NPOESS Preparatory Project Validation Program for the Imagery and Cloud Mask Data Products from the Visible/Infrared Imager/Radiometer Suite

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Overview

The National Polar-orbiting Operational Environmental Satellite System (NPOESS) Program, in partnership with National Aeronautical Space Administration (NASA), will launch the NPOESS Preparatory Project (NPP), a risk reduction and data continuity mission, prior to the first operational NPOESS launch.

The NPOESS Program, in partnership with Northrop Grumman Aerospace Systems, will execute the NPP Calibration and Validation (Cal/Val) program to ensure the data products comply with the requirements of the sponsoring agencies. The Imagery and VIIRS Cloud Mask (VCM) plans incorporate a combination of real-time users, scientists, and climate specialists to insure a viable and effective set of products. The Imagery team includes subject matter experts and organization representatives of all aspects of imagery application, from clouds to sea ice to aerosols along with ground/ocean features of meteorological interest.

The VCM plan considers not only the VCM as a single product, but extensive evaluation regarding its impacts on all downstream VIIRS products. Both leakage and false alarms are accounted for, and users for both the confidently cloudy and confidently clear output are included as part of the evaluation team.

Evaluation tools include the capability to display each cloud detection test, match ups between the VCM with CloudSat, CALIPSO, and MODIS, quantitative comparisons between the VCM and manual analysis produced by subject matter experts, and statistical impacts on dependent Environmental Data Products such as Sea Surface Temperature (SST) and surface reflectance. This comprehensive approach will allow all dependent users to obtain a reliable measure of the capabilities of the Imagery and VCM.

Imagery Environmental Data Record (EDR) Approach

- Evaluating imagery involves both Subject Matter Experts (SME) and non-experts, and considers the diverse uses of imagery across the spectrum. It includes critical interaction with the VIIRS Sensor Data Record (SDR) Cal/Val team, as most of the potential problems with imagery would be addressed by the SDR experts. Our approach first screens the usefulness of the imagery by SME; then submits the imagery for assessment by the remaining team members and their associated organizations.

- Post-launch work will be in two sequential "steps" both during the Intensive Cal/Val (ICV) phase.
  1. SMEs will evaluate the quality of the imagery itself. This small group will be comprised at a minimum of one lead, and will focus on the overall quality of the imagery with an emphasis on items that would interfere with the usefulness of the image, to include striping, scattering, ghosting, and errors in band-to-band registration (BBR) that prevents proper overlays of the imagery.
  2. Customer SMEs will evaluate imagery based on their needs and the "operational viability" criteria that defines' their use of imagery, and NGAS will perform the quantitative analysis of the imagery relative to the System Specification.

- Data Product Maturity Definitions
  - Beta – The imagery EDR is produced consistently but has undergone only minimal validation and is not suitable for operational use.
  - Provisional – The imagery has passed step 1 above for evaluation by the Centrals, but has not been accepted by any of the Centrals as operationally viable.
  - Validated Stage 1 – The Centrals acknowledge that for clouds and sea ice, the two atmospheric items that the SS has explicit requirements to meet, imagery is suitable for operational use.
  - Validated Stage 2 – The IPO and NGAS agree the imagery meets or beats the System Specification.
  - Validated Stage 3 – The Centrals acknowledge that the imagery meets all operational viability criteria, to include real-time applications not considered in the Sys Spec. These include identification of SST gradients, use in aerosol detection, and NexSat applications.

Imagery Validation Team

Name	Organization	Sponsor
Thomas Kopp	Aerospace	IPO
Pablo Clemente-Color	NIC	NIC
Chris Elvidge	NOAA/SNCDC	IPO
	AFWA	AFWA
Jeff Hawkins	NRL-Monterey	IPO
Keith Hutchison	NGAS	NGAS
Mike Plonski	NGAS	NGAS
Jeff Tesmer	FNMOC	FNMOC

VIIRS Cloud Mask Internal Data Product Approach

- Evaluating VCM involves Subject Matter Experts (SME) in cloud detection algorithms and imagery interpretation, with significant coordination with SMEs for each of the VIIRS EDR products. The VCM Cal/Val effort will basically be two steps:
  1. 30-day rapid tuning event to produce a VCM adequate for other EDR products to employ. This step commences when the SDR and Imagery is determined adequate for VCM evaluation and is intended to allow for validation of the dependent downstream EDRs to begin earlier in ICV
  2. Simultaneous set of studies performed to fully characterize the VCM's performance. These studies are expected to take approximately 6-9 months after the initial 30-day tuning process.
     a) quantitative analysis using manual determination of cloud over a specified set of VIIRS granules (NGAS developing tool)
     b) quantitative comparison of other cloud algorithms with the VCM
     c) quantitative analysis comparing the VCM to other external sources of cloud measurements such as CALIPSO and CloudSat. Other sources such as LIDAR and ARM sites also apply, though their benefits are limited for the VCM. Comparisons to cloud masks created from MODIS and AVHRR are planned.
     d) incorporating feedback from the other Cal/Val disciplines and EDRs, especially SST and surface reflectance, into tuning corrections that maximize the quality of the VCM.
        - SST effects will be analyzed by NAVO, who will run the SST algorithm using different cloud masks and focus on specific regions to isolate cloud types causing issues and detecting anomalies
        - Land EDR effects will be studied using a time series of surface reflectance to detect adverse affects from potential errors in the VCM and will report errors to the VCM team

VIIRS Cloud Mask Validation Team

Name	Organization	Sponsor
Thomas Kopp	Aerospace	IPO
John Eylander	AFWA	AFWA
Jeff Hawkins	NRL-Monterey	IPO
Andrew Heidinger	NOAA/CIMS	IPO
Keith Hutchison	NGAS	NGAS
Doug May	NRL-Stennis	IPO (Ocean Team Rep)
Mike Plonski	NGAS	NGAS
Jeff Tesmer	FNMOC	FNMOC
Eric Vermote	UMCP/GSFC	IPO (Land Team Rep)

Activities by Cal/Val Phase

PRE-LAUNCH

- Imagery
  - Develop/Adapt tools for EDR Assessment.
- VCM
  - Develop tool for quantitative VCM assessment against System Specification, tune algorithm using global synthetic data, evaluate tuning against MODIS proxy data, and analyze algorithm condition sensitivities using PEATE processed operational code and correlative data match-ups.

INTENSIVE CAL/VAL

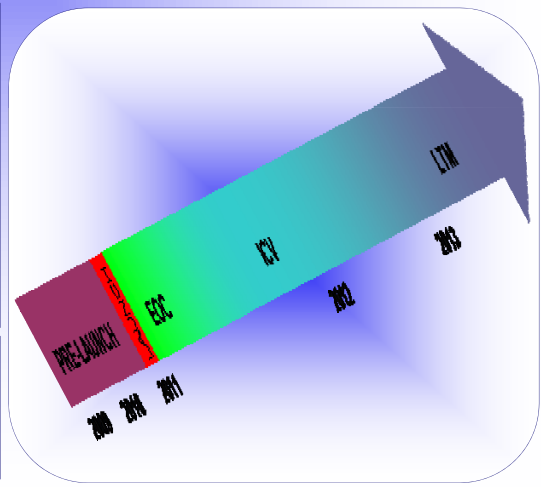
- Imagery
  - Evaluate quality of EDR, emphasizing assessment of interferences with usefulness, such as striping, scattering, ghosting, etc., evaluate EDR based on operational viability to Customers and quantify performance against System Specification.
- VCM
  - Perform 30-day rapid tuning for use with downstream algorithms once SDRs and Imagery products are adequate for use and characterize VCM performance via a quantitative analysis using manual determination of cloud over a specified set of VIIRS granules, a quantitative comparison of other cloud algorithms with the VCM, a quantitative analysis comparing the VCM to other external sources of cloud measurements such as CALIPSO, and incorporating feedback from the other Cal/Val disciplines and EDRs, especially SST and surface reflectance, into tuning corrections that maximize the quality of the VCM.

EARLY ORBIT CHECK-OUT

- Imagery
  - Analyze initial EDRs for issues and coordinate with SDR calibration team.

LONG-TERM MONITORING

- Transition applicable tools and techniques to Operations and Sustainment team for monitoring product performance
- Monitor product performance and correct when needed.
- Monitor sensor performance and analyze impact on product performance.



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