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
  o Few real-time publically accessible data streams
  o Limited spatial coverage and channels, reduced resolution
  o Different data formats - imagery versus digital data
  o 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
  o Extremely large data volume
  o Few receiving stations with publically available data streams

• Develop and implement innovative dissemination strategies addressing past limitations
  o 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)
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
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 (0.64µm, 6.2µm, 11.2µm)
- 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
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Classic Web Viewer

https://weather.msfc.nasa.gov/GOES/

GOES-16 Wavelength: 11.20 µm Channel: 14 Resolution: 2 km
Used for imagery, sea surface temperature, clouds, rainfall.

Additional sectors / channels (hover over elements for description):
Choose


30 Nov 2017
13:32 UTC

Preliminary Non-operational
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

Input: Multi-spectral Data
Output: R-G-B Color Components

- Implements RGB Recipe:
  \[
  \text{Byte} = 255 \times \left(\frac{\text{Value} - \text{Min}}{\text{Max} - \text{Min}}\right)^{1/\gamma}
  \]
- Computes 8-bit value for each R-G-B color

![Image of multi-spectral data and RGB components]
Quick-Look Images

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

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