



# GOES-T and -U Post-Launch Product Testing Plans and Lessons Learned from GOES-R and -S

Katherine Pitts<sup>1</sup>, Elizabeth Kline<sup>2</sup>, Jon Fulbright<sup>3</sup>, Matthew Seybold<sup>4</sup>

<sup>1</sup>Science & Technology Corporation, <sup>2</sup>NOAA/NESDIS/GOES-R, <sup>3</sup>Arctic Slope Technical Services, Inc., <sup>4</sup>NOAA/NESDIS/OSPO/SPSD

katherine.pitts@noaa.gov

GOES-16 ABI GeoColor  
Image credit: NOAA/CIRA

## Readiness, Implementation and Management Plans

## RIMPs

The Readiness, Implementation, and Management Plans (RIMPs) have been created to document information about the Post-Launch Product Tests (PLPTs):

- Analysis techniques
- Methodology
- Test duration
- Tools
- Data needs
- Resources
- Staffing
- Schedule

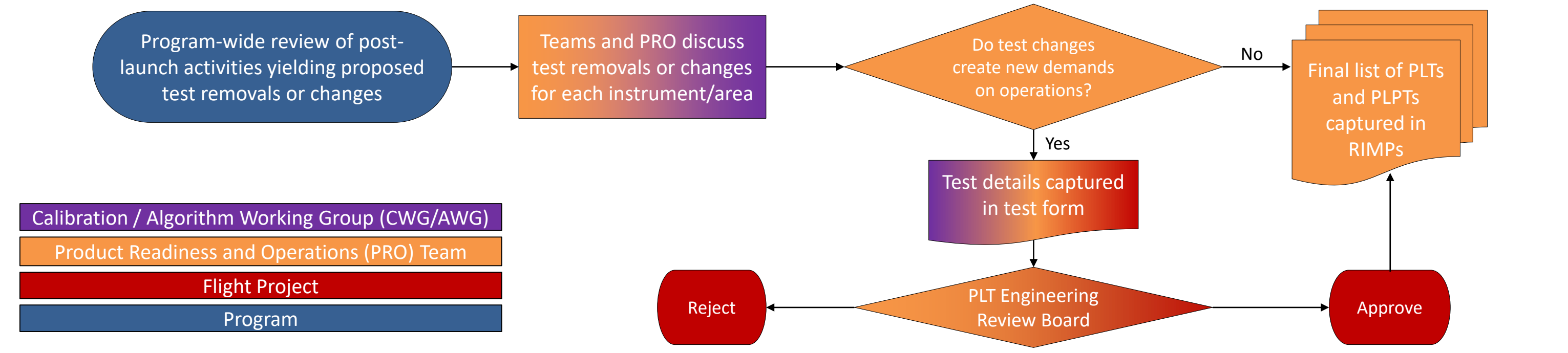
RIMPs are primarily used by the calibration and validation (cal/val) science teams to:

- Prepare for Launch
- Demonstrate how a product will achieve each product maturity level

GOES-R Program uses RIMPs to prepare for cal/val activities:

- Ensure Post-Launch Tests (PLTs) and PLPTs are necessary and sufficient to demonstrate on-orbit performance
- Understand science teams' data and resource needs

Using the experiences and lessons learned from the cal/val efforts for GOES-R and GOES-S, the RIMP for each product is in the process of being updated in preparation for GOES-T and GOES-U:



## GOES-R Program Product Maturity Levels

Science product maturity is assessed at Peer Stakeholder Product Validation Reviews (PS-PVRs). The three levels of maturity are Beta, Provisional, and Full, and each level indicates an increase in confidence and knowledge in the products. The status of the product is measured against Program definitions that are used throughout NOAA satellite missions.

**Beta Validation**

- Initial calibration applied
- Anomalies may be found in the product and the resolution strategy may not exist
- Product is made available to users to gain familiarity with data formats and parameters (via GOES Rebroadcast [GRB])
- Product has been minimally validated and may still contain significant errors
- **Product is not optimized for operational use**

**Provisional Validation**

- Validation activities are ongoing and the general research community is now encouraged to participate
- Severe algorithm anomalies are identified and under analysis. Solutions are in development and testing.
- Product analyses are sufficient to communicate product performance to users relative to expectations (on-orbit predicted performance)
- **Product is ready for operational use and for use in comprehensive cal/val activities and product optimization**

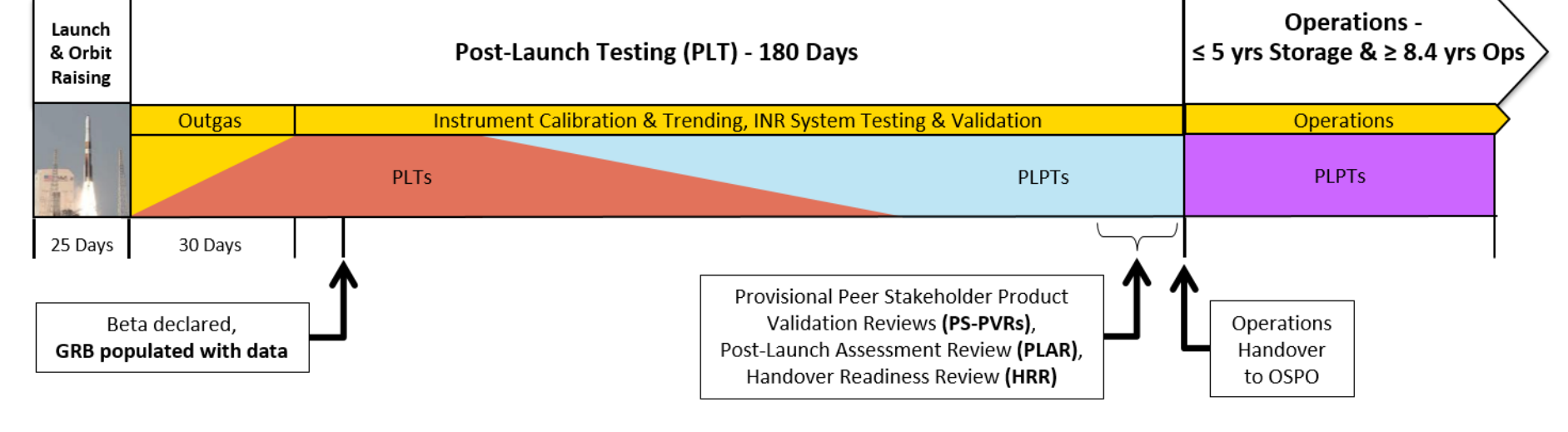
**Full Validation**

- Validation, quality assurance, and anomaly resolution activities are ongoing
- Product performance is documented over a wide range of representative conditions via ongoing ground-truth and validation efforts
- All known product anomalies are resolved and/or documented and shared with the user community
- **The product remains fit for operational use, but with a higher level of confidence in accuracy and precision**

Even though this maturity level is titled "Provisional", it is acceptable to use for research publications. At any maturity level, be aware of the caveats, which are described in the READMEs.

Check out all of the PS-PVR artifacts! GOES-16 and GOES-17 PS-PVR documents are all hosted on NOAA OSPO's NOAAASIS website. README documents list caveats and remaining algorithm issues.

## GOES-R Series Post-Launch Science Product Validation Schedule



A key milestone of the PLPT period is reaching Provisional maturity, at which point the products are considered ready for operational use and the real-time data are distributed through Product Distribution and Access (PDA) to all subscribing end users. The data are also archived at Comprehensive Large Array-data Stewardship System (CLASS) and publicly available from Beta maturity onward.

**Launch and Initial Activities**

- Orbit raising to 89.5° West
- Outgassing
- Instrument activation
- Internal data flow begins

**Flight/Vendor Post-Launch Tests (PLTs)**

Flight Project and instrument vendors work to perform the initial assessments. CWG involved with cal/val-related tests.

Some PLTs require special instrument modes

Data flow internal to Flight, vendor, and cal/val teams

**Post-Launch Product Tests (PLPTs)**

- Level 1b Tests Performed by the CWG
- Level 2+ Tests Performed by the AWG
- Receive feedback from Stakeholders, User Community, Product Working Group, etc.
- PS-PVR for L1b Provisional Validation
- Ends with Handover of Satellite to NOAA's Office of Satellite and Product Operations (OSPO)

**Operations**

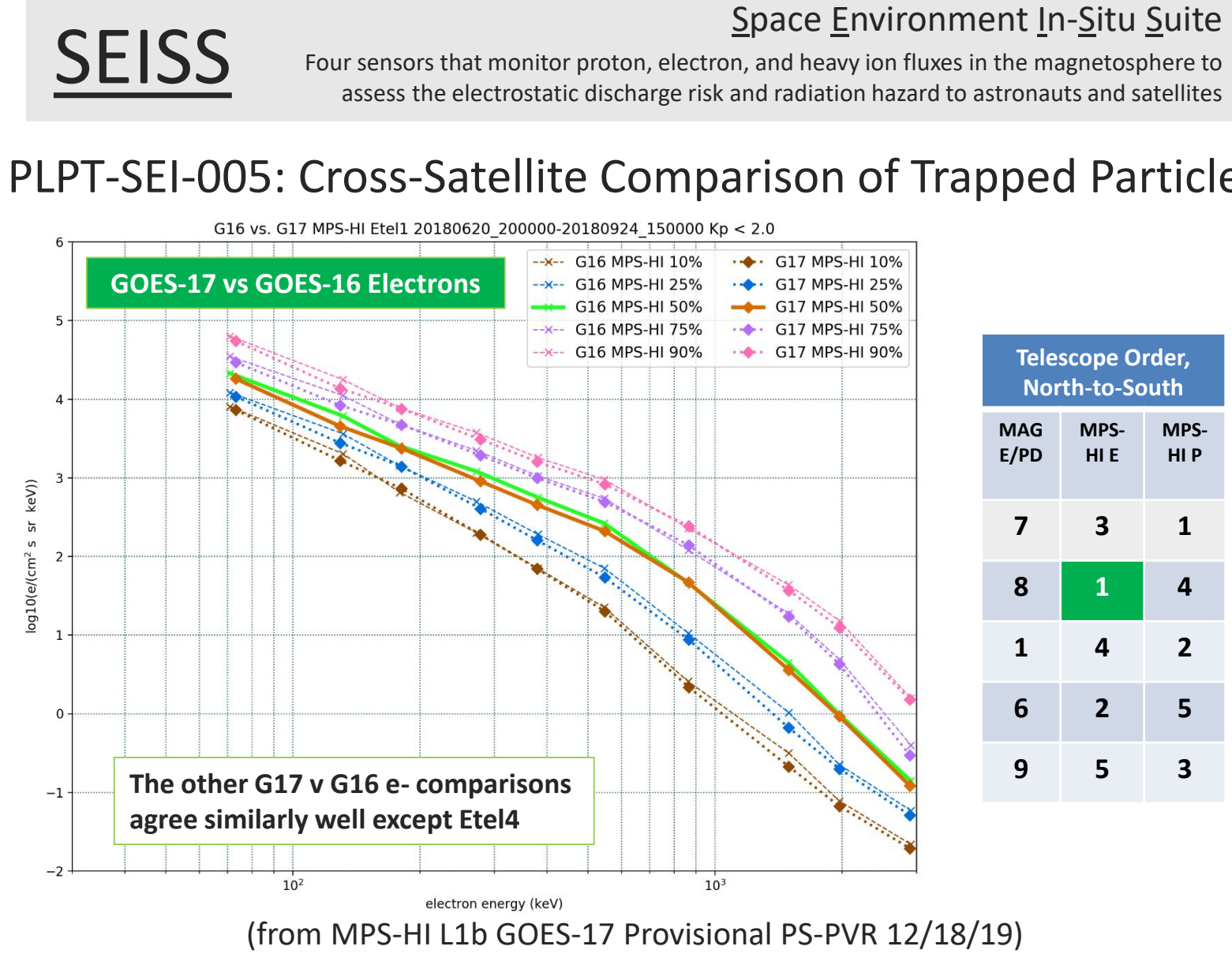
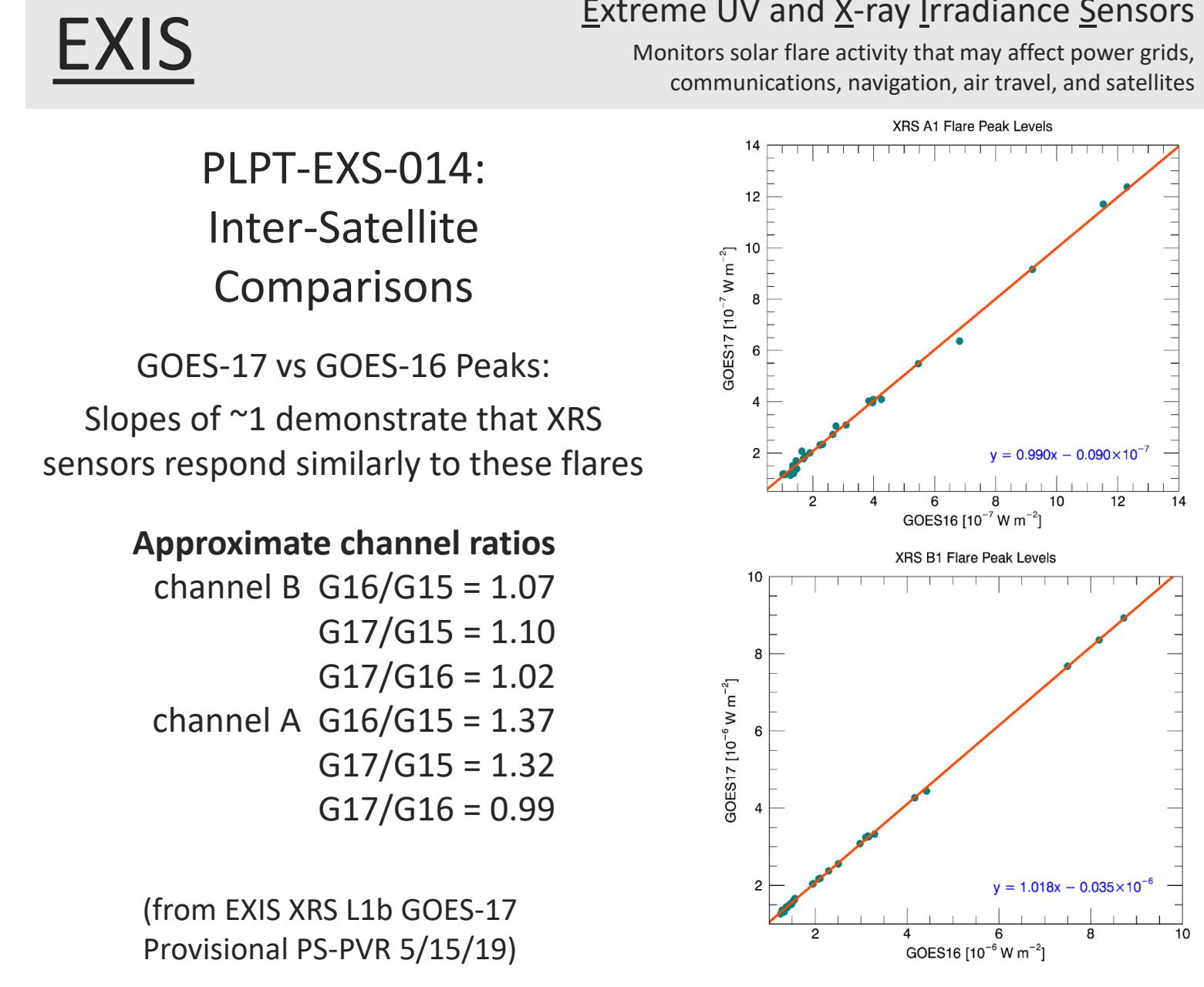
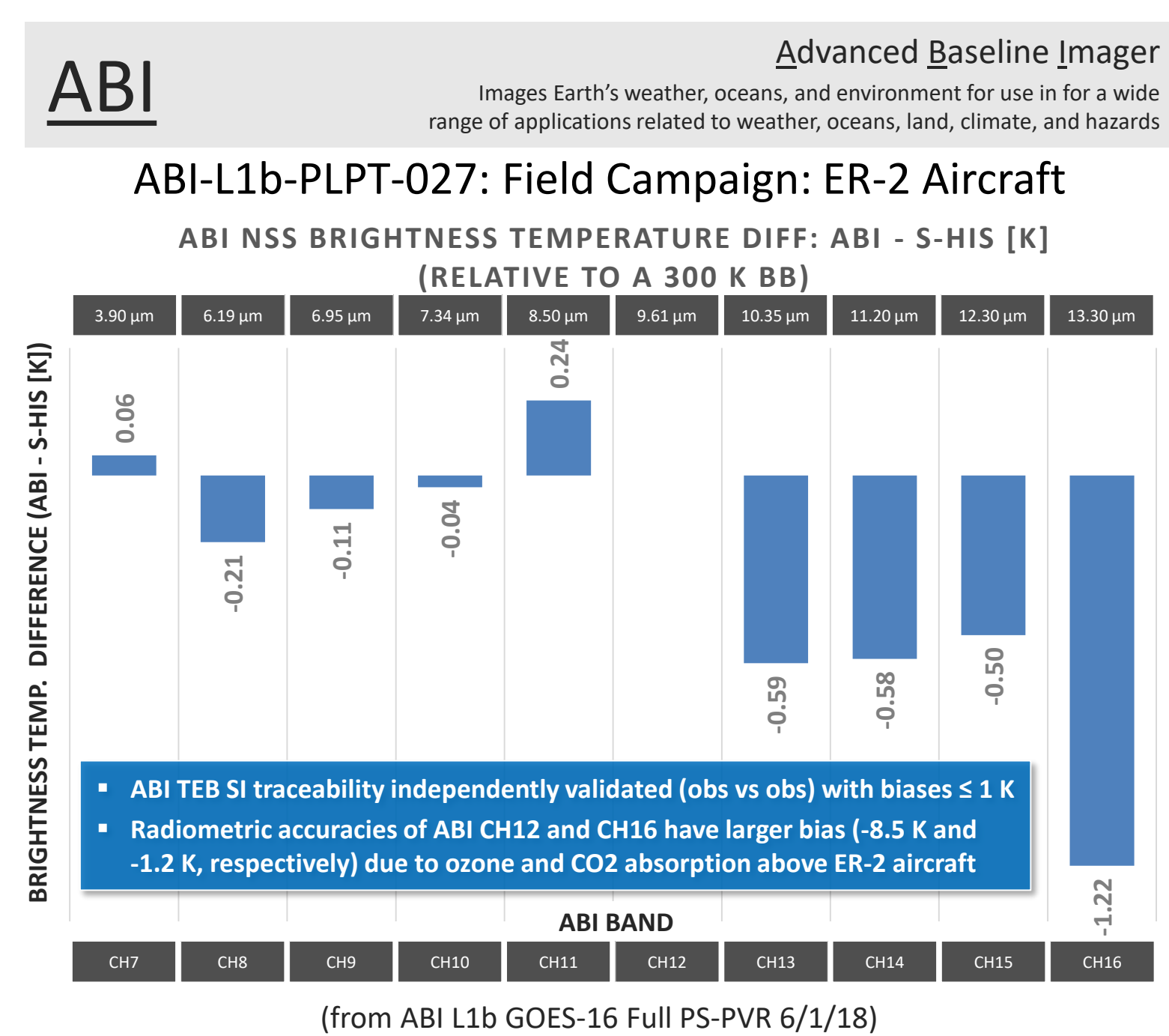
- Handover + 6 Months: PS-PVR for L2+ Provisional Validation
- Handover + 12 Months: PS-PVR for L1b Full Validation
- Handover + 18 Months: PS-PVR for L2+ Full Validation

Example PLPT results from PS-PVR artifacts

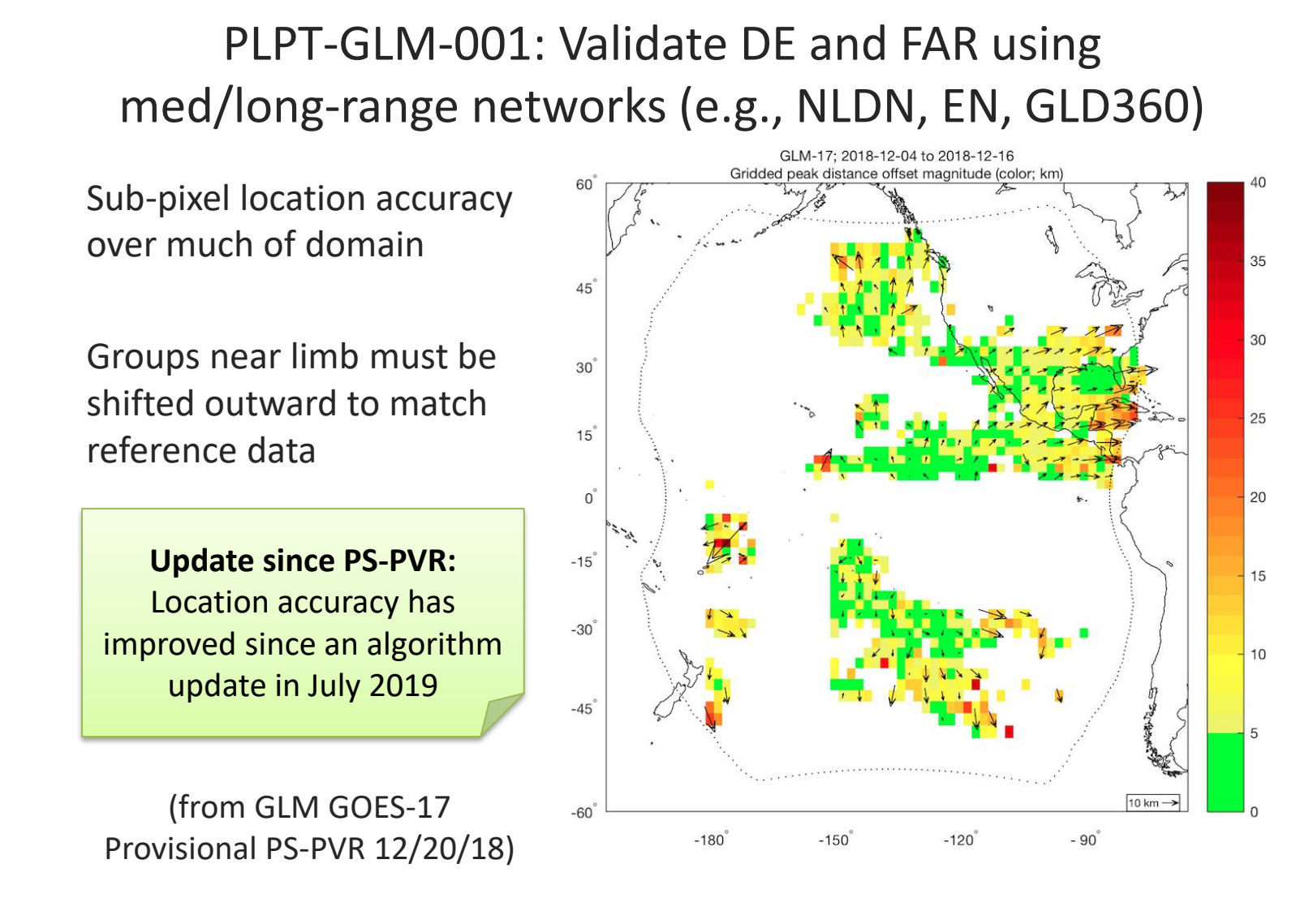
## Post-Launch Product Tests

GOES-R Series data products need to pass through a series of calibration and validation tests with the results showing that the instruments and products have achieved each level of maturity defined by the Program.

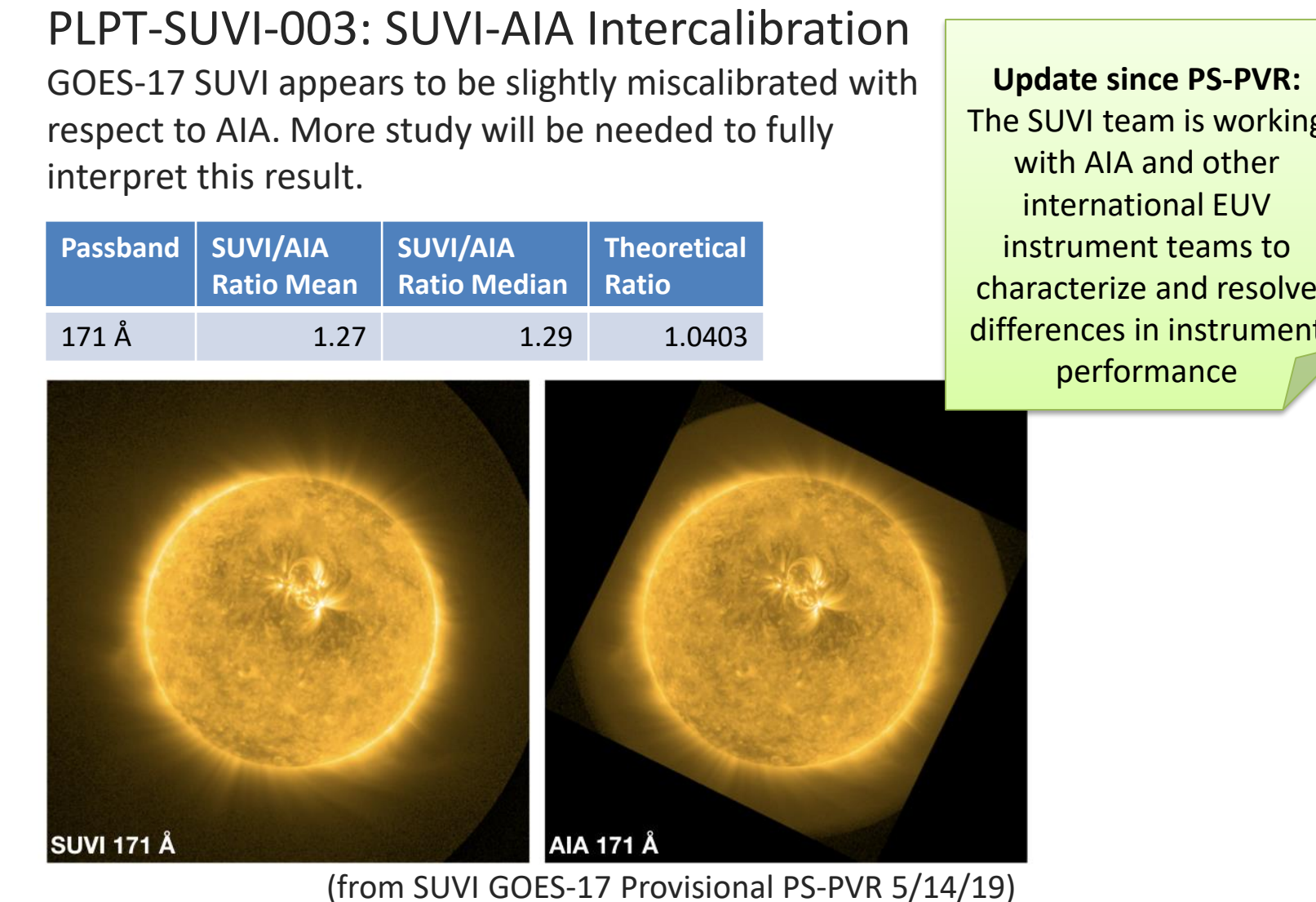
## PLPTs



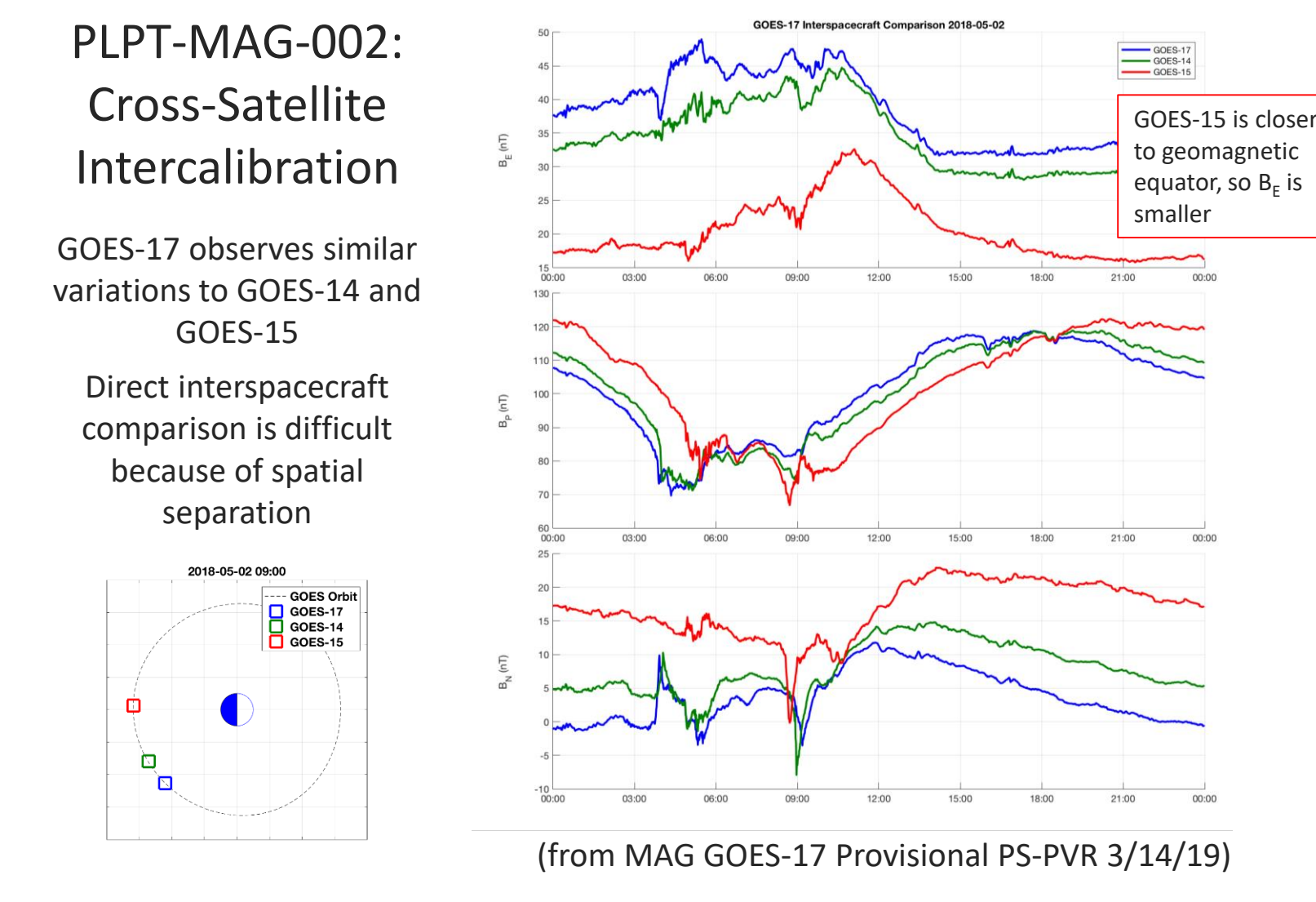
## GLM



## SUVI



## MAG



## Applying Lessons Learned

- Lessons Learned:**
1. With two GOES-R Series satellites in orbit, the instruments are well characterized. Going forward, data collects can be optimized by:
    - Removing unneeded or obsolescent PLTs and PLPTs
    - Relying more on passive data collects
    - Being more efficient with actively commanded tests
  2. Original PLPT descriptions in RIMPs did not list intercomparisons between GOES-R Series satellites once 2+ satellites are on-orbit
    - The RIMP updates will emphasize and codify intercomparison methods using data from existing GOES-R Series satellites
  3. Prior to the GOES-R launch, simulated and proxy on-orbit data were used to create and test analysis tools
    - Now that two GOES-R Series satellites have launched, the tools have been optimized using on-orbit ABI data
  4. It can take significant time for the Ground System (GS) contractor to implement changes to the GS baseline code
    - The PRO - Product Algorithm Science Support (PASS) Team was established to expedite changes to the GS, such as installing Look-Up Table (LUT) updates and making algorithm changes
- Applying lessons learned will streamline the path to Beta and Provisional maturities

Activities in GOES-16, -17 PLT	Plans for GOES-18, -19 PLT
First public image/data released	First public image/data released
Beta PS-PVRs	No Beta PS-PVRs
GRB turn-on criteria: ✓ Pass the Beta PS-PVR	GRB turn-on criteria: ✓ Instrument activated ✓ Internal data flow has begun ✓ Select priority PLTs executed ✓ First public image released ✓ Product declared Beta
ABI L1b Provisional PS-PVR held before Handover	All L1b Provisional PS-PVRs to be held before Handover
No dry runs were held before Provisional PS-PVRs	Dry runs for ABI, GLM, and EXIS will be held 2-3 weeks before Provisional PS-PVRs

- New Path to Beta Validation:**
- Instead of holding a PS-PVR for each instrument after PLTs have completed, Beta maturity can now be declared based on the quality assessment needed for the first public image/data release
  - Greater Flight Project & Instrument Vendor collaboration with PRO and CWG in PLTs
- Less time until data are added to GRB for cal/val assessment
- New Path to Provisional Validation:**
- Remove experimental PLPTs
  - Convert some PLPTs to reserve tests that are only run if anomalies are found from the results of other PLPTs
  - PLPT period starts earlier and is woven into PLT period
- Shorter time until products are available through PDA and CLASS

