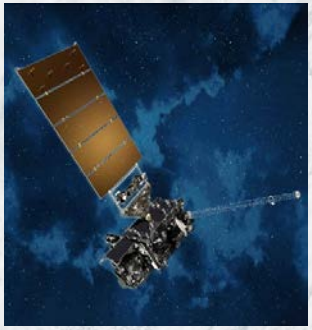
Overview of NOAA NESDIS Direct Readout Services

CSPP/IMAPP Users' Group Meeting



June 28, 2017

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Office of Satellite and Product Operations
National Environmental Satellite, Data, and Information Service

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Direct Broadcast and Direct Readout Services

- GOES-R Series Direct Broadcast (DB) and Direct Readout Services
  - GOES Rebroadcast (GRB)
  - High Rate Information Transmission (HRIT) Service and the Emergency Managers Weather Information Network (EMWIN)
  - Community Satellite Processing Package (CSPP) Geo
- JPSS DB and Direct Readout Services
  - High Rate Data (HRD)
  - NOAA Direct Broadcast Real-Time Network (Testbed)
  - Field Terminal Support (FTS)
  - CSPP
- User Notifications

GOES-R Series GOES Rebroadcast

- The GOES Rebroadcast (GRB) downlink is standards-based, making use of the following protocols:
  - Digital Video Broadcasting (DVB-S2)
  - Consultative Committee for Space Data Systems (CCSDS) Advanced Orbiting Systems (AOS)
  - Space Data Link Protocol
  - CCSDS Space Packet Protocol
- GOES-R Product Definition and Users' Guide (PUG) Volume 4 http://www.goes-r.gov/users/docs/PUG-GRB-vol4.pdf
- GRB Downlink Specification

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

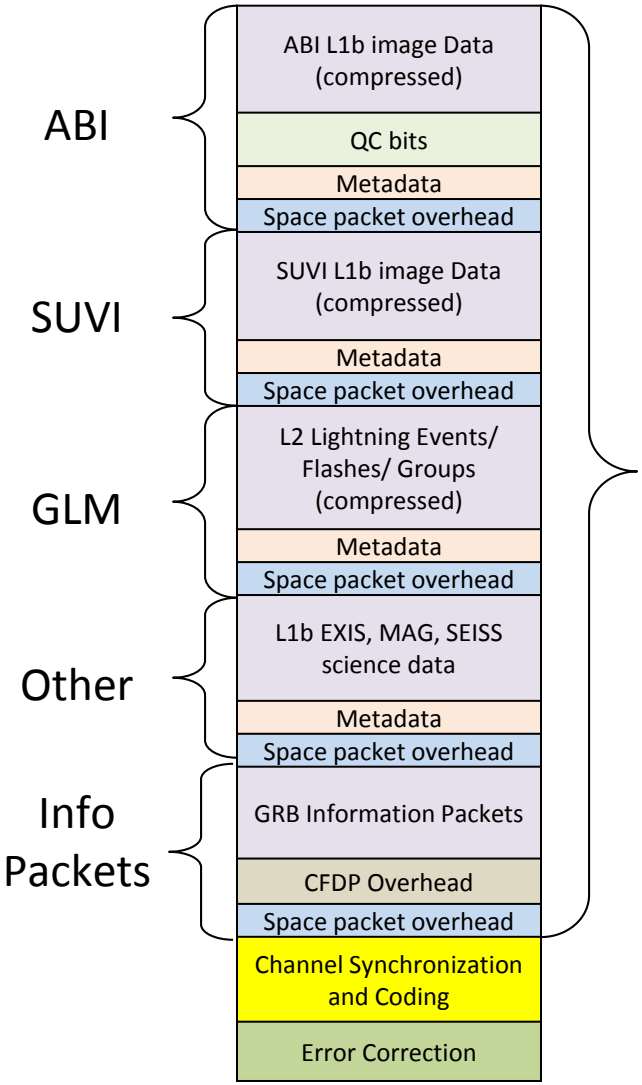
GVAR and GRB Comparison

	GOES Variable (GVAR)	GOES Rebroadcast (GRB)
Full Disk Image	30 Minutes	5 Minutes (Mode 4) 15 min (Mode 3)
Other Modes	Rapid Scan, Super Rapid Scan	3000 km X 5000 km (CONUS: 5 minute) 1000 km X 1000 km (Mesoscale: 30 seconds)
Polarization	None	Dual Circular Polarized
Receiver Center Freq	1685.7 MHz (L-Band)	1686.6 MHz (L-Band)
Data Rate	2.11 Mbps	31 Mbps
Antenna Coverage	Earth Coverage to 5^0	Earth Coverage to 5^0
Data Sources	Imager and Sounder	ABI (16 bands), GLM, SEISS, EXIS, SUVI, MAG
Space Weather	None	~2 Mbps
Lightning Data	None	0.5 Mbps

GOES-16 Products on GRB

- Level 1b products:
  - Radiances from Advanced Baseline Imager (ABI): 16 Bands; Full Disk, CONUS, and Mesoscale
  - Solar Imagery from Solar Ultraviolet Imager (SUVI)
  - Solar Flux from the Extreme Ultraviolet and X-ray Irradiance Sensors (EXIS)
  - Energetic Heavy Ions from the Space Environment In-Situ Suite (SEISS)
- Level 2 products:
  - Geostationary Lightning Mapper (GLM)

GRB Channel Content Summary



Note: This is a catalog of the contents and not a sequential organization of the stream

Included in two 15.5 Mbps Bandwidth channels

- For each instrument: image data + metadata + CCSDS Space Packet overhead
- ABI has per pixel QC bits, coded separately
- ABI, SUVI, GLM compressed
- GRB Info packets via CCSDS File Delivery Protocol (CFDP)
- Channel synchronization and coding (link layer) for DVB-S2
- Error correction (LDPC)

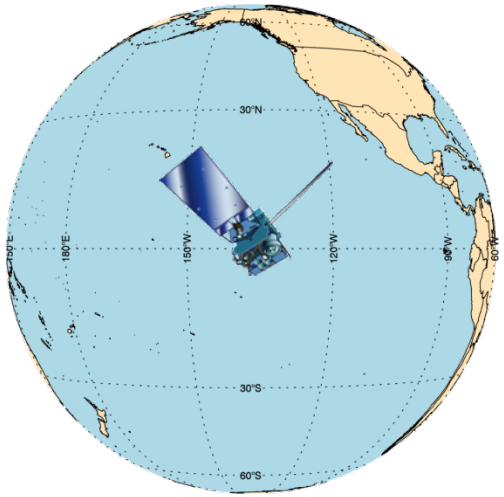
GOES-R Series Direct Readout Services

- Direct readout requires new antenna, receiver hardware, and processing system to handle the greater data volume
- Receiver frequency shift from 1685.7 MHz (GVAR) to 1686.6 MHz (GRB)
- Dual circular polarized signals
- Data rate increased from 2.11 Mbps (GVAR) to 31 Mbps (GRB)
- List of GRB Vendors and Manufacturers at:

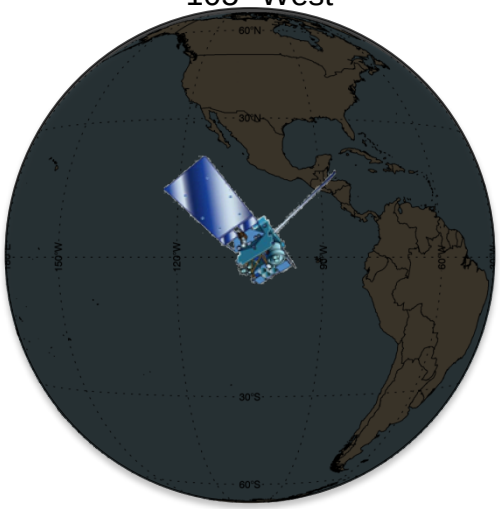
http://www.goes-r.gov/users/docs/GRB_ReceivingSystemManufacturersList.pdf

GOES Constellation

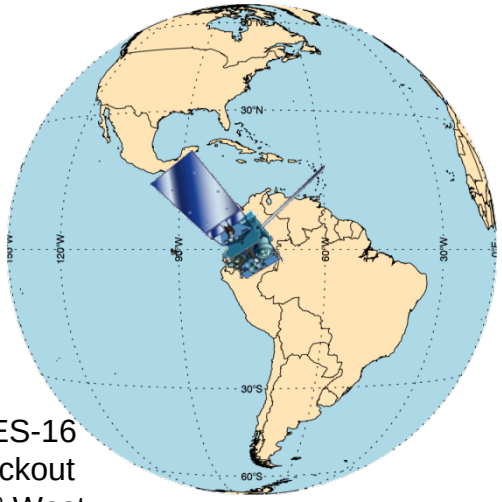
GOES-West
GOES-15
135° West



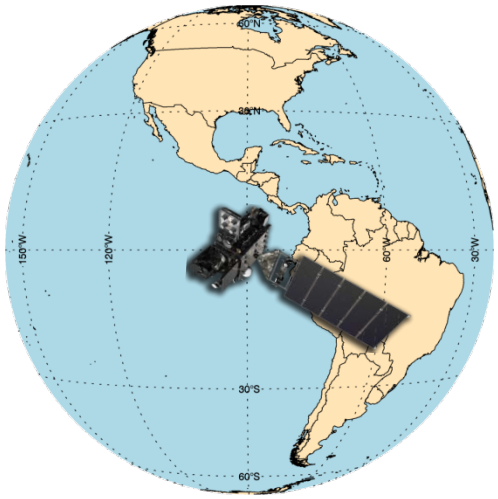
Standby
GOES-14
105° West



GOES-East
GOES-13
75° West



GOES-16
Checkout
89.5° West



GOES-16 will be moved to the GOES-East position in November 2017

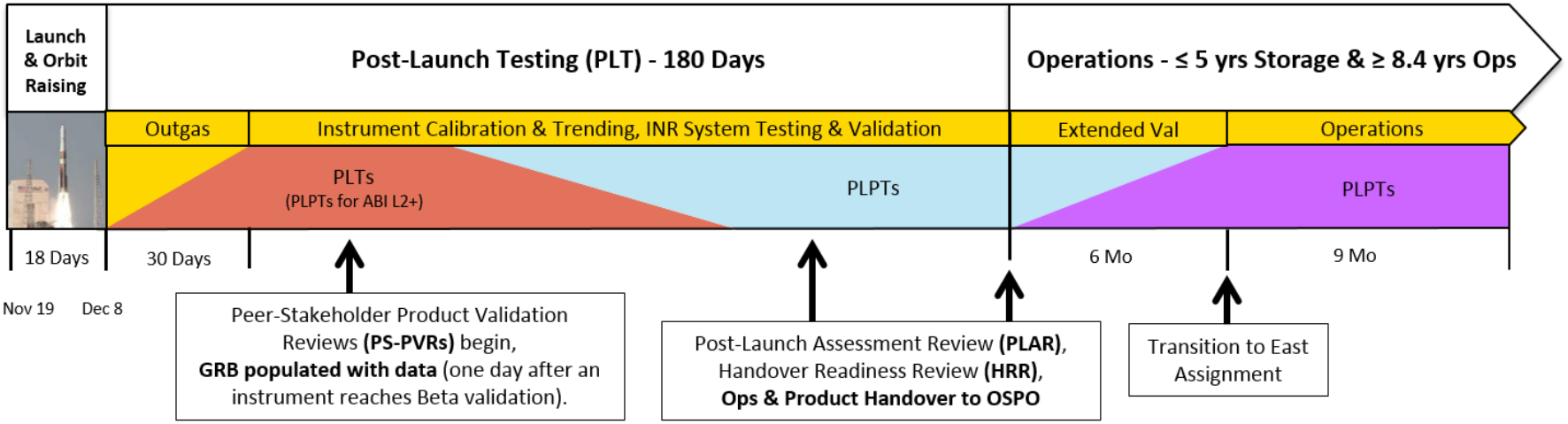
GOES-16 will be GOES East

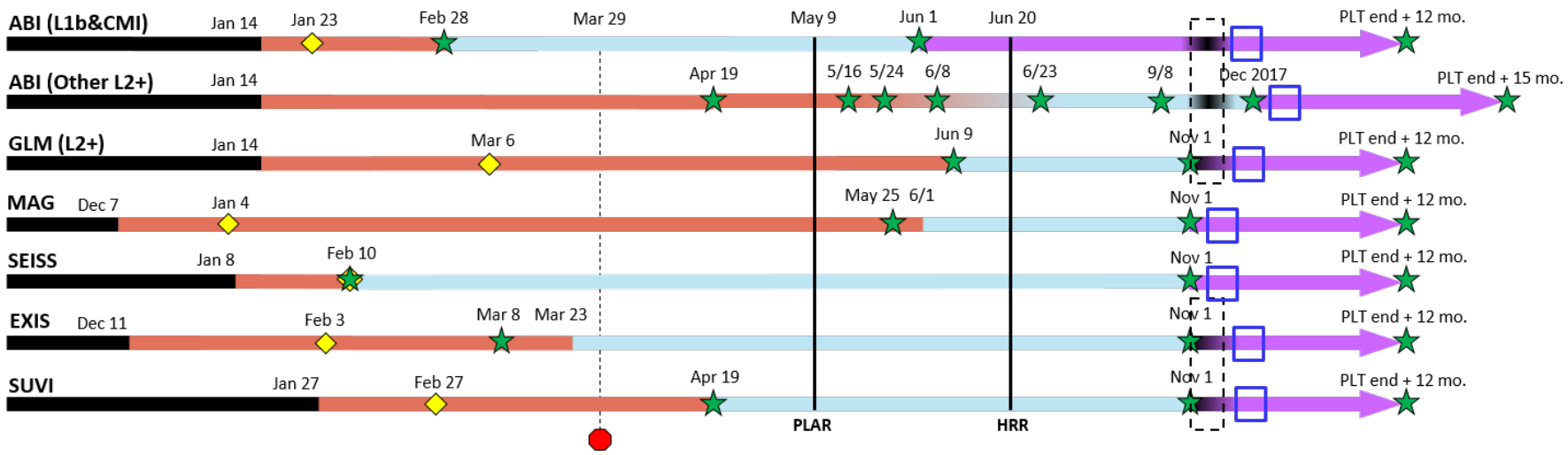
- GOES-13 is currently in the GOES East position (75^{o} W)
- GOES-16 is scheduled to drift from 89.5^{o} W to its GOES East position in November

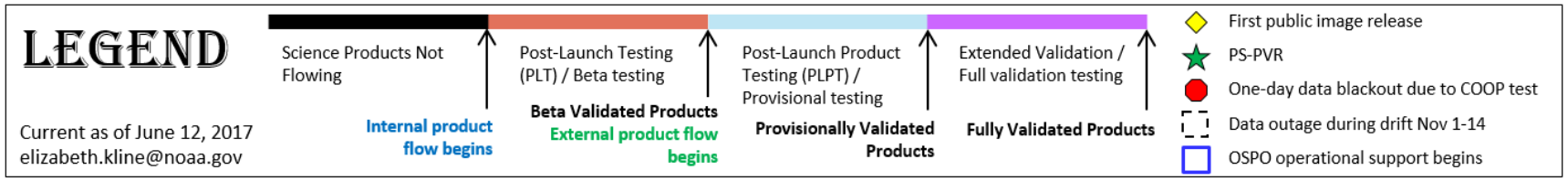
http://www.noaa.gov/media-release/noaa-s-newest-geostationary-satellite-will-be-positioned-as-goes-east-fall

- GOES-16 will not transmit on GRB during the drift

GOES-16 Post-Launch Science Product Validation Schedule







Note: All dates are coordinated with the Flight/MOST PLT SOE group and the T&H team and are subject to change.

GOES-16 Disclaimer

NESDIS issued the following disclaimer :

“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 and GRB) 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.”

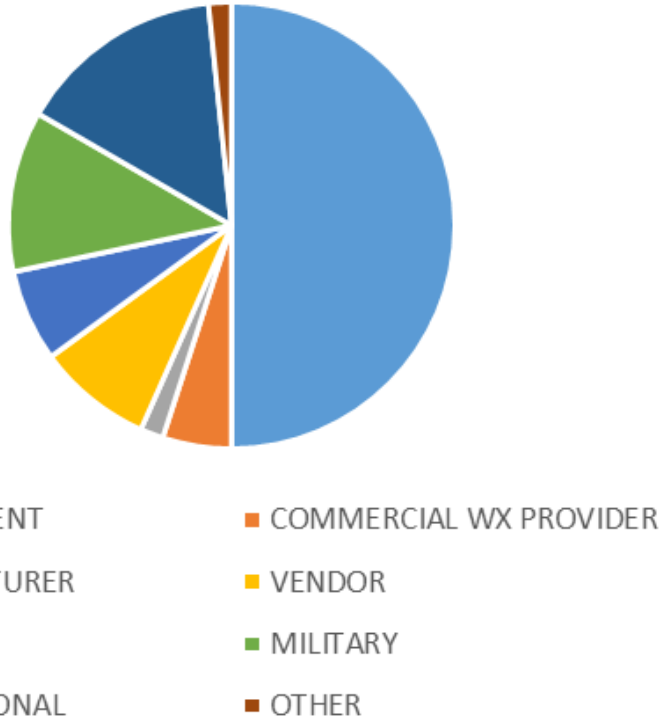
NESDIS required that the following caveat be posted with any image or plot: *"These GOES-16 data are preliminary, non-operational data and are undergoing testing. Users bear all responsibility for inspecting the data prior to use and for the manner in which the data are utilized."*

GOES Rebroadcast (GRB) Community Overview

Sector	Nr. of antennas
Government	30
Commercial Wx	3
Manufacturer	1
Vendor	5
Academic	4
Military	7
International	9
Other	1
Total	60

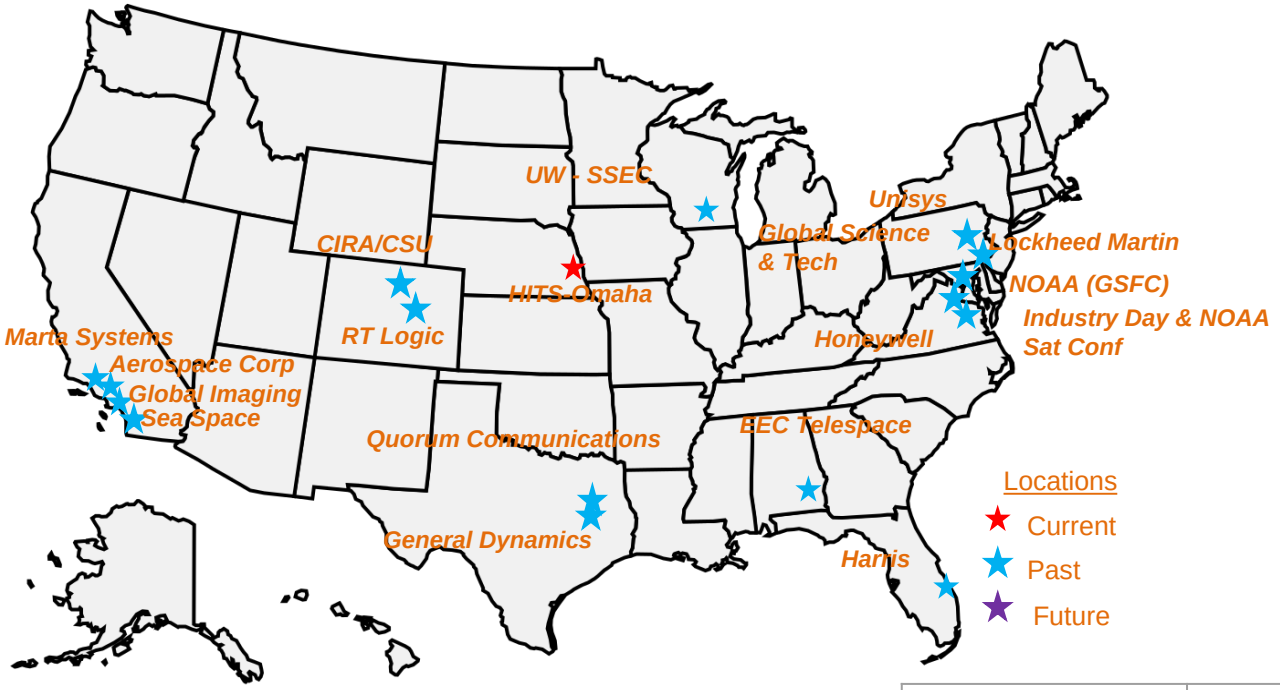
GRB User Group

- **66 members**
- **Members participated in GOES-16 Post-launch Test activities**

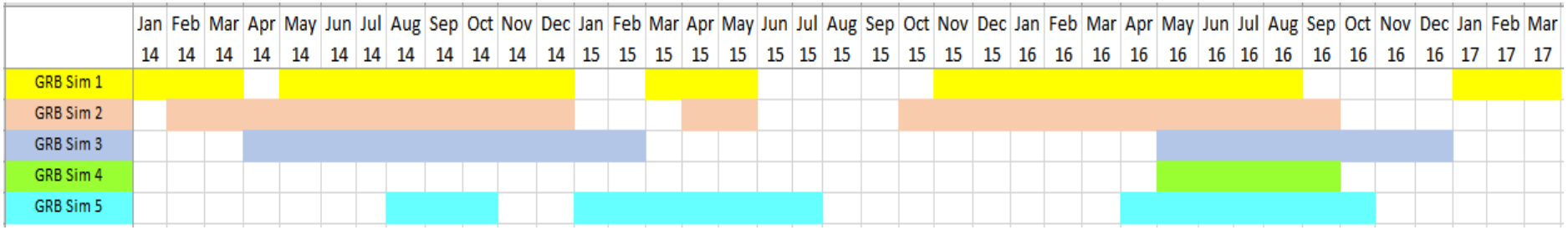


Updated on 6/19/17

GRB Simulator Loan Program



	2014	2015	2016
# Sims Loaned Out	9	5	7



GRB Sim 4 and 5 transferred to WCDAS in April 2017 and repurposed for BER baselining and monitoring

Outreach and Notifications

• GRB User Group participated in GRB to DB User thread of GOES-16 PLT

• Updated webpages for GRB

• Request GRB and HRIT/EMWIN users register in DCS Administration and Data Distribution System (DADDS). Use the link that says "Register for Direct Readout and Services Notifications“
https://dcs1.noaa.gov/Account/SurveyForm

•Users should also subscribe to Environmental Satellite Processing Center (ESPC) Notifications. Contact:

ESPC.Notification@noaa.gov

HRIT/EMWIN

- High Rate Information Transmission (HRIT) Service and the Emergency Managers Weather Information Network (EMWIN) will go operational when GOES-16 becomes the operational East satellite. There is currently a HRIT/EMWIN broadcast on GOES-16
- The GOES-16 Cloud and Moisture Imagery (CMI) was added in early June
- Initial offering includes:
  - EMWIN products including watches, warnings, forecasts and graphics
  - Copy of the GOES-DCS observations
  - Environmental products such as tropical weather
  - GOES-16 products – ABI Cloud and Moisture Imagery (CMI) converted to the LRIT/HRIT standard
  - ABI Full Disk in Band 2, 7, 8, 9, 13, 14 and 15. 2 km spatial resolution every 30 minutes. ABI mesoscale images in Bands 2, 7 and 13 every 15-30 minutes

HRIT/EMWIN

- EMWIN products will be transmitted as a contiguous file on the HRIT/EMWIN broadcast
- A departure from the Quick Block Transfer (QBT) protocol packet transmission
- EMWIN Priority 1 and 2 products will be broadcast twice approximately 5 seconds apart, to help assure product reception in marginal or noisy radio frequency environments
- File Names. The EMWIN file naming convention has been revised to follow the WMO format identified in WMO Pub 386.
- More information can be found at http://www.nws.noaa.gov/emwin/index.htm
- Broadcast for 4 days in March 2017, with two users reporting successful signal lock. Both were able to visualize the imagery and products
- Post Launch Testing (PLT) was conducted during 6/5/17 – 6/16/17

	LRIT & EMWIN - GOES-NOP	HRIT/EMWIN on GOES-R Series
Full Disk Image	3 hourly full disk; .5 hourly Nh/SH Follows GOES East/West Schedule	7 Channels of Full Disk Level 2 imagery Full disk at 2 Km spatial resolution Every 30 minutes (time based subscriptions)
Other Modes	Rapid Scan	3 channels of mesoscale imagery every half an hour
Polarization	Linear	Linear – Vertical offset
Receiver Center Freq	LRIT 1691.0 MHz EMWIN 1692.7 MHz	1694.1 MHz (L-Band)
Data Rate	LRIT 128 Kbps EMWIN 19.2 Kbps	400 Kbps
Antenna Coverage	Earth Coverage to 5^0	Earth Coverage to 5^0
Data Sources (Imagery)	Imager Vis, IR and WV	ABI CMI (7 bands), 2, 7, 8, 9, 13, 14, 15
Lightning Data	None	None initially, still evaluating
Other major sources	Legacy EMWIN, copy of GOES-DCS, Tropical Wx, etc	EMWIN products, Copy of DCS observations, Topical Weather, etc

Outreach and Training

- July 15-16, 2017, a two day VLab Train-the-Trainer event organized by the VLab and CIRA prior to NSC-17
- August 1-4, 2017, a four day AmeriGEOSS Week training event at the National University of Costa Rica.
- January-February, 2018, an AmeriGEOSS University Seminar at the National University of Colombia
- All will include GOES-R / JPSS satellite and sensor information
  - ABI / VIIRS sensor imagery bands and their use
  - Hands-on-Training from NOAA, CIRA and INPE

Joint Polar-orbiting Satellite System (JPSS) Direct Readout

JPSS-1 launch – Q4 FY 2017

S-NPP and JPSS-1 High Rate Data

- Direct Broadcast is the HRD
- Direct Readout services include:
  - Field Terminal Support (FTS) is funded by the JPSS program
  - Community Satellite Processing Package (CSPP). CSPP packages and distributes open source science software. CSPP is funded by the JPSS program
- NOAA Direct Broadcast Real-Time Network (DBRTN) is a demonstration of a method for providing low latency infrared and microwave sounder data to NOAA's National Weather Service

High Rate Data (HRD)

• The HRD provides real-time mission data (which includes instrument science data, instrument engineering data, and instrument telemetry data), and real-time Spacecraft housekeeping data via X-Band downlink transmission

• The data rate is 15 Mbps at a nominal downlink frequency of 7812 MHz

• The Mission Data Formatter (MDF) within the Command and Data Processor (CDP) provides a HRD Formatter function that allows Consultative Committee for Space Data Systems (CCSDS) Channel Access Data Units (CADU) to be generated from CCSDS Advanced Orbiting Systems (AOS) transfer frames provided by the CDP flight software (FSW)

Field Terminal Support

- The JPSS Ground Project Field Terminal Support (FTS) Web Portal has been operational since March 8, 2017. The FTS node provides FTS fundamental processing "building blocks" (software components, data and documentation) using a public web portal. This includes:
  - – Mission Support Data (including ancillary data, auxiliary data and Mission Notices) and
  - – Hardware and software specifications needed for processing the broadcasts. Orbital data to assist the DB community in locating the satellites of interest.
  - – Access to the FTS web portal is through a self-registration process and all customers around the world will be granted access. To access the FTS web portal please go to: https://fts.jpss.noaa.gov

Community Satellite Processing Package

• A user friendly software processing system has been developed that enables the Direct Broadcast community to easily integrate the algorithms into their remote terminals

• Community Satellite Processing Package (CSPP)

https://cimss.ssec.wisc.edu/cspp/

• The software integrator interacts with and serve the DB community with web portals that they have independently established

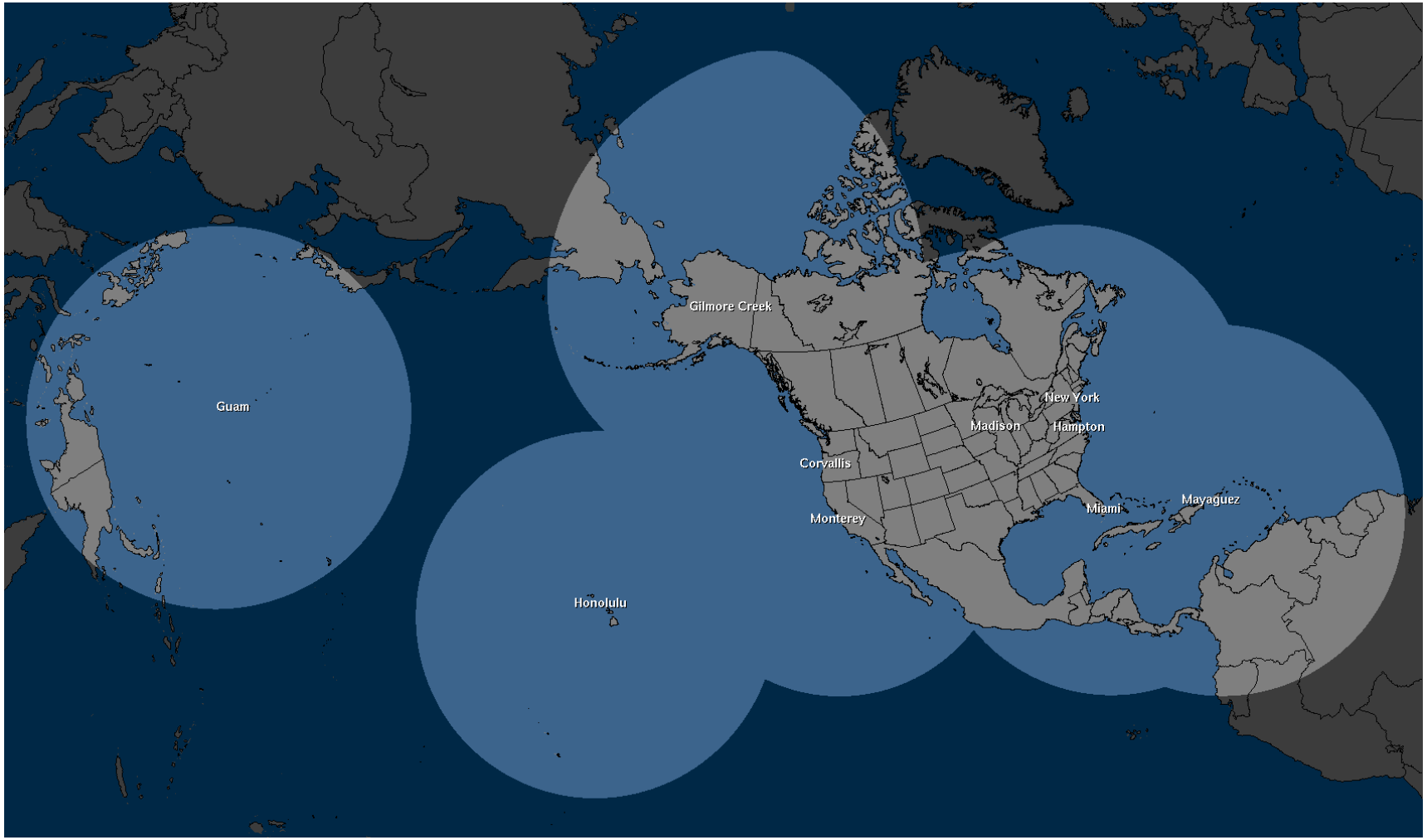
NOAA Direct Broadcast Real-Time Network (DBRTN)

- NOAA DBRTN is part of the WMO DBNET Program and adheres to the DBNET guidelines and best practices
  - WMO "Guide to the Direct Broadcast Network (DBNet) For Near Real-Time Relay of Low Earth Orbit Satellite Data"

http://www.wmo.int/pages/prog/sat/documents/DBNet_Guide-to-DBNet.pdf

- The sounder data is now assimilated by the National Centers for Environmental Prediction (NCEP) and will shortly be added to GTS (CriS, ATMS, IASI) to increase the percentage of polar data used in NCEP NWP models and provide backup in case of anomalies in polar global processing
- Heritage ATOVS still provided through RARS, but new DBNET will soon include ATOVS

DBRTN Antenna Sites



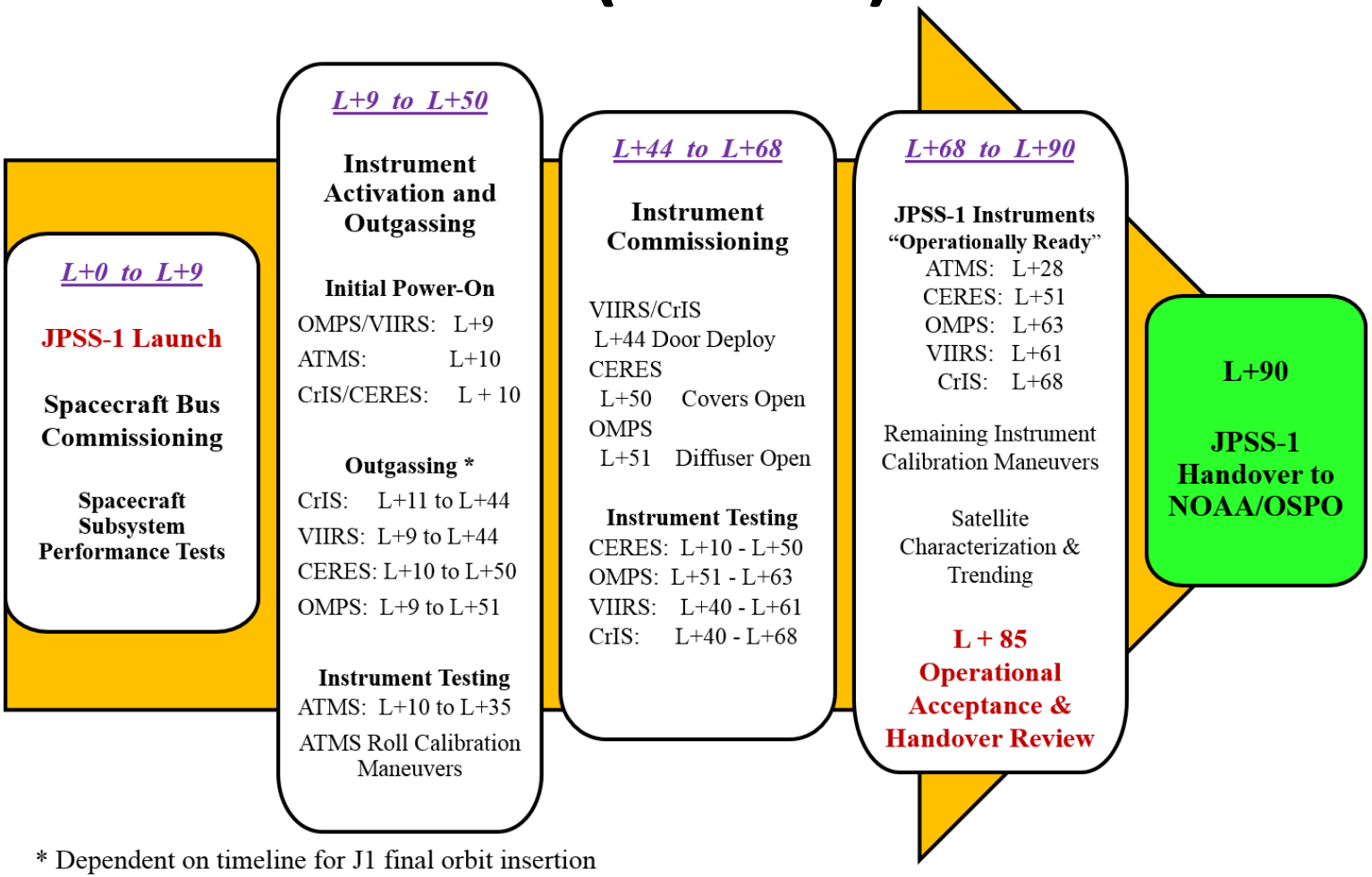
DBRTN Sites Providing Data

Name	Location
Honolulu Community College	Honolulu, HI
NOAA “Sandy Dog”	Gilmore Creek, AK
UW-Madison	Madison, WI
NOAA AOML	Miami, FL
Univ. Of Puerto Rico	Mayaguez, PR
NOAA Monterey	Monterey, CA
NOAA Guam	Guam, Marianas Islands
Oregon State Univ.	Corvallis, OR
Hampton Univ.	Hampton, VA
CREST/CCNY	New York City, NY

Product Level Maturity

- Beta Maturity = releasable, but not operational ready
- Provisional Maturity = Operationally available
- Validated Maturity

Launch, Early Orbit, & Anomaly Resolution (LEO&A) Phases



* Dependent on timeline for J1 final orbit insertion

Phase 1	Phase II A	Phase II B	Phase III

Summary

- The OSPO Direct Readout Program Manager is the NESDIS user services point of contact for GVAR, GRB, HRPT, and HRD users
- Notifications will be issued by the ESPC Help Desk after handover (when NESID OSPO assumes responsibility for satellite operations)
- Communications channels are open!

ESPC Notifications, Status, and Contacts

24/7 Help Desk	ESPCOperations@noaa.gov
ESPC Messages	http://www.ssd.noaa.gov/PS/SATS/messages.html
User Services	SPSD.UserServices@noaa.gov
Data Access	NESDIS.Data.Access@noaa.gov
Facebook	www.facebook.com/NOAANESDIS
Twitter	www.twitter.com/noaasatellites
Press releases	http://www.nesdis.noaa.gov/news_archives/
GOES Status	http://www.ospo.noaa.gov/Operations/GOES/status.html
GOES User Information and Documents	http://www.ospo.noaa.gov/Operations/GOES/documents.html
POES Status	http://www.ospo.noaa.gov/Operations/POES/status.html

Questions?