Comparison of tropical ozone from SHADOZ with remote sensing retrievals from Suomi-NPP Ozone Mapping Profile Suite (OMPS)

A NASA public archive of tropical ozonesonde profile data for remote sensing research, model and process studies & education.

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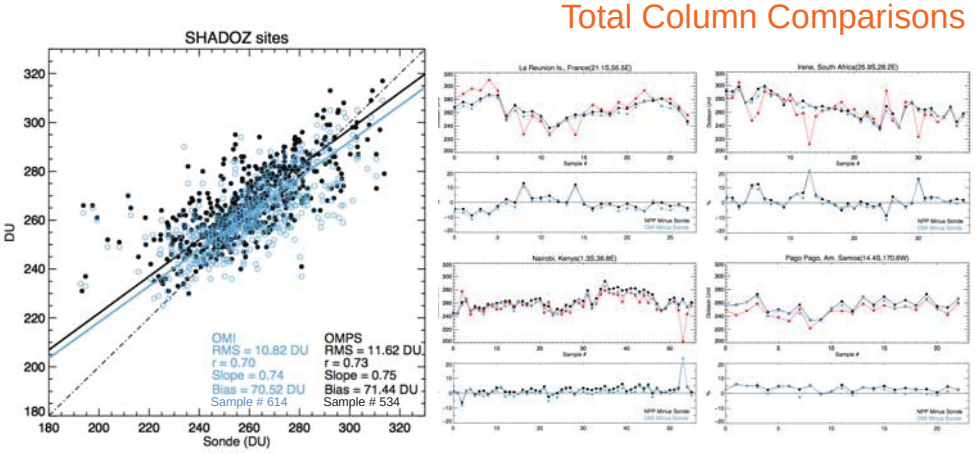
Abstract: The Ozone Mapping Profile Suite (OMPS) was launched October 28, 2011 on-board the Suomi NPP satellite (http://npp.gsfc.nasa.gov). OMPS is the next generation total column ozone mapping instrument for monitoring the global distribution of stratospheric ozone. OMPS includes a limb profiler to measure the vertical structure of stratosphere ozone down to the mid-troposphere. This study uses tropical ozonesonde profile measurements from the Southern Hemisphere Additional Ozonesondes (SHADOZ, http://croc.gsfc.nasa.gov/shadoz) archive to evaluate total column ozone retrievals from OMPS and concurrent measurements from the Aura Ozone Monitoring Instrument (OMI), the predecessor of OMPS with a data record going back to 2004. We include ten SHADOZ stations that contain data overlapping the OMPS time period (2012-2013). This study capitalizes on the ozone profile measurements from SHADOZ to evaluate OMPS limb profile retrievals. Finally, we use SHADOZ sondes and OMPS retrievals to examine the agreement with the GEOS-5 Ozone Assimilation System (GOAS). The GOAS uses data from the OMI and the Microwave Limb Sounder (MLS) to constrain the total column and stratospheric profiles of ozone. The most recent version of the assimilation system is well constrained to the total column compared with SHADOZ ozonesonde data.

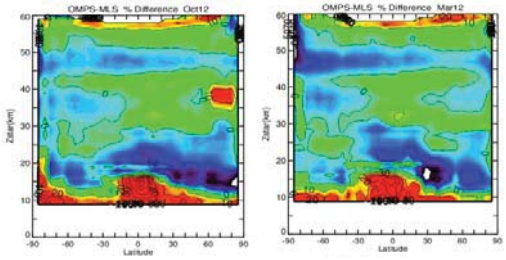
Total Column Comparisons



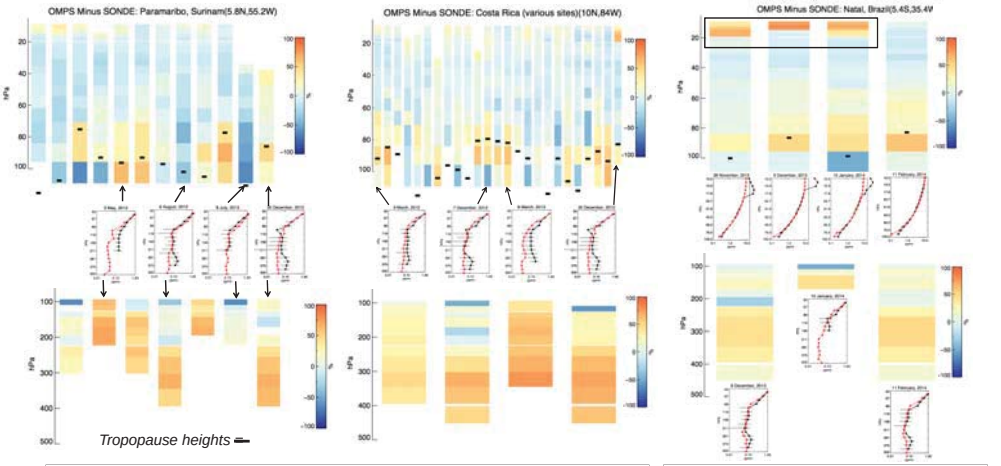
- Data include years 2012-2013.
- McPeters and Labow ozone climatology is added from sonde balloon burst to the top of the atmosphere *[McPeters, R. D., and G. J. Labow (2012), Climatology 2011: An MLS and sonde derived ozone climatology for satellite retrieval algorithms, J. Geophys. Res., 117, D10303, doi:10.1029/2011JD017006]*.
- Ozone Mapping Profiler Suite contains a Total Column (TC) sensor that measures the daily global distribution of the total atmospheric O_3 column.
- OMPS TC measures UV radiances in the range from 300 to 380 nm. The total column algorithm uses 22 wavelengths from this range. The retrieval algorithm is adapted from the heritage TOMS version 7 algorithm.
- OMI and OMPS are co-located to the sondes within ±2° Lat. × ±4 ° Long.
- OMI and OMPS TC comparisons are in very good agreement with SHADOZ sondes. OMPS shows a slightly better agreement overall (correlation = 0.73).
- Timeseries of selected stations show satellite measurement deviations from the sondes to be within 10%. This is generally true for all SHADOZ stations in the 2012-2013 record.
- Large deviations between OMI, OMPS and the sondes (seen in the timeseries plots) may be due to errors in the sonde measurements. The quality of these individual profiles will be assessed.

Profile Comparisons

- Recently released OMPS Level 2 data and documentation are available here: http://ozoneaq.gsfc.nasa.gov/omps
- The OMPS Limb Profiler (LP) algorithm is adopted from the heritage SBUV/2 operational algorithm. The sensor is designed to observe the Earth's limb radiance in the 290-1020 nm spectral range.
- Data include years. 2012-2013 and are co-located to the sondes within ±2° Lat. x ±4 ° Long.
- There are large differences between co-located OMPS LP and SHADOZ sonde profiles, particularly below the tropopause (positive bias generally > 25%). Above the tropopause the bias in the lower stratosphere is negative (upper plots: biases generally within 25 %). A few stations are shown but this positive tropospheric /negative stratospheric bias is true at all SHADOZ stations.
- These positive bias in the tropopshere is consistent with OMPS - MLS comparisons where zonal monthly mean OMPS LP ozone mixing ratios are much higher than MLS in the tropical troposphere (% difference plots below) . This is true for all months of the OMPS record.



An individual bar is a profile color coated by percentage difference relative to OMPS at the OMPS resolution. Top plots show the stratosphere (100-10 hPa), bottom plots the troposphere

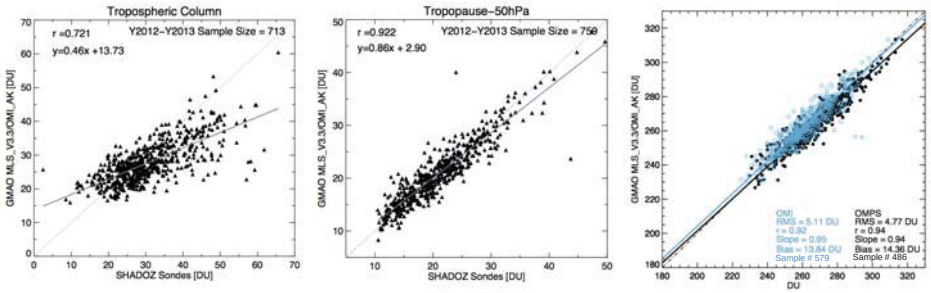


OMPS ozone profiles over Paramaribo, Surinam and San Pedro, Costa Rica show a large positive bias below the tropopause and negative bias above, relative to SHADOZ sondes. This is true for all SHADOZ stations (not shown, above are just a few examples).

Odd kinks in the OMPS ozone profile retrieval above 20 hPa over Natal, Brazil (above, black rectangle). The cause is currently unknown, needing further investigation into the temporal and geographical extent, and causes of error.

- Algorithm development in the tropospheric portion of the OMPS LP profiles continues. However, this preliminary study indicates the OMPS LP ozone record below the tropopause in the tropics remains unusable for scientific studies. We note anomalous data in the OMPS profile retrieval that should be re-examined, i.e. see Natal profile plots on the right.

GEOS-5 Ozone Assimilation System Comparisons



- The improved system is used in a multi-year analysis with 2° x 2.5° latitude-long. resolution and about 1 km vertical resolution in the UT/LS.
- GOES-5 tropospheric columns are in good agreement (r=0.71) with SHADOZ sondes and excellent agreement (r=0.92) in the lower stratosphere (tropopause – 50 hPa).
- Total column ozone measurements with OMI and OMPS TC sensors show an excellent agreements with GEOS-5 output.

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