



GOES-R

GEOSTATIONARY OPERATIONAL ENVIRONMENTAL SATELLITE R-SERIES

QUARTERLY NEWSLETTER ■ APRIL-JUNE 2019 ■ ISSUE 26

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



GOES-16 and GOES-17 continue to provide high definition imagery to forecasters, monitoring Hurricane Barry as it came ashore

near New Orleans, viewing the first eruption of the Raikoke volcano in the northwest Pacific since 1924, and even detecting a refinery explosion in Philadelphia and an asteroid entering Earth's atmosphere south of Puerto Rico. Meanwhile, the program is focused on the redesign of the Advanced Baseline Imager radiator and the repair of the Geostationary Lightning Mapper to support the new GOES-T launch planning date of December 2021. The Ground Segment server replacement is also progressing, on plan to be completed before the GOES-T launch. GOES-U's new space weather instrument, the Compact Coronagraph, passed its Critical Design review and is proceeding with fabrication.

PROGRAM HIGHLIGHTS

GOES-T has a new launch date. The NOAA/NASA Agency Program Management Council approved a new launch commitment date in May and the program is planning for a December 2021 launch. Design changes to the ABI loop heat pipes to address thermal control issues detected on GOES-16 and -17, and parts issues with the Geostationary Lightning Mapper (GLM) required the GOES-R Program to re-plan the GOES-T schedule. The delay does not impact the overall availability of imaging from geostationary orbit; the operational satellites within NOAA's geostationary constellation – GOES-17 as GOES West, GOES-16 as GOES East, and GOES-14 as the on-orbit spare – continue to deliver key Earth and space weather observations for the nation. The delay also does not increase the risk of a gap in the constellation. GOES-T, when it is launched, is planned to go into on-orbit storage and thus the delay only affects the length of the storage time and not its operational service.



GOES-T in a Lockheed Martin cleanroom. Credit: Lockheed Martin

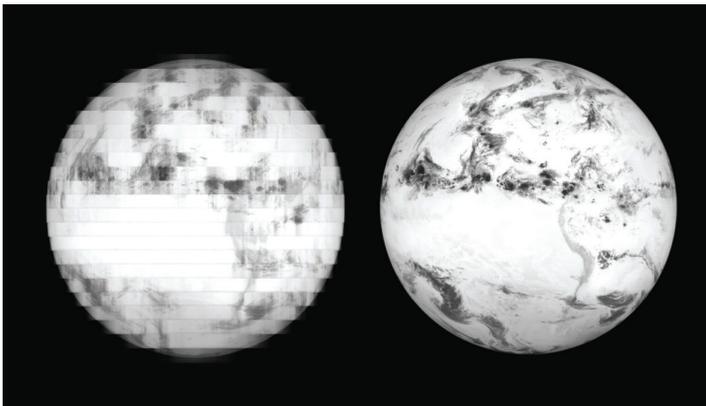
DID YOU KNOW?

Solar wind commonly blows 5,000 to 10,000 times faster than a Category 5 hurricane, defined by speeds >156 mph.

PROGRAM HIGHLIGHTS (CONTINUED)

On April 2, the [GOES-16 and GOES-17 Advanced Baseline Imagers \(ABIs\) began operating in 10-minute flex mode](#), which provides a full disk scan every 10 minutes, a contiguous United States (CONUS) scan every 5 minutes, and two mesoscale (targeted 1000x1000 km areas) every 60 seconds (or one sub-region every 30 seconds). The previous default operational mode provided a full disk scan every 15 minutes. This new scan mode has a number of advantages. It allows NOAA to match the full-disk scanning cadence of our international partners, which means nearly global advanced imager coverage every 10 minutes. Ten-minute full disk imagery is also critical to National Weather Service Weather Forecast Offices, National Centers, and Volcanic Ash Advisory Centers in monitoring hazardous weather conditions and providing additional information in observationally-limited areas like over the oceans or in the mountains. The faster temporal cadence will also improve aviation safety.

[Aerospace America published an article on April 2, "Saving GOES-17,"](#) authored by John Van Naarden, ABI chief engineer at Harris Corporation, and Dan Lindsey, NOAA's senior scientific advisor to the GOES-R Program. The article outlined the issues that were discovered with the cooling system on GOES-17's primary instrument, the ABI, and efforts to improve performance of the instrument. Despite a thermal system operating at only about 5% of its capacity, ABI is now delivering more than 97% of its intended data, thanks to recovery efforts.



In the photo at left, elevated detector temperatures caused the current to bleed into adjacent detectors, resulting in blurred images. The GOES team solved the problem, right, by adjusting the voltage that controls the flow of photocurrent. Credit: NOAA

Several GOES-17 data products successfully completed Peer Stakeholder – Product Validation Reviews this quarter and achieved provisional maturity. Once a product reaches provisional maturity status, the product is ready for operational use but not yet fully validated.

- April 24 Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS) extreme X-ray irradiance
- May 6 ABI clear sky masks, cloud top temperature, cloud top height, cloud top phase, and cloud top pressure
- May 14 Solar Ultraviolet Imager
- May 16 ABI derived motion winds, rainfall rate/ quantitative precipitation estimate, and legacy atmospheric profiles
- May 22 Space Environment In-Situ Suite (SEISS) energetic heavy ions
- June 13 ABI land surface temperature, daytime cloud optical depth, daytime cloud particle size
- June 27 ABI shortwave radiation budget, aerosol detection, aerosol optical depth

The GOES-R ground system completed the Antenna System Acceptance Review on May 31. Development of the ten GOES-R ground system antennas is now complete and all ten are contractually accepted.

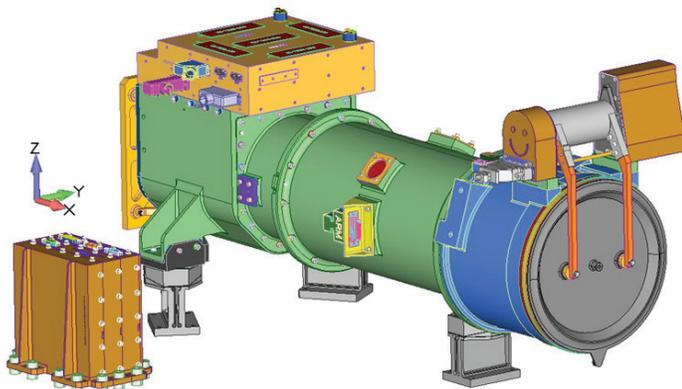
The winners of the 2019 GOES-16/17 Virtual Science Fair were announced on June 7. Two middle school teams tied for first place: Auburn, Massachusetts, and Medford, New Jersey. The high school first place team is from Santa Fe, New Mexico. Students from grades 6-14 were invited to participate in the virtual science fair. Each team used data from GOES-16 and GOES-17 to investigate weather and natural hazards. [View all the science project submissions.](#) One of the winning middle school teams also created a [rap video, "GOES-16 Nation."](#)



GOES-16/17 Virtual Science Fair first place high school team from Santa Fe High School, coach Derek Buschman (left) and student Faris Wald (right). Credit: Santa Fe High School.

PROGRAM HIGHLIGHTS (CONTINUED)

The Critical Design Review (CDR) for the Compact Coronagraph (CCOR) was successfully completed on June 26. The CDR reviewed the detailed design of the



Model of CCOR, courtesy of the Naval Research Laboratory.

instrument and ensured that the design implementation meets the requirements. The review confirmed that the maturity of the design is appropriate to support proceeding with full-scale fabrication, assembly, integration, and testing. CCOR is a Naval Research Laboratory instrument developed for NOAA's Office of Projects, Planning and Analysis that will ride aboard GOES-U. [A new feature story highlights how CCOR will image the solar corona and help detect and characterize coronal mass ejections.](#)

GOES-15 will continue to operate alongside GOES-17 through December 2019 to allow users more time to transition to the new space weather data products available from GOES-16 and GOES-17 and continue to correlate GOES-17 ABI thermal data during short data outage periods.

SCIENCE APPLICATIONS

The NOAA Satellite Proving Ground 2019 Hazardous Weather Testbed Spring Experiment was conducted April 22 – June 7, at the National Weather Center in Norman, Oklahoma. GOES-R Series and Joint Polar Satellite System (JPSS) products were demonstrated during the experiment. This experiment fostered collaboration between research and operations to test and evaluate new and emerging technologies and science to advance National Weather Service (NWS) warning operations. Products were demonstrated through a simulated warning operations environment. NWS forecasters and broadcast meteorologists were the primary evaluators. Various project scientists were also in attendance throughout the experiment to provide project expertise and to communicate directly with the user community. [The Satellite Proving Ground Hazardous Weather Testbed Blog](#) and [Experimental Warning Program Blog](#) provided daily forecaster feedback and comments.

Volcanic ash is a significant health, aviation, infrastructure and economic hazard.

GOES East and GOES West observe a significant fraction of the most volcanically active region on Earth, known as the "Pacific Ring of Fire."

[A new feature story highlights new capabilities from the GOES-16 and GOES-17 ABI and GLM provide improved volcanic hazard forecasting and monitoring](#)



GOES-17 captured visible imagery (on the limb of the satellite's coverage) of the Raikoke volcano erupting in the Kuril Islands off Russia on June 21. This major eruption was the volcano's first since 1924. [An animation of the event is available from CIRA.](#)

through sophisticated new data products and automated detection tools. Volcanic Ash Advisory Centers use information from GOES-16 and GOES-17 to monitor clouds whose location, evolution and/or spectral properties are consistent with volcanic activity. As forecasters gain more experience with new GOES-R Series datasets, the value of the measurements will increase significantly, resulting in safer and more efficient air transportation and a better understanding of volcanic processes and the complex relationship between volcanic emissions and weather and climate. [A new fact sheet on volcanic ash detection is also available.](#)

Atlantic Hurricane season began on June 1. Hurricanes are one of the most menacing natural hazards, especially for island and coastal populations. A warming climate is expected to impact sea level rise, storm surge, tropical cyclone rainfall rates, and tropical cyclone intensity. We are also seeing a pattern of slower storms, remaining stationary over a location for longer periods of time and increasing flooding impacts. This isn't great news for the millions of people in the paths of hurricanes each year. Fortunately, GOES-16 and GOES-17 continuously view the entire Atlantic and Eastern/Central Pacific hurricane basins. [The latest generation of GOES carry sophisticated instruments that provide new and dramatically improved capabilities for forecasting, tracking and monitoring hurricanes as well as the environmental conditions that cause them to form.](#) Along with a feature story, the GOES-R Program also published a [new hurricane monitoring applications fact sheet](#). The fact sheet highlights the advanced observational capabilities available from the

SCIENCE APPLICATIONS (CONTINUED)

GOES-R Series to help NOAA's National Hurricane Center and Central Pacific Hurricane Center meet their mission to save lives, mitigate property loss, and improve economic efficiency by issuing the best watches, warnings, forecasts and analyses of hazardous tropical weather and by increasing understanding of these hazards.



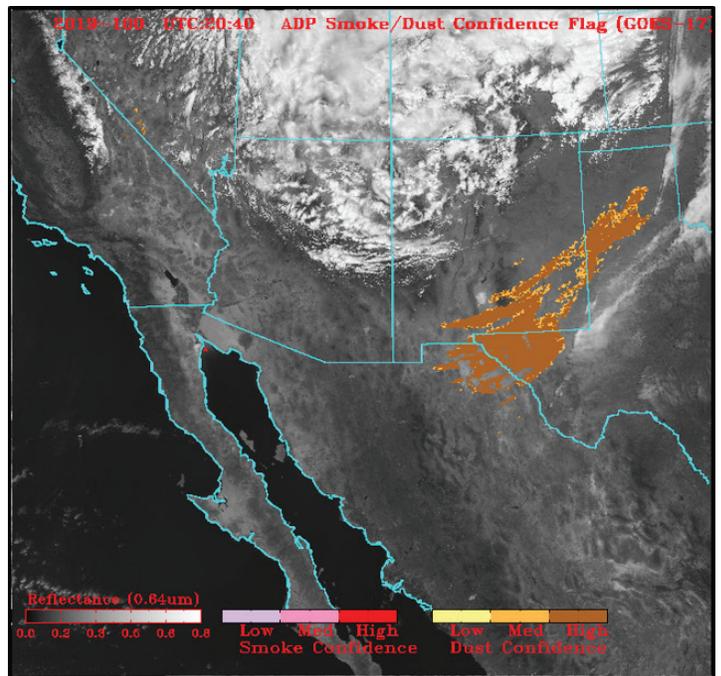
Subtropical Storm Andrea became the first named storm of the 2019 Atlantic Hurricane Season on May 20. Andrea had maximum sustained winds of 40 mph and was located nearly 300 miles west-southwest of Bermuda, according to the National Hurricane Center. Andrea weakened to a subtropical depression on May 21. This marked the fifth year in a row where the first named storm developed before the official start of the Atlantic hurricane season. Credit: NOAA

The GOES-R Program released several new fact sheets highlighting science applications from the satellites.

The [GOES-R cloud and moisture imagery fact sheet](#) explains what types of imagery are available from the ABI. The GOES-R Series ABI measures energy at different wavelengths, which is either reflected (visible and near infrared) or emitted (infrared) from the Earth's surface.

The GOES-R fire detection and characterization fact sheet highlights the new tools available for detecting and monitoring fires, observing and monitoring smoke from those fires, monitoring burn scars, and predicting flash floods from rain events after a fire.

The GOES-R aerosols/air quality applications fact sheet explains how GOES-R satellites enable forecasters to better monitor areas of smoke and dust, which can be critical factors in visibility, aviation and air quality forecasts. In addition to short-term prediction, they also enable better monitoring of the long-term trends in aerosol quantities



GOES-17 aerosol detection product for a dust outbreak on April 10, 2019. Credit: NOAA

and distribution throughout the atmosphere to help climate scientists monitor and predict climate change.

Snow and ice applications are highlighted in another new fact sheet. Cryospheric observations and information from the GOES-R Series provide a new opportunity to continuously observe snow and ice from geostationary orbit, improving weather forecasting and hazard warnings and helping to reduce the risk of loss of life and property from natural and human-induced disasters.

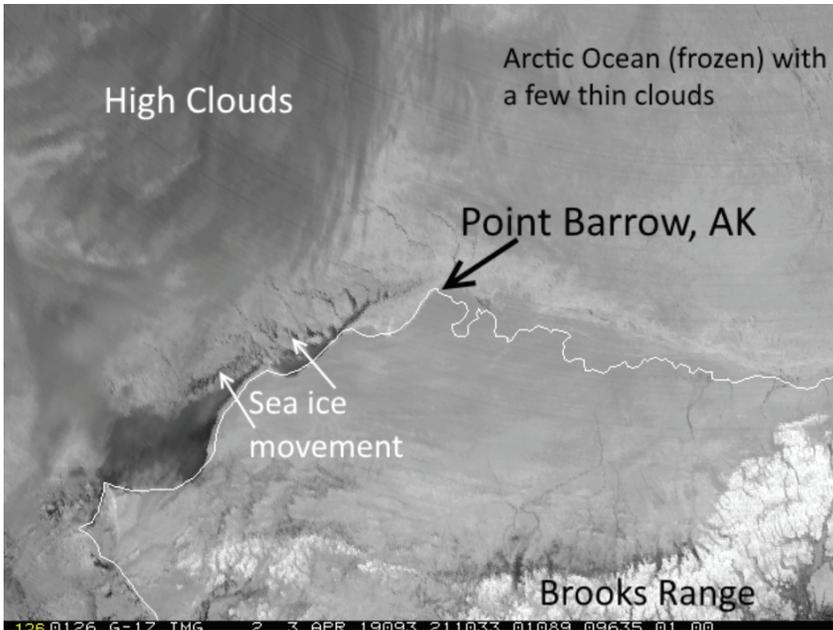
GLM data reveal convective storm development and evolution and provide insights beyond the presence of a lightning strike, including the spatial extent and distance lightning flashes travel. **The GOES-R lightning detection fact sheet** explains how trends in total lightning available from GLM provide critical information to forecasters, allowing them to identify initial thunderstorm development and focus on potentially severe storms before they produce damaging winds, hail or tornadoes.

DATA AND IMAGERY

GOES-17 is providing unprecedented views of Alaska.

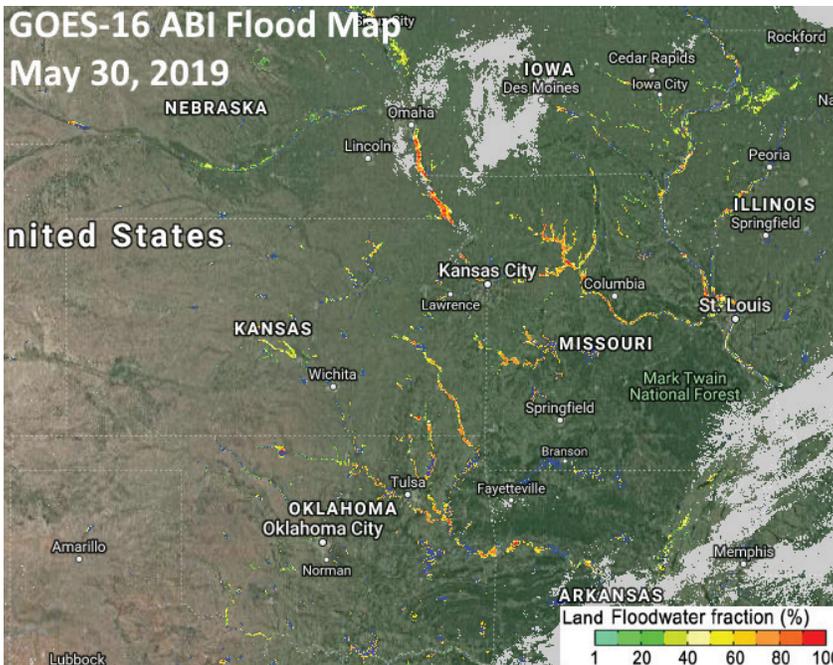
In this visible imagery from April 3, we clearly see the north coast of Alaska and multiple meteorological and topographical features. The Brooks Range, high clouds, and the frozen Arctic Ocean with a few thin clouds are seen.

Sea ice movement can also be seen in an animation of this imagery. Barrow is the northernmost city in the U.S. The previous generation of GOES did not have sufficient resolution at the limb of coverage to provide clear details of northern Alaska.



GOES-17 view of the north coast of Alaska on April 3. Credit: NOAA

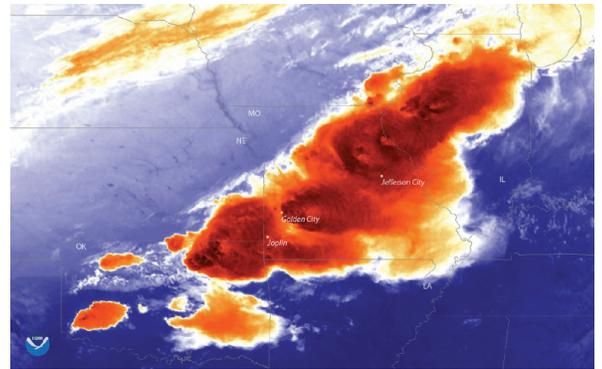
Prolonged severe weather over the Plains and Midwest led to historic rainfall and flooding this spring. The Mississippi, Missouri, and Arkansas rivers have been filled to near-historic proportions. In this GOES-16 ABI flood map from the morning of May 30, flooding is shown in green (less flooded), yellow, orange, and red (most flooded) while dark blue is normal water levels. Gray is cloud cover and brown is land. These new flood maps help forecast where flooding is likely to occur and aid officials in determining where to employ limited resources during a flood. They help determine the impact of a storm and provide first responders important information about the location and extent of flooding, how long it will last, and what damage the flood is causing. The



ABI flood map from May 30 showing flooding from the Mississippi, Missouri, and Arkansas rivers. Credit: NOAA/George Mason University

flood maps also allow insight into where water is receding. The new flood map products were developed by scientists at George Mason University with NOAA support.

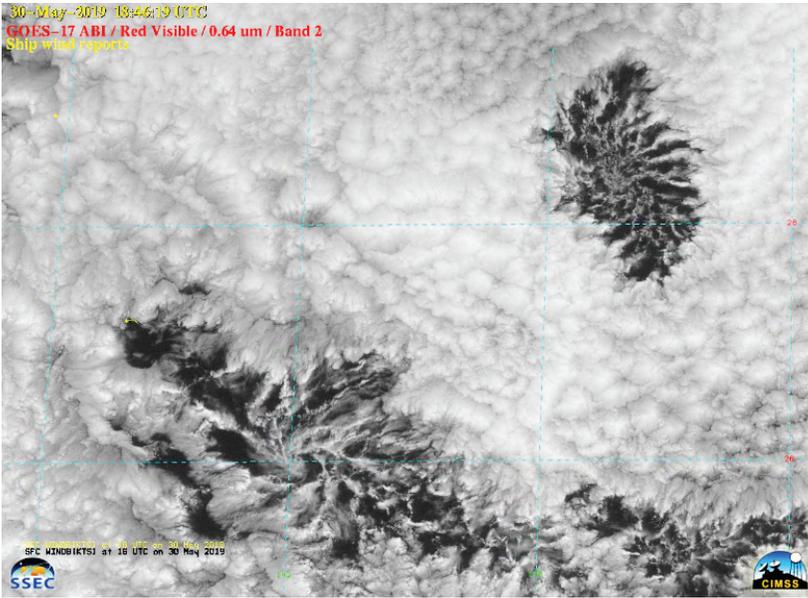
A violent tornado touched down in Jefferson City, Missouri on May 22 just before midnight, according to the NWS in St. Louis. The Missouri Department of Public Safety said at least nine people were hospitalized due to storm-related injuries. [This was just one of more than two dozen tornadoes reported across parts of Missouri and Oklahoma that night, including several that prompted tornado emergencies.](#) Three people were killed when a tornado struck Golden City. This area is no stranger to deadly tornado outbreaks. On May 22, 2011, an EF-5 tornado struck Joplin, which is located southwest of Golden City, killing more than 100 people and causing \$2.8 billion in damages.



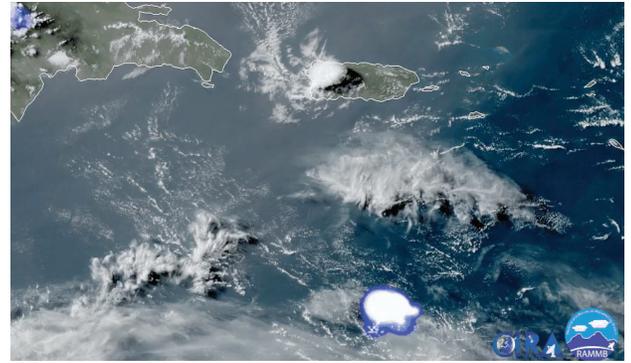
GOES-16 captured the severe weather outbreak across parts of Missouri and Oklahoma on May 22 at 10 p.m. CST as the storms were beginning to ramp up. Credit: NOAA

GOES-17 captured elusive actiniform clouds in the central Pacific Ocean on May 30. Visible imagery revealed the mesoscale cyclonic circulations of these clouds within the marine boundary layer stratocumulus cloud field. Actiniform clouds are a collection of marine low clouds with a radial structure. In satellite imagery, they look like distinct leaf-like or spokes-on-a-wheel patterns that stand out from the rest of the low-lying cloud field. This type of cloud feature was originally identified in TIROS-V imagery over the Pacific Ocean in 1962 and was featured in the first Monthly Weather Review "Picture of the Month" series in January 1963.

DATA AND IMAGERY (CONTINUED)



Actiniform clouds in the central Pacific on May 30. Credit: CIMSS

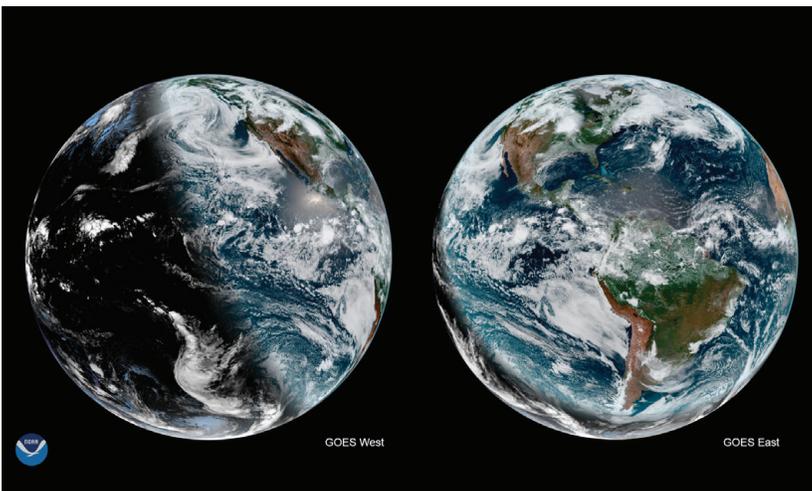


Asteroid captured by GLM on June 21. [View animation of the event on the YouTube.](#) Credit: NOAA/CIRA

On June 21, GOES East and GOES West simultaneously saw the slanted shadows separating day and night on Earth just minutes after the summer solstice occurred. Summer solstice is the start of astronomical summer in the Northern Hemisphere and the moment that hemisphere reaches its greatest tilt toward the sun.

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The GOES-16 GLM captured an asteroid entering the atmosphere south of Puerto Rico on June 22. At 4:25 p.m. EDT, meteorologists noticed an unusually bright flash signature over Caribbean waters 170 miles south of Puerto Rico. Its light was visible in an area as large as Rhode Island — far too big to be a lightning strike. Also, there were no clouds in the area. A spattering of debris showed up on the radar of the National Weather Service's office in San Juan, Puerto Rico, a telltale sign of a meteor or asteroid impact. Comprehensive Nuclear Test Ban Treaty sensors in Bermuda measured the resulting mid-air blast between 3 and 5 kilotons of TNT.



The daylight terminator (slanted shadow that separates day from night) is seen in both GOES West (left) and GOES East (right) imagery from June 21. Credit: NOAA

CONFERENCES AND EVENTS



From left: Moderator Meredith Garofalo, Dr. Neil Jacobs, and Dr. Stephen Volz at the NOAA panel discussion on April 10 at the Space Symposium.

The 35th Space Symposium was held April 8-11 in Colorado Springs, Colorado. NOAA was a destination booth at the conference where several groups of teachers and students stopped by to learn about the agency and vital services it provides. The GOES-R Program provided educational materials for the teachers and students. On April 10, there was a panel, "A Fireside Chat with NOAA Leadership." Dr. Neil Jacobs and Dr. Stephen Volz participated with moderator Meredith Garofalo from WeatherNation. Also, GOES-R Program assistant director Mike Stringer gave a presentation at the conference on the GOES-17 ABI loop heat pipe anomaly and recovery and also provided an overview of the program at the NOAA booth.

CONFERENCES AND EVENTS (CONTINUED)

The GOES-R Program “Almost Summer Solstice” Summit was held June 4-6 at Harris Corporation in Melbourne, Florida. The summit brought NOAA and NASA program personnel, contractors, and industry and academic partners together and covered technical, financial, operations, data products, data access, science applications, and user feedback topics.

On June 11, a GOES-R short course “[Understanding and Using GOES-16/17 Data and Products for Broadcast Forecasting](#)” was held prior to the American Meteorological Society 47th Conference on Broadcast Meteorology/Fifth Conference on Weather Warnings and Communication in San Diego. Short-course participants learned about GOES-16/-17 imagery and derived products for weather and hazards monitoring and forecasting. They also participated in short, guided hands-on exercises covering various uses of the data, showcasing the many applications to help improve forecasts and warnings of high impact weather and environmental



phenomena. The course culminated in a team-based hands-on exercise where the teams were challenged to produce forecasts for the public utilizing only GOES-16/-17 data and select additional information. Each team was given a scenario and associated data and presented their forecasts as if they were live on air or online.

*Short course participants work together to put together a forecast using GOES-17 data.
Credit: Scott Lindstrom*

ACCOLADES AND AWARDS

Several people were recipients of the Department of Commerce 2019 Bronze Medal for their work on the GOES-R Program. The highest honor

award granted by the Under Secretary of Commerce for Oceans and Atmosphere, Bronze Medals recognize federal employees for superior performance and are awarded to individuals, groups (or teams), and organizations. Dan Lindsey received a Bronze Medal for Scientific Engineering/Achievement for providing the first light full disk true color imagers from both the GOES-16 and GOES-17 ABI, as the primary visualization of NOAA’s latest generation of geostationary satellites. Matthew Seybold, Wayne MacKenzie and Kathryn

Mozer were recipients of the Bronze Medal for Customer Service for expertly transitioning new state-of-the-art satellite imagery, products, and procedures into operations from GOES-16 for user exploitation. Tim Walsh was awarded a Leadership Bronze Medal for his exemplary leadership of the GOES-R program team in transitioning its first satellite into operational service and launching its second satellite. The award winners were honored in a ceremony on May 14 at NOAA headquarters in Silver Spring, Maryland.



Dr. Dan Lindsey (center) accepted his bronze medal from Dr. Neil Jacobs (left), Assistant Secretary of Commerce for Environmental Observation and Prediction and Mark Paese (right) Deputy Assistant Administrator for Satellite and Information Services. Credit: NOAA

Several GOES-R Program team members are recipients of 2019 NASA Agency Honor Awards. The Agency Honor Awards are approved by the Administrator and presented to the most highly-deserving individuals and groups who have distinguished themselves by making outstanding contributions to the agency's mission. These are NASA's most prestigious awards. Recipients will be honored at a ceremony on September 5.

Outstanding Leadership Medal

Jamie Dunn

Dan Lindsey

Joel McCorkel

Angela Melito

Kevin Schrab

Pam Sullivan

Tim Walsh

Outstanding Public Leadership Medal

Dan Linebarger

Exceptional Engineering Achievement Medal

Alexander Krimchansky

John Van Naarden

Group Achievement Award

GOES-17 Advanced Baseline Imager Optimization Team/Alexander Krimchansky

ACCOLADES AND AWARDS (CONTINUED)



GOES-R Program Administrative Officer Angela Michael received an Unsung Hero award at the Goddard Space Flight Center Flight Projects Directorate peer award ceremony in June. This award is given to employees who support the directorate in a behind-the-scenes role. Angela provides extraordinary service to the GOES-R Program as an Administrative Officer. She has mastered the intricacies of the front office and of her many roles within it. As a result, the rest of the team is able to focus on the success of the GOES-R mission.

MEET THE TEAM

In this issue, meet Seth Iacangelo, GOES-R Mission Operational Support Team (MOST) ABI Operations and Engineering Lead.

Seth is responsible for creating, testing, and validating all operational and contingency products related to ABI. Prior to launch, he ensures ABI has a successful end-to-end and mission rehearsal campaign. Once the spacecraft launches, Seth is responsible for powering on ABI, post-launch testing (PLT), and the health and safety of the instrument.



Seth has been supporting NASA for nearly ten years. He joined the GOES team in 2014. Prior to that, he supported the Aqua and Terra missions. Seth appreciates the flexibility the program allows for him to tackle problems from different angles and perspectives, and as an engineer he can be creative. How he solves a problem or develops a product is up to him as long as the solution works and objectives were met. He also has the opportunity to create utilities the entire MOST team can benefit from, not just the ABI team.

Seth's most significant achievement is executing successful PLTs for GOES-16 and GOES-17. "For GOES-16, everything was new and everyone wanted ABI data as quickly as possible. This meant an extremely fast-paced PLT along with learning the quirks of a new operational spacecraft. For GOES-17, PLT was a balance of optimization efforts and root cause investigation into the thermal issues, as well as keeping schedule for a nominal PLT," he said.

Seth holds a bachelor's degree in physics and mathematics, and a Master of Science in geospatial information science. He rides his bicycle to work and finds it much less stressful than sitting in traffic and better exercise as well.

UPCOMING EVENTS

NWS Satellite User Applications Workshop

July 30 – August 1, 2019

Kansas City, MO

44th Annual National Weather Association (NWA) Meeting

September 7-12, 2019

Huntsville, AL

Joint NOAA/AMS/EUMETSAT Satellite Conference

September 29 – October 4, 2019

Boston, MA

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