

# GOES-R and GeoXO

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



It has been an eventful quarter for the GOES-R/GeoXO Program. GOES-T is finishing up testing in preparation for its

shipment to the launch site this fall, while critical activities to test communications between the satellite and ground system and rehearse launch procedures continue. GOES-16 and GOES-17 provided critical data for recent severe weather, wildfire, and tropical storm/hurricane events. GeoXO completed its first technical review and is moving forward into the concept and technology development phase of the mission. We issued the RFP for the GeoXO sounder instrument, as well as RFIs for the spacecraft and ocean color and lightning mapping instruments. As we work toward completing the GOES-R mission, we are also full steam ahead on bringing GeoXO to fruition. I commend our team for the remarkable work they do every day to advance the mission.

## PROGRAM HIGHLIGHTS

GOES-T continues testing in preparation for its upcoming launch. Post-environmental comprehensive performance testing is complete and the spacecraft began electromagnetic interference/electromagnetic compatibility (EMI/EMC) testing in June, which ensures the electromagnetic signals produced by satellite components do not interfere with its operation.



GOES-T undergoes EMI/EMC testing. Credit: Lockheed Martin

**On June 24, 2021, NOAA announced that GOES-T will replace GOES-17 in the GOES West position**, following a successful launch and checkout period. The decision to place GOES-T into operational service as soon as possible after launch is a result of the blockage in the loop heat pipe of the Advanced Baseline Imager (ABI), the key instrument on GOES-17. GOES-T will be renamed GOES-18 once it reaches geostationary orbit. [After it completes checkout of its instruments and systems, GOES-18 will go into operation as GOES West](#) and work in tandem with GOES-16, which operates in the GOES East position.

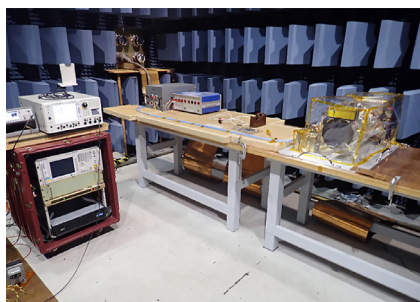
## DID YOU KNOW?

Actiniform clouds were not discovered until the satellite era. They are usually so large they aren't recognizable from below. [These collections of shallow clouds, organized in a distinctive radial pattern, were first observed by NASA's TIROS V satellite in 1962.](#)

## PROGRAM HIGHLIGHTS (CONTINUED)

The second GOES-T mission rehearsal was held Apr. 26-30, 2021. This rehearsal focused on post-launch instrument activation and early calibration activities. During mission rehearsals, a satellite simulator is used with the ground system to train operations personnel and test the readiness of operational products and the ground system.

On May 6-7, 2021, the Mission Operations Support Team successfully completed the GOES-T end-to-end test (ETE) 3b to demonstrate operational connectivity and functionality between the spacecraft, instruments, and the control center at the NOAA Satellite Operations Facility (NSOF). The team made significant use of the new Remote Access for Development system to minimize travel and staffing at NSOF during these activities.



CCOR undergoes environmental testing.  
Credit: NRL

**GOES-U development, testing, and integration continue.** The GOES-U ABI completed vibration and thermal vacuum testing in May and

mass property testing in June. The instrument has been placed in storage, where it will remain until it is needed for integration with the GOES-U spacecraft. The GOES-U Compact Coronagraph (CCOR) completed electromagnetic interference/electromagnetic compatibility (EMI/EMC) testing in May. In June, the Naval Research Laboratory team conducted a successful GOES-U CCOR Pre-Environmental Review.

**The GOES-16 and GOES-17 Extreme Ultraviolet and X-Ray Irradiance Sensors (EXIS) Extreme Ultraviolet Sensor (EUVS) data product is now fully validated and operational,** following a successful Peer Stakeholder – Product Validation Review on May 19, 2021.

**All ground system data operations software and hardware updates needed for the GOES-T launch campaign are complete.** GOES-R operational science data processing transitioned to new server hardware in the Product Processing Zone (PPZ) in April. The GOES-R ground system successfully transitioned the NOAA Satellite Operations Facility (NSOF) Satellite Operations Zone (SOZ) Integration and Test Environment to new server hardware in May. In July, the team transitioned the NSOF SOZ Operational Environment to the new server hardware.

## GeoXO

With the release of the President's FY22 budget, the program name has officially changed from Geostationary and Extended Orbits (GEO-XO) to Geostationary Extended Observations (GeoXO) to more accurately reflect the planned scope of the program.

The revised GeoXO program budget plan, meeting NESDIS guidelines, was approved by NOAA. The new plan refines the scope, cost phasing, constellation configuration, and schedule to meet program budget parameters. The revised plan reverts to the previous constellation recommendation, which consists of an East and West satellite carrying the imager, lightning mapper, and ocean color instrument, plus a Central U.S. satellite with hyperspectral sounder and atmospheric composition instrument. To reduce peak annual costs, the planned launches of the sounder and atmospheric composition instrument will be delayed by three years.



Recommended GeoXO constellation: Credit: NOAA

**The GeoXO Mission Concept Review (MCR), the first technical review for the program, was successfully completed on June 10, 2021.** The MCR evaluated the proposed objectives and the ability of the mission concept to meet the stated objectives and affirmed the need for the mission. The Goddard System Review Team (GSRT) commended GeoXO's exciting new capabilities, solid flight architecture, strong connections to the

extended science/user community, low risk ground system approach, and extensive leveraging of GOES-R experience. The review team concluded that GeoXO is ready to move into Phase A—concept and technology development. The team is preparing for Key Decision Point A in July, which will formalize Phase A activities.

**On April 30, 2021, NASA posted the GeoXO Sounder (GXS) Phase A Study Request for Proposals (RFP)** to solicit [proposals for a definition-phase study of an infrared geostationary sounder instrument for the GeoXO mission](#).

Proposals have been received and are under evaluation. The program plans to award the contract in August 2021.

**On May 18, 2021, NASA released the GeoXO Spacecraft Request for Information (RFI)** to [solicit information on spacecraft system design concepts](#) to facilitate ongoing mission architecture trade studies, to help define the scope of Phase A work, and to prepare for a potential, future release of an RFP to procure up to six spacecraft and/or related services for the NOAA GeoXO program series

of geostationary satellites. The six spacecraft will each accommodate three Earth-viewing instruments and four of the six spacecraft will need to accommodate five space weather instruments, which will have solar views and take in-situ measurements. Responses are due July 30, 2021.

**On May 26, 2021, NASA released the GeoXO Ocean Color Phase A Study RFI** to [solicit responses from vendors interested in bidding on a definition-phase study of a geostationary ocean color instrument \(OCX\)](#) and seek information on instrument system design concepts to facilitate ongoing trade studies of feasible instrument capabilities and observational value relative to budget constraints to refine the mission architecture and prepare for a potential future release of an RFP.

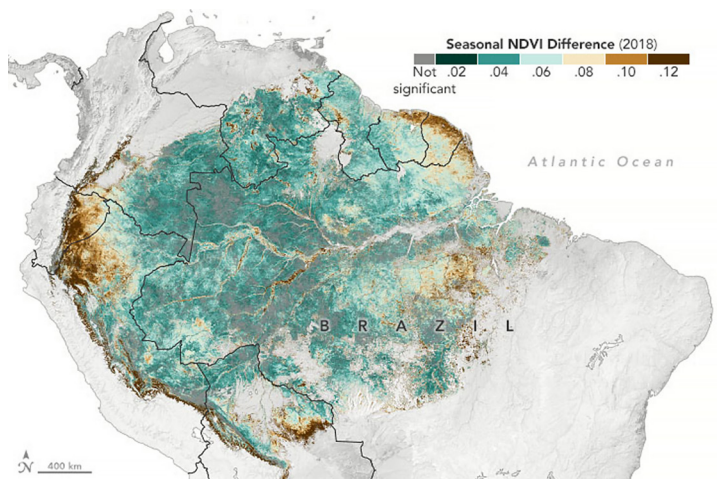
**On June 15, 2021, NASA posted the GeoXO Lightning Mapper (LMX) Phase A Study RFI** to [seek information related to an instrument for lightning mapping observations under consideration to be a part of the GeoXO program](#).

## IMAGERY AND SCIENCE APPLICATIONS

**Semi-annual NOAA/NASA Research Opportunities in Space and Earth Sciences (ROSES) reports for the time period Sept. 2020 – Feb. 2021 have been posted.** These grants are intended to advance research and practical applications using data derived from instruments aboard U.S. and international geostationary satellites. These include NOAA's GOES-R Series, the Japan Meteorological Agency's Himawari, and Korea's GEO-KOMPSAT-2A. [The research projects will address ways to improve the generation of data products and/or the utilization of data products in scientific research and operational applications from operational geostationary satellite data.](#) All FY2020 awards have a three-year period of performance and status reports will be provided for each project twice per year.

**In temperate deciduous forests, seasonal changes are hard to miss.** Green forests turn red, yellow, or orange in autumn and brown by winter. The Amazon rainforest experiences seasons as well, but the changes are far more subtle. Temperatures and sunlight remain pretty consistent year-round, but rainfall varies cyclically, becoming more common in certain months and less common in others. In recent decades, scientists have been using satellite data to study whether these seasonal variations have a significant effect on the “greenness” of the rainforest canopy. Multiple studies suggest that a key measure of vegetation, Normalized Difference Vegetation Index (NDVI), can detect subtle seasonal cycles. [Information collected from the GOES-R ABI offers view of the differences in vegetation](#)

[greenness between wet and dry seasons of the Amazon Basin in 2018.](#) The analysis found that 85 percent of forested areas exhibited some seasonality—with the most pronounced signals in Ecuador, western Peru, Bolivia, French Guiana, and Suriname. Understanding Amazon seasonality should help scientists develop a more nuanced and accurate view of the carbon cycle.



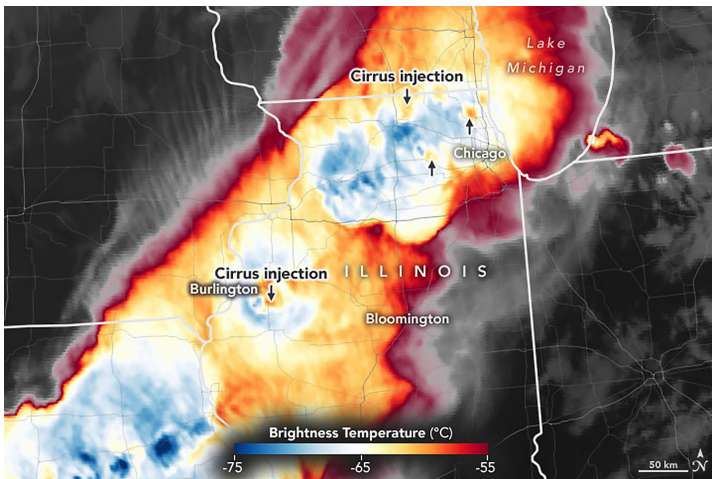
GOES-16 Normalized Difference Vegetation Index over the Amazon Basin shows a view of the differences in vegetation greenness between wet and dry seasons in 2018. Credit: NOAA/NASA

**On June 16, 2021, National Weather Service forecasters in Grand Forks, North Dakota, used a variety of GOES-16 data to track wildfire smoke.** As smoke from the Robertson Draw Fire in Montana moved toward their County Warning Area, forecasters knew the smoke

## IMAGERY AND SCIENCE APPLICATIONS (CONTINUED)

could affect daytime temperatures, and in turn, potential convection later in the afternoon. [Close observation of the elevated smoke using GOES-16 visible, GeoColor and aerosol optical depth imagery was used to assess the trajectory of the smoke and determine which areas would most likely be under a veil of elevated smoke.](#) Ultimately, smoke and clouds did effect temperatures within portions of the Red River Valley into northwest Minnesota by limiting the amount of heating and lessening convective potential.

**After a group of tornadoes emerged from a squall line on June 20, 2021**, and one touched down in the Chicago suburb of Naperville, the effects on the ground were obvious. The EF3 tornado had 140-mile-per-hour winds that toppled thousands of trees, injured 11 people, and cut electricity to tens of thousands. The tornado damaged at least 230 houses, including one that collapsed. [From a satellite perspective, the dynamics of the storm system were more subtle, but they offered at least one early clue that the squall line had a good chance of unloading destructive weather.](#) Cloud temperature data from the GOES-16 ABI was collected about 45 minutes before the tornado touched down. The data revealed plumes of warm air downwind of updrafts—cold overshooting cloud tops called above-anvil cirrus plumes (AACPs). An analysis of 400 severe weather events using GOES data showed that about 75% of the time, these cirrus plumes appeared 10 minutes or more before the most severe weather hits.

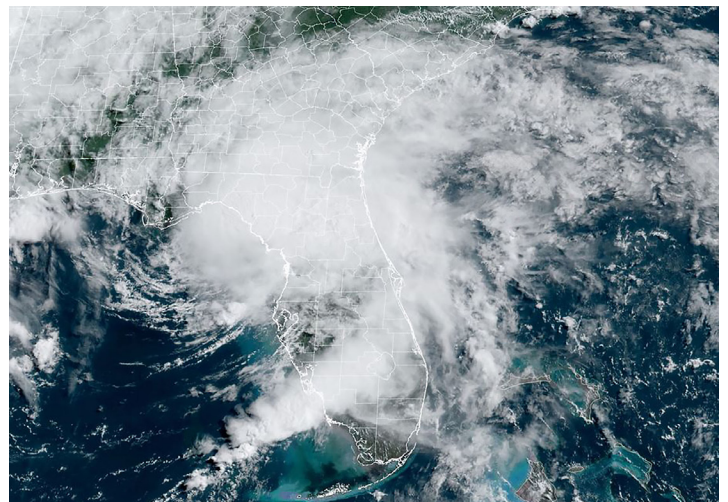


GOES-16 cloud temperature data of storm over Illinois on June 16, 2021. Warmer air is red and cooler air is blue. Credit: NOAA/NASA

**The NASA Health and Air Quality Applied Sciences Team (HAQAST) has selected a multi-agency/institute proposal for funding.** This proposed activity will ingest NOAA's surface GOES hourly PM2.5 product into the Environmental Protection Agency's (EPA's) AirNow system for air quality monitoring and management applications.

NOAA has begun generating surface PM2.5 data using the GOES-16 and GOES-17 ABI aerosol optical depth product. This surface PM2.5 product is currently experimental but will transition into NOAA operations for National Weather Service air quality model forecast guidance applications. Through this joint NASA-NOAA-EPA project led by HAQAST team members, the NOAA experimental surface PM2.5 product will be provided to NASA to evaluate and enhance for EPA's AirNow needs. AirNow is a one-stop source for air quality data that is widely used by stakeholders such as state and local air quality agencies. This project will be executed on the Amazon Web Services Cloud for easy data transfer and distribution.

**The 2021 Atlantic Hurricane Season is underway and breaking records.** Tropical Storm Elsa formed about 865 miles east-southeast of the Windward Islands on July 1 [as the earliest fifth-named storm on record, breaking Edouard's record from July 6, 2020.](#) Elsa strengthened into a Category 1 hurricane on July 2, becoming the first hurricane of the 2021 Atlantic season. Elsa was also the easternmost hurricane recorded in the Main Development Region (MDR). The MDR, which is a region south of 23.5°N, is an important boundary that is used in hurricane development metrics. There hasn't been a hurricane this early in the calendar year in that area since 1933's Trinidad hurricane. As Elsa moved forward at a speed of 29 mph, it became the fastest-moving Atlantic tropical cyclone undergoing rapid intensification recorded in the MDR, Caribbean, or Gulf of Mexico as well as the first storm to undergo rapid intensification in that region this early in the calendar year since a previous storm in 1908. [NOAA is predicting an above-average 2021 Atlantic hurricane season](#), with a likely range of 13 to 20 named storms.



GOES-16 captured Tropical Storm Elsa's landfall along the North Florida Gulf Coast on July 7, 2021, Credit: NOAA

## EDUCATION AND OUTREACH

The GOES-R Program, in partnership with JPSS, NOAA Satellite and Information Service, NASA GSFC, and the Cooperative Institute for Research in the Atmosphere (CIRA) produced 13 “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 each week, as seen by NOAA satellites. The videos provide a look at the science behind the highlighted topic and imagery. A short article with additional information accompanies each video. Topics highlighted this quarter include a ship backup in the Suez Canal, the eruption of the La Soufrière volcano, gravity waves, Earth Day, severe weather and supercells, von Kármán vortices, the world’s largest iceberg breaking apart, actiniform clouds, wildfires, and tropical storm/hurricane activity.



**What causes tides?** If you’ve ever spent a day at the beach, you’ve probably noticed that the ocean water is constantly moving. Waves cause the ocean to move all day long. And tides cause the ocean to rise and fall twice each day. But what exactly causes high tides and low tides? [Learn more in a new video from NOAA SciJinks.](#)



**A web story and video highlighted the successful test deployment of the GOES-T solar array.** [This critical test verified that the satellite’s large, five-panel solar array — which is folded up when the satellite is launched — will properly deploy when GOES-T reaches geostationary orbit.](#)

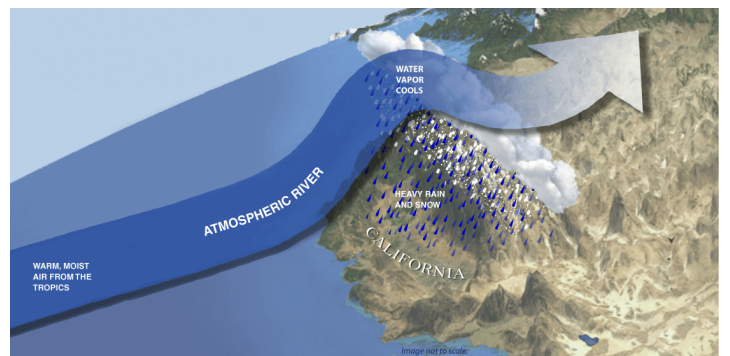
During this test, engineers unfurled the five panels on rails that simulated the zero-gravity environment of space. Once in orbit, the deployed solar panels will form a single solar array wing to power the satellite using energy from the sun.



Engineers conduct the GOES-T solar array deployment test. Credit: Lockheed Martin

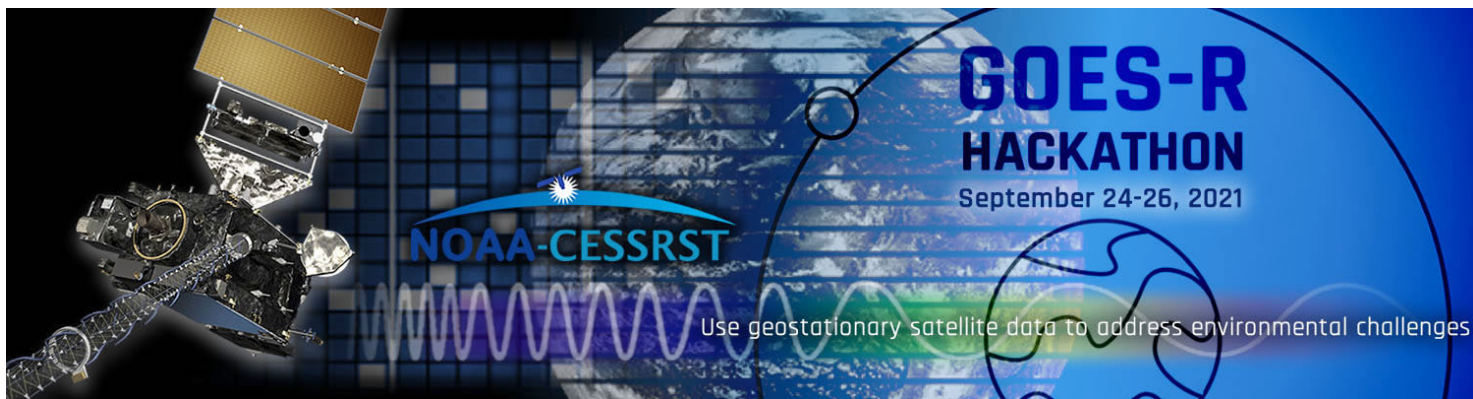
**Winners of the 2021 GOES-16/17 Virtual Science Fair were announced in June.** In this nationwide virtual science competition, students worked in small teams to design projects that use GOES 16/17 satellite data to investigate weather or natural hazards. [Each team shared their project through a scientific poster and a short video presentation.](#) “The Virtual Science Fair serves as an important pipeline to NOAA’s future workforce by engaging students in real-time data and requiring them, with help, to share their projects in a universally recognized scientific format,” said Margaret Mooney, the education director at the Cooperative Institute for Meteorological Satellite Studies (CIMSS).

**What Is an Atmospheric River?** Atmospheric rivers are long, flowing regions of the atmosphere that carry water vapor through the sky. They are about 250 to 375 miles wide and can be more than 1,000 miles long. Rivers on land generally flow downhill; atmospheric rivers flow in the direction of moving air created by weather systems. [Learn more about these moving columns of water vapor in the sky.](#)



Atmospheric rivers begin as rising moist air in the tropics and result in heavy rain and snow over land. Credit: NOAA

## EDUCATION AND OUTREACH (CONTINUED)



The GOES-R Program will conduct a virtual hackathon event on September 24-26, 2021. [During the hackathon, teams of college students will collaborate to develop interdisciplinary solutions to contemporary environmental issues using GOES-R Series geostationary satellite data.](#)

Undergraduate students of any academic major from NOAA Center for Earth System Sciences and Remote Sensing Technologies (CESSRST) institutions are eligible to participate.

## CONFERENCES AND EVENTS

A GeoXO Atmospheric Composition Town Hall was held virtually on April 29, 2021. [The Town Hall meeting introduced the GeoXO mission to the atmospheric composition \(AC\) community](#), shared potential AC capabilities from GeoXO, and provided a forum for the research and user community to ask questions as well as submit comments and ideas. The meeting also introduced the Pathfinder Program, which is recruiting 'early adopters' associated with each instrument. Nearly 300 people attended the event.

The GOES-R Program conducted a satellite training workshop with World Meteorological Organization (WMO) Regions III and IV and the Instituto de

**Hidrología, Meteorología y Estudios Ambientales (IDEAM) in Colombia.** The workshop was held virtually on April 6, 7, 13, 14, and 15, for participants in Colombia and neighboring countries of the WMO South America Region III/IV. The workshop covered GOES-R and JPSS satellite capabilities and data access to support AmeriGEO's Social Benefit Areas (SBA) and the forecasting challenges of WMO Region III/IV. Daily sessions included an overview of GOES-R, JPSS and other satellites, their instruments, data, products and tools, and opportunities for hands-on exercises involving local case studies for participants to use satellite data to understand environmental scenarios and make forecasts. The workshop was conducted in Spanish.

## AWARDS AND ACCOLADES

NOAA and Cooperative Institute for Satellite Earth System Studies scientists were honored with an *SPIE Journal of Applied Remote Sensing* 2020 Best Papers Award. Their paper, ["On-orbit calibration and characterization of GOES-17 ABI IR bands under dynamic thermal conditions,"](#) was selected as the best paper for Photo-Optical Instrumentation and Design. The paper summarizes efforts by NOAA's GOES-R Calibration Working Group (CWG), in collaboration with other teams, to evaluate and alleviate the negative impacts of warmer and floating focal plane module temperatures on ABI infrared calibration. Authors include Z. Wang, X. Wu, F. Yu, J. Fulbright, E. Kline, H. Yoo, T. Schmit, M. Gunshor, M. Coakley, M. Black, D. Lindsey, H. Qian, X. Shao, and R. Iacovazzi.

**A team of GOES-R and SWFO-L1 personnel finished first at GSFC and 11<sup>th</sup> overall in the 2021 NASA Moves competition.** NASA Moves is an agency-wide competition that has team members recording steps (or equivalent steps) each day as a way of encouraging everyone to add a little activity to their lives. There were 431 teams NASA-wide and 68 teams at GSFC who participated. The GOE-SWFtly team ran, walked, danced, climbed, scuba-dived, yogaed, ellipticaled, spun, and biked their way through the competition. Multiple team members routinely exceeded the 35,000 daily step limit set by the competition, with one member exceeding that limit every day of the four-week competition.

## AWARDS AND ACCOLADES (CONTINUED)

**Several GOES-R Program individuals and teams were recognized with 2020 Robert H. Goddard Honor Awards.** Each year, NASA Goddard Space Flight Center (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.

### Customer Service

*Monica Coakley*

### Engineering

*Perry Baltimore*

*Edwin Harvie*

*Michael Mesarch*

*Richard Schnurr*

*Maryjane Stephenson*

### Leadership

*Michelle Rizzo*

### Quality & Process Improvement

*Vince Ruland*

### Science

*Robert Levy*

### Secretarial & Clerical

*Judy Brudi*

## MEET THE TEAM



**In this issue, meet Salim Leyva, Mission Operations Manager (MOM) for the GOES-R Program.** As part of NOAA's Office of Satellite and Product Operations (OSPO) Mission Operations Division, Salim is responsible for overseeing the GOES-R constellation, including the upcoming launches of GOES-T and

GOES-U. He joined the GOES-R Program in March 2021.

Salim has been with NOAA for 34 years. He began his career at the Office of Oceanic and Atmospheric Research Aircraft Operations Center on an electrical engineering internship assignment while attending Florida International University in Miami. He has also worked at the National Hurricane Center, Office of Dissemination, Office of Planning and Program Services, and the National

Ocean Service Center for Operational Oceanographical Products and Services. Salim's entire NOAA career has involved collecting/processing critical weather data and disseminating it for forecasting and weather model improvements as well as public consumption.

Salim said the most rewarding part of his job is knowing what he's doing benefits the American people and that every day there is a new challenge and opportunity to improve something. "As a first-generation American, I would say my most significant achievement has been getting to where I am today and all the things I have been able to accomplish throughout my career at NOAA to safeguard the American people from adverse weather conditions and ensure the nation's blue economy," he said.

Salim enjoys outdoor activities like gardening and exercising, spending time with family, and painting. He appreciates the opportunity to serve as the GOES-R Mission Operations Manager to help meet NOAA's mission and he looks forward to new and challenging things that may come his way.

## UPCOMING EVENTS

### GeoXO Key Decision Point A (KDP-A)

July 21

### GOES-T Pre-Shipment Review

Aug. 17-18, 2021

### GOES-T Operational Readiness Review

Sept. 1-2, 2021

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