Ozone Instrument Calibration and EDR Products Validation with STAR ICVS

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1. Introduction

Integrated Calibration Validation System (ICVS) ozone section is created to monitor onboard ozone instrument performance and ozone data quality in real time.

2. Objectives

•Provide real time ozone sensor instrument performance and Ozone EDR data quality monitoring to meet operation mission.

•Provide long term monitoring ozone sensor instrument performance and Ozone EDR data quality to meet the requirements of climate study.

•Provide Ozone product bias analyses and feedback/recommendations to science team for solutions to turn instrument measurements into accurate ozone environmental products.

3. Monitoring S-NPP OMPS Performance and Products

-The cross-track measurements can be used to provide internal consistency checks on the OMPS instrument calibration. The lines in the **Figure 1** show the weekly, one-percentile effective reflectivity values for January 2013 for all the OMPS Nadir Mapper total ozone retrievals in the Equatorial Pacific box versus cross-track view position and same product for total ozone. We expect the one-percentile effective reflectivity values to be approximately 4% for this region of the globe from climatological measurements made by other instruments. The larger values observed here are due to inaccuracies in the initial solar spectrum and radiance calibration.

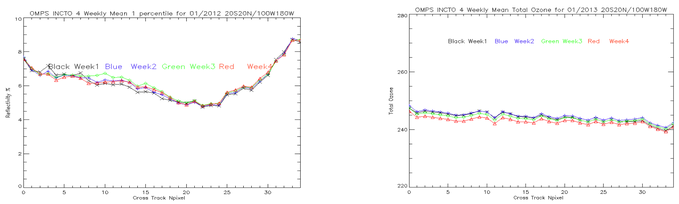

Figure 1

Figures 2 shows Initial Measurement Residuals for the OMPS NP V8 Profile Product: The 3 panels show the initial measurement residuals for profile wavelengths [288, 292, 298nm respectively] for the V8PRO product from OMPS compared to the same product for the operational NOAA-18 and NOAA-19 SBUV/2 for the equatorial daily zonal means (20N to 20S) with 0-90W removed to avoid the South Atlantic Anomaly. The residuals are in N-values (1 N ~ 2.3%). The time period is 2012(Feb to Dec for OMPS). Notice that the residuals for OMPS, have maintained a persistent bias relative to the SBUV/2 residuals. There were large shifts taking place in August when the new solar

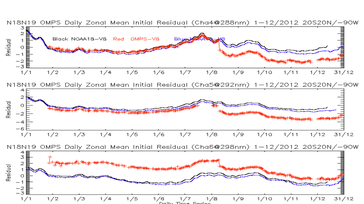

Figure 2

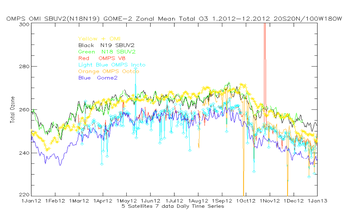

Figure 3

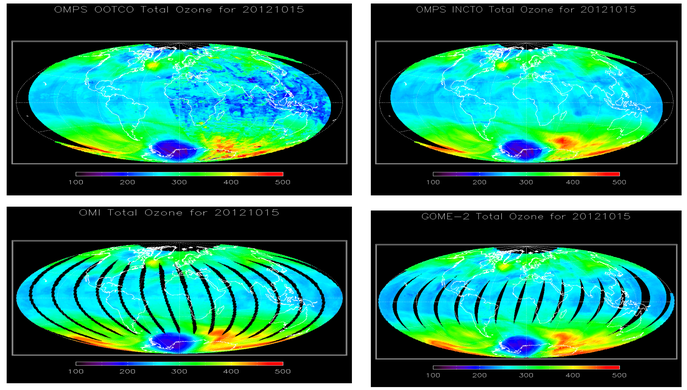

Figure 4

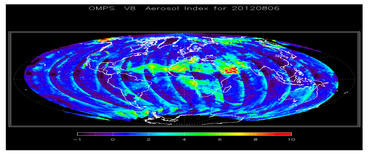

Figure 5 OMPS V8 AI 20120806

came into use with the OMPS V8Pro. Also notice there were some data missing for OMPS on late Nov and for N18 on late Dec.

Figures 3 demonstrates time series of Pacific box zonal means total ozone for 5 satellite measurement comparisons (OMPS with 3 algorithms: V8, INCTO and OOTCO) NOAA-18 and NOAA-19 SBUV/2, MetOp-A GOME-2, and EOS Aura OMI. The SBUV/2 and GOME-2 estimates are from Version 8 algorithms. The GOME-2 has not been adjusted for known degradation in the scan mirror. The figure shows a bias of ~3% between the OMPS and SBUV/2 products. This is near the accuracy performance limit.

Figure 4: The false color daily maps (Oct.15, 2012) of Total Column Ozone from OOTCO, INCTO, OMI and Gome-2 on the above 4 panels show the expected distribution of global ozone values for October including the Antarctic ozone hole. The OOTCO map (first) has greatly varying quality depending on the consistency of the VIIRS cloud fraction for the first half of the day followed by a transition to the use of a measurement-based calculation for the second half of the day (the western hemisphere). The same day data from OMPS INCTO, OMI and Gome-2 are also presented for comparisons.

Figure 5: The false color daily map (Aug. 6, 2012) of Aerosol Index shows the expected distribution of global aerosol with high values over Northern Africa and the Middle East due to desert dust. The north-south bands evident in the southern hemisphere are caused by cross-track bias across each of the 14 orbital tracks.

Figure 6 shows the full solar eclipse happened in the southern hemisphere, starting east of Australia at dawn their time, 3:45 pm our time (13 November), ending about 500 miles west of Chile. All reflectivity, aerosol index and ozone maps show the eclipse: the Eclipse measurements appear as dark areas in the reflectivity, very high values in aerosol index and lower values in ozone maps.

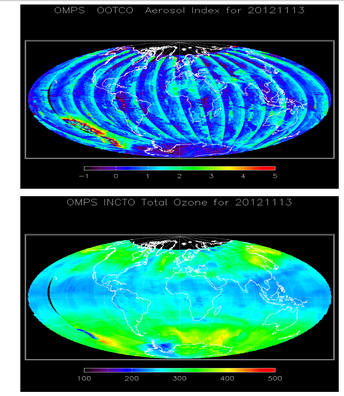

Figure 6

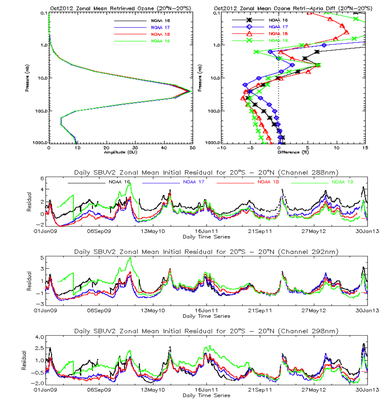

Figure 7 SBUV Operation plots

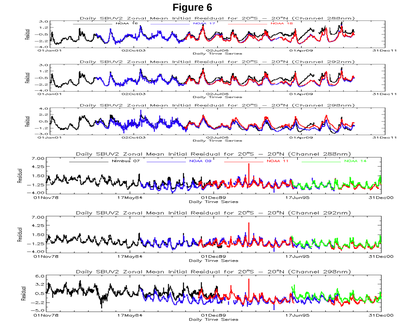

Figure 8 SBUV reprocess plots

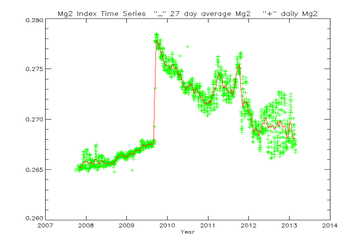

Figure 9 Gome-2 Time Series Mg-II

4.Monitoring NOAA SBUV/2 and Metop Gome-2 Performance and Products

NASA ozone series of instruments started operation with the Nimbus-7 TOMS and the NOAA SBUV/2 series of instruments. They have been conducting measurements of atmospheric ozone since 1978 with TOMS, Solar Backscatter Ultraviolet (SBUV) and continued until the second generation SBUV/2 began with the NOAA TIROS series of satellites in1984. **Figure 7** is SBUV operation plots**:** the up one shows comparison of monthly zonal means (for Oct 2012) for the NOAA-16,17,18,19 SBUV/2 profile retrievals. The lines show the differences between the retrieved profiles and the A priori profiles for the Equatorial Zone (20S to 20N) as a function of atmospheric pressure; the lower one tracks the average initial measurement residuals for the NOAA-16, 17, 18 and 19 SBUV/2 instruments for the 288,292 298 nm channels. The curves connect the daily Equatorial Zonal Mean values for each instrument. The shared variations are due to real geophysical ozone changes from day to day. The divergent values are caused by differences in each instruments viewing conditions or calibration. The NOAA-16 has increasingly poorer viewing conditions as the record progresses. **Figure 8** also tracks initial residuals but from re-processed data and for longer time period (11.1978 to 10.2011).

Figures 9 is Gome-2 time series of Magnesium Index 2. It is shown that solar activities are more active in 2012 comparing to 2008 to 2009. The jump in late 2009 is due to the instrument heating and a change in the etalon. Using 27 day average in solid line Mg-II is related to the 27.2 days of sun rotation period.

5.Conclusion

ICVS ozone section is an efficient tool for monitoring ozone data quality and instrument performance. It is an integrated system that incorporates prelaunch, post launch onboard, real time and long term monitoring system.

Acknowledgement

The views, opinions, and findings contained in this report are those of the authors and should not be construed as an official NOAA or U.S. Government position, policy, or decision.

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