MEMORANDUM FOR: The JPSS Program Record
SUBMITTED BY: JPSS Aerosol Detection Product Team Lead Shobha Kondragunta
CONCURRED BY: JPSS Algorithm Management Project Lead Lihang Zhou
JPSS STAR Program Manager Ingrid Guch
APPROVED BY: JPSS Program Scientist Satya Kalluri

SUBJECT: NOAA-21 VIIRS Aerosol Detection Product
Provisional Maturity Status
DATE: 09/01/2023

Provisional maturity status declaration for Aerosol Detection Product
Maturity Review Date: **08/24/2023**
Effective Date: **02/11/2023**
Operational System: **NCCF Version3r2**

The JPSS Algorithm Maturity Readiness Review Board approved the release of the Aerosol Detection Product to the public with a Provisional maturity level quality as of February 11, 2023 based on the JPSS Validation Maturity Review held on August 24, 2023.

1. **Provisional Maturity stage definition:**
   - Product performance has been demonstrated through analysis of a large, but still limited (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from selected locations, time periods, or field campaign efforts.
   - Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose.
   - Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists.
   - Product is recommended for potential operational use (user decision) and in scientific publications after consulting product status documents.
2. **Algorithm Description:**
   List of Products: Aerosol Detection Product (ADP)

Product requirements/Exclusions (DPS):

Attribute	Requirement/Threshold	
Applicable Conditions	Clear sky, daytime only, any altitude; AOD > 0.15	
Horizontal Cell Size	750m at nadir	
Vertical Cell Size	Total column	
Mapping Uncertainty, 3s	3km	
Measurement Range	Type: smoke, dust	
Accuracy Reported as Probability of Correct Detection (POCD)	Smoke	Dust
Over Land	80%	80%
Over Water	70%	80%

Quality flags:

Bits	"QC_Flag" Variable Quality Flag Name	Meaning (2-bits)			
		01	10	00	11
0-1	QC_ASH_CONFIDENCE	Low quality	Medium quality	High quality	Bad/ missing
2-3	QC_SMOKE_CONFIDENCE				
4-5	QC_DUST_CONFIDENCE				
6-7	QC_NUC_CONFIDENCE				

Product evaluation/validation:

NOAA-21 ADP data files from the NDE I&T string were used for evaluation and validation. EDR data and global gridded (0.25°) fields of ADP from NOAA-21, NOAA-20 and S-NPP for the period February 11 to July 21, 2023 were examined. Validation with ground-based AERONET Ångström-based smoke/dust classification and satellite CALIPSO/CALIOP vertical feature mask (VFM) indicates NOAA-21 ADP meets requirements for Accuracy, measured as Probability of Correct Detection (POCD). Overall, NOAA-21 ADP performance is very similar to NOAA-20.

Product availability/reliability:

The NOAA-21 primary Ka-Band transmitter experienced an anomaly on December 16, 2022. The secondary Ka-Band transmitter was initiated on February 2, 2023, and all VIIRS detectors were reported as stable on February 10. As a result, NOAA-21 VIIRS ADP data were evaluated starting on February 11, 2023.

Algorithm performance dependence:

The VIIRS EPS ADP algorithm requires good quality Sensor Data records (SDR) for VIIRS bands M1-M13 and M15-M16 and Environmental Data Records (EDRs) for VIIRS Cloud Mask and Snow Cover. The ancillary land/water mask and snow/ice mask must also be good quality. Detection of volcanic ash and its quality flags are passed through the ADP algorithm from the Volcanic Ash EDR, so the performance of the ADP algorithm is not impacted by the quality of the

Volcanic Ash product.

Known errors/issues/limitations:

The VIIRS Aerosol team has identified the following APD data quality issues that the users should be aware of:

- Thick brown-colored smoke plumes may be mis-classified as thick dust over land and water.
- Sulfur dioxide (SO_2) plumes from volcanic eruptions may be identified as smoke.
- Thin dust plumes over vegetated surfaces may be mis-classified as smoke.
- Some thin clouds may be mis-classified as dust at high latitudes.

3. **Changes since last maturity stage:** None
4. **Review board recommendations:** The review team encourages the Aerosol Cal/Val team to work closely with the Volcanic Ash Cal/Val team to ensure needs are met as they transition away from the legacy processing to the VOLCAT system.
5. **Path Forward/Future Plan:** For the Validated Maturity review, a longer record of NOAA-21 ADP, covering at least one full year, will be evaluated by comparing NOAA-21 ADP to ADP from NOAA-20 and S-NPP and by validation with ground-based AERONET Ångström-based smoke/dust classification data. Alternative datasets will be explored to mitigate the loss of CALIPSO/CALIOP VFM data, including ground-based LIDAR networks and the upcoming ESA/JAXA EarthCARE satellite's atmospheric lidar (ATLID). Corrections and updates to the EPS ADP algorithm will be made, as needed.
6. **Additional Items to note:** None

Additional information is available in the VIIRS EPS ADP algorithm theoretical basis document (ATBD) and validation maturity review briefing, which can be accessed at:
http://www.star.nesdis.noaa.gov/jpss/Docs.php

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