



CSPP Geo: What's New and What's Coming

CSPP Users' Group Meeting, Darmstadt, Germany

20 May 2026

Graeme Martin



Cooperative Institute for Meteorological Satellite Studies
University of Wisconsin - Madison



The CSPP Geo Project

CSPP Geo team

Jessica Braun, Geoff Cureton, Alan De Smet, Ray Garcia, Liam Gumley, Dave Hoese, Tommy Jasmin, Graeme Martin, Levi Pfantz, Eva Schiffer, Kathy Strabala

The Community Satellite Processing Package for Geostationary Data (CSPP Geo) project creates software allowing users to process data received from geostationary satellites.

- Primarily funded by NOAA STAR and the GOES-R Program.
- Software is available to process raw data, create imagery and generate higher level products.
- Input can be obtained from direct broadcast, NOAA Open Data Dissemination (NODD) and other sources.
- Most packages are based on code that was developed by NOAA-funded science teams, some are developed from scratch.
- Science code is typically provided by NOAA ASSISTT
- All software is free to download and use.
- The software is easy to install and run and well-documented.

Available CSPP Geo software packages

Package	Supported satellites								Description		
	GOES-16	GOES-17	GOES-18	GOES-19	Himawari-8	Himawari-9	GK2A	FY4A		FY4B	MTG (prelim.)
GRB	✓	✓	✓	✓							Process raw GRB data stream
AIT Framework	✓	✓	✓	✓							Level 2 retrieved geophysical products
GEOCAT					✓	✓					Level 2 retrieved geophysical products
Geo2Grid	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Imagery, animations, reprojection
Gridded GLM	✓	✓	✓	✓							Higher-level lightning products
AXI Tools	✓	✓	✓	✓	✓	✓					Utility package
LightningCast (beta)	✓	✓	✓	✓	✓	✓					Lightning prediction
ABI Flood Mapping	✓	✓	✓	✓							Hourly and daily flood mapping



CSPP Geo Users

Who are CSPP Geo users?

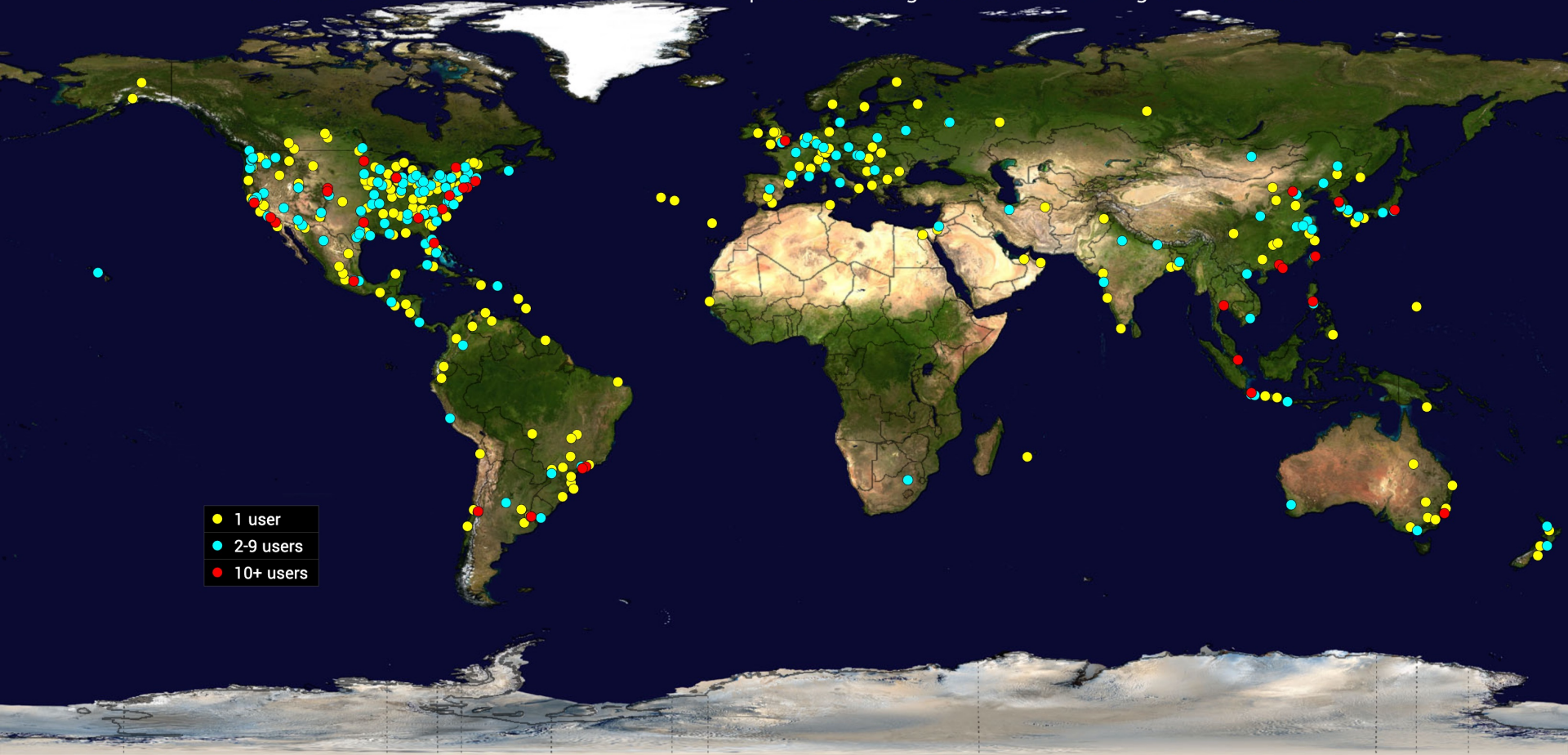
- NWS
- NASA
- Receiving station vendors
- Weather products and services companies
- Aerospace / defense industry
- Broadcast meteorologists
- International meteorological agencies
- News media
- Hobbyists
- Science / academia / education

How do we connect with users?

- User support email
- Public user forum
- Announcements emailed to user registrants list
- CSPP User Group meetings (~every two years)
- GRB User Group
- AMS and other conferences
- Workshops and training courses



CSPP GEO user database on 2026-05-12 comprises 2195 registrants downloading to 79 countries



GOES Rebroadcast (GRB) Data Stream and the GRB Package

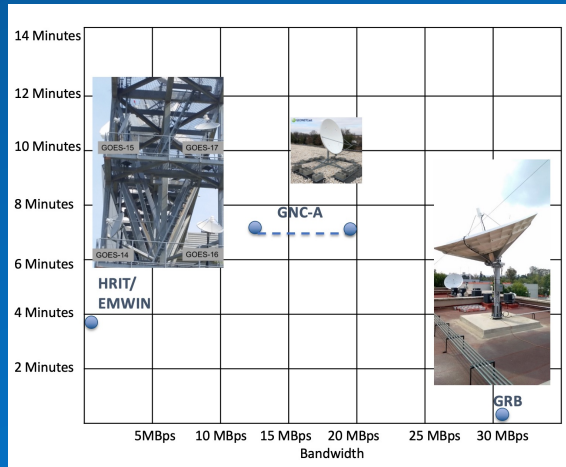
Users who are within the GOES-East (19) or GOES-West (18) satellite footprint can receive data via the **GOES Rebroadcast (GRB) stream**.

- Data from GOES-R instruments is included, at full resolution
 - Advanced Baseline Imager (ABI)
 - Geostationary Lightning Mapper (GLM)
 - Solar Ultraviolet Imager (SUVI)
 - Space Environment In-Situ Suite (SEISS)
 - Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS)
 - Magnetometer (MAG)
- GRB offers high reliability and low latency



Product Latencies

Antenna-based options to receive GOES-R data



Jim McNitt, NOAA

Observed GRB product latencies, in seconds

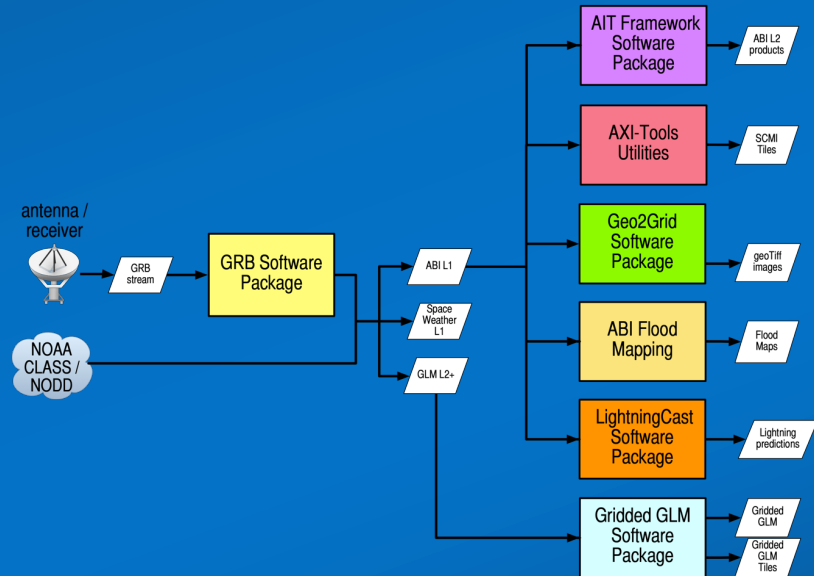
ABI CONUS	mean: 8.1	median: 8.3	max: 11.4	min: 3.5
ABI Full Disk	mean: 8.1	median: 7.9	max: 12.8	min: 4.1
ABI Mesoscale	mean: 6.4	median: 5.8	max: 12.3	min: 4.0
EXIS	mean: 6.9	median: 7.3	max: 11.2	min: 2.5
GLM	mean: 5.0	median: 4.1	max: 8.8	min: 2.9
MAG	mean: 2.5	median: 2.5	max: 2.9	min: 2.4
SEISS	mean: 5.6	median: 3.2	max: 67.2	min: 2.9
SUVI	mean: 32.2	median: 32.8	max: 34.4	min: 30.4

- Latencies are measured from observation end time to product file completion time on GRB receiving system
- Statistics are based on ~20mins of GOES-16 GRB data received on SSEC's antenna

GOES Rebroadcast (GRB) Data Stream and the GRB Package

GRB Package

- Initial package in the GOES-R processing chain
- Reconstructs products locally
- Higher level products and can then be generated with other CSPP Geo software packages



GOES Rebroadcast (GRB) Data Stream and the GRB Package

GRB v1.0.28 – current version (Oct 2023)

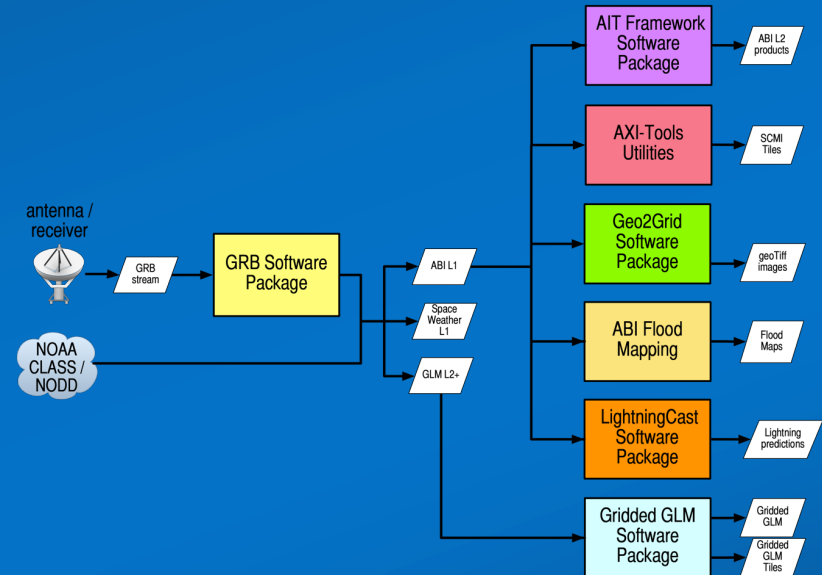
- Updates to bundled libraries

Recent / ongoing activities

- Evaluation of GOES-R Ground System updates with possible GRB impacts
- Reporting and troubleshooting of issues affecting GRB stream
- Continued work toward agile methodology to support short-fuse releases

Current focus

- NOAA will transition Level 1 processing and GRB generation to the GEO Cloud Compute Subsystem (GCCS)
- CSPP Geo team is evaluating test data, will monitor GRB stream for impacts



AIT Framework Package

Supported products

- Clear Sky Masks
- Cloud and Moisture Imagery
- Cloud Top Height
- Cloud Top Phase
- Cloud Top Pressure
- Cloud Top Temperature
- Derived Motion Winds
- Aerosol Detection: Smoke and Dust
- Aerosol Optical Depth
- Cloud Optical Depth (day/night)
- Cloud Particle Size Distribution (day/night)
- Land Surface Temperature (skin)
- Low Cloud and Fog

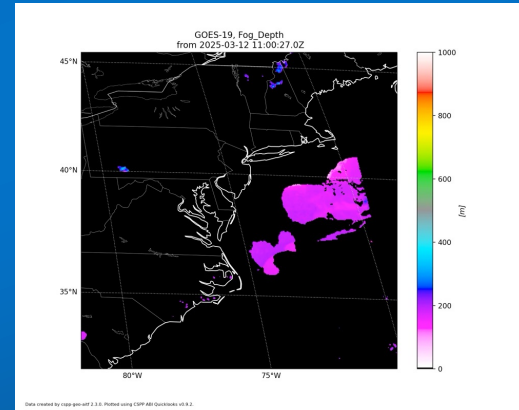
Level 2 product package for GOES-R series ABI

- Runs research versions of GOES-R product algorithms developed by NOAA-funded science teams

V2.3.1 (released September 2025)

- Aerosol Optical Depth: updated look-up table (LUT) for GOES-19; improves the GOES-19 AOD product over land.
- Cloud Mask: science updates, including LUT updates and the addition of subpixel statistics inputs.
- Fix for bug that could cause an empty dynamic ancillary data file in rare circumstances.

Quicklook images created from AITF products



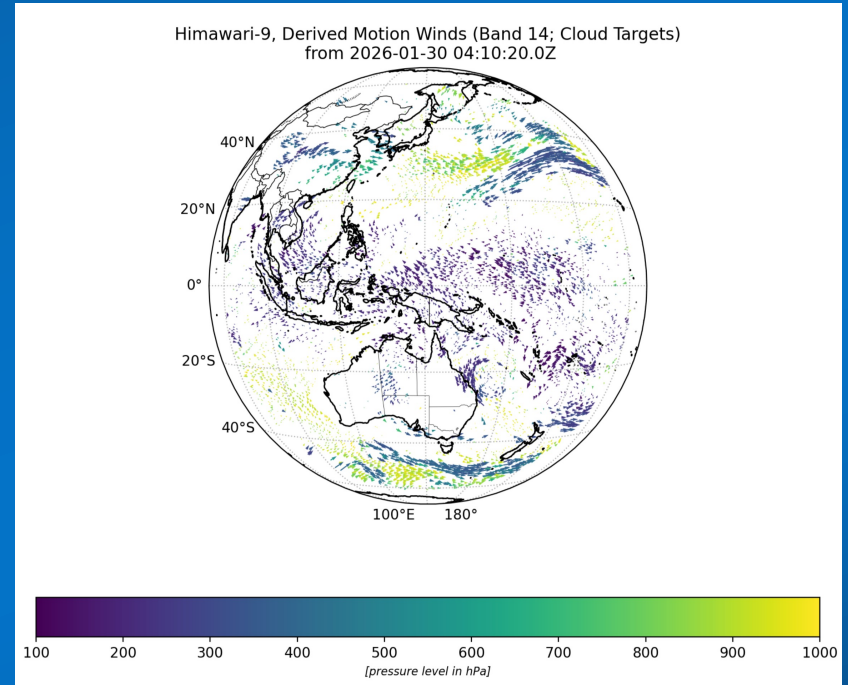
AIT Framework Package – Himawari Winds

AIT Framework v2.4 beta is coming soon

- Development is funded by Central Weather Administration (Taiwan)
- The ASSISTT team provided science code and core software development

New capabilities:

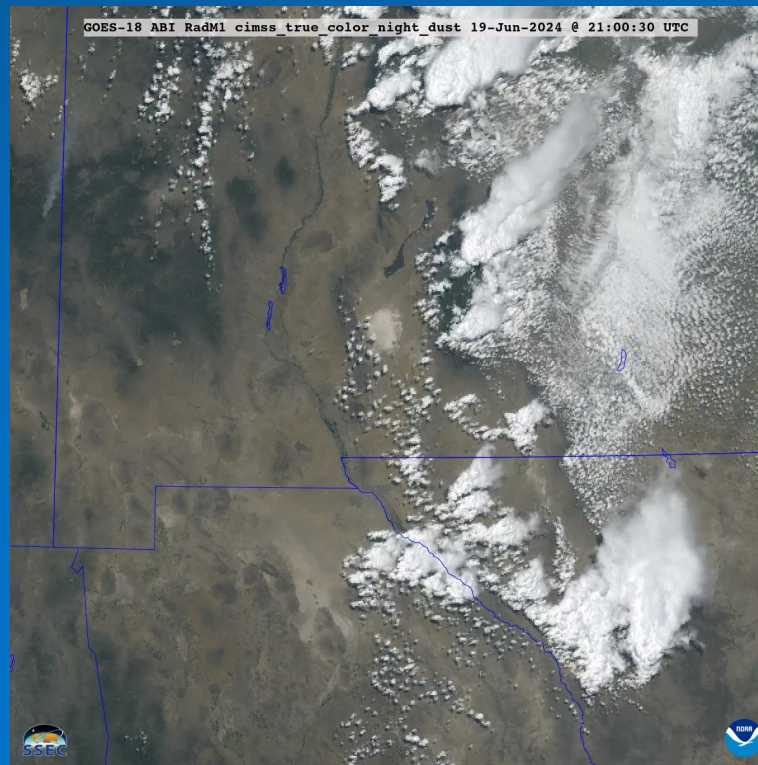
- Himawari 8/9 support for:
 - Derived Motion Winds
 - Clear Sky Masks
 - Cloud Top Height
 - Cloud Top Phase
- Full Disk and Target Area (not Japan region)
- HSD processing (not HimawariCast)



Geo2Grid

The **Geo2Grid software package** allows users to create high quality single band, combined Red/Green/Blue (RGB), and satellite product image files in an easy and efficient manner

- The Satpy open-source python library is used under the hood



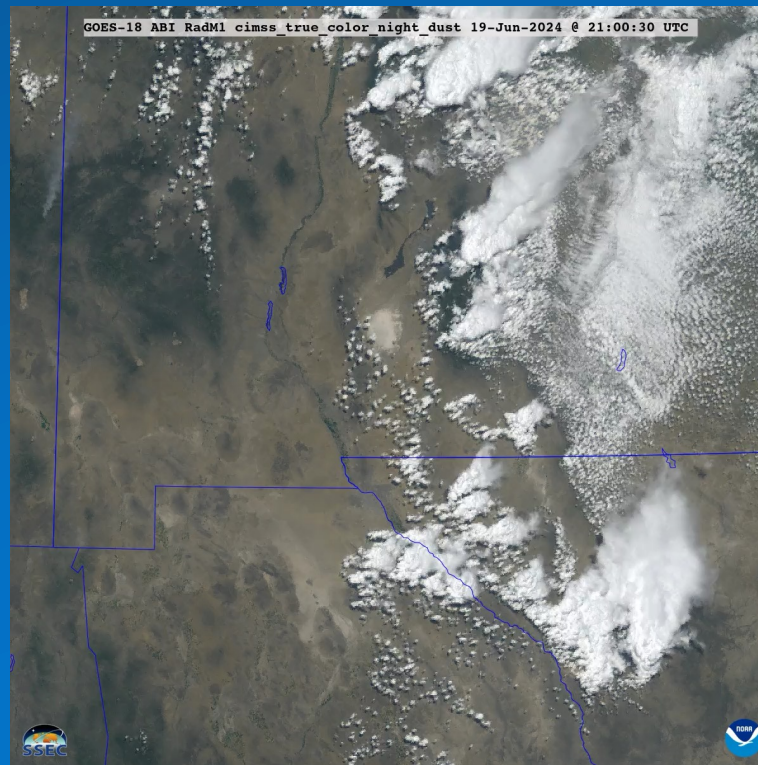
Tim Schmit / NOAA



Geo2Grid

Geo2Grid Version 1.3 was just released!

- Finalized GOES-19 ABI reader support
- Finalized EUMETSAT MTG FCI reader support
- Additional ABI Product readers support added:
 - Cloud Top Pressure
 - Cloud Top Phase
- Additional ABI RGB support added:
 - Airmass (airmass)
 - Nighttime Microphysics (night_microphysics)
 - Day Cloud Type (day_cloud_type)
 - Day Severe Storms (day_severe_storms)
 - Ash (ash)
 - Dust (dust)
 - Volcanic Emissions (volcanic_emissions)
 - Fog (fog)
- Optimizations
- Bug fixes



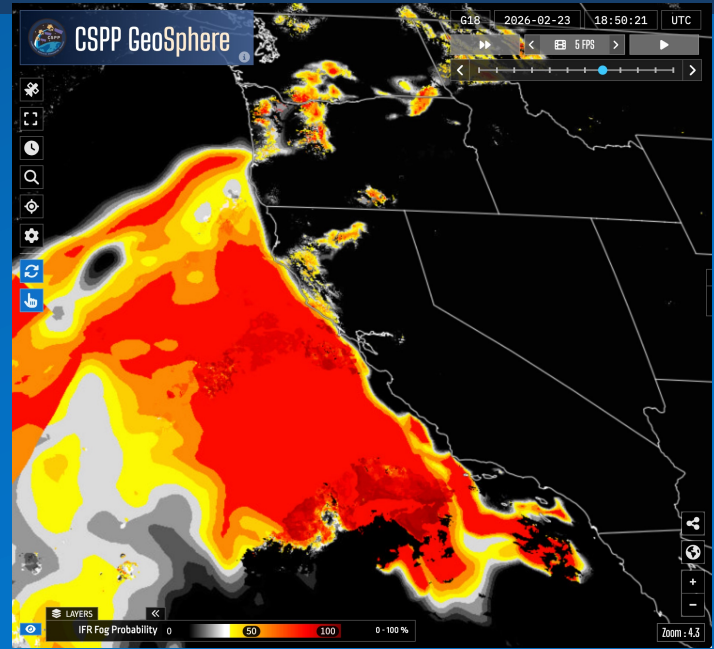
Tim Schmit / NOAA



CSPP GeoSphere

The **CSPP GeoSphere website** displays and animates tiled ABI imagery in near real-time

- GRB data is received on antennas at U. Wisc
- Processed with CSPP Geo software running on local cloud infrastructure
- Available imagery includes single channel, RGB, and Level 2 products
- Products are generated and displayed with very low latency
- High-quality images and animations can be downloaded



CSPP GeoSphere screen capture: IFR (Instrument Flight Rules) Fog Probability

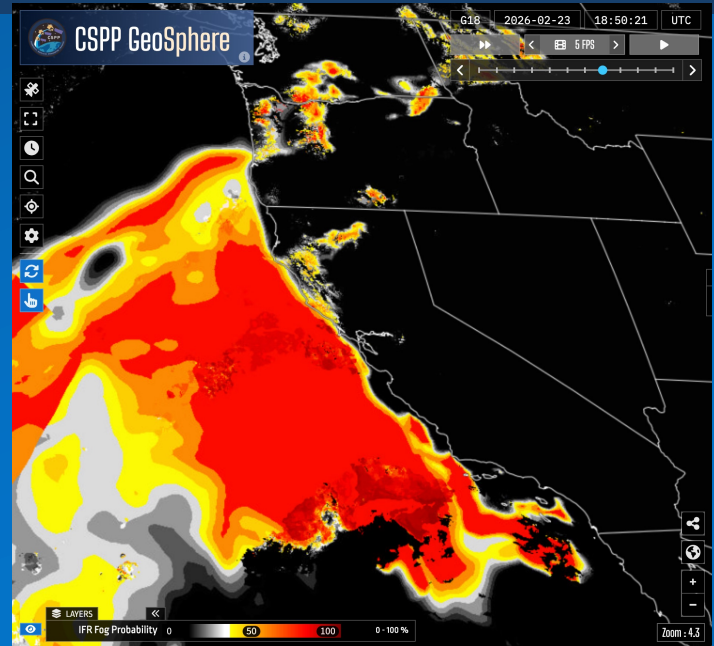
<https://geosphere.ssec.wisc.edu>



CSPP GeoSphere

October 2025 update:

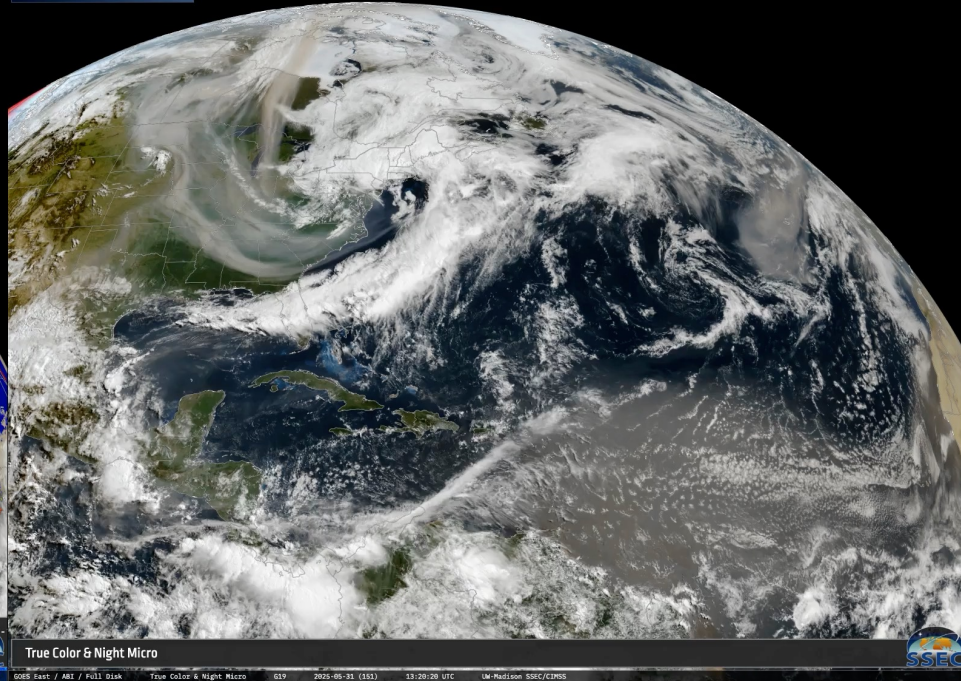
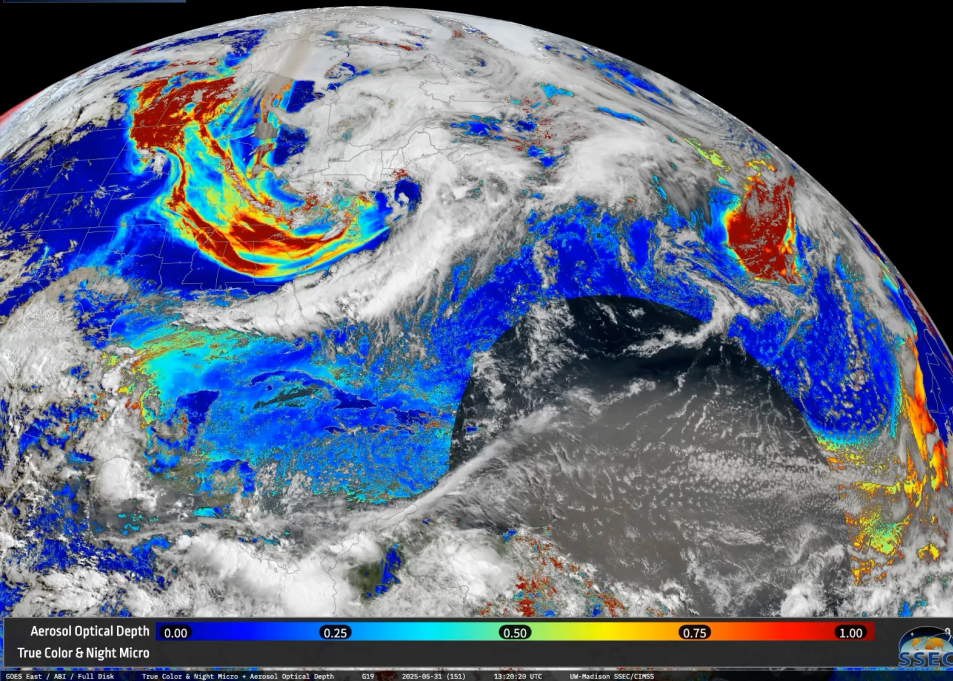
- Update CSPP Geo AITF package to version 2.3.1: Improves GOES-19 Aerosol Optical Depth product over land, updates Cloud Mask algorithm to latest NOAA version
- Level 2 products added: Fog Depth, IFR Fog Probability, LIFR Fog Probability, and MVFR Fog Probability
- Mobile UI updates
- Mobile image and video download fixes
- Animation UI fixes



CSPP GeoSphere screen capture: IFR (Instrument Flight Rules) Fog Probability

<https://geosphere.ssec.wisc.edu>





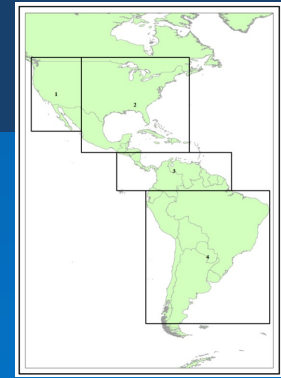
2025-05-31



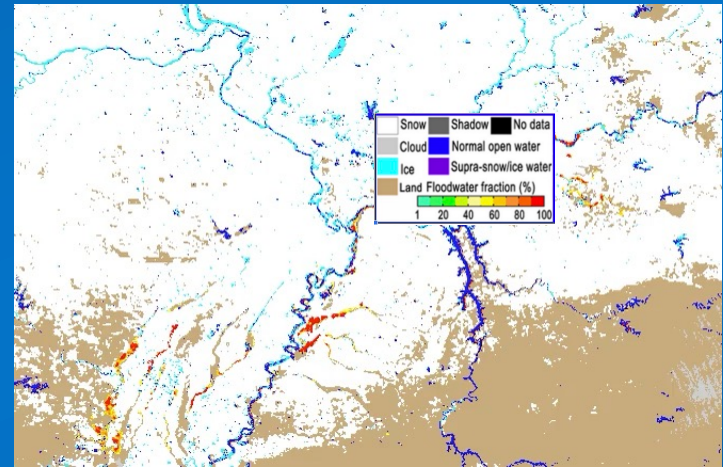
Flood Mapping packages

The ABI Flood Mapping (AFM) package

- Based on science code developed by Sanmei Li, provided to the CSPP Geo team by NOAA ASSISTT
- Leverages the high temporal resolution of ABI data to maximize cloud-free views of the surface.
- As the day progresses, a clearer view of the total extent of flooding emerges



Default areas of interest



Daily flood maps showing flooding in the Ohio/Mississippi river valleys (2025-02-20 to 2025-02-27)



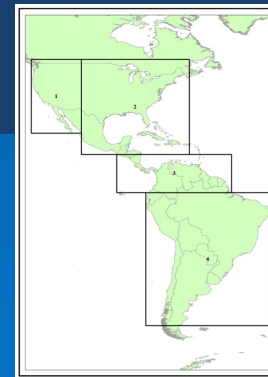
Flood Mapping packages

ABI Flood Mapping v1.0 (Jan 2026):

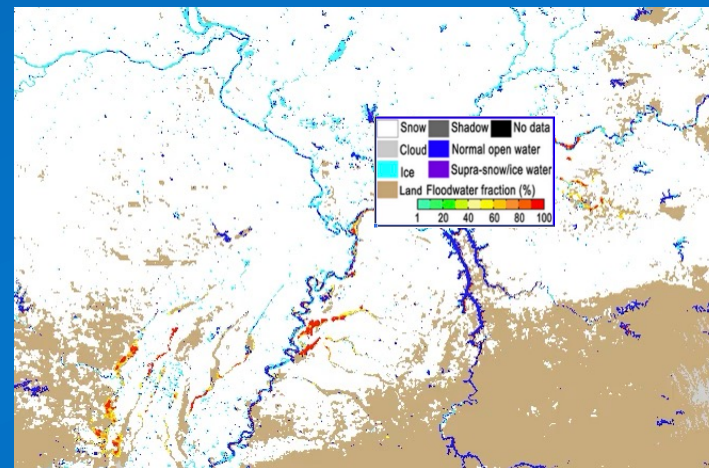
- GOES-R series ABI
- Hourly and daily composite images showing extent of flooding
- User-definable areas of interest
- Output: NetCDF4, PNG, GeoTIFF, shapefiles

Blended Flood Mapping (BFM) package – planned for mid-2027

- The BFM package will combine the high temporal resolution of ABI data with the high spatial resolution of VIIRS data to generate an improved product.
- Joint CSPP LEO / Geo release



Default areas of interest



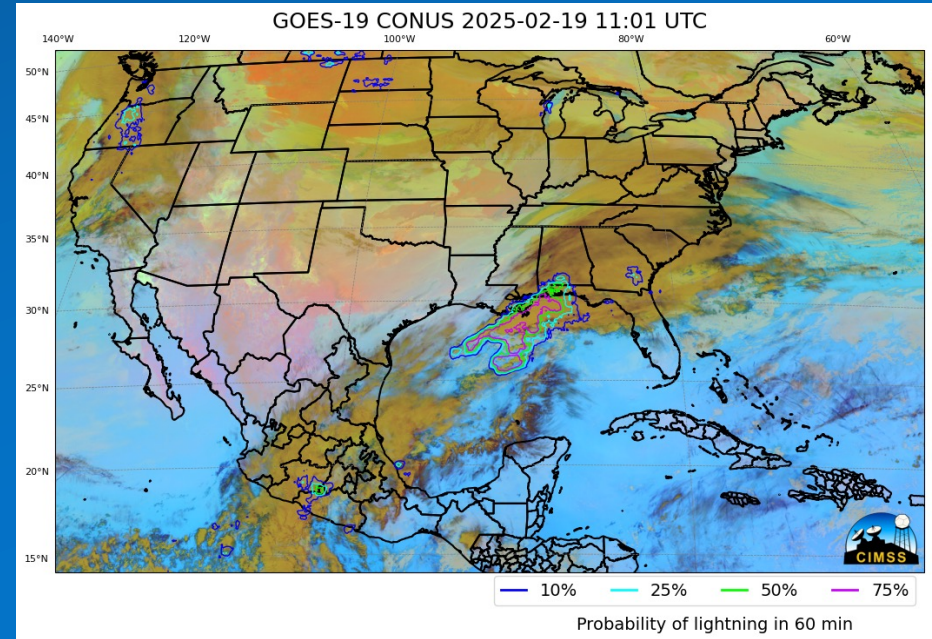
Daily flood maps showing flooding in the Ohio/Mississippi river valleys (2025-02-20 to 2025-02-27)



LightningCast Package

The LightningCast software package

- Based on science code developed by John Cintineo and Mike Pavolonis
- Predicts the probability and location of lightning within the next hour
- Uses a deep learning model trained on Geostationary Lightning Mapper (GLM) and ABI data
- Run-time input is imager only



*Imagery generated with the CSPP Geo
LightningCast v1.0beta2 package : lightning
probability contours overlaid on IR Cloud Phase*



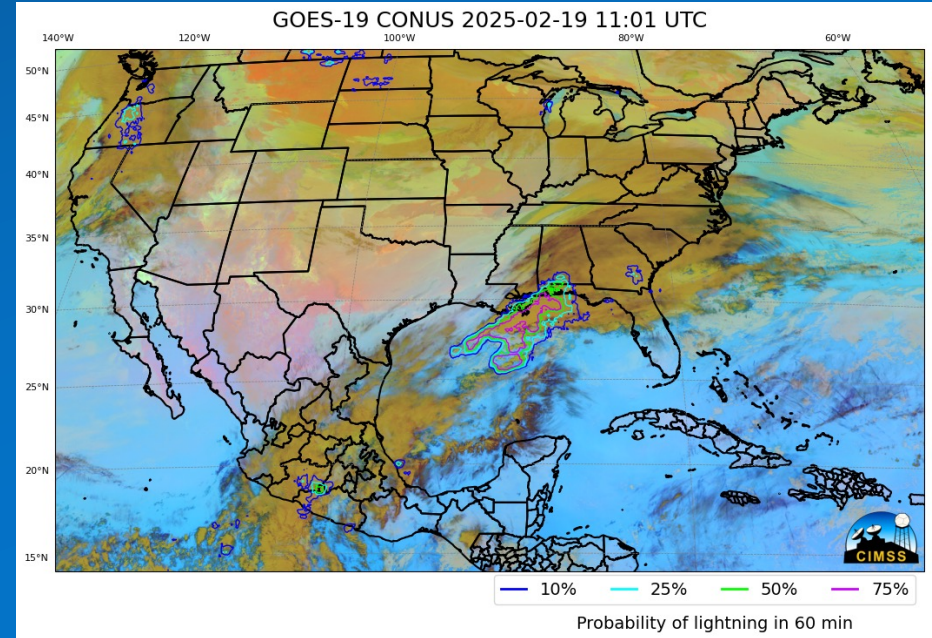
LightningCast Package

LightningCast v1.0 beta2

- GOES and Himawari
- Outputs: geoJSON, NetCDF (optionally AWIPS-compatible), placefile, PNG
- Lightning contours can be overlaid on RGB imagery
- User-definable areas of interest

v1 initial production release - coming soon:

- Meteograms (point forecasts)
- Updated tensor flow model
- Improved standards compliance in output files
- Additional science updates, bug fixes and improvements coming from beta testing



*Imagery generated with the CSPP Geo
LightningCast v1.0beta2 package : lightning
probability contours overlaid on IR Cloud Phase*



Next Generation Fire System

Next Generation Fire System (NGFS)

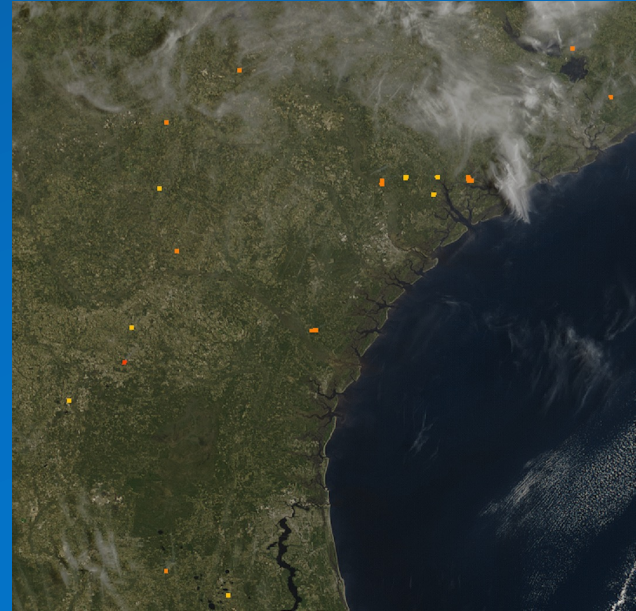
- Experimental AI-based software system designed for early detection of potential new fires and near continuous monitoring of wildland fire activity
- Developed by a NESDIS and CIMSS science team led by Mike Pavolonis and Jason Otkin
- Continuously informed by NWS forecasters, land managers, and firefighters
- Demonstrated within the NOAA Fire Weather Testbed



CSPP Geo/LEO NGFS Package

Next Generation Fire System (NGFS) package - in development

- Joint CSPP Geo/LEO package
- Composed of multiple containers but will behave like a typical CSPP package
- Dynamic ancillary data cadence will be higher than a typical package

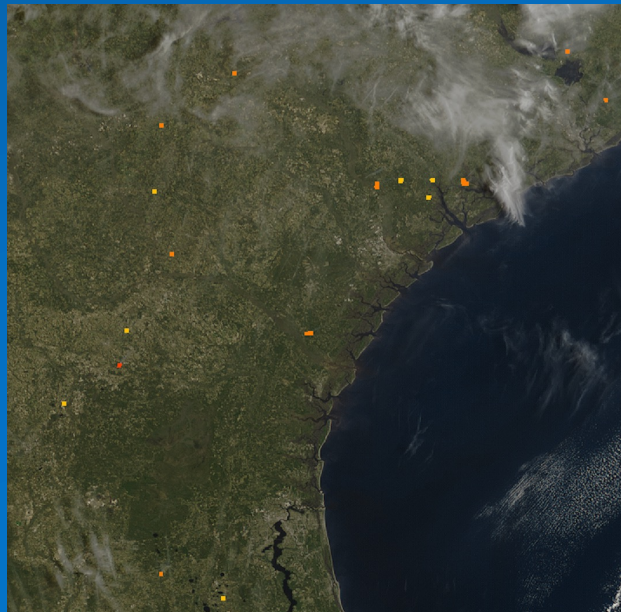


Visualization of fire pixels from NGFS geoJSON file, overlaid using GDAL on true color created by Geo2Grid (2026-03-11 1520z)

CSPP Geo/LEO NGFS Package

CSPP NGFS Package

- Initial beta planned for Q4 2026
 - GOES-R series only
 - All ABI sectors
 - User-definable areas of interest
 - Outputs generated per scene and per day
 - CSV, GeoJSON, NetCDF
- Second beta planned for Q1 2027
 - Added support for JPSS VIIRS



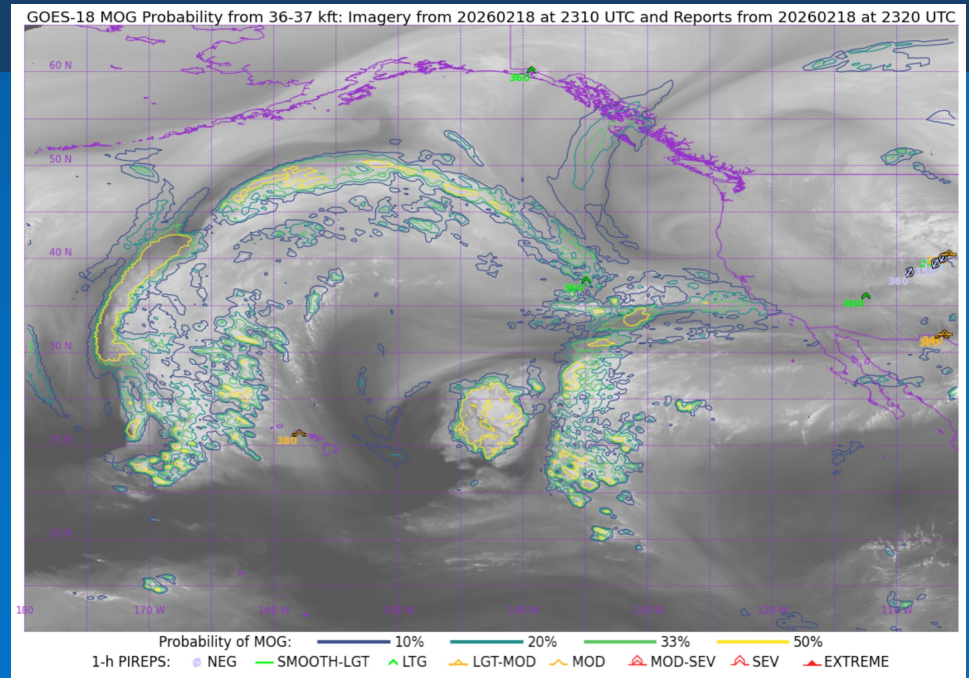
Visualization of fire pixels from NGFS geoJSON file, overlaid using GDAL on true color created by Geo2Grid (2026-03-11 1520z)



Turbulence Package

The Turbulence Package will predict the probability of moderate or greater turbulence affecting a medium or greater sized aircraft at least once within ten minutes

- Based on science code developed by Tony Wimmers et al., at CIMSS
- A kickoff meeting was held with the science team in January, and work has begun toward an initial release in 2027
- Inputs will be GOES ABI, potentially Himawari and MSG
- Outputs will be NetCDF and imagery



Screen capture from the CIMSS Turbulence website: Probability of experiencing Moderate or Greater (MOG) turbulence over a 10-minute flight segment through the area.

<https://cimss.ssec.wisc.edu/turbulence/>



All-Sky Retrieval

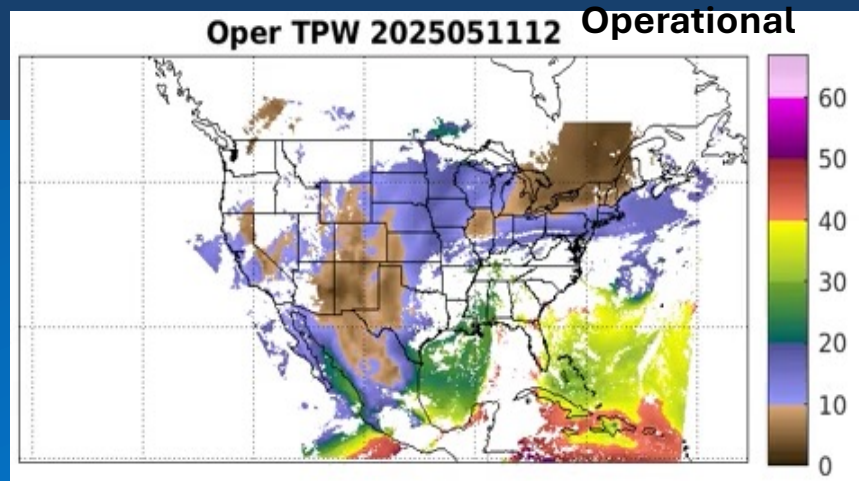
An **All-Sky Retrieval Algorithm** is being developed by Zhenglong Li's group at CIMSS under GeoXO funding.

- ABI currently supported
- Support is planned for IRS, Himawari-10, and eventually GX5 (GeoXO sounder).
- NWS will evaluate the algorithm via Hazardous Weather Testbed in Spring 2027.

Flash flood in western Maryland 5/13/2025



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CSPP Geo All-Sky Retrieval Package

Planned CSPP Geo package

- Initial capabilities: Total Precipitable Water for ABI.
- Beta may be released in 2027 if the algorithm is considered sufficiently mature.
- A goal is to release a promising new experimental capability to users, which should inform future algorithm development



Thank you

CSPP Geo software



<https://cimss.ssec.wisc.edu/csppgeo/>

GeoSphere website



<https://geosphere.ssec.wisc.edu/>

Contact: csppgeo.issues@ssec.wisc.edu



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Backup slides



GeoXO Update

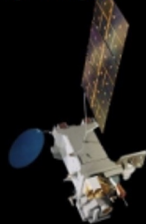
PENDING APPROVALS:

- Restructured program in August 2025 to prioritize weather observations
- Two satellite constellation (East and West) provides full disk imagery and sounding through 2055
- First launch planned for 2032
- Continuity of imaging driving 2032 launch prioritization

GeoXO-West

VIS/IR Imager

IR Sounder



GeoXO-1 (2032): ABI 5 and GXS

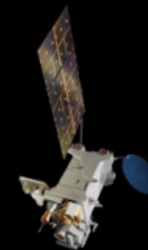
GeoXO-3 (2039): GXI and GXS

Two-satellite
operational
constellation with
replacement satellites
for continuity through
2055

GeoXO-East

VIS/IR Imager

IR Sounder



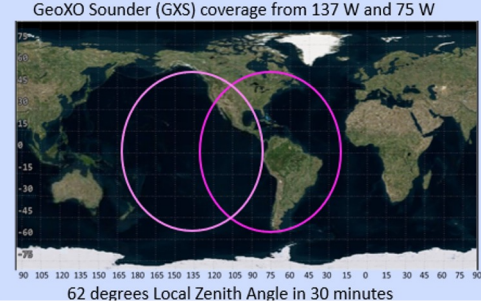
GeoXO-2 (2034) and GeoXO-4

(2043): GXI and GXS

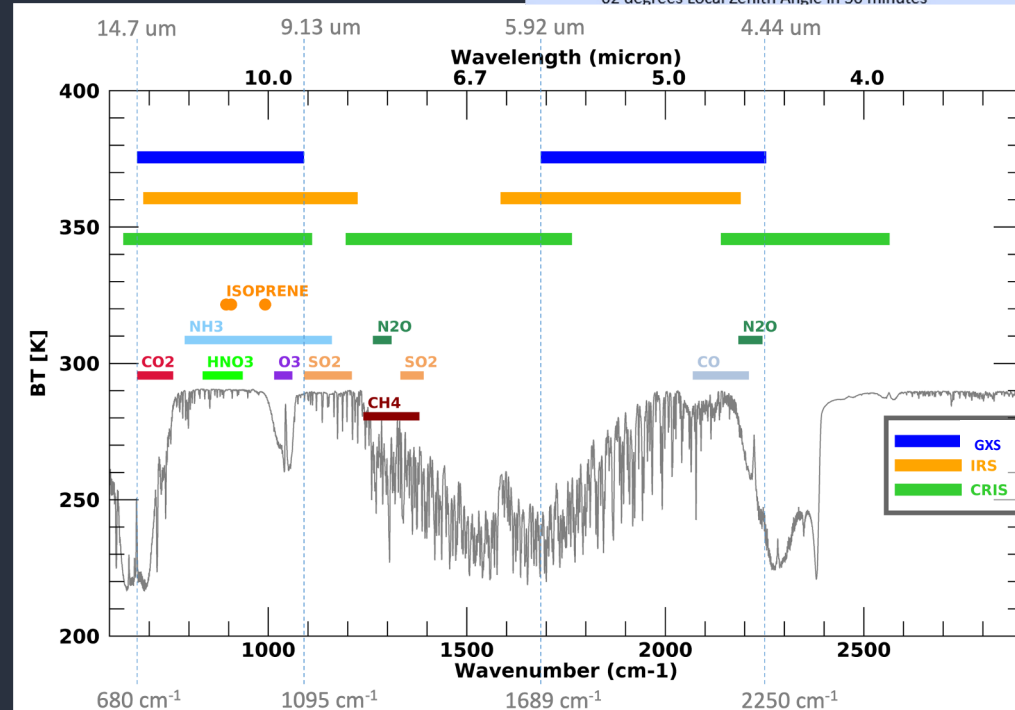


DIRECT-TO-CLOUD

Baseline Requirements: IR Sounder(GXS)



Baseline Requirements	
GSD	4 km (<i>Same as GOES-13 Imager IR</i>)
Coverage Area	Sounding Disk (SD) defined by a 62° zenith angle centered at 75W & 135W
Revisit Time	60 minutes
Spectral Coverage	4.44-5.92μm, 9.13-14.7μm
Spectral Resolution	0.625 cm ⁻¹
Signal:Noise	NEdN requirements are comparable to those of other IR hyperspectral sounders



GXI Channels

Changes from GOES-R ABI

Type	Band number	Central wavelength (μm)	What is it used for?	Best spatial resolution
Visible	1	0.47	Monitoring smoke and aerosols	0.5 km
	2	0.64	Detection/analysis of clouds and weather systems during daytime	0.25 km
Near-infrared	3	0.865	Detect daytime clouds, fog and land characteristics such as burn scars and flooded regions	0.5 km
	4	0.91	Detect and track low-level water vapor, a critical ingredient for severe storms (used in combination with band 9)	1 km
	5	1.378	Detect high clouds during the daytime; discernment of very thin cirrus clouds	2 km
	6	1.61	Identify regions of ice and snow; detection of fires at night	1 km
	7	2.25	Cloud particle size; used as input for a number of derived products such as cloud mask, aerosol optical depth, and cloud phase	1 km
Mid-wave infrared	8	3.9	Primarily used for fire detection; identifies fog and low clouds at night; estimates sea-surface temperatures; estimates low-level atmospheric winds; discriminate between ice crystal sizes during the day	1 km
	9	5.15	Detect and track low-level water vapor, a critical ingredient for severe storms (used in combination with band 4); detect regions of low-level turbulence; track lower tropospheric winds	1 km
	10	6.185	Track upper-tropospheric winds; identify jet streams; monitor severe weather potential; forecast hurricane track and motion; identify regions of potential turbulence	2 km
	11	6.95	Track middle-tropospheric winds; identify jet streams; monitor severe weather potential; forecast hurricane track and motion; estimate mid-level moisture; identify regions of potential turbulence	1 km
	12	7.34	Track lower-tropospheric winds; identify jet streaks; monitor severe weather potential; estimate lower-level moisture; highlight volcanic plumes rich in sulfur dioxide, track lake-effect snow bands; identify regions of potential turbulence	2 km
Long-wave infrared	13	8.5	Monitor volcanic activity; used as input for cloud phase product	2 km
	14	9.61	Information about dynamics of the atmosphere near the tropopause both day and night; used in composite imager products (like airmass RGB)	2 km
	15	10.35	Continuous day/night cloud feature identification and classification; identify convective severe weather signatures; estimate hurricane intensity; input for data products and composite imagery	1 km
	16	11.2	Used in many data products: fire detection, volcanic ash detection, derived motion winds, precipitable water, cloud top properties, aerosol detection and land surface temperature	2 km
	17	12.3	Detects both moisture and dust and is used in many data products including cloud products and fire hot spot characterization; distinguish between volcanic ash and dusty	2 km
	18	13.3	Estimate cloud-top heights; discern level of derived motion winds; identify volcanic ash	2 km