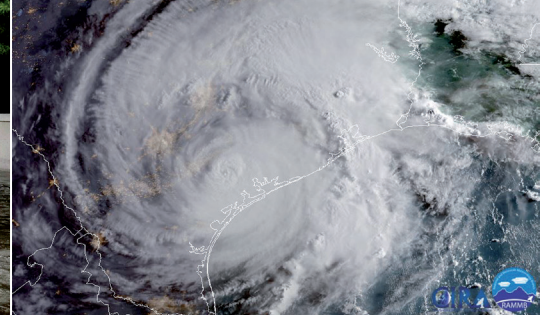




# GOES-R Hurricane Monitoring

## What are the advantages of monitoring hurricanes from space?

Hurricanes are one of the most menacing natural hazards, especially for island and coastal populations. Continuous monitoring of these events as they unfold is of utmost priority to forecasters as storms bear down on



Left: Texas National Guard soldiers arrive in Houston to aid residents in heavily flooded areas from the storms of Hurricane Harvey on August 27, 2017. Texas Army National Guard photo by 1st Lt. Zachary West. Right: GOES-16 GeoColor image of Hurricane Harvey on August 26, 2017, after it made landfall on the Texas coast. Credit: NOAA/CIRA

hazard-prone areas. From their vantage point in geostationary orbit, the GOES East and GOES West satellites continuously view the entire Atlantic and Eastern/Central Pacific hurricane basins to forecast, track and monitor hurricanes as well as the environmental conditions that cause them to form.

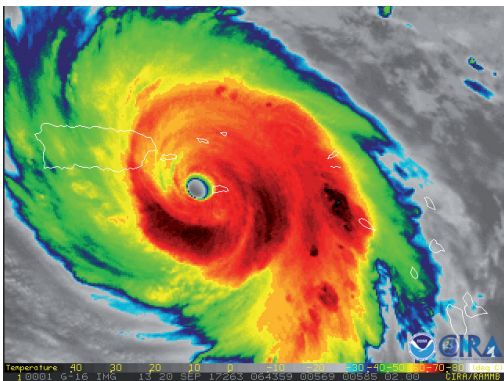
## How do GOES-R Series satellites monitor hurricanes?

NOAA maintains two operational GOES satellites, GOES East in view of the Atlantic hurricane basin, and GOES West over the Eastern/Central Pacific basin. With such a wide view of the Western Hemisphere, the new GOES-R Series satellites are in position to monitor the environmental conditions that spawn hurricanes, including **vertical wind shear**, **sea surface temperatures**, and the **Saharan Air Layer (SAL)**. The SAL is a dry and sometimes dust-laden layer of the troposphere that often stabilizes the environment around tropical systems as it traverses across the Atlantic Ocean basin. Most of the properties associated with the SAL deter hurricane development.

Equipped with an **Advanced Baseline Imager (ABI)**, GOES-R Series satellites can monitor environmental conditions in high-resolution detail to help identify tropical storms as they're developing. Once a hurricane forms, ABI can monitor the storm in near real-time, identifying cloud features and patterns, and providing crucial estimates of central pressure and maximum sustained winds.

## What improvements do GOES-R Series satellites bring to hurricane monitoring?

ABI is able to scan a targeted area of interest as often as every 30 seconds, providing **unprecedented real-time monitoring of a storm from space**. Faster image frequency allows forecasters to more easily discern the movement of cloud features and provide greater confidence in estimating the center of the storm and its wind speeds. The added confidence in locating the center of circulation also helps guide reconnaissance aircraft ("hurricane hunters") to the correct location. Rapid-scan imagery of intense hurricanes just prior to or during landfall can improve the ability to observe quickly evolving changes in the storm's intensity and convective structure during this critical part of the warning process.



GOES-16 infrared imagery of Hurricane Maria approaching Puerto Rico on September 20, 2017. The dark red color, like that near the eyewall of the storm, corresponds to areas of greatest convective intensity. Credit: NOAA/CIRA

**ABI has additional channels not available from previous GOES.** New infrared channels help forecasters better determine how cold cloud tops are and how rapidly they are cooling, which aids predictions for rainfall intensity and potential flash flooding associated with hurricane rain bands. For instance, the "clean" longwave infrared window channel is used to monitor cloud characteristics and hurricane eye temperatures.

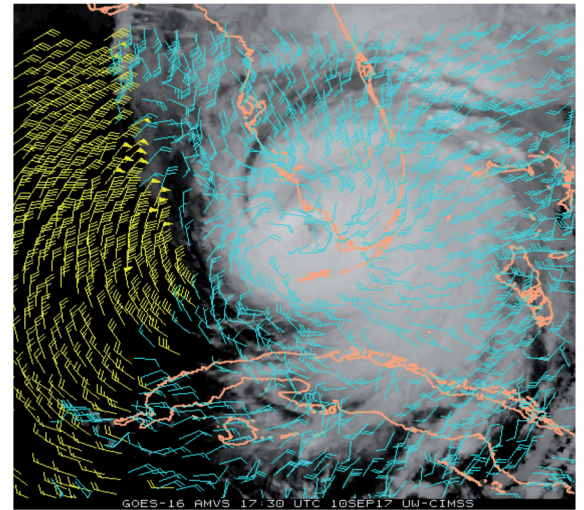
The ABI's improved spatial resolution (four times greater than previous GOES imagers) also helps forecasters **better identify storm cloud patterns and analyze the intensity of a hurricane**. For



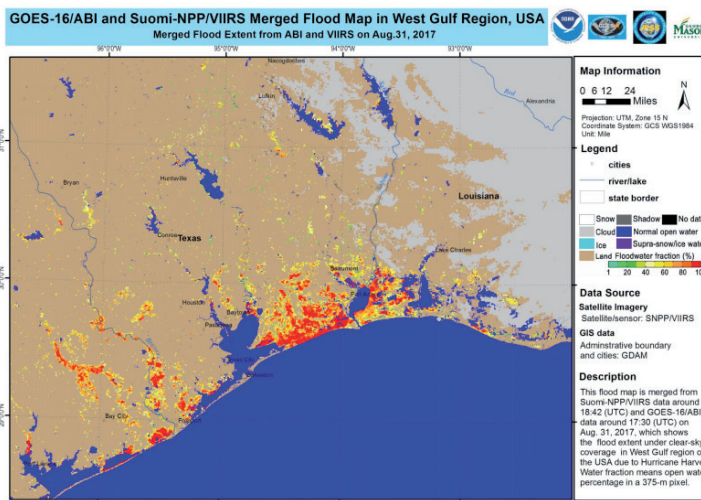
example, subtle details in the storm’s convective organization or the emergence of an eye can alert forecasters of impending intensity fluctuations. The **Dvorak Technique** (forecaster assessment) and **Advanced Dvorak Technique** (computer-based) are common methods to estimate hurricane intensity from satellite imagery, and are benefiting from the improved spatiotemporal sampling of the GOES-R Series ABI.

The ability to characterize the wind fields in and around a hurricane is critical to predicting future storm motion and intensity. **Atmospheric motion vectors (AMVs) are estimates of wind**, determined by tracking clouds and moisture features in successive satellite images. The improved spatial resolution and faster scanning from the ABI enable higher quantity and quality of AMV wind estimates. These AMVs are then fed to numerical weather prediction models to improve initial analyses, which leads to better forecasts.

Research has shown that lightning can correlate with hurricane intensity changes. **The Geostationary Lightning Mapper (GLM)**, the first operational lightning mapper flown in geostationary orbit, is a new capability that is enhancing the observation of lightning activity in hurricanes. GLM provides higher detection efficiency, including continuous observations of total lightning (cloud-to-ground and in-cloud), and better observations over oceans. **GLM can help forecasters predict future hurricane rapid intensification up to 24 hours ahead of time.**



GOES-16 atmospheric motion vectors for Hurricane Irma on September 10, 2017. High-level winds are shown in cyan, and low-level winds in yellow. Credit: CIMSS/NOAA



This map highlights the large areas of land flooded by Hurricane Harvey in the Gulf Region as of August 31, 2017. Flooding is seen in yellow, orange and red. Brown is land, and dark blue is normal water levels within bodies of water. Credit: NOAA/George Mason University.

**New NOAA flood map products**, developed by scientists at George Mason University with NOAA support, use data from the NOAA-NASA Suomi NPP, NOAA-20, GOES-16, and GOES-17 satellite imagers. The maps, along with aircraft, unmanned drones, and ground assets help determine the impact of a storm. They give the Federal Emergency Management Agency (FEMA), local emergency managers, and first responders important information about the location and extent of flooding associated with landfalling hurricanes, how long it will last, and what damage the flood is causing. The maps allow officials to quickly determine where to employ limited resources during a flood. They also allow for insight into where water is receding and when it’s safe for people to return to their homes.

and improve economic efficiency by issuing the best watches, warnings, forecasts, and analyses of hazardous tropical weather and by increasing understanding of these hazards.

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**Related links:**

**National Hurricane Center and Central Pacific Hurricane Center:** <https://www.nhc.noaa.gov/>

**NOAA tropical system data products:** <http://bit.ly/2WKfDCR>