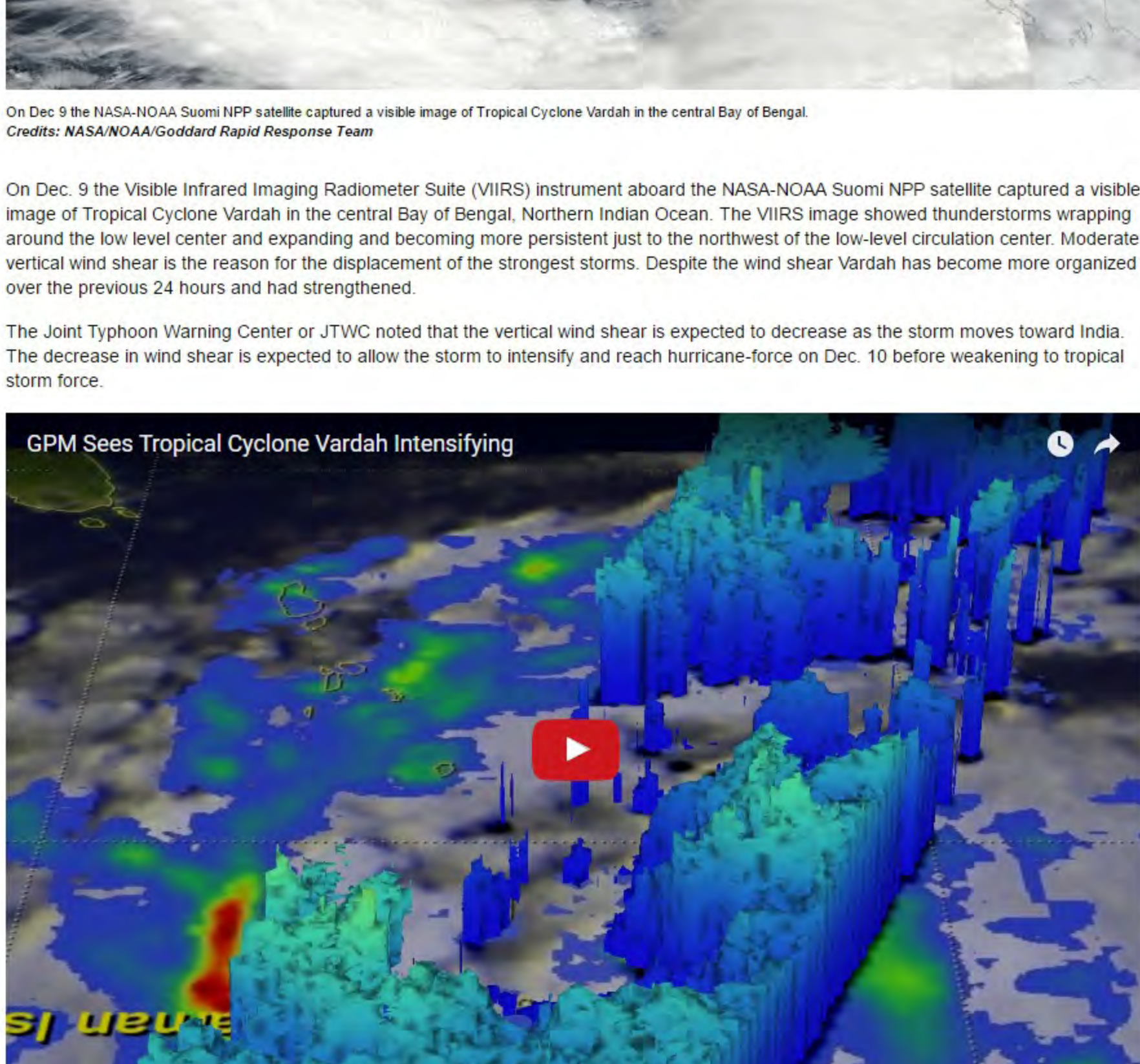
Vardah's center was located near 13.2 degrees north latitude and 80.6 degrees east longitude. That put the cloud-filled eye of the storm about 718 nautical miles southwest of Kolkata, India. It was moving to the west at 10.3 mph (9 knots/16.6 kph).

The Joint Typhoon Warning Center expects Vardah to continue to move further inland and dissipate there.

Rob Gutro
NASA's Goddard Space Flight Center

Dec. 09, 2016 - NASA Spots Tropical Cyclone Vardah's Off-Center Strength

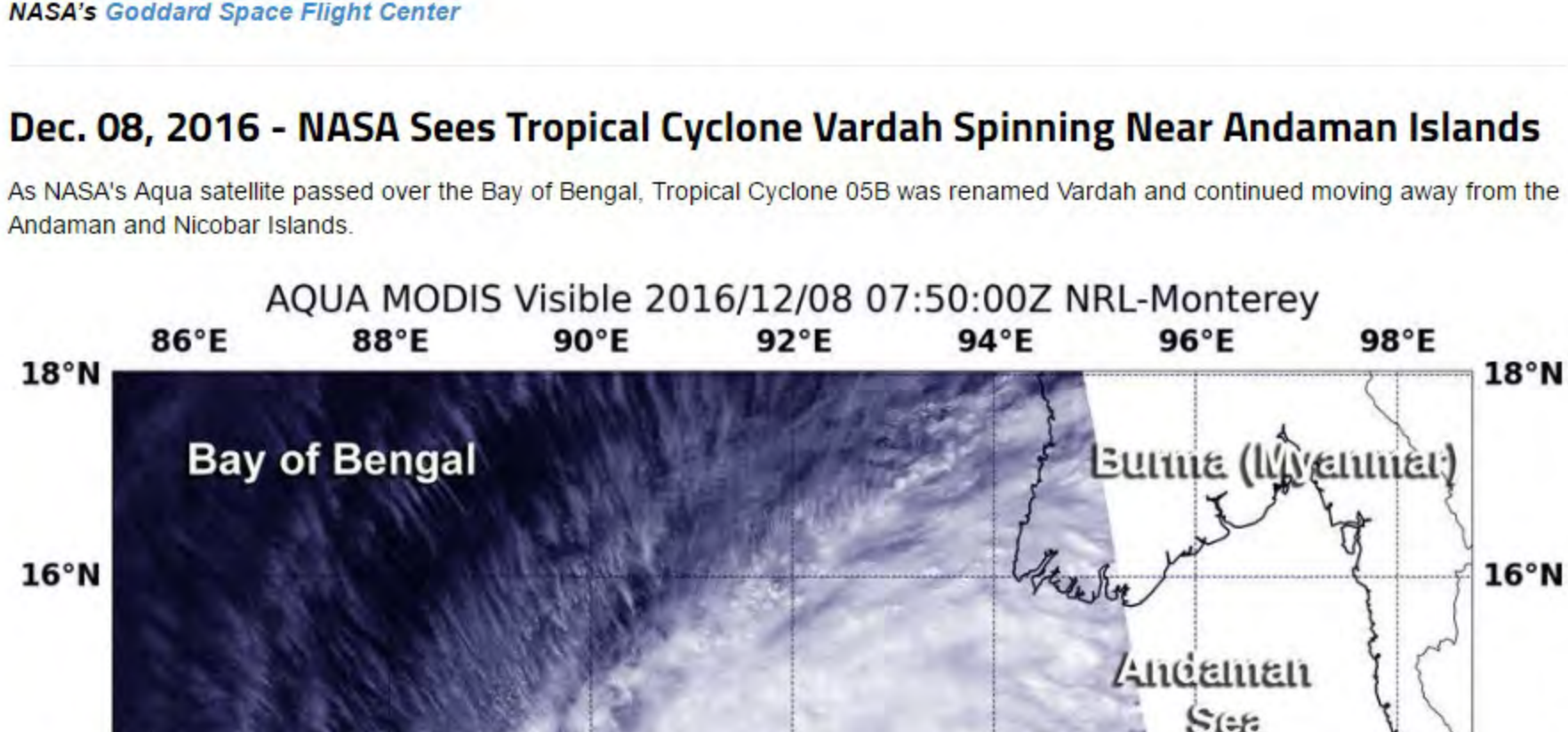
NASA-NOAA's Suomi NPP satellite captured an image of Tropical Cyclone Vardah that showed strongest storms expanding west of the center.



On Dec. 9 the NASA-NOAA Suomi NPP satellite captured a visible image of Tropical Cyclone Vardah in the central Bay of Bengal.
Credits: NASA/NOAA/Goddard Rapid Response Team

On Dec. 9 the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument aboard the NASA-NOAA Suomi NPP satellite captured a visible image of Tropical Cyclone Vardah in the central Bay of Bengal, Northern Indian Ocean. The VIIRS image showed thunderstorms wrapping around the low level center and expanding and becoming more persistent just to the northwest of the low-level circulation center. Moderate vertical wind shear is the reason for the displacement of the strongest storms. Despite the wind shear Vardah has become more organized over the previous 24 hours and had strengthened.

The Joint Typhoon Warning Center or JTWC noted that the vertical wind shear is expected to decrease as the storm moves toward India. The decrease in wind shear is expected to allow the storm to intensify and reach hurricane-force on Dec. 10 before weakening to tropical storm force.



The Global Precipitation Measurement mission or GPM core observatory satellite analyzed Tropical Cyclone Vardah on Dec. 8 at 0301 UTC. GPM's Microwave Imager (GMI) showed that two intense feeder bands were bringing moisture from the Andaman Sea into the northeastern side of the tropical cyclone. GPM's Dual-Frequency Precipitation Radar (DPR) coverage is shown in a slightly lighter shade through the center of the tropical cyclone. DPR's (Ku Band) data revealed that rain was falling at a rate of over 266 mm (10.5 inches) in some of the very strong convective storms moving around the northern side of the tropical cyclone. GPM also showed a slot of dry air moving into Vardah's southern side.
Credits: NASA/JAXA, Hal Pierce

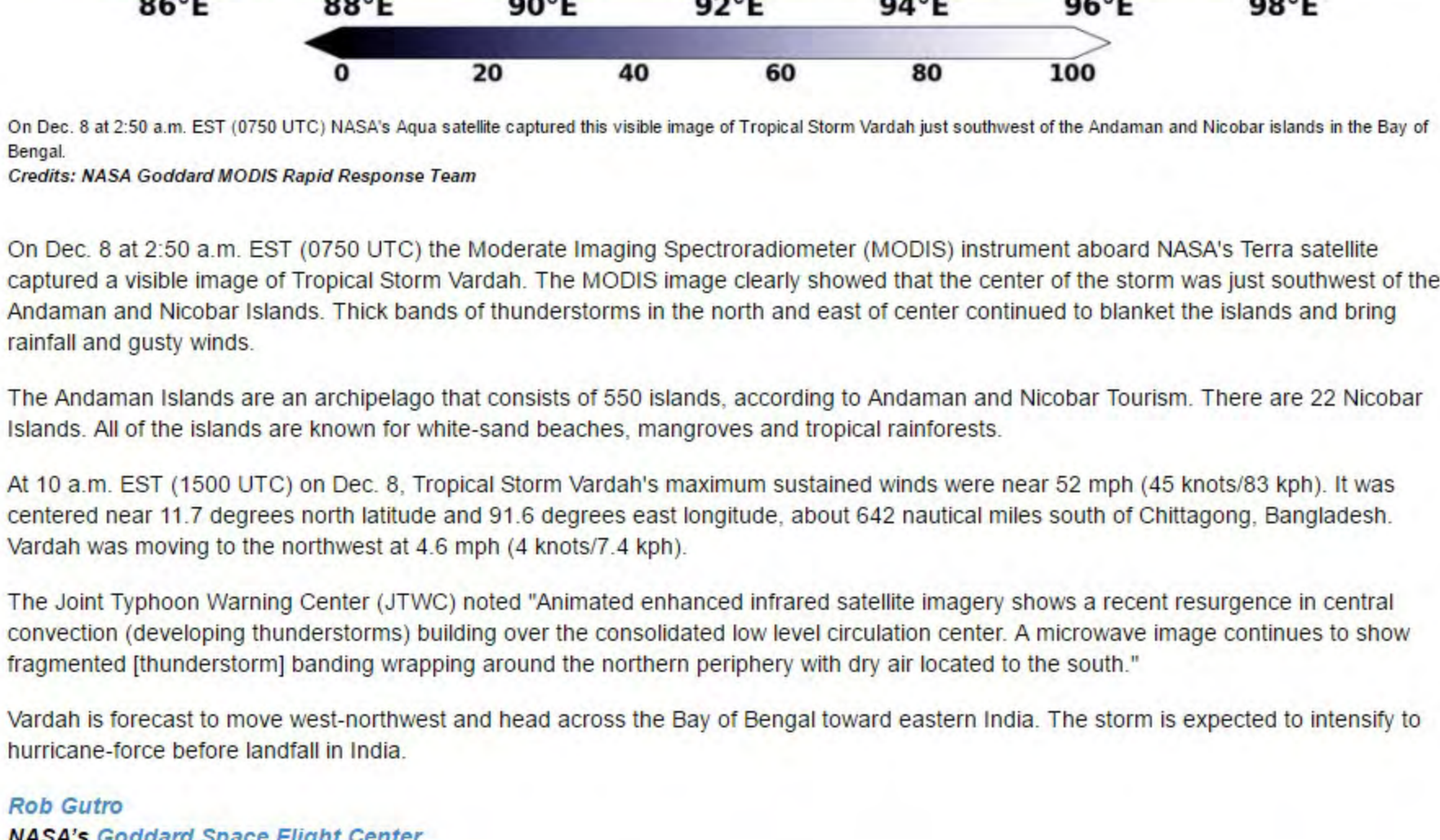
At 10 a.m. EST (1500 UTC) on Dec. 9 Tropical Cyclone Vardah had maximum sustained winds near 51.7 mph (45 knots/83.3 kph). Vardah was located near 12.1 degrees north latitude and 89.7 degrees east longitude, about 632 nautical miles south of Chittagong, India. The tropical storm was moving to the west-northwest at 8 mph (7 knots/13 kph).

The JTWC forecast expects Vardah to continue moving to the west-northwest toward India, where it is expected to make landfall as a tropical storm by Dec. 12 south of Visakhapatnam, India.

Rob Gutro
NASA's Goddard Space Flight Center

Dec. 08, 2016 - NASA Sees Tropical Cyclone Vardah Spinning Near Andaman Islands

As NASA's Aqua satellite passed over the Bay of Bengal, Tropical Cyclone 05B was renamed Vardah and continued moving away from the Andaman and Nicobar Islands.



On Dec. 8 at 2:50 a.m. EST (0750 UTC) NASA's Aqua satellite captured this visible image of Tropical Storm Vardah just southwest of the Andaman and Nicobar islands in the Bay of Bengal.
Credits: NASA Goddard MODIS Rapid Response Team

On Dec. 8 at 2:50 a.m. EST (0750 UTC) the Moderate Imaging Spectroradiometer (MODIS) instrument aboard NASA's Terra satellite captured a visible image of Tropical Storm Vardah. The MODIS image clearly showed that the center of the storm was just southwest of the Andaman and Nicobar Islands. Thick bands of thunderstorms in the north and east of center continued to blanket the islands and bring rainfall and gusty winds.

The Andaman Islands are an archipelago that consists of 550 islands, according to Andaman and Nicobar Tourism. There are 22 Nicobar Islands. All of the islands are known for white-sand beaches, mangroves and tropical rainforests.

At 10 a.m. EST (1500 UTC) on Dec. 8, Tropical Storm Vardah's maximum sustained winds were near 52 mph (45 knots/83 kph). It was centered near 11.7 degrees north latitude and 91.6 degrees east longitude, about 642 nautical miles south of Chittagong, Bangladesh. Vardah was moving to the northwest at 4.6 mph (4 knots/7.4 kph).

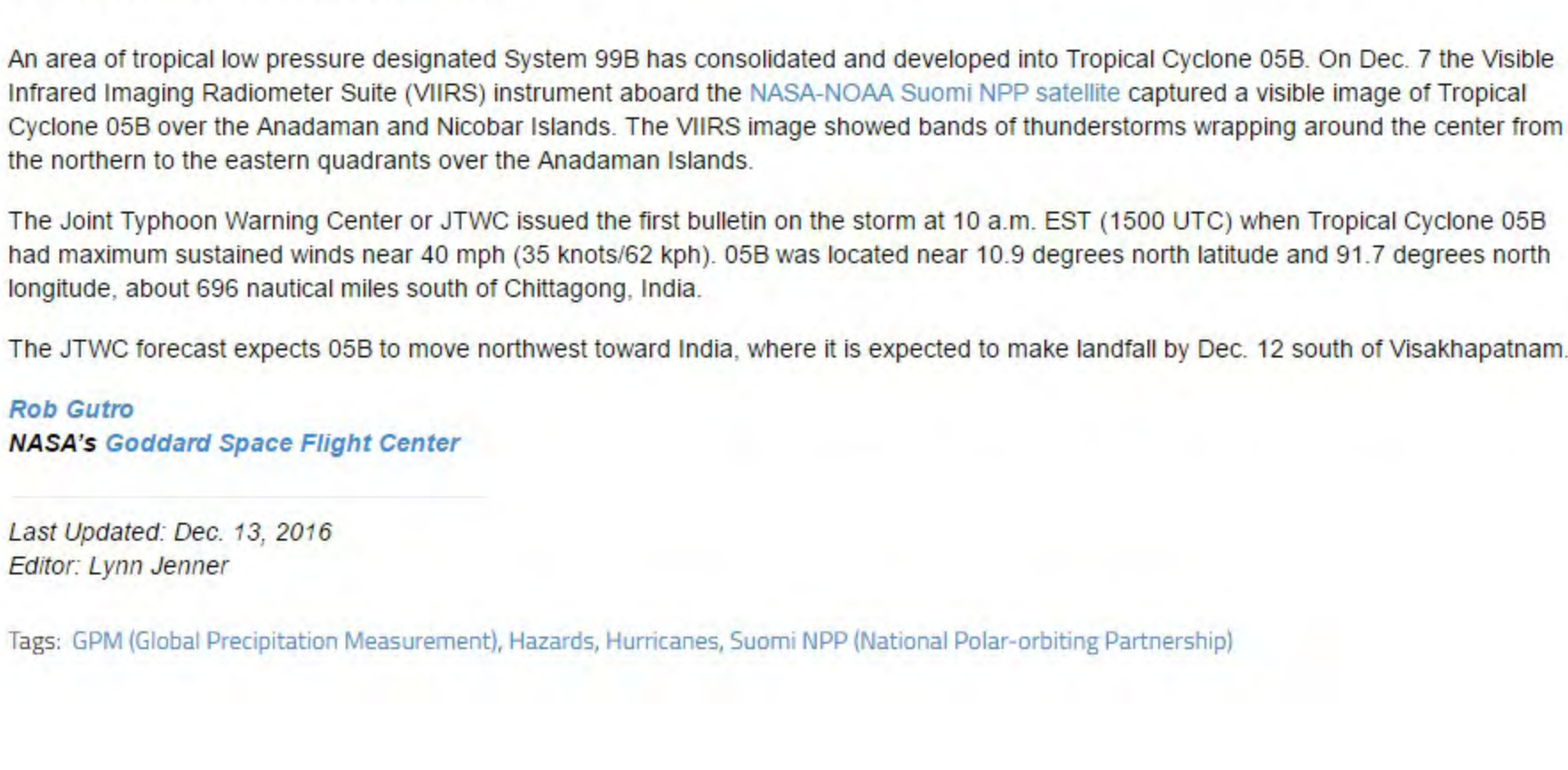
The Joint Typhoon Warning Center (JTWC) noted "Animated enhanced infrared satellite imagery shows a recent resurgence in central convection (developing thunderstorms) building over the consolidated low level circulation center. A microwave image continues to show fragmented [thunderstorm] banding wrapping around the northern periphery with dry air located to the south."

Vardah is forecast to move west-northwest and head across the Bay of Bengal toward eastern India. The storm is expected to intensify to hurricane-force before landfall in India.

Rob Gutro
NASA's Goddard Space Flight Center

Dec. 07, 2016 - NASA Sees Tropical Cyclone 05B Form

NASA-NOAA's Suomi NPP satellite captured an image of newly formed Tropical Cyclone 05B in the Bay of Bengal, Northern Indian Ocean.



On Dec. 7 the NASA-NOAA Suomi NPP satellite captured a visible image of Tropical Cyclone 05B in the Bay of Bengal.
Credits: NASA/NOAA/Goddard Rapid Response Team

An area of tropical low pressure designated System 99B has consolidated and developed into Tropical Cyclone 05B. On Dec. 7 the Visible Infrared Imaging Radiometer Suite (VIIRS) instrument aboard the NASA-NOAA Suomi NPP satellite captured a visible image of Tropical Cyclone 05B over the Andaman and Nicobar Islands. The VIIRS image showed bands of thunderstorms wrapping around the center from the northern to the eastern quadrants over the Andaman Islands.

The Joint Typhoon Warning Center or JTWC issued the first bulletin on the storm at 10 a.m. EST (1500 UTC) when Tropical Cyclone 05B had maximum sustained winds near 40 mph (35 knots/62 kph). 05B was located near 10.9 degrees north latitude and 91.7 degrees north longitude, about 696 nautical miles south of Chittagong, India.

The JTWC forecast expects 05B to move northwest toward India, where it is expected to make landfall by Dec. 12 south of Visakhapatnam.

Rob Gutro
NASA's Goddard Space Flight Center

Last Updated: Dec. 13, 2016
Editor: Lynn Jenner

Tags: GPM (Global Precipitation Measurement), Hazards, Hurricanes, Suomi NPP (National Polar-orbiting Partnership)