GOES-R
GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE R-SERIES

QUARTERLY NEWSLETTER ■ APRIL–JUNE 2020 ■ ISSUE 30

A Note from Pam Sullivan, GOES-R System Program Director:

As we continue operations with most personnel working remotely and on-site work limited to mission-critical activities, the GOES-R team continues to shine. We delivered the GOES-T ABI and GLM instruments and integrated them with the spacecraft. We completed testing of the Goddard Magnetometers and they will ship this month. GOES-T is preparing for environmental testing. We are restarting work at NOAA operational facilities to support current GOES-16/17 operations, GOES-T launch preparations, and a ground system upgrade. Our satellites continue to provide critical data and imagery to forecasters. I continue to be amazed at just how well we've adapted to our new working conditions. Thank you all for your hard work and ingenuity in keeping this critical mission going!

PROGRAM HIGHLIGHTS

Progress continues on GOES-T integration and testing in preparation for a December 2021 launch. The Geostationary Lightning Mapper (GLM) and Advanced Baseline Imager (ABI) sensor units completed successful Pre-Shipment Reviews, were delivered to Lockheed Martin in Littleton, Colorado, and were integrated with the GOES-T spacecraft. The Goddard Magnetometer (GMAG) electronics units were also delivered for spacecraft integration. The GOES-R flight project successfully completed a NASA

Technicians at Lockheed Martin conduct GOES-T satellite integration activities. Credit: Lockheed Martin

DID YOU KNOW?

The Geostationary Lightning Mapper (GLM) takes a new image of Earth every 2 milliseconds, a rate 20 times faster than a regular video camera. In the time it takes for the light from a lightning stroke to travel from the cloud top to the satellite, GLM has already taken more than 60 new images. To date, the GOES-16 and GOES-17 GLMs have taken about 90 billion images!

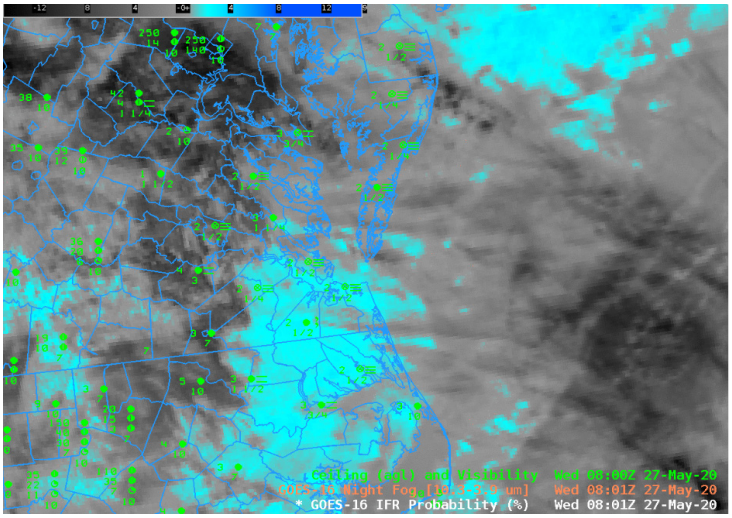
PROGRAM HIGHLIGHTS (CONTINUED)

Goddard Space Flight Center (GSFC) Restart Readiness Review for testing of the GMAG sensor units in early June. The GMAG sensor units are expected to ship in July, completing GOES-T instrument deliveries. The GOES-T spacecraft Pre-Environmental Review is planned for August, with satellite-level environmental testing scheduled to begin in October.

The NOAA Office of Satellite and Product Operations implemented the GOES-17 (GOES-West) ABI mode 3 cooling timeline April 9 – May 1. This operation mitigates the number of saturated images resulting from the loop heat pipe temperature regulation anomaly. In this timeline, ABI generates a single full disk once per 15 minutes and generates one mesoscale domain sector (MDS) each minute for a six-hour period each day. The contiguous United States (CONUS) domain is not scanned during the timeline, as those periods are used for cooling. The previous cooling operation reduced the daily peak focal plane module temperature by ~4 Kelvin, which shortened the period of lost imagery by 30–90 minutes. For most channels and on most days, that means an additional 50–150 MDS images, 2–8 CONUS images, and 2–6 full disk images. The same timeline will occur seasonally in operations for four periods each year. The next cooling timeline is scheduled for August 12 – September 1.

GOES-U development activities continue. The Naval Research Laboratory received approval to bring its integration and testing team back onsite to begin assembly of the first Compact Coronagraph (CCOR-1), which will fly on GOES-U. The GOES-R flight project completed a Restart Readiness Review on May 27 and received approval to restart CCOR manufacturing efforts at GSFC.

On June 17, NOAA's Satellite and Information Service declared the GOES-16 ABI fog/low stratus (FLS) data product ready for operations. The GOES-16 FLS algorithm utilizes machine learning and data fusion to determine the probability of critical aviation flight rule conditions. The data will be available to users after data distribution system updates, likely in July.



GOES-16 nighttime fog brightness temperature difference imagery shows dense fog over Virginia on May 27. More info and animation of this example available at the GOES-R Fog Blog. Credit: NOAA/SSEC

The GOES-R Program completed a successful Restart Readiness Review on June 26 to resume work at NOAA operational facilities. The restart work will support current GOES-16 and GOES-17 operations, GOES-T launch preparations, and a ground system upgrade. The GOES-R ground system project is also developing improved remote access development capabilities to support these activities.

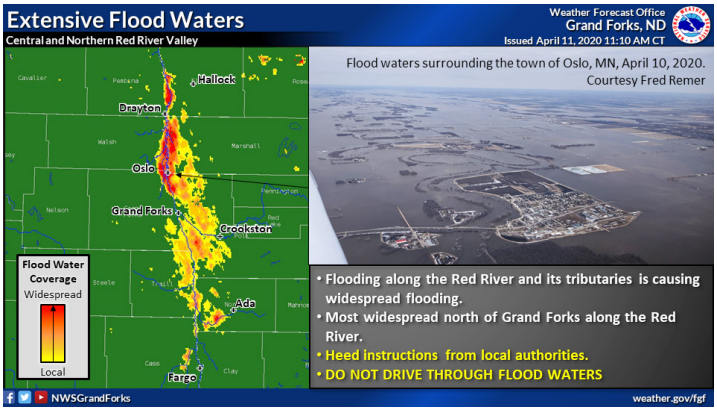
Trade studies are in progress to finalize the satellite constellation and payload configuration for the Geostationary and Extended Orbits (GEO-XO) mission. GEO-XO is the mission that will follow the GOES-R Series Program. A number of NOAA and industry observational capability studies and quantitative value assessments are also underway, as are efforts to define the operational ground system. Future scenario assessments and user needs will also inform the requirements for GEO-XO. The program is working toward the determination of initial requirements by the end of calendar year 2020 and a Mission Concept Review in early 2021.

IMAGERY AND SCIENCE APPLICATIONS

An interview with GOES-R Program Scientist, Dan Lindsey, aired on the Weather Channel Weather Geeks podcast on April 8. The episode, "With Severe Weather, Anything GOES," included a description of how we use satellites to observe the weather, the improvements that have come with GOES-16 and GOES-17, how satellite data is used to help model forecasts, what we can see with severe storms, and a short discussion on planning for future satellites. The podcast is an extension of the Weather Geeks TV show and is hosted by Marshall Shepherd, director of the Atmospheric Sciences Program at the University of Georgia and 2013 president of the American Meteorological Society. The podcast looks at how weather intersects with technology, pop culture,

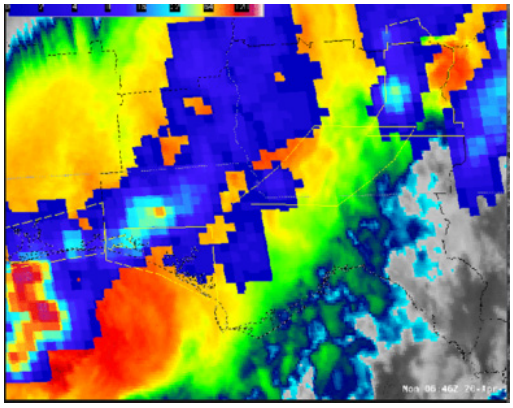
industry — and everything in between — and includes in-depth conversations from the biggest names in weather and earth sciences.

GOES-16 (GOES-East) data assisted National Weather Service (NWS) Grand Forks, North Dakota, flood operations on April 10. Moderate to major flooding was occurring along the Red River and its tributaries within the central and northern basin. Satellite river flood products provided excellent details for gauging flooding impacts from river and overland flooding. The imagery was also useful in public messaging about the event.



Decision support services graphic issued by NWS Grand Forks on April 10. Credit: NOAA NWS.

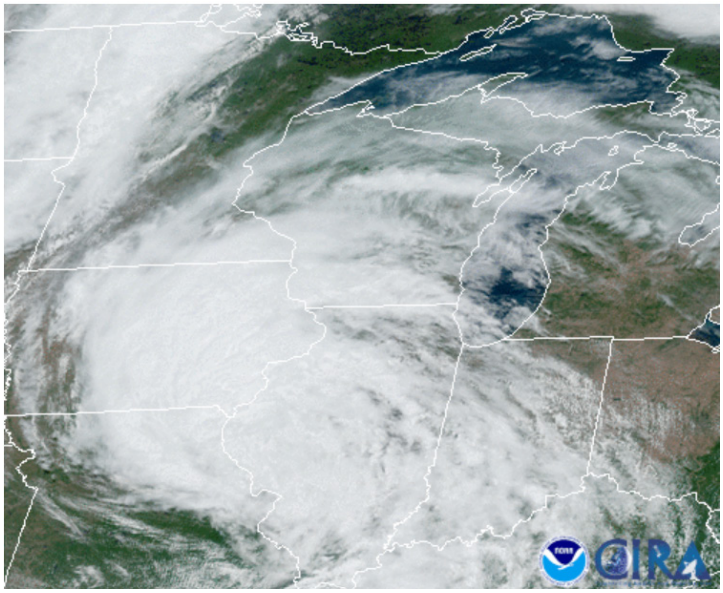
GOES-16 (GOES-East) provided critical information for NWS warning operations on April 19, when severe thunderstorms developed across the Southeast**.** Data from area radars were unavailable/intermittent during the event and NWS relied on satellite and lightning data for warning decisions. The primary tools used following the loss of radar data was GOES-East infrared (IR) imagery and total lightning data from both ground-based Earth Networks and the GOES-East GLM. GOES-East provided confidence in continuing severe weather warnings, as well as the later decision to let warnings expire. More info and imagery of the April 19 Southeast storms at the Satellite Liaison Blog



GOES-East infrared imagery, GLM flash extent density product, and NWS severe thunderstorm (yellow) and tornado (red) warning polygons for the April 19 storm. Credit: NOAA NWS

Eos, science news by the American Geophysical Union, published an article on April 24 highlighting the use of GLM data by NWS**.** A greater understanding of lightning mechanisms is spurring the development of more accurate weather forecasting, increased public health precautions, and a more sophisticated understanding of lightning itself.

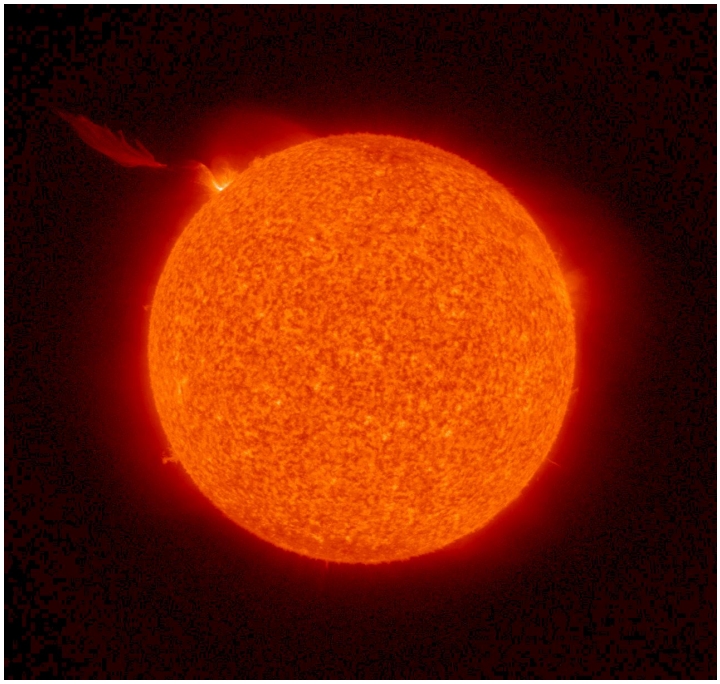
The 2020 Atlantic hurricane season got off to an early and busy start. Tropical Storm Arthur formed on May 17, becoming the first named storm of the 2020 Atlantic hurricane season, which didn't officially begin until June 1. On May 27, Tropical Storm Bertha quickly formed and made landfall to the east of Charleston, South Carolina, in less than two hours. This is the sixth year in a row that a named storm has formed before June. Tropical Storm Cristobal, the third named storm of the Atlantic hurricane season, formed over the southwestern Gulf of Mexico on June 2. Cristobal set a record as the earliest incidence of a third named storm in the Atlantic basin. Cristobal went on to break other records. On June 9, the remnants of Cristobal entered Wisconsin. This was the farthest northwest a tropical system has traveled in North America and the first that crossed Lake Superior since records began in 1850. It also had the lowest pressure ever (988 millibars) recorded in Madison, Wisconsin, in June. The previous record was 990.2 millibars on June 1, 1936.



On June 9, GOES-16 (GOES-East) watched the remnants of Cristobal entering Wisconsin. Credit: NOAA/CIRA

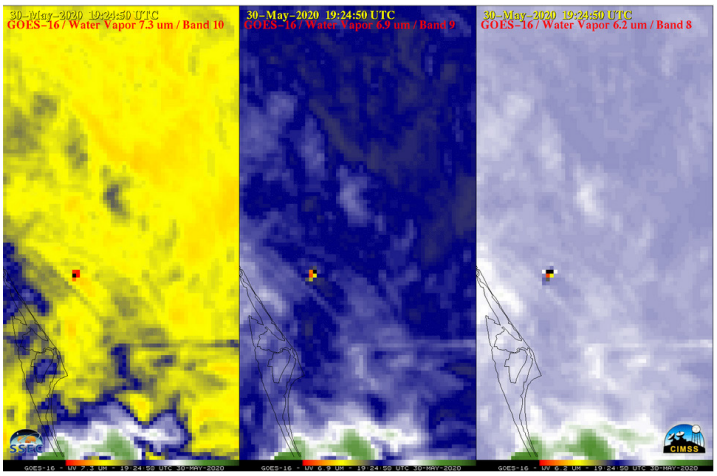
The GOES-16 (GOES-East) Solar Ultraviolet Imager (SUVI) observed two solar flares on the morning of May 29, the first significant solar activity since October 2017. This may be a sign of the sun's solar cycle ramping up and becoming more active. As the sun moves through its natural 11-year cycle, in which its activity rises and falls,

sunspots rise and fall in number, too. NASA and NOAA track sunspots to determine and predict the progress of the solar cycle — and ultimately, solar activity. Currently, scientists are paying close attention to the sunspot number as it's key to determining the dates of solar minimum, which is the official start of Solar Cycle 25. It takes at least six months of solar observations and sunspot-counting after a minimum to know when it's occurred. Because that minimum is defined by the lowest number of sunspots in a cycle, scientists need to see the numbers consistently rising before they can determine when exactly they were at the bottom. That means solar minimum is an instance only recognizable in hindsight. This new sunspot activity could be a sign that the sun is possibly revving up to the new cycle and has passed through the minimum. View animation of the solar flares.



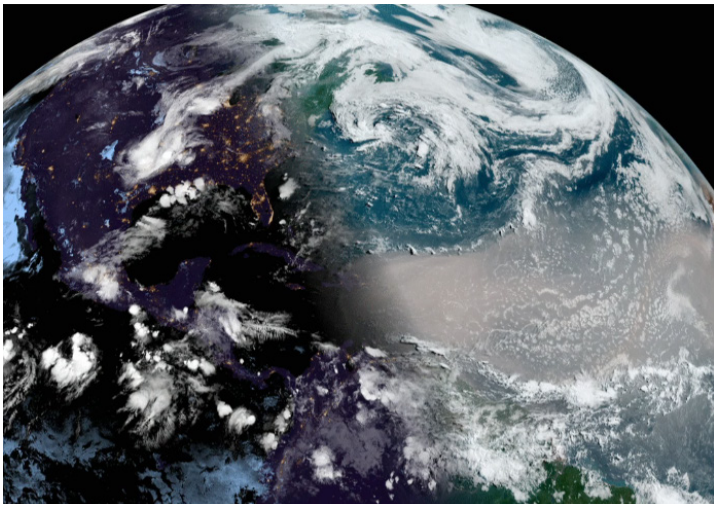
Solar flare observed by the GOES-16 SUVI instrument on May 29. Credit: NOAA

GOES-16 and GOES-17 mesoscale sector coverage was provided for the successful launch of the SpaceX Falcon 9 Dragon Demo-2 mission from Cape Canaveral Air Force Station on May 30. This launch, the first launch of American astronauts from U.S. soil since 2011, carried NASA astronauts Robert Behnken and Douglas Hurley to the International Space Station. The one-minute imagery was used to characterize the atmosphere near the launch and in launch analysis. View animations of the launch at the CIMSS Satellite Blog.



GOES-16 low-level (7.3 µm, left), mid-level (6.9 µm, center) and upper-level (6.2 µm, left) water vapor images show the thermal signature of hot combustion byproducts (water vapor and carbon dioxide) in the wake of the Falcon 9 booster engines from the Demo-2 launch on May 30. Credit: CIMSS

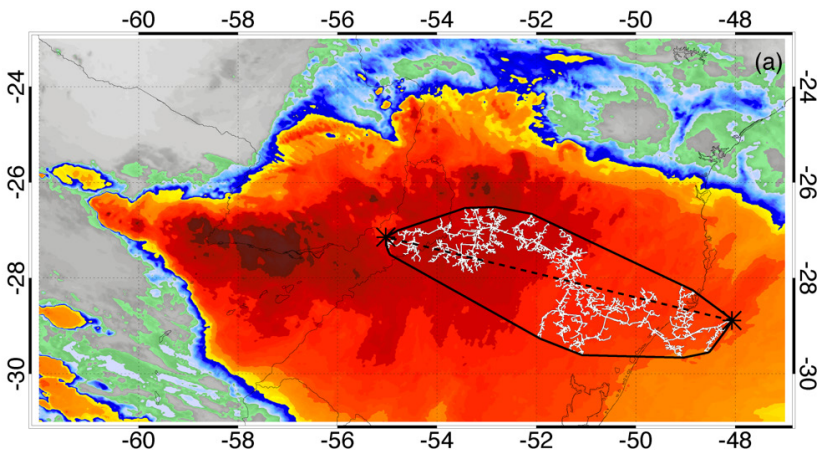
GOES-16 (GOES-East) monitored a large plume of Saharan dust as it traveled from Africa's west coast across the Atlantic Ocean, into the Caribbean, and up through the Gulf of Mexico in June. View an animation of true color and nighttime dust imagery of the plume from June 8 – June 28 from our partners at the CIMSS Satellite Blog. The Saharan Air Layer (SAL), a dry and sometimes dust-laden layer of the troposphere, forms over the Sahara Desert and moves westward across the tropical North Atlantic. While Saharan dust transport across the Atlantic Ocean is not uncommon, the size and strength of this particular event was unusual. Learn more about the Saharan Air Layer and how NOAA tracks it with satellites.



GOES-16 GeoColor imagery of Saharan dust reaching the Caribbean on June 22. View animation of this imagery. Credit: NOAA/CIRA

IMAGERY AND SCIENCE APPLICATIONS (CONTINUED)

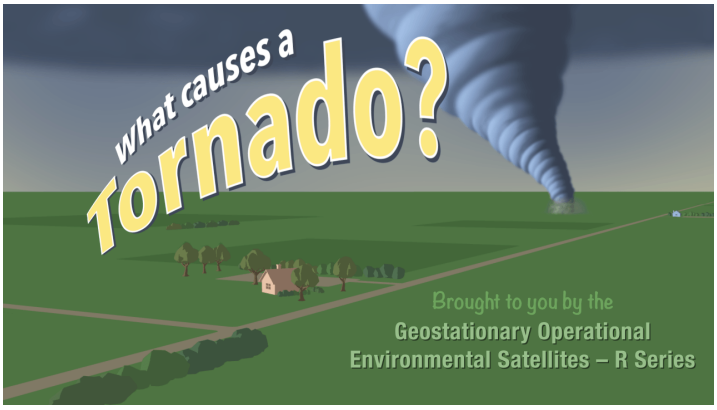
On June 25, the World Meteorological Organization (WMO) certified two new lightning "megaflash" records. A panel of experts confirmed new world records for the longest reported distance for a single lightning flash (440 miles) in Brazil in 2018, and the longest duration of a single lightning flash (16.73 seconds) in Argentina in 2019. The panel used data from the GOES-16 GLM to verify the records. View an animation of this flash.



GOES-16 image of record extent of lightning flash over Brazil on October 31, 2018. Credit: Michael Peterson

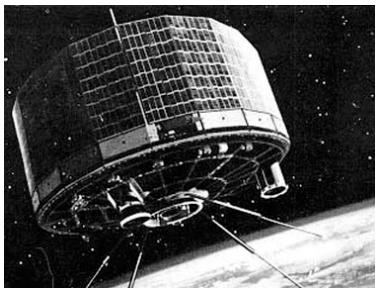
EDUCATION AND OUTREACH

The swirling, funnel-shaped winds of a tornado are easily recognizable—and they can be very dangerous. But what causes these unique and violent weather phenomena? A new animated video explains how a tornado forms and also how satellites help forecasters warn us when severe weather might lead to a tornado.



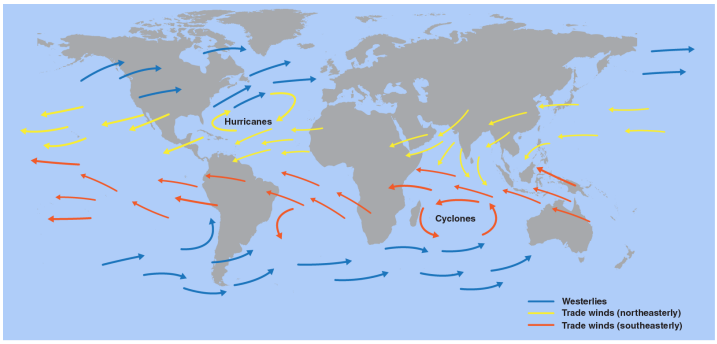
What causes a tornado? Credit: NOAA SciJinks

On April 1, 1960, NASA launched TIROS-1, the world's first successful meteorological satellite. Since then, NASA and NOAA have worked together to launch satellites that track clouds, oceans, carbon dioxide, atmospheric ozone and more. The latest generation of satellites, GOES-R and the Joint Polar Satellite System (JPSS), monitor lightning flashes, hurricanes, wildfires, sea ice, electric lights, solar activity and so much more! These satellites are significantly enhancing our understanding of the Earth as a whole system. A new story map looks at the value and importance of the nation's weather satellites and game-changing moments in their 60-year history.



Artist rendering of the TIROS-1 satellite: Credit: NASA

A new article from NOAA SciJinks, published April 15, explains trade winds. The trade winds are winds that reliably blow east to west just north and south of the equator. The winds help ships travel west, and they can steer storms such as hurricanes, too. GOES-East keeps an eye on how trade winds impact the movement of hurricanes and tropical storms toward the southeastern United States.



The trade winds blow from east to west near the equator. Credit: NASA/JPL-Caltech.

April 22 marked the 50th anniversary of the first Earth Day. Shortly after the first Earth Day, NOAA was created along with the U.S. Environmental Protection Agency (EPA). In celebration of Earth Day, NOAA looked at just how far geostationary satellite technology has come since 1970,

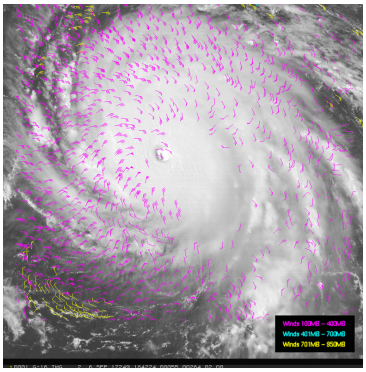
when the first geostationary satellite, ATS-1 was

Earth Day then and now. ATS-1 image of Earth from April 22, 1970 (left) and GOES-16 full disk on April 22, 2020 (right). Credit: NOAA

launched.**On May 18, 1980, iconic Mount St. Helens erupted in southwestern Washington State in the deadliest and most economically destructive volcanic event in U.S. history.** A feature story, published on May 18, takes a look back at the eruption as viewed by GOES-3 and highlights how far satellite monitoring of volcanic activity has come since then. This feature also showcases some of the most compelling volcano imagery NOAA has collected over the last four decades.

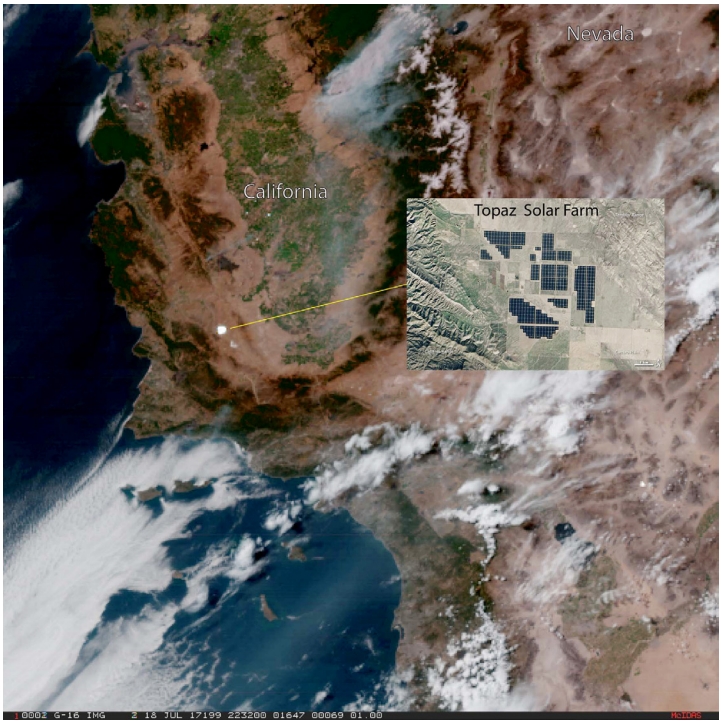
Eruption of Mt. St. Helens on May 18, 1980. Photograph by Joseph Rosenbaum, courtesy of USGS.

Hurricane forecast models got an upgrade this year, thanks to new satellite data. For the first time, GOES-16 (GOES-East) and GOES-17 (GOES-West) high-resolution wind data are being fed into NOAA's Hurricane Weather Research and Forecasting (HWRF) computer model used to forecast the track and intensity of tropical cyclones. The ability to characterize the wind fields in and around a hurricane is crucial to predicting future storm motion and intensity.



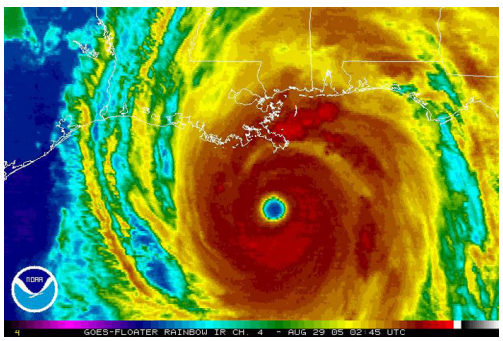
GOES-16 winds generated over Hurricane Irma on September 6, 2017, overlaid on GOES-16 visible imagery. Credit: NOAA

GOES satellites are known for providing critical data to weather forecasters, but the information they collect can also help the renewable energy sector. The detailed data GOES-16 (GOES-East) and GOES-17 (GOES-West) provide about clouds is useful for forecasting solar energy production. Clouds affect the output of ground-based solar power generation systems. Information from the satellites can be used to track the motion of clouds, predict the passage of cloud shadows, and estimate the amount of sunlight reaching solar energy systems. These data are crucial for harnessing solar energy and efficiently delivering it to consumers.



GOES-16 true color imagery over California, collected on July 18, 2017, shows the reflection of sunlight off solar panels at the Topaz Solar Farm (inset) seen in the bright white patch noted in the imagery. Credit: CIRA

A NESDIS feature story, published June 8, looks back at the 2005 Atlantic Hurricane Season that broke many long-standing records. It began on



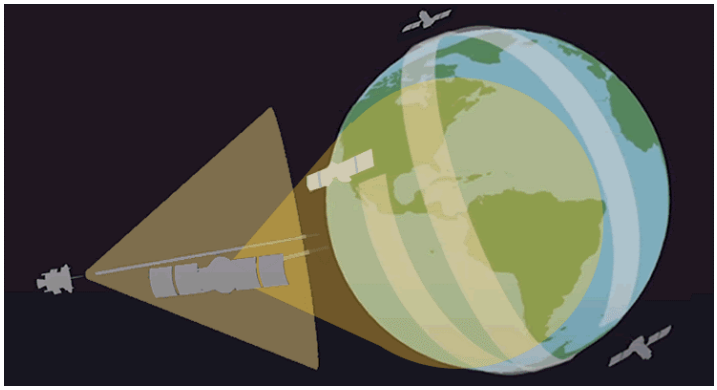
Hurricane Katrina, captured by GOES-12 on August 29, 2005. Credit: NOAA

EDUCATION AND OUTREACH (CONTINUED)

June 8, 2005, with Tropical Storm Arlene, one of 27 named storms that formed during that unprecedented hurricane season. The story summarizes the 2005 season, including imagery from GOES-12, and highlights the advancements the GOES-R Series bring to hurricane forecasting, monitoring and tracking.

The powerful hurricane that struck Galveston, Texas, on September 8, 1900, killing an estimated 8,000 people and destroying more than 3,600 buildings, took the coastal city by surprise. A new video looks at advances in hurricane forecasting in the 120 years since, with a focus on the contributions from weather satellites. A fleet of Earth-observing satellites, including those from JPSS and GOES-R, provides remarkable advances in hurricane forecasting. This satellite technology has allowed us to track hurricanes – their location, movement and intensity.

Two orbits, one mission. NOAA maintains a fleet of satellites to monitor Earth's weather, environment and climate. These satellites provide essential data that feed forecasts and warn us of severe weather and environmental hazards. There are two primary types of satellites used for weather forecasts: geostationary and polar-orbiting. Together, they make a powerful team. Each provides critical information about severe storms, tornadoes, hurricanes, snowstorms, and flooding, as well as wildfires, smoke plumes, volcanic eruptions, and dust storms. Different vantage points, imaging frequency, and instrumentation provide complementary measurements for a complete picture of what's happening on Earth.



Geostationary and polar-orbiting satellites work together to provide critical information for weather forecasts. Credit: NOAA/Steve Sabia

AWARDS

The GOES-R Product Readiness and Operations (Pro) Product Algorithm Science Support (Pass) Team was awarded a NOAA Bronze Medal for Scientific/ Engineering Achievement. The highest honor award granted by the Under Secretary of Commerce for Oceans and Atmosphere, the Bronze Medal recognizes federal employees for superior performance. The PRO PASS team delivered 38 science products from all six GOES-R instruments for both GOES-16 and GOES-17 despite formidable schedule challenges from the ABI thermal anomaly. Their work has delivered science products that have saved lives and property from land-falling hurricanes, wildfires, severe storms, blizzards, flooding, and numerous other environmental hazards.

Several GOES-R Program individuals and teams were recognized with 2020 Robert H. Goddard Honor Awards. Each year, GSFC recognizes the achievements of its workforce through the Robert H. Goddard Honor Awards. Recipients are chosen for their exceptional contributions in support of the center's scientific, technical and institutional capabilities on the path to mission success.

Michael Burnett

Norman Reese

Chris Morris

Joyce White

Engineering:
Michael Burnett

Engineering Team:
Solar Ultraviolet Imager (SUVI) Extended Coronal Imaging (ECI) Team

Mission & Enabling Support:
Norman Reese

Leadership:
Chris Morris

Quality and Process Improvement:
GOES-R Ground Segment Project Engineering Change Process 033 Integrated Project Team

Professional Administrative:
Joyce White

CONFERENCES AND EVENTS

A series of GEO-XO user needs virtual workshops began in June. The Fire Stakeholder Virtual Workshop was held June 3-5. This workshop engaged members of the fire sector community who use NOAA's remote sensing data in

CONFERENCES AND EVENTS (CONTINUED)

the fields of fire preparedness, fire response, fire damage assessment, and fire impacts to critical infrastructure. The workshop gathered feedback on NOAA's environmental satellite data products through structured discussion. Future workshops include Weather, Human Health, Agriculture and Land Use, Water and Flooding, Energy, and Transportation. These user needs will be used to inform GEO-XO remote sensing capabilities. Additional Information is available on the GEO-XO User Needs Virtual Workshop Series website.

Part 1 of the National Academy of Sciences Space Weather Operations and Research Infrastructure Workshop was held virtually June 16-17. This workshop of the Space Weather Operations and Research Infrastructure Committee focused on discussions with NOAA. The workshop considered options for continuity and future enhancements of the U.S. space weather operational and research infrastructure. The workshop reviewed current and planned U.S. and international space weather-related observational capabilities and discussed observational needs. Part 2 of the workshop is planned for September 10-11.

MEET THE TEAM

In this issue, meet Michelle Rizzo, GOES-R flight project chief safety and mission assurance officer. Michelle is responsible for the implementation of the GOES-R Series spacecraft and instruments mission assurance program to ensure the mission is successful and meets its performance goals. Her responsibilities include parts, materials, hardware quality, software quality, reliability, safety, supply chain management, mission operations assurance, and technical system design reviews. She also serves as the safety and mission technical authority for the flight project.

Michelle's most significant accomplishment has been working with the L3 Harris and NASA teams to assist in the recovery efforts from the GOES-17 ABI on-orbit cooling system anomaly. "It has been a long and challenging road to determine the root cause of this anomaly, redesign the radiator system, and oversee the manufacture of the hardware," Michelle said. The successful build and test of the new hardware concluded with the delivery of the rebuilt ABI radiator for GOES-T in June. "I am very excited to get this instrument installed and to eventually see its performance on orbit," said Michelle.

Her favorite part of her job is seeing the positive impact that our satellites have on people. "Recently, I saw a social media post highlighting how the NWS forecast office in Amarillo, Texas, used imagery from the GOES-16 ABI to warn residents in the path of a quickly spreading fire, said Michelle. "The fact that I had a small part in making this mission successful and allowing something like this capability to exist is extremely rewarding."

Michelle holds a Bachelor of Science degree in aerospace engineering from Virginia Tech. She completed an internship and co-op at GSFC. After graduation, she was hired in the Safety and Mission Assurance Directorate, where she's worked for the past 10 years. Michelle was previously the project safety manager for a series of NASA flight instruments and missions before coming to GOES-R.

Michelle loves to travel. She and her husband especially enjoy hiking and exploring national parks. They are hoping to take a trip to see Grand Teton, Yellowstone, and Glacier National Park.

UPCOMING EVENTS

GEO-XO Weather Stakeholder Virtual Workshop
July 20-24, 2020

GEO-XO Human Health Stakeholder Virtual Workshop
July 27-31, 2020

NOAA Environmental Data Management Workshop
August 17-21, 2020

Community Meeting on NOAA Satellites
Sept. 29 - Oct. 2, 2020

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