Validated Stage 1
Science Maturity Review
for
OMPS Total Column Ozone EDRs

Presented by
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September 3, 2014

Outline

- Algorithm Cal/Val Team Members
- Product Requirements
- Evaluation of algorithm performance to specification requirements
  - Evaluation of the effect of required algorithm inputs
  - Quality flag analysis/validation
  - Error Budget
- Documentation
- Identification of Processing Environment
- Users & User Feedback
- Conclusion
- Path Forward

Ozone Cal/Val Team Membership

EDR	Name	Organization	Task
Lead	Lawrence Flynn	NOAA/NESDIS/STAR	Lead Ozone EDR Team
Member	Irina Petropavlovskikh	NOAA/ESRL/CIRES	Ground-based Validation Lead
Member	Craig Long	NOAA/NWS/NCEP	Product Application Lead
Member	Trevor Beck	NOAA/NESDIS/STAR	Algorithm development and ADL implementation
Member	Jianguo Niu	STAR/IMSG/SRG	Algorithm development, trouble shooting, Limb Profiler science
Member	Eric Beach	STAR/IMSG	Comparisons, ICVS/Monitoring, Data management
Member	Zhihua Zhang	STAR/IMSG	V8 Algorithms implementation & modification
JAM	Maria Caponi	JPSS/Aerospace	Coordination, DRs and CCRs
Member	Bhaswar Sen	NGAS	Current Algorithms

Raytheon team members with major contributions include Derek Stuhmer and Daniel Cumpton.

Table 2.1.3 - Ozone Total Column

EDR Attribute	Threshold (1,2)	Objective
a. Horizontal Cell Size	50 x 50 km^2 @ nadir (10)	10 x 10 km^2 (10)
b. Vertical Cell Size	0 - 60 km	0 - 60 km
c. Mapping Uncertainty, 1 Sigma (3)	5 km at Nadir (3)	5 km
d. Measurement Range	50 - 650 milli-atm-cm	50-650 milli-atm-cm
e. Measurement Precision (4)		
1. X < 0.25 atm-cm	6.0 milli-atm-cm (4,5)	1.0 milli-atm-cm
2. 0.25 < X < 0.45 atm-cm	7.7 milli-atm-cm (4,5) ~ 2%	1.0 milli-atm-cm
3. X > 0.45 atm-cm	2.8 milli-atm-cm + 1.1% (4,5)	1.0 milli-atm-cm
f. Measurement Accuracy (6)		
1. X < 0.25 atm-cm	9.5 milli-atm-cm (6,5)	5.0 milli-atm-cm
2. 0.25 < X < 0.45 atm-cm	13.0 milli-atm-cm (6,5) ~ 3%	5.0 milli-atm-cm
3. X > 0.45 atm-cm	16.0 milli-atm-cm (6,5)	5.0 milli-atm-cm
g. Latency	120 min. (7)	15 min
h. Refresh	At least 90% coverage of the globe every 24 hours (monthly average) (8)	24 hrs. (8)
i. Long-term Stability (9)	1% over 7 years	0.5% over 7 years
		v1.4.2, 7/29/11

Notes:

1. The OMPS Limb Profiler instrument does not fly on JPSS-1. Thus, only the Ozone Total Column elements are shown in this Table.
2. The loss of the OMPS Limb Profiler has had a small effect on the total column performance as the estimates of the profile shape and the tropospheric ozone are poorer, so the corrections are also poorer. There is new information that the OMPS algorithm use of the IR cloud top pressures will lead to errors as the IR values tend to be higher than the UV ones that should be used. A Discrepancy Report has

Data Product Maturity Definition

Validated Stage 1:

Using a limited set of samples, the algorithm output is shown to meet the threshold performance attributes identified in the JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions

Nine Things to Know about the OMPS Total Ozone EDR

- The algorithm uses information at 22 wavelengths obtained from 44 macropixels (20 or more spatial pixels) x 35 cross-track measurements.
- Channels are combined three at a time to generate ozone, reflectivity and wavelength dependence of reflectivity (e.g., aerosol effects) estimates.
- A single triplet is used to generate the heritage Version 7 ozone estimate.
- A single triplet (317, 331 and 336 nm) is used to generate the SO2 Index. It shows the effect of inter-channel biases and its use is problematic at high Solar Zenith Angles.
- Internal comparisons monitoring cross-track variations in ozone, reflectivity, aerosol and SO2 Index values provide direct information on inter-channel biases.
- Absolute calibration of the reflectivity channels is tested by vicarious methods by using Greenland and Antarctic ice fields, cloud-free equatorial Pacific ocean, and minimum land values.
- Absolute calibration of ozone sensitive channels can be set to agree with the validation "truth" data set of choice.
- The First Guess IP and EDR products have been converging.
  - Partial Cloud calculations are the same except for the use of differing Snow/Ice information
    - Identical logic for cloud fractions and input for cloud top pressures
    - Snow/Ice for NRT VIIRS in EDR is still erroneous – Snow/Ice tilings in 1st Guess are very good climatology; These will be updated daily starting in 2014
  - Temperature data options – Climatology, NCEP, CrIMSS (and correction On/Off)
    - Need to bring forecasts for the stratosphere into IDPS and turn on the correction for the IP.
- The total ozone column products do not currently meet requirements; soft calibration adjustments to remove inter-channel and cross-track calibration errors in the SDR are necessary to achieve the performance.

Evaluation of algorithm performance to specification requirements

- Improvements since Provisional
  - Algorithm Improvements
    - Restricted extrapolation of Profile Mixing Fraction
    - Implemented stray light corrections in SDR
    - Implemented Intra-orbital wavelength scale in SDR
  - LUT / PCT updates
    - Regular weekly updates of Dark corrections
- Cal/Val Activities for evaluating algorithm performance:
  - Ground truth and Satellite data sets

Evaluation of the effect of required algorithm inputs

- Required Algorithm Inputs
  - Primary Sensor Data
    - Stray light including out-of-range contributions are now well corrected
    - Measurement based intra-orbit wavelength scale adjustments are implemented
    - New Day 1 and wavelength scale in testing
    - Calibration Factor Earth (CFE) Soft Calibration in preparation
      - One-percentile reflectivity
      - OMI Ozone
      - Aerosol and SO2 free regions
  - Ancillary Data
    - The TC EDR and First Guess IP have been converging in their use of external data. NRT products from VIIRS and CrIS are being replaced with Internal Calculations, Forecasts and UV specific climatologies.
  - LUTs / PCTs
    - RT LUTs are stable. Measurements radiance/irrradiance ratios are interpolated to table channel wavelengths. Corrections for SO2 absorption coefficients.
    - Weekly dark updates are continuing.
    - Bi-annual Solar reference diffuser measurements show a very stable instrument.
- Evaluation of the effect of required algorithm inputs
  - SDR Performance for most attributes meets requirements.

Important EDR/SDR Changes

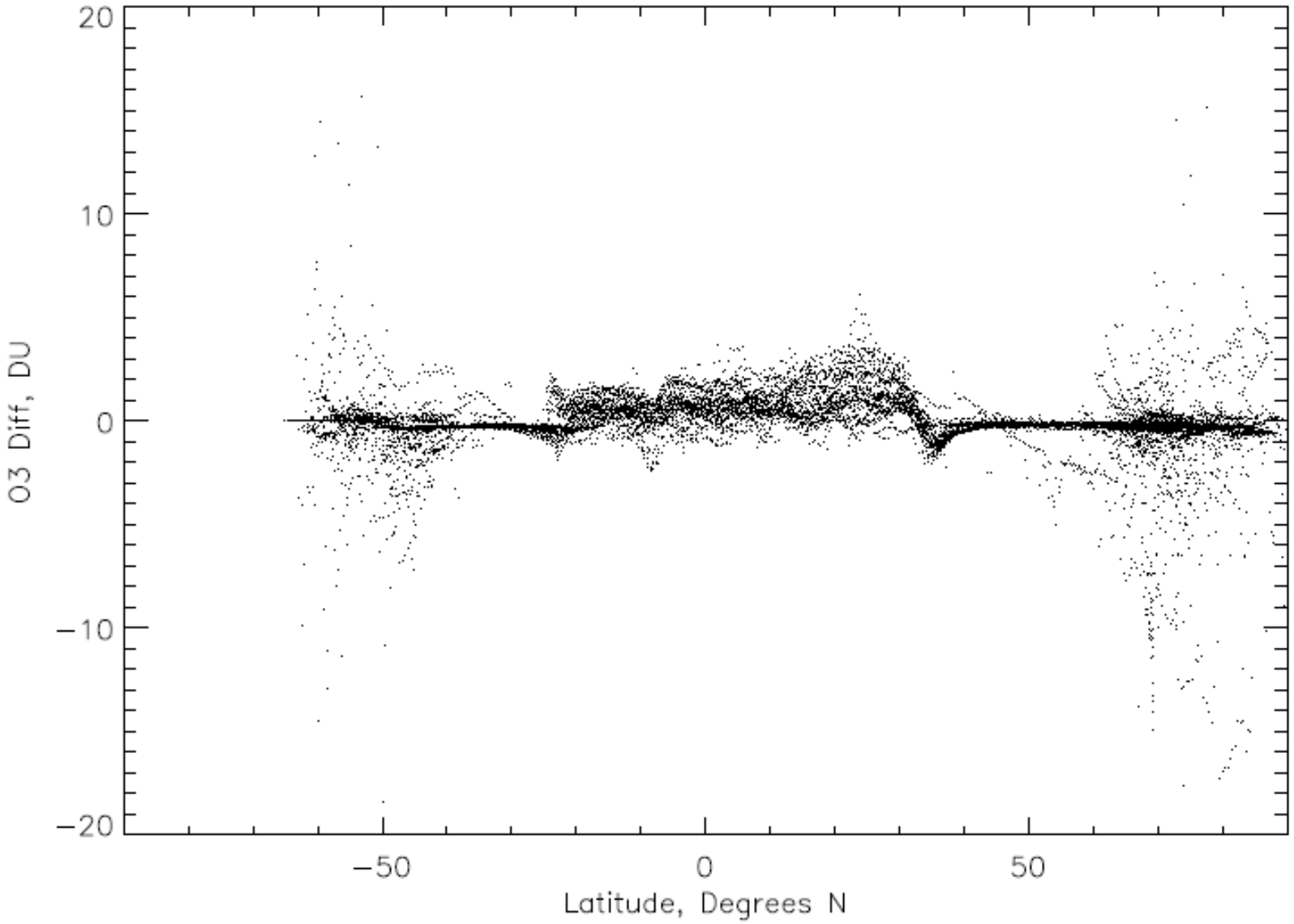
- DR7387/CCR1879 (SDR) TC SDR TC Stray Light Out-of-Range LUT update
- DR4266/CCR411 Implemented partial cloud logic;
- DR4955/CCR736 Replace cloud top pressure with UV-based climatology; Mx7.0.
- DR4918/CCR829 Replace SO2 absorption coefficients.
- DR7310/CCR1215 Restrict the profile mixing fraction in the OMPS NM EDR;
- Turn on temperature corrections for the IP; can be done out of build.

CCRs actions include updates to appropriate documents, e.g., ATDBs.

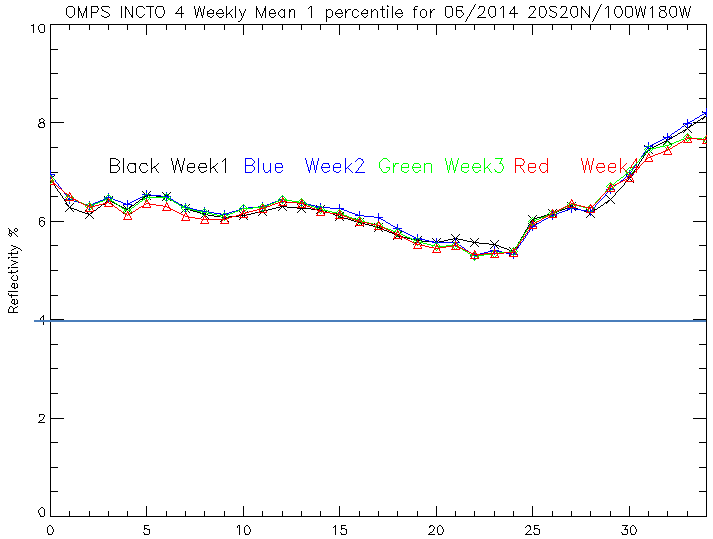
Open DRs Today

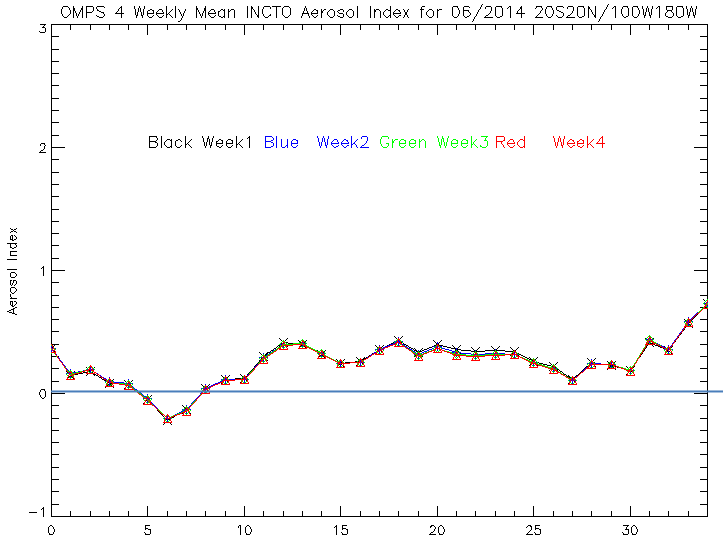
DR #	Short Description
7334	Impact of dichroic shifts (Stable; Soft Calibration 7314)
7260	Impact of wavelength scale shift (Small after correction)
7315 4818	Bias and smear errors (Closed – Fixed 20140722 no impact)
7753	VIIRS Cloud Fraction clean up (No impact on product)
5009	QF 1 Bit 2 snow/ice fraction is set incorrectly (Redundant flags are set correctly – Note in Readme.)
7044	VIIRS snow/ice (Replace NRT product with Daily Tilings) (In use in First Guess IP)
7235 7254	Loss of CrIS temperature data; use of NCEP. (First guess has Temp correction turned off. Do not set degraded flag.)
7653	V8 Algorithm for Total Ozone EDR (Future)
7655	Day 1 Solar Spectra (Updates in testing)
7451	Day 1 Wavelength Scale (Update to orbital average in testing)
7314	Generate soft calibration coefficients (Set CFE using Equatorial Pacific Box, 1-percentile reflectivity = 4%, OMI TOz, no aerosol, no SO_2. Reduce SO_2 sensitivity if necessary.

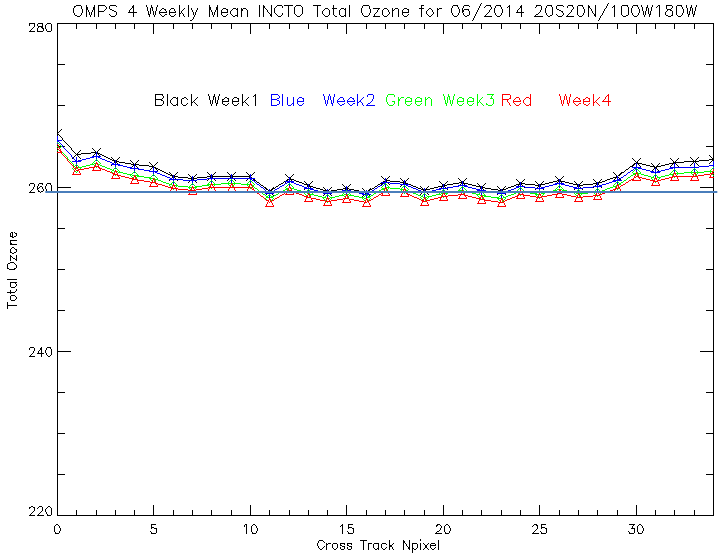
Differences in Temperature Corrections using NCEP Forecast versus CrIMSS Profiles

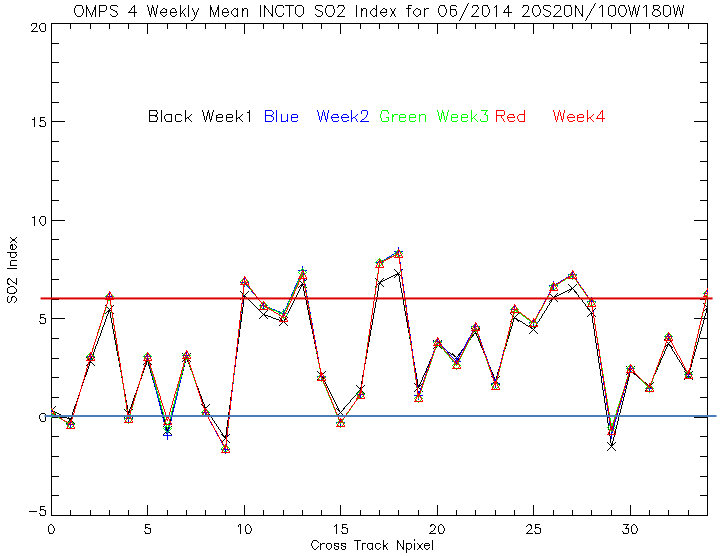


Internal Consistency and Vicarious Calibration/Validation
DR 7314 OMPS TC EDR: Generation of soft calibration coefficients (CFE) – Use Equatorial Pacific Box, Minimum Reflectivity = 4%, no aerosol, no SO2, Toz set to OMI TOz. Reduce SO2 sensitivity if necessary.





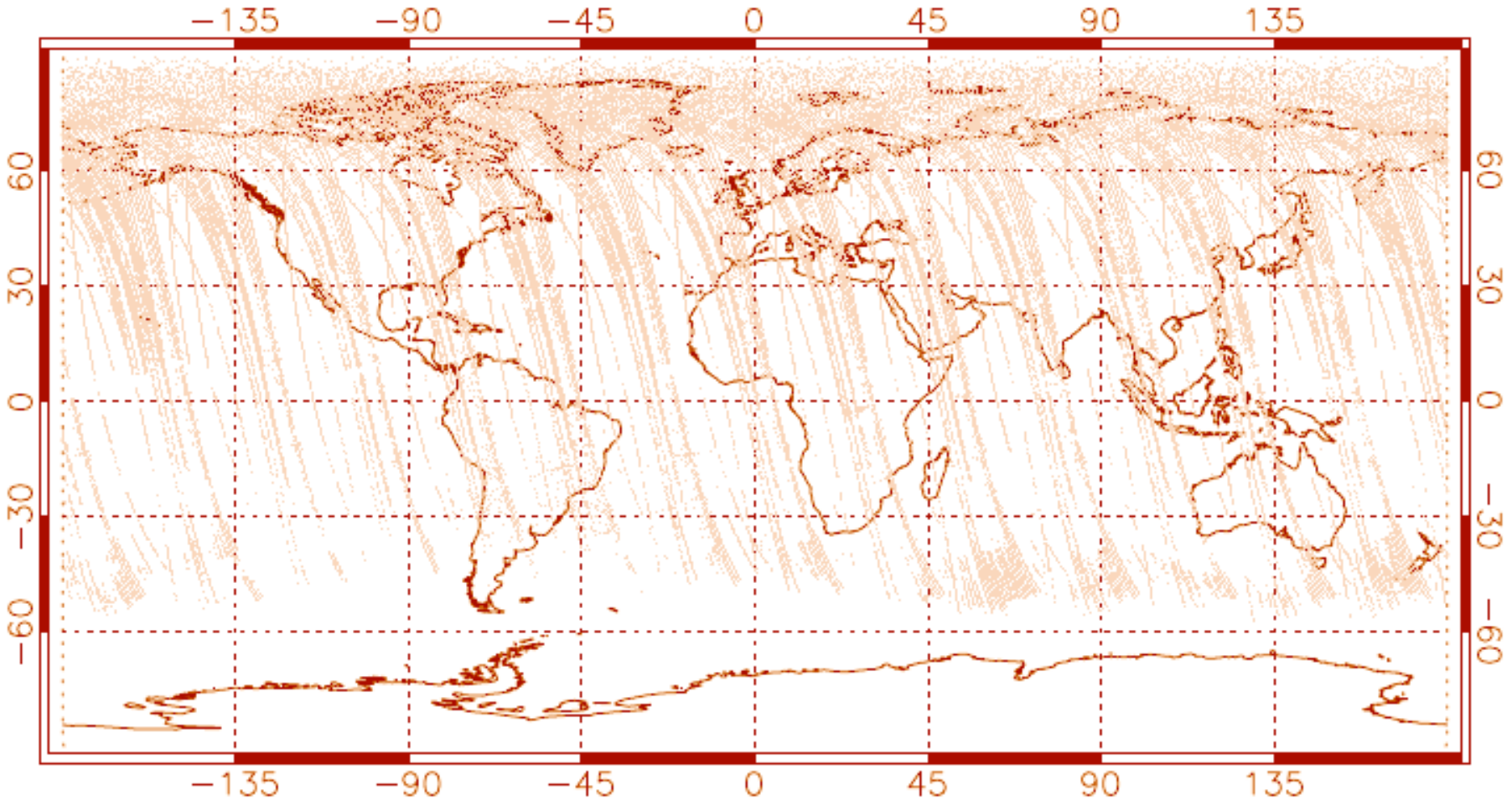




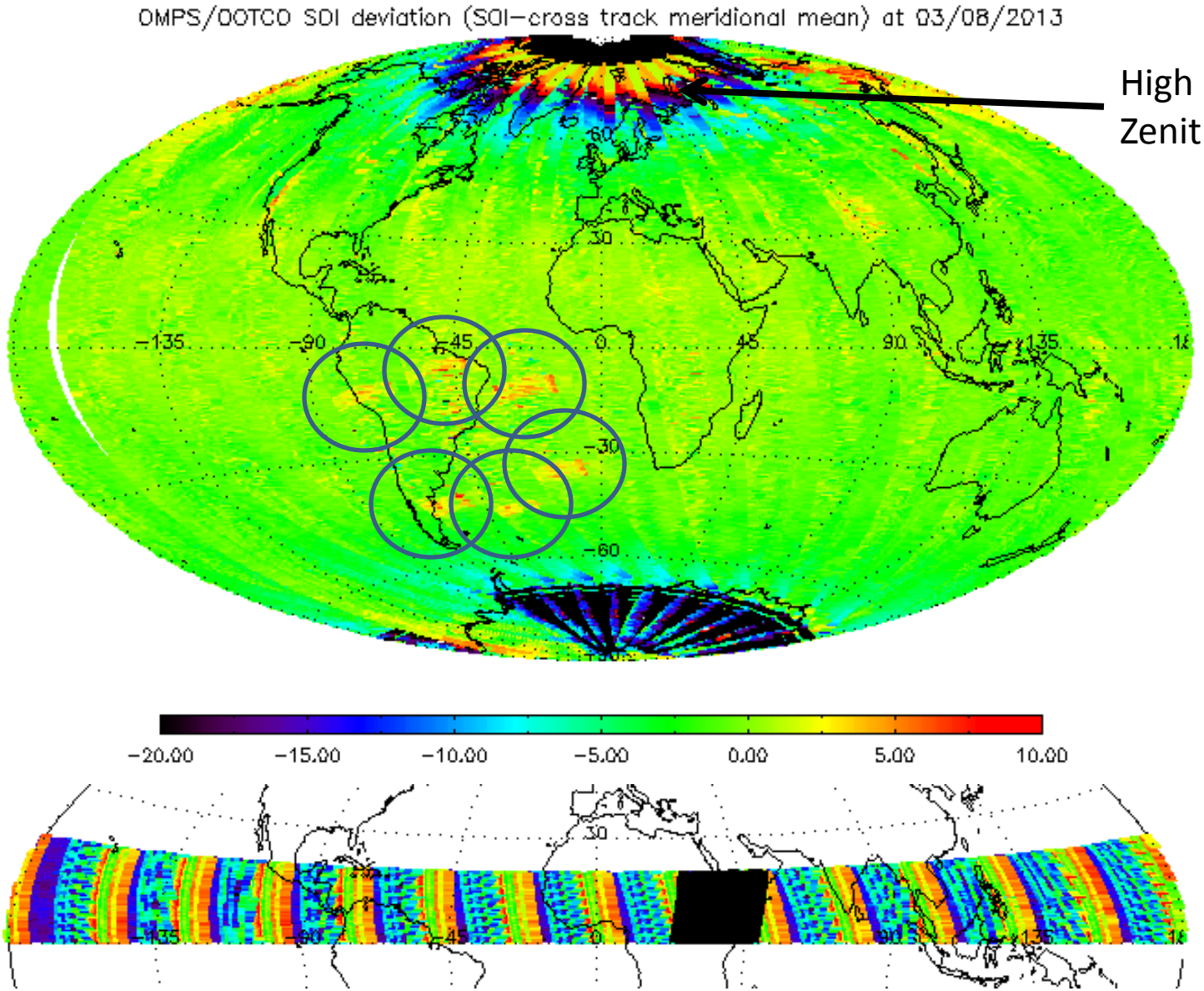
Weekly average Effective Reflectivity, Total Column Ozone, Aerosol Index and SO2 Index values, for June 2014 for a latitude / longitude box in the Equatorial Pacific versus cross-track pixel.

SO_2 exclusion

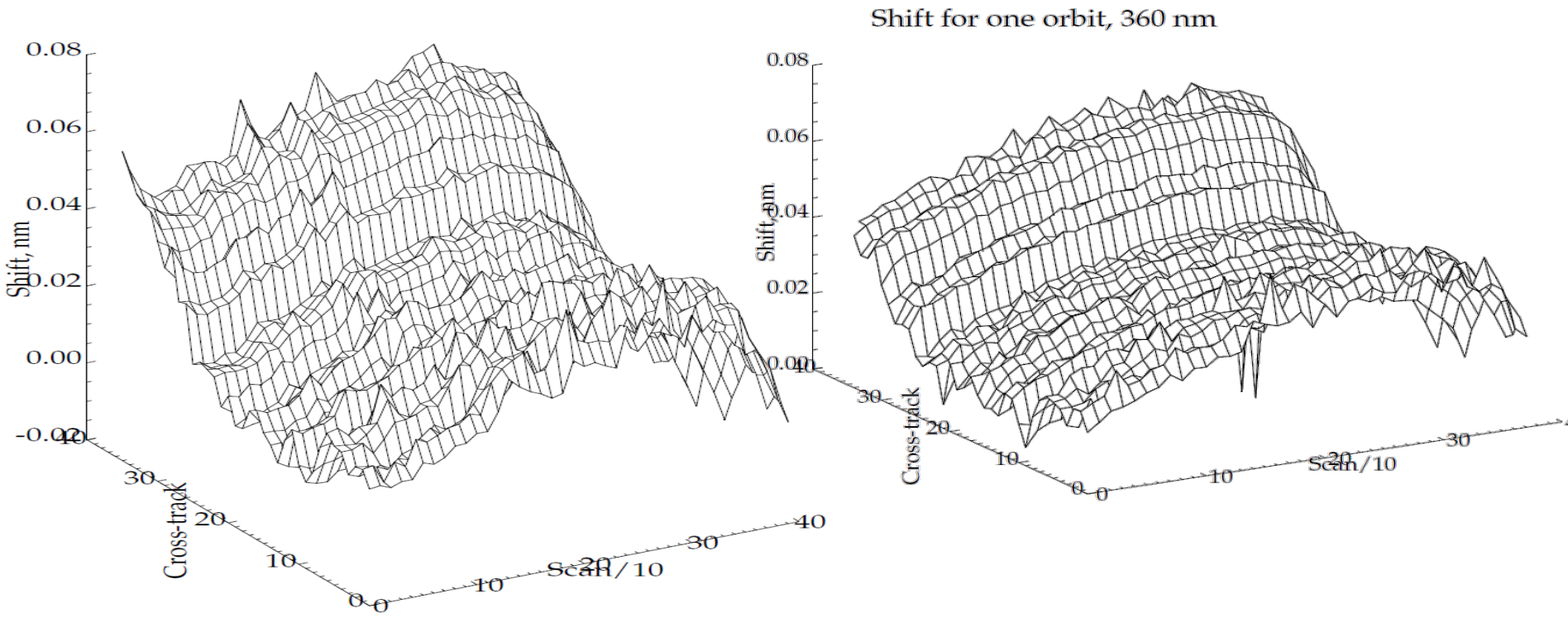
SO2 Error Currently Set



SO2 Map After Removal of Cross-Track Biases



These features were removed with the change in SAA dark correction process.

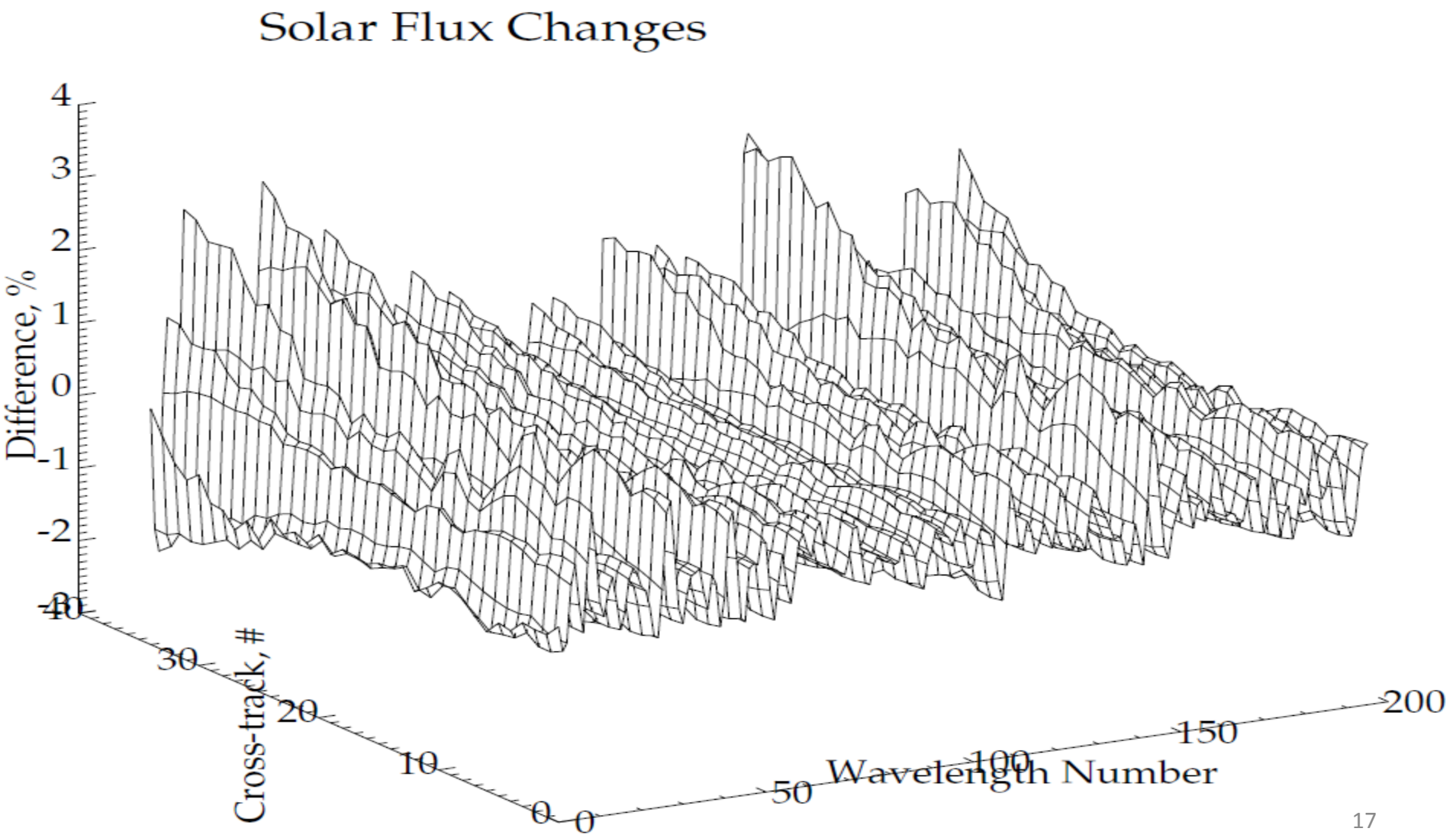


Comparison of cross-track and orbital patterns of estimated Earth radiance scales relative to the current day 1 solar from the proposed method using 346 nm to 380 nm with those from an analysis in an SO_2 product formulation. The two sets of results agree well in both along orbit and cross track variations. The results for every tenth scan are used to create the figures.

Comparison of Results for Test Granule

SOMTC_npp_d20130205_t1500128_e1500502_b06615_c20130205221511027836_noaa_ops.h5

SOMTC_npp_d20130205_t1500128_e1500502_b06615_c20130812180617128986_ssec_cspp.h5



INCTO/OOTCO Error and Quality Flags

- Error Flag
  - Bit1 0 good, 1 large residual; Bit2 1 large SO2 Index&; Bit3 1 triplet inconsistency; Bit4 1 ozone out of range; Bit5 1 surface reflectivity out of range.
- Quality Flag 1
  - Bit1/Bit2 Quality 0 no retrieval, 1 low, 2 medium, 3 high; Bit3 1 input data quality is not good; Bit4 1 triplet selection is not consistent; Bit5 1 inconsistent residuals; Bit6/Bit7 0 SZA<80, 1 80<SZA<88, 2 SZA>88
- Quality Flag 2 – Duplicates other flags or information
  - Bit1 1 snow/ice present; Bit2 1 sun glint geometry over open water; Bit3 1 solar eclipse in FOV; Bit4 1 TOZ<50 or TOZ>650; Bit5/6 0 TOZ> 450*, 1 250<TOZ<450, 2 TOZ<250, 3 not used; Bit7 1 Aerosol Index Too Large, AI> 0.5; Bit8 Spare
- South Atlantic Anomaly Flag – Climatological intensity
  - 0 0-10%, 1 10-20%, 2 20-30%, 3 30-40%, 4 40-50%, 5 50-60%, 6 60-70%, 7 70-80%, 8 >80%
- Scene Condition Flag
  - Bit1 0 Descending, 1 Ascending^; Bit2 1 Snow/Ice present #; Bit3 1 Troposheric Aerosols present; Bit4 1 Snow/Ice Fraction > 0; Bit5 1 Solar Zenith Angle (>80^{o}); Bit6 1 Surface Reflectivity (>1.2 or <-0.05)

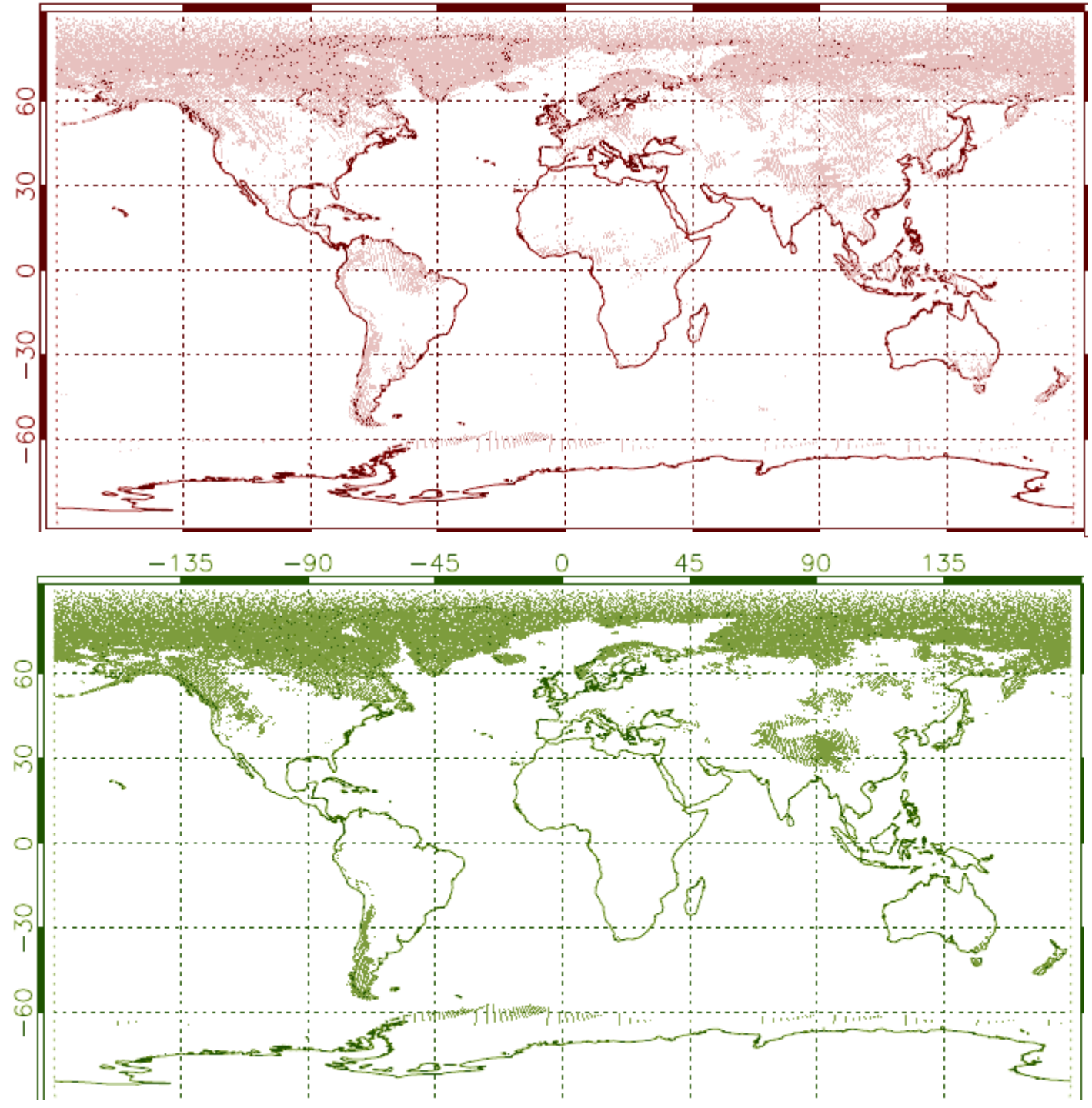
See references on in the Provisional Presentation for more details on these flags.

&EF B2 the SO2 Index is affecting performance as data with SO2 incorrectly estimated as greater than 6 DU are flagged as poor retrievals.

*QF2 B5/6 can be 0 when the condition is not checked in addition to when the total column ozone is greater than 450 DU. It is not affecting the algorithm performance.

^SCF B1 was not currently set properly according to the orbital A fix was implemented with Mx7.1 in June 2013. path, i.e., by checking the changes in latitude during a measurement. It was almost always set to 1, except for the first and last granules in a sequence of measurements as processed at IDPS. It did not affect the algorithm performance.

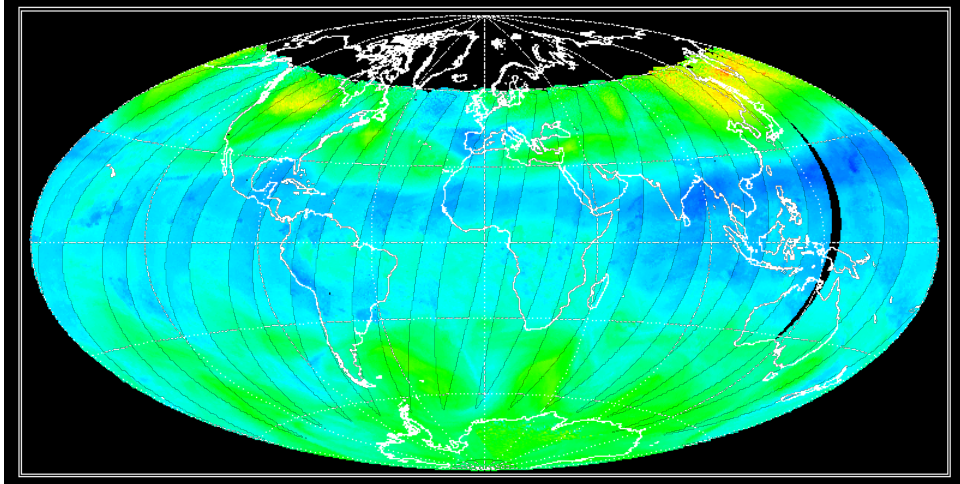
#SCF B2 is not currently set properly. It is set to snow/ice present almost everywhere. It is inconsistent with SCF B4 Snow/Ice Faction > 0. It is not affecting the algorithm performance.



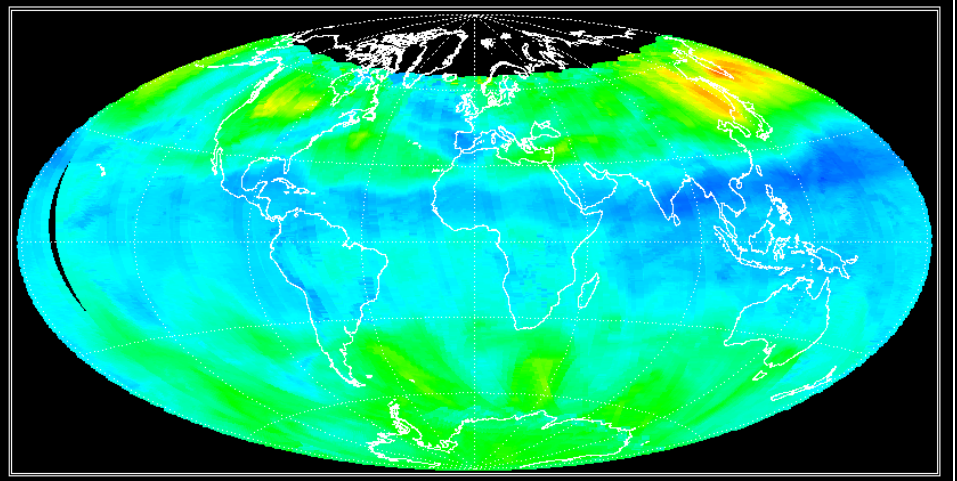
Bad Snow/Ice from VIIRS NRT. Figure shows results for a day in July 2014. Top is for VIIRS NRT product. Bottom is for Weekly tilings

Comparisons among Total Column Ozone Products for MetOp-A/B GOME-2, NASA EOS Aura OMI and S-NPP OMPS (First Guess IP)

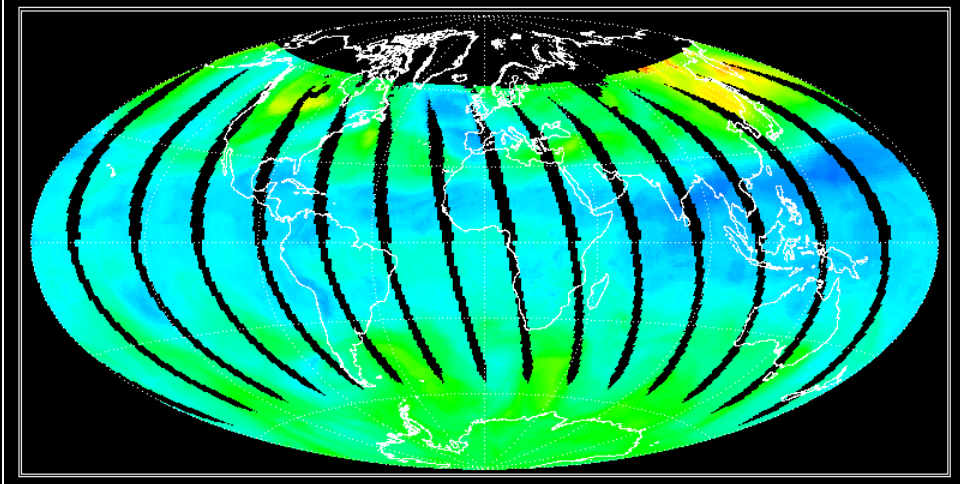
Metop_B GOME-2 Total Ozone for 20131205

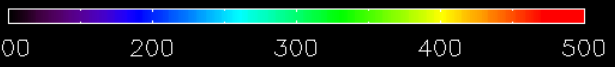


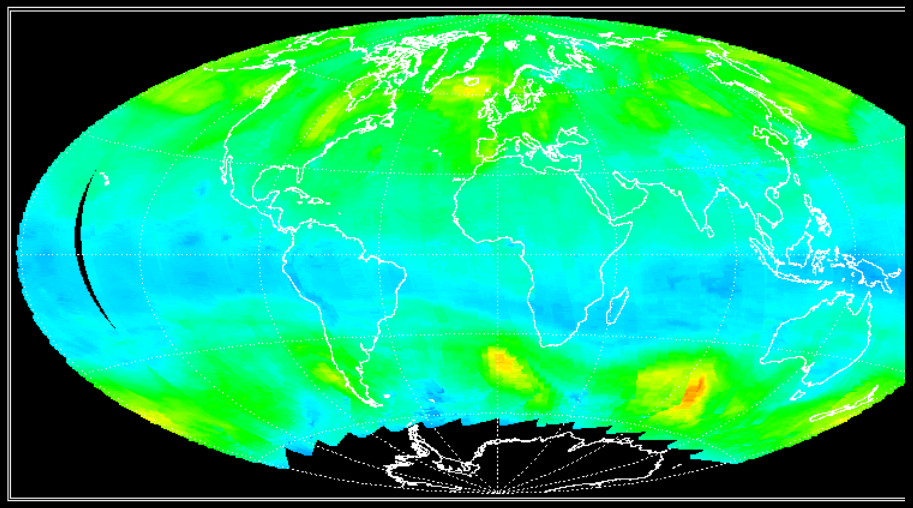
OMPS INCTO Total Ozone for 20131205

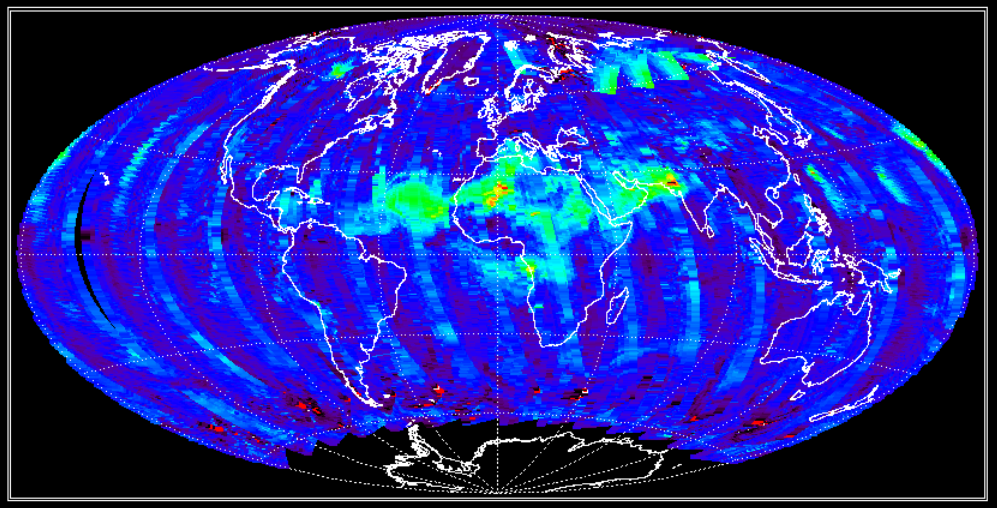


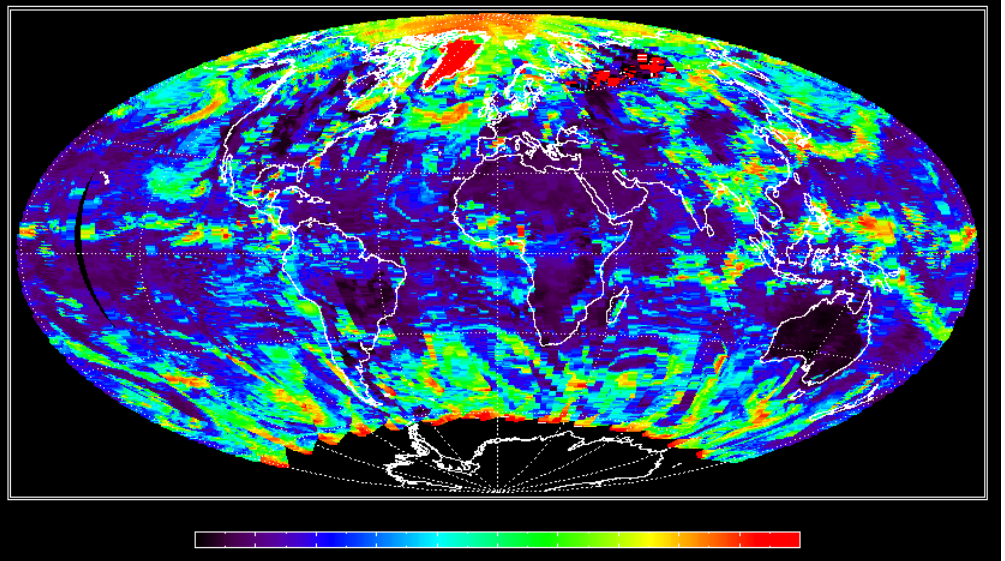
OMI Total Ozone for 20121205



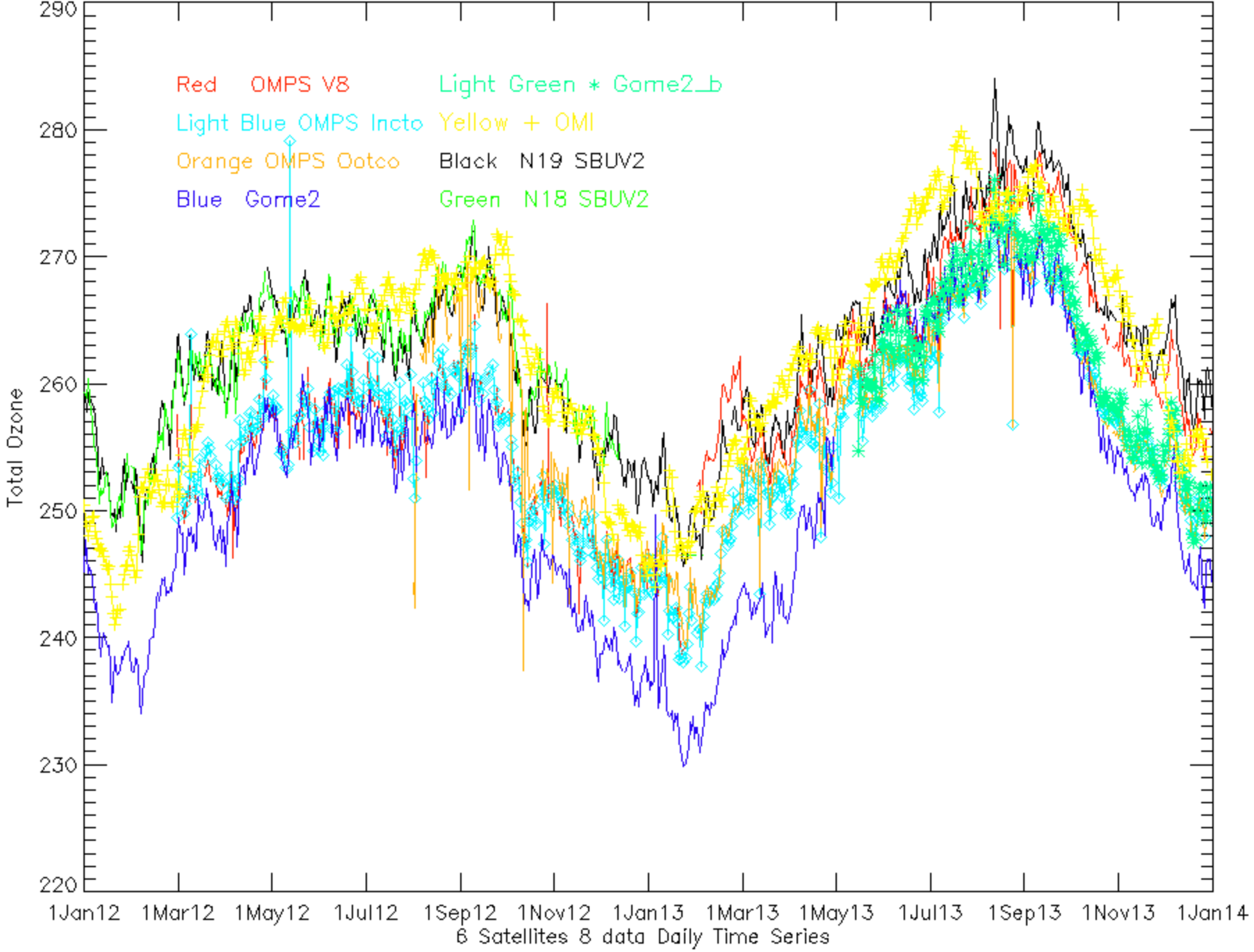


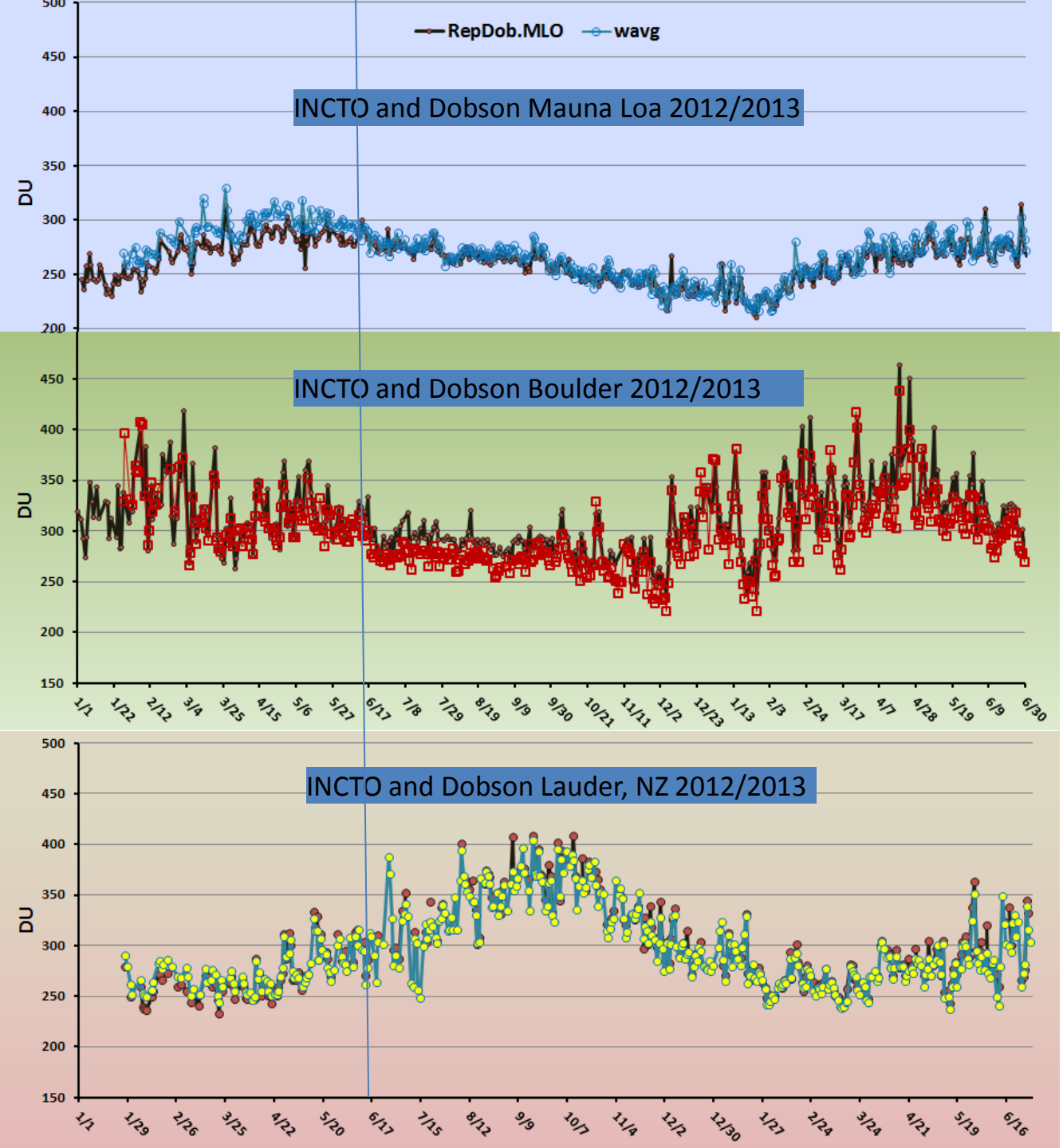




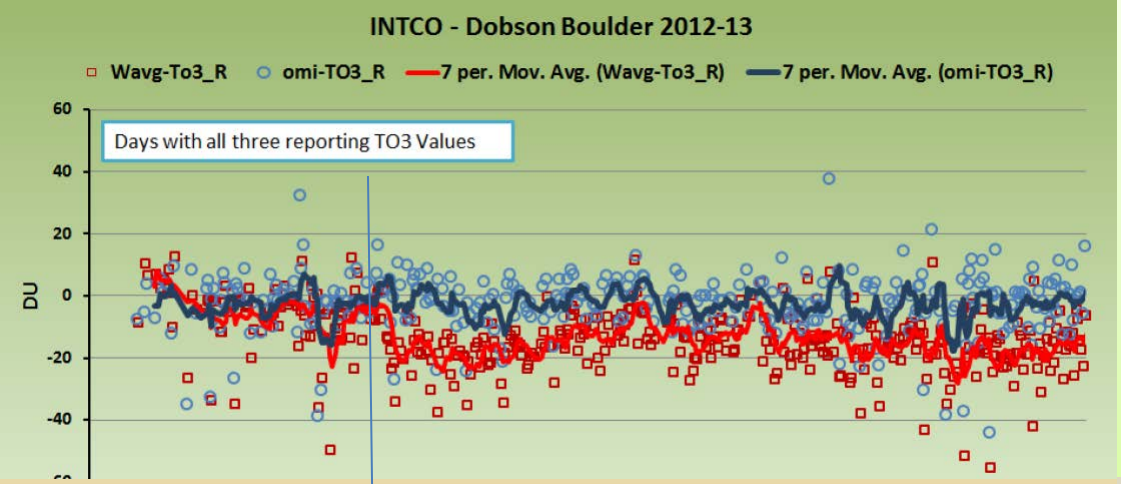


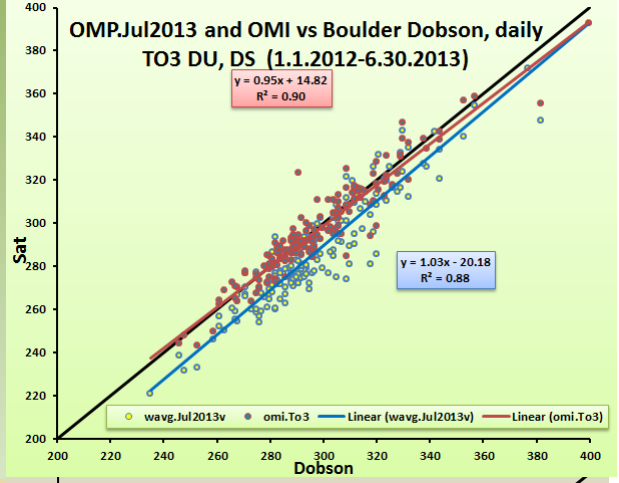
Current S-NPP OMPS (First Guess IP) products for July 3, 2014. Total Column Ozone, Effective Reflectivity and Aerosol Index.

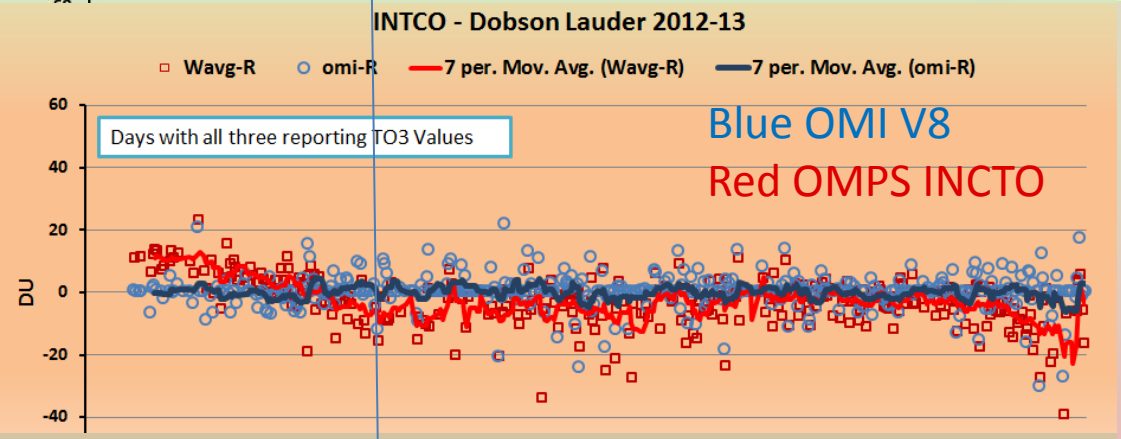

Red OMPS V8
Light Blue OMPS Incto
Orange OMPS Ootco
Blue Gome2
Light Green * Gome2_b
Yellow + OMI
Black N19 SBUV2
Green N18 SBUV2
Total Ozone
290
280
270
260
250
240
230
220
1Jan12
1Mar12
1May12
1Jul12
1Sep12
1Nov12
1Jan13
1Mar13
1May13
1Jul13
1Sep13
1Nov13
1Jan14
6 Satellites 8 data Daily Time Series

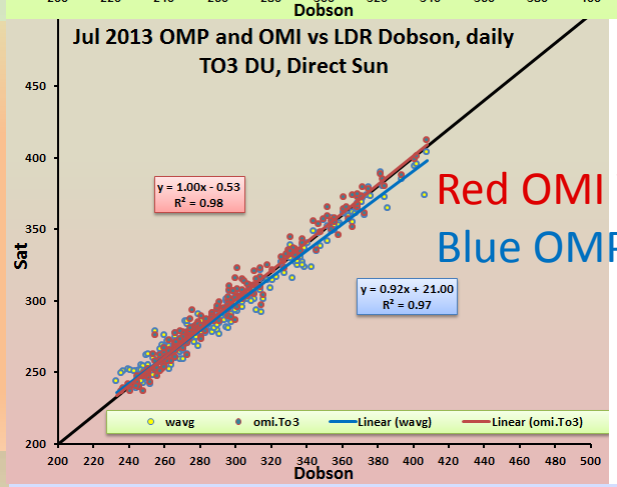


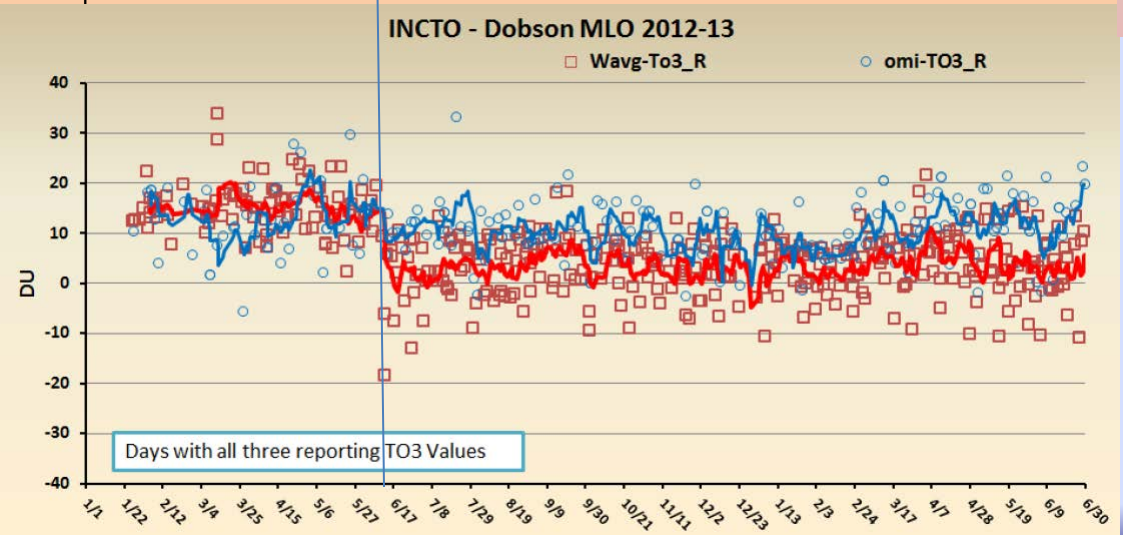
Comparisons of INCTO to three very good Dobson ground stations 1/2012 to 6/2013. Notice the shift in biases in June 2012 with the introduction of new solar flux and wavelength scales.

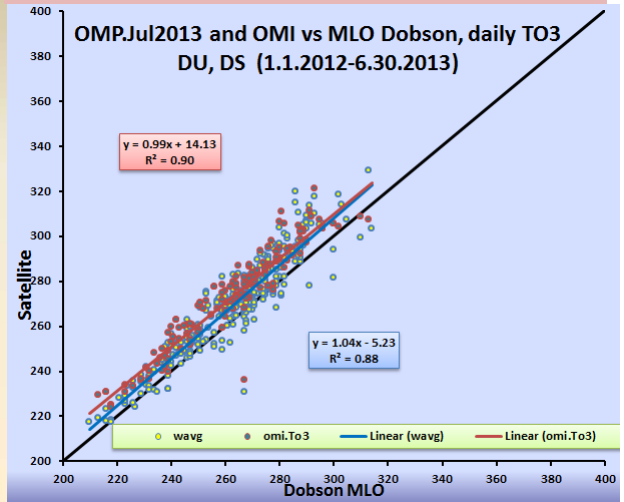

INTCO - Dobson Boulder 2012-13
Wavg-To3_R
omi-TO3_R
7 per. Mov. Avg. (Wavg-To3_R)
7 per. Mov. Avg. (omi-TO3_R)
Days with all three reporting TO3 Values
DU


OMP.Jul2013 and OMI vs Boulder Dobson, daily TO3 DU, DS (1.1.2012-6.30.2013)
y = 0.95x + 14.82
R² = 0.90
y = 1.03x - 20.18
R² = 0.88
wavg.Jul2013v
omi.To3
Linear (wavg.Jul2013v)
Linear (omi.To3)
Sat
Dobson


INTCO - Dobson Lauder 2012-13
Wavg-R
omi-R
7 per. Mov. Avg. (Wavg-R)
7 per. Mov. Avg. (omi-R)
Days with all three reporting TO3 Values
Blue OMI V8
Red OMPS INCTO
DU


Jul 2013 OMP and OMI vs LDR Dobson, daily TO3 DU, Direct Sun
y = 1.00x - 0.53
R² = 0.98
y = 0.92x + 21.00
R² = 0.97
wavg
omi.To3
Linear (wavg)
Linear (omi.To3)
Sat
Dobson
Red OMI V8
Blue OMPS INCTO


INCTO - Dobson MLO 2012-13
Wavg-To3_R
omi-TO3_R
Days with all three reporting TO3 Values
DU


OMP.Jul2013 and OMI vs MLO Dobson, daily TO3 DU, DS (1.1.2012-6.30.2013)
y = 0.99x + 14.13
R² = 0.90
y = 1.04x - 5.23
R² = 0.88
wavg
omi.To3
Linear (wavg)
Linear (omi.To3)
Satellite
Dobson MLO

Nine Things to Know about the OMPS NM SDR

- System linearity is stable and well-corrected.
- Dark currents continue to trend higher but measurement signal-to-noise ratios remain high – weekly dark updates are flowing into the system and have good accuracy. The SAA dark strategy has been revised.
- The offset biases are actually variable but the current constant corrections are superfluous unless they create negative radiances. They have intentionally been set to lower values to avoid zero truncation of negative intermediate quantities.
- Stray light corrections are in place and an improvement for out-of-range contributions has been provided. Remaining errors are small.
- Intra-orbital wavelength scale drifts have been identified and are related to variations in thermal gradients. A measurement-based approach to providing better estimates for each granule has been implemented. Day 1 solar wavelength scales will be set at the averages of the orbital excursions.
- Transient spikes are affecting a very small fraction of smear calculations. Possible solutions are under discussion.
- A second round of Day 1 Solar spectra with soft calibration adjustments is under development.
- Soft calibration adjustments will remove much of the inter-triplet imprecision and cross-track biases and provide a zero-mean SO2 index.
- The two and a half years of solar measurements show good long-term stability of instrument throughput and wavelength scales.

Instrument Performance – OMPS NM

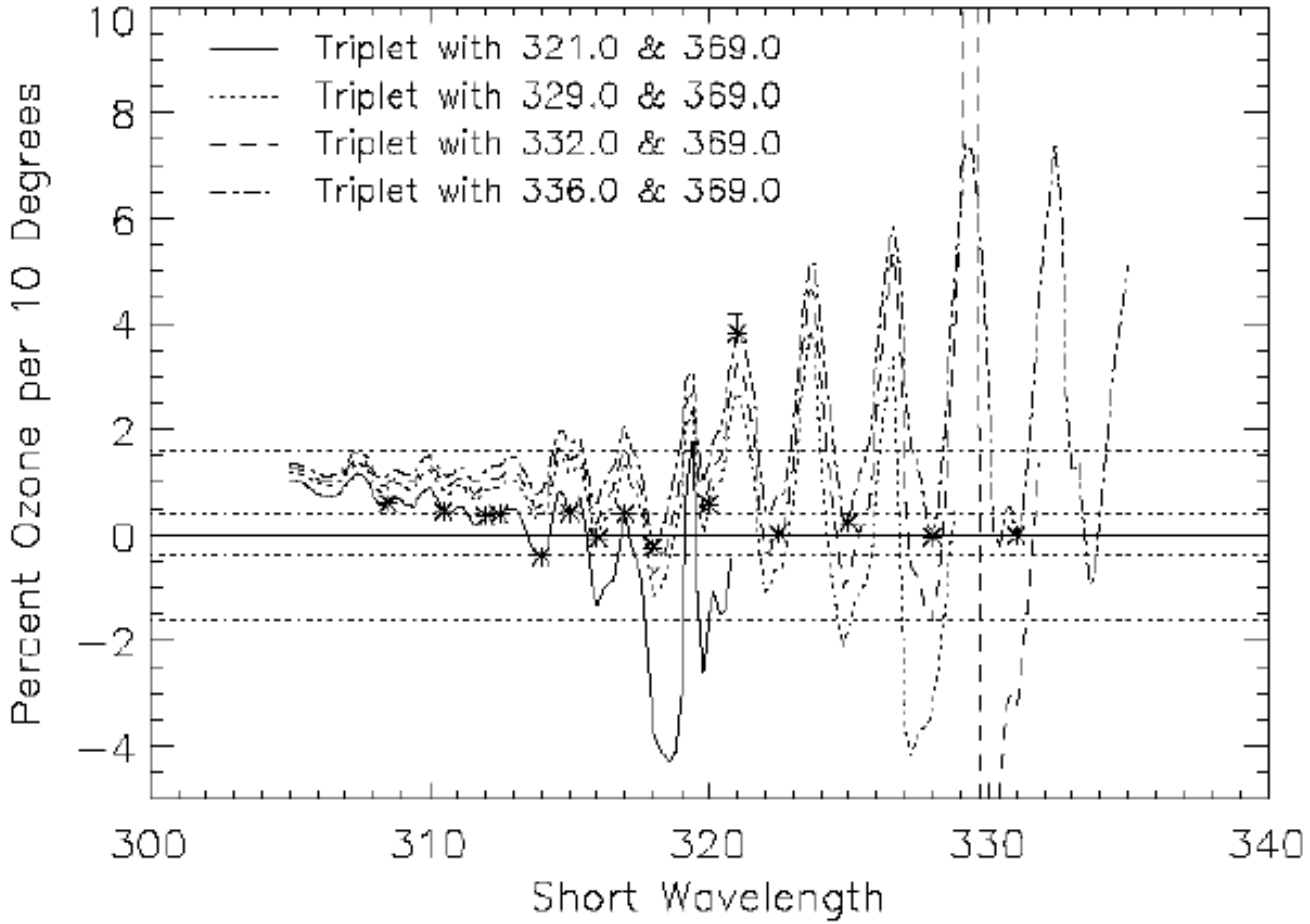
Requirement	Specification/Prediction Value	On-Orbit Performance
Non-linearity	< 2% full well	< 0.46%
Non-linearity Knowledge	< 0.5%	~0.1%
On-orbit Wavelength Calibration	< 0.01 nm	0.01 nm#
Stray Light NM Out-of-Band + Out-of-Field Response	≤ 2	average ~± 0.5%^
Intra-Orbit Wavelength Stability	<0.02 nm	< 0.01 nm*
SNR	>1000	> 1000 from SV and EV
Inter-Orbital Thermal Wavelength Shift	<0.02 nm	<0.01 nm
CCD Read Noise	<60 –e RMS	< 25 –e RMS
Detector Gain	>46	~42
Absolute Irradiance Calibration Accuracy	< 7%	5%
Absolute Radiance Calibration Accuracy	< 8%	< 5%

After new analysis for Day 1 wavelength scale.
^ After ground-based correction for TOz algorithm channels.
* After intra-orbit adjustments.

C. Pan

Example of Triplet Sensitivity Analysis

Figure 2.4-3. Impact of temperature changes on OMPS triplet channels



Documentation

- The following documents will be updated and provided to the EDR Review Board before AERB approval:
  - ATBD
- **474-00029 Joint Polar Satellite System (JPSS) OMPS NADIR Total Column Ozone Algorithm Theoretical Basis Document (ATBD) 20110422**
  - OAD
- **474-00066 Rev E: Joint Polar Satellite System (JPSS) Operational Algorithm Description (OAD) Document for Ozone Mapping and Profiler Suite (OMPS) Total Column (TC) Environmental Data Records (EDR) Software**
  - Updating Provisional README file for CLASS

Identification of Processing Environment

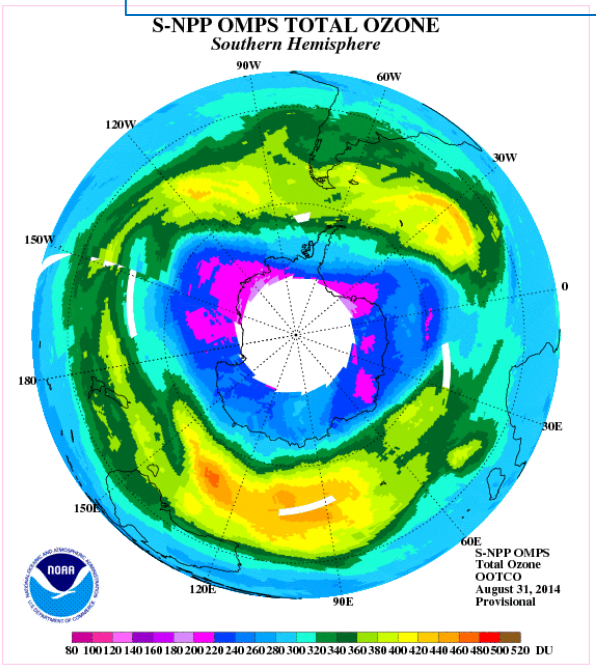
- IDPS Mx8.6 (with planned revision for Mx8.8 February 2015)
- The algorithm version is the Multiple Triplet IP and EDR algorithm.
- The EDR and First Guess IP have been converging in their use of external data. NRT products from VIIRS and CrIS are replaced with internal calculations, forecasts and UV specific climatologies.
- IDPS Build: I1.05.08.05 (Mx 8.5)
- EDR version: Mx 8.5
- LUT Version: PS-1-O-CCR-13-0829-JPSS-DPA-002-PE
- PCT Version: N/A
- Environment for testing: Linux (ADL Mx 8.x) and AIX (ADA Mx 8.x)

Users & User Feedback

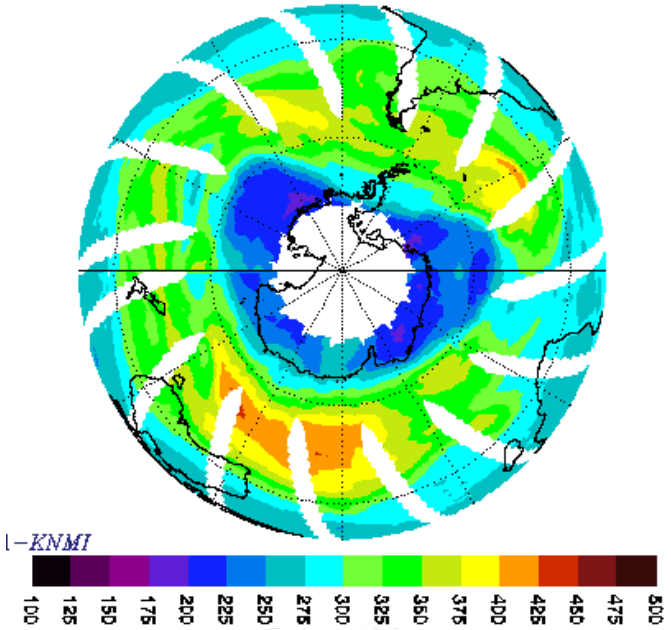
- Users list
  - NCEP, NASA, NRL, Environment Canada, EuMetSat
- Feedback from users
  - BUFR product in testing at NCEP, EC, and EuMetSat
- Downstream product list
  - NCEP assimilation (UV Index and weather)
  - Ozone Hole Monitoring (Stratospheric Summaries)
  - Ozone Layer Assessments
- Reports from downstream product teams on the dependencies and impacts
  - Calibration bias creates offsets with OMI total ozone products
  - Request for V8TOz algorithm for consistency with OMI, GOME-2 and SBUV/2.

Total Column Ozone : Aug 31, 2014

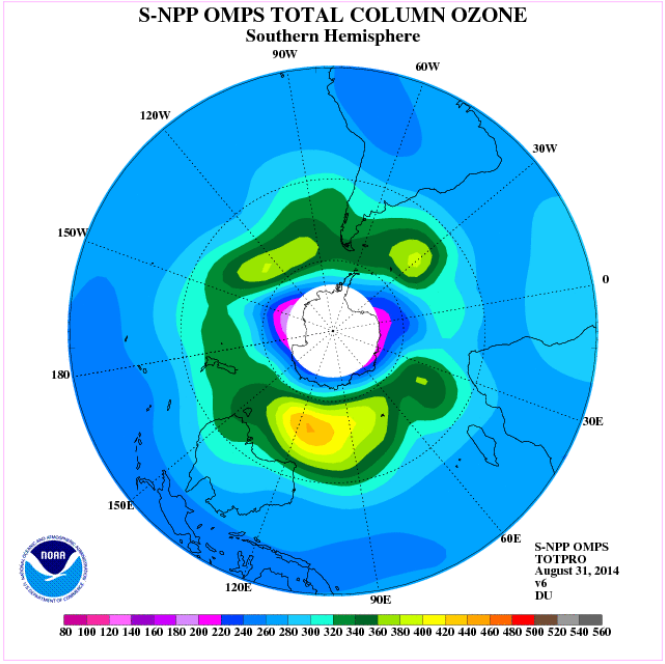
OMPS NM TOTAL OZONE



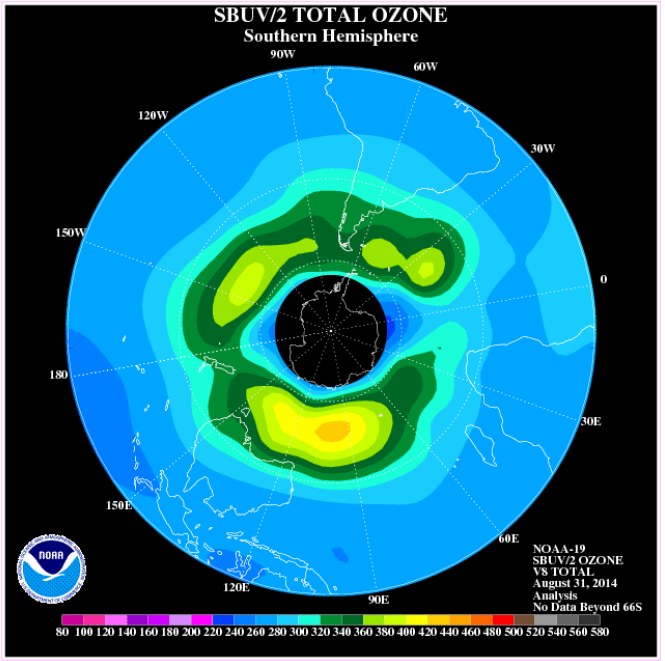
OMI TOTAL OZONE



OMPS NP v6 SH TOTPRO



SBUV/2 v8 SH TOTPRO



Conclusions

- Cal/Val results summary:
  - Team recommends Validated Stage 1 Maturity
    - Products in OOTCO (EDR) flagged with snow/ice present should not be used until VIIRS input is replaced. Products in INCTO (First Guess IP) are good.
    - Data will have small changes in performance when CrIMSS temperature products are replaced with forecasts.
    - Products will meet performance requirements after three Key SDR CCRs are implemented.

Path Forward

- Planned further improvements
  - Implement V8TOz with true SO2 retrieval using the OMI Linear Fit algorithm.
  - Adapt system to process smaller FOV products.
- Planned Cal/Val activities / milestones
  - December 2014 Demonstrate reduced bias (and better cross-track consistency) of OMPS Column Ozone products with improved SDR versus OMI and SBUV/2
  - March 2015 complete global validation with corrected snow/ice fields and forecast temperatures for Validated Stage 2.
  - July 2015 demonstrate validation for annual variations and stability of products for Validated Stage 3.

Backup

Brief mapping of sensor and algorithm performance

Table 5.1-1. Sensor Parameters and Performance Requirements

Parameter	Baseline Algorithm Needs	Baseline Sensor Allocation	Comments
Wavelength range	308-377 nm	300-380 nm	Ozone and path length range
Bandwidth	1 nm	1 nm	Pair/triplet approach
Samples/FWHM	1 min.	2.4	λ shift, Ring effect
Number of channels	22*	192	Triplets, over-sampling, aerosols
Horizontal cell size	50 km @ nadir	50 km @ nadir	
Horizontal coverage	> 2800 km	> 2800 km	
SNR	> 1000 for SZA < 80 at specified radiances	> 1000 for SZA < 80 at specified radiances	Precision
λ registration	< 0.01 nm	< 0.01 nm	Ozone cross-section error
Albedo calibration	2%	2%	Accuracy and stability
Pixel to pixel calibration (includes linearity)	0.5% max.	0.5% max.	Accuracy
Albedo deviation error	< 1%	< 1%	Accuracy and stability

* The 22 wavelengths are: 308.5, 310.5, 312.0, 312.5, 314.0, 315.0, 316.0, 317.0, 318.0, 320.0, 321.0, 322.5, 325.0, 328.0, 329.0, 331.0, 332.0, 336.0, 364.0, 367.0, 372.0, and 377.0 nm

Pixel to pixel calibration will contribute to both **Accuracy and Precision** error budgets. Notice that this allocation is at the 0.5% level.

Requirements (1 slide)

Product Requirements from JPSS L1RD

Attribute	Threshold	Objective
Geographic coverage		
Vertical Coverage		
Vertical Cell Size		
Horizontal Cell Size		
Mapping Uncertainty		
Measurement Range		
Measurement Accuracy		
Measurement Precision		
Measurement Uncertainty		

Error Budget

Compare analysis/validation results against requirements, present as a table. Error budget limitations should be explained. Describe prospects for overcoming error budget limitations with future improvement of the algorithm, test data, and error analysis methodology.

Attribute Analyzed	L1RD Threshold	Analysis/Validation Result	Error Summary

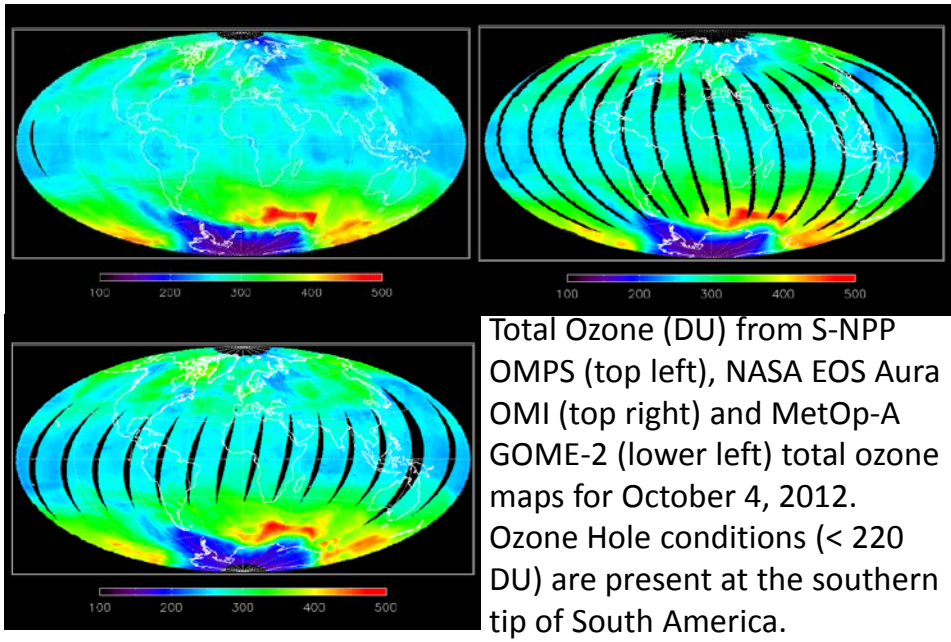
Provisional Maturity for S-NPP OMPS EDR products

Supports the CLIMATE Mission and the WEATHER & WATER Goals

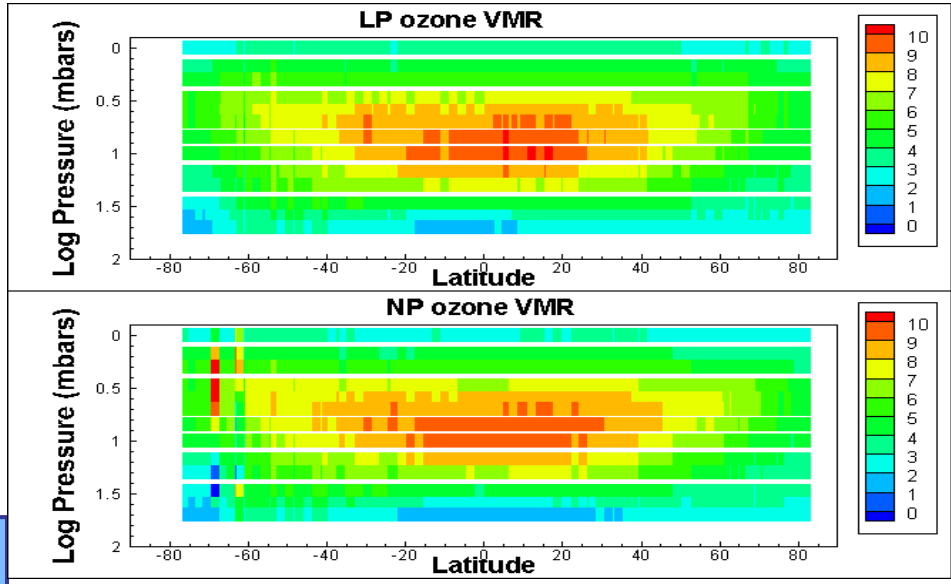
- The Ozone Mapping & Profiler Suite (OMPS) was launched on the Suomi National Polar Partnership (S-NPP) satellite on October 28, 2011. The OMPS is the next generation of operational ozone sensors for NOAA. Its products will replace existing ones from the Solar Backscatter Ultraviolet (SBUV/2) instruments.
- NOAA/NESDIS has provided validation and analysis of the Total Column and Nadir Profile operational ozone products from the Interface Data Processing Segment (IDPS) to justify their advance to *Provisional Maturity*. This will be applied retroactively to the products as of March 1, 2013. Findings presentations & ReadMe files are provided with the products at CLASS.

The two figures on the right compare the OMPS Limb Profiler and Nadir Profiler ozone profiles for September 6, 2012. They show the zonal mean mixing ratios at pressures from 100 to 1 mbars versus Latitude. The Limb data has been smoothed vertically to be similar to the Nadir resolution. Refinements of both products are continuing. (Limb Profiler data and figures are from the NASA OMPS NPP Science Team.)

Significance: The OMPS instruments provide the measurements to continue monitoring atmospheric ozone.



Total Ozone (DU) from S-NPP OMPS (top left), NASA EOS Aura OMI (top right) and MetOp-A GOME-2 (lower left) total ozone maps for October 4, 2012. Ozone Hole conditions (< 220 DU) are present at the southern tip of South America.

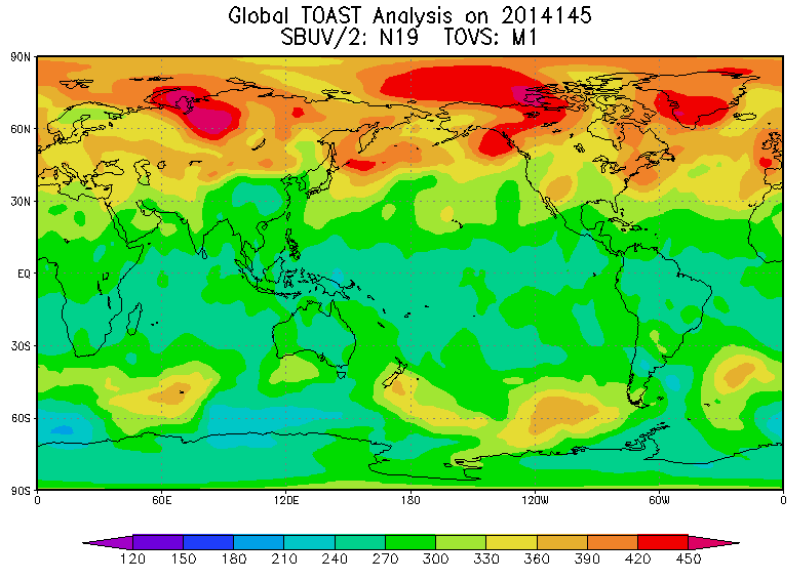


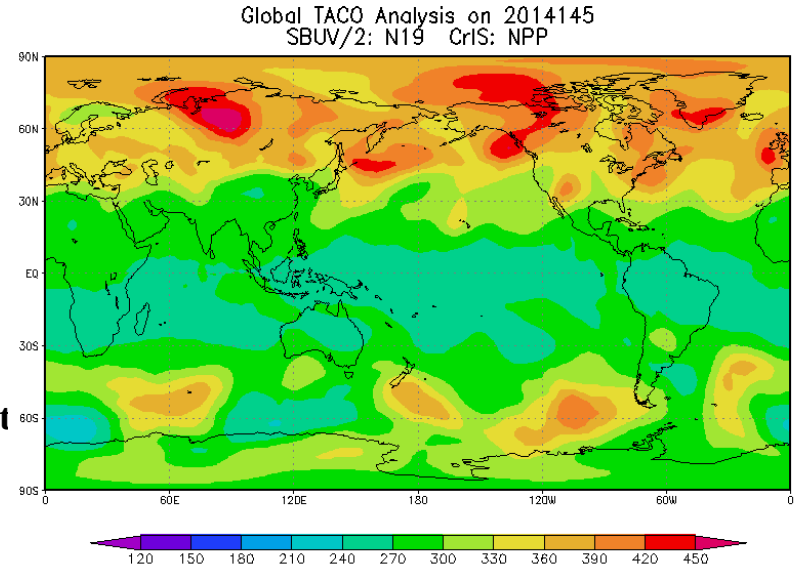
Slide courtesy of L. Flynn; Maps by W. Yu.

New Products from S-NPP OMPS

Supports the CLIMATE Mission and the WEATHER & WATER Goals

- The Ozone Mapping & Profiler Suite (OMPS) was launched on the Suomi National Polar Partnership (S-NPP) satellite on October 28, 2011. The OMPS is the next generation of operational ozone sensors for NOAA. Its products will replace existing ones from the Solar Backscatter Ultraviolet (SBUV/2) instruments.
- NOAA/NESDIS are now providing BUFR versions of the OMPS Nadir Ozone Profile and Total Column maps to users in NRT from the NDE system. This format is compatible with applications for the NWS and other operational users.
- A newer version of the combined UV/IR total ozone maps (called TACO) using information from the CrIS Ozone product in place of HIRS is now in operational production at OSDPD. As soon as the OMPS Ozone Profile product advances to validated maturity, it will use that information in place of the SBUV/2 data.





The two figures on the right compare the current TOAST Product using HIRS and SBUV/2 (top) with the new (TACO) one using CrIS and SBUV/2. Validation studies confirm that the CrIS ozone product information is superior to the HIRS single channel retrievals.

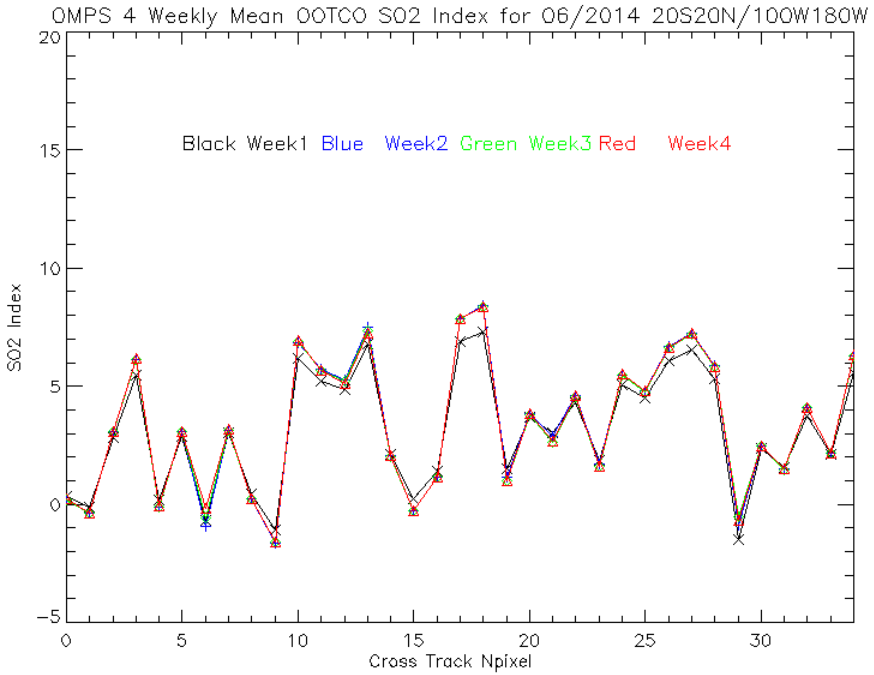
Significance: The OMPS instruments provide the measurements to continue monitoring atmospheric ozone.

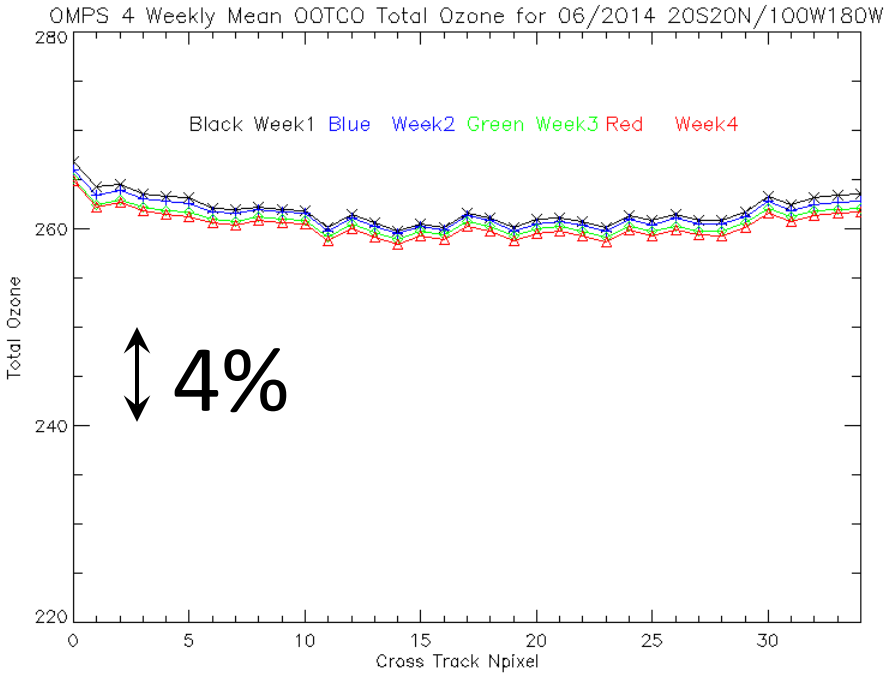
Slide courtesy of L. Flynn; Maps by J. Niu.

Total Ozone Path to Validation

- New Day 1 solar spectra are under development to improve the corrections for intra-orbit wavelength scale variations.
- Soft calibration adjustments are also under development to correct for cross-track calibration uncertainties and SO_2 sensitivity.
- Both problems show repeatable behaviors that are now well-characterized.
- The Total Ozone products from OMPS will be validated by the end of the year.

Current Total Ozone Deficiencies





The wavelength quadruplet chosen for the SO_2 index is too sensitive to calibration uncertainties. This leads to a large number of false positives.

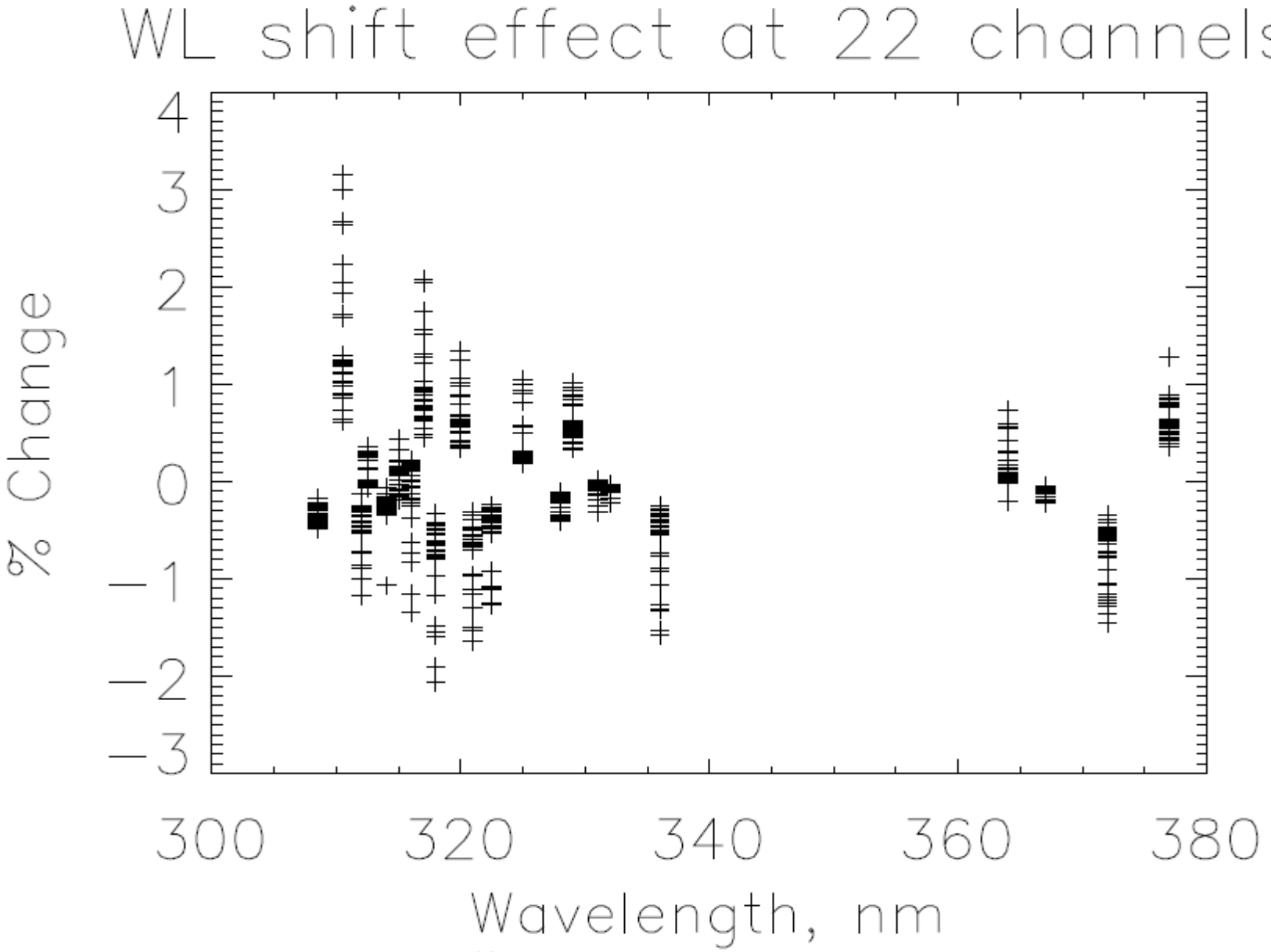
Small uncertainties in the calibration produce a cross-track dependence in the total ozone with satellite view angle

The figures show weekly averages for June 2014 for a latitude/longitude box in the equatorial Pacific. The horizontal axes are cross-track position. These patterns are repeatable and will be removed with soft calibration adjustments.

Future Refinements for the Total Ozone Product

- The total ozone product algorithm will be upgraded to the Version 8 TOMS algorithm currently in use at NOAA to produce operational products from the SBUV/2 and GOME-2 instruments.
- The new algorithm will include an improved SO_2 product for detection of volcanic eruptions.

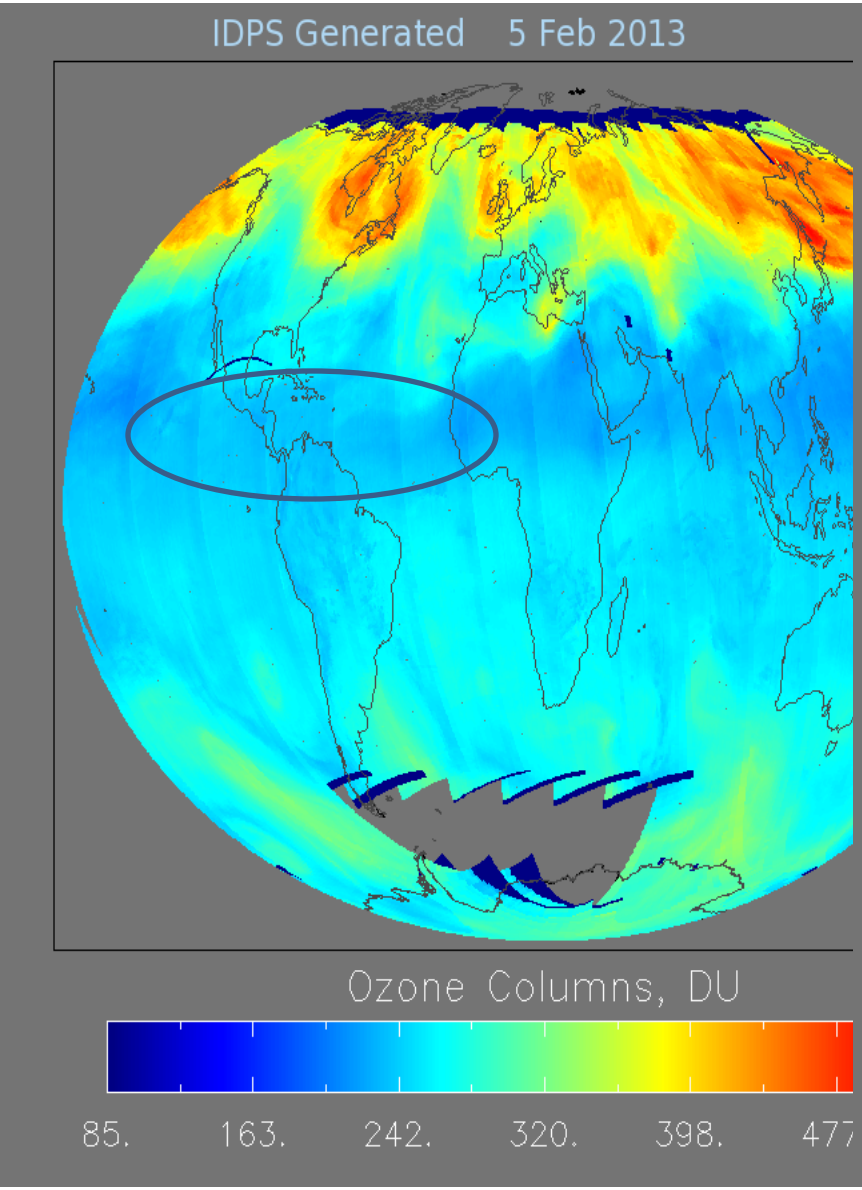
Wavelength shifts can be determined from Earth measurements



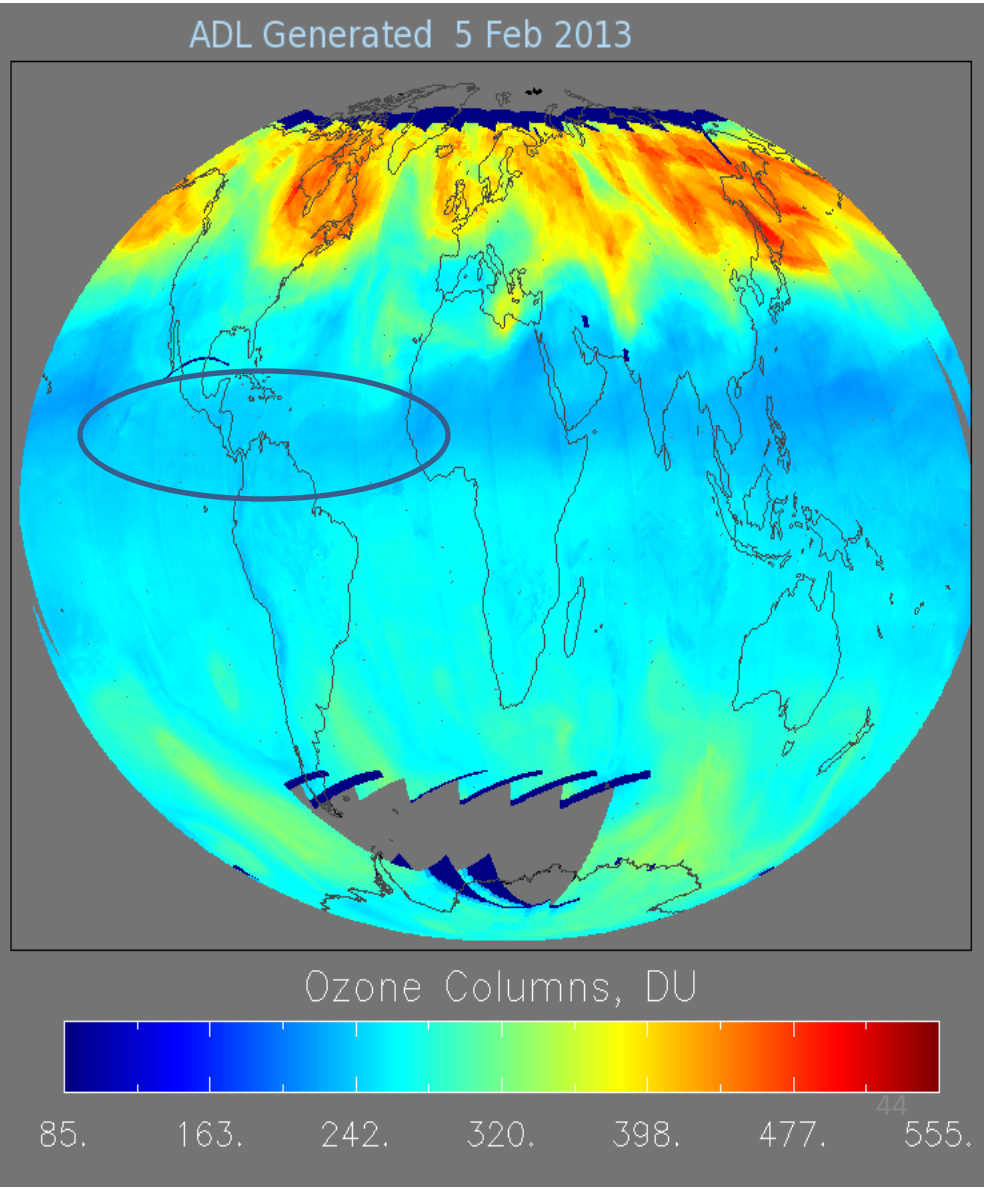
The cross-track and triplet differences in these changes contribute to both the accuracy and precision error budget. (DONE)

Comparison of INCTO Ozone wo/w wavelength scale knowledge

BEFORE



AFTER



Notice the reduced striping – better cross track consistency