



GOES-R and GeoXO

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



Goodbye to 2021, a challenging year, which did not at all deter the GOES-R/GeoXO team. Our team continues to accomplish

outstanding things—achievements made even more impressive because of the pandemic. In the last quarter of the year alone, we delivered GOES-T to Florida and began readying it for a March 1 launch, executed a number of ground system and mission operations rehearsals and tests to prepare for the GOES-T launch, got the brand-new CCOR instrument through thermal vacuuming testing, received approval to formally initiate the GeoXO Program and received concurrence on proposed program and project acquisition strategies. Congratulations to the GOES-R/GeoXO team on a truly amazing year! I cannot wait to see GOES-T on-orbit and GeoXO fully in Phase A.

PROGRAM HIGHLIGHTS

GOES-T arrived in Florida on Nov. 10 to begin final preparations for launch. [Shipping a satellite is no small feat.](#) GOES-T is the size of a small school bus and weighs over 6,000 pounds! The spacecraft team at Lockheed Martin in Littleton, Colorado, where GOES-T was built, carefully packed the satellite in a special shipping container that protected its sensitive instruments and functioned as a miniature cleanroom during transport. GOES-T was then driven to Buckley Space Force Base in Aurora, Colorado, where it hitched a ride aboard a C-5 Super Galaxy aircraft to Kennedy Space Center. [View additional photos via the GOES-T Road to Launch image gallery.](#) Stay informed as GOES-T moves closer to launch by visiting the [GOES-T launch webpage.](#)



After arriving at the Kennedy Space Center, technicians slowly bring GOES-T off the aircraft. Photo credit: NASA/Elizabeth Wilk

DID YOU KNOW?

A [kona low](#) is a type of seasonal subtropical cyclone in the Hawaiian Islands that tends to form in the winter months from winds coming from the southwesterly “kona” (leeward) direction. These storms can lead to torrential rainfall and even heavy snow accumulation across the highest volcanic peaks of the Big Island.

PROGRAM HIGHLIGHTS (CONTINUED)

NOAA and NASA are now targeting March 1, 2022, for the launch of the GOES-T satellite. The launch was previously scheduled for Feb. 16, 2022. However, shifts in launch dates for missions scheduled ahead of GOES-T prompted NASA, NOAA, and United Launch Alliance (ULA) to coordinate the [new launch date](#).

The Atlas V rocket that will launch GOES-T into space arrived at Cape Canaveral Space Force Station on Nov. 15. The launch vehicle includes two main parts that will work together to deliver GOES-T to orbit. The Atlas V first stage booster is the backbone of the launch vehicle. It holds the fuel and oxygen tanks that feed the engine for powering the spacecraft into orbit. The Centaur upper stage is the vehicle's "brain," providing guidance and flight control and containing fuel and oxidizer to insert the vehicle into orbit.



The GOES-T Atlas V first stage booster is offloaded from its transport boat at Cape Canaveral Space Force Station. Photo credit: United Launch Alliance.

The GOES-T team conducted several rehearsals and tests to prepare for the upcoming launch. GOES-T Data Operations Exercise #3 was conducted Nov. 8-19. The exercise included the generation and distribution of GOES data products from three satellites (GOES-T, GOES-16, and GOES-17), and validated ground system processing, operations personnel and procedures, and external interfaces. The fourth GOES-T end-to-end test was completed on Dec. 2 and served as a launch site test. GOES-T Mission Rehearsal #5, conducted Dec. 6-10, covered launch, orbit-raising, station acquisition, magnetometer boom deployment and calibration slews, and health and safety operations. Finally, the third countdown readiness test was completed on Dec. 17.

GOES-U development, testing, and integration continue. The Advanced Baseline Imager (ABI) and Space Environment In-Situ Suite (SEISS) instruments arrived at the spacecraft facility in Colorado for integration with the satellite. The Compact Coronagraph (CCOR) completed thermal vacuum and optical performance testing.

The GOES-R ground system completed the installation of new servers in the Satellite Operations Zone Development Environment at the Wallops Command and Data Acquisition Station on Oct. 29.

The GOES-16 and GOES-17 SEISS Magnetospheric Particle Sensors – High Energy range (MPS-HI) data products are now fully validated, following a successful Peer Stakeholder-Product Validation Review on Oct. 13.

GEOXO



Planned GeoXO constellation. Image credit: NOAA

The GeoXO Program was formally initiated in November, following a successful Milestone 1 Review. [GeoXO will now enter the program definition phase of development.](#) During the program definition phase, the GeoXO team will refine mission requirements, detail acquisition strategies, schedules, cost estimates, resource planning and risk management, and confirm technology readiness.

On Oct. 28, NASA posted the GeoXO Lightning Mapper (LMX) Phase A Study Request for Proposals (RFP) to [solicit proposals for a definition-phase study of a geostationary lightning mapper instrument](#) that will be used by NOAA and other public and private agencies to produce forecasts of severe weather and to issue warnings

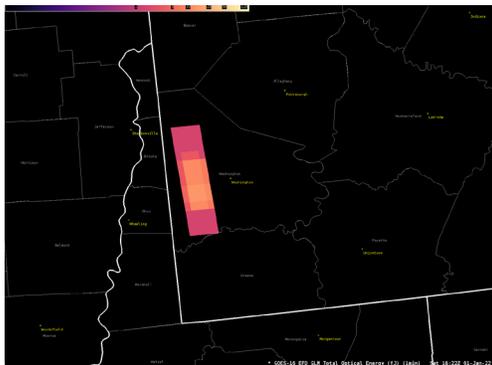
for public safety. Proposals were received in December and are under review.

The GeoXO Acquisition Strategy Meeting was held on Nov. 16 with NOAA and NASA. The Acquisition Strategy Meeting is a decision-making forum where senior agency management reviews proposed program and project acquisition strategies and approves the strategy for acquiring the various mission elements.

On Nov. 18, NASA posted an amended GeoXO spacecraft Request for Information. The [draft technical documents were updated](#) to reflect the removal of space-weather instrument accommodation aboard the GeoXO spacecraft. The release of the GeoXO spacecraft RFP is planned for early 2022.

IMAGERY AND SCIENCE APPLICATIONS

The GOES-R Geostationary Lightning Mapper (GLM) detects more than just lightning. The instrument is also able to pick up the signals of meteors in Earth's atmosphere. The loud "booms" with no visible source can cause a lot of anxiety, especially in populated areas. The National Weather Service (NWS) and broadcast meteorologists have begun using GLM data to quickly confirm the source and help calm nerves. On Oct. 10, residents in parts of Massachusetts and New Hampshire heard a mysterious loud boom. [GLM data indicated that the source was likely a bolide – a large meteor exploding in the atmosphere.](#) On Jan. 1, 2022, there were reports of loud booms heard in southwestern Pennsylvania and many emergency calls to 911. The area was cloudy at the time, but the GOES-16 (GOES-East) GLM picked up a strong signature that made a bolide the likely source. [NWS Pittsburgh posted a GLM image to explain the event,](#) which was used in local, national, and international media coverage. A nearby infrasound station registered the blast wave from the meteor as it broke apart; the data enabled NASA to estimate the energy at 30 tons of TNT and the size about a yard in diameter, with a mass close to half a ton.

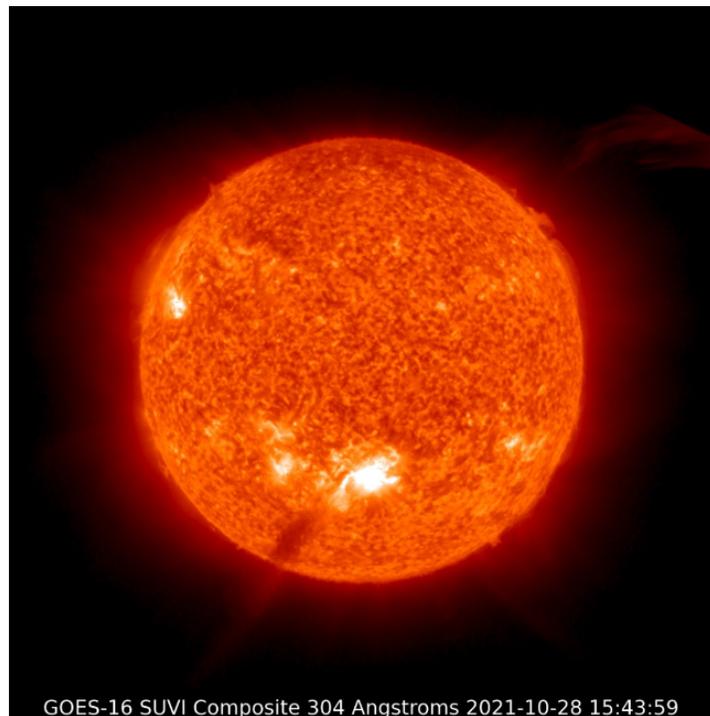


GOES-16 GLM data identified the likely source of a loud boom over southwestern Pennsylvania on Jan. 1, 2022, as a meteor exploding in the atmosphere. Image credit: NOAA/NWS

[how data from the GOES-16 and GOES-17 GLM is being used to create a database that could help the planetary defense community.](#)

The ability of GLM to detect exploding meteors was also highlighted in a recent *Eos* article. On Dec. 13, the American Geophysical Union (AGU) science news publication highlighted

On Oct. 28, the GOES-16 Solar Ultraviolet Imager (SUVI) captured a strong X1 solar flare. [The flare unleashed a coronal mass ejection directed at Earth](#) and produced auroras that were visible across Canada and as far south as Pennsylvania, Iowa and Oregon. As the solar cycle moves toward the solar maximum in 2025, GOES satellites will be an important tool to monitor the sun's activity.



GOES-16 SUVI Composite 304 Angstroms 2021-10-28 15:43:59
Solar flare captured by GOES-16's SUVI on Oct. 28. Image credit: NOAA/CIMSS

A new day cloud type RGB (red-green-blue) product, which combines data from multiple ABI channels, will soon be available to NWS forecasters. [Developed by NESDIS GEO senior scientist Andy Heidinger, this new data product allows for better detection and discrimination of thin and thick cirrus clouds.](#) The day cloud type RGB also provides information on high-level smoke and allows for the visual separation of cirrus clouds from lower-level features.

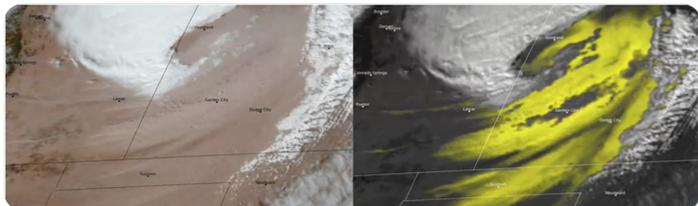
IMAGERY AND SCIENCE APPLICATIONS (CONTINUED)

The 2021 Atlantic Hurricane Season officially ended on Nov. 30 and was the third-busiest Atlantic season on record. [This year, a total of 21 named storms formed, seven of which became hurricanes.](#) Of these, four were considered major (Category 3 or above) on the Saffir-Simpson Hurricane Wind Scale—Hurricanes Grace, Ida, Larry, and Sam. In all, the season was the fourth-costliest on record, causing more than \$70.5 billion in damages and 161 fatalities.



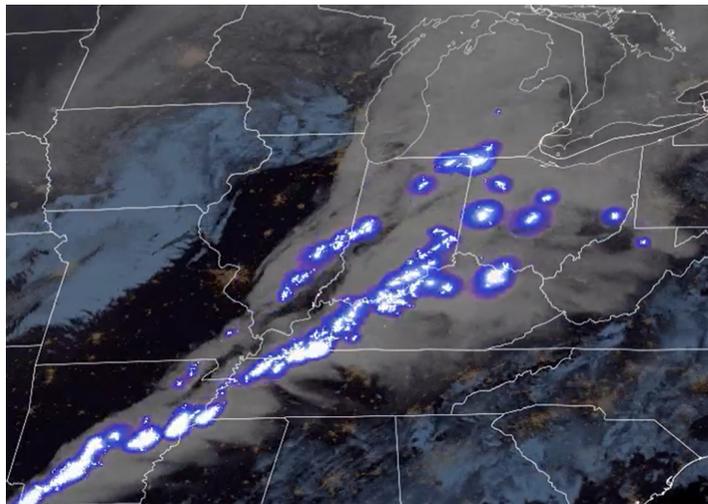
GOES-16 view of Hurricane Ida as it approached the coast of Louisiana. Ida struck near Port Fourchon as a powerful Category 4 hurricane on the 16th anniversary of Hurricane Katrina's landfall in Louisiana. Image credit: NOAA

A very dynamic weather system moved across the center of the country on Dec. 15, resulting in a wide swath of wind damage from Colorado to Wisconsin, including both straight-line winds and tornadoes. The strong winds also kicked up a tremendous amount of dust across Kansas and Nebraska and surrounding states.



GOES-16 GeoColor imagery (left) shows brown dust from the Dec. 15 storm. The Dynamic Enhancement Background Reduction Algorithm (DEBRA) dust product on the right denotes blowing dust in yellow. Image Credit: NOAA/CIRA

A severe thunderstorm and tornado outbreak occurred on the evening of Dec. 10 across Arkansas, Tennessee, Missouri, Illinois, and Kentucky. One notable supercell thunderstorm held together for many hours across four states and produced several deadly tornadoes, including a direct hit on the town of Mayfield, Kentucky. The large scale of this outbreak is very unusual for December.



GOES-16 view of the large scale of the Dec. 10 severe weather outbreak shows GLM data overlaid on ABI imagery. Image credit: NOAA

A Dec. 16 *Eos* article highlights the improved capabilities GOES-R satellites provide for monitoring solar energetic particle events. Energetic protons erupting from the sun are a hazard for both satellites and astronauts. The Solar and Galactic Proton Sensor (SGPS), part of the SEISS instrument, provides [new data for operations and scientific discovery and enables exceptionally long baseline measurements for understanding long-term trends in solar eruptions.](#)

EDUCATION AND OUTREACH



GOES-R participated in Vice President Kamala Harris' visit to NASA Goddard Space Flight Center (GSFC) on Nov. 15. [The vice president received a firsthand look at how the nation's space program studies climate change and provides crucial information to understand our planet's changes and their impacts on our lives.](#) The six-decade NOAA-NASA partnership was highlighted during the tour, including a GOES-R Program presentation that emphasized the essential data the satellites provide for accurate and timely forecasts that save lives and help people adapt to climate change.

GOES-R system program director Pam Sullivan highlights GOES-16 imagery for Vice President Harris. Photo Credit: NASA/Taylor Mickal

EDUCATION AND OUTREACH (CONTINUED)

The GOES-R Program, in partnership with the Joint Polar Satellite Program, NOAA Satellite and Information Service, NASA GSFC, and the Cooperative Institute for Research in the Atmosphere produced six “Earth from Orbit” videos this quarter. [Earth from Orbit](#) is a series of short videos that showcase a compelling weather event, environmental hazard, or interesting meteorological phenomenon, as seen by NOAA satellites. A web article with additional information accompanies each video. Topics highlighted this quarter include atmospheric rivers, hurricanes, solar flares, haunting sights from NOAA satellites, GOES-T’s arrival in Florida, and a kona low.



Earth from Orbit: Atmospheric River Hits the West Coast. Credit: NOAA/NASA/CIRA

How do clouds affect solar energy? [A new SciJinks article explains how low clouds can block light from the sun, which means less solar energy.](#) Weather satellites like the GOES-R Series keep an eye on these clouds, which can help make predictions about the capture of solar energy.



Solar panels in Jurupa Valley, California. Photo credit: Janet Purchase/US Dept of Energy

A monsoon is a shift in winds that often causes a very rainy season or a very dry season. Although monsoons are usually associated with parts of Asia, they can happen in many tropical and subtropical regions – including several locations in the United States. [Learn more about monsoons and how GOES-R Series satellites monitor them from space in this new article from SciJinks.](#)

The GOES-R Program participated in NOAA DataFest, a month-long celebration of NOAA’s vast collection of environmental data, in November. [This year’s theme focused on the data that will be available from the upcoming GOES-T and JPSS-2 satellites](#) – how data from each are used and how together, they bring us an array of useful information along with the most advanced weather forecasts. During DataFest, there were three NOAA Environmental Data Talks (NEDTalks) from various data experts, end-users, and data scientists about how they use satellite data.



The GOES-R and GeoXO programs were featured in the Winter 2021 issue of *The Critical Path*, NASA Goddard Space Flight Center’s flight projects directorate quarterly newsletter. The six-page feature, [“NOAA’s Geostationary Satellite Missions Take Off,”](#) highlights the upcoming GOES-T launch, the advanced instruments the satellite carries, and the critical data the mission will provide. The article also introduces the GeoXO program and the new capabilities the mission will bring in support of U.S. weather, ocean, and climate operations in the 2030s. In addition, GOES-R Program senior project support specialist Jen Clark was profiled in the flight project support community spotlight.



A new GOES-T mission overview video was published on Dec. 14.

GOES-T will be renamed GOES-18 upon reaching geostationary orbit and will go into operational service as GOES West, following a successful on-orbit checkout of its instruments and systems.

[As GOES West, GOES-18 will provide critical data for the U.S. West Coast, Alaska, Hawaii, Mexico, Central America, and the Pacific Ocean.](#)

AWARDS AND ACCOLADES

The GOES-R Ground System Remote Access Development Team received the NOAA Administrator's Award for delivering the remote access for development capability in response to the COVID-19 pandemic, enabling GOES-T launch preparations to safely proceed.

The GeoXO User Engagement Team received a 2021 NESDIS Collaboration Award for their hard work and significant user engagement achievements.

Vanessa Escobar was honored with the 2021 NESDIS Outstanding Science and Research Team Member of the Year Award for her exceptional, collaborative leadership of user engagement on behalf of GeoXO.

Chris Wheeler was awarded the NOAA Order of Sherman's Lagoon for his extraordinary and sustained contributions to the GOES-R and GeoXO Programs, to ensure NOAA's essential geostationary satellite observations will be sustained through 2050 to protect the current and future residents of the Americas.

MEET THE TEAM



In this issue, meet Joanna Joiner, atmospheric physicist in the NASA Laboratory for Atmospheric Chemistry and Dynamics and GeoXO ACX (atmospheric composition) instrument scientist. She has been at NASA for over three decades and joined the GeoXO team last year. In her primary role,

Joanna is responsible for using the raw measurements of backscattered sunlight for satellite instruments and turning them into high-quality data products for end users.

Joanna graduated from the Georgia Institute of Technology with a Ph.D. in electrical engineering and has worked at NASA Goddard ever since. Over her career, she recalls that her most significant achievements have been through the work she's done with the Ultraviolet-

Visible Satellite Team in the Atmospheric Chemistry and Dynamics Laboratory. They have accomplished much together, like improving nitrogen dioxide measurements by carefully accounting for the effects of light reflected from the Earth's surface. "It is very powerful to map this pollution across the globe and to study trends," said Joanna. Improving air quality measurements like these are essential because everyone is impacted by air pollutants, such as nitrogen dioxide emitted during the combustion in automobile engines or power plants.

Joanna is excited to be working on the next generation of GEO air quality instruments that will provide hourly measurements of air pollutants. "I am always very excited to do something new and unexpected with available satellite data," she said. Similar instruments have launched recently and are already producing exciting data. The GeoXO ACX will provide continuity for these measurements.

In her free time, Joanna enjoys biking, hiking, and recently learned how to play pickleball. She is also an avid fan of the Washington Nationals, the Washington Capitals, and the Baltimore Ravens.

UPCOMING EVENTS

GOES-T is scheduled to launch on March 1, 2022, aboard an Atlas V 541 rocket from Cape Canaveral Space Force Station in Florida. Once in geostationary orbit, GOES-T will be renamed GOES-18. After a successful on-orbit checkout, GOES-18 will join NOAA's operational fleet in early 2023, replacing GOES-17 as GOES West. Together, GOES-16 and GOES-18 will watch over more than half the globe, from the west coast of Africa to New Zealand and from near the Arctic Circle to the Antarctic Circle.



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