OMPS ozone validation by the NOAA ground-based ozone network

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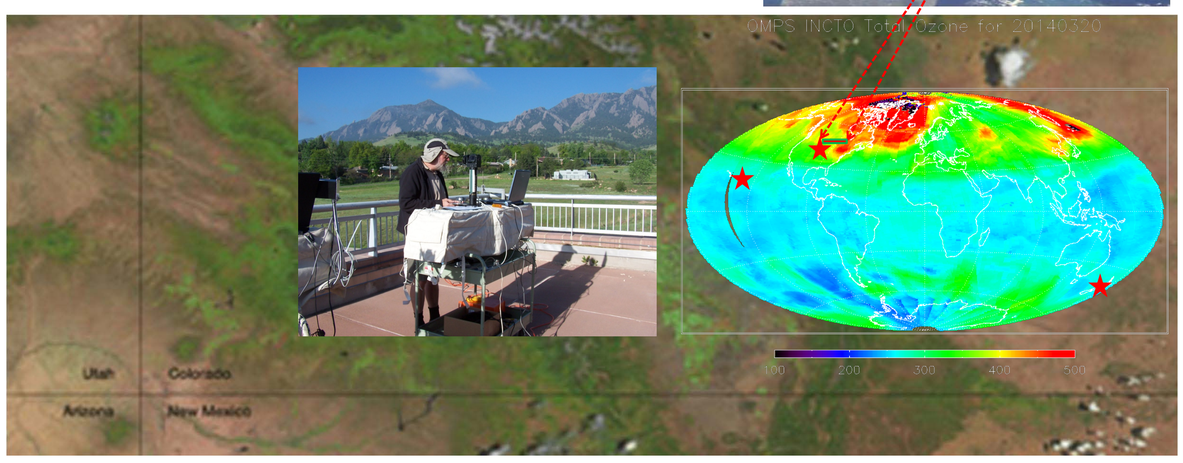
Abstract. The National Polar-orbiting Partnership satellite (S-NPP) was launched on October 28, 2011. Measurements from the satellite have been used to derive total ozone products (e.g., OMPS-TC-EDR/OOTCO and OMPS-TC-Oz-Fist-Guess-IP/INCTO). Several long-term NOAA Dobson stations were selected for the first round of total column ozone (TCO) validation due to an almost real time processing option that became recently available with the Dobson automation system upgrade at several stations to an automation system designed by the Japanese Meteorological Agency. Three stations are located at MLO, Hawaii (tropics), Lauder, New Zealand (Southern Hemisphere middle latitudes), and in Boulder, CO (Northern Hemisphere middle latitudes), and are part of the WMO/GAW network. Dobson direct sun observations are used to derive the best Dobson ozone product (precision is better than 1%). The TCO observations are typically taken three times a day, excluding overcast conditions and weekends, when Zenith sky measurements are used to derive TCO. The number of direct sun (AD-pair) observations at Boulder, MLO and Lauder observatories in 2012 and 2013 are 1334, 1604 and 475 respectively. These same three stations also make measurements of the Umkehr effect, from which an ozone profile over the station is derived. The overpass satellite product corresponding to the ground-based station value is one determined within 12 hours and within area of +/- 5 degrees in latitude and longitude centered on a station location. During the first stage of the comparisons the OOTCO and INTCO datasets continued to be modified and adjusted through calibration and algorithm changes. It was noticed that the average difference between OMPS and Dobson at MLO prior to middle of June 2013 was at +15DU, while after that, it changed to 4 DU. At the same time difference between OMI (NASA Ozone Monitoring Instrument on EOS Aura) and Dobson at MLO was on average at 13 DU before, and remained close at 11 DU after the change in OMPS output. At MLO the correlation (R^2) between Dobson and INTCO (OMI) is 0.88 (0.9) for the period between January 1 2012 and July 30, 2013, where mean Dobson, OMPS and OMI TCOs are 262, 268 and 273 DU. Similar correlation results are found for Boulder, CO. However, over Lauder station the Dobson TCO daily correlations are 0.98 and 0.97 with OMI and OMPS overpass ozone respectively. The differences could be due to the altitudes of the stations and the surrounding topography: Lauder (370 mmsl) to Boulder (1640 mmsl) and MLO (3400 mmsl). Profile comparisons were also performed for Boulder station and show some biases, most likely due to treatment of the stray light in both satellite and Dobson Umkehr data.

Ground-based validation sites for rapid delivery:
Boulder (40 N, 105W), MLO(19.5 N, 156W) ,
Lauder (45S, 170E)



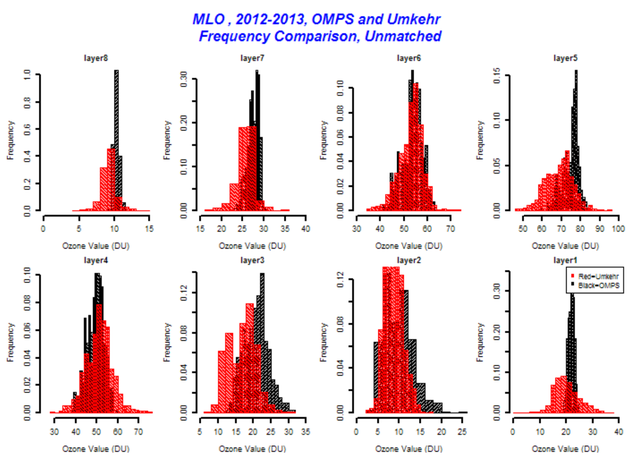


Figure A. Frequency distribution plots to compare Umkehr ozone profiles at MLO and OMPS overpass without date-coincidence matching

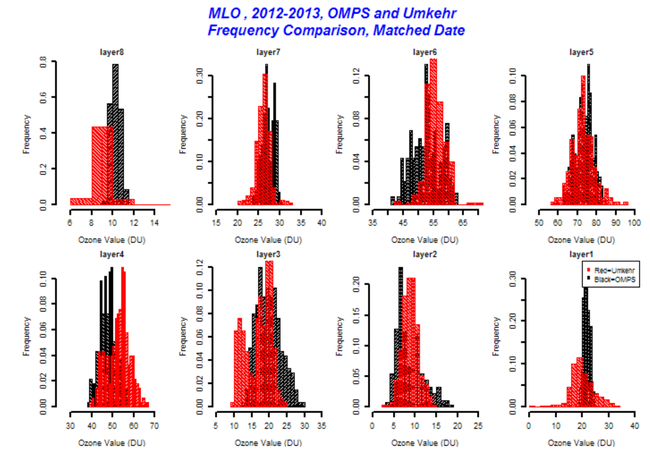
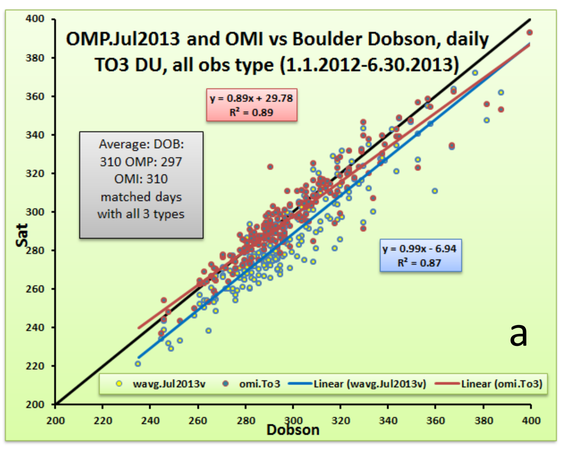
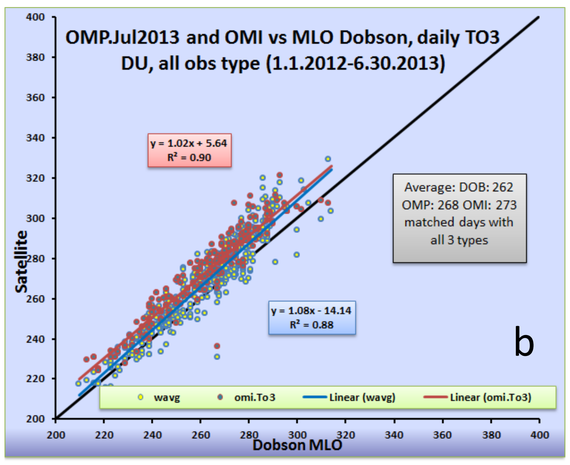


Figure B. same as **A**, but with date co-incidence selection applied – clear differences in the tails in layer 6 and layer 3, offset in median value in layer 4.

All Dobson data





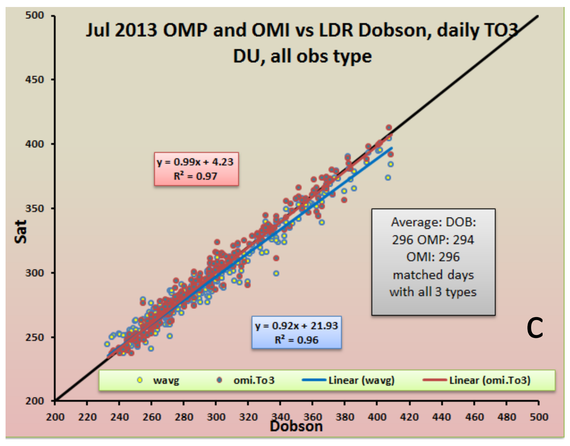
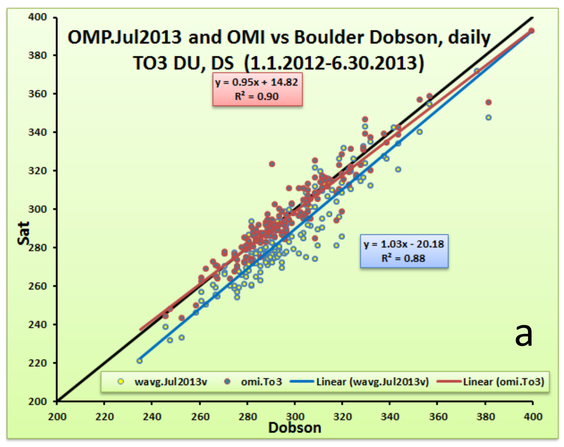
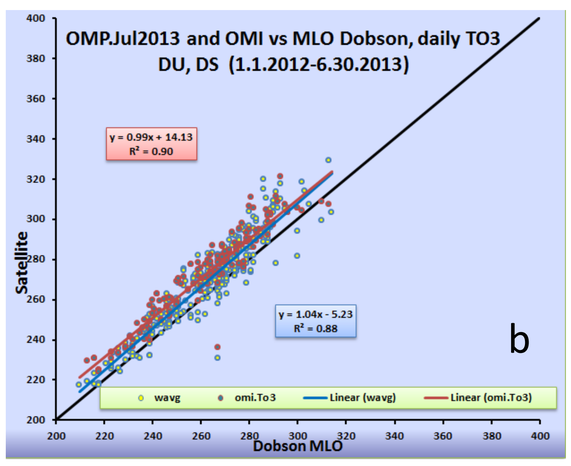


Figure 1 a) Scatter plot between daily Dobson observations and OMPS or OMI overpass over Boulder, CO, b) same as a), but for MLO, HI, c) same as a), but for Lauder, NZ

Only DS Dobson data





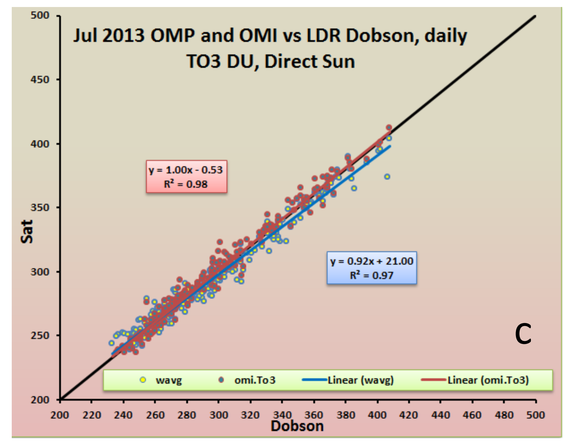
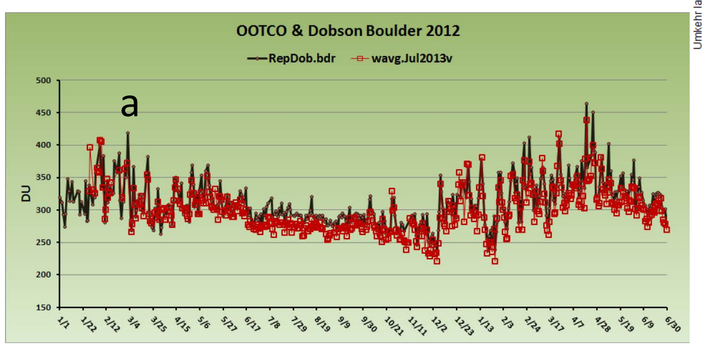
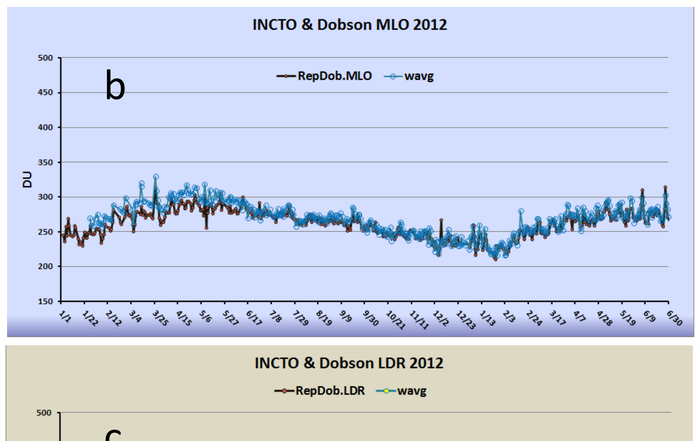


Figure 2 a) Scatter plot between only direct-sun Dobson observations and OMPS or OMI overpass over Boulder, CO, b) same as a), but for MLO, HI, c) same as a), but for Lauder, NZ

As time series





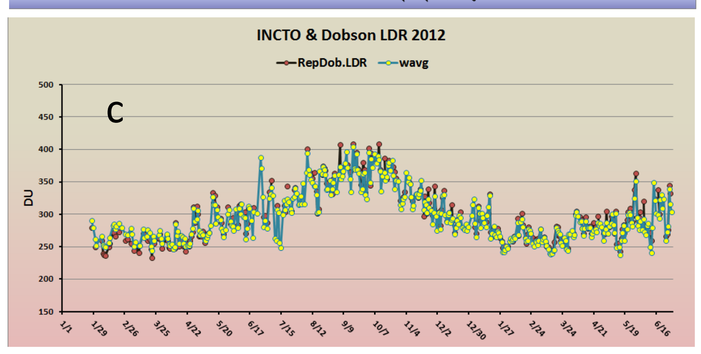


Figure 3 a) Time progression of co-incident measurements by Dobson and OMPS overpass over Boulder, CO, b) same as a), but for MLO, HI, c) same as a), but for Lauder, NZ

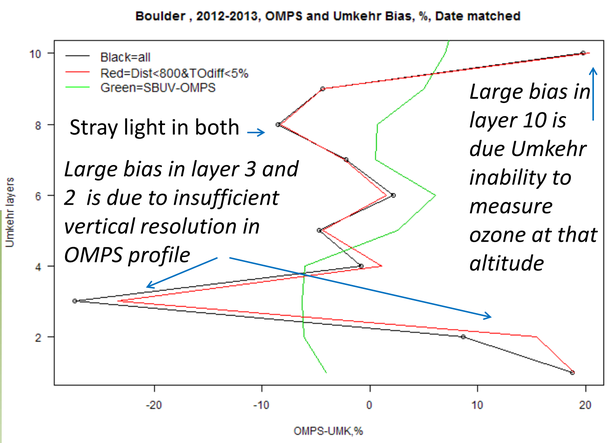


Figure C. Bias between OMPS and Umkehr (black line), difference after restriction was applied (red): on the distance of OMPS pixel from station (<800 km) and difference in Total ozone column (< 5 %), difference between SBUV and OMPS

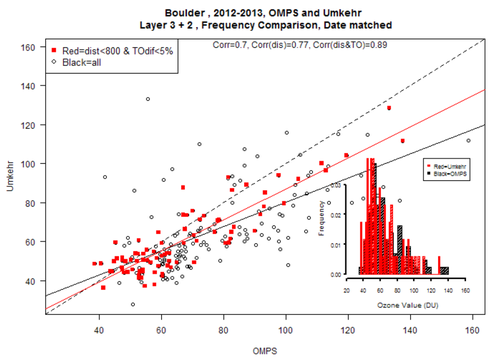


Figure D. Scatter plot between OMPS and Umkehr (black circles) ozone in combined layer 2 and 3 (250-63 hPa), and after restriction was applied (red): distance of OMPS pixel from station (<800 km) and difference in Total ozone column (< 5 %). Correlation for two sets of data is shown in the legend at the top.