

# NASA MSFC GOES-16 Receiving Station and Data Visualization

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# Introduction/Motivation

- **Access to real-time GOES satellite data is extremely valuable to the weather enterprise, however**
  - Few real-time publically accessible data streams
  - Limited spatial coverage and channels, reduced resolution
  - Different data formats - imagery versus digital data
  - Expense of satellite receiving station
- **GOES-R series satellites provide 3x spectral – 4x spatial – 5x faster creating an extremely valuable real-time data source for weather applications**
  - Extremely large data volume
  - Few receiving stations with publically available data streams
- **Develop and implement innovative dissemination strategies addressing past limitations**
  - Application Programming Interface (API), Web Mapping Service (WMS), advanced storage and computing technology

# TeleSpace Capella-GR from Enterprise Electronics Corporation (EEC)

## Hardware

- Dish: ASC Signal 6.5-m reflector
- Positioning: ASC Signal motor control system
- Feed: Quorum GRB
- Demodulator/Receiver: Quorum GRB-200
- Dehydrator
- Linux workstations – acquisition, data processing, visualization

## Software

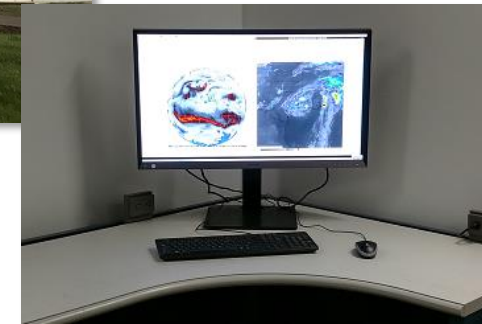
- GEOSat
- CSPP (v.0.4.4)
- AIT
- PROTEUS (visualization)



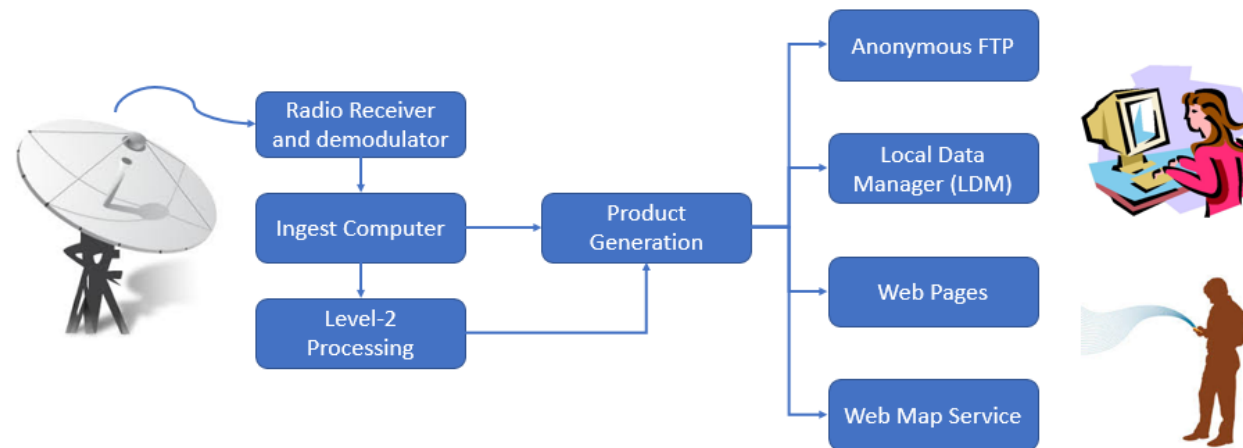
NASA MSFC receiving station at Activities Building (4316)



Acquisition and Data Processing



Visualization



# Data Processing

- Receive and process all data from all 6 instruments aboard GOES-16:
  - ABI - Level 1b
  - GLM - Level 2: events, groups, flashes
  - Space weather instruments - Level 1b data from EXIS, MAG, SEISS, and SUVI
- Temporary local data storage (~ 10 days)
- Real-time transfer of data to NSSTC via 10 Gbps connection for additional product generation and dissemination
- McIDAS-X and Python used for data processing



National Space Science and Technology Center

# Data Products

- ABI: Generation of value-added NASA L2 products

- Single Channels

- RGB suite

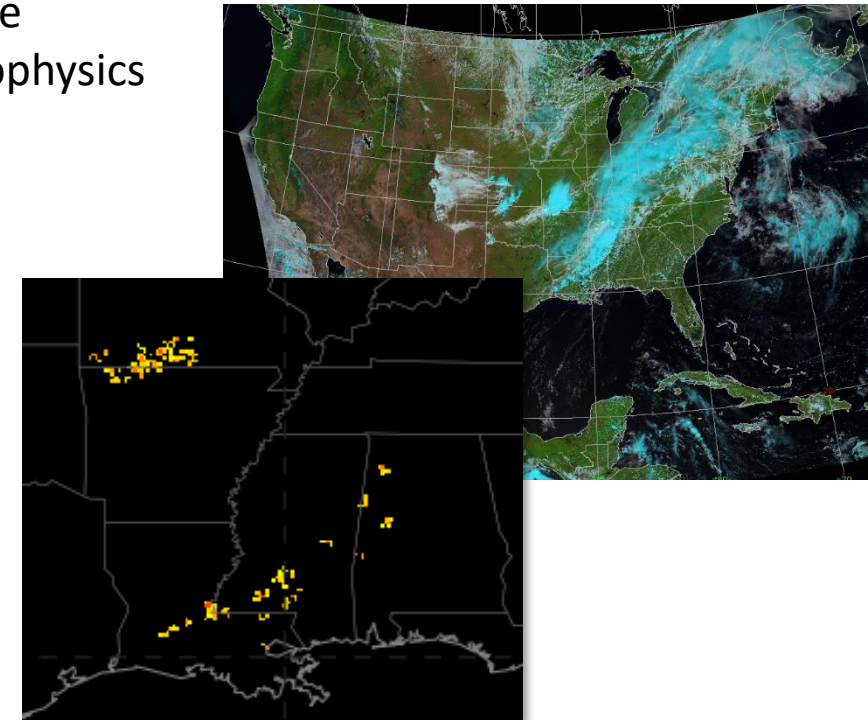
- Air Mass
- Ash
- Day Convection
- Day Land Cloud
- Day Land Cloud Fires
- Day Ocean Cloud Convection
- Day Snow Fog
- Daytime Microphysics
- Dust
- Fire Temperature
- Nighttime Microphysics
- Simple Water Vapor
- SO2

- GLM

- Acquiring data via GRB dissemination
- Code written to aggregate data into 2-minute intervals (events, groups, flashes)

- SUVI

- Imagery from various channels and integration times





# Classic Web Viewer

- Developed a web-based interactive interface for viewing GOES imagery in 1997

- ~500,000 unique visitors/month
- ~50M hits/month

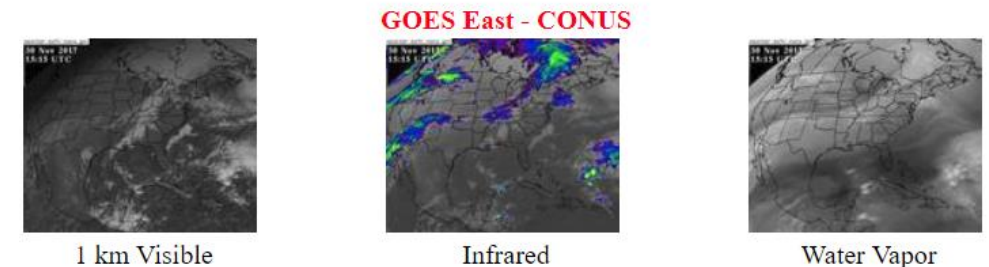
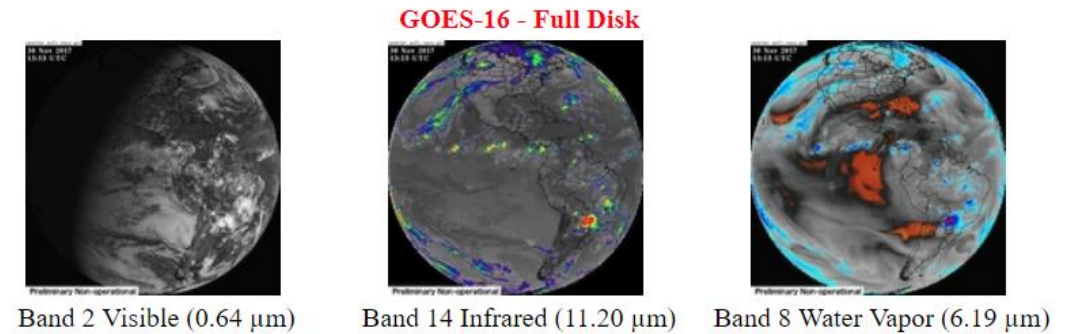
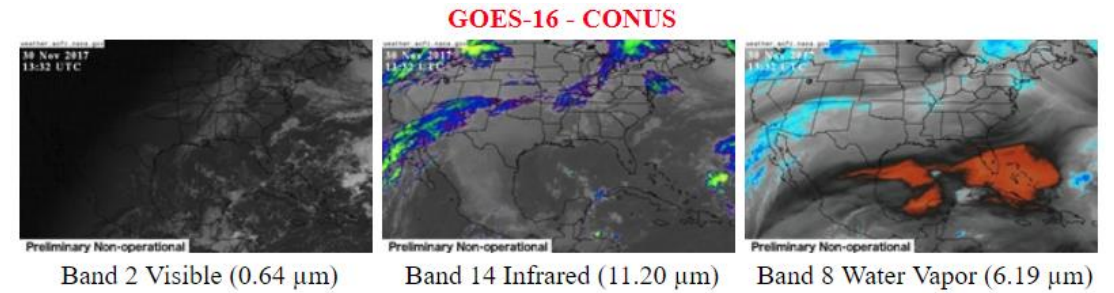
- Select channels (0.64 $\mu$ m, 6.2 $\mu$ m, 11.2 $\mu$ m)

- Users define area of interest to display

- Animations are very quick to load

- Options:

- Color palettes
- Map overlays
- Quality
- Resolution
- Width/height
- Static or animation







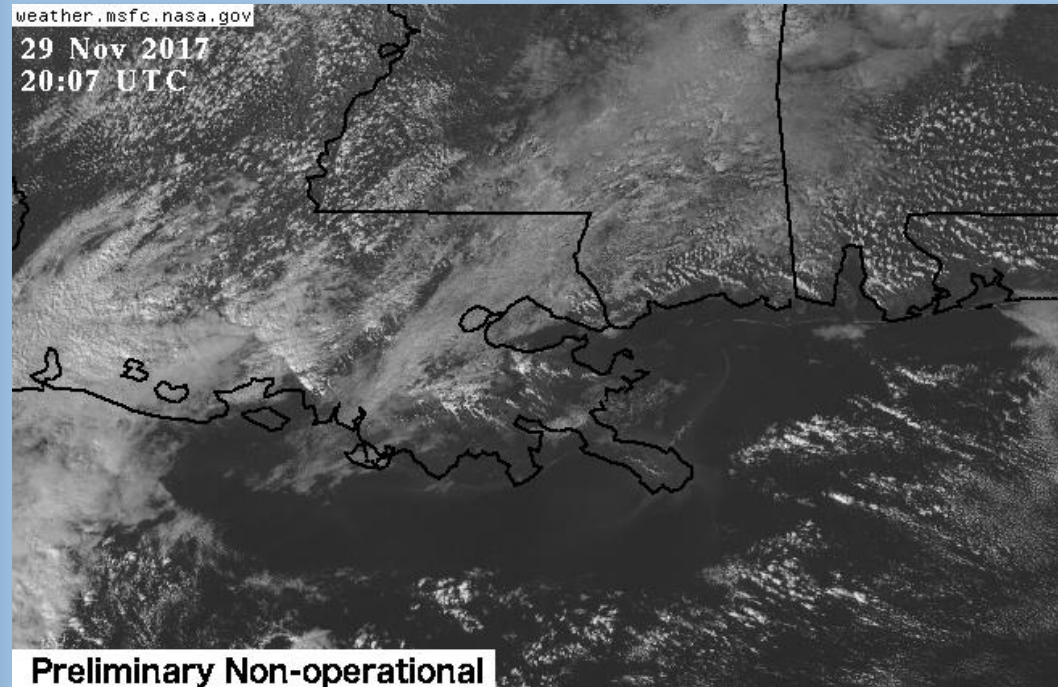
# Classic Viewer Application Programming Interface

- Provides a method for requesting single images or a series of images via specially-constructed URLs
- Requests can be submitted with common commands like get and curl
- Scriptable
- Easy to integrate real-time imagery into web pages and apps
- Popular with social media users
- Documentation:

<https://weather.msfc.nasa.gov/goes/abi/wxSatelliteAPI.html>

## Usage Example to Request Single Image

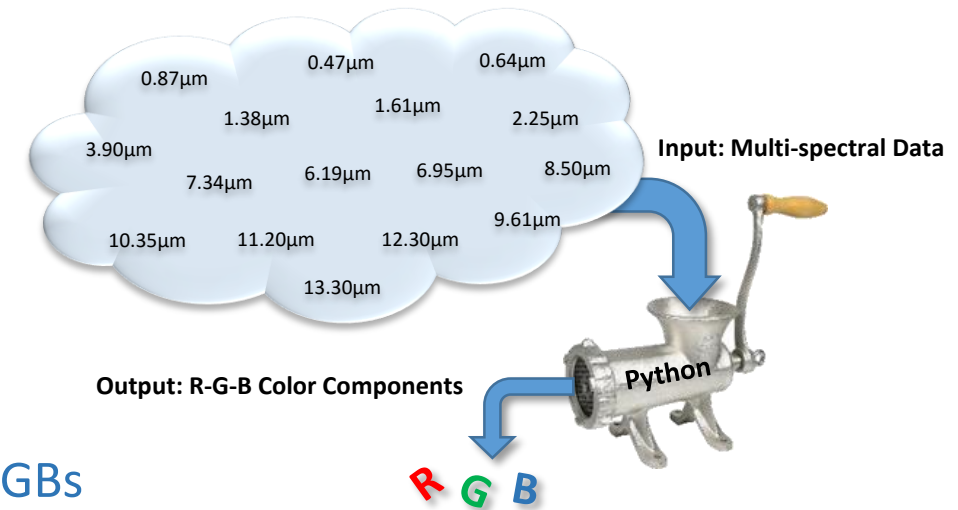
```
https://weather.msfc.nasa.gov/cgi-bin/get-abi?  
satellite=GOESEastconusband02&  
lat=30&  
lon=-90&  
zoom=2&  
width=650&  
height=425&  
quality=100
```





# Client-Side RGB Generation

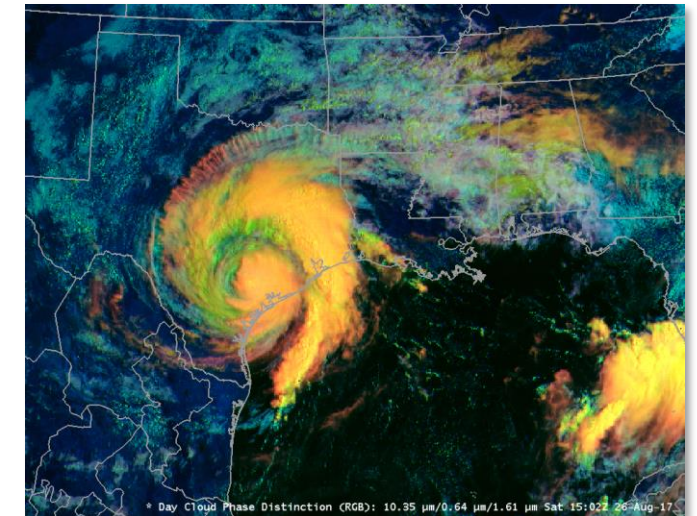
- New version of NWS display system (AWIPS II) allows developers to expand capabilities
- SPoRT developed client-side RGB capability
  - No modifications required to base code
  - Python implements EUMETSAT recipe for simple /advanced RGBs
  - Recipes defined via XML files, allowing for adjustments and new recipes
  - Greater color fidelity (24-bit)
  - Sampling
- Provided capability to NWS Operations Proving Ground to support AHI RGB demonstration
- NWS is deploying capability to all offices for GOES-16 with 13 RGBs initially available
- Pre-generate RGB products at SPoRT for display in less capable NWS display systems like NAWIPS



- Implements RGB Recipe:

$$Byte = 255 \times \left[ \frac{Value - Min}{Max - Min} \right]^{1/Gamma}$$

- Computes 8-bit value for each R-G-B color



# Quick-Look Images

- Used to verify data integrity for all geostationary products
- Supports long animation sequences
- Fixed resolutions

GOES-16 ABI CONUS - Air Mass  
Nov. 30, 2017 - 13:32 UTC

- Note: NOAA's GOES-16 satellite has not been declared operational and its data are preliminary and undergoing testing. Users receiving these data through any dissemination means (including, but not limited to, PDA, GeoNetcast Americas, HRIT/EMWIN, and GOES Rebroadcast) assume all risk related to their use of GOES-16 data and NOAA disclaims any and all warranties, whether express or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose.
- Sectors: [CONUS](#) | [Full Disk](#) | [Mesoscale 1](#) | [Mesoscale 2](#)
- Quick Guides: [Air Mass RGB](#) | [Day Convection RGB](#) | [Daytime Microphysics RGB](#) | [Dust RGB](#) | [Nighttime Microphysics RGB](#)
- [Locations of mesoscale sectors](#)

Select an image:  
Nov. 30, 2017 - 13:32 UTC

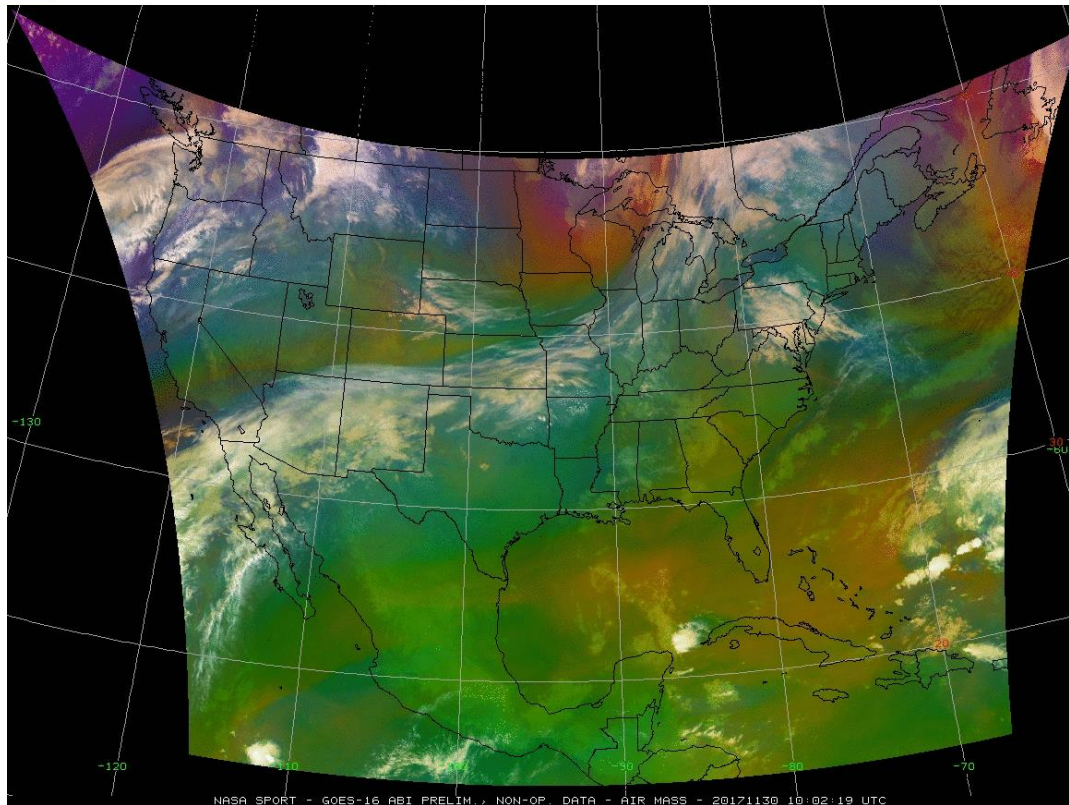
« Previous Next »  
by product

- Products**
- 0.47 um (Band 1)
  - 0.64 um (Band 2)
  - 0.87 um (Band 3)
  - 1.38 um (Band 4)
  - 1.61 um (Band 5)
  - 2.25 um (Band 6)
  - 3.90 um (Band 7)
  - 6.19 um (Band 8)
  - 6.95 um (Band 9)
  - 7.34 um (Band 10)
  - 8.50 um (Band 11)
  - 9.61 um (Band 12)
  - 10.35 um (Band 13)
  - 11.20 um (Band 14)
  - 12.30 um (Band 15)
  - 13.30 um (Band 16)

- [Air Mass](#)
- [Ash](#)
- [Day Cloud Convection](#)
- [Day Cloud Phase](#)
- [Day Convection](#)
- [Day Land Cloud](#)
- [Day Land Cloud Fires](#)
- [Day Snow Fog](#)
- [Daytime Microphysics](#)
- [Differential Water Vapor](#)
- [Dust](#)
- [Fire Temperature](#)
- [Nighttime Microphysics](#)
- [Advanced](#)
- [Simple Water Vapor](#)
- [SO2](#)

**Legend**  
Currently Displayed  
Available  
Unavailable

[Animate This Product](#)



NASA SPORT - GOES-16 ABI PRELIM., NON-OP. DATA - AIR MASS - 20171130 10:02:19 UTC

SUVI 195 Å  
Nov. 30, 2017 - 13:42 UTC

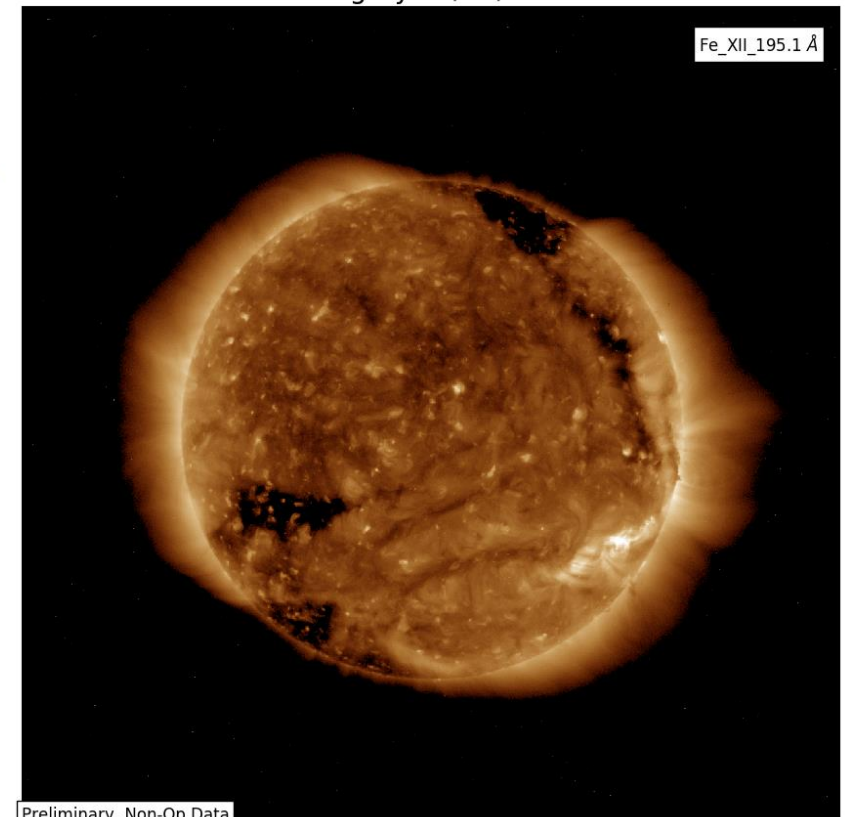
- Note: NOAA's GOES-16 satellite has not been declared operational and its data are preliminary and undergoing testing. Users receiving these data through any dissemination means (including, but not limited to, PDA, GeoNetcast Americas, HRIT/EMWIN, and GOES Rebroadcast) assume all risk related to their use of GOES-16 data and NOAA disclaims any and all warranties, whether express or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose.
- Fe: [095 Å](#) | [131 Å](#) | [171 Å](#) | [195 Å](#) | [284 Å](#)
- He: [303 Å](#)

Select a time:  
Nov. 30, 2017 - 13:42 UTC

**Legend**  
Currently Displayed  
Available  
Unavailable

[Animate This Product](#)

SUVI L1b Solar Imagery 11/29/2017 23:00:12 UTC



Preliminary, Non-Op Data

<https://weather.msfc.nasa.gov/cgi-bin/sportPublishData.pl?dataset=goes16abiconus>

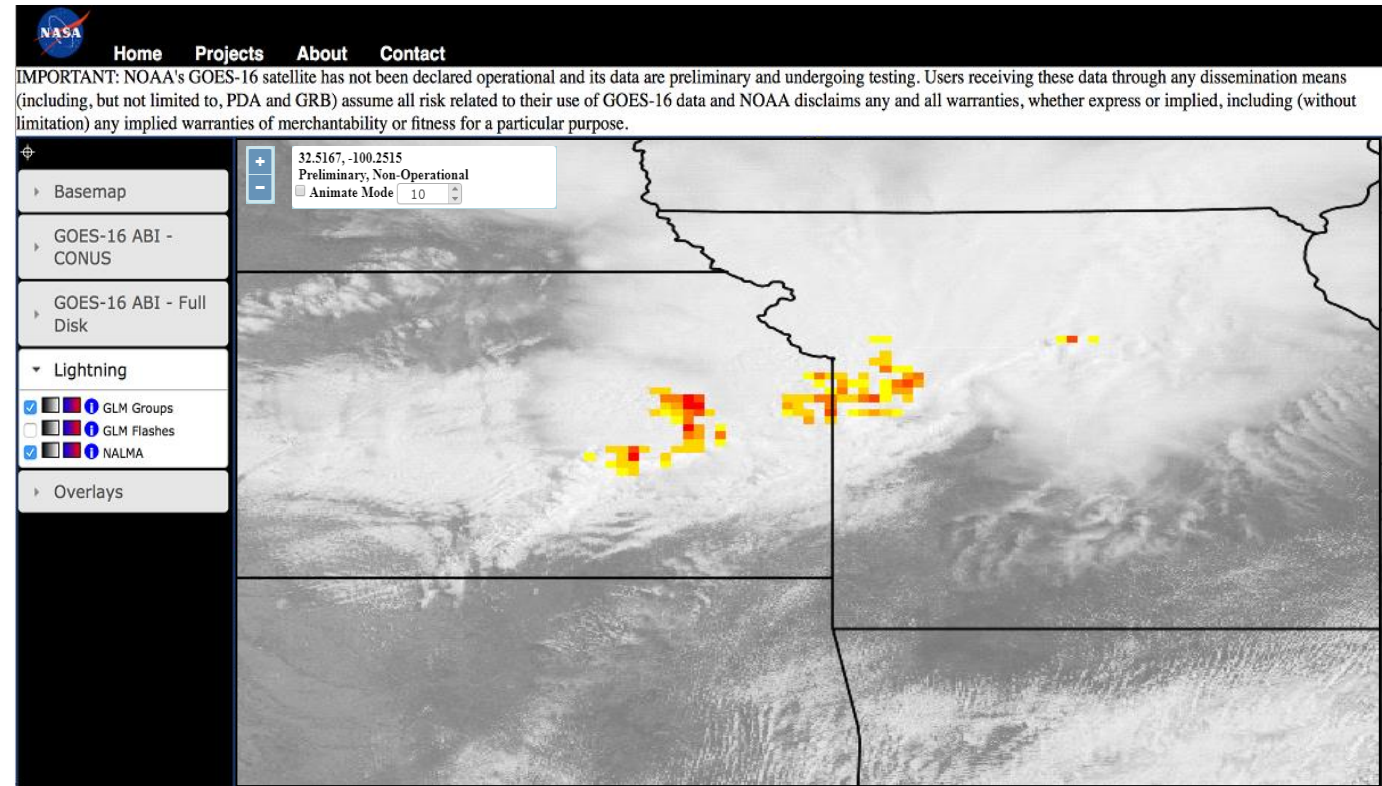
[https://weather.msfc.nasa.gov/cgi-bin/sportPublishData.pl?dataset=goes16suvi\\_fe195](https://weather.msfc.nasa.gov/cgi-bin/sportPublishData.pl?dataset=goes16suvi_fe195)



# Web Map Service

Provides an Open Geospatial Consortium standard protocol for serving georeferenced images

- WMS service currently being provided by GeoServer
- Supports various requests to list imagery, generate images in various formats, get legends, etc.
- Access methods:
  - Custom interactive web interface based upon OpenLayers
  - Interface from GIS applications
- Transitioning to Esri Enterprise Server to increase ease of sharing layers with other GIS users



GLM 2-Minute Groups Overlaid on ABI 0.64μm in WMS Web Interface



# Summary/Future

- Visualization and dissemination of real-time data
  - ABI
    - Addition of mesoscale sectors and unique NASA products
  - GLM
    - Implement display in classic viewer
  - Space weather instruments
    - SUVI: Create quick-look displays
    - EXIS, MAG, and SEISS: Visualize temporal changes as graphical plots
  - WMS
    - Improved animation
    - Migration to Esri ecosystem
- Integrate NASA unique value-added products as part of the GOES L2 processing within CSPP
- Acquire a second GOES-R series receiving station – replicate visualization and dissemination capabilities

