NESDIS Rebroadcast Overview

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GOES DCS Technical Working Group Meeting

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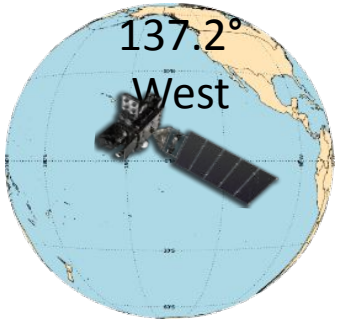
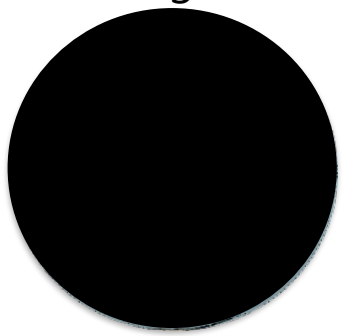
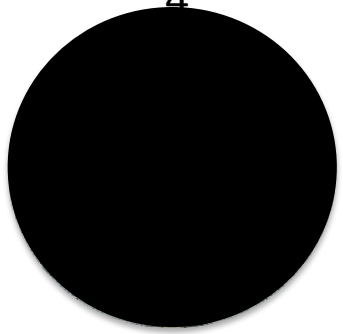
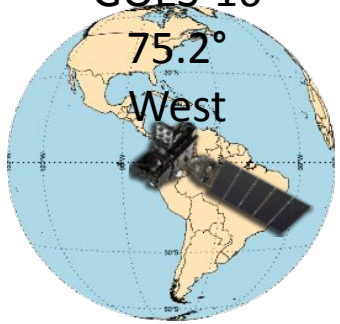
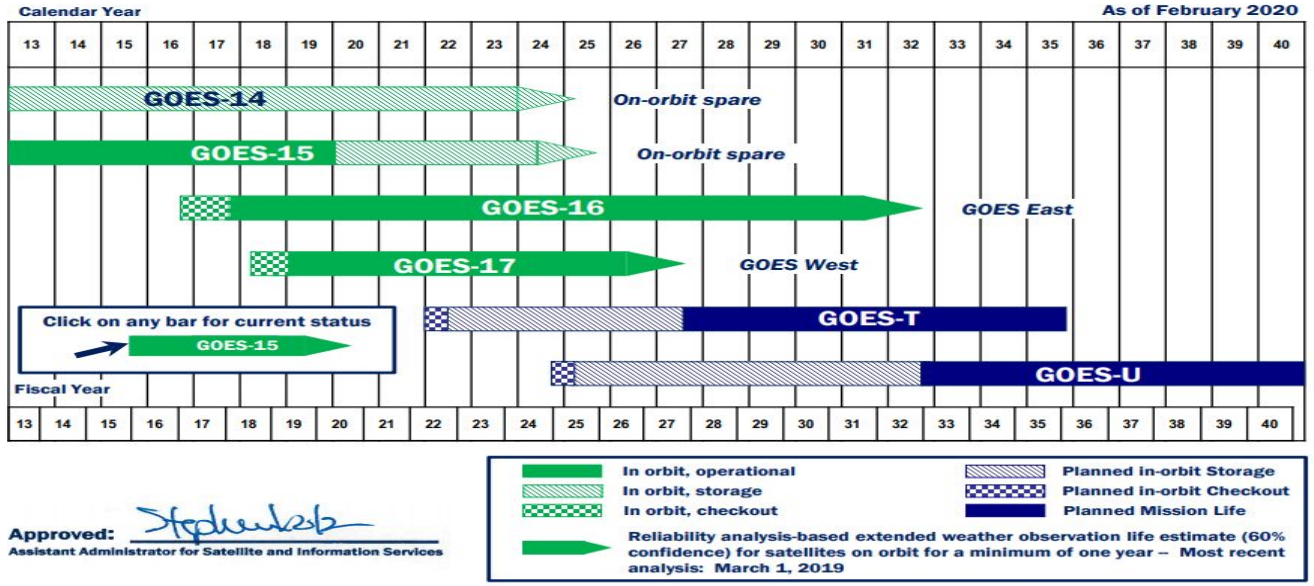
Overview of NESDIS Rebroadcasts

Acronym	System Name	Description
GRB	GOES Rebroadcast	The primary relay of full resolution, calibrated, near-real-time broadcast of GOES-R for Level 1b data products (Advanced Baseline Imager L1b, Space Weather L1b, and Geostationary Lightning Mapper L2). These data are available to all users with GRB receivers in view of a GOES-R series satellite at the East or West operational longitudes.
HRIT/ EMWIN	High Rate Information Transmission/ Emergency Managers Weather Information Network	The HRIT/EMWIN service is a new high data rate (400 Kbps) broadcast for GOES-R satellite imagery and selected products to remotely-located user terminals. Combines LRIT and the EMWIN direct broadcast service that provides users with weather forecasts, warnings, graphics and other information directly from the NWS in near real-time. Also included is a copy of GOES-DCS.
GNC-A	GEONETCast Americas	GEONETCast Americas is the Western Hemisphere component of GEONETCast, a near real time, global network of satellite-based data dissemination systems designed to distribute space-based, air-borne and in situ data, metadata and products to diverse communities. Data is not rebroadcasted from a NOAA operated GOES satellites, but commercial.

Present GOES Constellation and Flyout

	GOES-West	Storage	Standby	GOES-East
Current	GOES-17 137.2° West	GOES-15	GOES-14	GOES-16 75.2° West
				
	GRB, DCS, HRIT/EMWIN Active	GVAR, DCS, LRIT Disabled EMWIN Disabled	GVAR, DCS, LRIT Disabled EMWIN Disabled	GRB, DCS, HRIT/EMWIN Active

GOES-T (GOES-18) scheduled for launch ~FY2022, on-orbit storage after post-launch checkout. GOES-U scheduled for launch sometime in 2024-2025 timeframe.



GOES-R Series GOES Rebroadcast (GRB)

The GOES Rebroadcast (GRB) provides the primary relay of GOES-R Series full resolution, calibrated, near-real-time direct broadcast Level 1b data from the Advanced Baseline Imager and the Space Weather instruments and Level 2 data from the Geostationary Lightning Mapper

The GRB downlink is standards-based and documented in the Product Definition and Users' Guide and Downlink Specifications

DVB-S2

CCSDS

Product Definition and Users' Guide

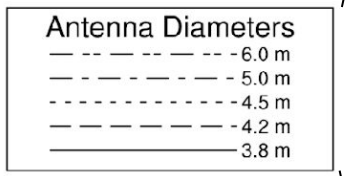
GRB Downlink Specifications for Users

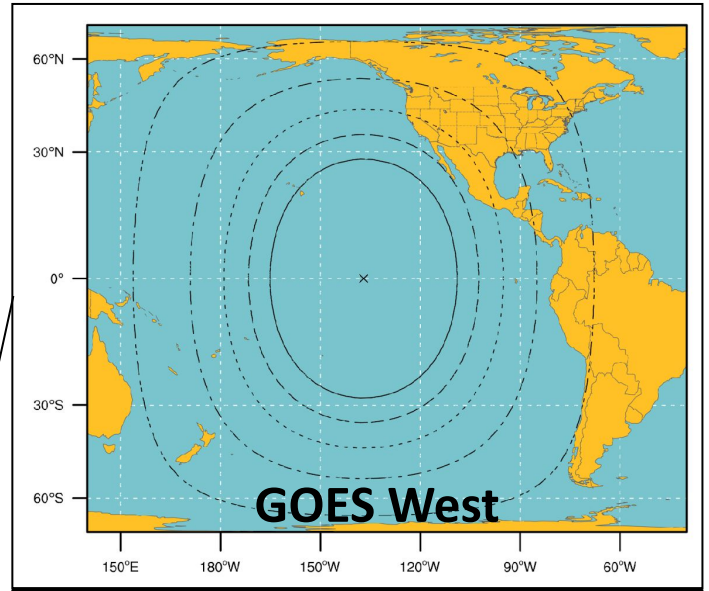
Digital Video Broadcasting

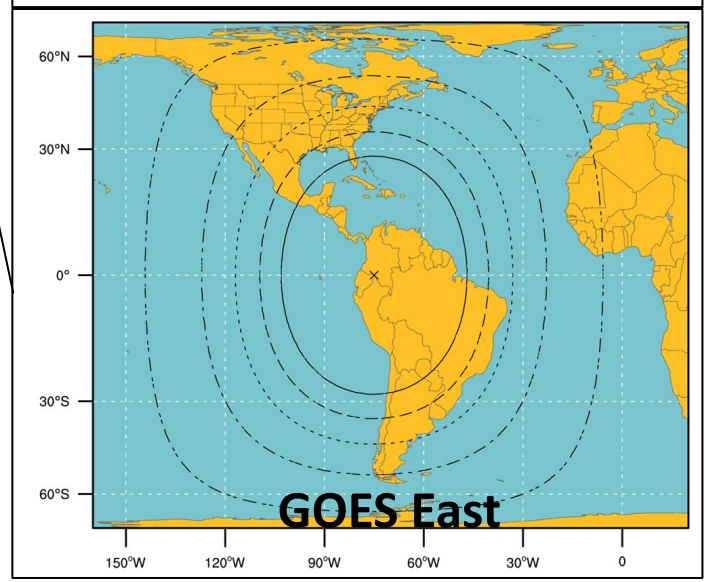
Consultative Committee for Space Data Systems

GOES-R Documents are available at:
https://www.goes-r.gov/resources/docs.html

https://www.goes-r.gov/users/docs/GRB_downlink.pdf







GRB Specifications

	GOES Rebroadcast (GRB)
Full Disk Image	5 mins (Mode 4) and 10 mins (Mode 6)
Other Modes	3000 km X 5000 km (CONUS: 5 minute) 1000 km X 1000 km (Mesoscale: 30 seconds)
Polarization	Dual Circular Polarized
Receiver Center Frequency	1686.6 MHz (L-Band)
Data Rate	31 Mbps
Antenna Coverage	Earth Coverage to 5^0
Data Sources	ABI (16 bands), GLM, SEISS, EXIS, SUVI, MAG
Space Weather	~2 Mbps
Lightning Data	0.5 Mbps

GOES-16 Products on GRB

Level 1b Products:

Radiances from the Advanced Baseline Imager: 16 Bands; Full Disk, CONUS, and Mesoscale

Solar imagery from the Solar Ultraviolet Imager

Solar flux from the Extreme Ultraviolet and X-ray Irradiance Sensors

Energetic heavy ions from the Space Environment In-Situ Suite

Space environment magnetic field from the Magnetometer

Space Weather Products

Level 2 products:

Geostationary Lightning Mapper

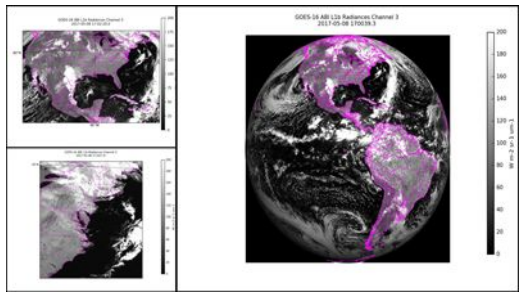
Community Satellite Processing Package for Geostationary Data

Univ. of Wisconsin – Madison SSEC/CIMSS is funded by NOAA through the GOES-R Program to develop and maintain the CSPP Geo software package. CSPP Geo software is available at: http://cimss.ssec.wisc.edu/csppgeo/

All CSPP Geo software is free to download and use.

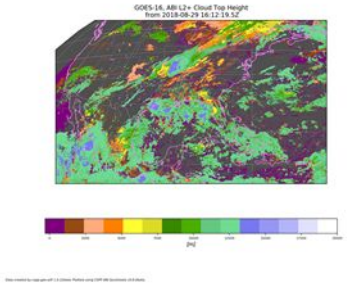
Capabilities include:

- Process the GOES-16 and GOES-17 GRB data streams, reconstructing the products that were generated on the ground system
- Further process GOES-16 and GOES-17 ABI data to generate Level 2 products



ABI L1 Quicklooks

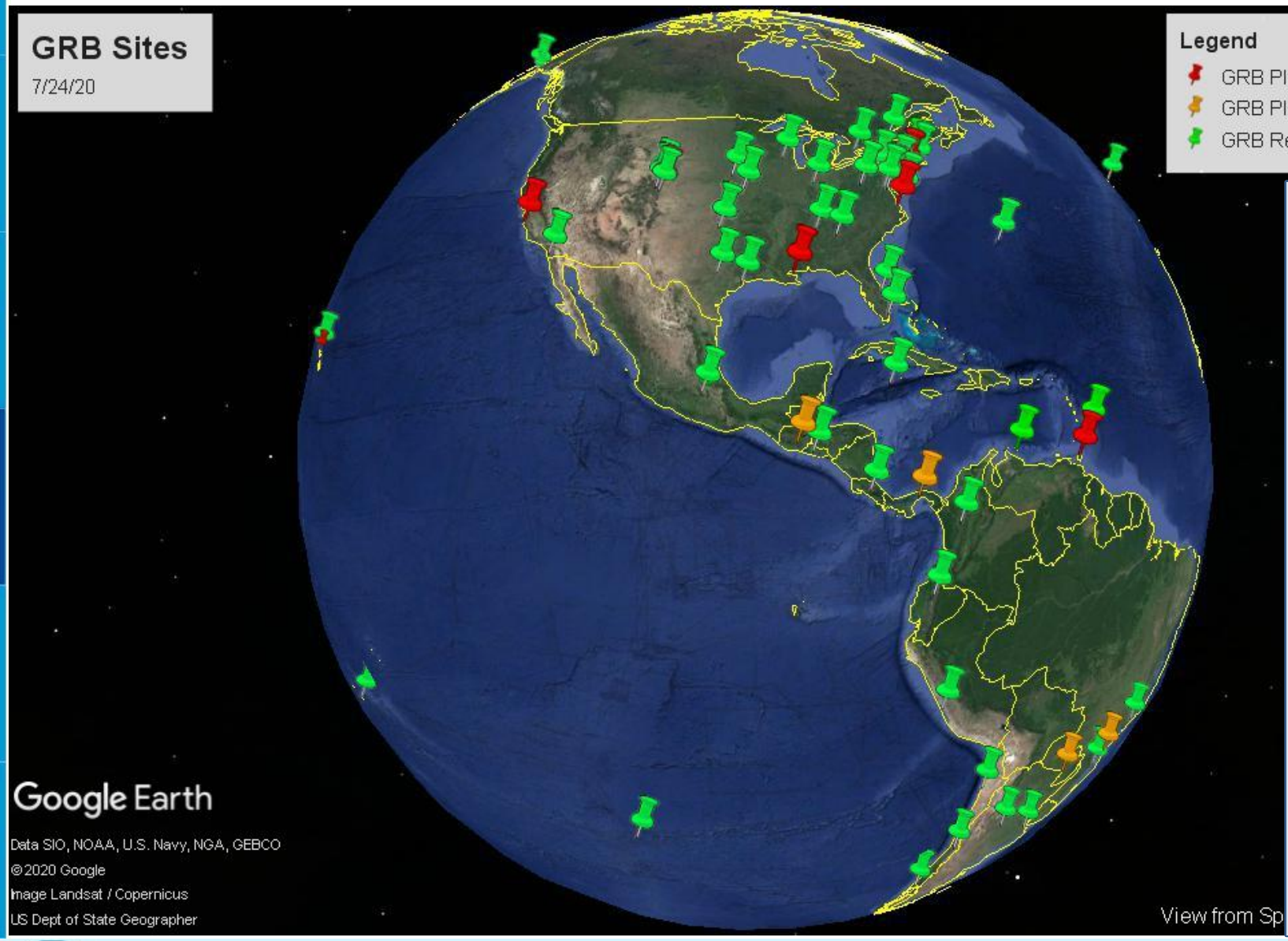
ABI true color



Level 2 products are available in CSPP Geo AIT Framework Version 1:

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

Current Known GRB Sites



- There are 67 GRB sites. Some sites have more than 1 receive station
- There are 94 receive stations (antennas)
- Many of the sites use the CSPP Geo software package
- More information and a list of GRB manufacturers is available at:
- https://noaasis.noaa.gov

GEONETCast Americas (GNC-A)

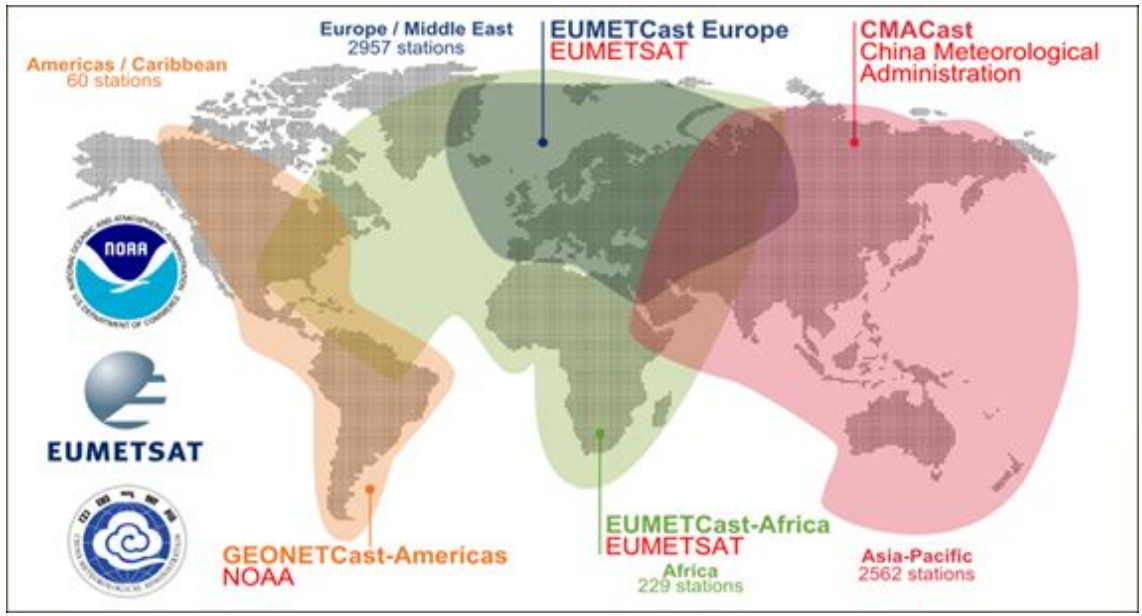
→ GEONETCast (the combination of three systems) is a low-cost global environmental information delivery system that transmits satellite and in-situ data, products, and services to users through commercial TV satellites, using multi-cast, access-controlled broadband capability.

→ GEONETCast is a system of systems aiming at facilitating access to Earth observation data and information, complementary and independent from internet access. It is particularly relevant for time critical applications (e.g. warning, safety-of-life, etc) or for users located in areas with poor internet access (e.g. in developing countries).

→ GEONETCast is a key of the Group on Earth Observations (or GEO) infrastructure.

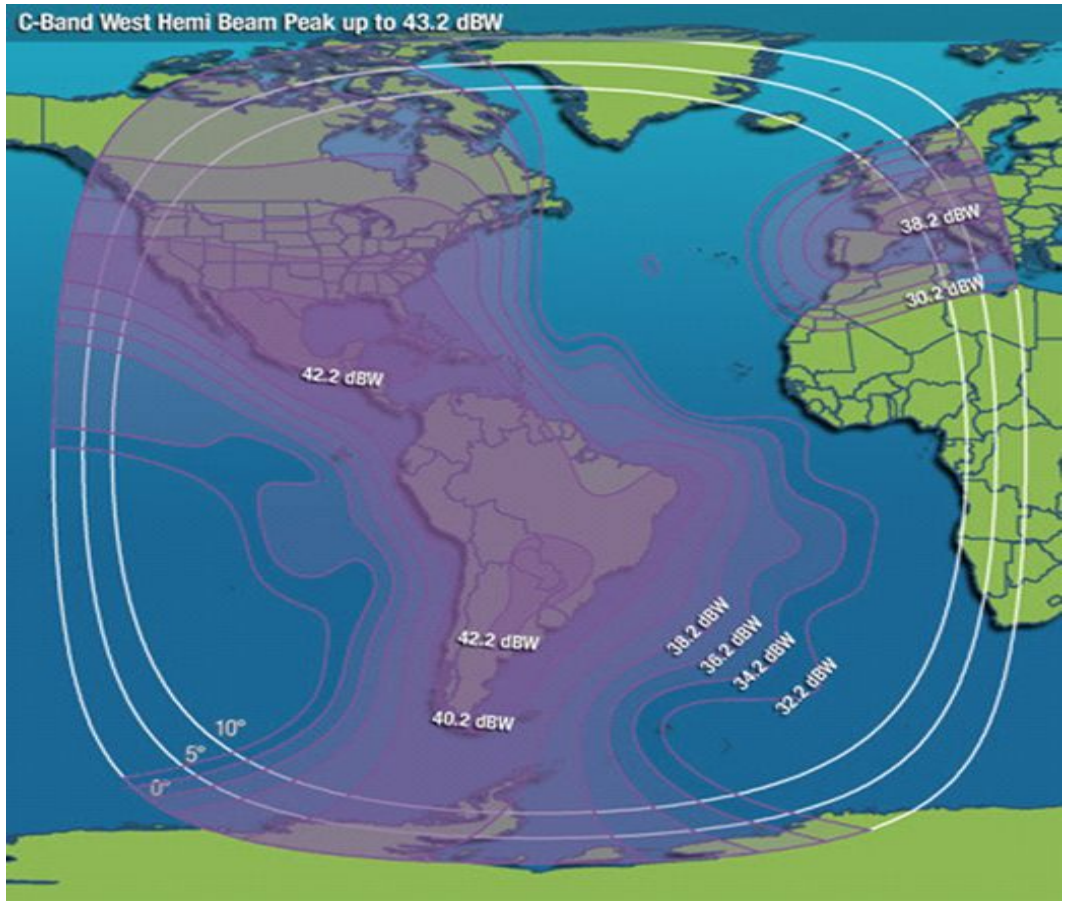
→ GEONETcast is an operational system, fully resourced by the contributing entities and their partners. It is being used on a daily basis by numerous users in all continents (with a total of about 6000 users (stations)).

→ GEONETcast is a cross-cutting infrastructure, in the sense that it supports various type of applications and initiatives; GEONETCast is an enabling activity that cuts across SBAs, includes elements of infrastructure/hardware/software and data/information streams. Further, it supports the implementation of Flagships and Initiatives.



GNC-A Broadcast Specifications & Footprint

GEONETCast Americas Broadcast Parameter	Parameter Value
Satellite	IS-21 (Intelsat)
Location	58 ° West or 302° East
PID	4201
Transponder	19C
Radio Frequency Band	C-band
Frequency	4080 MHz
Frequency Range	3700 – 4200 MHz
Symbol Rate	30.00 Msps
Polarization	Linear – Vertical (Horizontal or Vertical)
Typical Edge of Coverage Effective Isotropic Radiated Power	> 31.3 dBW
Datacasting Client Software (Required)	Kencast FAZZT Professional Client
FEC (Forward Error Correction – Kencast FAZZT)	5/6
Peak G/T (antenna gain-to-noise-temperature)	Up to 2.5 dB/K

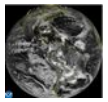
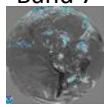
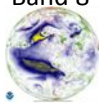
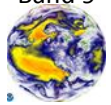
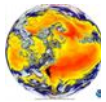
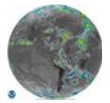
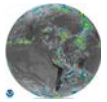
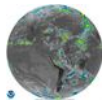


GEONETCast-Americas Bandwidth

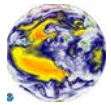
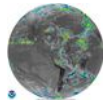
2013	2014	2015	2016	2017	2018	2019	2020
2.0 Mbps	2.0 Mbps	2.0 Mbps	6.7 Mbps	12.0 Mbps	12.0 Mbps	12.0 Mbps	20.0 Mbps
21 GB Day	21 GB Day	21 GB Day	72 GB Day	125 GB Day	129 GB Day	129 GB Day	134 GB Day

GOES Products on GNC-A

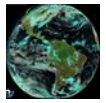
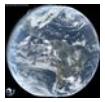
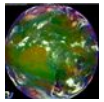
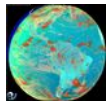
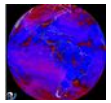
GOES-16 Cloud Moisture Imagery Full Disk

Band 2 
Band 5 
Band 7 
Band 8 
Band 9 
Band 10 
Band 13 
Band 14 
Band 15 

GOES-17 Cloud Moisture Imagery Full Disk

GOES-16 RGB Composites

Dry Land 
True Color 
Air mass 
Day/Night Microphysics 

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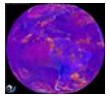
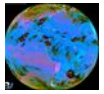
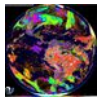
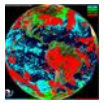
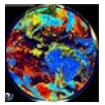
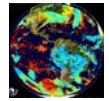
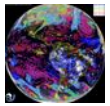
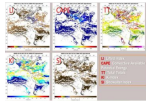
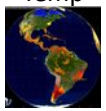
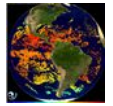
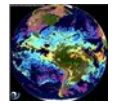
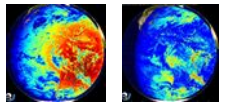
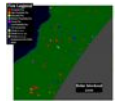
Day Convection 
Dust 

GOES-16 Level II Products

Aerosol Detection and Optical Depth 
Clear Sky Masks 
Cloud Optical Depth & Particle Size 
Cloud Top Height 
Cloud Phase 
Cloud Top Pressure 
Cloud Temperature 

Derived Winds Bands 2, 7, 8, 9, 10 and 14 
Snow Cover 
Derived Stability Indices 
Land Temp 
Sea Surface Temp 
Rainfall Rate/QPE 
Total Precip Water 

Downward/Reflective SW Radiation 
Fire/Hot Spot Characterization 
GLM 

For more product detail please visit: https://geonetcast.wordpress.com/gnc-a-product-catalog/

JPSS Products on GNC-A

CIMSS provides the following N20 + SNPP High Rate Data (HRD) from 5 separate receive stations:

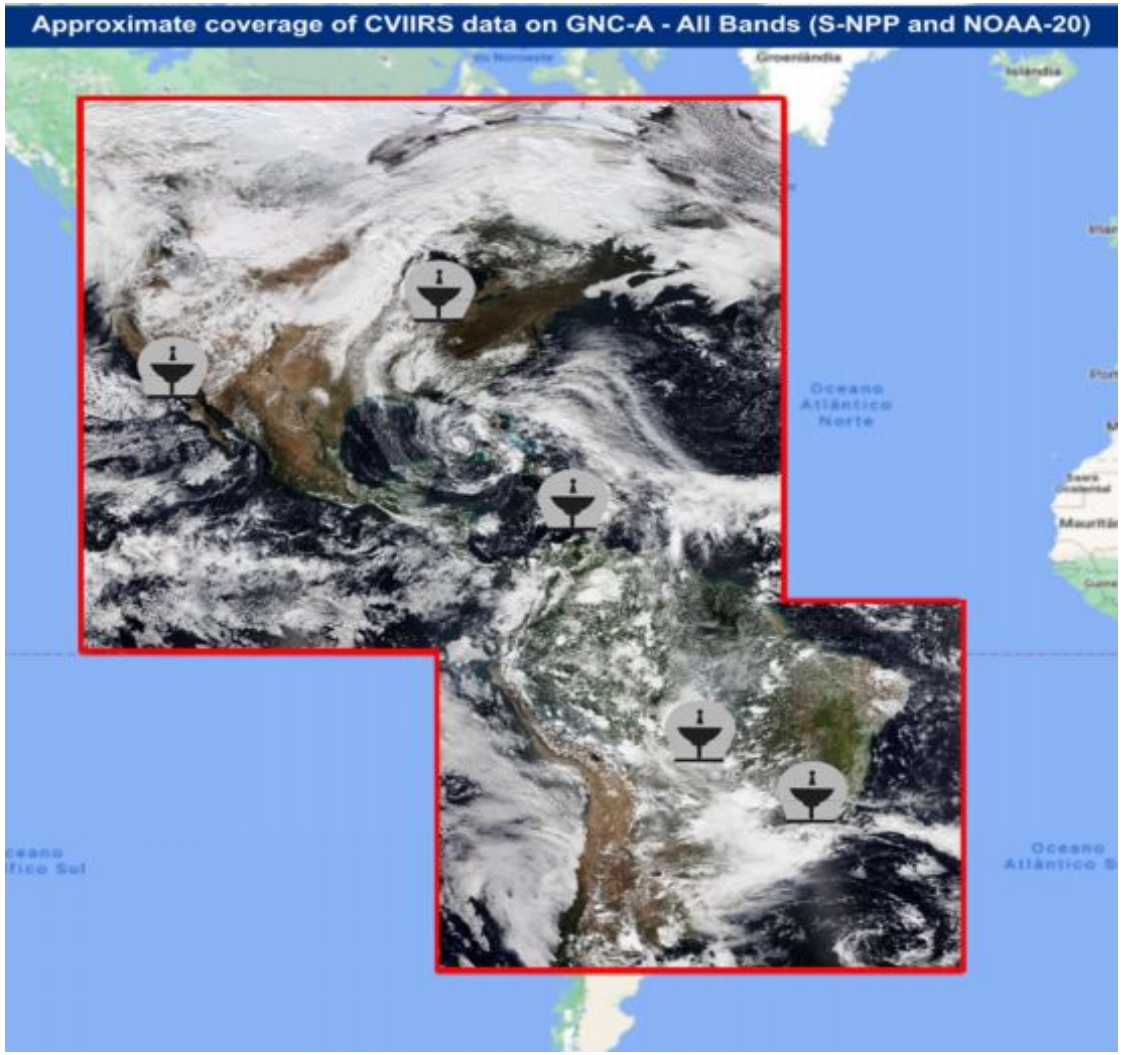
→ VIIRS M bands 1, 3, 4, 5, 7, 9, 10, 12, 14 and 15

→ VIIRS I bands I, 2 and 5

→ VIIRS Day/Night Band (DNB)

Other notable products include:

→ VIIRS Active Fires, VIIRS Ocean Color, MIRS, NUCAPS, TOAST and Blended Total Precipitable Water products



For more product detail please visit: https://geonetcast.wordpress.com/gnc-a-product-catalog/

Other Products on GNC-A

EUMETSAT

- ASCAT Coastal Winds 12.5km
- ASCAT Coastal Winds 25km
- Medium/Low Resolution METOP Sea Ice Drift
- Medium/Low Resolution METOP Sea Ice Concentration
- Global Sea Ice Emissivity
- METOP SST IASI
- METEOSAT 0° SST

GCOM-W1

- AMSR2 Brightness Temps
- Precipitation (Rain Rate, Convective and Probability)
- Soil Moisture
- Sea Ice
- Snow Cover, Depth, Water Equivalent
- Ocean SST, Wind speed, TPW and Cloud Liquid Water)

Miscellaneous

- Low Res full disk/sectorized GOES Imagery
- NA/SA NWS Surface and QPF Charts
- GFS 0.5 + 1.0° resolution GRIB products
- N. America Drought Monitor
- Hourly + Realtime Ozone and Particulate matter from EPA
- Argentina provided SA wave height and direction
- Multiagency Monitoring of Vegetation Fires Product
- Central America WRF Winds forecast 925-250 hPa

ISCS NWS

- AMSR2 Brightness Temps
- Precipitation (Rain Rate, Convective and Probability)
- Soil Moisture
- Sea Ice
- Snow Cover, Depth, Water Equivalent
- Ocean SST, Wind speed, TPW and Cloud Liquid Water)

For more product detail please visit: https://geonetcast.wordpress.com/gnc-a-product-catalog/

GEONETCast User Community

New GNC-A stations will be procured and installed at the following locations in the near future (7):

- Antigua & Barbuda;
- Barbados;
- Dominica;
- Grenada;
- St. Kitts & Nevis;
- Saint Lucia
- Saint Vincent and The Grenadines

Types of users:

- Regional Offices: 39
- NWS: 24
- Universities: 16
- Military: 5
- Private: 3
- Airport: 3
- Emergency / Civil Defense: 2

Estimated GEONETCast User & DCS User Overlap

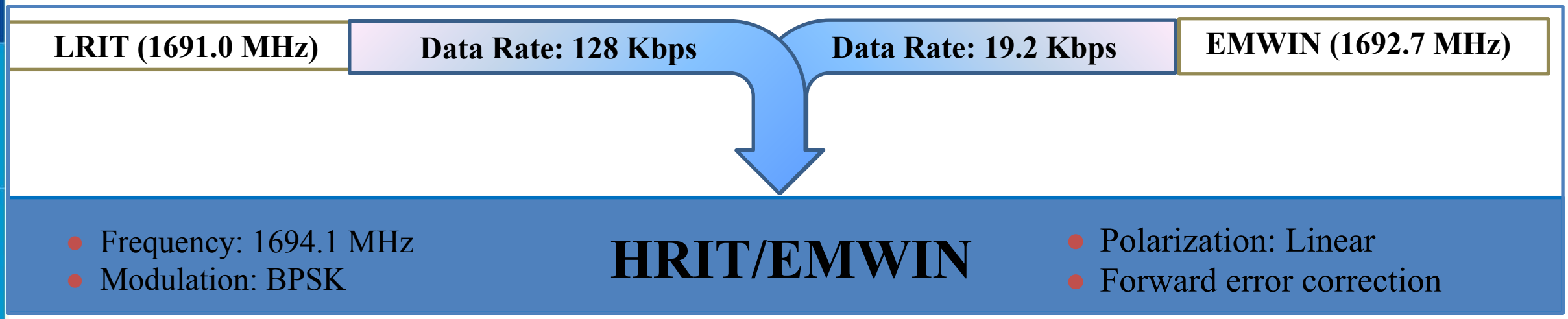
	Total DCP's
Argentina	0
Antigua & Barbuda	6
Barbados	11
Brazil	107
Belize	9
Chile	0
Colombia	85
Costa Rica	31
Cuba	0
Dominican Republic	1
Dominica	47
Ecuador	70
El Salvador	54
Grenada	45

	Total DCP's
Guatamala	54
Haiti	0
Honduras	24
Mexico	40
Panama	205
Paraguay	0
Peru	359
St Vincent & Grenadines	10
St Kitts & Nevis	7
St Lucia	14
Uruguay	5
Total including Caribbean	1184
Total w/o Caribbean	1055

High Rate Information Transmission (HRIT)

What is HRIT/EMWIN?

- The High Rate Information Transmission/Emergency Manager Weather Information Network's (HRIT/EMWIN) is available only on the GOES-R series satellites and is the follow up to both the separate LRIT and EMWIN broadcasts onboard the GOES-NOP satellites.
- HRIT/EMWIN's objective is to continue the previous broadcast services of LRIT and EMWIN at a significantly higher data capacity. This is accomplished by combining the two services into a single service with a data relay capacity of **400Kbps**.
- HRIT/EMWIN provides more imagery channel selection with greater resolution at a more frequent rate than previous LRIT broadcasts.



Description of the Broadcast

Characteristic	HRIT/EMWIN Broadcast Specifications
Platform	Operational East and West GOES-R Series Satellites
Operating Frequency Range	L-band
Center Frequency	1694.1 MHz
Data Rate	400 kilobits per second (Kbps)
Symbol Rate	927,000 symbols per second (sps)
Modulation	BPSK
Polarization	Linear – Vertical offset
Antenna System	At 5 degree elevation, the minimum antenna is 1.2 meter. At 10 degrees or more, the minimum size is 1.0 meter

HRIT/EMWIN Bandwidth Management

- HRIT "subscribes" to various products within the Product Distribution and Access (PDA) system. One being DCS data.
- When each of the subscriptions gets pulled for HRIT dissemination based on their availability or when they're scheduled, they move over to HRIT's Broadcast Management system where the subscriptions get labeled under a group listing and pushed to the dissemination queue for FEP uplink.
- HRIT separates subscriptions into three different groups and prioritizes each product on how its configured into the system.
  - DCS data is the second highest priority behind EMWIN data

PDA Product Group Name	Guaranteed Bandwidth	Maximum Bandwidth	Group Order Rank
EMWIN	8%	15%	1
DCS	**5%**	**10%**	**2**
Imagery	87%	100%	3

HRIT/EMWIN Virtual Channel ID and Group Listing

VCID #	Product Name	GOES-16 Availability	GOES-17 Availability	Period -Min	Format	Resolution	Product Source Information
0	Admin Text	X	X	60	Text Messages	N/A	Active and available
1	Mesoscale Imagery	X	X	15	HRIT/LRIT	0.5km Band 2, 2km for bands 7 and 13	Active and available
2	Cloud Moisture Imagery Band 2	X	X	30	HRIT/LRIT	2 km	Active and available
5	GOES-15 WV Imagery		X	30 - 180	LRIT	4 km	Unavailable
6	GOES-15 IR Imagery		X	30 - 180	LRIT	4 km	Unavailable
7	Cloud Moisture Imagery Band 7	X	X	30	HRIT/LRIT	2 km	Active and available
8	Cloud Moisture Imagery Band 8	X	X	30	HRIT/LRIT	2 km	Active and available
9	Cloud Moisture Imagery Band 9	X	X	30	HRIT/LRIT	2 km	Active and available
13	Cloud Moisture Imagery Band 13	X	X	30	HRIT/LRIT	2 km	Active and available
14	Cloud Moisture Imagery Band 14	X	X	30	HRIT/LRIT	2 km	Active and available
15	Cloud Moisture Imagery Band 15	X	X	30	HRIT/LRIT	2 km	Active and available
16	G16 CMI Band 13		X	60	HRIT/LRIT	4 km	Active and available
17	G17 CMI Band 13	X		60	HRIT/LRIT	4 km	Active and available
20	EMWIN - Priority	X	X	Variable	Text	N/A	Available
21	EMWIN - Graphics	X	X	Variable	Graphic (e.g. GIF, JPEG)	N/A	Available
22	EMWIN - Other	X	X	Variable	Text and Graphic	N/A	Available
24	NHC Maritime Graphics Products	X	X	Variable	Graphic (e.g. GIF, JPEG)	N/A	Active and available
25	GOES-R/S Level II Products	Not Available	Not Available	Variable	HRIT/LRIT	2-10 km	Active and Available
30	**DCS Admin**	**X**	**X**	**Continuous**	**Text**	**N/A**	**Active and available**
32	**DCS Data**	**X**	**X**	**Continuous**	**Formatted Text**	**N/A**	**Active and available**
60	Himawari-8		X	60	LRIT	4 km	Active and available

Group Legend
- EMWIN
- DCS
- Imagery

Summary

There are a number of alternatives for obtaining GOES-R Series data products:

- GOES Rebroadcast (GRB) is the fastest and most reliable way. It is also the most expensive for the user
- High Rate Information Transmission/ Emergency Managers Weather Information Network (HRIT/EMWIN) provides low-resolution imagery. Cost to user is less than GRB. There is a delay due to processing at ESPC
- GEONETCast Americas (GNC-A) provides a subset of products. Cost to user is less than GRB. There is a delay due to processing at ESPC and distribution to NOAA's contractor

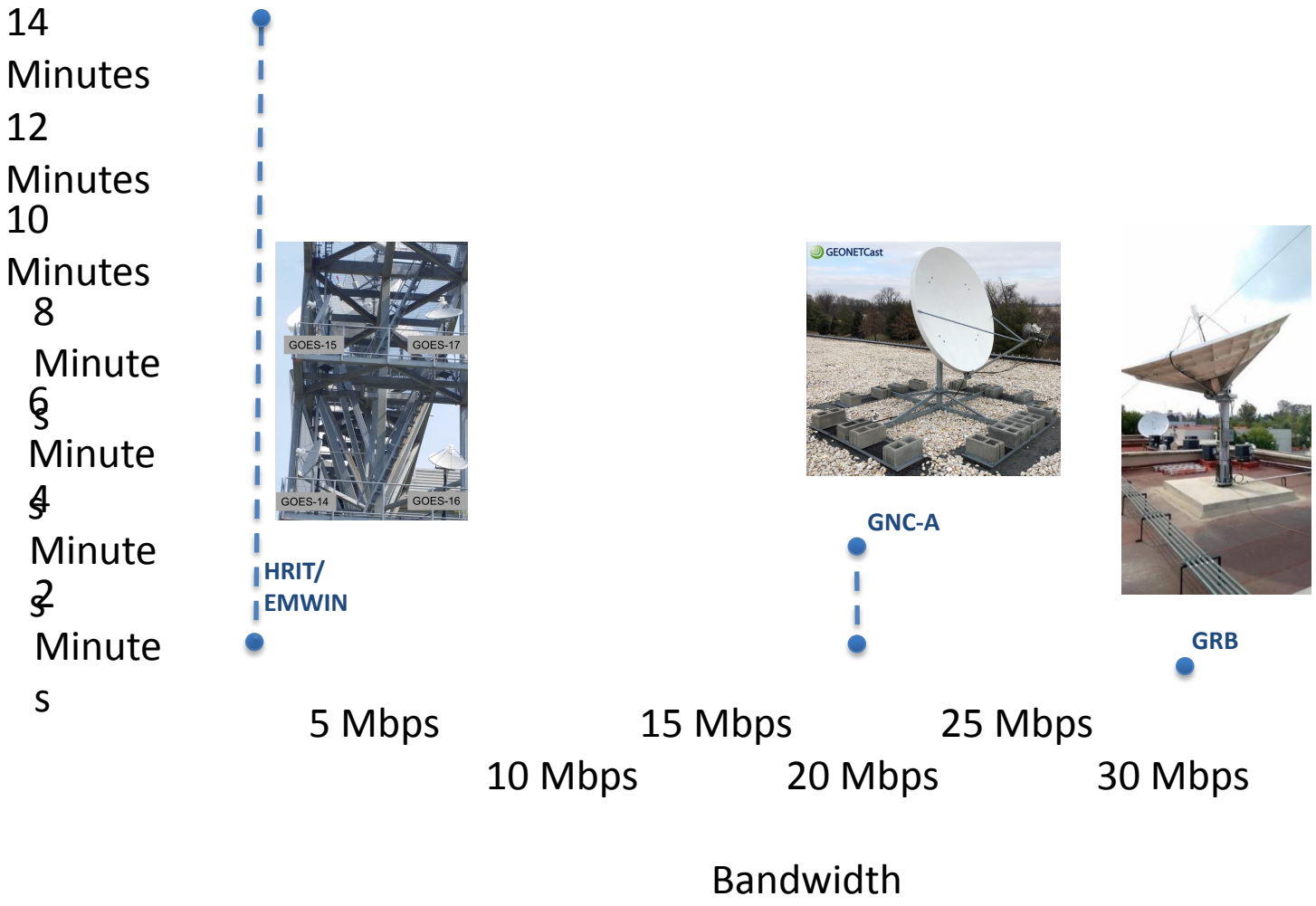
There other terrestrial means to get GEOS-R data such as the following:

- Production Distribution and Access (PDA). PDA service is dedicated for authorized near real-time users. New user onboarding is currently suspended while the organization assesses time critical user needs and evaluates available capacity on the system
- Comprehensive Large Array-data Stewardship System (CLASS). Level 1b and Level 2 products available with a delay
- Internet Access

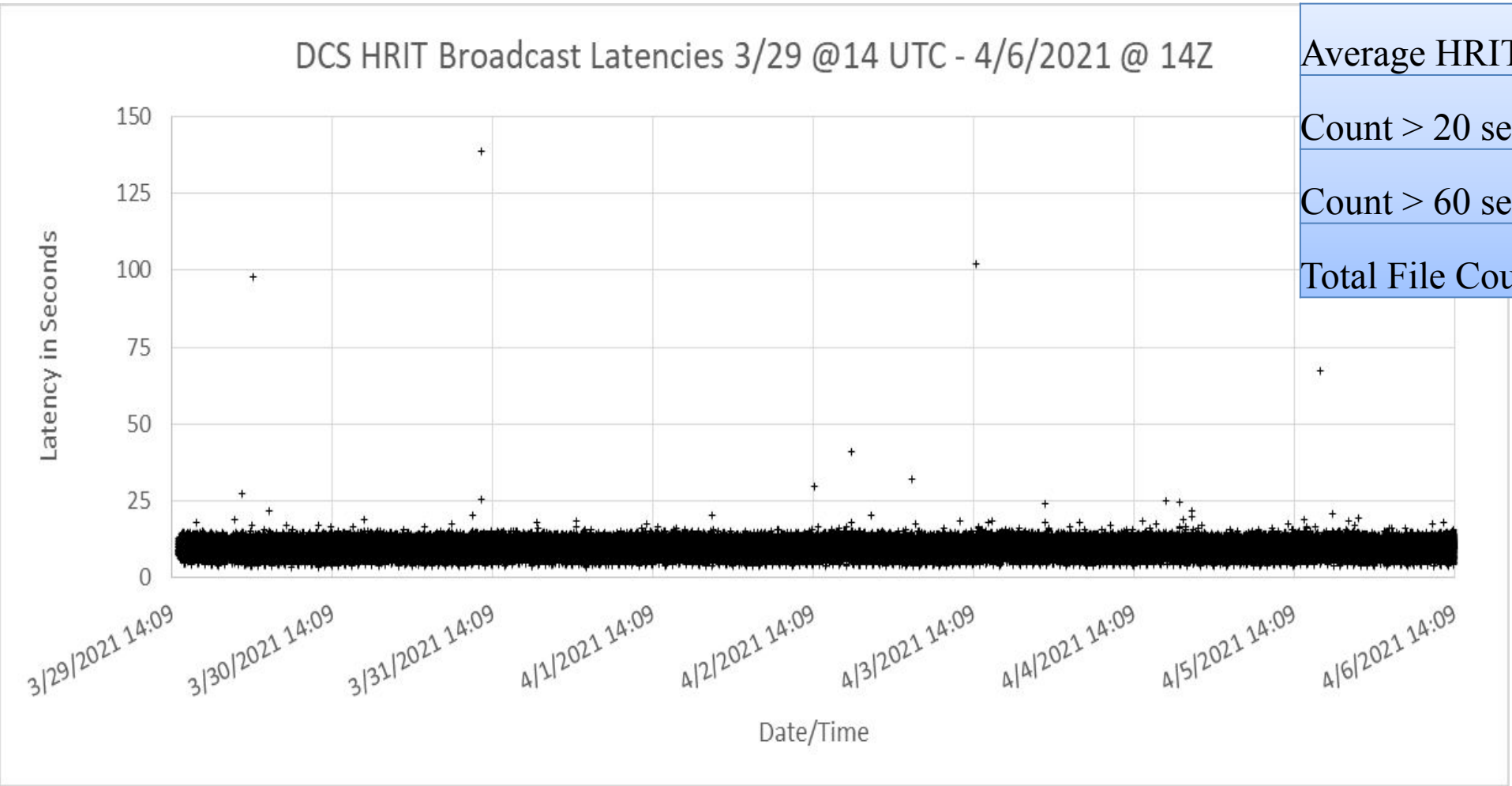
Imagery Rebroadcast Bandwidth vs Latency

Data Latency

(From L1b generation to receipt by receive station), note GNC-A & HRIT/EMWIN use L2 CMI Data



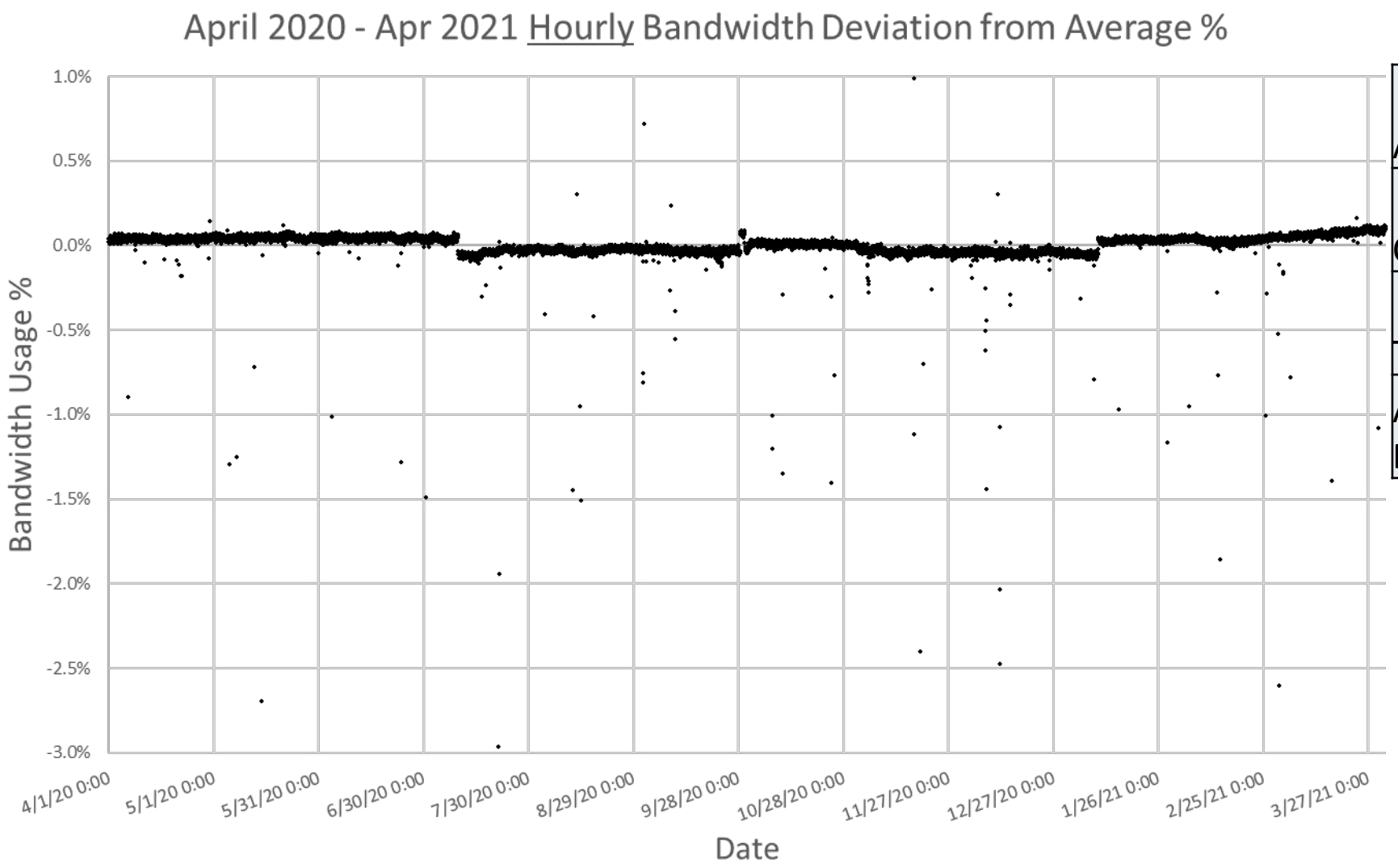
DCS Broadcast Latencies



Average HRIT Latency (s)	9.604798
Count > 20 seconds	18
Count > 60 seconds	4
Total File Count	147300

- DCS end-to-end latency is measured from DADDS timestamp to broadcast receipt. DADDS adds latency in gaining the necessary messages to make 8 KB file size.

DCS on HRIT Availability Estimate



Average Bandwidth %	3.33%
Count < 95% Received	42
Total Counted Hours	8760
Availability >95% Expected	**0.995205**

- DCS file availability on HRIT is a bit higher than 99.5% as anything upstream will affect these %
  - PDA Anomalies
  - HRIT uplink site failovers
  - DADDS DRGS missing data

Points of Contact

https://noaasis.noaa.gov/ORGANIZATION/contacts.html

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