OMTO3 Release Specific Information

Software Version

The current release of OMTO3 is version 2.2.1

Data Collection

OMTO3 v2.2.1 replaces the previous version in collection 3. Changes from the previous version, 1.1.2, are detailed in the Release History section later in this document.

Known Issue List

This section describes significant issues related to the OMTO3 v2.2.1 product:

1. In OMTO3, post-launch calibration adjustments are made to the measured OMI radiances as a function of cross-track position and for each of the 12 processed by the algorithm: 308.70, 310.80, 311.85, 312.61, 313.20, 314.40, 317.62, 322.42, 331.34, 345.40, 360.15, and 372.80 nm. The wavelengths and radiance adjustments remain unchanged from the v1.1.2 release.
2. The OMI calibration has drifted by about 1% since launch. No correction for this drift is applied in OMTO3 v2.2.1 because the ozone algorithm is relatively insensitive to change in instrument calibration that is wavelength independent. However, the OMCLDRR cloud pressures used in OMTO3 are sensitive to absolute calibration change, and since the ozone retrieval can be sensitive to cloud pressure in some conditions, uncorrected calibration drift can translate into an ozone error indirectly through cloud pressure errors. A correction to the instrument calibration as a function of time which corrects for this error is applied annually in OMCLDRR v1.9.0. Step changes in cloud pressures where this correction is updated may result in small discontinuities in ozone at the start of each year.
3. OMI measured radiances have been affected at some cross-track measurement positions by an unknown blockage in the Earth-view optical path since late June of 2007. The effect of the blockage is complex, causing both increase and decrease in radiance signal, or both, depending on the position of the instrument during orbit. These effects are tentatively attributed to blockage of earthshine radiance which cause decrease in signal, and increases in signal believed to be due to scattering of stray Earthshine and sunlight into the instrument's Earth-viewing entrance port. The combined effects are referred to as the OMI “row anomaly. Measured radiances often yield in a reduction in reflectivity at 331 nm, leading to increased values of Aerosol Index (AI). Anomalous ozone values at these cross-track positions have resulted from the erroneous reflectivity and AI values. The anomaly may have developed gradually since as early as mid-2006. It is first observed in OMTO3 data as a small blockage effect on the radiance signal at cross-track positions (rows) 54-55. Another set of rows affected by blockage is seen in May 2008 around row 40 at northern high latitudes. By the end of the year this region grows wider,

with blockage affecting these rows at all latitudes and the addition of scattered sunlight that contaminates Earthshine radiance signal in the north. In January 2009, the row anomaly expands significantly to affect OMTO3 in a band of rows extenings over most of the right side of the measurement swath and in some rows to left of nadir. Since then the anomaly has continued to show gradual change through time, with a few further rows lost to the anomaly, but also sometimes recovered. More about the development of the anomaly can be found here:
http://www.knmi.nl/omi/research/product/rowanomaly-background.php

4. No corrections for the anomaly have been implemented in the operational Level 1B and Level 2 data because studies found attempts insufficiently effective. Users should avoid affected data using the new row anomaly flag added in this release. The new flag is described further in the **Release History** below.
5. Compared to TOMS, OMI's smaller field-of-view results in more "sea-glint" per unit field-of-view and a corresponding larger error in derived ozone under these conditions. The ozone error typically manifests itself as cross-track dependence over water that is not corrected by the adjustments described in the previous item. This uncorrected error in the ozone can be up to 3%.
6. The OMTO3 AI is not valid for solar zenith angles greater than approximately 60 degrees. Because the OMI solar zenith angles are typically higher than the solar zenith angles for TOMS at the same latitude, the OMI AI become invalid at somewhat lower latitudes than TOMS. This may show up as cross-track dependence in the OMI AI, and is not corrected by the radiance measurement adjustments. This uncorrected error in the AI can be up to 4%.
7. The snow/ice climatological data set, developed for the TOMS processing and used by OMTO3 to identify observing conditions, may yield erroneous snow/ice coverage due to the changes in snow/ice distribution over the decades. The misidentifications of observing conditions could lead to noticeable step changes in the derived ozone values across cloud/ice boundaries perceived by the OMTO3 algorithm.

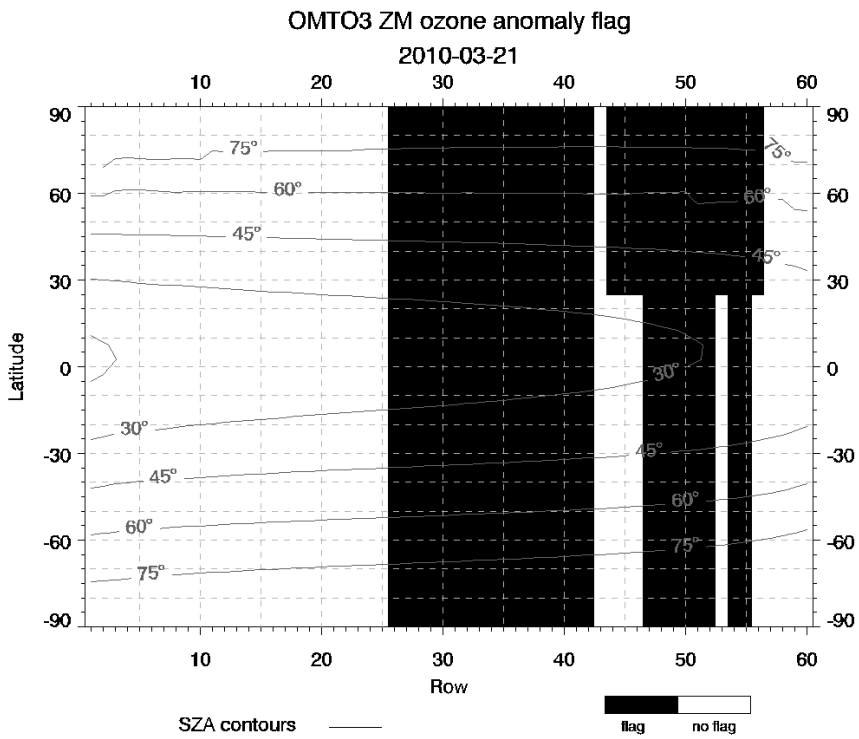
Release History

OMTO3 v2.2.1 contains the following changes relative to the v1.1.2 release:

1. The calibration adjustments discussed in the **Known Issue List** above are now stored in the L2 data field “CalibrationAdjustment”. The adjustments are reported in N-Values where 1 N = - 100 * $\log_{10}$ (I/F_0), I is measured radiance and F_0 is the solar irradiance. An adjustment of +1 N is equivalent to a decrease in I/F_0 of 2.3%.
2. The flagging of OMTO3 data affected by the OMI row anomaly has been improved using a statistical approach to evaluate error in the ozone product directly. Data found affected by the anomaly are flagged with values 8 or 18 in the error flag sub-field of the QualityFlags field. This flag is also stored in bit 6 of the QualityFlags field to ensure backwards compatibility for users of the earlier anomaly flag in v1.1.2. **Users should exclude bad data using either of these flags. Failure to do so risks introducing significant error in your results.** Row anomaly flags have also been assigned by KNMI based on analysis of radiances. These flags are in the XTrackQualityFlags field

and are copied from the OMI L1B data. However, users are advised to use the flags in the QualityFlags field since they are derived specifically for the OMTO3 ozone product. The anomaly flags assigned for each cross-track row vary with latitude and time. In the forward processing stream, the flags are determined through analysis of averages for each row of previous ten days of data. Upon reprocessing, the flags for each ten day period are determined using data from the same period. Rows in which the average ozone in a 5 degree latitude band differs from row 15 by more than 5 D.U. are identified as in error. The pattern of anomalies in each latitude band is then reduced to a simple flag set for a range of latitudes with a separation between north and south based on solar zenith angle because it correlates with a sharp change in character of the anomaly. The figure below gives an example of the row anomaly flags for March 21, 2010.

3. A programming error in the previous version that caused ozone errors of up to 3 D.U. over highly reflective (R > 0.8) snow and ice been fixed.



OMTO3 v1.1.2 contains the following changes relative to v1.1.0:

1. The threshold for the 360 nm residual error flag has been lowered to more conservatively flag ozone data affected by aerosol loads beyond the range of effective correction. Recent analysis suggests the parametric model used in the algorithm to correct the basic derived ozone for the effect of absorbing aerosols is less effective than previously believed when aerosol loading is high. Users can continue to select the best quality data with

"QualityFlags" field error flag value of 0 or 1. The newly flagged data will be excluded from these samples.

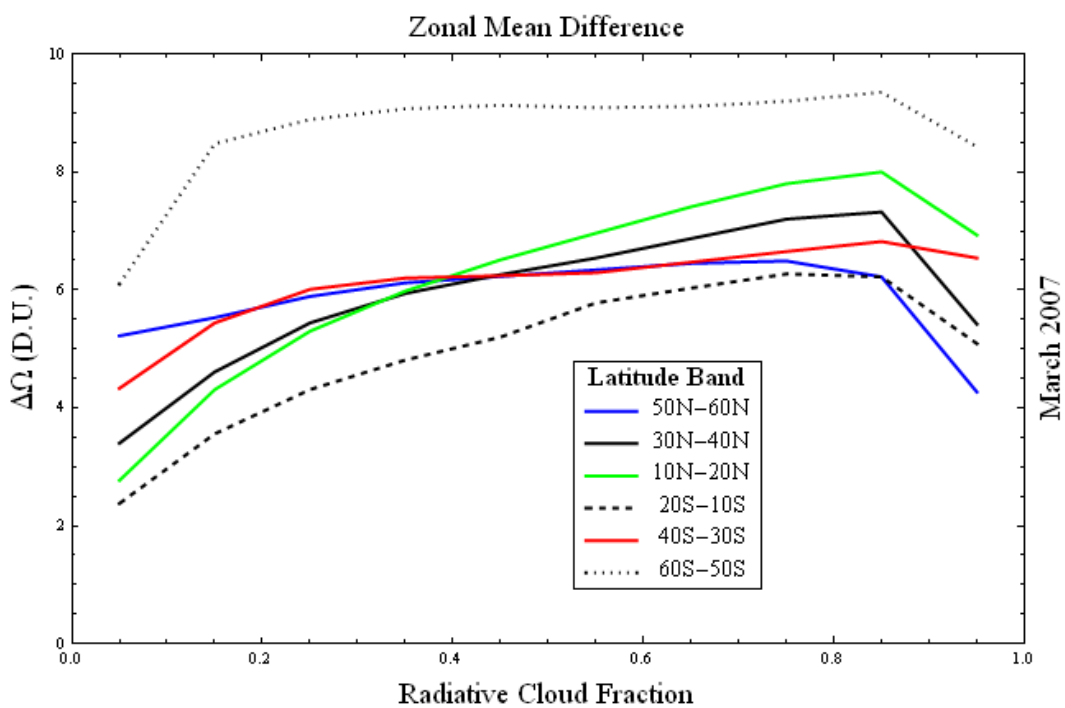
2. This version of OMTO3 (1.1.2) now includes a flag on each measurement pixel that indicates where data may be affected by the OMI radiance row anomaly at some point in the orbit. This flag is set based on the best information now available and will occasionally be updated as changes in the row anomaly warrant. Users should use a new flag to exclude cross-track measurements that are affected by the error. The flag is stored in bit 6 of the QualityFlags field and a value of 0 indicates the data are unaffected. Further information on the interpretation of the information in the QualityFlags field in the OMTO3 file specification.

V1.1.0 OMTO3 contains the following changes from the previous release V0.9.45:

1. V1.1.0 OMTO3 uses a seven-day (centered on December 31, 2004) composite solar irradiance data (V1.1.00 OML1BIRR) collected under conditions where measurement error is considered the smallest. This composite filters out spurious data and reduces noise compared to solar data from a single-day measurement.
2. V1.1.0 OMTO3 uses the collection 3 OMI radiance (V1.1.00 OML1BRUG) dataset, which contains significant improvements over its previous version, collection 2. These improvements include an internally consistent instrument calibration, a more elaborate dark current correction, and a more accurate stray-light correction. Note that straight-light correction has a larger impact on a smaller radiance. Consequently radiance measurements at short wavelength (< 315 nm) and high solar zenith angle (> 70°) have undergone bigger revisions to the correction, leading to larger changes in the retrieved ozone under these conditions (identified in the OMTO3 output with algorithm flag = 2).
3. The bias in the V0.9.45 OMTO3 AI relative to the TOMS data record has been removed by reducing OMI radiance measurements at 360 nm by approximately 0.5 N-value (1%) relative to other wavelengths. Users who were previously making their own adjustments to OMTO3 AI data for consistency with the TOMS record are advised this is no longer necessary. Note that under low ozone and low solar zenith conditions (algorithm flag = 1), ozone values are adjusted by aerosol corrections that are dependent on the AI values; at high ozone and high solar zenith conditions (algorithm flag = 3), ozone values are also changed due to the use of C-pair (331 and 360 nm) measurements for retrievals. In summary, ozone values for a majority of the retrievals are revised as a result of these adjustments to radiance measurements at 360 nm.
4. V1.1.0 OMTO3 replaces the infrared-derived climatological cloud top pressure (used in V0.9.45 and earlier versions) inputs with the collection 3 OMCLDRR radiative cloud pressure. The OMCLDRR pressure is consistent with MLER model used in the OMTO3 algorithm, consequently ozone values and other derived parameters are more accurate than those of the previous releases for observations under cloudy conditions.
5. V1.1.0 OMTO3 algorithm change: the onset of profile shape correction for the ozone values is changed from a threshold of solar zenith angle of 70° to a slant ozone column threshold of 2000 D.U. which, when exceeded, activates this correction (identified in the OMTO3 output with algorithm flag=2). This change eliminates the step change across 70° solar zenith angle boundaries on maps of the total ozone field.

6. V1.1.0 OMTO3 algorithm change: a condition is imposed such that if input cloud pressure is higher than the input terrain pressure (i.e., cloud is lower than the terrain surface), input cloud pressure value is reset to that of the terrain. This eliminates the negative ozone-below-cloud values sometimes observed in the Himalayas and the Andes mountain ranges.
7. V1.1.0 OMTO3 algorithm change: Radiative transfer tables used in the retrieval calculations are now interpolated where reflecting surfaces, generally clouds, lie between 0.4 and 0.25 atm. In V0.9.45 OMTO3, calculations were extrapolated at pressures below 0.4 atm. This change improves the ozone values derived for the high cloud conditions, which are rare occurrences according to OMCLDRR observations.

In summary, the most important changes from collection 2 (V0.9.45) to collection 3 (V1.1.0) OMTO3 are their inputs, i.e., L1B radiance and cloud pressure. To illustrate the impacts of these changes, we show the zonal mean differences in ozone (calculated as $\Delta\Omega$ = collection 2 – collection 3) as a function of radiative cloud fraction for six latitude bands in the figure below. This figure shows that when the radiative cloud fraction is low, the monthly zonal mean differences are mainly resulted from the changes in input L1B radiances; for retrieval with large radiative cloud fractions, the changes in cloud pressures induce additional changes in the retrieved total ozone.



OMTO3 V0.9.45 contains two modifications from the previous release V0.9.41:

1. V0.9.45 OMTO3 calculates radiance residuals at the 12 wavelengths listed below, in nm. They include the six EP/TOMS wavelengths used in the v0.9.41 release, plus six

additional wavelengths.

308.70	310.80	311.85	312.61	313.20	314.40
317.62	322.42	331.34	345.40	360.15	372.80

The residuals at the additional wavelengths are used to check instrument calibration and also serve as input for deriving the SO2 column. Note, that the algorithm for deriving total ozone remains the same as in v0.9.41.

2. The OMTO3 algorithm uses the solar irradiances measured by OMI on a single day (orbit 3725 on March 28, 2005), and assumes that neither the true solar irradiance (at 1 AU) nor the instrument calibration change with time. However, the solar irradiance needs to be corrected for the Sun-Earth distance effect. This was inadvertently left out in Version 0.9.41 for orbits 3709 through 4794. Version 0.9.45 makes the necessary adjustment. Orbits 3709 through 4794 have been reprocessed with v0.9.45 and the data replaced.