



MEMORANDUM FOR: The JPSS Program Record
SUBMITTED BY: JPSS OMPS Team, Banghua Yan, Chunhui Pan, and Trevor Beck
CONCURRED BY: JPSS Algorithm Management Project Lead Lihang Zhou
JPSS STAR Program Manager Satya Kalluri
APPROVED BY: JPSS Program Scientist Mitch Goldberg
SUBJECT: NOAA-20 OMPS SDR validated maturity status and public release
DATE: 04/23/2020

Validated Maturity status declaration for OMPS NP-SDR

Maturity Review Date: 04/23/2020
Effective Date: 04/23/2020
Operational System: IDPS with OMPS LUT from ADR 9093, 9066

1. Background:

The Joint Polar Satellite System-1 (JPSS-1) was successfully launched on November 18, 2017 and renamed NOAA-20 after reaching polar orbit. Forty-eight days after launch, on January 5, 2018, the NOAA-20 Ozone Mapper Profiler Suite (OMPS) started collecting science data. With the same design as the Suomi NPP OMPS Nadir Suite, NOAA-20 OMPS consists of two spectrometers each with different spectral and spatial coverage. The nadir mapper has spectral coverage from 300nm to 380nm with 196 channels and 1.1nm bandpass. The nadir profiler has spectral coverage from 250nm to 310nm with 150 channels and 1.1 nm bandpass. The OMPS nadir suite provides global measurements of radiance, total ozone, ozone profile, sulfur dioxide, and an aerosol index.

Several weeks after door-open phase of data collection it was discovered there were significant problems with the OMPS-NM measurements in low resolution. The problem was found to be the sample and macropixel tables. These are flight and ground tables that determine which CCD pixels are to be binned together by the flight software prior to the data downlink. The binned CCD pixels are referred to as macropixels. The macropixels are necessary due to data downlink bandwidth limitations. There is not enough bandwidth capacity to collect the full resolution measurements. The OMPS-NM medium resolution mode has a ground pixel size at nadir of approximately 17km by 17km. The IDPS SDR processor aggregates the measurements spatially to a hybrid of low resolution and medium resolution by binning the macropixels in the cross track dimension. The OMPS-NM aggregated measurements have a nadir ground pixel size of 50km across by 17km along track. The OMPS-NP ground pixel size is 50km by 50km at nadir. No binning of the macropixels is necessary for OMPS-NP in the ground processor. On February 13, 2019 new flight tables were uploaded for NOAA-20 OMPS. There are two primary measurement periods, before and after this date. *The measurements prior to this date cannot meet validated maturity goals due to spatial mismatch in the fields of view of the OMPS-NP and OMPS-NM.*

The OMPS SDR team consists of experts from NOAA, University of Maryland/CICS, NASA, GST Inc, Aerospace Corp., and industry partner Raytheon. The team has been working intensively on post-launch instrument performance optimization and OMPS SDR pre- and post-launch calibration and validation. The NOAA-20 OMPS was declared Beta Maturity on February 20, 2018. The NOAA-20 OMPS reached provisional maturity on July 2, 2018. The OMPS-TC reached validated maturity on September 19, 2019. The NOAA-20 OMPS-NP SDR performance was reviewed in September 2019, but it was still defined as provisional maturity due to a couple of issues to be addressed (see April 2020 maturity review briefing presentation for details). *It is expected that OMPS-NP reached validated maturity on April 23, 2020.*

2. Validated maturity stage definition:

- 1) Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).
- 2) Comprehensive documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies for a full range of retrieval conditions and severity level.
- 3) Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.
- 4) Product is ready for operational use based on documented validation findings and user feedback.
- 5) Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.

3. Justifications for declaring OMPS-NP SDR data products validated maturity:

The first NOAA-20 OMPS entered into its current operational configuration on Feb. 13, 2019. Based on OMPS NP-SDR datasets from the IDPS, the following assessments of the OMPS SDR products were performed:

- 1) The NOAA-20 OMPS-NP On-orbit sensor performance characterized and calibration parameters have been adjusted accordingly, meeting requirements.
 - i) All issues resulting from 2019 September Review are well addressed.
 - ii) Wavelength performance meets specification.
 - iii) Stray light performance meets specification.
 - iv) Signal to Noise Ratio (SNR) meets specification.
 - v) Geolocation uncertainty meets the 5km requirement at nadir.
 - vi) Albedo calibration meets requirement.
- 2) The NOAA-20 OMPS SDR is ready for use in applications and scientific publications.
 - i) Wavelength LUT, solar flux LUT and radiance coefficient LUT were updated from on-orbit measurements for OMPS-NP.
 - ii) NOAA-20 OMPS SDR quality is assessed globally and seasonally.
 - iii) The SDR performance has been stable for more than 12 months since provisional maturity.
 - iv) Routine operational calibration are carried out to maintain OMPS-NP SDR stability. OMPS-NP are updating the dark calibration on a weekly basis, and solar calibration on a bi-weekly basis.
- 3) Comprehensive documentation of instrument status and product performance exists,

including ICVS reports, (NASA) Algorithm Theoretical Basis Documents (ATBD), Operational Algorithm Description (OAD), ReadMe file, Cal/Val plan and regular weekly/monthly reports.

- 4) The NOAA STAR EDR team has successfully used the SDR data in total ozone and ozone profile retrievals.

The detailed justifications for declaring OMPS NP-SDR validated maturity is provided in the attached presentation.

4. NOAA-20 OMPS NP-SDR Validated Maturity Caveats

The OMPS C/V team recommends that users be aware of certain specific data product characteristics. The following caveats are provided to the validated product users:

- 1) OMPS SDR datasets prior to Feb. 13, 2019 have a variety of problems documented in the OMPS provisional Readme document. Data measured prior to this date do not meet validated maturity requirements. This is the Field of View mismatch problem fixed with DR8617 with a change in flight sample tables.
- 2) Prior to implementation of DR8616 there were up to 20 missing scans per day in the OMPS-NP measurements. The IDPS processor would drop measurements from the processing stream due to clock skew between CCSDS packet times and OMPS measurement times. This was corrected in IDPS build Blk2.1 MX3.
- 3) Datasets prior to DR8685 did not have correctly set quality flags, this was corrected in the IDPS in February 2019.
- 4) There was a problem with the non-linearity flight table correction, fixed with DR8730, on Dec. 4, 2018. Radiances below 290nm region had discretization errors in low signal (high SZA) measurements.
- 5) The NOAA-20 OMPS-NP did not have transient smear correction until August 2019. Within the SAA and auroral oval regions high energy particles can induce transients in the OMPS-NP CCD smear pixels, this may cause negative radiances in some measurements. A correction algorithm was implemented in the IDPS Block 2.1 MX06 build.
- 6) For a few wavelengths at a high latitude > 65 deg. region, there is inconsistency issue in radiances between the S-NPP OMPS-NP and the NOAA-20 OMPS-NP. This issue is under active investigation.
- 7) Dark calibration algorithm for S-NPP OMPS and NOAA-20 OMPS NP and NM is under review. It will be upgraded if necessary.
- 8) A change was made to the OMPS-NP calibration constants in conjunction with adjustments to the wavelength scale. This is documented under DR9066. OMPS-NP SDR datasets prior to the implementation of DR9066 do not meet the validated requirements wavelength registration.



In summary OMPS-NP data from the IDPS prior to approximately Feb. 13, 2019 should not be used unless reprocessed data are provided. OMPS-NP data from the IDPS prior to approximately April 2020 should not be used without corrections for the errors in radiance, solar flux, and wavelength.

5. Path Forward

The team will work diligently to continue with the following planned Cal/Val tasks after validated Maturity of the OMPS SDR data products:

- 1) Continue to improve OMPS-NP SDR data quality to further address any additional comments/concerns from OMPS EDR and other users
- 2) Monitor degradation in the OMPS-NP shortest spectral region and mitigate impact if needed
- 3) Explore SNPP NP spectral feature to improve the inconsistency between S-NPP and NOAA-20 OMPS sun-normalized radiances
- 4) Check normalized radiance with radiative transfer modelling
- 5) Improve the ICVS to monitor OMPS instrument LTM stability and performance, as well as SDR data quality
- 6) Continue to work with OMPS EDR and other users together to address their concerns

Additional information is available in the OMPS algorithm theoretical basis document (ATBD) and maturity review briefing, which can be accessed at:

<http://www.star.nesdis.noaa.gov/jpss/Docs.php>

<https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>

Operational NOAA-20 OMPS near real time status and performance monitoring web page is available using the following URL at:

https://www.star.nesdis.noaa.gov/icvs/status_N20_OMPS_NM.php

https://www.star.nesdis.noaa.gov/icvs/status_N20_OMPS_NP.php

Point of Contact:

Name: Banghua Yan

Email: banghua.yan@noaa.gov

Phone: 301-683-3602