Geostationary Operational Environmental Satellite (GOES) – R Series

ABI L2+ Cloud Optical Parameters (Phase, Optical Depth, and Particle Size) Beta, Provisional and Full Validation Readiness, Implementation and Management Plan (RIMP)

Check the VSDE at https://goessp.ndc.nasa.gov to verify correct version prior to use

ABI L2+ Cloud Optical Parameters (Phase, Optical Depth, and Particle Size) Beta, Provisional and Full Validation Readiness, Implementation and Management Plan (RIMP)

Submitted by:

Signatures can be viewed in the CMO file 09/26/2016

Matthew Seybold
GOES- R Product Readiness and Operations Manager

Concurred by:

Signatures can be viewed in the CMO file 10/20/2016

Jaime Daniels
GOES-R Algorithm Working Group Lead

Signatures can be viewed in the CMO file 11/02/2016

Edward Grigsby
GOES-R Program Systems Engineering Lead

Signatures can be viewed in the CMO file 11/15/2016

Raymond Pages
GOES-R Ground Chief Project Engineer

Approved by:

Signatures can be viewed in the CMO file 11/29/2016

James Valenti
GOES-R Ground Segment Project Manager

Change Record

	DOCUMENT TITLE: ABI L2+ Cloud Optical Parameters (Phase, Optical Depth, and Particle Size) Beta, Provisional and Full Validation Readiness, Implementation and Management Plan (RIMP)			
VERSION	**DATE**	**CCR #**	**PAGES AFFECTED**	**DESCRIPTION**
1.0	09/02/2016	03213	All	Initial

The document version number identifies whether the document is a working copy, final, revision, or update, defined as follows:

- **Working copy or Draft:** a document not yet finalized or ready for distribution; sometimes called a draft. Use 0.1A, 0.1B, etc. for unpublished documents.
- **Final:** the first definitive edition of the document. The final is always identified as Version 1.0.
- **Revision:** an edition with minor changes from the previous edition, defined as changes affecting less than one-third of the pages in the document. The version numbers for revisions 1.1 through 1.xx, 2.1 through 2.xx, and so forth. A revision in draft, i.e. before being re-baselined, should be numbered as 1.1A, 1.1B, etc.
- **Update:** an edition with major changes from the previous edition, defined as changes affecting more than one-third of the pages in the document. The version number for an update is always a whole number (Version 2.0, 3.0, 4.0, and so forth).

Table of Contents

Preface....1
1. Cloud Optical Parameters Validation Overview....3
2. Schedule of Events....7
3. Roles and Responsibilities....9
4. Tools....10
5. Analysis Methods....11
6. Output Artifacts....13
7. Pre-launch....15
8. References....16
A. Appendix A: Validation Events....17
B. Appendix B: GOES-R and Validation Reference Data....20
C. Appendix C: Tools....23
D. Appendix D: Acronyms....25

Table of Figures and Tables

Figure 1. GOES-R product maturity levels....2
Figure 2. Delineation of accountability between GOES-R and STAR....2
Table 1. COP documented product cadence and verification approach. 4
Figure 3. Schedule of events. 7

Preface

The evolving calibration and validation (cal/val) maturity of Geostationary Operational Environmental Satellite R-Series (GOES-R) products throughout the beginning of the mission is described by three levels: Beta, Provisional, and Full validation. The Flight Project is responsible for producing the Level 1b (L1b) products according to the Level III requirement documents. Once Beta Maturity of the L1b products is achieved, the Level 2+ (L2+) will begin analysis towards Beta maturity. Further levels of maturity (Provisional and Full validation) require additional and often long-term activities. A detailed description of the three product maturity levels is given in Figure 1, but brief descriptions of the three maturity levels are:

Beta: the product is minimally validated and may still contain significant errors; based on product quick looks using the initial calibration parameters.
Provisional: product performance has been demonstrated through a large, but still (seasonally or otherwise) limited, number of independent measurements. The analysis is sufficient for limited qualitative determinations of product fitness-for-purpose, and the product is potentially ready for testing operational use.
Full: product performance has been demonstrated over a large and wide range of representative conditions, with comprehensive documentation of product performance, including known anomalies and their remediation strategies. Products are ready for operational use.

Assessment and declaration of maturity levels is performed during Peer Stakeholder–Product Validation Reviews (PS-PVRs). At each PS-PVR, the status of products will be presented by members of the cal/val science teams. For L2+ products, Beta maturity PS-PVRs are held in close proximity with and prior to Operations Handover. The review panel at the PS-PVRs will include the GOES-R Operational Readiness Working Group (GORWG), GOES-R Program System Engineering (PSE), NOAA Office of Satellite and Product Operations (OSPO), and GOES-R Product Readiness and Operations (PRO). The Readiness, Implementation, and Management Plans (RIMPs) have been created to document the analysis techniques, methodology, duration, tools, data, resources, staffing, and schedule of the Post-Launch Product Tests (PLPTs) to be used by the cal/val science teams to demonstrate the different levels of product maturity. The primary purpose of the RIMPs is to act as a planning resource for the cal/val teams as they prepare for Launch. Additionally, the RIMPs can be used by other members of the GOES-R Program to prepare for cal/val activities, to assess the suitability of the cal/val test plans, and to understand the data and resource requirements the science teams have. Cal/val testing is likely to reveal necessary algorithm changes to evolve the product quality through the maturity levels. The Algorithm Change Management Plan (ACMP) will be used to track and implement these algorithm changes.

The introspection necessary to create these RIMPs has led to extensive consultations between the cal/val teams and other groups within the GOES-R Program, including the Flight Project, the Ground Segment, and a team of experts from The Aerospace Corporation under contract from GOES-R PSE to help improve the cal/val mission. Figure 2 below describes the responsibilities and accountability of each of the main parties involved in the creation of the RIMPs. This delineation is required because GOES-R operations are to be handed over from the GOES-R Program to NOAA OSPO at the end of the PLT period, yet the process of validating product maturity will continue. This changing nature of accountability during the process must be acknowledged. Accountability of the RIMPs changes at Operations Handover from NASA to NOAA and is aligned with the level of each RIMPs' validation maturity objective. Accountability determines which organization owns documentation, process, and procedures. Responsibility determines which organization creates, executes, and maintains specific activities.

GOES-R Product (L1b and L2+) Maturity Levels

Beta Validation

Preparation Activities
- Initial calibration applied (L1b).
- Rapid changes in product input tables, and possibly product algorithms, can be expected.
- Product quick looks and initial comparisons with ground truth data (if any) are not adequate to determine product quality.
- Anomalies may be found in the product and the resolution strategy may not exist.

End state
- Products are made available to users to gain familiarity with data formats and parameters.
- Product has been minimally validated and may still contain significant errors.
- Product is not optimized for operational use.

Provisional Validation

Preparation Activities
- Validation and quality assurance (QA) activities are ongoing, and the general research community is now encouraged to participate.
- Severe algorithm anomalies are identified and under analysis. Solutions to anomalies are in development and testing.
- Incremental product improvements may still be occurring.
- Users are engaged in the Customer Forums (L2+ products only), and user feedback is assessed.

End state
- Product performance (L1b or L2+) has been 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 to communicate product performance to users relative to expectations.
- Documentation of product performance exists that includes recommended remediation strategies for all anomalies and weaknesses. Any algorithm changes associated with severe anomalies have been documented, implemented, tested, and shared with the user community.
- Testing has been fully documented.
- Product ready for operational use and for use in comprehensive calibration/validation activities and product optimization.

Full Validation

Preparation Activities
- Validation, QA, and anomaly resolution activities are ongoing.
- Incremental product improvements may still be occurring.
- 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 ongoing ground-truth and validation efforts.
- Products are operationally optimized, as necessary, considering mission parameters of cost, schedule, and technical competence as compared to user expectations.
- All known product anomalies are documented and shared with the user community.
- Product is operational.

Figure 1. GOES-R product maturity levels.

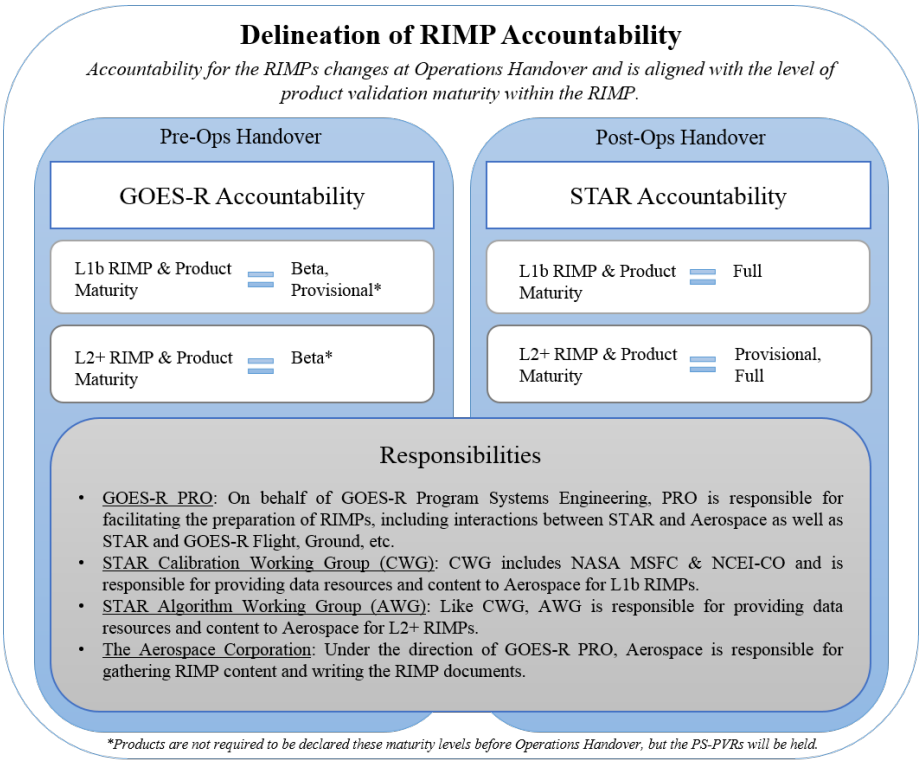

Figure 2. Delineation of accountability between GOES-R and STAR.

1. Cloud Optical Parameters Validation Overview

This Readiness, Implementation, and Management Plan (RIMP) covers all validation stages for the GOES-R Advanced Baseline Imager (ABI) Cloud Optical Parameter (COP) products. There are three stages in the validation process: Beta, Provisional, and Full. Each stage is defined by PLPTs which guide the overall validation process. The RIMP includes a summary of the methods and tools employed to prove the COP set of products have met a given validation stage. Appendices are included that present more detail on each applicable PLPT and detail on the different data sets employed in the COP validation process.

Because of the nature of the PLPTs for the three Cloud Optical Parameters required by the GOES-R program, these three products have been combined into one document. These three products are Cloud Phase (CPH), Cloud Optical Depth (COD), and Cloud Particle Size (CPS). All three contain the same sequence of PLPTs, and use similar tools and processes for verification. Any exceptions will be noted below.[1] No specific type of mesoscale scene is necessary for any of the two required products (see Table 1), other than some should have clouds (a reasonable expectation). The COP validation effort does not require any field campaign data, though it will be used in the full validation phase if available. No North/South (N/S) scan data is needed or used for the validation of COP. National Weather Service (NWS) feedback will be via the Peer Stakeholder-Product Validation Review (PS-PVR) process, with additional insight from the National Center for Environmental Prediction (NCEP) and the Earth System Research Laboratory (ESRL).

The actual requirements have COP products produced on a "Hemisphere" instead of a Full Disk (FD). Since only a FD scan can cover a hemisphere, it is assumed they are similar. For this document, any requirements referencing hemisphere will be verified by products derived from the FD.[1,3]

Eight PLPT events in the PLPT list have been defined to attain Beta maturity for the COP set of products. Three of these state the COPs are created at Mode 3 for FD, CONUS, and mesoscale scans and they are generated at the frequencies required. Two additional ones apply to FD and CONUS in Mode 4. These five are all verified in the first week of PLPT, and are verified by PRO. The remaining three require COPs to be quantitatively analyzed (range, accuracy, and precision) with shortfalls documented, but only for a limited time frame. The range, accuracy, and precision related Beta PLPT events last approximately 10 weeks, occur in parallel, and also commence at the end of PLT. These are the responsibility of the cal/val team to verify.[1,2] PLPT events that support the Beta maturity are listed below; details are in Appendix A[1]:

- **ABI-FD_CPH/CPS/COD01:** verify the FD product is generated every 15 minutes in Mode 3.
- **ABI-CONUS_CPH/CPS/COD01:** verify the CONUS product is generated every 5 minutes in Mode 3.
- **ABI-MESO_CPH/CPS01:** verify the mesoscale product is generated every 5 min in Mode 3.
- **ABI-FD_CPH/CPS/COD02:** verify the FD product is generated every 5 minutes in Mode 4.
- **ABI-CONUS_CPH/CPS/COD02:** verify the CONUS product is generated every 5 minutes in Mode 4.
- **ABI-FD_CPH/CPS/COD03:** determine the extent to which the COP FD products meets the F&PS product specification over a very limited number of independent measurements.
- **ABI-CONUS_CPH/CPS/COD03:** determine the extent to which the COP FD product meets the F&PS product specification over a very limited number of independent measurements.
- **ABI-MESO_CPH/CPS02:** determine the extent to which the COP mesoscale product meets the F&PS product specification over a very limited number of independent measurements.

The following Table identifies the frequency of each scan type for Modes 3 and 4. It includes the required cadence of the COP products as defined by both the GOES-R Functional and Performance Specification (F&PS) and the Product User's Guide (PUG). The bottom three lines reflect, for each appropriate scan type, the frequency of that product used for verification purposes. Any validation that occurs will use the frequency of the operational output, as indicated in the Table. Note the F&PS and the PUG do not agree, as the PUG is a forward looking document that reflects the frequency at which the ground system will actually produce the product. That is the product frequency to be used for validation. Note there is no COD product required in Mode 3 for the mesoscale scan type, as indicated in both documents.

** There is no CONUS scan type for Mode 4, but there are required products over the CONUS that are derived from the FD output*

Mode	Mode 3			Mode 4		
Scan Type	FD	CONUS	Mesoscale	FD	CONUS*	Mesoscale
Scan Freq	15 min	5 min	30 sec	5 min	5 min	N/A
CPh – F&PS	15 min	5 min	5 min	15 min	5 min	N/A
CPh - PUG	15 min	5 min	5 min	5 min	5 min	N/A
COD – F&PS	15 min	15 min	N/A	15 min	15 min	N/A
COD – PUG	15 min	5 min	N/A	5 min	5 min	N/A
CPSD - FPS	15 min	5 min	5 min	15 min	5 min	N/A
CPSD – PUG	15 min	5 min	5 min	5 min	5 min	N/A
CPh – Ver Freq	15 min	5 min	5 min	5 min	5 min	N/A
COD – Ver Freq	15 min	5 min	N/A	5 min	5 min	N/A
CPSD – Ver Freq	15 min	5 min	5 min	5 min	5 min	N/A

Table 1. COP documented product cadence and verification approach.

Three events in the PLPTs list have been defined to attain Provisional maturity. The Provisional stage brings in user community feedback while increasing the amount of statistical verification indicative of the true performance of the COP products. In a broad sense, to declare Provisional maturity, these events must validate that the quality of the COP has been assessed sufficiently to characterize the COP products to the user community. The Provisional PLPT events last 24 weeks, occur in parallel, and commence immediately after Beta has been attained.[1,2] PLPT events that support Provisional maturity are listed below; details are in Appendix A[1]:

- **ABI-FD_CPH/CPS/COD04:** assess the accuracy and precision of the COP FD products over a large and wide range of representative conditions.
- **ABI-CONUS_CPH/CPS/COD04:** assess the accuracy and precision of the COP CONUS products over a large and wide range of representative conditions.
- **ABI-MESO_CPH/CPS03:** assess the accuracy and precision of the COP mesoscale products over a large and wide range of representative conditions.

The criteria by which the GOES-R CTP products will be evaluated to determine if Provisional status has been met are:

- Assess the accuracy and precision of all Cloud Optical Parameters over a wide range of representative conditions.
- Document impacts from challenges with upstream dependencies.
- The following requirements must be met at Provisional; horizontal resolution, mapping accuracy, and measurement range.
- Accuracy and precision do not have to be met to attain Provisional status, however, if they do not do so, the reasons behind not meeting these requirements must be documented, to include

reporting of incidents/issues as an Algorithm Discrepancy Report (ADR) for discussion at the Algorithm Action Review Team (AART).
- Have remediation strategies in place for known issues.
- Product is ready for potential operational use (user decision) and for use in scientific publications.

Moving to the final stage of validation, Full maturity, the COP products must now show they have at least met all of the documented requirements, most importantly those of measurement accuracy and precision. They must also be of operational quality. This does depend upon an accurate Clear-Sky Mask (CSM), and hence the schedule of validated activities must account for the time it takes the CSM to attain Full maturity. For the COP products, it will take 6 months beyond the CSM attaining Full maturity for the COP products to reach Full maturity themselves. There is also dependence on some of the Cloud Top Parameter (CTP) products, however, it is expected the validation efforts for CTP may parallel those for COP.[19] Note, the work to prove Full maturity may start before the CSM itself has reached the Full maturity stage.

Requirements for the various COP products are generally consistent across the different scan types (FD, CONUS, and mesoscale), decreasing the complexity to validate the PLPT events below. Cloud Phase has only an accuracy requirement, and not a precision requirement, otherwise its requirements are consistent across the scan types. Daytime and nighttime COD and CPS are determined by different algorithms, referred to as DCOMP and NCOMP (Daytime and Nighttime Cloud Optical and Microphysical Properties) respectively, but this has no direct impact on the requirements themselves. COD have matching requirements for the different scan types but the product itself is only required for the FD and CONUS scans, as there is no requirement for a mesoscale COD product. However a mesoscale COD will be produced. Therefore validating COD for mesoscale will use CONUS requirements except for horizontal resolution and refresh rate, where it will use the Cloud Phase requirements at mesoscale. There are no complications with CPS other than differing daytime and nighttime algorithms, as noted above. For all COP products, daytime is defined as those pixels containing a solar zenith angle (SZA) of 65 degrees or less, while the definition of night is those pixels containing a SZA of 96 degrees or greater. Those pixels in between SZAs of 65 and 96 degrees are considered in the "terminator" region, and no requirements are levied for those pixels, though COP products will still be produced. The methods and tools necessary to prove the Full maturity stage are the same as those for proving Provisional. Events that support Full maturity are listed below; details are in Appendix A[1]:

- **ABI-FD_CPH/CPS/COD05:** assess the accuracy and precision of the COP FD products over a large and wide range of representative conditions sufficient to prove all COP product requirements have been met.
- **ABI-CONUS_CPH/CPS/COD05:** assess the accuracy and precision of the COP CONUS products over a large and wide range of representative conditions sufficient to prove all COP product requirements have been met.
- **ABI-MESO_CPH/CPS04:** assess the accuracy and precision of the COP mesoscale products over a large and wide range of representative conditions sufficient to prove all COP product requirements have been met.

Besides the criteria necessary to meet Provisional, all of which apply to Full maturity, the following must also be met to achieve the Full maturity stage:

- A measurement accuracy of 80% correct classification for Cloud Phase must be met for all scan types.
- The measurement accuracies for FD and CONUS concerning COD must be met as follows: for liquid water phase clouds in daytime to a maximum of 2 tau or 20%, whichever is larger; for

liquid water phase clouds in nighttime to a maximum of 3 tau or 30%, whichever is larger; for ice phase clouds in daytime to a maximum of 3 tau or 30%, whichever is larger; and for ice phase clouds at nighttime to a maximum of 30%; these same values will be applied to the mesoscale product, since it is also produced and used in the cloud product chain.

- The measurement precision for FD and CONUS concerning COD must be met as follows: for daytime clouds a maximum or 0.5 tau or 20%; for nighttime clouds a maximum of 0.8 tau or 30%; these same values will be applied to the mesoscale product, since it is also produced and used in the cloud product chain.
- The measurement accuracies for all scan types regarding CPS must be met as follows: for liquid phase clouds in daytime within 4 µm; for liquid phase clouds at night a maximum of 4 µm or 30%, and for ice phase clouds within 10 µm.
- The measurement precision for all scan types regarding CPS must be met as follows: for daytime liquid phase clouds to 2 µm; for liquid phase clouds at night to a maximum of 4 µm or 25%, whichever is larger; for daytime ice phase clouds to within 4 µm; and for ice phase clouds at night to a maximum of 10 µm or 25%.
- If the accuracy and precision requirements are not met due to errors with upstream data sources, to include the CSM, these must be documented appropriately.

The validation processes and procedures, monitoring and analysis methods, tools, and expected output artifacts are described in the following sections. The details of each PLPT are contained in Appendix A and of each reference data set are in Appendix B. Any item below where the reference is to "Optical Properties" applies to both COD and CPS, any exceptions will be noted in the document.

The COP products at handover are to be, at a minimum, at the Beta stage of verification. For the COP products, Beta is defined as the COP products being quantitatively analyzed over a limited data set with any anomalies and shortfalls properly documented.[1,2,17]

2. Schedule of Events

Figure 3 shows the GOES-R validation schedule. System Performance Operation Test (SPOT) begins 44 days after launch when ABI L1b and the L2 Cloud and Moisture Imagery (CMI) Key Performance Beta evaluation begins and should be declared Beta maturity by L+87 days. One day later, the GOES Rebroadcast (GRB) will be populated with that data. The L2 products must reach Beta maturity by handover at L+197 days, the same time that ABI L1b and CMI must reach Provisional. Given that L2 Beta tests require at least 6 weeks, L2 Beta testing must get underway by L+155 days, but can begin as soon as the ABI L1band CMI reach Beta (L+87 days).

The GOES-R Operations phase begins after handover marking the start of a 12 month Extended Validation period for ABI L1b and CMI, which is coincident with the start of the 6 month L2 Provisional evaluation, followed by another nine months period for L2 products to reach Full maturity, 15 months after handover. The COP schedule contains some margin against the no-later-than dates.

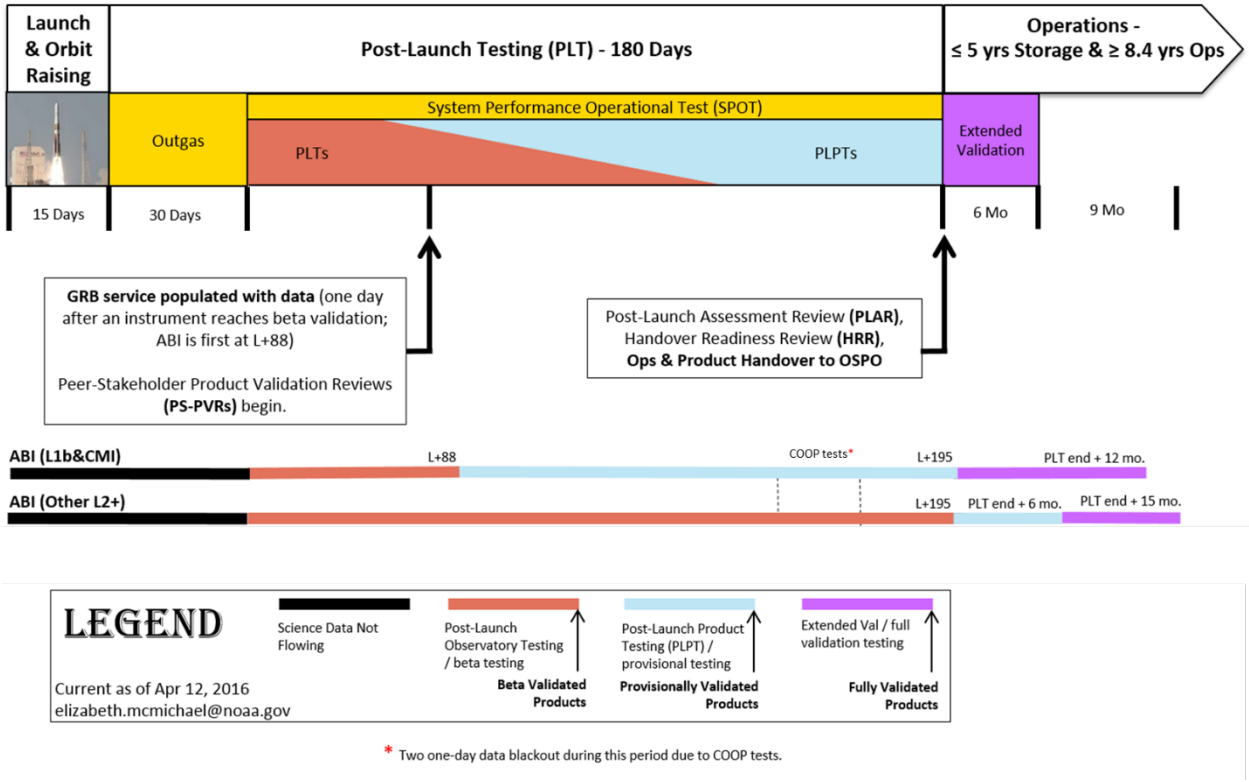

Figure 3. Schedule of events.

A schedule of specific COP activities includes:

- Current – September 2016: evaluate results using data from DOE-3/4.
- July 2016: complete final version of all COP validation tools.
- Current – October 2016: test and evaluate algorithm with Himawari-8 data.
- July – September 2016: test tools with data from DOE 4.
- L+70 days: begin COP Beta cal/val activities.

- L+77 days: complete verification of cadence requirements (OSPO).
- L+140 days: complete Beta validation activities (no later than date L+197 days).
- L+300 days: complete Provisional phase of validation (no later than date L+337 days).
- L+620 days: complete all phases of validation (no later than date L+647 days).

Other aspects related to schedule include:

- The initial Beta testing will focus on the COP being produced at the proper cadence for each of FD, CONUS, and mesoscale for both Modes 3 and 4.[1]
- The first stage will take one week.[1]
- Simultaneously, but to continue through the entire Beta period, the COP products will be quantitatively compared to data sets as described in Section 4.[1,2,6,7]
- Additional Cloud Optical Parameters products will be brought in and/or produced at Cooperative Institute for Meteorological Satellite Studies (CIMSS) to compare with the COP as available starting with the Provisional phase.[17]
- The time frame for Provisional assumes the CSM attains its Provisional schedule, if not the impact is linear with the delays in the CSM Provisional work.
- The COP products are generally the final ones produced in the cloud chain of algorithms, and as such are the lowest priority of the net list of cloud products, should resource contention occur, with the exception of Cloud Phase, which is determined after the CSM.[10,11,17]

3. Roles and Responsibilities

3.1 Primary Point of Contact

The primary point-of-contact for managing COP products and coordinating algorithm updates is Andy Heidinger.[1,6,7]

3.2 GOES-R Point of Contact

The primary POC at GOES-R for the COP validation effort is Wayne MacKenzie.

3.3 Test Analyst/Engineer

Corey Calvert is the primary Test Analyst for CPH, with assistance from Pat Heck.[9] Andi Walther is the primary Test Analyst for DCOMP (CPS and COD in daytime), with Pat Heck the primary analyst for NCOMP (CPS and COD at night) for all validation phases.[9,17]

3.4 GOES-R Feedback

Formal feedback to the GOES-R program regarding COP products will be provided by the cloud product lead, Andy Heidinger.[17]

3.5 Level of Effort

All three test analysts (Corey Calvert, Pat Heck, and Andi Walther) will validate their respective COP products at an effort of 0.5 FTE through the Provisional phase.

4. Tools

The COP validation methodology includes a set of seven tools. Each of these tools is detailed in Appendix C. Colocation tools operate to collocate clouds identified by independent platforms, such as CALIPSO, with GOES-R pixels and the associated COP output. The analysis tools either enable visualization of the results and/or provide for the necessary statistical comparisons that indicate if COP has achieved a given validation stage. These tools also tie the COP validation to that of the Clear Sky Mask (CSM), so false clouds may be removed from the analysis. The same tools are used throughout the COP validation process.

5. Analysis Methods

5.1 Method 1: quantitative comparisons with "truth" data[1,6,7]

- GOES-R COP products will be compared to Atmospheric Radiation Measurement (ARM) results for all COP products.[1,6,7,17]
- GOES-R COP products will be compared to Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) based output for NCOMP only.[1,6,7,17]
- Tools which collocate CALIPSO and ARM COP measurements with the output from GOES-R, especially patmosx_colocate_1km.pro and plot_acha_val.pro, will provide the primary statistical basis to prove Beta and Provisional (DCOMP will use only ARM).[6,7,12,17]
- The requirements for COPs, for all scan types, provide the baseline as appropriate for range, accuracy, and precision; however, they will not be used as the baseline to determine Beta and only range must be met for Provisional.[1,3,17]
- Cloud Top Phase output is defined as one of four specific types (liquid, supercooled, mixed, or solid) and as such it has no precision requirement.[3]
- Because CPH is created on the GOES-R IR pixel scale, inspection of CPH results is sufficient to validate the horizontal resolution requirement.[3]
- Despite using different algorithms, the only requirement that is different between day and night is for ice phase clouds, and is only the COD maximum measurement accuracy error (20% for day, 30% for night); this will be accounted for in the final artifacts of the Provisional phase.[1,3,13]
- As the mesoscale product has no requirements for Optical Depth, the values for CONUS will be used as the baseline for the mesoscale Optical Depth product, with the exception of horizontal resolution.
- The requirements for mapping accuracy and refresh rate will be coordinated with the L1b team and the ground system, as these requirements are not science based.[3]
- Due to the very limited number of quantitative comparisons for the DCOMP output, comparisons to MODIS- and VIIRS-based COP products will be necessary and will be considered, for Beta, as a type of quantitative analysis (as described in method #2)[17]

5.2 Method 2: qualitative comparisons with COP products derived from other sensors[1,6,7]

- COPs derived from MODIS and VIIRS will be used to compare to the GOES-R COP products.[1,6,7]
- This heritage method has been used with prior sensors as a way to check consistency among the different results.[6,7]
- Significant differences indicate issues on a larger scale not possible with available truth data noted above.[6,7,11]
- Displays of the COP results will be placed side-by-side with the matching GOES-R locations, primarily using GLANCE, to note if any large disparities are observed in the GOES-R COP products.[7]
- Any anomalies identified through this method will be properly documented as part of fulfilling the Beta criteria.[17]
- Other comparative sources from the Cloud Development Workshop will be used as they are available and appropriate to compliment the sources identified in Appendix B, however while not critical for Beta they are a necessary component for establishing COP products have achieved Provisional and/or Full.[17]

5.3 Method 3: qualitative comparisons with COP output derived from Numerical Weather Prediction (NWP) output[1,6,7]

- COPs can be determined via NWP output.[1,6,7,13]
- This heritage method has been used with prior sensors as a way to check consistency among the different results.[6,7]

- Since NWP output does not contain defined accuracies, it may only be used as a qualitative output for GOES-R COP validation.[1,6]
- This method primarily applies only to Provisional and Full stages.[17]

6. Output Artifacts

- The primary method to evaluate COP is match-up data with sensors of sufficient quality to be considered "truth", via the methods in Section 5.[1,6,7,13]
- Statistics will be derived which compare the results of the GOES-R COPs with those derived from other satellites.[6,7]
- Since the algorithms for day and night are vastly different, the statistical artifacts will separate the results into, at a minimum, day and night categories.[1,3,13,17]
- Displays of the GOES-R COP will be displayed over a range of conditions to verify the products produce reasonable results for a variety of cloud types.[1,3]
- Side-by-side examples via GLANCE will also be included to reveal the consistency of GOES-R COP output with that derived from other sensors and with NWP simulations.[1,6,7,12]
- Quantitative comparisons between COP products from GOES-R and similar outputs derived from MODIS and VIIRS for DCOMP will be applied during Beta, since there are few quantitative truth sources to use for DCOMP verification.[17]
- The time allocated to proving the beta phase is sufficient to verify the different types of clouds the CTP algorithm must operate on (e.g. fog/stratus, cirrus, etc.), though seasonal events may be missed during PLPT depending on the period (will it be spring/fall or summer/winter).[17]

6.1 Beta Maturity Artifacts

The criteria for declaring Beta maturity as indicated in section 1.0 are: (1) quantitatively assess the performance of the COP products with a limited set of data; and (2) identify any issues with the COP products. Range, accuracy, and precision performance and product issues will be documented in a Beta test report.

ABI-FD_CPH/CPS/COD01
ABI-CONUS_CPH/CPS/COD01
ABI-MESO_CPH/CPS01
ABI-FD_CPH/CPS/COD02
ABI-CONUS_CPH/CPS/COD02
ABI-FD_CPH/CPS/COD03
ABI-CONUS_CPH/CPS/COD03
ABI-MESO_CPH/CPS02

6.1.1 These tests of priority 1 all must pass.

6.1.2 There are no tests of priority 2.

6.2 Provisional Maturity Artifacts

The criteria for declaring Provisional maturity are maturity as indicated in section 1.0. Range, accuracy, and precision performance and product issues will be documented through the PS-PVR process via a power point presentation

ABI-FD_CPH/CPS/COD04
ABI-CONUS_CPH/CPS/COD04
ABI-MESO_CPH/CPS03

6.2.1 These tests of priority 1 all must pass.

6.2.2 There are no tests of priority 2.

6.3 Full Maturity Artifacts

The criteria for declaring Full maturity are maturity as indicated in section 1.0. Range, accuracy, and precision performance and product issues will be documented through the PS-PVR process via a power point presentation.

ABI-FD_CPH/CPS/COD05
ABI-CONUS_CPH/CPS/COD05
ABI-MESO_CPH/CPS04

6.3.1 These tests of priority 1 all must pass.

6.3.2 There are no tests of priority 2.

6.4 Key Artifacts

Key artifacts will be the presentation of the statistical accuracy of the COPs (graphs and sample output) as derived from comparisons to CALIPSO (NCOMP only) and ARM sites. These will be shown as part of the power point presentations at the PS-PVRs.[2,7]

6.5 More Output Artifacts

There are no additional output artifacts for COP.

6.6 Delivery Schedule

The delivery schedule of artifacts for the COP validation effort is tied to the schedule for completing beta, provisional, and full validation as given in section 2. All statistical analysis necessary to prove a given validation stage will be included in a power point presentation in time for the appropriate PS-PVR.

7. Pre-launch

- The only pre-launch verification of the COP was to insure the format and data content is correct.[2,4]
- Pre-launch work has exercised the ability to recreate the COP algorithms using Spinning Enhanced Visible and Infrared Imager (SEVERI).[7,13]
- Examples based on proxy SEVERI data also gave confidence to the tools intended for GOES-R COP analysis.[6,7]
- Output from the DOEs was be used to verify the tools can properly read and use applicable diagnostics[17]
- The Cloud cal/val team planned to use output from DOEs-3 and 4 to verify use of their tools with the proper diagnostics.[17]
- Data flows for DOE output were through STAR.[17]

8. References

The references listed below were used to generate this document, augmented with written and/or verbal feedback with the STAR product team. Superscripts are invoked within the text of this document to indicate a reference that can provide additional detail for the reader.

[1] PLPT_Validation_Event_List_L2_v0_1_20140903_with_Post-PLT_Entries.
[2] GOES-R Series Calibration/Validation Plan Volume 2: Level 2+ Product Validation.
[3] GOES-R Series Mission Requirements Document.
[4] GOES-R Series System – Level Calibration and Product Measurement Validation Concept of Operations (CONOPS) and Operational Concepts (OPSCON).
[5] GOES-R Post-Launch Product Testing Overview February 3, 2015.
[6] GOES-R AWG Algorithm Product Validation Tool Development, Cloud Products; 1st GOES-R Validation Workshop, May 10, 2011.
[7] GOES-R AWG Product Validation Tool Development, Cloud Team Report, 2nd GOES-R Validation Workshop, January 9, 2014.
[8] http://www-calipso.larc.nasa.gov/about/payload.php (CALIOP sensor).
[9] Spreadsheet containing PLPT Leads and PLPT Analysts (L2 Products_POCs).
[10] Algorithm Theoretical Basis Document, Daytime Cloud Optical and Microphysical Properties (DCOMP).
[11] Algorithm Theoretical Basis Document, Nighttime Cloud Optical and Microphysical Properties (NCOMP).
[12] Developing a Product Validation and Merged JPSS/GOES-R System Using Advanced Collocation Methods, 2nd GOES-R Validation Workshop, January 9, 2014.
[13] GOES-R AWG Product Validation Tool Development, Nighttime Cloud Optical and Microphysical Properties (NCOMP), 2nd GOES-R Validation Workshop, January 9, 2014.
[14] GOES-R Field Campaign, NOAA Satellite Science Week, February, 2015.
[15] Stubenrauch, C. J., and co-authors, 2013, Assessment of Global Cloud Datasets From Satellites; Bull. Amer. Meteor. Soc., **94**, 1031 – 1049.
[16] http://www.star.nesdis.noaa.gov/star/documents/corp/SATB/SATBgeocat.pdf (GeoCAT).
[17] Interview with Cloud Product Team, June 2, 2015.
[18] GOES-R Field Campaign Preparation, October 26, 2015.
[19] GOES-R Cloud Top Parameter Resource, Management, and Implementation Plan

A. Appendix A: Validation Events

A.1 PLPT Events that Support Beta Maturity

A.1.1 Event Name: ABI-FD_CPH/CPS/COD01[1]

Objective: Verify that product is generated every 15 min for every Full Disk (FD).[3]
Start Time: Start of PLPT[1]
Duration: 1 week.[1]
ABI Mode: Mode 3.[1]
GOES-R Data Type(s): 15 min FD/Hemisphere.[1,3]
Beta Success Criteria: Product generated and falls within expected measurement range; all that is required for this PLPT is that the product is created and received at the validation site with a one hour cadence.[1,3]
Dependencies: The COP products are created by the ground system and delivery of such product to the validation team is sufficient to keep up with the cadence of the FD.[1,4]
PLPT Lead: PRO[5,6,7]
PLPT Analyst: PRO.
Validation Data: None (quality assessed in a different PLPT).[1]
Procedural References: None (quality assessed in a different PLPT).[1]
Comparison/Reference Data: B.1, B.2, and B.3.
Monitoring and Analysis Method: Product Inspection, either the COPs are produced at the correct cadence or they are not.[1,3]

A.1.2 Event Name: ABI-CONUS_CPH/CPS/COD01

Same as for ABI-FD_CPH/CPS/COD01 except for:
GOES-R Data Type(s): 5 minute CONUS.[1,3]

A.1.3 Event Name: ABI-MESO_CPH/CPS01

Same as for ABI-FD_CPH/CPS/COD01 except for:
GOES-R Data Type(s): 5 minute mesoscale.[1,3]

A.1.4 Event Name: ABI-FD_CPH/CPS/COD02

Same as for ABI-FD_CPH/CPS/COD01 except for:
ABI Mode: Mode 4.[T]
GOES-R Data Type(s): 5 min FD/Hemisphere.[1,3]

A.1.5 Event Name: ABI-CONUS_CPH/CPS/COD02

Same as for ABI-CONUS_CPH/CPS/COD01 except for:
ABI Mode: Mode 4.[1]
GOES-R Data Type(s): 5 minute CONUS.[1,3]

A.1.6 Event Name: ABI-FD_CPH/CPS/COD03

Objective: Determine the extent to which COP products meet the F&PS product specification over a very limited number of independent measurements and identify any appropriate issues negatively impacting the COP products.[1]
Start Time: Start of PLPT.[1]
Duration: 30 days.[1]
ABI Mode: Mode 3.[1]
GOES-R Data Type(s): 15 minute FD COPs.[1]

Beta Success Criteria: The FD COPs are quantitatively assessed for a limited set of independent measurements, and any issues are properly identified. No quantitative requirements for accuracy, range, or precision is needed to be met for Beta. This must occur with a horizontal resolution of 2 km (4 km for FD COD) and a mapping accuracy of 1 km (2 km for FD COD).[1,2,6,7]
Dependencies: The COP products are created by the ground system and delivery of such products to the validation team is sufficient to keep up with the cadence of FD/Hemispheric COP output.[1,3]
PLPT Lead: Andy Heidinger.[6,7]
PLPT Analyst: Corey Calvert (Phase), Andi Walther (DCOMP), and Pat Heck (NCOMP).[9,17]
Validation Data: Overlapping data from CALIPSO and ARM.[1,6]
Procedural References: Section 5, methods #1, 2, and 3.
Comparison/Reference Data: All available data sets in Appendix B.
Monitoring and Analysis Method: Derive statistics using the match-up data as truth, and produce comparative statistics with COPs generated over the same area as GOES-R but derived from MODIS and VIIRS.[1,6,7]

A.1.7 Event Name: ABI-CONUS_CPH/CPS/COD03

Same as for ABI-FD_CPH/CPS/COD04 except for:
GOES-R Data Type(s): 15 minute CONUS COPs.[1,3]
Beta Success Criteria: The CONUS COPs are quantitatively assessed for a limited set of independent measurements, and any issues are properly identified. No quantitative requirements for range, accuracy, or precision is needed to be met for Beta. This must occur with a horizontal resolution of 2 km and a mapping accuracy of 1 km, at a 15 min cadence.[1,2,6,7]

A.1.8 Event Name: ABI-MESO_CPH/CPS02

Same as for ABI-FD_CPH/CPS/COD04 except for:
GOES-R Data Type(s): 5 min mesoscale COP.[1,3]
Beta Success Criteria: The mesoscale COPs are quantitatively assessed for a limited set of independent measurements, and any issues are properly identified. No quantitative requirements for range, accuracy, or precision is needed to be met for Beta. This must occur with a horizontal resolution of 2 km and a mapping accuracy of 1 km (recall there are no requirements for COD for mesoscale).[1,2,6,7]

A.2 PLPT Events that Support Provisional Maturity

A.2.1 Event Name: ABI-FD_CPH/CPS/COP04[1]

Objective: Assess the accuracy and precision of the COP products over a large and wide range of representative conditions sufficient to validate to the user community the extent to which the COP products are operationally applicable.[1]
Start Time: Immediately following PLPT.[1]
Duration: 4 months.[1]
ABI Mode: Mode 3.[1]
GOES-R Data Type(s): 15 min FD/Hemispheric COPs.[1]
Provisional Success Criteria: The FD COPs meet their quantitative requirements for a limited/seasonal set of independent measurements. The results must be sufficient to inform users of the status and capabilities of the COP products.[1,2,6,7]
Dependencies: The COPs has reached the Beta level of maturity.[1,2,4]
PLPT Lead: Andy Heidinger.[1,6,7]
PLPT Analyst: Corey Calvert (Phase), Andi Walther (DCOMP), and Pat Heck (NCOMP).[9]
Validation Data: Overlapping data from CALIPSO and ARM.[6,7]
Procedural References: Section 5, methods #1, 2, and 3.
Comparison/Reference Data: All data sets available in Appendix B.

Monitoring and Analysis Method: Derive statistics using the match-up data as truth, and produce comparative statistics with COPs generated over the same area as GOES-R but derived from MODIS and VIIRS.[1,6,7]

A.2.2 A. 2.2 Event Name: ABI-CONUS_CPH/CPS/COD04

Same as for ABI-FD_CPH/CPS/COD04 except for:
GOES-R Data Type(s): 15 minute CONUS COPs.[1,3]

A.2.3 A. 2.3 Event Name: ABI-MESO_CPH/CPS03

Same as for ABI-FD_CPH/CPS/COD04 except for:
GOES-R Data Type(s): 5 min mesoscale COP.[1]

A.3 PLPT Events that Support Full Maturity

A.3.1 Event Name: ABI-FD_CPH/CPS/COP05[1]

Objective: Assess the accuracy and precision of the COP products over a large and wide range of representative conditions sufficient to prove all COP product requirements have been met.[1]
Start Time: immediately following Provisional.[1]
Duration: 1 year.[1]
ABI Mode: Mode 3.[1]
GOES-R Data Type(s): 15 min FD/Hemispheric COPs.[1]
Full Success Criteria: The FD COPs meet their quantitative requirements as shown by, at a minimum, an annual set of independent measurements. The results must be sufficient to verify all requirements and inform users of the status and capabilities of the COP products.[1,2,6,7]
Dependencies: the COPs has reached the Provisional level of maturity.[1,2,4]
PLPT Lead: Andy Heidinger.[1,6,7]
PLPT Analyst: Corey Calvert (Phase), Andi Walther (DCOMP), and Pat Heck (NCOMP).[9]
Validation Data: Overlapping data from CALIPSO and ARM.[6,7]
Procedural References: Section 5, methods #1, 2, and 3.
Comparison/Reference Data: All data sets available in Appendix B.
Monitoring and Analysis Method: Derive statistics using the match-up data as truth, and produce comparative statistics with COPs generated over the same area as GOES-R but derived from MODIS and VIIRS.[1,6,7]

A.3.2 A. 2.2 Event Name: ABI-CONUS_CPH/CPS/COD05

Same as for ABI-FD_CPH/CPS/COD04 except for:
GOES-R Data Type(s): 15 min CONUS COPs.[1,3]

A.3.3 A. 2.3 Event Name: ABI-MESO_CPH/CPS04

Same as for ABI-FD_CPH/CPS/COD04 except for:
GOES-R Data Type(s): 5 min mesoscale COP.[1]

B. Appendix B: GOES-R and Validation Reference Data

B.1 Data Set #1: ABI-L2-ACOP[3]

Storage Location: CIMSS Data Center.[17]
Access Process: Product Distribution and Access (PDA) or STAR.[4,17]
Point of Contact: Jerald Robaidek.[17]
Spatial Coverage: All modes, FD, CONUS, and mesoscale.[1,3]
Temporal Coverage: All modes, hourly for FD/CONUS and 5 min for mesoscale.[1,3]
Contingency: None, this is the Cloud Phase product the team must validate, there is no validation without the core product.
Special Considerations: The cloud product team expects to obtain the data through PDA, but the status of that is unclear. The data may also be obtained through STAR, though with a delay of unknown extent.

B.2 Data Set #2: ABI-L2-CPS[3]

Storage Location: CIMSS Data Center.[17]
Access Process: PDA or STAR.[4,17]
Point of Contact: Jerald Robaidek.[17]
Spatial Coverage: All modes, FD, CONUS, and mesoscale.[1,3]
Temporal Coverage: All modes, hourly for FD/CONUS and 5 min for mesoscale.[3,11]
Contingency: None, this is the Cloud Particle Size product the team must validate, there is no validation without the core product.
Special Considerations: The cloud product team expects to obtain the data through PDA, but the status of that is unclear. The data may also be obtained through STAR, though with a delay of unknown extent.

B.3 Data Set #3: ABI-L2-COD[3]

Storage Location: CIMSS Data Center.[17]
Access Process: PDA or STAR.[4,17]
Point of Contact: Jerald Robaidek.[17]
Spatial Coverage: All modes, FD, CONUS, and mesoscale.[1,3]
Temporal Coverage: All modes, hourly for FD/CONUS and 5 min for mesoscale.[3,11]
Contingency: None, this is the Cloud Optical Depth product the team must validate, there is no validation without the core product.
Special Considerations: The cloud product team expects to obtain the data through PDA, but the status of that is unclear. The data may also be obtained through STAR, though with a delay of unknown extent.

B.4 Data Set #4: CALIPSO[1,6,7]

Storage Location: Science Investigator-led Processing System (SIPS).[15]
Access Process: Public internet.[8,17]
Point of Contact: Liam Gumley.[17]
Start Time: Immediately following PLPT.[1]
Spatial Coverage: 333 meters across track, 1-5 meters along track.[8]
Temporal Coverage: N/A.
Contingency: If Cloud Aerosol Transport System (CATS) data is available it is capable of replacing CALIPSO, should the CALIPSO become unavailable after the launch of GOES-R, then CATS data will be used instead.[17]

Special Considerations: The Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) sensor on CALIPSO measures clouds and aerosols via lidar, and is often used to verify many aspects of clouds, including cloud optical characteristics.[8]

B.5 Data Set #5: Atmospheric Radiation Measurement (ARM) sites[1,6,7]

Storage Location: SIPS.[17]
Access Process: NOAA Public internet (http://www.arm.gov/).[17]
Point of Contact: N/A.[17]
Start Time: Immediately following PLPT.[1]
Spatial Coverage: Single point locations.
Temporal Coverage: Hourly.
Contingency: For NCOMP it is CALIPSO, there is no replacement at present for DCOMP[17]
Special Considerations: ARM locations include hourly measurements of cloud characteristics, which may be used as single point sources of truth for COP verifications.[9]

B.6 Data Set #6: MODIS derived COPs[1]

Storage Location: SIPS.[17]
Access Process: CLAVR-X.[17]
Point of Contact: Liam Gumley.[17]
Start Time: Immediately following PLPT.[1]
Spatial Coverage: GOES coverage area.[1,2]
Temporal Coverage: N/A.
Contingency: Use the other available COPs from other weather satellites.[1,7]
Special Considerations: The MODIS COPs have been in existence for over a decade. The algorithm may be executed on site at SSEC.[17]

B.7 Data Set #7: VIIRS derived COPs[1]

Storage Location: SIPS.[17]
Access Process: CLAVR-X.[17]
Point of Contact: Liam Gumley.[17]
Start Time: Immediately following PLPT.[1]
Spatial Coverage: GOES coverage area.[1,2]
Temporal Coverage: N/A.
Contingency: Use the other available COPs from other weather saetllites.[1,7]
Special Considerations: The operational COP products from VIIRS has struggled to attain its required characteristics, but CIMSS has pursued an alternative algorithm that may be applied to the VIIRS SDRs to create applicable COP output which may be compared to that of GOES-R.[15,17]

B.8 Data Set #8: GOES derived COPs[1]

Storage Location: SIPS.[17]
Access Process: CLAVR-X.[17]
Point of Contact: Liam Gumley.[17]
Start Time: Immediately following PLPT.[1]
Spatial Coverage: GOES coverage area.[1,2]
Temporal Coverage: N/A.
Contingency: Use the other available COPs from other weather satellites.[1,7]
Special Considerations: The GOES COPs use an algorithm designed and led by CIMSS. It may be executed on site at SSEC.[17]

B.9 Data Set #9: Field Campaign Data

Source: If available, Cloud Physics Lidar (CPL) and the Cloud Radar System (CRS) placed on the ER-2 aircraft.[14]
POC: Francis Padula
Access Process: TBD.
Frequency of Transmission: N/A, any field campaign is a finite event.[14]
Contingency If Not Available: Validation of the COPs can be significantly benefitted by field campaign results, but at this time those results are not expected to be available before Beta or Provisional is completed. If any field campaign data is available during the final (Full) stage, it will be used as part of the quantitative verification process. Note however that validation will proceed independent of the availability of field campaign data.[1,6,7,14,18]

C. Appendix C: Tools

C.1 Tool #1: Man-computer Interactive Data Access System (McIDAS).[1,6,7]

Location: Cooperative Institute for Meteorological Satellite Studies (CIMSS).[6,7]
Description: In house, though tool itself is employed by many outside of CIMSS, McIDAS has the capability to display COP output from numerous sensors over the original imagery, to include those produced from data sets in B.1, B.2, B.3, B.6, B.7, and B.8.[6,7]
Developer: Space Science Environmental Center (SSEC) McIDAS programmers.[17]
Development Schedule: Tool is ready for cal/val use with GOES-R, though certain diagnostic data has yet to be tested.[17]
Data Dependencies: GOES-R, MODIS, and VIIRS COP output.[6,7]
Testing Accomplished or Planned: Testing has been accomplished with both surrogate and simulated GOES-R COP output, the only remaining testing is with diagnostics that are planned with upcoming DOE testing.[17]
POC: McIDAS User's Group (MUG).[17]

C.2 Tool #2: patmosx_colocate_1km.pro[17]

Location: CIMSS.[17]
Description: In house tool that collocates cloud product files, either the GOES-R COP products or those derived from data sets B.6, B.7 and B.8 in Appendix B, with CALIOP L2 1 km cloud layer data files.[17]
Developer: CIMSS.[17]
Development Schedule: Development for this tool has been completed.[17]
Data Dependencies: GOES-R, MODIS, and VIIRS COP output and CALIOP data.[6,7,17]
Testing Accomplished or Planned: Testing has been all but completed, a minor amount of testing remains with output that includes diagnostics, as planned in upcoming DOEs.[17]
POC: Cloud Product Team.[17]

C.3 Tool #3: plot_calipso_matchup.pro[17]

Location: CIMSS.[17]
Description: In house tool that plots cloud output, including COP output, with CALIOP 1 km cloud layer data files.[17]
Developer: CIMSS.[17]
Development Schedule: Development for this tool has been completed.[17]
Data Dependencies: GOES-R, MODIS, and VIIRS COP output and CALIOP data.[6,7,17]
Testing Accomplished or Planned: Testing has been all but completed, a minor amount of testing remains with output that includes diagnostics, as planned in upcoming DOEs.[17]
POC: Cloud Product Team.[17]

C.4 Tool #4: make_training_data.pro[17]

Location: CIMSS.[17]
Description: In house tool which creates a save file from the data and results created by other tools employed in the COP cal/val process.[17]
Developer: CIMSS.[17]
Development Schedule: Development for this tool has been completed.[17]
Data Dependencies: CLAVR-X and CALIOP 1 km cloud layer data, see tool #7.[17]
Testing Accomplished or Planned: Testing has been all but completed, a minor amount of testing remains with output that includes diagnostics, as planned in upcoming DOEs.[17]
POC: Cloud Product Team.[17]

C.5 Tool #5: plot_acha_valpro[17]

Location: CIMSS.[17]
Description: In house tool which computes statistics of COP output determined through CLAVR-X (tool #7) and compares them to CALIOP 1 km cloud layer data, then create plots from those outputs.[17]
Developer: CIMSS.[17]
Development Schedule: Development for this tool has been completed.[17]
Data Dependencies: COP output derived from CLAVR-X along with CALIOP 1 km cloud layer data, see tool #7.[17]
Testing Accomplished or Planned: Testing has been all but completed, a minor amount of testing remains with output that includes diagnostics, as planned in upcoming DOEs.[17]
POC: Cloud Product Team.[17]

C.6 Tool #6: GLANCE[1,6,7]

Location: CIMSS.[6,7]
Description: GLANCE allows users to perform inter-comparisons, in this case among COP products from different sources, or between COP output created from the same source but through different methods or with different inputs, to include the L1b/SDR data sets noted in Appendix B.[17]
Developer: Algorithm Integration Team (AIT).[17]
Development Schedule: AIT has completed development and it has been delivered to the Cloud Product Team.[17]
Data Dependencies: GOES-R, GOES, VIIRS, and MODIS COP products or COP output derived from their L1b/SDRs.[17]
Testing Accomplished or Planned: AIT has completed its testing activities.[17]
POC: AIT.[17]

C.7 Tool #7: Clouds from AVHRR extended (CLAVR-X).[17]

Location: CIMSS.[17]
Description: In the context of GOES-R cal/val, CLAVR-X is actually an architecture under which much of the validation for the COP will occur. The CLAVR-X architecture includes the capability to compute COP output from a variety of sources, including GOES-R, GOES, MODIS, VIIRS, and Advanced Very High Resolution Radiometer (AVHRR). The resulting COP products are tied to the validation of the GOES-R COP products. As such, it is listed here as a "tool", though its purpose extends far beyond the validation of GOES-R products, and it is not a "tool" in the strict sense of the word.[17]
Developer: CIMSS.[17]
Development Schedule: Development for this tool has been completed.[17]
Data Dependencies: GOES-R, GOES, MODIS, VIIRS, and AVHRR L1b/SDRs.[17]
Testing Accomplished or Planned: Testing has been completed.[17]
POC: Cloud Product Team.[17]

D. Appendix D: Acronyms

Acronym	Definition
AART	Algorithm Action Review Team
ABI	Advanced Baseline Imager
ADR	Algorithm Discrepancy Report
AIT	Algorithm Integration Team
ARM	Atmospheric Radiation Measurement
AVHRR	Advanced Very High Resolution Radiometer
AWG	Algorithm Working Group
Cal/Val	Calibration and Validation
CALIOP	Cloud-Aerosol Lidar with Orthogonal Polarization
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations
CATS	Cloud Aerosol Transport System
CCR	Configuration Change Request
CIMSS	Cooperative Institute for Meteorological Satellite Studies
CLAVR-X	Clouds from AVHRR - Extended
CMI	Cloud and Moisture Imagery
COD	Cloud Optical Depth
CONUS	Continental United States
COP	Cloud Optical Parameter
CPH	Cloud Phase
CPL	Cloud Physics Lidar
CPS	Cloud Particle Size
CRS	Cloud Radar System
CSM	Clear-Sky Mask
CWG	Calibration Working Group
DCOMP	Daytime Cloud Optical and Microphysical Properties
DOE	Data Operations Exercise
ER-2	Earth Resources 2
ESRL	Earth System Research Laboratory
F&PS	Functional and Performance Specification
FD	Full Disk
GeoCAT	Geostationary Cloud Algorithm Testbed
GOES	Geostationary Operational Environmental Satellite
GOES-R	GOES R-Series
GORWG	GOES-R Series Operational Requirements Working Group
GRB	GOES Rebroadcast
IR	Infrared
JPSS	Joint Polar Satellite System
L1b	Level 1b

Acronym	Definition
L2	Level 2
McIDAS	Man-computer Interactive Data Access System
MODIS	Moderate Resolution Imaging Spectroradiometer
MSFC	Marshall Space Flight Center
MUG	McIDAS User's Group
N/A	Not Applicable
NASA	National Aeronautics and Space Administration
NCEI	National Centers for Environmental Information
NCEI-CO	NCEI - Colorado
NCEP	National Center for Environmental Prediction
NCOMP	Nighttime Cloud Optical and Microphysical Properties
NLT	No Later Than
NWP	Numerical Weather Prediction
NWS	National Weather Service
OSPO	Office of Satellite and Product Operations
PDA	Product Distribution and Access
PLAR	Post-Launch Assessment Review
PLPT	Post-Launch Product Test
PLT	Post-Launch Test
POC	Point of Contact
PRO	Product Readiness and Operations
PSE	Program System Engineering
PS-PVR	Peer Stakeholder-Product Validation Review
PUG	Product User's Guide
QA	Quality Assurance
QC	Quality Control
RIMP	Readiness, Implementation and Management Plan
SDR	Sensor Data Records
SEVIRI	Spinning Enhanced Visible and Infrared Imager
SIPS	Science Investigator-led Processing System
SPOT	System Performance Operational Test
SSEC	Space Science and Engineering Center
STAR	Center for Satellite Applications and Research
SZA	Solar Zenith Angle
TBD	To Be Determined
VIIRS	Visible Infrared Imaging Radiometer Suite