



*Read-me for Data Users*

**MEMORANDUM FOR:** The JPSS Program Record  
**SUBMITTED BY:** JPSS Aerosol Team Leads, Istvan Laszlo and Shobha Kondragunta  
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**SUBJECT:** NOAA-20 Aerosol Optical Depth and Aerosol Particle Size Beta maturity status

**DATE:** 04/18/2018

**Beat maturity status declaration for Aerosol Optical Depth and Aerosol Particle Size**

**Maturity Review Date:** 04/18/2018  
**Effective Date:** 03/20/2018)  
**Operational System:** NDE I&T string, V1.2

The JPSS Algorithm Maturity Readiness Review Board approved the release of the Aerosol Optical Depth and Aerosol Particle Size to the public with a Beta maturity level quality as of 03/20/2018 (effective date), based on JPSS Validation Maturity Review held on 04/18/2018 (link to review artifacts).

- Beta maturity definition** (from <http://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>):
  - Product is minimally validated, and may still contain significant identified and unidentified errors.
  - Information/data from validation efforts can be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose.
  - Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists.

- Product:**
  - Aerosol Optical Depth (AOD)
  - Aerosol Particle Size (APS) (reported as the Angstrom Exponent)

Product requirements/Exclusions (LIRDS):

Attribute	AOD	APS
<i>Applicable Conditions</i>	Clear sky, daytime only, zenith angles $\leq 80^\circ$	
<i>Vertical Coverage</i>	Total column	
<i>Horizontal Cell Size</i>	0.75 km at nadir, 1.6 km at edge of scan	
<i>Vertical Cell Size</i>	Total column	

<i>Mapping Uncertainty, 3σ</i>	4 km			
<i>Measurement Range</i>	-0.05 to +5		-1 to +3	
<i>Measurement</i>	<i>Accuracy</i>	<i>Precision</i>	<i>Accuracy</i>	<i>Precision</i>
<i>Over Ocean</i>	0.08 (AOD < 0.3) 0.15 (AOD ≥ 0.3)	0.15 (AOD ≤ 0.3) 0.35 (AOD ≥ 0.3)	0.3	0.6
<i>Over Land</i>	0.06 (AOD < 0.1); 0.05 (0.1 ≤ AOD ≤ 0.8) 0.20 (AOD > 0.8)	0.15 (AOD < 0.1) 0.25 (0.1 ≤ AOD ≤ 0.8) 0.45 (AOD > 0.8)	n/a	n/a
<i>Refresh Rate</i>	90 minutes (~100 minutes)			

**Quality flags:**

There are four overall quality levels assigned to the product indicated by numbers 0, 1, 2, and 3.

- Quality flag 3 identifies pixels with “No retrieval”. They are pixels where the presence of cloud, snow or sea ice, shallow water, sunglint, ephemeral water, or fire prevented reliable AOD retrieval, or the scene (over land) is too inhomogeneous.
- Quality flag 2 identifies pixels with “Low” quality. These are pixels for which either of the following conditions is true: the retrieved AOD is out of range, the solar zenith angle is larger than 80 degrees, external cloud mask and internal cloud test indicate conflicting conditions (clear vs. cloudy), pixel is in coastal area, standard deviation of reflectances of a given channel calculated from 3x3 pixels is large, and the retrieval residual is large. Over-land pixels for which the retrieval required extrapolation to positive AOD are also deemed “Low” quality.
- Quality flag 1 identifies pixels with “Medium” quality. These are pixels in cloud-shadow areas, adjacent to clouds or snow, affected by thin cirrus as indicated by internal test, standard deviation of reflectances of a given channel calculated from 3x3 pixels is large (but smaller than that for Low quality), and the retrieval residual is large (but smaller than that for Low quality). Over land, pixels that are in barren or sparsely vegetated areas, or for which certain internal tests lead to out-of-range values are also deemed “Medium” quality.
- Quality flag 0 identifies “High” quality. These are all remaining pixels after excluding pixels of “No retrieval”, “Low”, and “Medium” qualities.

For details consult Tables 3-9 and 3-12 of the ATBD.

**Product evaluation/validation:**

A preliminary evaluation of NOAA-20 AOD and APS retrievals used NOAA-20 retrievals from three sources: NDE I&T string, STAR ASSISTT and STAR Science Team, and S-NPP retrievals from NDE Operational string. Global fields of AOD from NOAA-20 and S-NPP for days examined are very similar. Somewhat larger differences are present in APS.

Limited evaluation with ground-based AERONET data indicates AOD and APS retrieved from NOAA-20 reflectances meet requirements. NOAA-20 Accuracy and Precision are similar to those from S-NPP.

**Product availability/reliability:**

VIIRS AOD and APS EDR data were produced since 02/26/2018 offline in the STAR Framework (ASSISTT), but data before about 03/20/2018 (Beta maturity effective date) may not be reliable because of the VIIRS LWIR channels (M5 and M6) degradation, although evaluation of AOD with AERONET does not suggest clearly recognizable negative impact. Access to AOD and APS in NDE I&T became available on 03/20/2018.

**Algorithm performance dependence:**

The VIIRS aerosol optical depth and aerosol particle size algorithm requires good-quality Sensor Data records (SDR), primarily reflectances in bands M1-M11 and brightness temperatures in M15 and M16. Degradation in reflectances will affect the quality of AOD; the impact on APS is expected to be more severe. Good quality of various masks (cloud, land/water, snow/ice, sunglint, fire, cloud shadow and heavy aerosol) used to screen out pixels where aerosol retrieval should not be attempted is also important. Out of these masks the quality of cloud mask is especially important. Reliable model data of total precipitable water, column amount of ozone, surface pressure and wind speed and direction are also required for high quality AOD and APS.

**Known errors/issues/limitations:**

- Metadata of averages are incorrect in NDE
- Many missing granules in NDE I&T
- NDE I&T (likely) does not yet use NOAA-20 LUTs and processing coefficients
- Saturation of channels (e.g., M6) may not be properly indicated in input to the aerosol algorithm. The impact is expected to be minimal.

**3. Changes since last maturity stage:** None

**4. Review board recommendations:**

**5. Path Forward/Future Plan:**

Processing of NOAA-20 AOD and APS in NDE I&T must stabilize well before reaching Provisional Maturity. The preferred source is NDE Operational string for evaluation for Provisional Maturity.

A long record (several month) of NOAA-20 AOD from **NDE Ops string** will be evaluated by comparing NOAA-20 retrievals of AOD and APS to corresponding products from S-NPP and ground-based reference from AERONET.

Planned activities include



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- update of spectral land-surface reflectance relationships derived from NOAA-20 VIIRS observations,
- update of thresholds used in internal tests,
- making sure saturation of channels is properly indicated in input to aerosol code.

There are also potential Algorithm Science updates beyond Provisional/Validated Maturity that the STAR Science Team is likely to undertake. This includes an attempt to improve regional performance by expanding/revising candidate aerosol models and surface reflectance relationships.

### **6. Additional Items to note:** None

Additional information is available in the JPSS Aerosol Optical Depth and Aerosol Particle Size 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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