



**GOES-R Product Operations Science  
Support Team (POSST): *Planning and  
Implementing GOES-R System-level Cal/Val***

**NOAA Satellite Science Week**

Bob Iacovazzi, Jr.

GOES-R POSST Ops Manager (POM)

March 10, 2014



# Outline

- GOES-R Program Cal/Val:
  - Product Operations Science Support Team (POSST)
    - Partners
    - Mission, scope, and activity timeline
    - Synopsis
  - Cal/Val planning documents
  - Product validation maturity stages
  - Product validation timeline
- POSST Planning for GOES-R Cal/Val

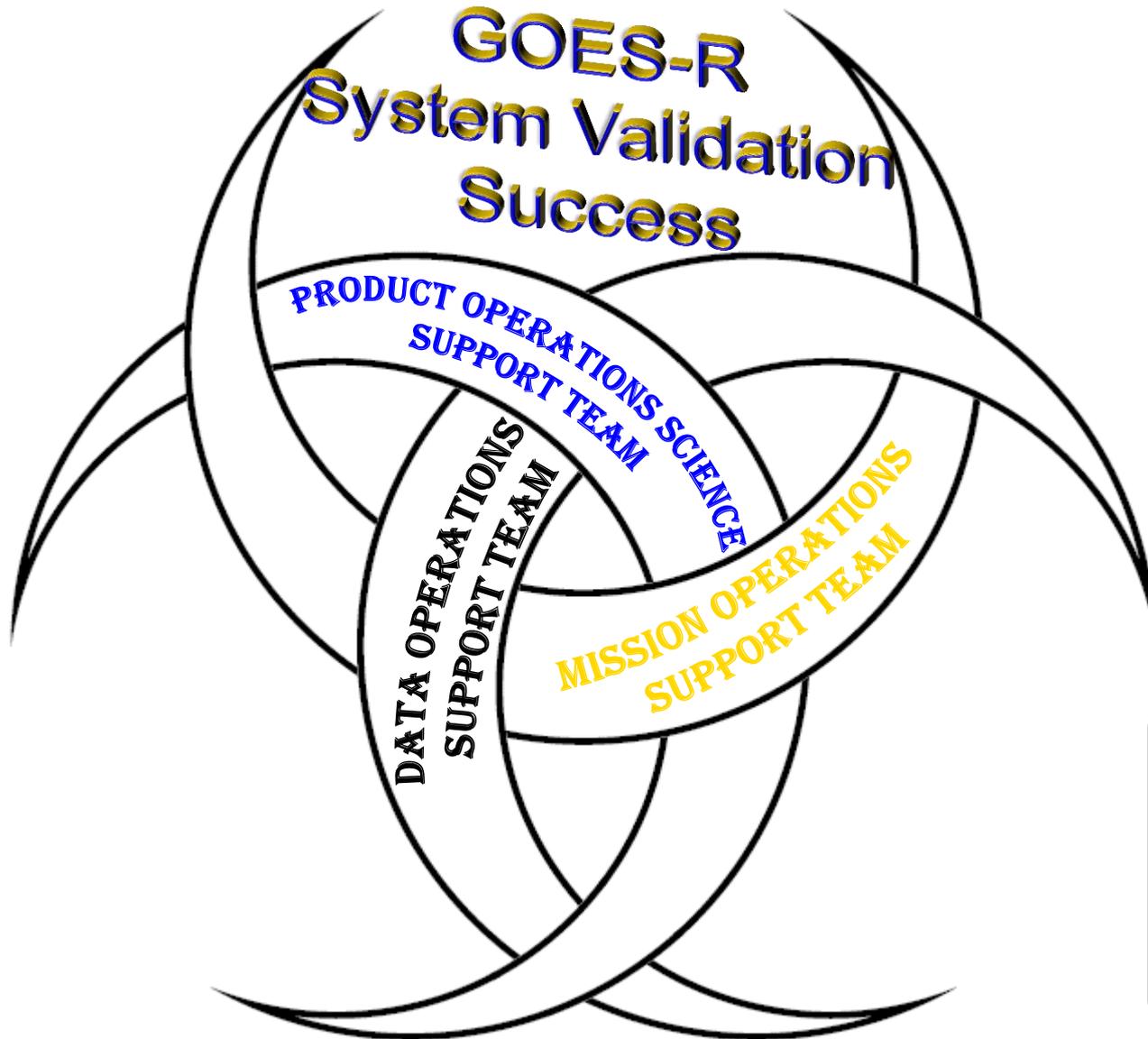


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# GOES-R System Validation Partners



- **Mission Operations Support Team (MOST)** – Flight segment certification with support from Flight Systems Engineering, and mission operations validation [*POC – Mission Operations Manager*]
- **Data Operations Support Team (DOST)** – Product generation, distribution, and monitoring operations validation [*POC- Data Operations Manager*]
- **Product Operations Science Support Team (POSST)** – Calibration, image navigation and registration (INR), and product science validation [*POC – POSST Operations Manager*]



# GOES-R POSST Mission Statement

- ***Achieve post-launch day-one cal/INR/product science (CIPS) validation readiness***
  - Define scope in relation to the MOST and DOST
  - Assure available, accessible, and functional routine and “deep-dive” monitoring and analysis resources
  - Define and rehearse operational processes
  - Clarify channels for collaboration with non-GOES-R partners (e.g., JPSS)
- ***Perform stakeholder and user-centered validation that meets their needs for GOES-R cal/val information***



# GOES-R POSST Scope

## POSST Validation:

- **Data output content from Mission Validation Test Data Set (MVT-DS) Input into GS Product Generation** [*Data Operations Testing*]
- **Instrument calibration performance** [*Post-launch Testing*]
- **GS cal/val product quality monitoring and analysis resources content and usability** [*Post-launch Product Testing*]
- **Product science performance to the maturity expected at Handover** [*Post-launch Product Testing*]

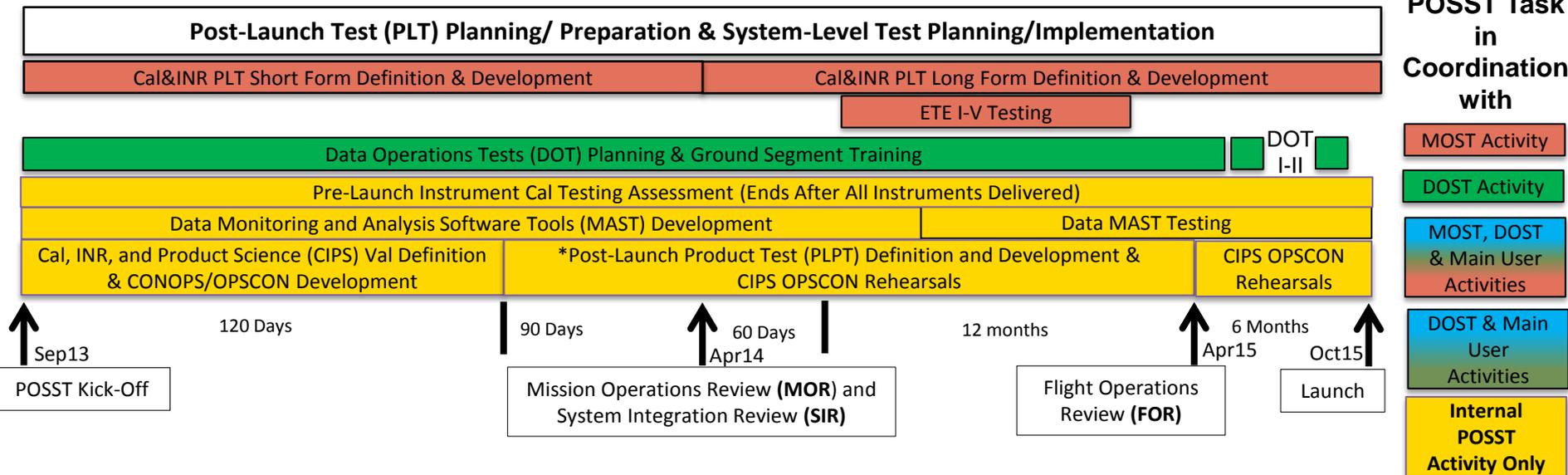
## POSST Handover to OSPO

- **Operational product monitoring, analysis, and anomaly resolution functions**
- **On-going product science performance validation effort**

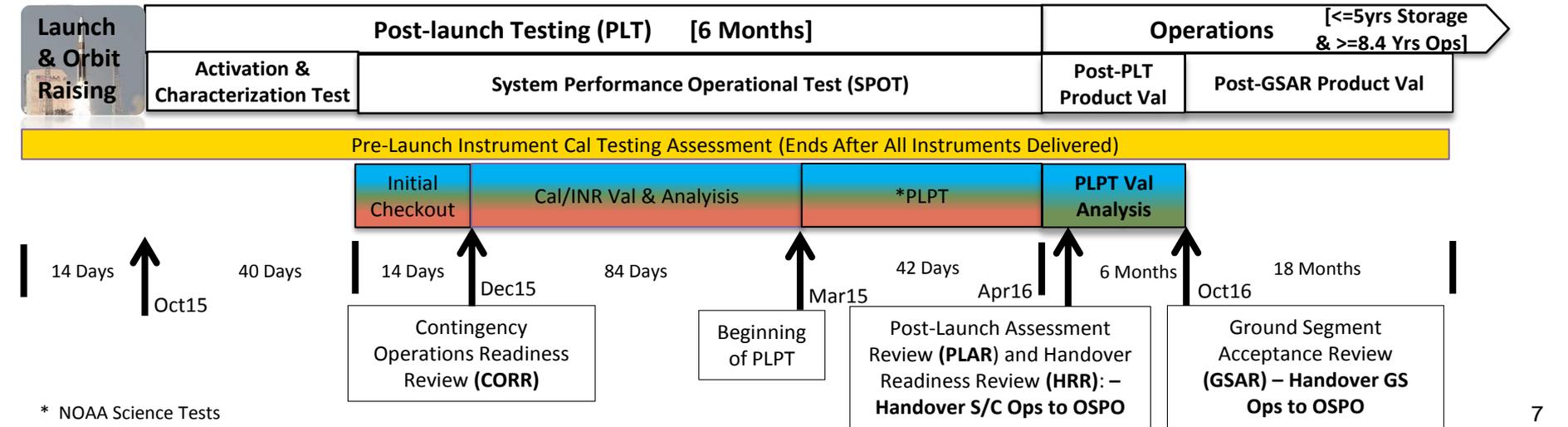


# GOES-R POSST Timeline

## GOES-R Series Pre-launch POSST Activities

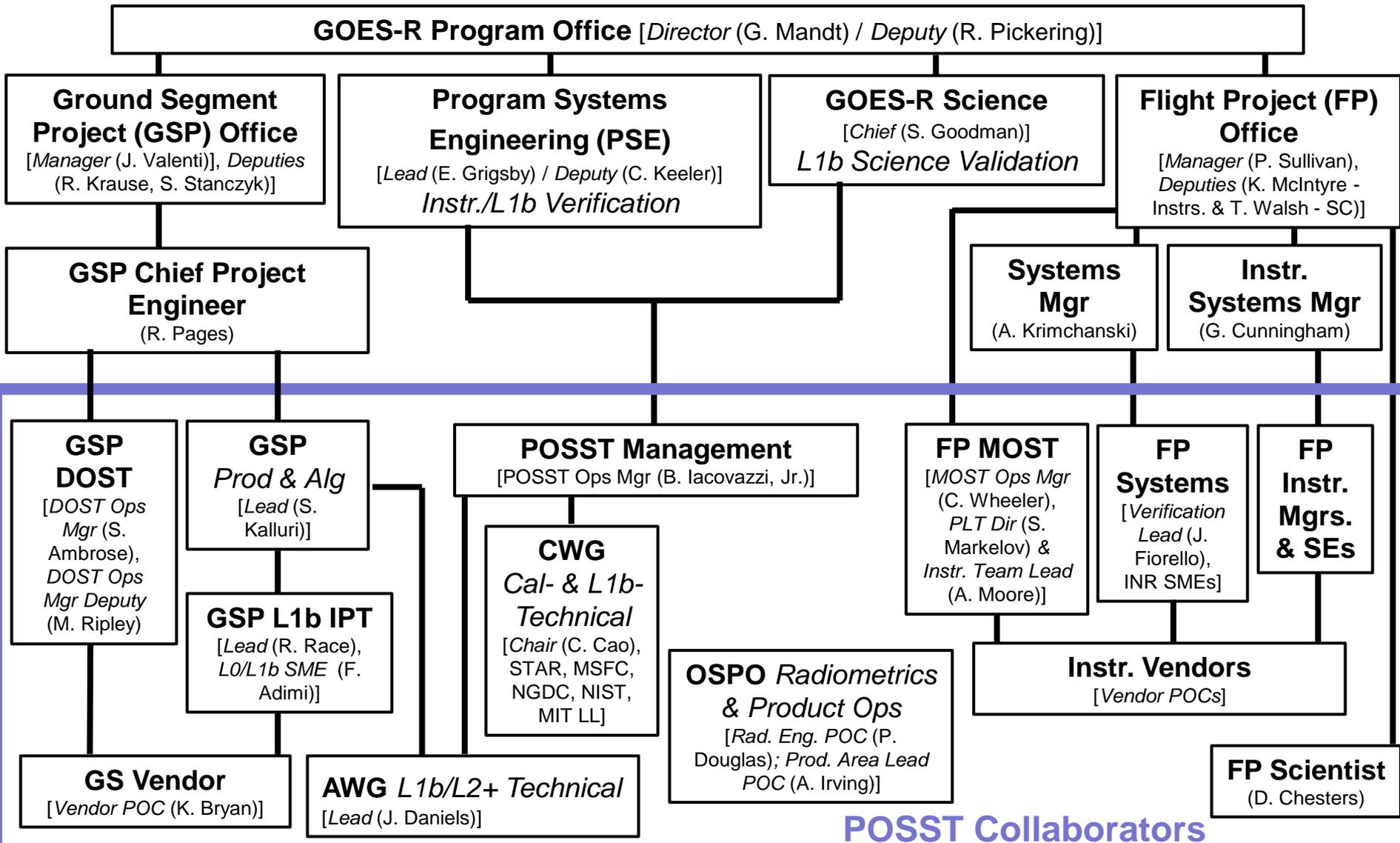


## GOES-R Series Post-launch POSST Activities





# GOES-R POSST Organizational Chart



POSST Collaborators



# GOES-R POSST Collaborator Responsibilities

Collaborator	Main Responsibilities	Cal	L1b Prod Val	L2+ Prod Val
<b>Flight Project (FP)</b>	Oversee SC/Instr. Design, Fabr., Integ., and Test Post-Launch INR V&V	✓	✓	
<b>SC/Instr Vendors</b>	SC/Instr. Design, Fabr., Integ., and Test	✓	✓	
<b>Ground Segment (GS) Project (GSP)</b>	Oversee GS Design, Fabr., Integ., and Test	✓	✓	✓
<b>GS Vendor</b>	GS Design, Fabr., Integ., and Test	✓	✓	✓
<b>Mission Ops Support Team (MOST)</b>	Gov't SC/Instr/GS-MM Test	✓	✓	✓
<b>Data Ops Support Team (DOST)</b>	Gov't GS-PG/PD Test	✓	✓	✓
<b>Cal Working Group (CWG)</b>	PSE Technical Support to GOES-R Instr. Cal, INR & L1b Val	✓	✓	✓
<b>Algorithm Working Group (AWG)</b>	L2+ Product Dev and V&V		✓	✓
<b>NESDIS Office of Satellite and Product Operations (OSPO)</b>	Ops Support to Cal/Val	✓	✓	✓



# POSST Val Teams Layout

## *External to GS*

## *GS*

**ABI Radiometrics Team (Lead: Changyong Cao)** – STAR+Coop. Institutes & MIT-LL (FLT, GSP, ABI Vendor & NWS Support)

**ABI/GLM INR Team (Co-Leads: Tim Schmit and Dennis Buechler)** - STAR+Coop Institutes, MSFC, & MIT-LL (FLT, GSP, NWS & ABI/GLM Vendors Support)

**Space Weather Products Team (Lead: Bill Denig)** – NGDC & MIT-LL (FLT, GSP, NWS, and Sp. Wx. Instr. Vendors Support)

**L2+ Product Teams\* (Lead: Jaime Daniels)** - STAR+Coop. Insts. & MSFC (FLT, GSP, & NWS Support)

STAR (OSPO, MOST, DOST & ABI and GS Vendors Support)

POSST (OSPO, MOST, DOST & ABI/GLM and GS Vendors Support)

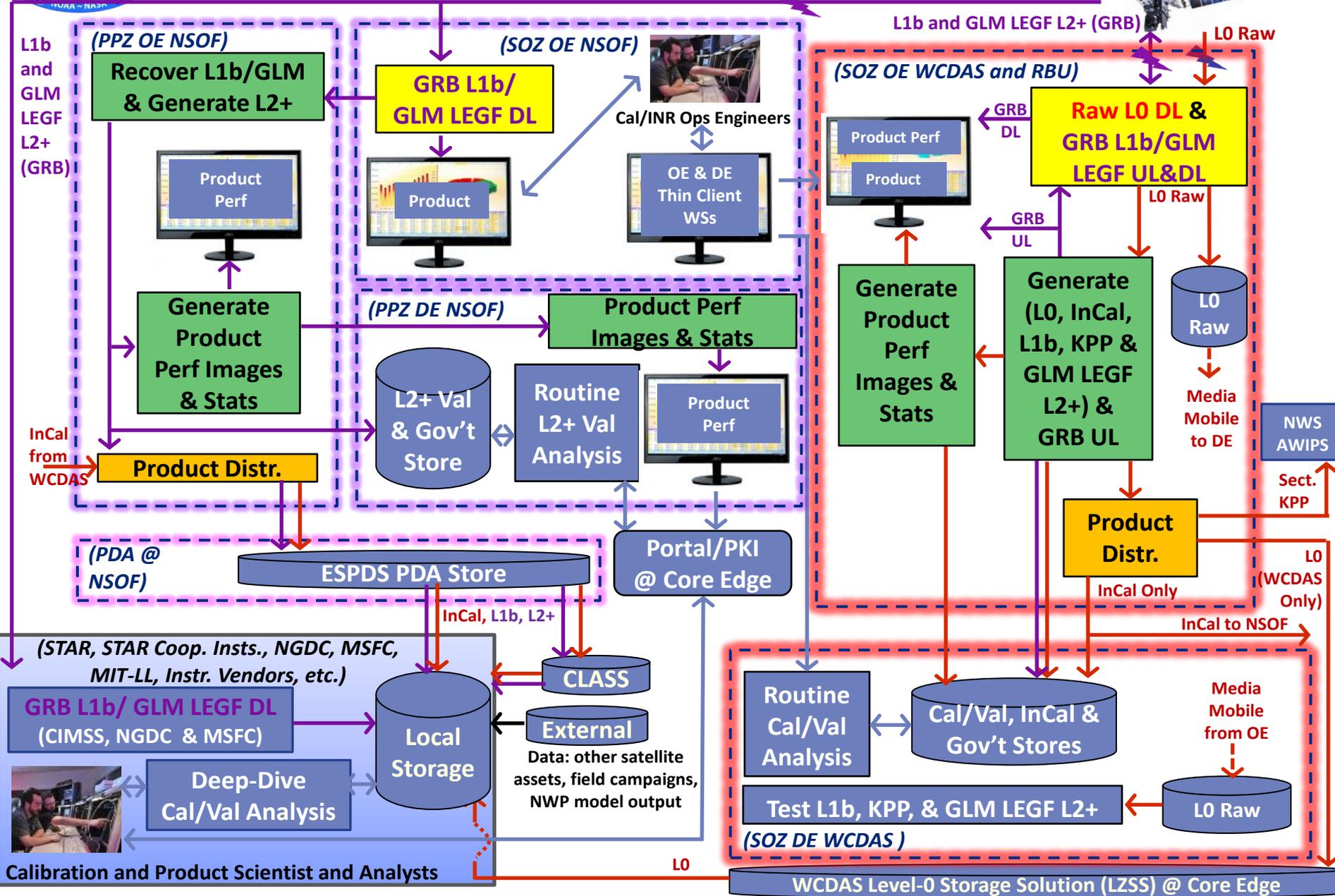
NGDC (MOST, DOST & Sp. Wx. Instr. and GS Vendors Support)

MSFC (OSPO, MOST, DOST & ABI/GLM and GS Instr. Vendors Support)

\*Teams based on product areas listed in Cal/Val Plan Volume 2

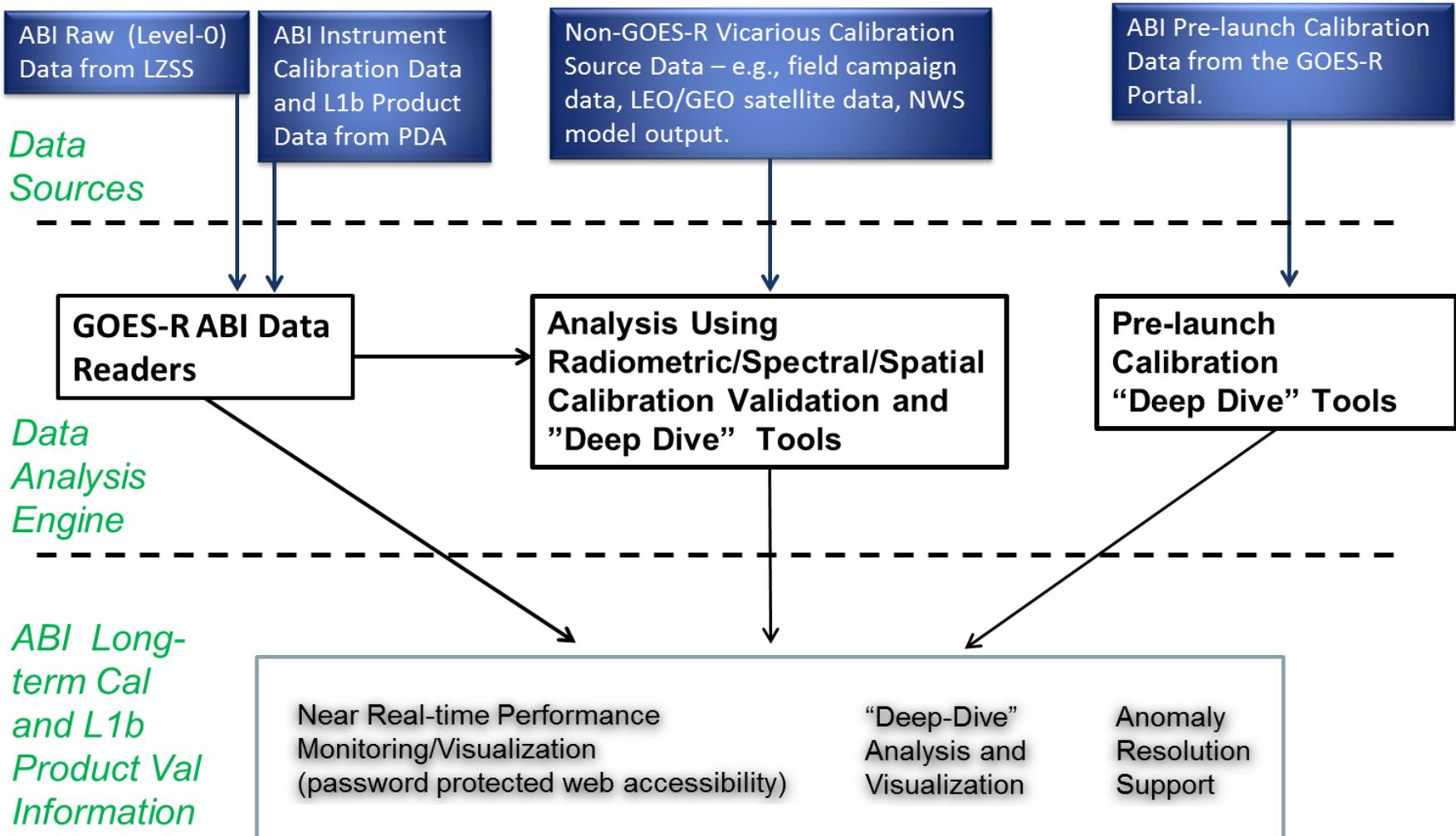


# GOES-R Cal/Val Data Generation, Distribution and Storage; Monitoring; and Analysis Capabilities





# Data Monitoring and Analysis Software Tools (MAST)





# GOES-R Program Cal/Val Documents

## Calibration and Product Validation Strategy



GOES-R Series Calibration and Product Validation Strategy

July 2012

Scope, Organizations & Working Groups, Roles & Responsibilities, and Schedules

## Cal/Val Plan Vol. 1 (L1b Data) & Vol. 2 (L2+ Product Val)



GOES-R Series Calibration/Validation Plan Volume 1: Level 1b Data

July 2012



U.S. Department of Commerce  
National Oceanic and Atmospheric Administration (NOAA)  
NOAA Environmental Satellite, Data, and Information Service (NESDIS)  
National Aeronautics and Space Administration (NASA)

Cal/Val Methods and Processes

GOES-R Series Calibration/Validation Plan Volume 2: Level 2+ Product Validation

May 2012



U.S. Department of Commerce (DOC)  
National Oceanic and Atmospheric Administration (NOAA)  
NOAA Environmental Satellite, Data, and Information Service (NESDIS)  
National Aeronautics and Space Administration (NASA)

## Cal/Val CONOPS & OPSCON



GOES-R Series System-Level Calibration and Product Measurement Validation Concept of Operations (CONOPS) and Operational Concepts (OPSCON)

September 2013

Capabilities, Functions, Resources and Operational Processes and Procedures

All documents at CDR-level, except for the Cal/Val CONOPS and OPSCON document (under development).



# GOES-R Product Validation

## Maturity Definitions Foundation

- The primary function of GOES-R product validation is to provide data and information to GOES-R Stakeholders regarding product performance relative to validation standards – e.g., in-situ data, other satellite measurements, etc.
- GOES-R validation does not fully judge product fitness-for-purpose, whether it be for operations or research. Stakeholders assess product fitness-for-purpose.
- GOES-R product validation efforts do not drive the algorithm change process, although it could provide important information needed for that process. So graduation through validation stages is not necessarily precluded by algorithm changes.
- For each GOES-R Product and for each product validation stage:
  - Document the scope of testing (type of measurement, geographical extent, temporal extent, etc.), analyses, and reporting to be completed.
  - Document product anomalies found during the validation process, and any resolution recommendations.
  - Clearly state the overall maturity level of validation, and its usefulness to a Stakeholder in judging product fitness-for-purpose.
- Ultimately need to associate validation stages with GOES-R transition and handover events.



# Proposed GOES-R Product (L1b and L2+) Validation Maturity Stages (Nominal Mission)

## 1. Beta

### • Activities

- Early release of product. (e.g., At-launch version of the product algorithm and its input parameter is initially used to generate the product)
- Initial calibration applied. (L1b)
- Rapid changes in product input tables can be expected. Some changes to product algorithms may be needed.
- Product quick looks and initial comparisons with ground truth data are performed.
- Anomalies may be found in the product, but thorough analysis may not be performed.
- Products are made available to users to gain familiarity with data formats and parameters.

### • End state

- Product is minimally validated, and may still contain significant identified and unidentified errors.
- Information/data from validation efforts can be used to make qualitative, but not quantitative, assessments regarding product fitness-for-purpose.
- Clear documentation of product performance exists that includes known product anomalies.

## 2. Provisional

### • Activities

- Validation and quality assurance (QA) activities are ongoing by the Government, and the general research community is now encouraged to participate.
- High severity algorithm anomalies are identified and analyzed, and lesser severity anomalies have been identified.
- Users are engaged and user feedback is assessed.

### • End state

- Product performance (L1b or L2+) is demonstrated through analysis of a small number of independent measurements obtained from selected locations, periods, and associated ground-truth/field program efforts.
- Product analysis are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose.
- Clear documentation of product performance exists that includes known product anomalies and recommended remediation strategies for high severity anomalies and weaknesses. Testing has been fully documented.

## 3. Comprehensive

### • Activities

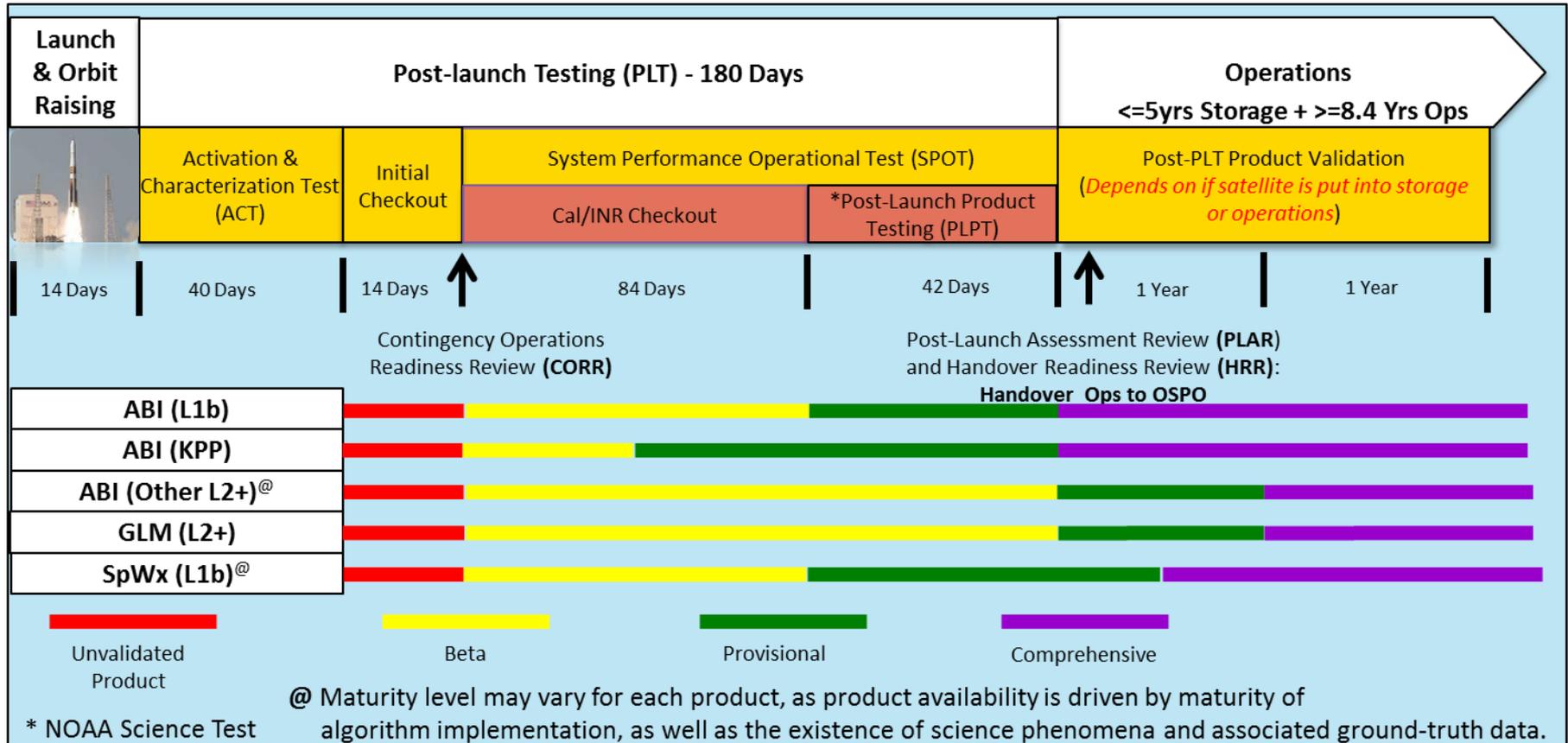
- Validation, QA, and anomaly resolution activities are ongoing by the Government and the general research community.
- Algorithm anomalies of all severities are identified and analyzed.
- Users are engaged and user feedback is assessed.

### • End state

- Product performance for all products is defined and documented over a wide range of representative conditions via numerous and ongoing ground-truth and validation efforts.
- Clear documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies, regardless of severity level.
- Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.
- Testing has been fully documented.



# GOES-R Post-Launch Product Validation Stages (Nominal Timeline)



- Beginning of each color represents when product enters a given validation stage.



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# POSST Planning for GOES-R Cal/Val

Activity	Status
System Integration Review (SIR) and Mission Operations Review (MOR) support	<ul style="list-style-type: none"> <li>• MOR agenda is completed</li> <li>• MOR success criteria have been flowed to POSST roles, responsibilities and activities</li> </ul>
GOES-R System-level Cal and Product Measurement Val CONOPS/ OPSCON finalization	Preparing a post-Handover operational concept to be added to the document
Cal/INR/Product Science (CIPS) Monitoring and Analysis Software Tool (MAST) planning, development, implementation, and testing	<ul style="list-style-type: none"> <li>• A MAST Manager (Dave Pogorzala) has been brought aboard to the POSST</li> <li>• He now has a provisional list of tool development expectations</li> </ul>
Defining CIPS-related external data operations validation objectives (EDOVOs)	<ul style="list-style-type: none"> <li>• Most EDOVOs have been written for the Calibration Working Group (CWG)</li> <li>• Algorithm Working Group (AWG) is developing EDOVOs</li> </ul>
Creating a CIPS post-launch test (PLT) suite	Cal and INR related Post-Launch Tests have been drafted and are being considered by the Mission Operations Support Team (MOST)
Ground Segment training coordination	The first round of feedback has been given to the GOES-R training lead regarding what types of courses that may be needed by POSST members.
PLT validation field campaign planning and coordination	See next slide from Steve Goodman.



# Cal/Val Support from Program Science Office

- Legacy Atmospheric Profiles
  - GPS Met TPW Validation (Seth Gutman)
  - NAST-I (Allen Larar)- deferred to PLT ER2 deployment
- GLM Lightning Detection
  - Lightning network data for sustaining cal/val
  - Airborne GLM Simulator (ER2/Global Hawk) in development
  - CHUVA -GPM Campaign in Brazil 2011-2012 cross-comparisons
  - WMO-HyMex 2012 (field campaign support for VSP)
- Aerosols, Clouds
  - DSCOVER field campaign (S. Kundragunta/Russ Dickerson) airborne spectral measurements
  - Aerosol, Cloud, Surface Radiation and Sounding instrumentation (Feltz/Pierce), eg, DC3 field campaign
- Radiation
  - Surfrad upgrades, portable system (Jos. Michalsky/Ellsworth Dutton)
- L1B Radiances-Sonora Desert AVIRIS Campaign (UMCP GRA Scott Ozog)



# Summary

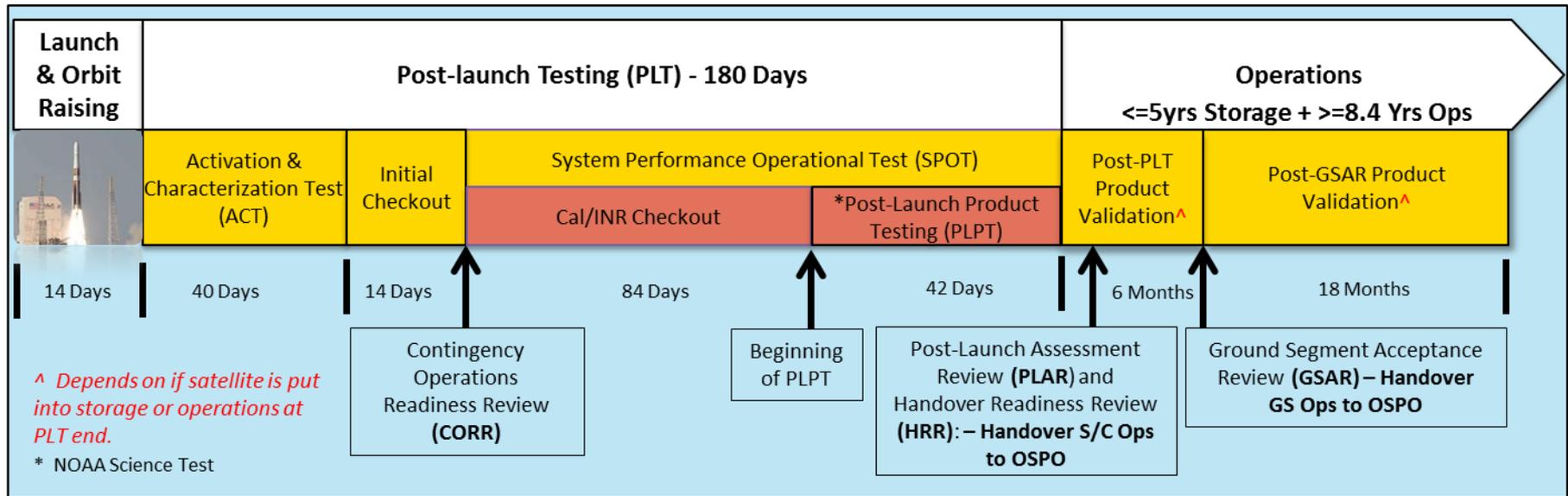
- The GOES-R POSST has been created to coordinate and manage all GOES-R system-level cal/val efforts.
- The GOES-R POSST has a comprehensive cal/val program to ensure product integrity
  - Cal/Val Strategy
  - Cal/Val Plans
  - Cal/Val CONOPS&OPSCON
- The GOES-R POSST is leveraging diverse complementary technical capabilities and resources
- The GOES-R POSST provides pre- and post-launch cal/val support for a successful GOES-R program



# Back-Up Charts



# GOES-R Post-Launch Cal, INR and Product Science Validation Stages





# Estimated Product Validation Stage @ CORR

L1b Products inside oval



Radiances*	3	○	Cloud and Moisture Imagery (KPP)	1	○
Solar Imagery: X-ray*	3	○	Rainfall Rate / QPE	10	○
Energetic Heavy Ions*	3	○	Legacy Vertical Moisture Profile	4	○
Magnetospheric Electrons and Protons: Low Energy*	3	○	Legacy Vertical Temperature Profile	4	○
Magnetospheric Electrons and Protons: Medium and High Energy*	3	○	Derived Stability Indices	4	○
Solar and Galactic Protons*	3	○	Total Precipitable Water	4	○
Geomagnetic Field*	3	○	Clear Sky Masks	4	○
Solar Flux: EUV*	3	○	Downward Shortwave Rad.: Surface	4	○
Solar Flux: X-Ray*	3	○	Fire / Hot Spot Characterization	4	○
Lightning Det: Events, Groups, Flashes	10	○	Land Surface (Skin) Temperature	4	○
Aerosol Detection (including Smoke & Dust)	4	○	Sea Surface Temperature (skin)	4	○
Aerosol Optical Depth	4	○	Reflected Shortwave Rad.: TOA	4	○
Volcanic Ash: Detection & Height	N/A	○	Snow Cover	10	○
Cloud Optical Depth	4	○	Derived Motion Winds	4	○
Cloud Particle Size Distribution	4	○	Hurricane Intensity	N/A	○
Cloud Top Phase	4	○	Cloud Top Pressure	4	○
Cloud Top Height	4	○	Cloud Top Temperature	4	○

L2+ Products are remainder outside of oval

## Product Validation State\*

- UNVALIDATED
- BETA
- PROVISIONAL
- COMPREHENSIVE

ABI	GLM
SEISS	EXIS
SUVI	Magnetometer

\* Included in GRB

\*Numbers in chart indicate the projected number of months to end of that validation state.



# Estimated Product Validation Stage @ PLPT Start

L1b Products inside oval



Radiances*	1	PROVISIONAL	Cloud and Moisture Imagery (KPP)	1	PROVISIONAL
Solar Imagery: X-ray*	1	UNVALIDATED	Rainfall Rate / QPE	7	BETA
Energetic Heavy Ions*	7	PROVISIONAL	Legacy Vertical Moisture Profile	1	BETA
Magnetospheric Electrons and Protons: Low Energy*	7	PROVISIONAL	Legacy Vertical Temperature Profile	1	BETA
Magnetospheric Electrons and Protons: Medium and High Energy*	7	PROVISIONAL	Derived Stability Indices	1	BETA
Solar and Galactic Protons*	7	PROVISIONAL	Total Precipitable Water	1	BETA
Geomagnetic Field*	7	PROVISIONAL	Clear Sky Masks	1	BETA
Solar Flux: EUV*	7	PROVISIONAL	Downward Shortwave Rad.: Surface	1	BETA
Solar Flux: X-Ray*	7	PROVISIONAL	Fire / Hot Spot Characterization	1	BETA
Lightning Det: Events, Groups, Flashes*	7	BETA	Land Surface (Skin) Temperature	1	BETA
Aerosol Detection (including Smoke & Dust)	1	BETA	Sea Surface Temperature (skin)	1	BETA
Aerosol Optical Depth	1	BETA	Reflected Shortwave Rad.: TOA	1	BETA
Volcanic Ash: Detection & Height	N/A	UNVALIDATED	Snow Cover	7	BETA
Cloud Optical Depth	1	BETA	Derived Motion Winds	1	BETA
Cloud Particle Size Distribution	1	BETA	Hurricane Intensity	N/A	UNVALIDATED
Cloud Top Phase	1	BETA	Cloud Top Pressure	1	BETA
Cloud Top Height	1	BETA	Cloud Top Temperature	1	BETA

L2+ Products are remainder outside of oval

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ABI	GLM
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\*Numbers in chart indicate the projected number of months to end of that validation state.



# Estimated Product Validation Stage @ PLAR/HRR<sup>^</sup>

L1b Products inside oval



L2+ Products are remainder outside of oval

Radiances*	TBD	Cloud and Moisture Imagery (KPP)	TBD
Solar Imagery: X-ray*	5	Rainfall Rate / QPE	5
Energetic Heavy Ions*	5	Legacy Vertical Moisture Profile	11
Magnetospheric Electrons and Protons: Low Energy*	5	Legacy Vertical Temperature Profile	11
Magnetospheric Electrons and Protons: Medium and High Energy*	5	Derived Stability Indices	11
Solar and Galactic Protons*	5	Total Precipitable Water	11
Geomagnetic Field*	5	Clear Sky Masks	11
Solar Flux: EUV*	5	Downward Shortwave Rad.: Surface	11
Solar Flux: X-Ray*	5	Fire / Hot Spot Characterization	11
Lightning Det: Events, Groups, Flashes*	5	Land Surface (Skin) Temperature	11
Aerosol Detection (including Smoke & Dust)	11	Sea Surface Temperature (skin)	11
Aerosol Optical Depth	11	Reflected Shortwave Rad.: TOA	11
Volcanic Ash: Detection & Height	N/A	Snow Cover	5
Cloud Optical Depth	11	Derived Motion Winds	11
Cloud Particle Size Distribution	11	Hurricane Intensity	N/A
Cloud Top Phase	11	Cloud Top Pressure	11
Cloud Top Height	11	Cloud Top Temperature	11

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ABI	GLM
SEISS	EXIS
SUVI	Magnetometer

\* Included in GRB

<sup>^</sup>Depends on if satellite is put into storage or operations at PLT end.

\*Numbers in chart indicate the projected number of months to end of that validation state.



# Estimated Product Validation Stage @ GSAR<sup>^</sup>

L1b Products inside oval



Radiances*	TBD	Cloud and Moisture Imagery (KPP)	TBD
Solar Imagery: X-ray*	TBD	Rainfall Rate / QPE	12
Energetic Heavy Ions*	TBD	Legacy Vertical Moisture Profile	6
Magnetospheric Electrons and Protons: Low Energy*	TBD	Legacy Vertical Temperature Profile	6
Magnetospheric Electrons and Protons: Medium and High Energy*	TBD	Derived Stability Indices	6
Solar and Galactic Protons*	TBD	Total Precipitable Water	6
Geomagnetic Field*	TBD	Clear Sky Masks	6
Solar Flux: EUV*	TBD	Downward Shortwave Rad.: Surface	6
Solar Flux: X-Ray*	TBD	Fire / Hot Spot Characterization	6
Lightning Det: Events, Groups, Flashes	12	Land Surface (Skin) Temperature	6
Aerosol Detection (including Smoke & Dust)	6	Sea Surface Temperature (skin)	6
Aerosol Optical Depth	6	Reflected Shortwave Rad.: TOA	6
Volcanic Ash: Detection & Height	N/A	Snow Cover	12
Cloud Optical Depth	6	Derived Motion Winds	6
Cloud Particle Size Distribution	6	Hurricane Intensity	N/A
Cloud Top Phase	6	Cloud Top Pressure	6
Cloud Top Height	6	Cloud Top Temperature	6

L2+ Products are remainder outside of oval

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