GeoXO Program Update

NOAA's Satellite Applications Symposium Series: Weather
August 2024

Pam Sullivan, GeoXO Program Director

NOAA
National Environmental Satellite, Data, and Information Service

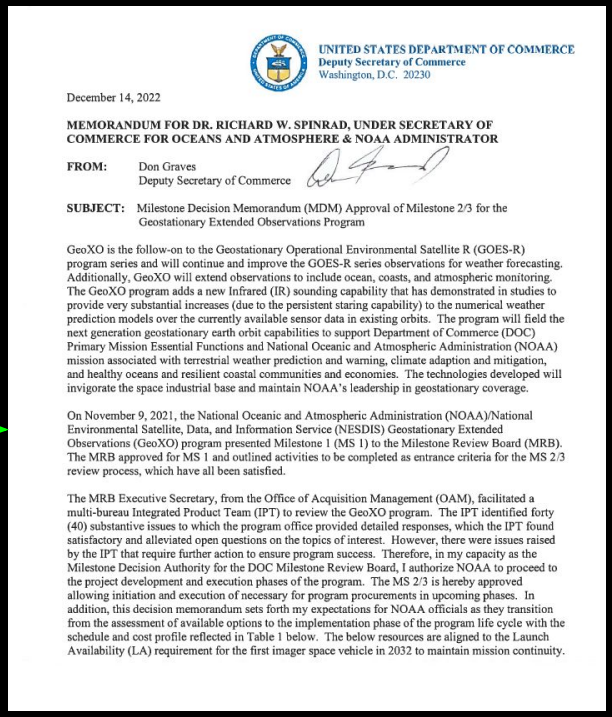
GOES-R Development Ends, GeoXO Begins

- The last GOES-R satellite, GOES-U, launched in 2024
- While GOES-R satellites will operate into the 2030s, replenishment is needed in 2032 for continuity

GOES-U was launched on June 25, 2024!

- To provide continuity after GOES-R, in 2020, NOAA began planning its next-gen system by surveying user needs and defining requirements
- In 2022, the new GeoXO program was approved for implementation by the Dept of Commerce

2022 DOC Decision Memo baselining GeoXO and approving implementation



UNITED STATES DEPARTMENT OF COMMERCE
Deputy Secretary of Commerce
Washington, D.C. 20230

December 14, 2022

MEMORANDUM FOR DR. RICHARD W. SPINRAD, UNDER SECRETARY OF COMMERCE FOR OCEANS AND ATMOSPHERE & NOAA ADMINISTRATOR

FROM: Don Graves
Deputy Secretary of Commerce

SUBJECT: Milestone Decision Memorandum (MDM) Approval of Milestone 2/3 for the Geostationary Extended Observations Program

GeoXO is the follow-on to the Geostationary Operational Environmental Satellite R (GOES-R) program series and will continue and improve the GOES-R series observations for weather forecasting. Additionally, GeoXO will extend observations to include ocean, coasts, and atmospheric monitoring. The GeoXO program adds a new Infrared (IR) sounding capability that has demonstrated in studies to provide very substantial increases (due to the persistent staring capability) to the numerical weather prediction models over the currently available sensor data in existing orbits. The program will field the next generation geostationary earth orbit capabilities to support Department of Commerce (DOC) Primary Mission Essential Functions and National Oceanic and Atmospheric Administration (NOAA) mission associated with terrestrial weather prediction and warning, climate adaption and mitigation, and healthy oceans and resilient coastal communities and economies. The technologies developed will invigorate the space industrial base and maintain NOAA's leadership in geostationary coverage.

On November 9, 2021, the National Oceanic and Atmospheric Administration (NOAA)/National Environmental Satellite, Data, and Information Service (NESDIS) Geostationary Extended Observations (GeoXO) program presented Milestone 1 (MS 1) to the Milestone Review Board (MRB). The MRB approved for MS 1 and outlined activities to be completed as entrance criteria for the MS 2/3 review process, which have all been satisfied.

The MRB Executive Secretary, from the Office of Acquisition Management (OAM), facilitated a multi-bureau Integrated Product Team (IPT) to review the GeoXO program. The IPT identified forty (40) substantive issues to which the program office provided detailed responses, which the IPT found satisfactory and alleviated open questions on the topics of interest. However, there were issues raised by the IPT that require further action to ensure program success. Therefore, in my capacity as the Milestone Decision Authority for the DOC Milestone Review Board, I authorize NOAA to proceed to the project development and execution phases of the program. The MS 2/3 is hereby approved allowing initiation and execution of necessary for program procurements in upcoming phases. In addition, this decision memorandum sets forth my expectations for NOAA officials as they transition from the assessment of available options to the implementation phase of the program life cycle with the schedule and cost profile reflected in Table 1 below. The below resources are aligned to the Launch Availability (LA) requirement for the first imager space vehicle in 2032 to maintain mission continuity.

GeoXO Constellation

GEO-West

Visible/Infrared Imager
Lightning Mapper
Ocean Color

GEO-Central

Hyperspectral Infrared Sounder
Atmospheric Composition
Partner Payload

GEO-East

Visible/Infrared Imager
Lightning Mapper
Ocean Color

NOAA Satellite Operations Facility, Suitland MD

Command and Data Acq. Station Wallops VA

Consolidated Back-Up, Fairmont WV

Geostationary Extended Observations

GXI
Vis/IR Imager

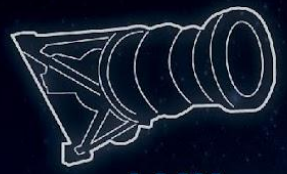
- Hurricane location / track
- Severe storms, rain, wind, hail
- Atmospheric rivers, flooding
- Winter storms, ice cover
- Wildfire, smoke, volcanic ash
- Methane plume monitoring
- Aviation hazards, turbulence

GXS
Hyperspectral IR Sounder

- Numerical weather prediction
- Hurricane track / intensity
- Now-casting
- Warn-on-Forecast
- Air quality monitoring

ACX
Atmospheric Composition Instrument

- Air quality forecasting
- Air quality monitoring
- Airborne hazards
- Emissions monitoring



LMX
Lightning Mapper

- Thunderstorm / tornado warning
- Wildfire ignitions
- Precipitation forecasts
- Tropical storm diagnosis

OCX
Ocean Color Instrument

- Harmful algal blooms
- Water quality
- Oil spill tracking
- Plankton classification
- Refined fisheries yield
- Habitat / species protection
- Naval forecasting

Climate

Weather Ready Nation

Resilient Coasts

Healthy Oceans

Note:
OCX represented by GLIMR
LMX represented by GLM
ACX represented by TEMPO

GOES-R ABI versus GeoXO Imager (GXI)

ABI CONFIGURATION

	Wavelength (μm)	Band	GSD
VNIR	0.47	Band 1	1 km
	0.64	Band 2	0.5 km
	0.865	Band 3	1 km
	1.378	Band 4	2 km
	1.61	Band 5	1 km
	2.25	Band 6	2 km
MWIR	3.9	Band 7	2 km
	6.185	Band 8	2 km
	6.95	Band 9	2 km
	7.34	Band 10	2 km
	8.50	Band 11	2 km
LWIR	9.61	Band 12	2 km
	10.35	Band 13	2 km
	11.20	Band 14	2 km
	12.30	Band 15	2 km
	13.30	Band 16	2 km

GXI CONFIGURATION

	Wavelength (μm)	Band	GSD
VNIR	0.47	Band 1	0.5 km
	0.64	Band 2	0.25 km
	0.865	Band 3	0.5 km
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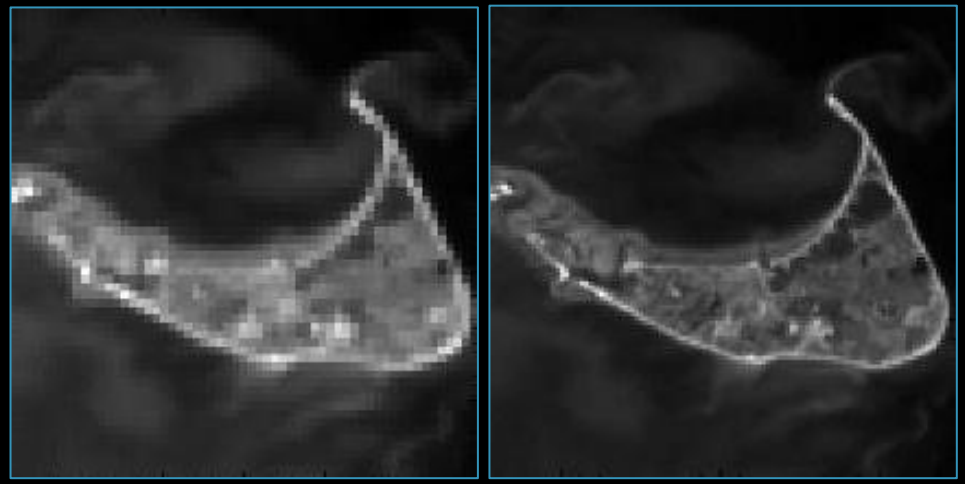
	11.20	Band 16	2 km
	12.30	Band 17	2 km
	13.30	Band 18	2 km

Nantucket Island at ABI 0.5km vs GXI 0.25km Resolution



GeoXO Lightning Mapper (LMX) Highlights

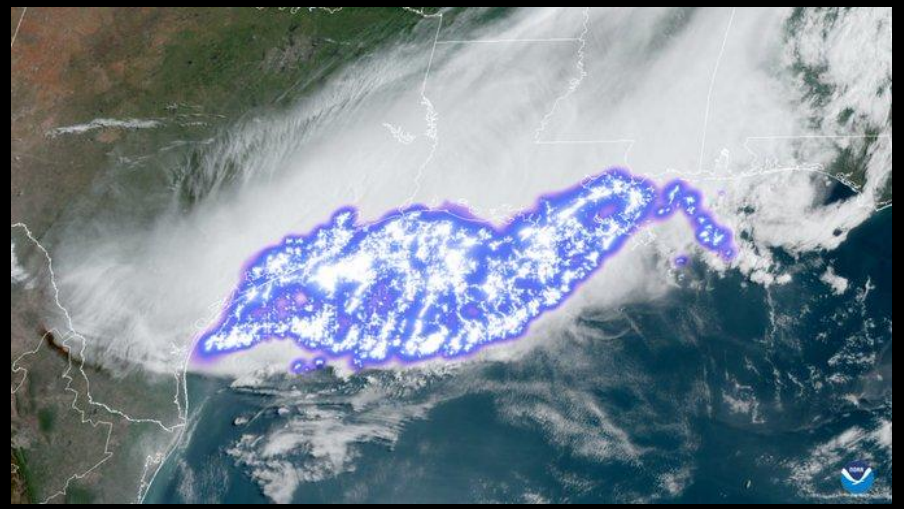
GeoXO LMX will continue providing lightning detection observations in Geo

- Full spatial extent of total lightning flashes, both intra-cloud and cloud-to-ground
- Temporal resolution to allow tracking of each lightning flash within a specific storm cell
- Earlier warnings of potential tornadic activity

Key Performance Features:

- Optical telescope tailored for 777.4 nm observations, with high frame and detector read rate and low latency

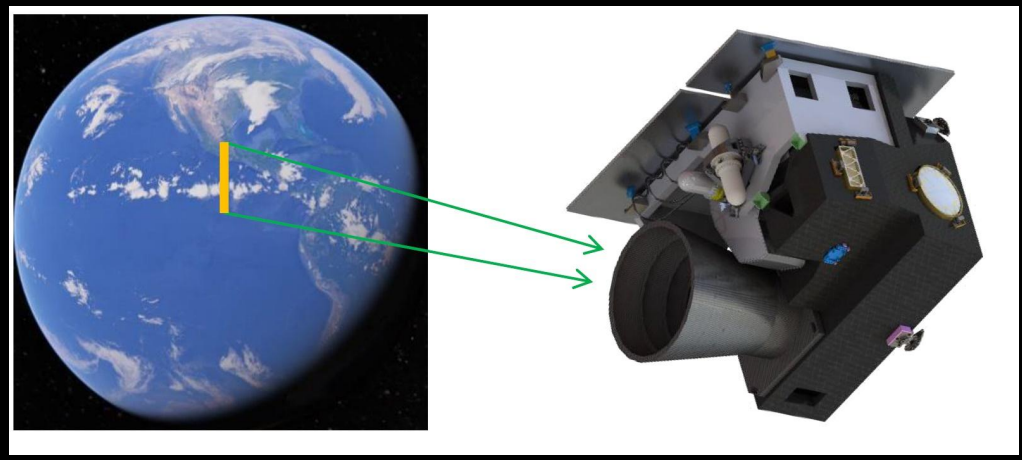
Parameter	Req. Value
Geographic Coverage	84%
GSD(nadir)	8km
Event Detection	70%
False Events	5%
SNR	4
Navigation Error	84 urad

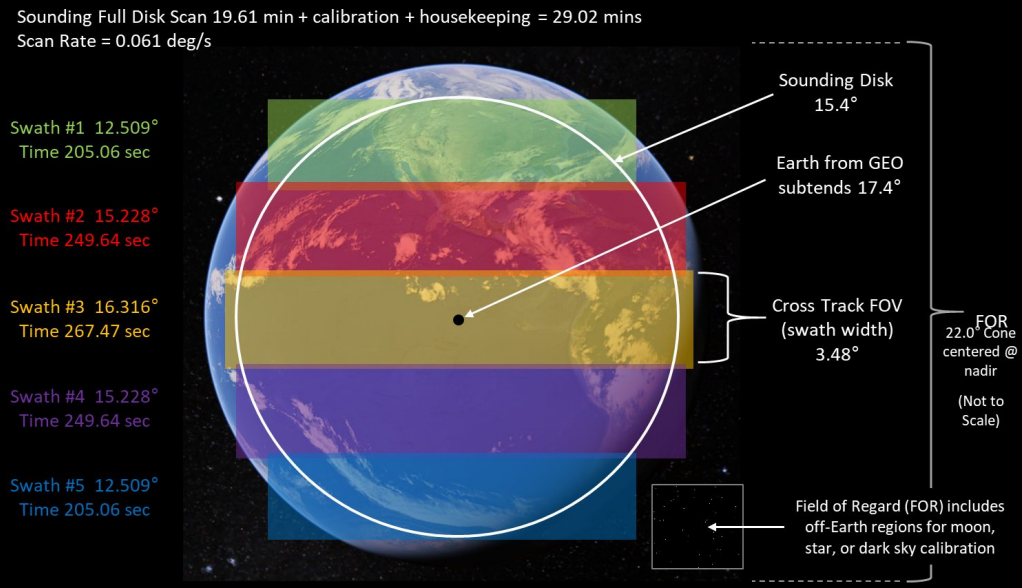


World's longest lightning flash as detected by GLM on 29 April 2022.

GeoXO Sounder (GXS) Highlights

- 0.625cm^{-1} spectral resolution (same as CrIS)
- 1540 MWIR and 1078 LWIR channels (2211 for CrIS), collected simultaneously
- Uses a dispersive grating technology (like AIRS), not an interferometer (like CrIS, IASI, GIIRS, IRS)
- Slit oriented N/S and projected onto field of regard
- One slit image samples 3.48 deg of N/S field of view
- Scan mirror slews slit image from West to East over the scan swath; swaths are scanned roughly 3.7° per minute
- Sounding Full Disk Scan completed in 5 swaths
  - Execution Time < 30 mins, including Star Senses/Space Looks, Calibration, and Housekeeping
- Other Scan Patterns possible, such as hourly full disk with interspersed super-regional and meso scans



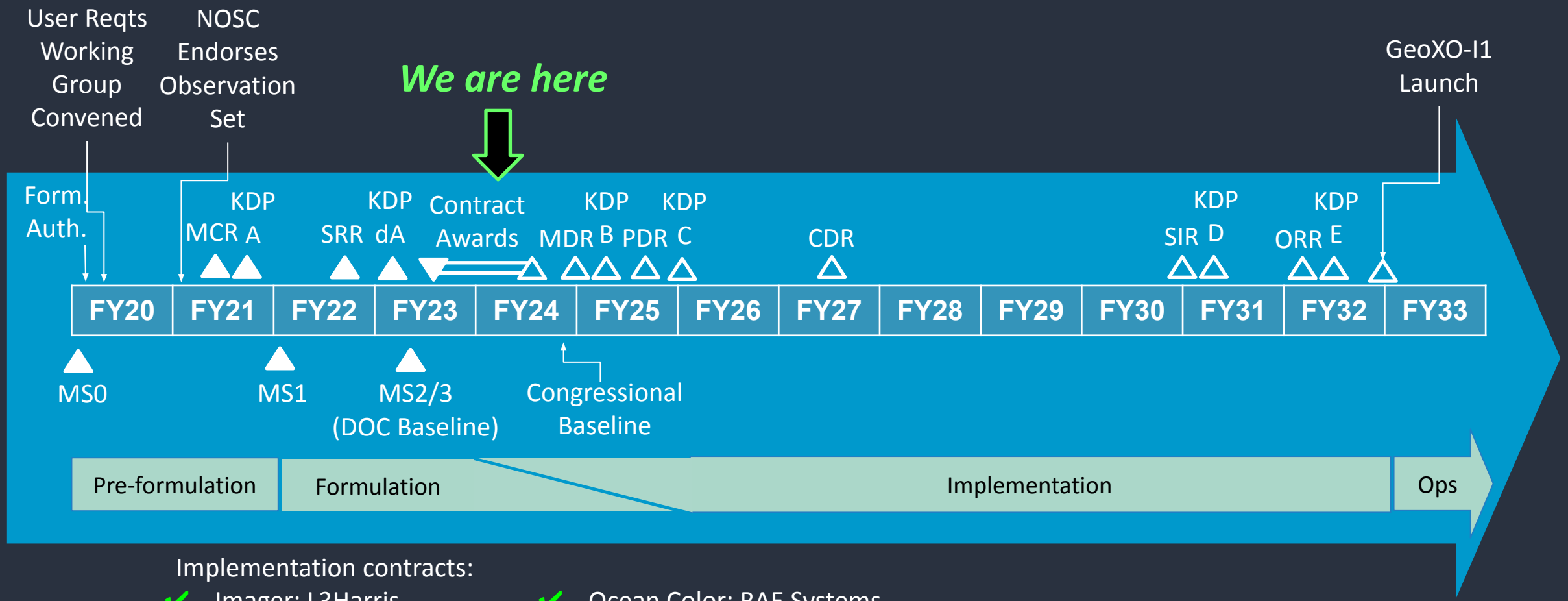


GeoXO Recent Progress

- Systems Requirements Review (SRR) completed Aug 2022
- Program officially approved by DOC Dec 2022
- Implementation begun w/selection of developers:
  - L3Harris for Imager (Mar 2023)
    - SRR completed Aug 2023
  - BAE for Sounder (Sep 2023)
    - SRR completed July 2024
  - BAE for Atmo. Composition sensor (May 2024)
  - BAE for Ocean Color sensor (May 2024)
  - Lockheed Martin for Spacecraft (June 2024)
  - Lightning Mapper award planned Aug 2024
- Will submit Congressional Baseline Report Aug 2024
- Planning Program Mission Definition Review Dec 2024
- User engagement, advocacy, readiness activities underway

GeoXO logos added to GOES-R store on LandsEnd:
https://business.landsend.com/store/goes-r_program/

GeoXO Timeline



Implementation contracts:

- ✔ Imager: L3Harris
- ✔ Sounder: BAE Systems
- ✔ Atmo. Comp.: BAE Systems
- ✔ Ocean Color: BAE Systems
- ✔ Spacecraft: Lockheed Martin
- \- Lightning Mapper: target award August 2024

Summary

- NOAA's geostationary satellites provide the only persistent weather observations of the Western Hemisphere, providing essential forecast information for public safety and efficient economic activity across multiple sectors
- A follow-on capability to GOES-R is required by 2032 to ensure data continuity
- GeoXO will provide continuity for weather forecasting and also add observations of the atmosphere, oceans, and coasts to meet growing environmental challenges facing our nation
- Support this year is critical to ensure GeoXO is ready in time to maintain continuity

GeoXO will maintain and advance U.S. observational capabilities through 2050

https://www.nesdis.noaa.gov/GeoXO