



Read-me for Data Users

MEMORANDUM FOR: The JPSS Program Record
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SUBJECT: NOAA-21 OMPS V8Pro EDR Provisional Maturity
DATE: 10/30/2023

Provisional maturity status declaration for OMPS Nadir Ozone Profile EDRs (V8Pro)

Maturity Review Date: 10/26/2023
Effective Date: xx/yy/2023
Operational System: NDE I&T V8Pro v4r2 & NCCF V8Pro v4r3 **5?**

1. Background:

The Joint Polar Satellite System-2 (JPSS-2) was successfully launch on November 10, 2022 and renamed NOAA-21 after reaching polar orbit. With the same basic design as that of the Suomi NPP and NOAA-20 OMPS Nadir Sensors, the NOAA-21 OMPS Nadir component consists of two spectrometers each with different spectral and spatial coverage. The OMPS Nadir Mapper (NM) SDR has spectral coverage from 300 nm to 380 nm with 196 channels and 1.1-nm bandpass. The OMPS Nadir Profiler (NP) SDR has spectral coverage from 250 nm to 310 nm with 150 channels and 1.1-nm bandpass. The OMPS nadir suite provides global measurements of total ozone, ozone profile, sulfur dioxide, UV reflectivity and an aerosol index. The main change from the NOAA-20 OMPS Nadir Sensors is that the NOAA-21 OMPS NM is sending down data with much less aggregation. The IDPS OMPS NM SDRs for NOAA-21 have 177 cross-track macro-pixels (of four spatial cross-track pixels each) while the NOAA-20 SDRs have 35 cross-track macro-pixels (of 20 spatial cross-track pixels each). The NOAA-21 reports measurements with twice the frequency, creating 30 1.25 S scans per 38 S granule compare with 15 2.5 S scans for NOAA-20. The nadir field-of-view (FOV) resolution is now 10x9 km² versus the precious 50x17² km sizes.

Since February 9, 2023 the instrument has been opened and, intermittent with continued diagnostic and calibration mode measurements, it has been operated in a high resolution Earth Science mode. The NDE processing of the IDPS SDRs for these measurements has created V8Pro, V8TOz and V8TOS ozone EDR products.

The OMPS Ozone EDR team consists of experts from NOAA, NASA, IMSG, cooperative institutes and industry partner Raytheon. The team has been working OMPS EDR pre- and post-launch calibration and validation for the Total Column Ozone EDRs from V8TOz and V8TOS, and the Ozone Profile EDRs from V8Pro as process at NDE I&T and NCCF Dev and UAT.

2. Provisional maturity stage definition

(<http://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>):

- 1) 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.
- 2) Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose.
- 3) Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists.

- 4) Product is recommended for potential operational use (user decision) and in scientific publications after consulting product status documents.

3. Justifications for declaring OMPS EDR data products provisional maturity:

After NOAA-21 OMPS activation, the OMPS SDR and EDR team members started analysis of OMPS science RDR, telemetry RDR, SDR and GEO and EDR data. The JPSS Algorithm Maturity Readiness Review Board approved the release of the NOAA-21 OMPS Nadir Mapper and Nadir Profiler SDRs to the public with a Beta Maturity level quality effective as of 03/23/2023, based on the JPSS Maturity Review held on 02/23/2023 and with a Provisional maturity level quality effective 6/20/2023, based on the Provisional Maturity Review held on 3/30/2023.

Based on seven months of evaluation and monitoring of OMPS data, the following assessments of the OMPS SDR and EDR products were compiled:

- The NOAA STAR EDR team has successfully used the SDR data in total ozone and ozone profile retrievals and are generally positive about the measurement quality.
- OMPS SDR products for the Earth-view Nadir Mapper SDR & GEO and Nadir Profiler SDR & GEO were checked and the performance is well within the specifications. The EDRs use the same geolocation information as the SDRs;
- The OMPS solar measurements were compared to prelaunch model spectra and wavelength shifts were found for both the OMPS Nadir Mapper (NM) and Nadir Profiler (NP). The SDR wavelength scales have been adjusted for these changes effective March 23, 2023, and the NM measurement-based intra-orbit wavelength scale adjustment is working well. The EDRs use the SDR solar and wavelength scale to compute the radiance/irradiance spectra;
- Dark current and LED calibration parameters were evaluated and compared to prelaunch measurements. The noise levels are as expected and the weekly updates will maintain them adequately for the EDR processing. The non-linearity is well within specifications;
- The pixel aggregation for the extreme cross-track FOV (#177) is incorrect. The SDR Team has provided a correction but it is not yet in operations. It will not be in until DR10039 is implemented in MX 8/9 TTO June 2023;
- Errors and artifacts in the SDR and EDR data products were documented. Solutions have been proposed and evaluated, but not necessarily implemented. These include the Solar Intrusion In-Band Straylight (IBSL) for the OMPS NP SDR at high solar zenith angles in the Northern Hemisphere, and the use of shifted wavelength centers for the V8TOz Radiative Transfer Instrument Table. The latter has been corrected in NDE I&T processes as of March 8, 2023. An initial correction for the solar intrusion will be implemented in November 2023 with an improved correction requiring code changes following six months later.
- The NOAA-21 EDR products from NDE were compared to S-NPP and NOAA-20 EDR – NOAA-21 ozone results are similar to those for S-NPP with differences and caveats as noted below; and
- NOAA-20 OMPS Nadir SDR and EDR data products can be used for making initial qualitative or limited quantitative assessments,

Following the SDR Provisional Maturity review, new errors and uncertainties were discovered in the NOAA-21 processing. The main ones are as follows:

- The NOAA-21 OMPS NM Stray Light correction was found to be performing poorly. The SDR team has implemented a first set of revised correction parameters but is continuing to investigate the out-of-band response from wavelengths longer than 380 nm.
- The NOAA-21 OMPS NP SDR biweekly wavelength scale updates to the solar

irradiance tables were not consistent with the wavelength scale evolution from analysis of the Earth radiances. Both S-NPP and NOAA-21 OMPS NP SDRs show good agreement in the shifts for the Mg II index locations between the radiance and irradiance with a consistent 0.04-nm and 0.05-nm, offsets, respectively. The SDR team expects to address this problem starting on October 26, 2023.

Additional information is available in the V8Pro Nadir Profile Ozone and V8TOz Total Column Ozone algorithm theoretical basis document (ATBD) and SDR and EDR validation maturity review briefings, which can be accessed at: <http://www.star.nesdis.noaa.gov/jpss/Docs.php> and <https://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>.

4. NOAA-20 OMPS Ozone EDR provisional maturity caveats

The following caveats were provided to beta EDR product users:

1) The NM SDRs have some cross-track biases which appear in the retrieved EDRs as striping in the V8TOz product maps. This problem was greatly reduced when a new corrected instrument table is used (in NDE I&T as of April 8, 2023) and the use of soft calibration adjustments.

2) The stray light corrections for the OMPS NM SDRs is still a work in progress. Changes in these will impact the absolute accuracy of the V8TOz EDRs and affect the final EDR adjustments. In particular, the latest table update (In operations on June 23rd, 2023) does not include the out-of-band contributions to the stray light correction. That is, the stray light with sources longer than 380 nm.

3) The SAA flag is not set for some of the affected retrievals beyond the edges of the currently defined region. The SAA has been drifting west over the last decade.

4) The NOAA-21 OMPS NP SDRs show evidence of the solar intrusion out-of-field stray light also seen in the NOAA-20 OMPS NP SDRs. The NOAA-20 OMPS NP SDR code apply an empirical-model-based correction to reduce the impact of this stray light error. The NOAA-21 parameters for this model have not yet been implemented. Until they are, the ozone profiles will have significant positive biases in the retrievals in the Northern Hemisphere for Solar Zenith Angles greater than 60°. The SDR Team is working on a higher fidelity correction but it requires code changes.

5) The Soft Calibration to force agreement between NOAA-21 V8Pro and S-NPP V8Pro EDRs did not produce good agreement in at the mid and high latitudes of the Southern Hemisphere. The source of these differences is under investigation. The 273 nm channel, in particular, shows large differences in the initial residuals. **The OMPS NP SDR Team has identified an error in their estimates of the wavelength scale shifts of 0.02 nm for NOAA-21 OMPS NP.** They will correct it beginning with the table implementation on 11/03/2023.

5. Path Forward

The team will work to continue with the following planned calibration and validation tasks to promote the OMPS EDR data products to provisional maturity:

- 1) Investigate possible sources of the poor agreement in profile retrievals between NOAA-21 and S-NPP in the Southern Hemisphere. In particular, we will recompute the soft calibration adjustments after the changes in the NOAA-21 OMPS NP wavelength scale are implemented.
- 2) Compare Equatorial Pacific regional means for V8Pro EDRs with those for NOAA-20 and S-NPP for longer overlap periods.
- 3) Track the impact of continued improvements in the SDR as planned by the SDR team.
- 4) Provide deliveries of adjustment tables and code changes for V8Pro to NDE and NCCF as SDR maturity progresses and stabilizes and validation results are analyzed.

Additional information is available in the OMPS V8TOz and V8Pro algorithm theoretical basis documents (ATBDs) and the SDR beta maturity review briefing, which can be accessed at:



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

and

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

NOAA-21 OMPS SDR near-real-time status and performance monitoring web page are available at the following websites:

https://www.star.nesdis.noaa.gov/icvs/status_N21_OMPS_NP.php

https://www.star.nesdis.noaa.gov/icvs/status_N21_OMPS_NM.php

Pre-operational NOAA-21 OMPS EDR near-real-time status and performance monitoring web pages will become available at the following websites:

Archive https://www.class.ncdc.noaa.gov/saa/products/search?datatype_family=JPSS_OZONE

Operations <http://www.ospo.noaa.gov/http://www.ospo.noaa.gov/Products/atmosphere/index.html>

Long-term <https://www-dev.star1.nesdis.noaa.gov/OMPSDemo/index.php>

Daily maps https://www.star.nesdis.noaa.gov/jpss/EDRs/products_ozone.php

Activity <https://ozoneaq.gsfc.nasa.gov/activity/omps/n21/>

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