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Highlights of TOMS Version 9 Total Ozone algorithm

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The fundamental basis of TOMS total ozone algorithm was developed some 45 years ago by Dave and Mateer. It was designed to estimate total ozone from satellite measurements of the backscattered UV radiances at few discrete wavelengths in the Huggins ozone absorption band (310-340 nm). Over the years, as the need for higher accuracy in measuring total ozone from space has increased, several improvements to the basic algorithms have been made. They include: better correction for the effects of aerosols and clouds, an improved method to account for the variation in shape of ozone profiles with season, latitude, and total ozone, and a multi-wavelength correction for remaining profile shape errors. These improvements have made it possible to retrieve total ozone with just 3 spectral channels of moderate spectral resolution (~1 nm) with accuracy comparable to state-of-the-art spectral fitting algorithms like DOAS that require high spectral resolution measurements at large number of wavelengths.

One of the deficiencies of the TOMS algorithm has been that it doesn't provide an error estimate. This is a particular problem in high latitudes when the profile shape errors become significant and vary with latitude, season, total ozone, and instrument viewing geometry.The primary objective of the TOMS V9 algorithm is to account for these effects in estimating the error bars. This is done by a straightforward implementation of the Rodgers optimum estimation method using a priori ozone profiles and their error covariances matrices constructed using Aura MLS and ozonesonde data. The algorithm produces a vertical ozone profile that contains 1-2.5 pieces of information (degrees of freedom of signal) depending upon solar zenith angle (SZA). The profile is integrated to obtain the total column. We provide information that shows the altitude range in which the profile is best determined by the measurements. One can use this information in data assimilation and analysis. A side benefit of this algorithm is that it is considerably simpler than the present algorithm that uses a database of 1512 profiles to retrieve total ozone. These profiles are tedious to construct and modify.

Though conceptually similar to the SBUV V8 algorithm that was developed about a decade ago, the SBUV and TOMS V9 algorithms differ in detail. The TOMS algorithm uses 3 wavelengths to retrieve the profile while the SBUV algorithm uses 6-9 wavelengths, so TOMS provides less profile information. However both algorithms have comparable total ozone information and TOMS V9 can be easily adapted to use additional wavelengths from instruments like GOME, OMI and OMPS to provide better profile information at smaller SZAs. The other significant difference between the two algorithms is that while the SBUV algorithm has been optimized for deriving monthly zonal means by making an appropriate choice of the a priori error covariance matrix, the TOMS algorithm has been optimized for tracking short-term variability using month and latitude dependent covariance matrices.

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