Read-me for Data Users

MEMORANDUM FOR: The JPSS Program Record
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SUBJECT: NOAA-20 OMPS SDR provisional maturity status and public release
DATE: 02/28/2018

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provisional maturity status declaration for OMPS TC-SDR
Maturity Review Date: **02/20/2018**
Effective Date: **02/18/2018**
Operational System: **IDPS with OMPS LUT from ADR 8507,8508,8576,8594,8615**

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.

The OMPS SDR team consists of experts from NOAA, University of Maryland/CICS, NASA, ERT Inc, The 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.

Several weeks after door-open phase of data collection it was discovered there were significant problems with the OMPS-TC measurements in low resolution. The original concept of operations had OMPS measuring in low resolution for the first nine months. 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 problems with the low resolution measurement mode is most apparent in the global maps where a striping pattern is noticeable at the western most and eastern most measurement fields of view. Based on the LEO measurements made in different spatial resolutions it was found that problem could be fixed by running OMPS-TC instrument in a medium resolution mode.

The OMPS-TC 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-TC aggregated measurements have a nadir ground pixel size of 50km across by 17km along track.

There were a total of eight tables that unexpectedly required updates post-launch. All table updates for provisional have been live in the IDPS ground processor system for the OMPS since March 30, 2018. The OMPS-TC SDR data prior to the operational implementation of these tables do not meet provisional requirements. The OMPS-NP currently has all of the necessary table updates for provisional.

The OMPS-NP is measuring in a medium resolution mode with 50km by 50km ground pixel size. A coding error was discovered that results in the OMPS-NP solar flux and wavelength values to be incorrect. The code changes to resolve this were delivered and were approved out of board on February 28. It is expected that the operational system will be updated to include the code changes in the July 2018 time frame. The IDPS OMPS-NP SDR output will not meet provisional requirements until the code change is in operations.

There was a large error in OMPS-NP geolocation. It was caused by the incorrect FAM(Field Angle Map) tables. These give the look angle for the OMPS instruments. This error also affected OMPS-TC geolocation but with a much smaller magnitude. These have been corrected. The OMPS SDR geolocation after February 25 have geolocation that meets the provisional requirements.

2. **provisional maturity stage definition:**
    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-TC SDR data products provisional maturity:**

After the first NOAA-20 OMPS low resolution door open measurements were made on January 19, OMPS SDR team members identified several major problems. These problems have been addressed and deliveries made to DPES. On February 9 OMPS entered into the nominal operations medium resolution mode. Based on OMPS TC-SDR datasets from the IDPS, the following assessments of the OMPS SDR products were performed:

1) OMPS SDR products for the major categories (Nadir Mapper SDR,GEO and Nadir Profiler SDR,GEO) were checked;
2) The OMPS solar measurements were compared to prelaunch model spectra;

3) Dark current and LED calibration parameters were evaluated and compared to prelaunch measurements;
4) Dark current deliveries were begun. Both OMPS-TC and OMPS-NP are updating the dark current Gnd-Pi on a weekly basis;
5) New solar flux and earthview measurement wavelength tables were derived from on-orbit measurements, for both OMPS-NP and OMPS-TC;
6) On-orbit SDR radiometric bias was estimated based on preliminary comparisons with Suomi NPP.
7) Errors and artifacts in the data products were documented. Solutions have been implemented. Deliveries were made to DPES to correct the problems.
8) The NOAA STAR EDR team has successfully used the SDR data in total ozone and ozone profile retrievals and are positive about the measurement quality.
9) The OMPS SDR team evaluated the geolocation accuracy at nadir to be within the 5km requirement (using off-line datasets). This task was aided by the NASA OMPS team, they provided estimates of geolocation errors using high resolution reflectivity datasets.

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

4. NOAA-20 OMPS TC-SDR provisional maturity caveats

The following caveats are provided to the provisional product users:

1) OMPS SDR prior to Feb. 9 have a variety of problems documented in the OMPS Beta Readme document. Measurements from that period were taken in high, medium, and low resolution. The medium resolution measurement modes is preferable. The data collected after Feb. 9 are in medium resolution mode.
2) The geolocation of the OMPS SDR datasets prior to implementation of DR_8576,8577 Field Angle Map update, have large errors. This was fixed in IDPS on February 25, 2018.
3) OMPS-TC SDR data produced by the IDPS prior to implementation DR_8594, poorly chosen sample tables, should not be used. The table updates were made to IDPS operational data stream March 30, 2018..
4) The OMPS-NP SDR datasets prior to implementation of DR_8615, Incorrect across track binning, have errors in the solar flux, wavelength, and radiance. The OMPS team is running these daily with off-line ADL runs that have the corrections in place. In general users should not use OMPS-NP SDR datasets from the IDPS prior to operational implementation of DR_8615. Sophisticated EDR users may use these datasets by replacing the solar flux and wavelength with a corrected solar and wavelength dataset. The errors in radiance are smaller and could be accounted for with multiplicative radiance adjustments in an EDR retrieval algorithm. The expected implementation of the fix for this problem is approximately July, 2018.

5) The high resolution mode data do not have complete spectral coverage at the short and long ends of the standard spectral interval.
6) OMPS-NP shortest spectral measurements. A waiver was written for OMPS-NP SDR on this issue. So far, there is no clear evidence of accelerated degradation based on solar measurements.
7) There is a missing scan problem, caused by unexpected variability in the OMPS CCSDS packet times. This apparently is the result of the time it takes for the OMPS flight software to compress the measurement counts. At ingest the variance in the packet time results in some RDRs being created with 16 scans per granule. The OMPS SDR processor assumes that the maximum size of an RDR will be 15 scans. It drops the entire 16 scan granule. In each day there are approximately five to 20 dropped granules. The missing granules are apparent when looking at a global map. There will be a configuration change to IDPS with PCR 65318, DR_8616. The expected time frame for this fix is September 2018, MX03.
8) There is a sub-optimal match in the CCD pixels for the OMPS-TC and OMPS-NP sample tables. The OMPS-TC and OMPS-NP are not viewing exactly the same spatial region within each FOV. A better alignment could be achieved. For example if a bright cloud is fills one OMPS-TC FOV pixel but is cloud-free in an adjacent FOV pixel the OMPS-NP alignment will sample both the cloud and cloud free pixel. The alignment difference is small but could be significant in some cases. The difference in field of view will sometimes in the worst case combine the bright scene and dark scene in the NP pixel. There is a report on this issue, DR_8617, "FOV Mismatch between N20-OMPS-TC and N20-OMPS-NP". This is not an issue that affects provisional maturity.

In summary OMPS-TC data from the IDPS prior to approximately March 30, 2018 should not be used. OMPS-NP data from the IDPS prior to approximately July 2018 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 to promote the OMPS SDR data products to validated maturity by launch+270 days:

1) Check normalized radiance with radiative transfer modelling
2) Continue to monitor OMPS instrument stability and performance, as well as SDR data quality
3) Analyze the high resolution data for evidence of diminished measurement counts due to FOD (Foreign Object Debris), so far, there appears to be no evidence of impact the

FOD on Earth-view or solar measurements. The FOD is clearly seen in the LED measurements.

4) Check for degradation in the OMPS-NP shortest spectral region.
5) Implement a fix to the missing scans problem by modifying the OMPS SDR code to stage multiple RDR inputs for each SDR output. This is similar to the method ATMS uses to stages multiple RDR granules for each SDR output. This is a configuration change to the IDPS system.
6) Address the spatial mismatch between OMPS-TC and OMPS-NP scenes.

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

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

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

https://www.star.nesdis.noaa.gov/icvs-beta/status_J01_OMPS_NP.php

https://www.star.nesdis.noaa.gov/icvs-beta/status_J01_OMPS_NM.php

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