OMPS Total Column Release, Provisional Data Quality
Recommended Cautions for Data Users
Last updated April 15, 2013

The JPSS Algorithm Engineering Review Board has reviewed the OMPS Total Column Ozone Data Record products (OMPS-TC-EDR/OOTCO and OMPS-TC-Oz-Fst-Guess-IP/INCTO) and set the Data Quality attribute to Provisional as of March 1, 2013. Provisional quality is defined as:

- The product quality may not be optimal.
- Incremental product improvements are still occurring.
- The general research community is encouraged to participate in QA and validation of products but need to be aware that product validation and QA are ongoing.
- Users are urged to consult the EDR product status document prior to the use of the data in publications.
- The product is ready for operational evaluation

The OMPS Total Column Ozone Products offer different ozone products with current and evolving strengths and weaknesses. Part of the purpose of the provisional period investigation is to learn more about the issues present for the different products. The four principal products to consider are as follows:

1. The First Guess Intermediate Product (IP), INCTO, has two important ozone values in the "ALL_DATA.OMPS_TC_OZ_FST_GUESS_IP_ALL" path of the HDF files named
COLUMNAMOUNTO3V7 & COLUMNAMOUNTO3

2. The definitive Environmental Data Record (EDR), OOTCO, has two corresponding ozone products in the "ALL_DATA.OMPS_TC_EDR_ALL" path of the HDF files named
COLUMNAMOUNTO3V7 & COLUMNAMOUNTO3

The Version 7 (V7) estimates of ozone come from a single triplet set of wavelengths (at 317, 331 and 364 nm) similar to a triplet available from the Total Ozone and Mapping Spectrometer (TOMS) instruments flown by NASA. The standard product selects its estimates from among multiple triplets based on viewing conditions. This creates a tradeoff between sensitivity to measurement uncertainties (as yet not fully validated) and optimal triplet information content. The First Guess IP estimates use static climatological input for some fields; this information is obtained from near-real-time CrIS and VIIRS retrievals (as yet not fully validated) for deriving the EDR retrieval values.

Even though both products have advanced to Provisional Data Quality, there are known differences in the quality of the two products related to their use of external data sets. The HDF format of the two products is the same. The INCTO product has its multiple triplet retrieval estimates in the columnamounto3 parameter and no value in the firstguesscolumnamounto3 parameter. Because of inter-channel calibration inaccuracies, many error and data quality flag bits are currently set. The following flagged cases should not be used for Provisional evaluation purposes:

1. Error Flag Bit 8 set to 1 – Ozone out of range, i.e., < 50 DU or > 650 DU,
2. Quality Flag #1 Bit 1 set to 0 – no retrieval,

3. Quality Flag #1 Bit 7 set to 1 – SZA > 88 degrees, and
4. Quality Flag #2 Bit 3 set to 1 – Solar eclipse in FOV.

All other non-fill ozone values maybe used for Provisional evaluation purposes.

Version 7 versus Multiple Triplet Total Column Estimates

The product files contain both Multiple Triplet and Heritage Version 7 Triplet Total Column Ozone estimates. The Heritage Version 7 products have a "V7" appended to their parameter names.

The multiple triplet combines an ozone insensitive wavelength channel (at 364, 367, 372 or 377 nm) to obtain cloud fraction and reflectivity information, with a pair of measurements at two shorter wavelengths. The pairs are selected to have one "weak" and one "strong" ozone absorption channel. The "strong" ozone channels are placed at 308.5, 310.5, 312.0, 312.5, 314.0, 315.0, 316.0, 317.0, 318.0, 320.0, 322.5, 325.0, 328.0, or 331.0 nm. They are paired with a longer "weak" channel at 321.0, 329.0, 332.0, or 336.0 nm. The hyperspectral capabilities of the sensor are used to select different sets of triplets to balance ozone sensitivity across the range of expected ozone column amounts and solar zenith angles.

Given the current state of the calibration, each triplet will have its own small biases. We are working on soft calibration adjustments to remove the inter-channel biases and homogenize the multiple triplet results. The nice thing about the Version 7 product is that its behavior is only affected by the relative calibration of the three channels in its single triplet. Its weakness is that this triplet is not ideal under all viewing conditions, particularly for high ozone amounts at large solar zenith or satellite viewing angles.

First Guess versus EDR Total Column Estimates

The Multiple Triplet algorithm described in the previous slide is applied twice for each set of measurements.

The First Guess products (INCTO) use climatological or forecast fields for surface reflectivity and pressure, snow/ice coverage, cloud optical centroid depth, and atmospheric temperature. This snow/ice tilings used in this product are currently generated from previous months data.

The EDR products (OOTCO) use cloud top pressures (soon to be replaced with the UV climatology) and snow/ice coverage from VIIRS near-real-time products and temperature profiles from CrIS near-real-time products. Recent studies have found that the estimates cloud top pressure from an infrared or visible sensor do not provide the correct quantities for use with UV radiances, e.g., thin cirrus may be optically opaque in the IR but optically thin in the UV. CCR #736 will implement a switch to a UV-based cloud top climatology in mid 2013. Since the VIIRS and CrIS products are currently provisional, not validated, one expects that there could be some changes in their uncertainties in the coming months as these products are improved.

Both implementations of the algorithm use internally calculated estimates of cloud fractions and effective reflectivity from measurements at non-ozone absorbing UV wavelengths.

The choice of which product to use at this time is complex. The recommendation is that users try out the Multiple Triplet EDR in their applications, but we would welcome any information on the relative performance of all four.

Product Caveats for OMPS Total Column Ozone EDR an IP Products
The Board recommends that users be aware of certain specific data product characteristics. The product caveats for OMPS Total Column Ozone products at this time are:

1. The OMPS-TC-EDR product quality is currently using cloud top pressure, snow/ice cover, coverage and atmospheric temperature profile data products derived from the VIIRS and CrIS sensors. Until those products complete their validation process, their use will create errors in this ozone product. The OMPS-TC First Guess product is using snow/ice tilings from VIIRS products. These are currently updated monthly. This is not as frequent as envisioned. The data from a prior month will not reflect the actual conditions in areas with seasonally varying snow/ice cover. The OMPS-TC-Oz-Fst-Guess-IP uses climatological values for cloud top pressures (from a UV-based set of measurements of cloud optical centroids) and temperature profiles.

2. Discontinuities in both of the OMPS Total Column Ozone products' performance (particularly accuracy) can be expected as calibration (e.g., dark current, transfer smear, and linearity corrections) and solar spectra (e.g., day one solar spectra and wavelength scales) tables are updated, and the OMPS SDR products progress from provisional maturity to validated. Additional details are provided below.

3. Fixes for some known problems are scheduled for implementation first seven months of 2013 (e.g., implementation of the UV cloud top pressure climatology for the OMPS-TC EDR product in place of the VIIRS IR cloud top pressures.). These will also produce changes in the products' accuracy and precision.

Product Caveats for OMPS Nadir Mapper Sensor Data Record (SDR) Products
Further as the total column ozone products are derived from the OMPS Nadir Mapper SDR products, the Board recommends that users be aware of certain specific data product characteristics. The product caveats for OMPS Nadir Mapper SDR products at this time are:

1. The OMPS NM and NP SDR processing was designed to automatically generate updates to the dark current estimates. We have begun providing weekly updates to the characterizations from direct analysis by a human-in-the-loop as of January 2013. This is being done in a less timely manner than originally planned – with weekly updates arriving in the system four to eight days after measurements are made. Since the dark current is changing, this will introduce minor inaccuracies.

2. The Solar spectra currently provided in the OMPS NM and NP Earth View SDRs are from preliminary analysis through July 2012. More accurate Day One solar spectra will be provided at a later date and additional adjustments may be implemented as the Solar spectra change. We are also considering soft calibration adjustments to remove biases between OMPS products and those from validation resources.

3. The wavelength scale for the OMPS NM and NP for both Earth and Solar spectra are based preliminary analysis of spectral features (e.g., Fraunhofer lines) to verify/characterize the on-orbit behavior. Initial adjustments to the wavelength scales were at the Ångstrom level. There are intra-oribit wavelength scale variations at the 0.2-Ångstrom level that create some small along-orbit biases.

4. While the OMPS NM South Atlantic Anomaly (SAA) flag is working well in identifying regions with higher frequency of charged particles, the system was designed to use a set of dark current corrections covering the range of SAA-effect exposure expressed as a percent. We now believe that the global dark corrections will perform well and are switching to use them everywhere. This change will enter the system in mid-2013. Before then, data flagged at 20% effects for the SAA will have poor dark corrections applied. Other SAA conditions already use the global dark corrections.

5. Out-of-band stray light is present in the OMPS NM measurements at the units percent level. The stray light was characterized on the ground. We are designing and testing stray light corrections with the in-orbit data for future implementation. A correction algorithm is present in the code but the input parameter table is currently populated with zeros – no correction.

6. The CCD smear corrections can be affected by charged particles. This has been observed to create a bias, albeit infrequently, in the smear corrections for an individual row. We are developing corrections and screening to handle this complication.

7. The non-linearity corrections for both the OMPS NP and OMPS NM used in the SDR processing are derived from the prelaunch characterization. In-orbit measurements show negligible changes, so updates to these tables are low priority.

8. OMPS NM SDR product dimensions allow for a future change in the horizontal resolution to much smaller FOVs. Most of the parameters in an HDF granule have spatial dimensions of 105 cross-track by 15 along-track. Currently, with the nadir FOV size set at 50×50 KM^2, only the first 35 cross-track by 5 along-track cells are used to store actual measurements, so eight ninths of the values will be zeros or fill values for a normal case. The OMPS NP SDR products allow for a future change in the horizontal resolution as well, from one 250×250 KM^2 FOV to twenty-five 50×50KM^2 FOVs. Currently only the first cross-track by first along-track cell contains an actual measurement, so twenty-four twenty-fifths of the cells contain zeroes or fill values.

Open Product Discrepancy Reports (DRs) & Configuration Control Requests (CCRs)

DR #7044: The VIIRs snow/ice cover product infrequently shows snow in unrealistic regions, e.g., the Amazon Basin. The total ozone retrievals will assume a reflective boundary at the surface instead of at a cloud top pressure creating an error on the order of the true below cloud ozone column.

DR #7012: The SO_2 Index is created by using the Version 7 triplet (317 nm, 331 nm and 360 nm channels). We are investigating the use of other triplets and measurement residuals to create better estimates of atmospheric SO_2.

DR #5047: We are conducting an investigation to include calibration coefficients that allow soft calibration of the products. These would allow us to make adjustments to remove the bias seem between OMPS products and other validation resources.

DR #5009: There is a technical error in Quality Flag #1 Bit 2. The Snow/Ice fraction set incorrectly to a placeholder value of 1. This is incorrect and inconsistent with the correct information available in the Scene Condition Flag Bit 4.

DR #4955: Replace the CTP calculation in the TC EDR (OOTCO). The current TC EDR (OOTCO) is using VIIRS for CTP that uses IR for the calculation. This is not appropriate for OMPS that relies on UV measurements. The CTP needs to be switched to one that uses UV (climatology). This change is progressing through the system as CCR #736 and will be implemented in mid-2013.

DR #4803: There is a technical error in Quality Flag #2 Bit 6. This flag will be set to 0 whtn the condition is not checked in addition to when it is properly set for total column ozone amounts greater than 450 DU.

DR #4692: Total Ozone out of range - There are rare instances where the total ozone amount retrieved by the OMPS TC IP significantly exceeds reasonable values (> 800 DU, valid range is 50 to 650DU). Most of these cases are flagged by the internal processing checks, but there are a few cases where the internal error flags indicate no problem but the ozone is still significantly out of range.

REFERENCES

Additional information is in the OMPS Total Column Algorithm Theoretical Basis and Operational Algorithm Description Documents, and a volume of the Common Data Format Control Book. These are available at http://npp.gsfc.nasa.gov/documents.html

OMPS Total Column Ozone ATBD 474-00029_Rev-Baseline.pdf

OMPS Total Column Ozone OAD 474-00066_OAD-OMPS-TC-EDR-SW_RevA_20120127.pdf

Atmospheric EDRs CDFCB 474-0001-04-02_Rev-Baseline.pdf