Findings for the OMPS Nadir Profiler Ozone Profile (IMOPO) Products

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from JPSS and S-NPP OMPS Teams
Last Updated August 14, 2012

Outline

- Beta & Provisional Definitions
- OMPS Background
- IMOPO Performance
  - Internal Evaluation
    - Flags SAA, tozcod, procod,
    - Initial and Final Residuals (also to V8Pro and SBUV/2)
  - External Evaluation
    - Effective Reflectivity to INCTO & SBUV/2
    - Total Column Ozone to INCTO & SBUV/2
    - Layer Amounts and Mixing Ratios
      - Comparisons to SBUV/2 V6PRO
  - Known Deficiencies (repeated)
- Summary of Findings and Recommendations (repeated)
  - Monitoring plots

http://www.star.nesdis.noaa.gov/icvs/PROD/proOMPSbeta.O3PRO_IMOPO.php

  - Promotion to Beta
  - Upgrade to V8PRO

Data Product Beta Maturity Definition

NPP EDR Product Maturity Levels

1. **Beta**

- Early release product
- Minimally validated
- May still contain significant errors.
- Versioning not established until a baseline is determined.
- Available to allow users to gain familiarity with data formats and parameters
- Product is not appropriate as the basis for quantitative scientific publications studies and applications

2. **Provisional**

- Product quality may not be optimal
- Incremental product improvements are still occurring.
- Version control is in affect
- General research community is encouraged to participate in the QA and validation of the product, but need to be aware that product validation and QA are ongoing
- Users are urged to consult the EDR product status document prior to use of the data in publications
- May be replaced in the archive when the validated product becomes available
- Ready for operational evaluation

IMOPO Summary of Findings & Recommendations

- Promotion to Beta
  - The IMOPO algorithm is functioning correctly. The product precision and accuracy are affected by the current state of the calibration, solar spectrum and wavelength scale. These will continue to change as improved characterizations are brought into the system.
  - The OMPS Team recommends that the IMOPO Product be promoted to Beta Maturity.
- Monitoring Figures are available at

http://www.star.nesdis.noaa.gov/icvs/PROD/proOMPSbeta.O3PRO_IMOPO.php

- Upgrade to V8TOZ
  - The team recommends an upgrade of the current Version 6 ozone profile retrieval algorithm to the V8Pro algorithm in use with the SBUV/2 measurements for both climate data records and operational products. (This is captured in the JPSS system under DR #4256.)

IMOPO Known Product Deficiencies

- Day One Solar needs a definitive spectrum. (Preliminary update expected in August 2012 – DR #4797, #CCR 0458^)
- Profile and total ozone error flags are switched in the output. (Parent PCR 27740 – Expected correction Fall 2012)
- Snow/Ice data is all zeroes (DR #4802)
- The input-out-of-bound flag (Error Code 20) is set with an incorrect check on surface pressure (DR #4860)
- Stray Light / Radiance Coefficients^
  - Correction subroutine and definitive estimates of coefficients are under development (DR #4823)
- Dark and Smear tables need work in the SDR (DRs #4749, #4818)
- Wavelength Scale and adjustments^
  - Working on definitive Day 1
  - Working on adjustments for intra-orbit scale drift

^ These may create large discontinuities in the product performance as they and similar changes enter the system.

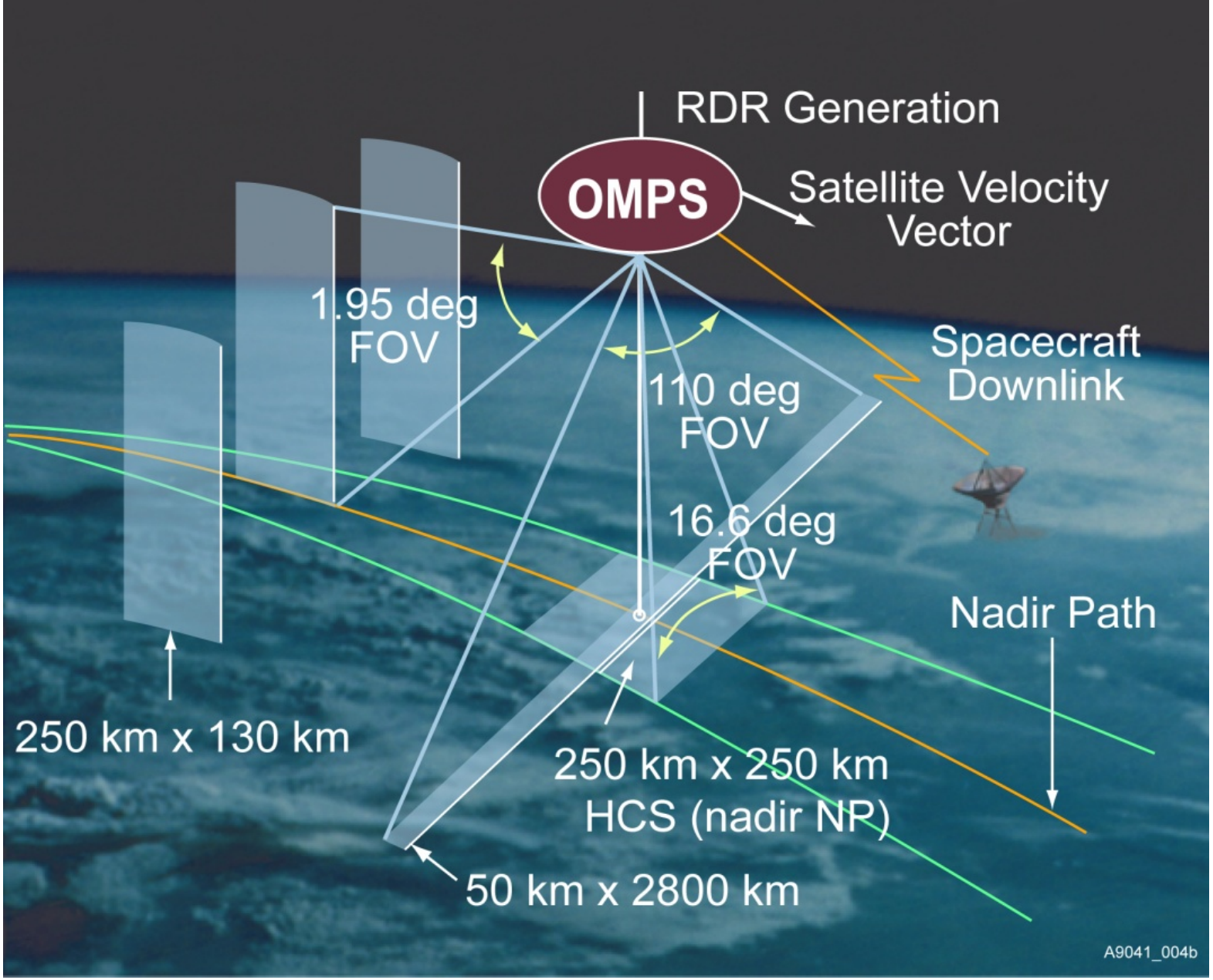
OMPS Fundamentals

NOAA, through the Joint Polar Satellite System (JPSS) program, in partnership with National Aeronautical Space Administration (NASA), launched the Suomi National Polar-orbiting Partnership (S-NPP) satellite on October 28, 2011. The Ozone Mapping and Profiler Suite (OMPS) consists of two telescopes feeding three detectors measuring solar radiance scattered by the Earth's atmosphere and solar irradiance by using diffusers. The measurements are used to generate estimates of total column ozone and vertical ozone profiles.

The nadir mapper (total column) sensor uses a single grating monochromator and a CCD array detector to make measurements every 0.42 nm from 300 nm to 380 nm with 1.0-nm resolution. It has a 110° cross-track FOV and 0.27° along-track slit width FOV. The measurements are currently combined into 35 cross-track bins: 3.35° (50 km) at nadir, and 2.84° at ±55°. The resolution is 50 km along-track at nadir, with a 7.6-second reporting period. The instrument is capable of making measurements with much better horizontal resolution.

The nadir profiler sensor uses a double monochromator and a CCD array detector to make measurements every 0.42 nm from 250 nm to 310 nm with 1.0-nm resolution. It has a 16.6° cross-track FOV, 0.26° along-track slit width. The current reporting period is 38 seconds giving it a 250 km x 250 km cell size collocated with the five central total column cells.

The limb profiler sensor is a prism spectrometer with spectral coverage from 290 nm to 1000 nm. It has three slits separated by 4.25° with a 19-second reporting period that equates to 125 km along-track motion. The slits have 112 km (1.95°) vertical FOVs equating to 0 to 60 km coverage at the limb, plus offsets for pointing uncertainty, orbital variation, and Earth oblateness. The CCD array detector provides measurements every 1.1 km with 2.1-km vertical resolution. The products for the Limb Profiler are not discussed here.



Instrument Fields of View. Schematic from Ball Aerospace and Technology Corporation.

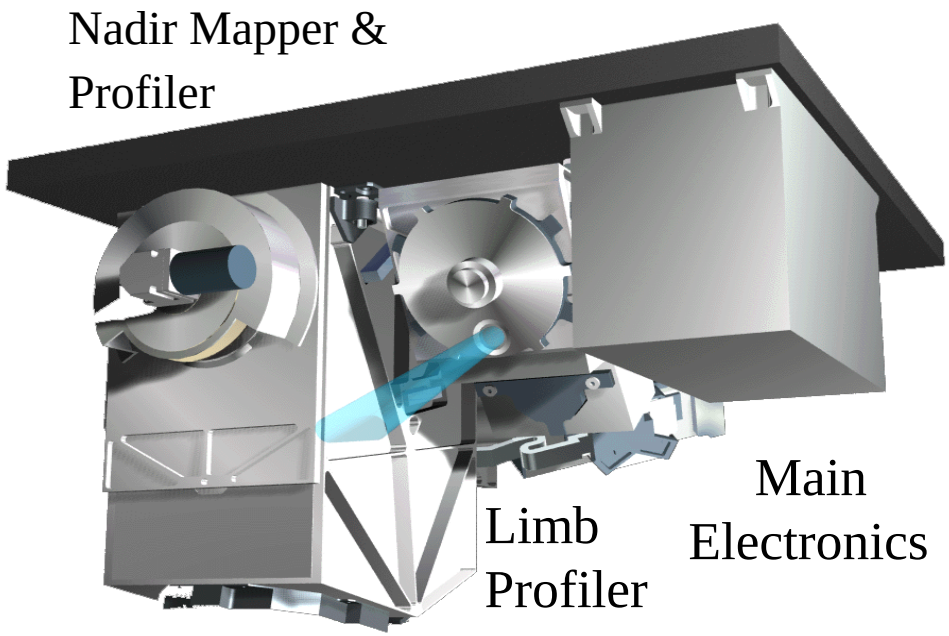
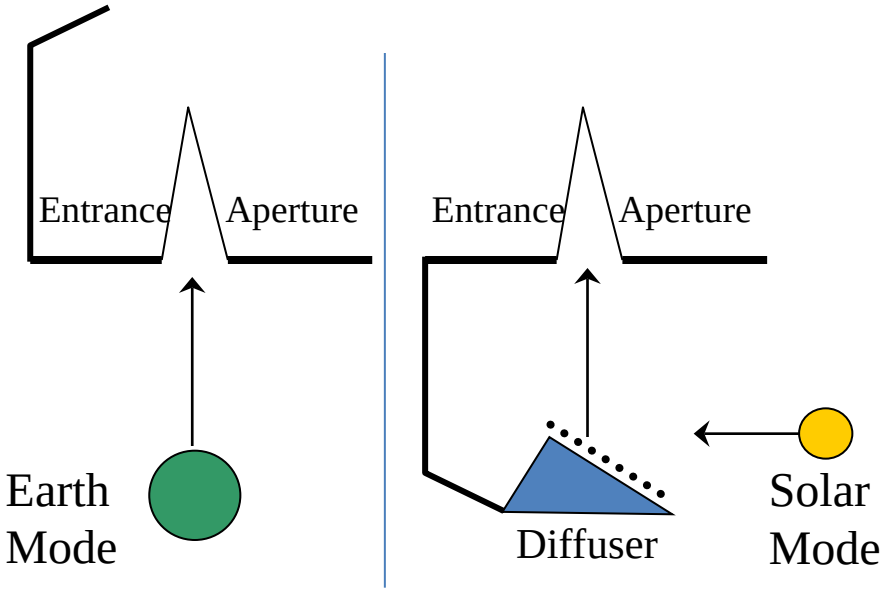
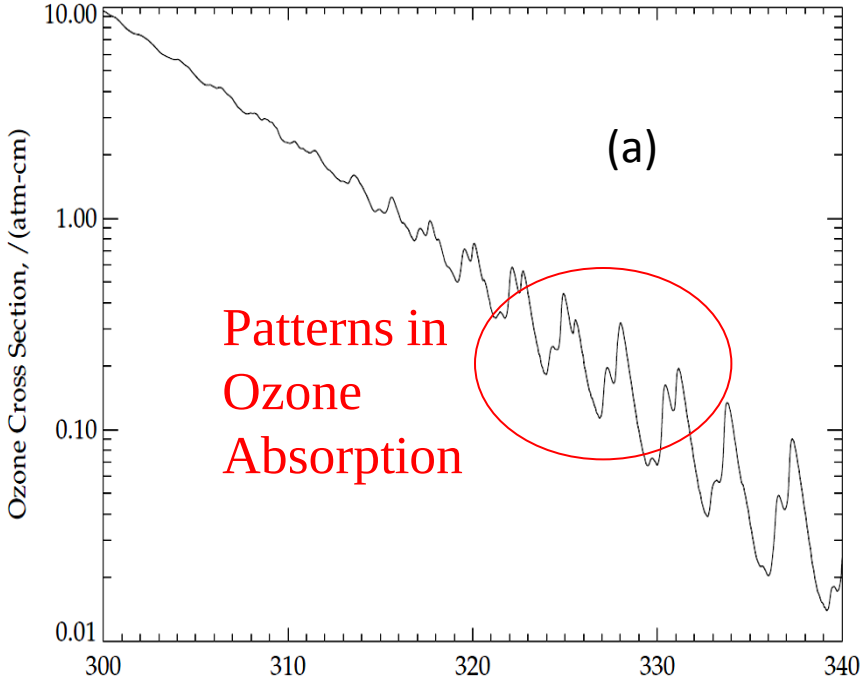


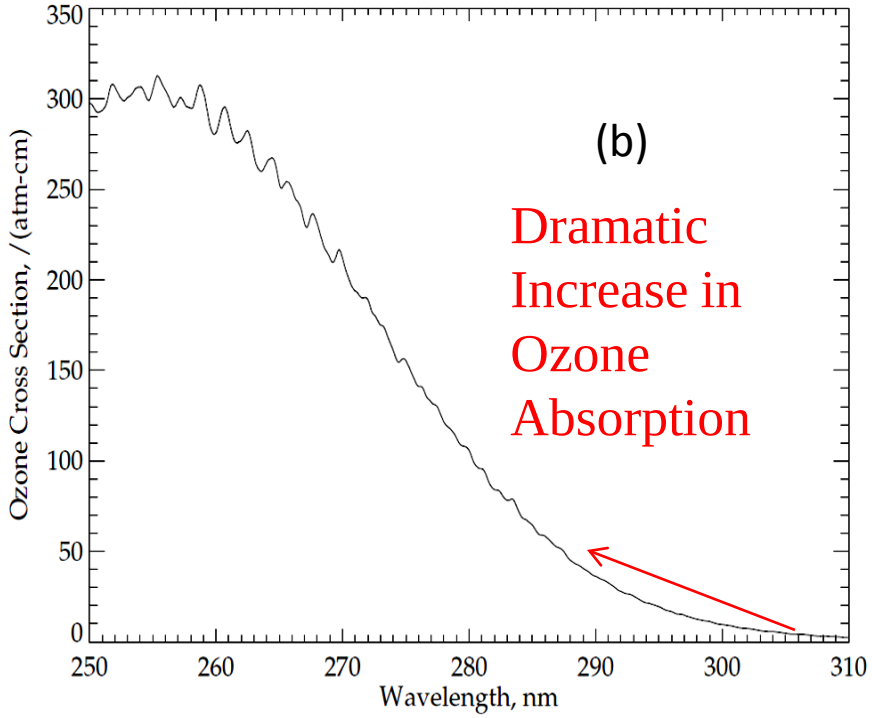
Diagram from Ball Aerospace and Technology Corporation



Each instrument can view the Earth or either of two solar diffusers; a working and a reference.

The instruments measure radiance scattered from the Earth's atmosphere and surface. They also make solar measurements using pairs of diffusers. Judicious operation of working and reference diffusers allows analysts to track the diffuser degradation. The solar measurements also provide checks on the wavelength scale and bandpass. The instruments have completed multiple passes through their internal dark and nonlinearity calibration sequences and are beginning to make regular solar measurements. (See information on the OMPS SDRs.)



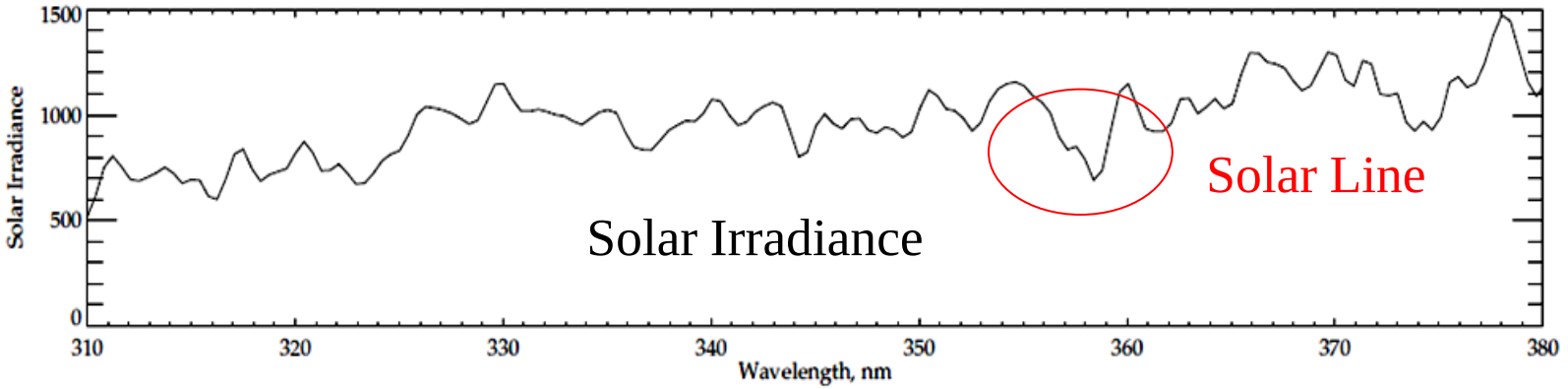


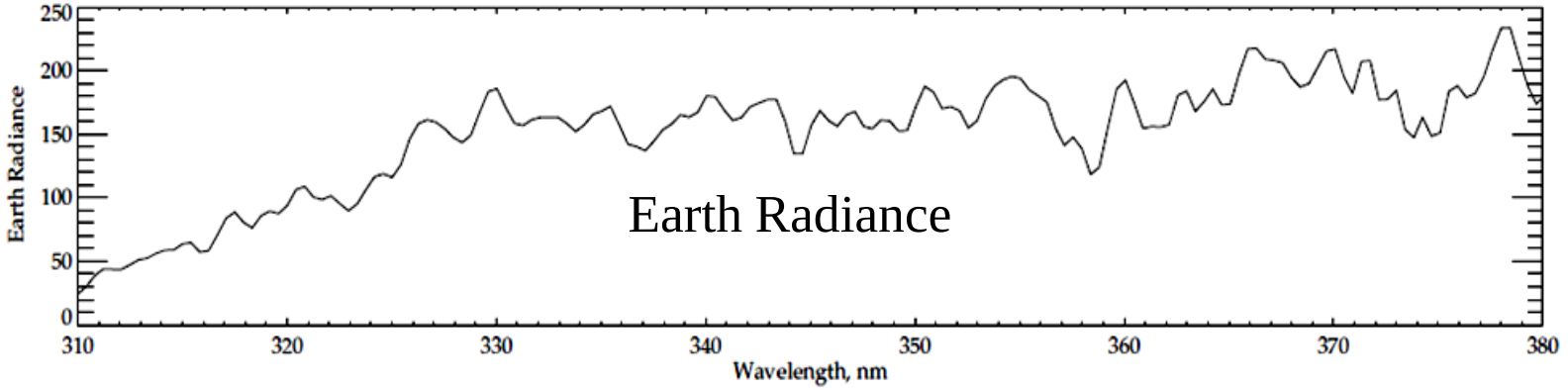
Ozone Absorption Cross Sections:
Ozone has four main absorption bands in the ultraviolet, visible and near-infrared as follows: the Hartley bands from 200 nm to 310 nm, the Huggins bands from 310 nm to 380 nm, the Chappuis bands from 400 nm to 650 nm, and the Wulf bands from 600 nm to 1100 nm. The OMPS nadir telescope directs photons to two spectrometers, one with a wide, cross-track field-of-view (FOV) and spectral coverage in the Huggins ozone absorption bands, and the other with a smaller, nadir FOV and spectral coverage in the Hartley ozone absorption bands. Figures (a) and (b) show the ozone absorption cross-sections at a nominal atmospheric temperature for parts of these bands. These cross-sections are for -50°C as estimated from a quadratic fit in temperature of the Brion-Daumont-Malicet data set.

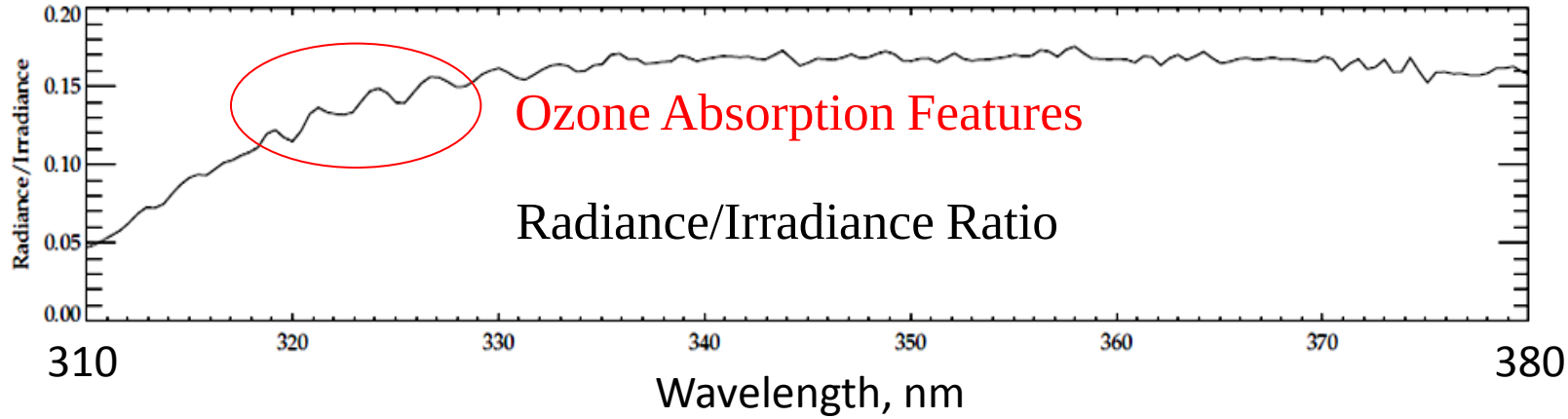
OMPS Nadir Mapper Spectra

- The plot at the top of the following slide shows a sample OMPS Nadir Mapper solar spectrum measured in January. The initial calibration, goniometry and wavelengths scales have been applied. Notice the Fraunhofer lines, e.g., a deep one near 360 nm.
- The plot in the middle shows a sample spectrum for the Earth View data for the nadir field-of view.
- The plot on the bottom shows the ratio of the first two spectra. Notice that much of the structure in the solar spectrum cancels out in the ratio. Also notice the variations between 320 nm and 330 nm produced by differential ozone absorption with wavelength as illustrated in the Figure (a) from two slides earlier.

Typical spectra from 310 to 380 nm for OMPS Nadir Mapper



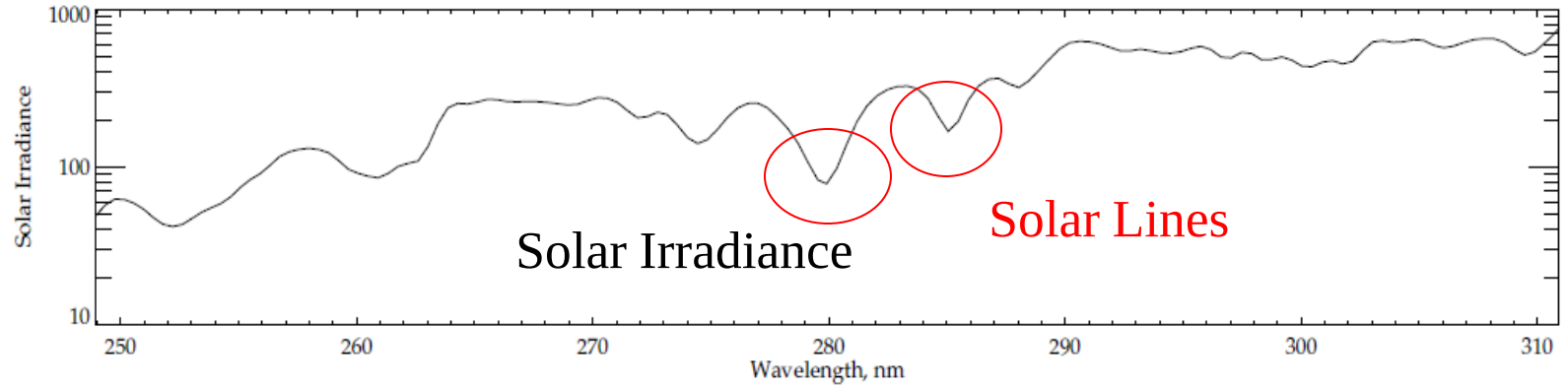


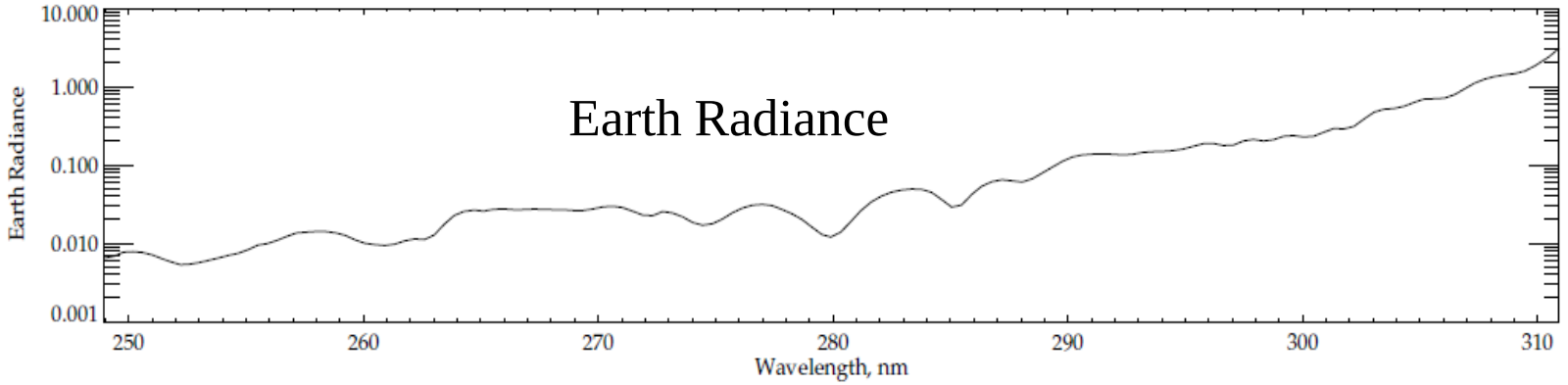


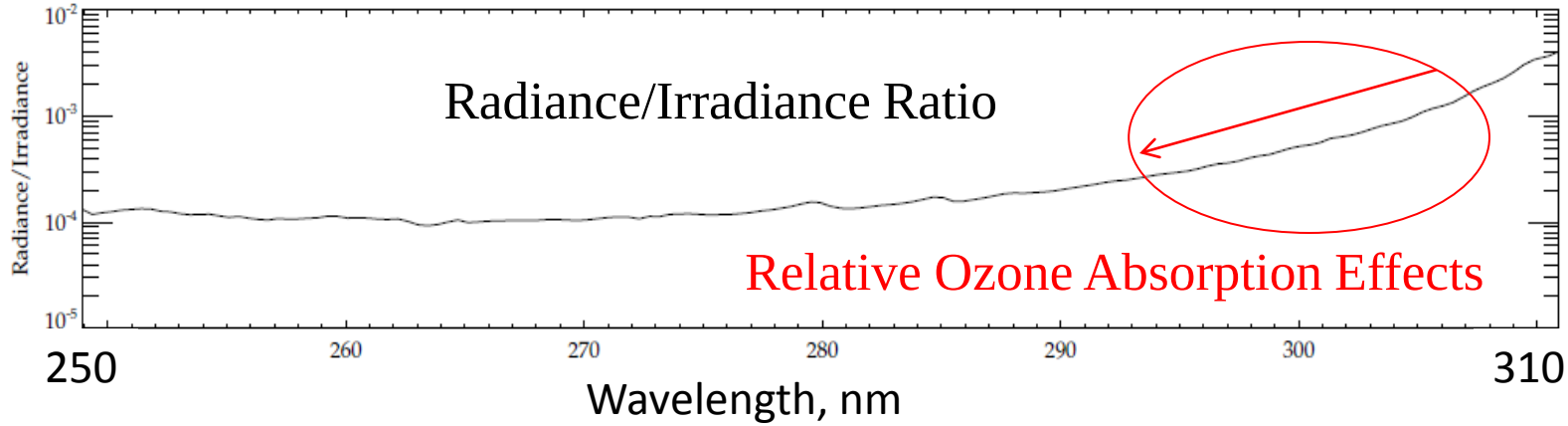
OMPS Nadir Profiler Spectra

- The plot at the top of the following slide shows a synthetic OMPS Nadir Profiler solar spectrum measured currently in use. The spectrum was created by combining the laboratory bandpass characterization with a high spectral resolution reference solar spectrum. Notice the Fraunhofer lines, e.g., a deep Mg one near 280 nm.
- The plot in the middle shows a sample spectrum for the Earth View data. The initial calibration, goniometry and wavelengths scales have been applied.
- The plot on the bottom shows the ratio of the first two spectra. Notice that much of the structure in the solar spectrum cancels out in the ratio. Also notice the rapid drop in albedo from 310 nm to 290 nm produced by differential ozone absorption with wavelength as illustrated in the Figure (b) from four slides earlier.

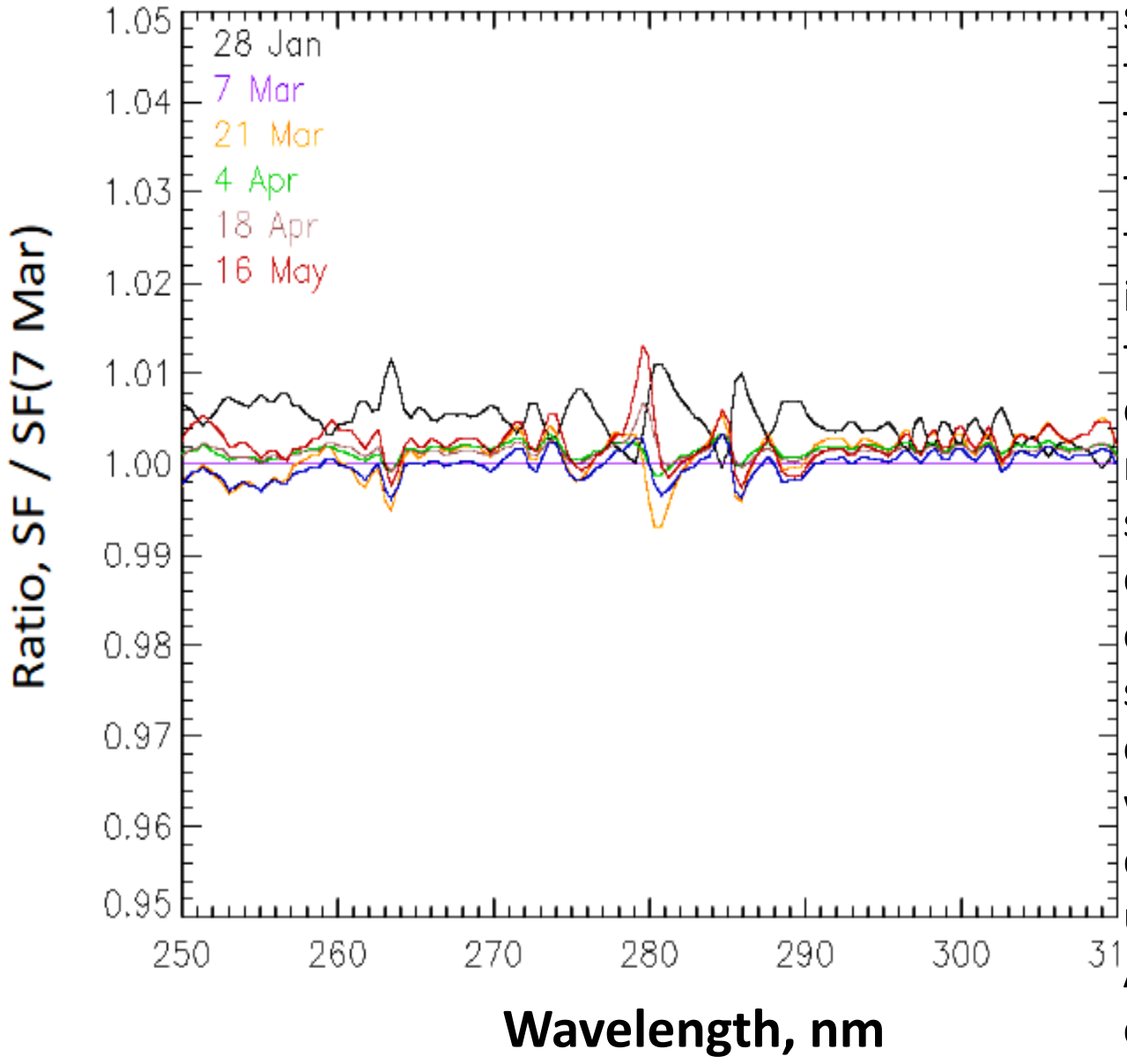
Typical spectra from 250 to 310 nm for OMPS Nadir Profiler







OMPS NP Solar Flux Measurements



Comparison of the first six solar measurements from the working diffuser.

The lines give the ratios of the five other measurements to the March 7th one. The instrument / diffuser throughput shows little change over the four months, especially as there should be some differences due to real solar spectrum changes. Possible additional sources (e.g., goniometric characterization, minor wavelength scale drift, and dark current evolution) are under investigation.

A future reference solar diffuser measurement will add more information.

Ozone Profile Product, **IMOPO**

The spectral measurements from the OMPS Nadir Profiler and Nadir Mapper of the radiances scattered by the Earth's atmosphere are used to generate estimates of the ozone vertical profile along the orbital track (**IMOPO**). The algorithm uses ratios of Earth radiance to Solar irradiance at a set of 12 wavelengths (at approximately 253, 273, 283, 288, 292, 298, 302, 306, 313, 318, 331 and 340 nm) with eight from the Nadir Profiler and four from the Nadir Mapper to obtain estimates of the total column ozone, effective reflectivity, and the ozone vertical profile in 12 Umkehr Layers. The radiances for the four longer wavelength are obtained from the 25 Nadir Mapper FOVs co-located with a single Nadir Profiler FOV. The longer channel radiance/irradiance ratios are used to generate estimates of the total column ozone and scene effective reflectivity. The total column ozone is used to generate a first guess ozone profile that becomes the A Priori for a maximum likelihood ozone profile retrieval using the ratios for the seven shortest wavelengths (omitting the 253 nm channel and including 313 nm at high SZA). Additional information is in the OMPS Nadir Profile Algorithm Theoretical Basis and Operational Algorithm Description Documents, and a volume of the Common Data Format Control Book at:
http://npp.gsfc.nasa.gov/documents.html

OMPS NP ATBD 474-00026_Rev-Baseline.pdf

OMPS NP OAD 474-00067_OAD-OMPS-NP-IP-SW_RevA_201

Intermediate Product CDFCB

474-00001-04-01_CDFCB-Vol4-Part1_Rev-_Block-1-1_31Mar2011.pdf20127.pdf

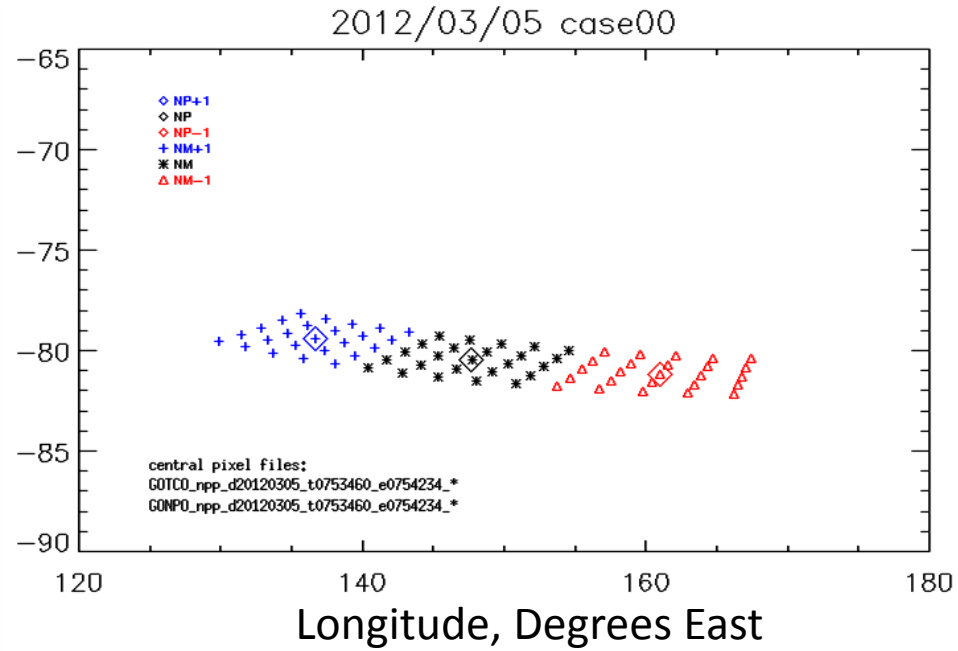
Matching the FOVs for the Nadir Mapper and Nadir Profiler

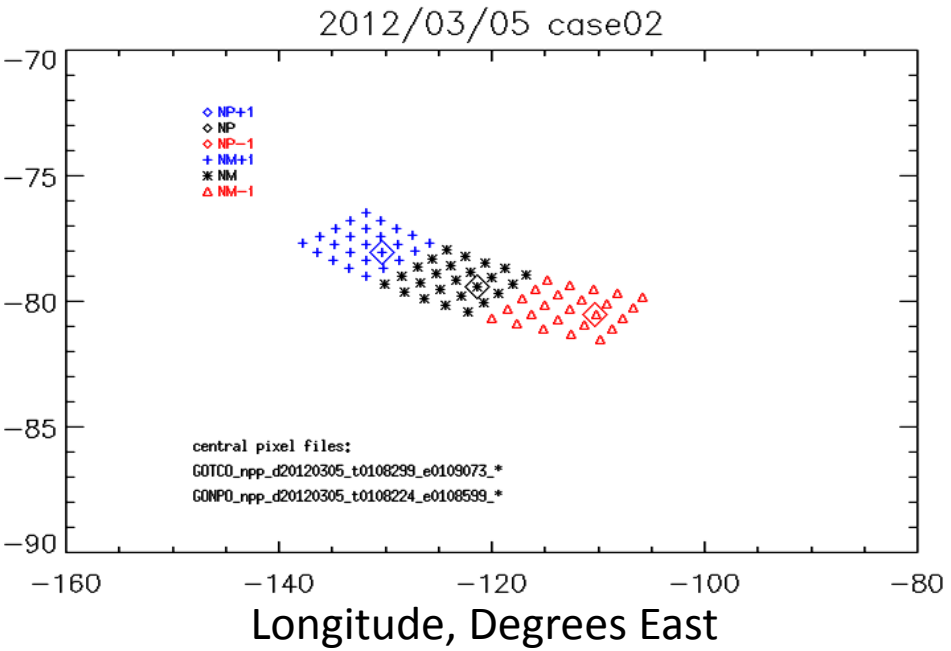
The Nadir Mapper and Nadir Profiler each produce data in 37.5 S(econd) granules. The Nadir Profiler IFOV is designed to coincide with the five central IFOVs of the Nadir Mapper, and a single measurement of the Nadir Profiler aggregated over 37.5 S matches up with five Nadir Mapper rows each aggregated for 7.5 S. The two instruments may begin their granules at different times relative to the southern terminator crossing offset by multiples of 7.5 S.

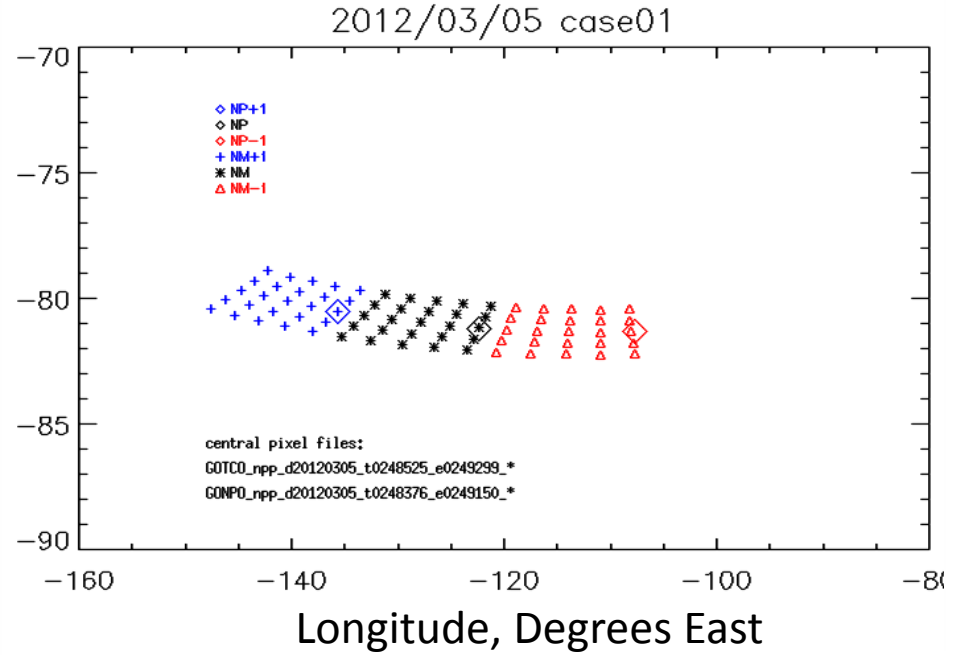
The Figures on the next slide show the results of an investigation into the alignment of Nadir Mapper and Nadir Profiler granules in their respective geolocation products, GOTCO and GONPO. The first three plots (top left, bottom left, and top right) each display the FOV center locations of three consecutive granules for both the Nadir Mapper and the Nadir Profiler. Each set of 25 small symbols show the location for the five nadir cross track FOVs (nadir and two nearest on both sides) for the five rows of measurements in a granule. The large symbols are the FOV center locations for the Nadir Profiler. Notice that the Nadir Profiler may matchup with a Nadir Profiler granule or it may be offset by one or two rows.

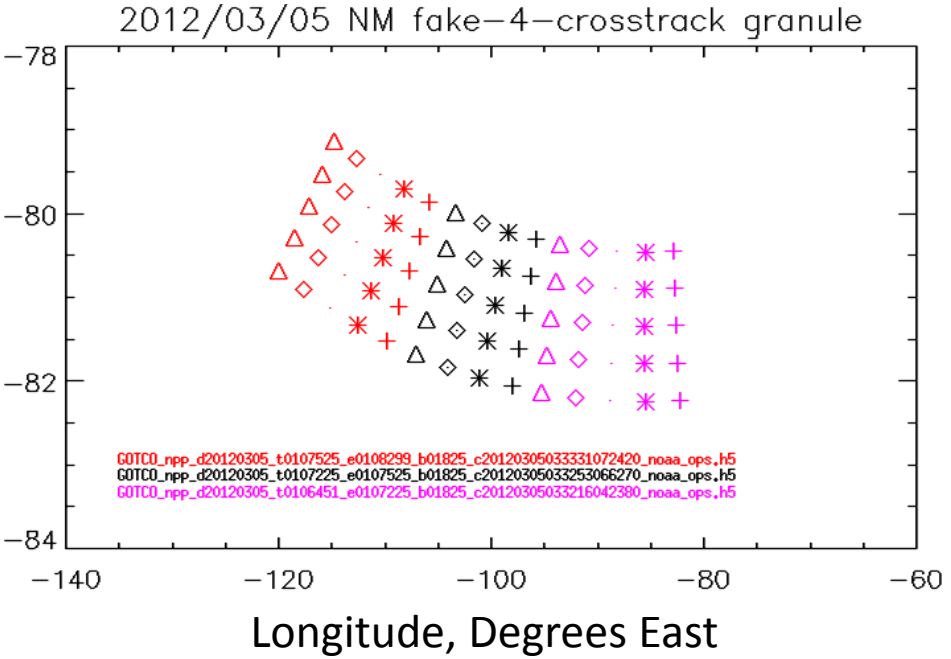
The figure on the bottom right shows an unusual case where there is a Nadir Mapper granule that only contains four rows – 30 S of measurements instead of 37.5 S. This can lead to changes in the offset between the granules for the Nadir Mapper and Nadir Profiler within an orbit. The IMOPO products follow the Nadir Profiler granularity.

Longitude & Latitude Locations for GOTCO and GONPO Granule Matching Cases









IMOPO Error Flags

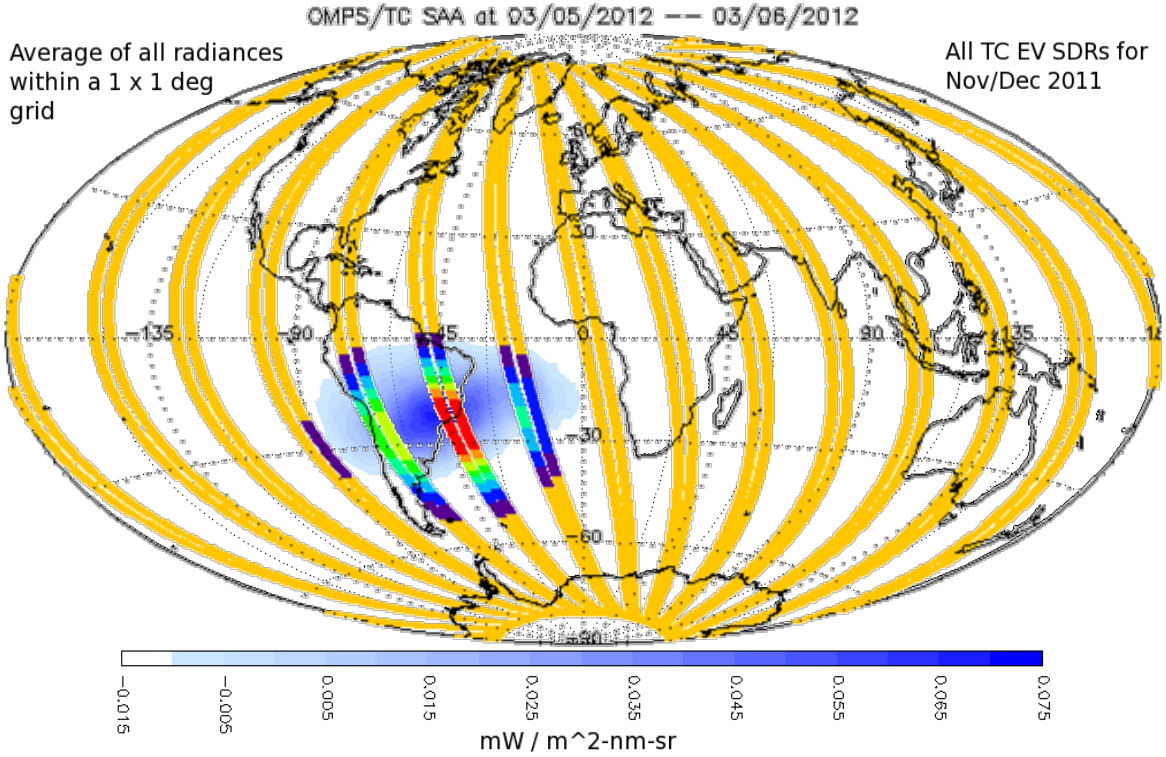
- Individual Flags
  - Sun Glint, SAA, and Eclipse are all set correctly
  - SO2 Index is running too negative; it and the Volcano Contamination Index (VMI) are affected by initial calibration uncertainties.
  - Snow/Ice is always zero – DR #4802
- Profile Error Codes*
  - Code 1 is set correctly (Lower three layers)
  - Code 2 is set correctly (BestTOZ vs ProTOZ)
  - Code 3 is set correctly (large final residuals – often for data in SAA)
  - Code 5 is set correctly (C outside of range – often for data in SAA)
  - Codes 4, 6, 7 & 8 conditions are not met in samples
  - Code 9 (Bad counts/missing measurements)
  - Code 20 Invalid or out-of-range inputs – Flagging all terrain pressure > 1.001 atm.
  - Descending Flag (+10) set incorrectly – A simple check of latitude changes will work.
- Total Ozone Error Codes*
  - Codes 1 & 2 are set correctly by comparing S x Omega to 1.5 and 3.5 atm-cm, respectively
  - Code 4 is set correctly (Pair differences)
  - TOZ Error Code 5 matches PRO Code 2
  - Code 7 not seen; Photometer Reflectivity difference is not in the output.
  - Codes 8 & 9 conditions are not met in samples; Codes 3 & 6 are Spares
  - Code 20 Invalid or out-of-range inputs – Flagging all terrain pressure > 1.001 atm.
  - Descending Flag (+10) matches Profile Error behavior

*Profile and total ozone error flags are switched in the HDF5 output. This should be repaired with the implementation of PCR 27740 in Fall 2012.

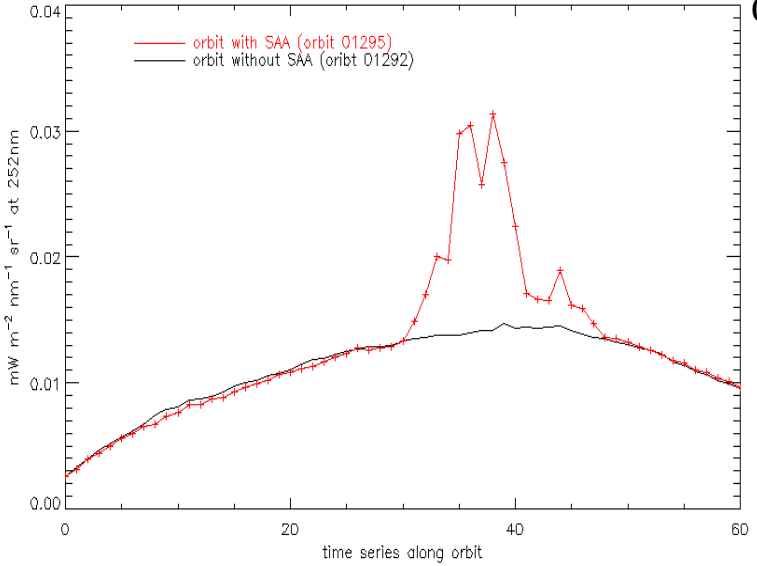
Examination of South Atlantic Anomaly (SAA) effects and product flagging.

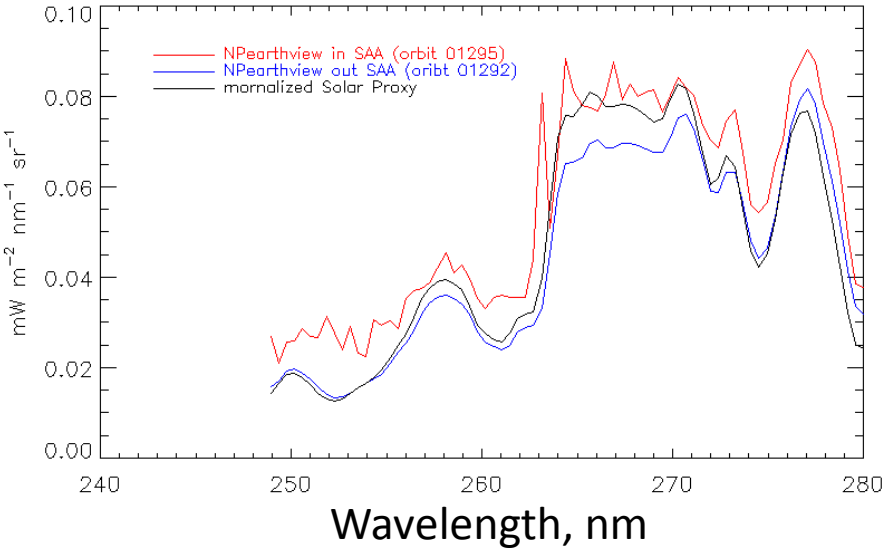
The noise/spikes below show the expected increases when an orbital path falls with within the SAA but return to normal levels after passing through it.

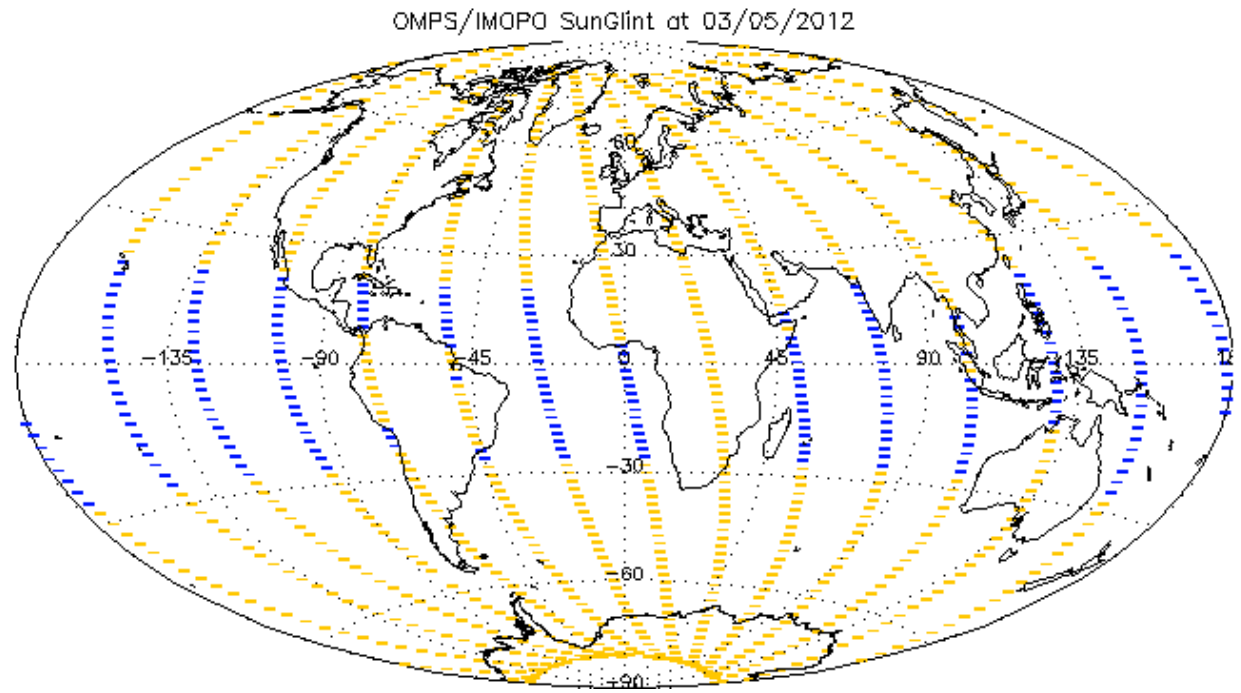
The OMPS was designed to use the OMPS Limb Profiler retrievals in the SAA where the OMPS Nadir Profiler is so greatly affected by charged particles that it cannot be used to produce ozone profiles.

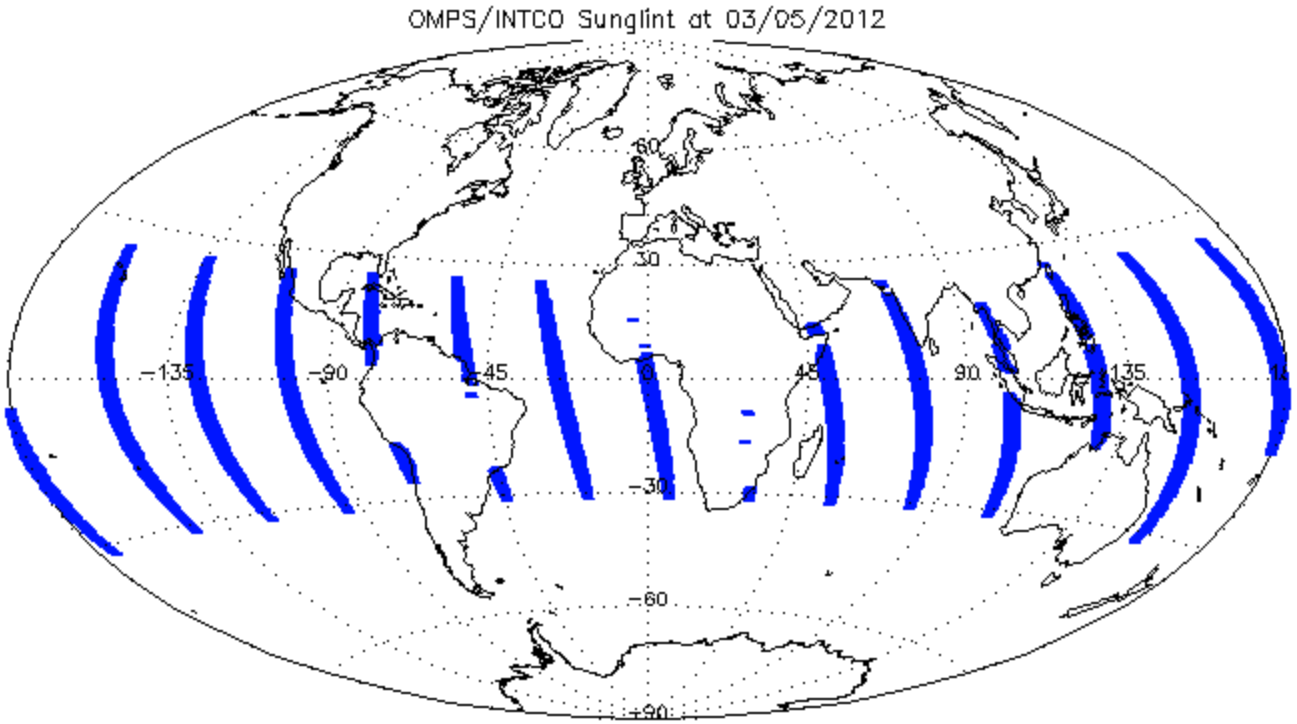


Map of South Atlantic Anomaly effects on OMPS NM closed-door dark current measurements in December and November 2011, overlaid with OMPS NP SAA Flags (**0** to **8**) for 3/5-6/2012

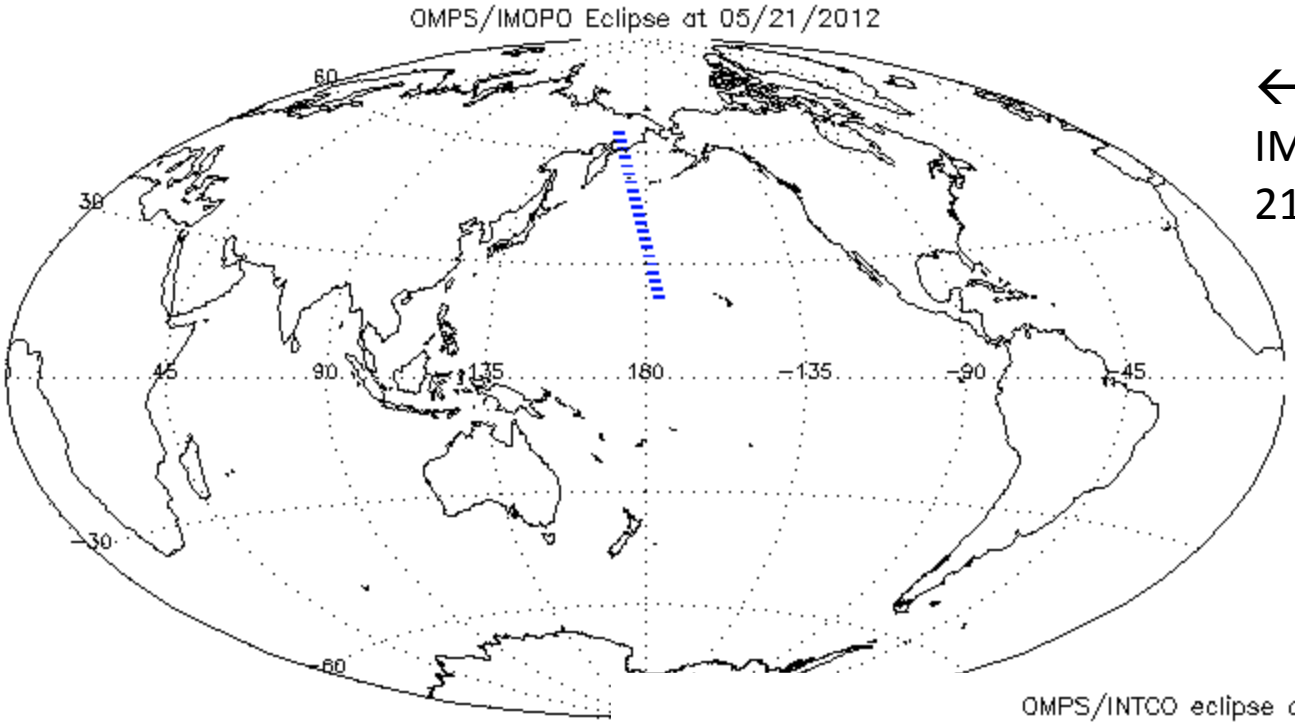








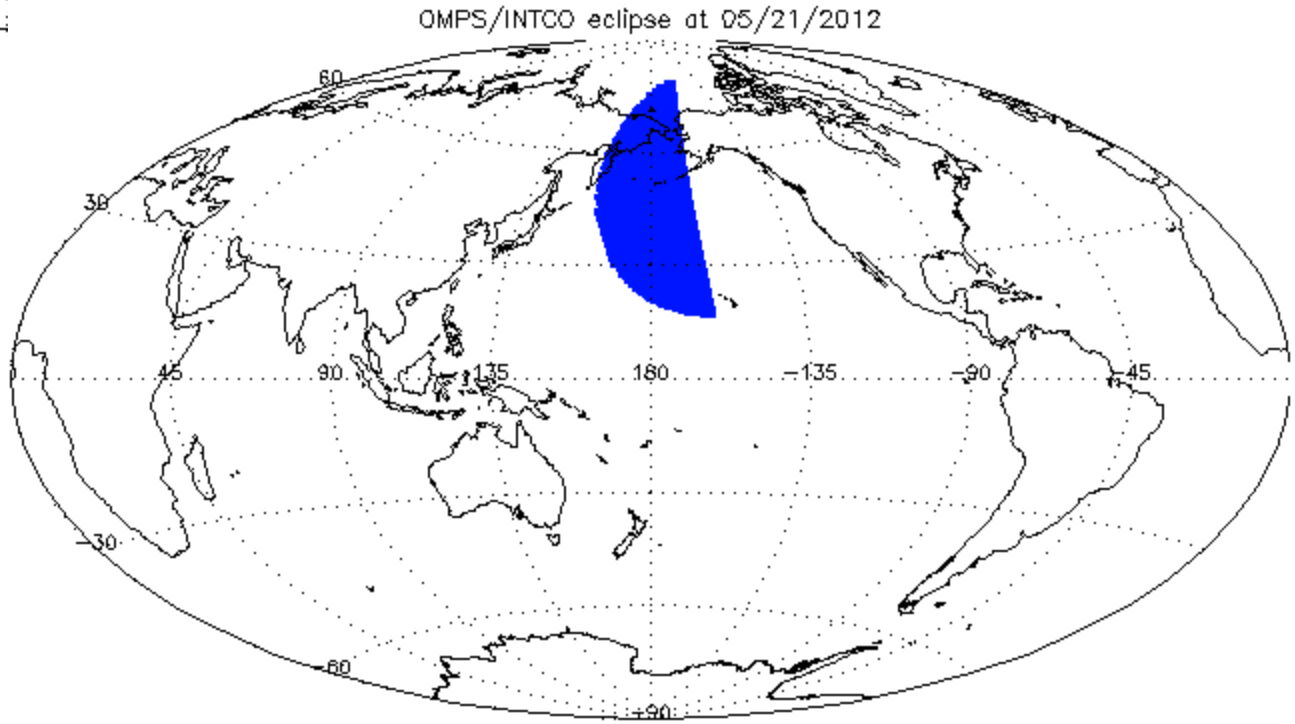
Daily Maps of Sun Glint for INCTO Nadir FOVs versus IMOPO. The two products are consistently and correctly passing these values through from the SDRs.



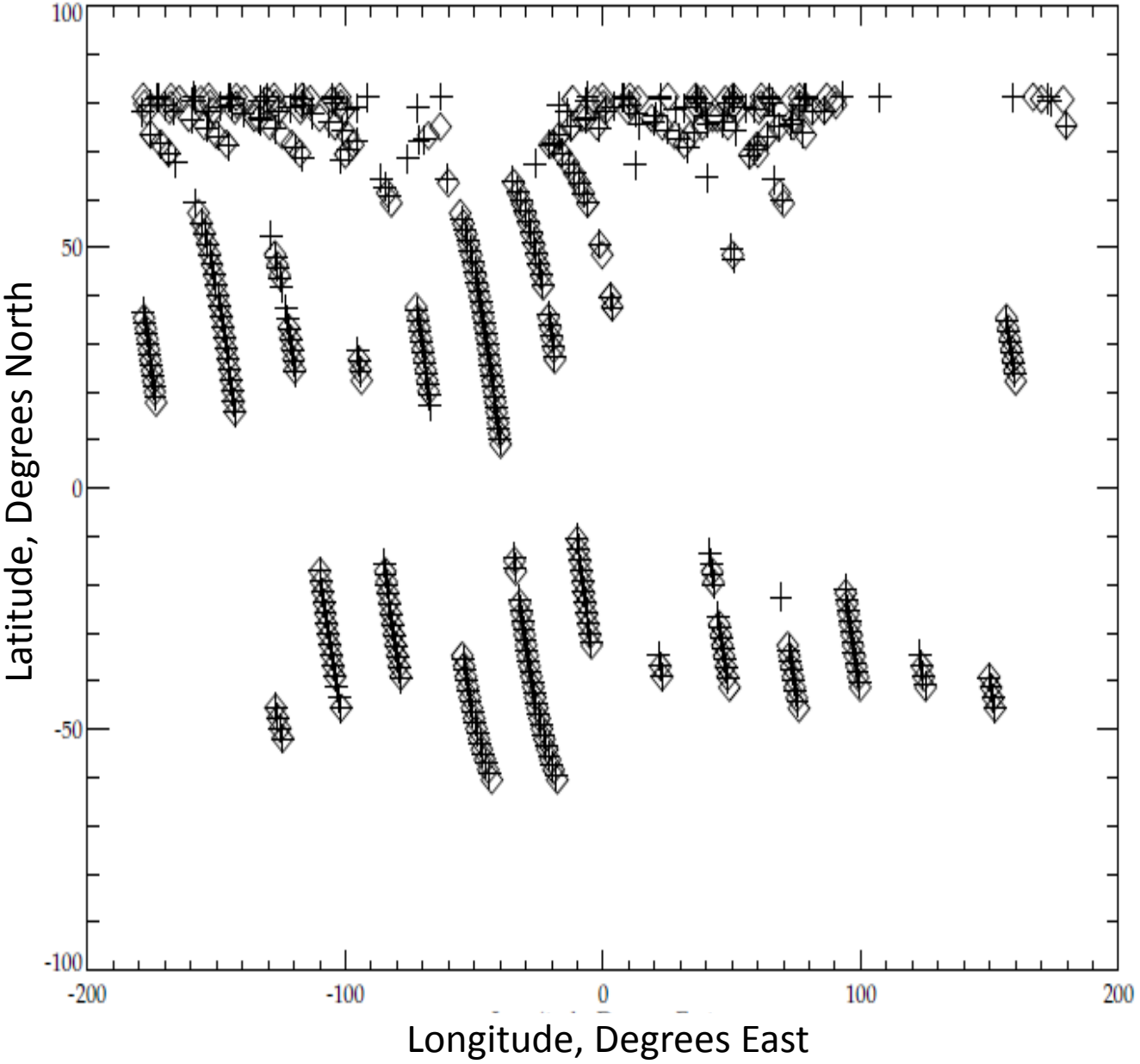
← Map showing locations of IMOPO Eclipse Flags for May 21, 2012.

The two products are giving correct and consistent results for the near nadir FOVS.

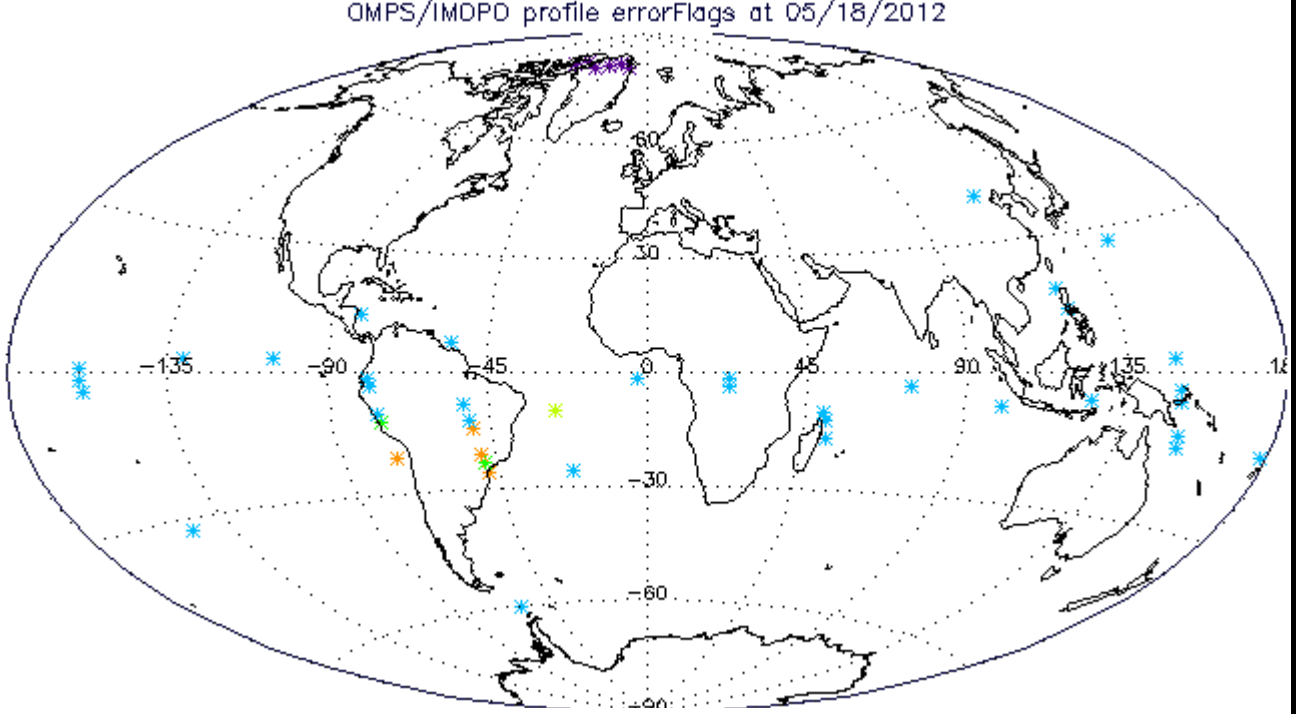
Location of Eclipse Flags for OMPS Nadir Mapper First Guess Total Column Ozone INCTO Product for May 21, 2012. →

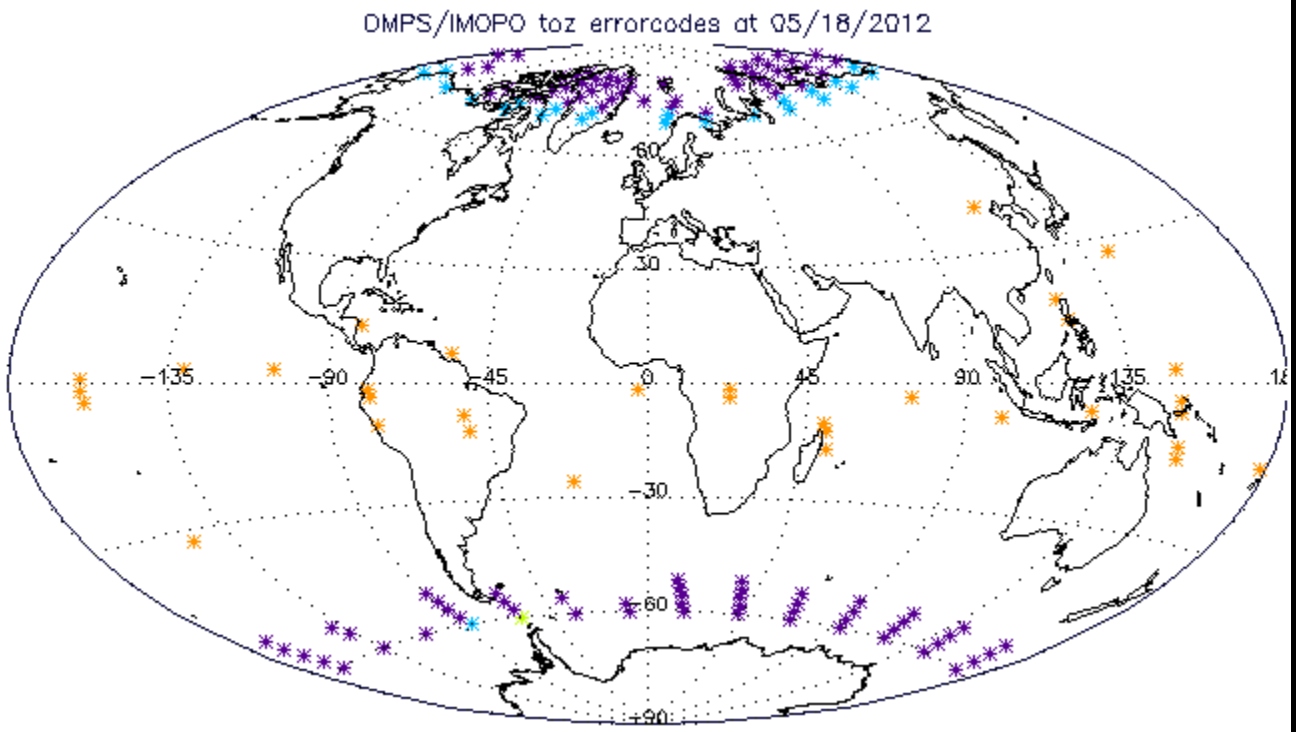


Map of Error Code 20 for IMOPO and of Terrain Pressure > 1.001 atm. for INCTO



This map shows the location of two sets of conditions. One is the location of Error Code 20 (inputs out of range) for IMOPO for May 16, 2012. The diamond symbols show the locations of these FOVs. The others are the locations where the Nadir Mapper INCTO total column ozone product reports values of terrain pressure greater than 1.001 atm. for the same day. The plus sign symbols are placed where the terrain pressure for the nadir FOV (cross track position 17) for the first row (of five rows) of a Nadir Mapper Granule satisfies this condition. Almost all of the Error Code 20 values are set because of this condition. The check is too restrictive and needs to be reset to a larger value. The highest pressure recorded on Earth was 1.071 atm. The Dead Sea is at ~1.045 atm.



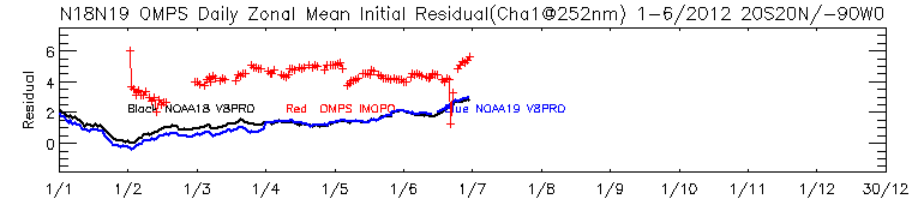


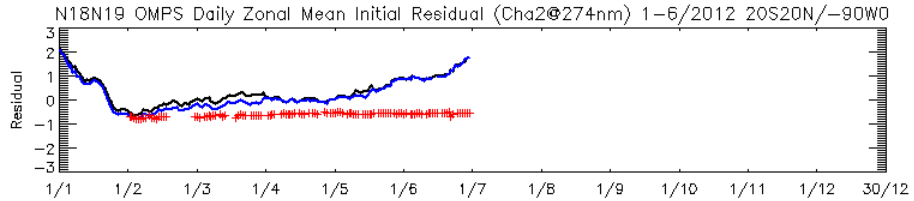
These maps show the distribution of non-zero (except for 20s) error codes for IMOPO May 18, 2012.

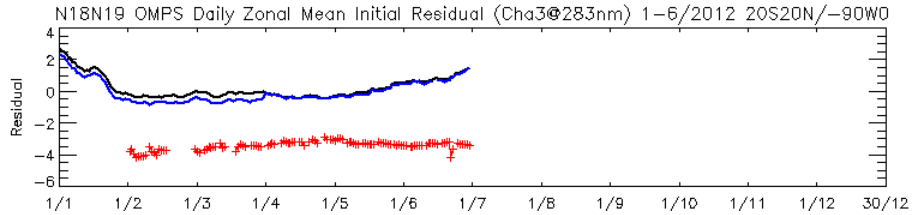
The top map shows the locations for the ozone profile errors (actual not as misnamed in the HDF). The colors (and frequencies) are as follows: 1 Lower Layer Anomaly (6); 2 Best Total Ozone difference with Profile Total Ozone (34); 3 Large Final Residual (2); 4 Large Initial Residual (1); and 5 C-Parameter Outside of Range (4).

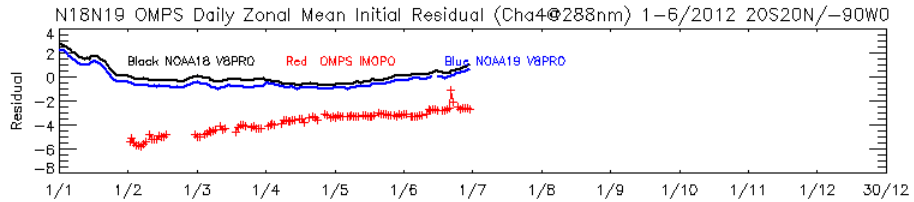
The bottom map shows the locations for the total ozone errors (again actual). The colors are as follows: 1 High Path (100); 2 Very High Path (23); 4 Pair Total Ozone Difference (1); and 5 same as Profile Code 2 (33).

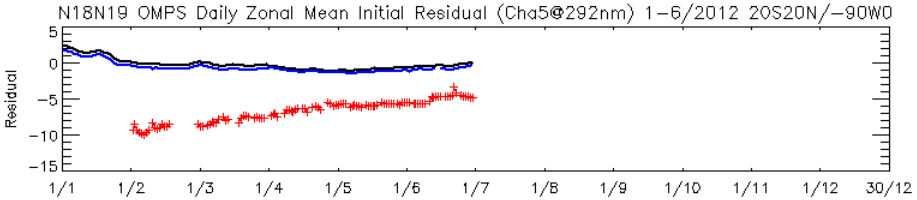
Time series of initial IMOPO residuals for OMPS NP February through June

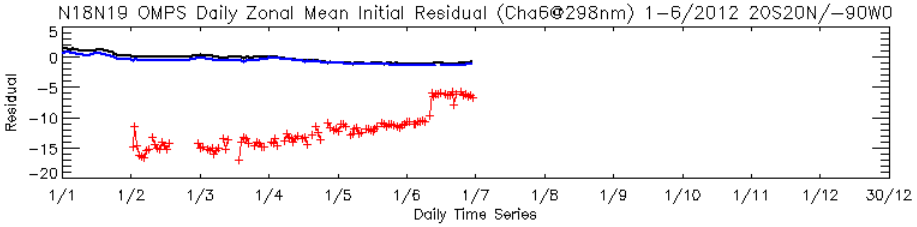


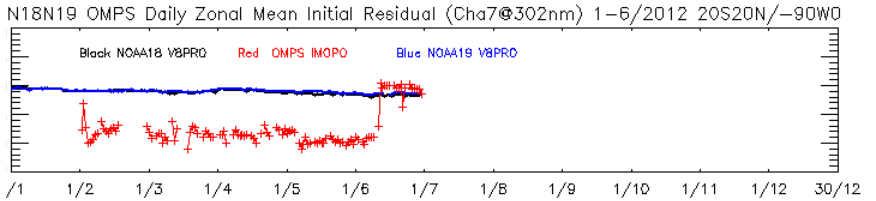


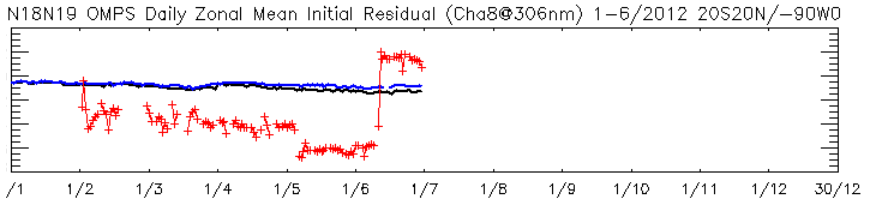


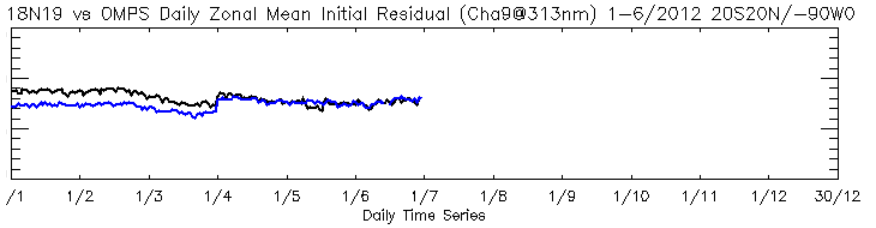






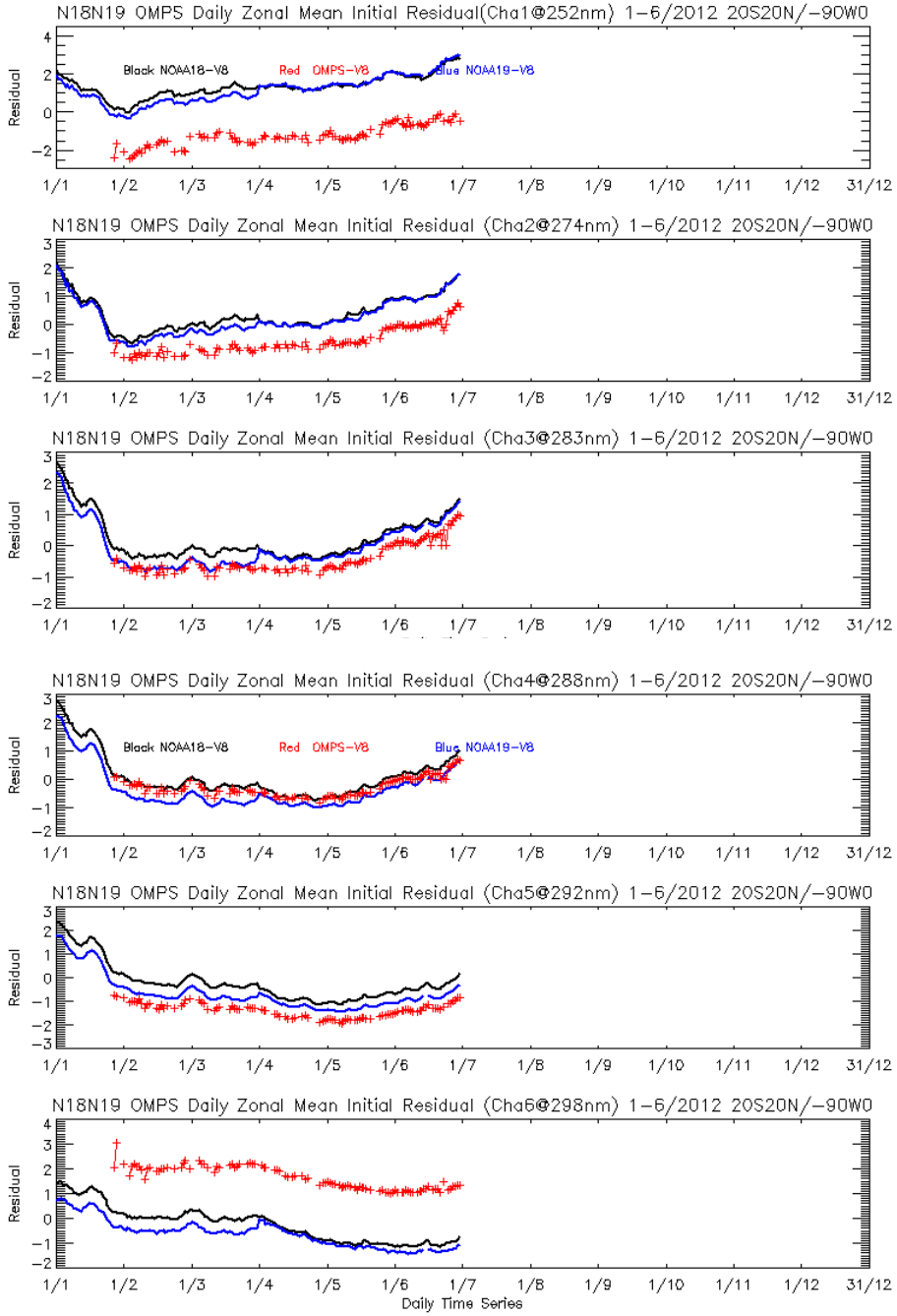


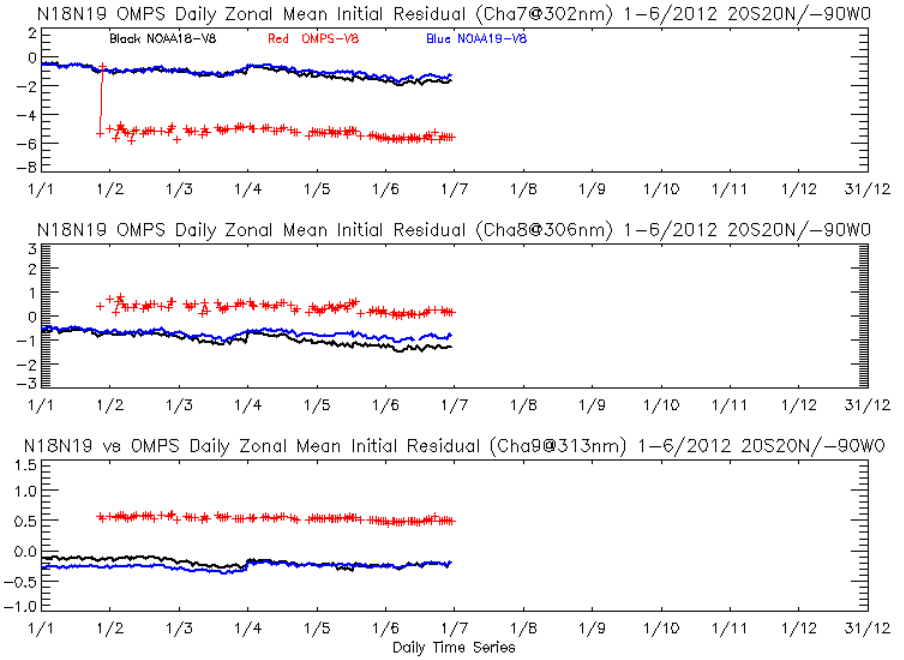




The nine figures show the initial residuals for profile wavelengths [252, 274, 283, 288, 292, 298, 302, 306 and 313 nm, (a) to (i), respectively] for the V6PRO (IMOPO) product from **OMPS** compared to the V8PRO product for the operational **NOAA-18** and **NOAA-19** SBUV/2 for the equatorial daily zonal means (20N to 20S) with 0-90W removed to avoid the SAA effects. The residuals are in N-values (1 N ~ 2.3%). The time period is the end of February through April of 2012. The residuals are computed with respect to differing first guess profiles for the two algorithms. The V6PRO does not use the 313 nm directly in its ozone profile retrievals at these latitudes, so no corresponding curve is present on the ninth plot. The jump in the initial residuals in early June is coincident with the introduction of a new Day 1 Solar Spectrum for the Nadir Mapper.

Time series of initial V8PRO residuals for OMPS NP February through June

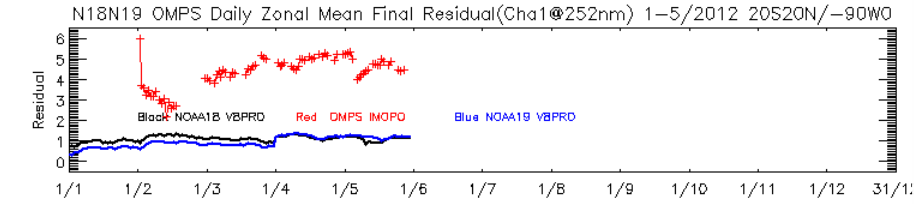


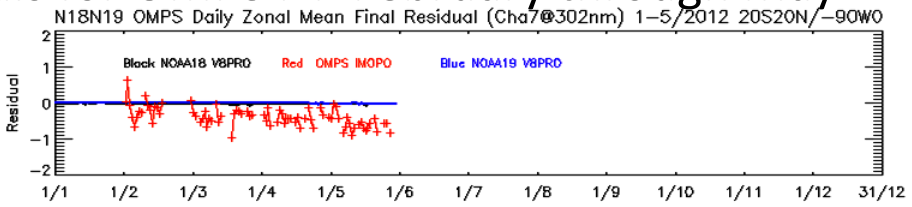


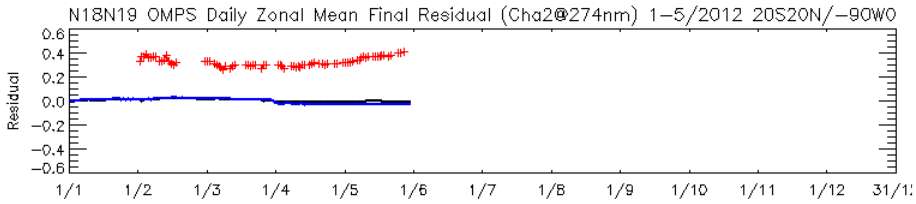
Initial Measurement Residuals for the OMPS NP Version 8 Profile Product: The nine figures show the initial residuals for profile wavelengths [252, 274, 283, 288, 292, 298, 302, 306 and 313 nm, (a) to (i), respectively] for the V8PRO product from **OMPS** compared to the same product for the operational **NOAA-18** and **NOAA-19** SBUV/2 for the equatorial daily zonal means (20N to 20S) with 0-90W removed to avoid the SAA. The residuals are in N-values (1 N ~ 2.3%). The time period is the first six months of this year (February to May for OMPS).

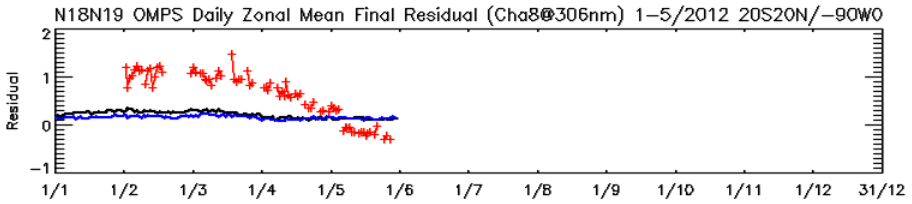
Notice that the residuals for OMPS, have maintained a persistent bias relative to the SBUV/2 residuals. This processing uses a fixed day one solar spectrum only adjusted for Earth/Sun distance.

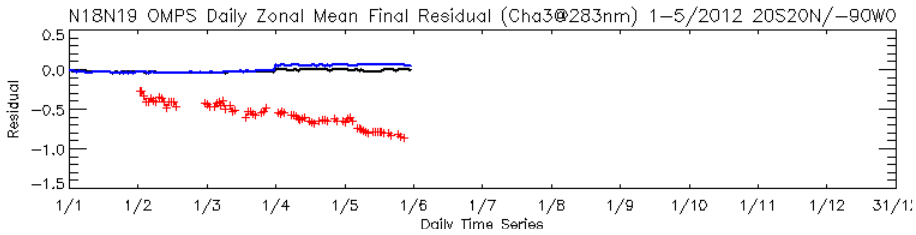
Time series of final IMOPO residuals for OMPS NP February through May

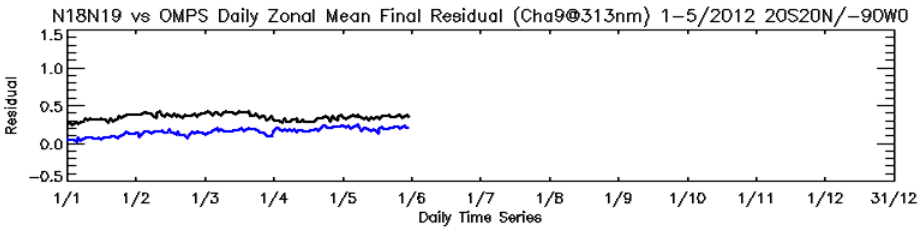


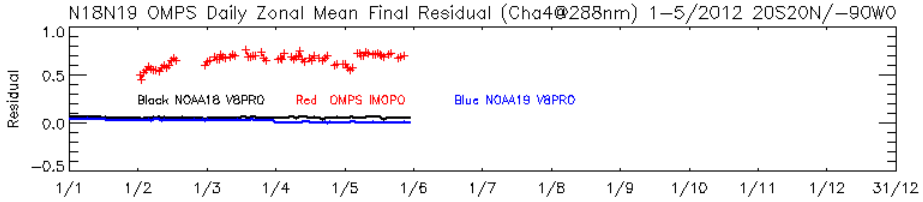


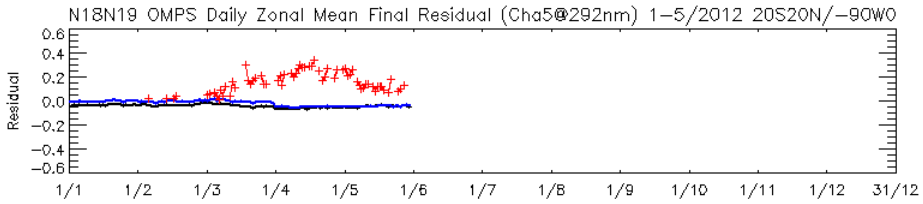


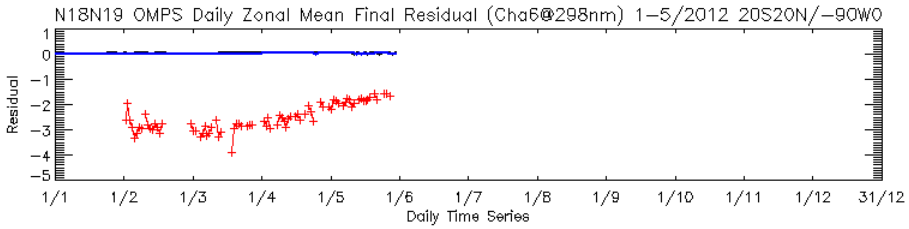






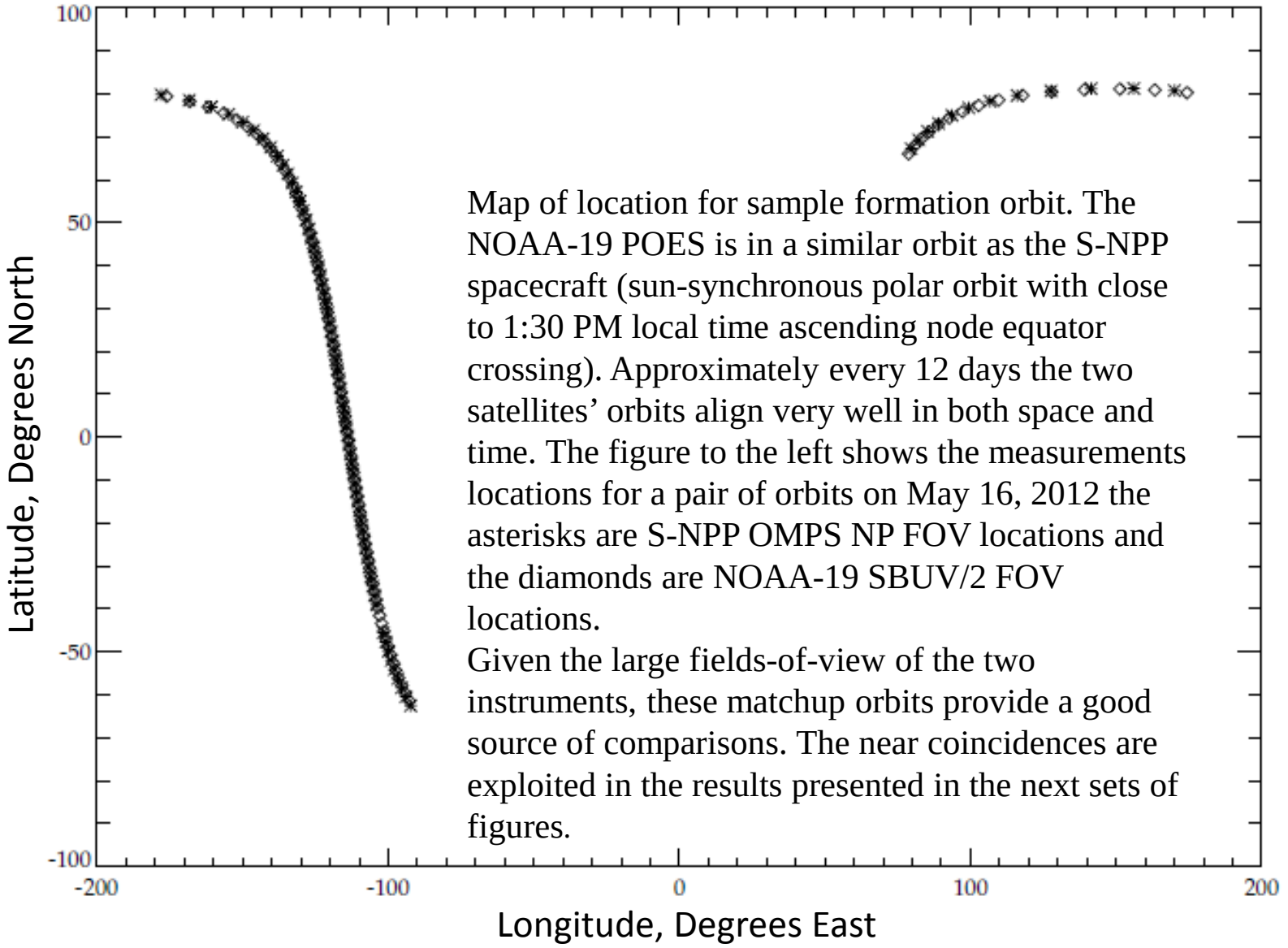






The nine figures show the final residuals for profile wavelengths [252, 274, 283, 288, 292, 298, 302, 306 and 313 nm, (a) to (i), respectively] for the V6PRO (IMOPO) product from **OMPS** compared to the V8PRO product for the operational **NOAA-18** and **NOAA-19** SBUV/2 for the equatorial daily zonal means (20N to 20S) with 0-90W removed to avoid the SAA effects. The residuals are in N-values (1 N ~ 2.3%). The time period is the end of February through May of 2012. The residuals are computed with respect to differing retrieved profiles for the two algorithms. The larger values for the IMOPO product are symptomatic of inter-channel calibration biases in the preliminary characterization. The V6PRO does not use the 313 nm directly in its ozone profile retrievals at these latitudes, so no corresponding curve is present on the ninth plot.

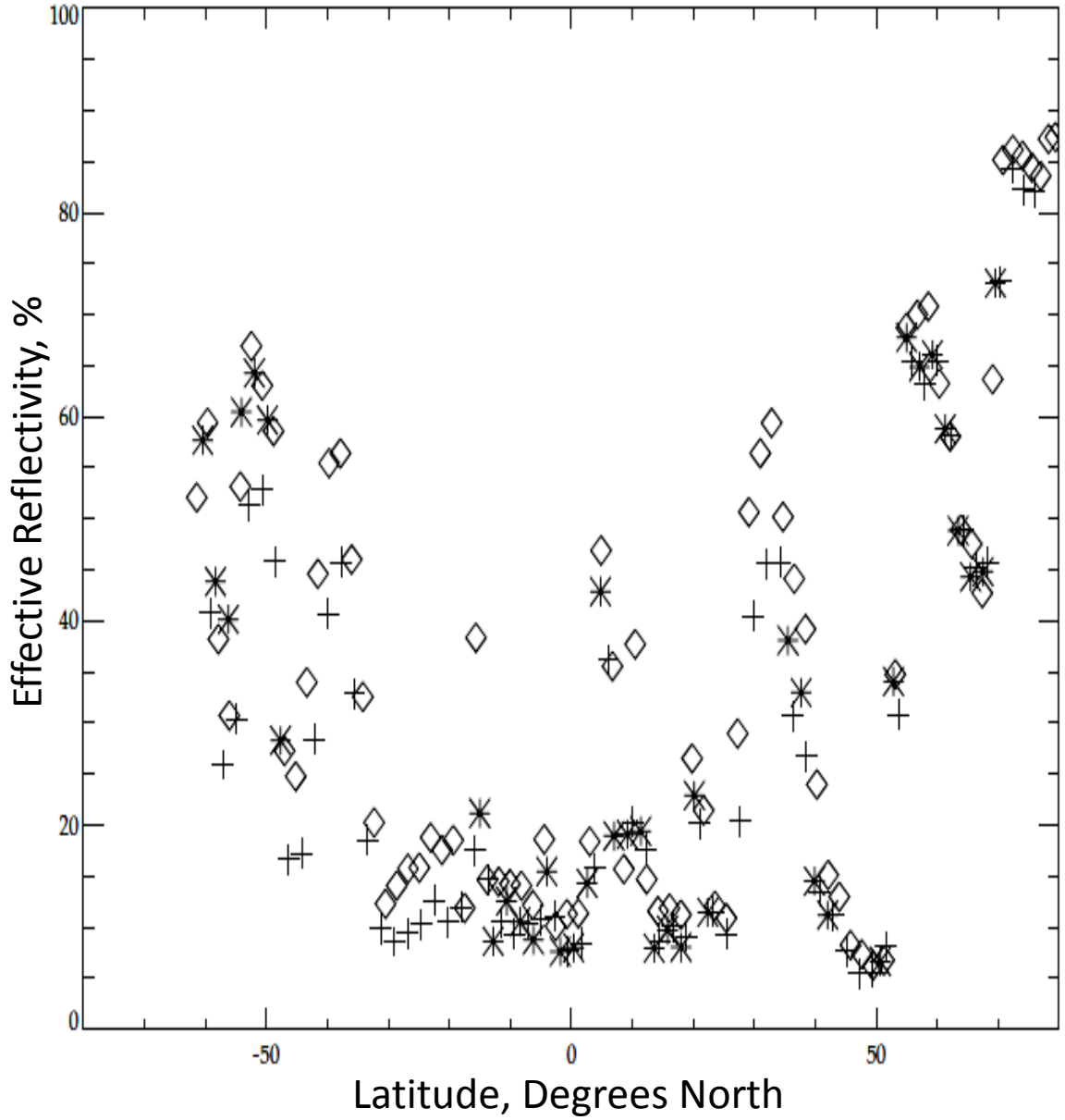
Well-matched Orbits for May 16, 2012



Map of location for sample formation orbit. The NOAA-19 POES is in a similar orbit as the S-NPP spacecraft (sun-synchronous polar orbit with close to 1:30 PM local time ascending node equator crossing). Approximately every 12 days the two satellites' orbits align very well in both space and time. The figure to the left shows the measurements locations for a pair of orbits on May 16, 2012 the asterisks are S-NPP OMPS NP FOV locations and the diamonds are NOAA-19 SBUV/2 FOV locations.

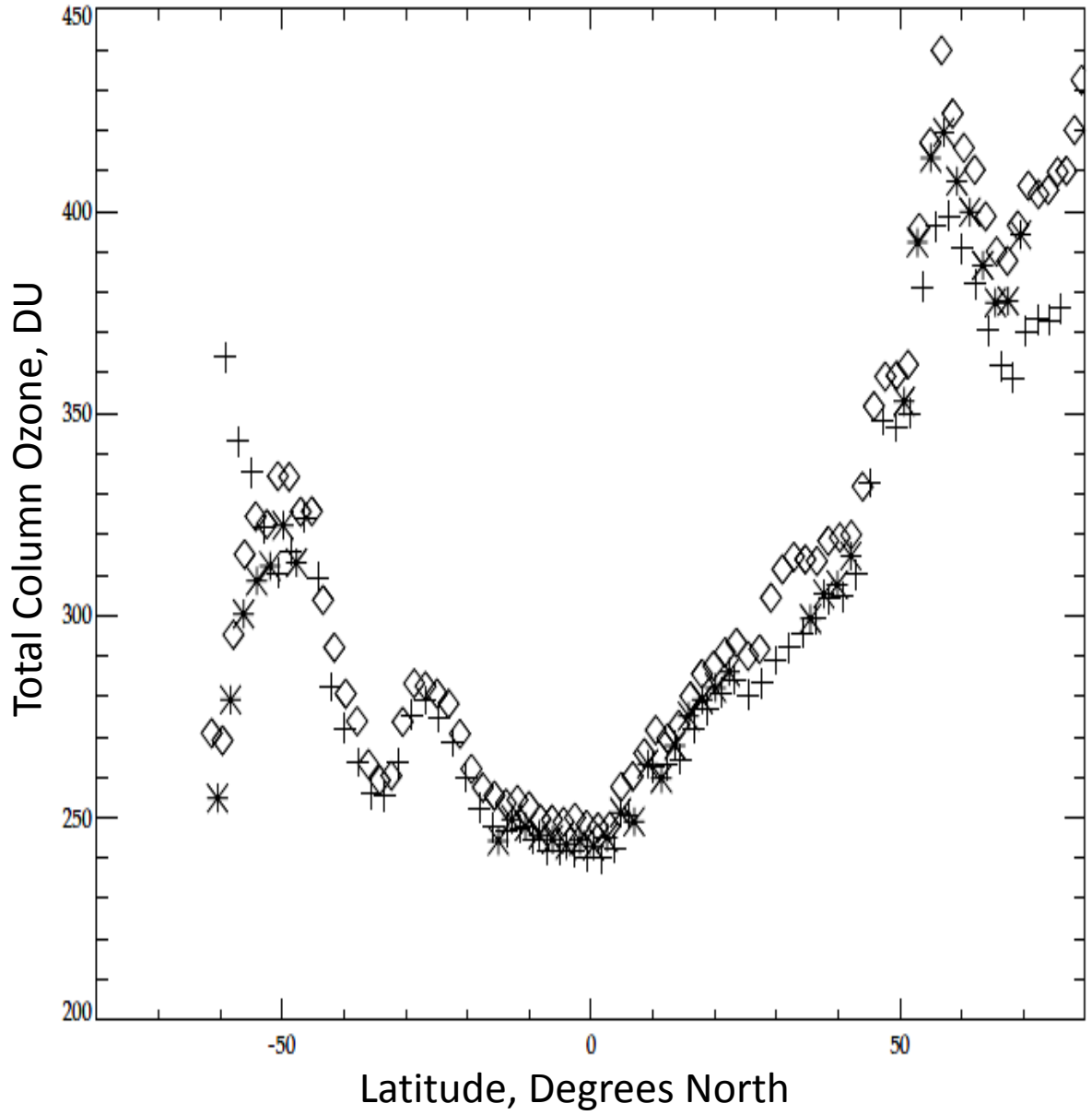
Given the large fields-of-view of the two instruments, these matchup orbits provide a good source of comparisons. The near coincidences are exploited in the results presented in the next sets of figures.

Reflectivity Comparisons to INCTO & SBUV/2



Comparisons of effective reflectivity estimates between IMOPO and the OMPS total ozone first guess product (INCTO) and between IMOPO and the NOAA-19 SBUV/2 processed with the Version 6 ozone profile retrieval algorithm. The data are from a single pair of orbits on May 16, 2012 where the two satellites are flying in formation (orbital tracks within 50 KM and sensing times with 10 minutes). The OMPS Nadir Profiler values are shown with asterisks (*), the OMPS Nadir Mapper values are shown with plus signs (+) and the SBUV/2 are shown with diamonds (<>). A significant number of the OMPS Nadir Profilers retrievals produce fill values because of Error Codes incorrectly set to 20.

Total Ozone Comparisons to INCTO & SBUV/2



Comparisons of total column ozone estimates between IMOPO and the OMPS total ozone first guess product (INCTO) and between IMOPO and the NOAA-19 SBUV/2 processed with the Version 6 ozone profile retrieval algorithm. The column amounts are the profile totals for the two Version 6 products. The data are from the same pair of orbits on May 16, 2012 used for the previous slide. The OMPS Nadir Profiler values are shown with * (asterisks), the OMPS Nadir Mapper values are shown with + (plus signs) and the SBUV/2 are shown with <> (diamonds). A significant number of the OMPS Nadir Profilers retrievals produce fill values because of Error Codes incorrectly set to 20.

Profile Comparisons between OMPS & SBUV/2 V6Pro

The figures on the next two slides show comparisons of the ozone profile retrievals estimates between IMOPO and the NOAA-19 SBUV/2 processed with the Version 6 ozone profile retrieval algorithm. The data are from another single pair of orbits on May 16, 2012 where the two satellites are flying in formation (orbital tracks within 50 KM and sensing times with 10 minutes).

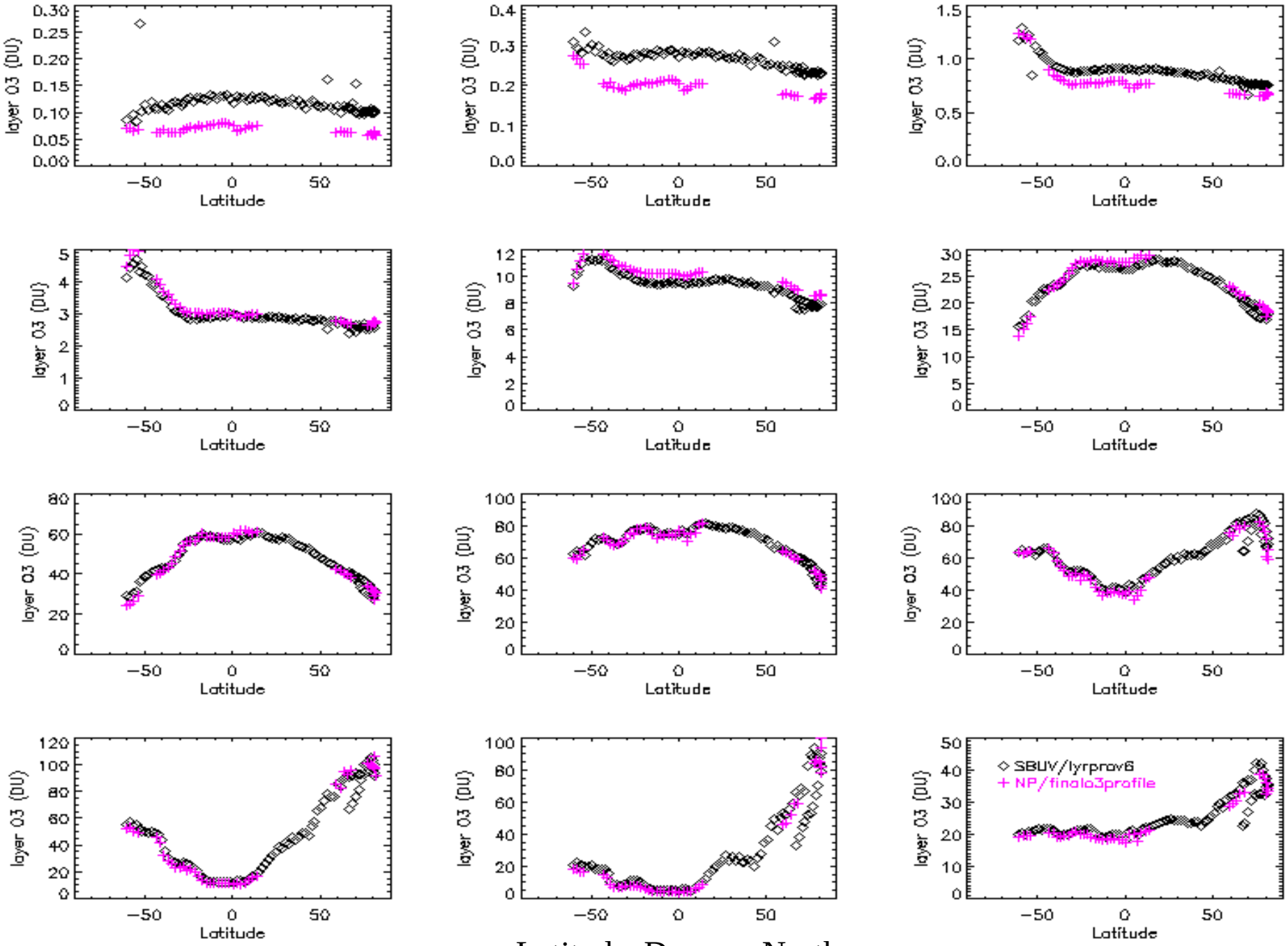
The next slide compares the ozone profile retrievals in 12 pressure layers in Dobson Units versus Latitude. The 12 layers are defined by the following 13 layer boundaries:
[0.0,0.247,0.495,0.99,1.98,3.96,7.92,15.8,31.7,63.3,127.0,253.0,1013] hPa.

The top three layers' results are in the top row with the topmost layer on the upper left. The lowest layer's results are in the figure on the bottom right. The OMPS Nadir Profiler values are in Pink and the **SBUV/2 are shown in Black**. A significant number of the OMPS Nadir Profilers contain fill values because of Error Codes incorrectly set to 20.

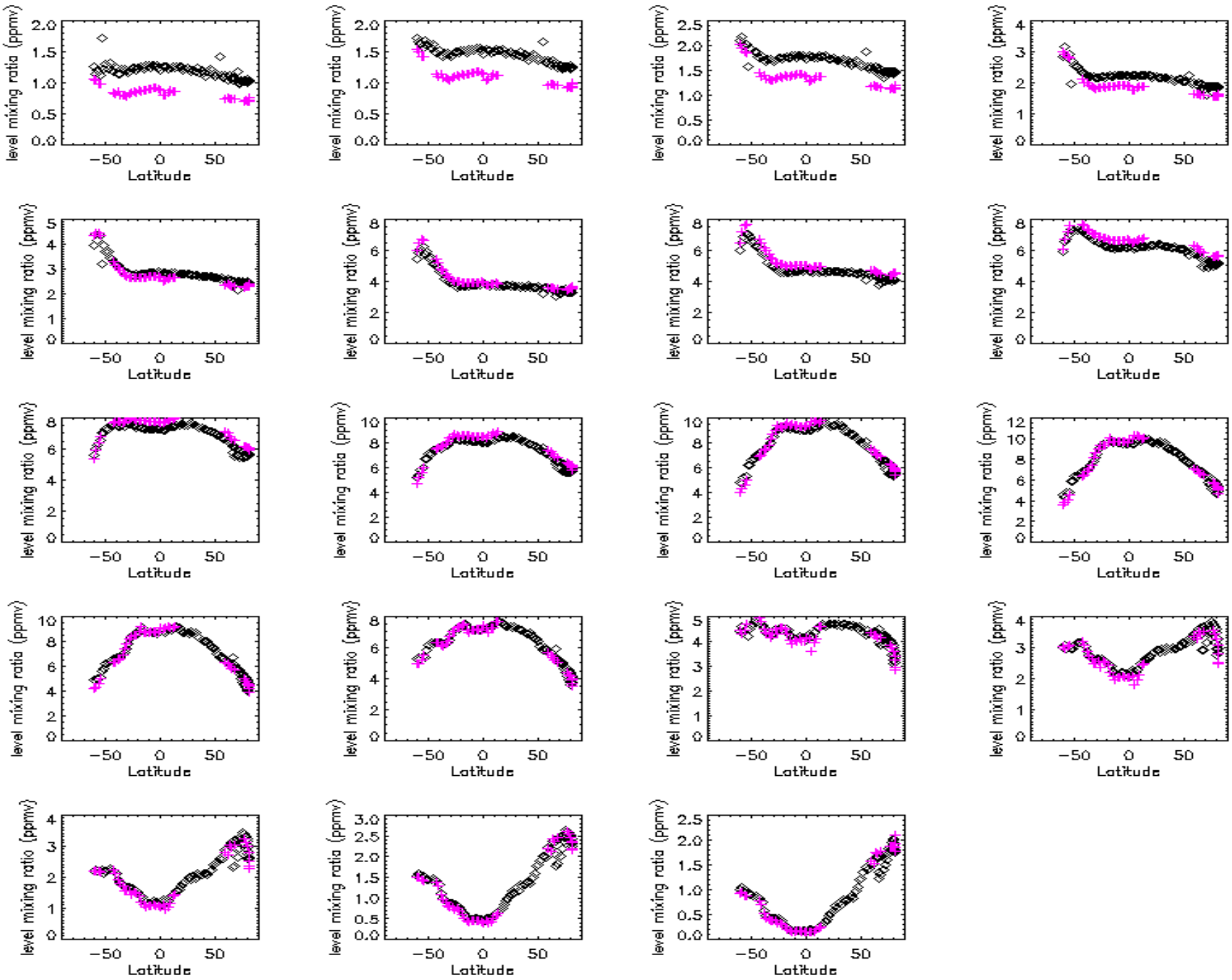
The second slide shows the results of comparison for the ozone mixing ratios at 19 pressure levels: [0.3,0.4,0.5,0.7,1.0,1.5,2.0,3.0,4.0,5.0,7.0,10.,15.,20.,30.,40.,50.,70.,100.] hPa.

The arrangement from top to bottom follows the same convention as for the layers.

The two sets of figures show similar results with general agreement between the retrievals for the two instruments but with the OMPS NP retrieving much smaller values at the top of the profiles. This is probably due to the inaccuracies in the initial calibration of the shorter wavelength channels but could also be symptomatic of stray light in the shorter wavelength channels providing information at those levels.



Latitude, Degrees North


level mixing ratio (ppmv)
Latitude
−50
0
50

IMOPO Known Product Deficiencies

- Day One Solar needs a definitive spectrum. (Preliminary update expected in August 2012 – DR #4797, #CCR 0458^)
- Profile and total ozone error flags are switched in the output. (Parent PCR 27740 – Expected correction Fall 2012)
- Snow/Ice data is all zeroes (DR #4802)
- The input-out-of-bound flag (Error Code 20) is set with an incorrect check on surface pressure (DR #4860)
- Stray Light / Radiance Coefficients^
  - Correction subroutine and definitive estimates of coefficients are under development (DR #4823)
- Dark and Smear tables need work in the SDR (DRs #4749, #4818)
- Wavelength Scale and adjustments^
  - Working on definitive Day 1
  - Working on adjustments for intra-orbit scale drift

^ These may create large discontinuities in the product performance as they and similar changes enter the system.

IMOPO Summary of Findings & Recommendations

- Promotion to Beta
  - The IMOPO algorithm is functioning correctly. The product precision and accuracy are affected by the current state of the calibration, solar spectrum and wavelength scale. These will continue to change as improved characterizations are brought into the system.
  - The OMPS Team recommends that the IMOPO Product be promoted to Beta Maturity.
- Monitoring Figures are available at

http://www.star.nesdis.noaa.gov/icvs/PROD/proOMPSbeta.O3PRO_IMOPO.php

- Upgrade to V8TOZ
  - The team recommends an upgrade of the current Version 6 ozone profile retrieval algorithm to the V8Pro algorithm in use with the SBUV/2 measurements for both climate data records and operational products. (This is captured in the JPSS system under DR #4256.)

Backup

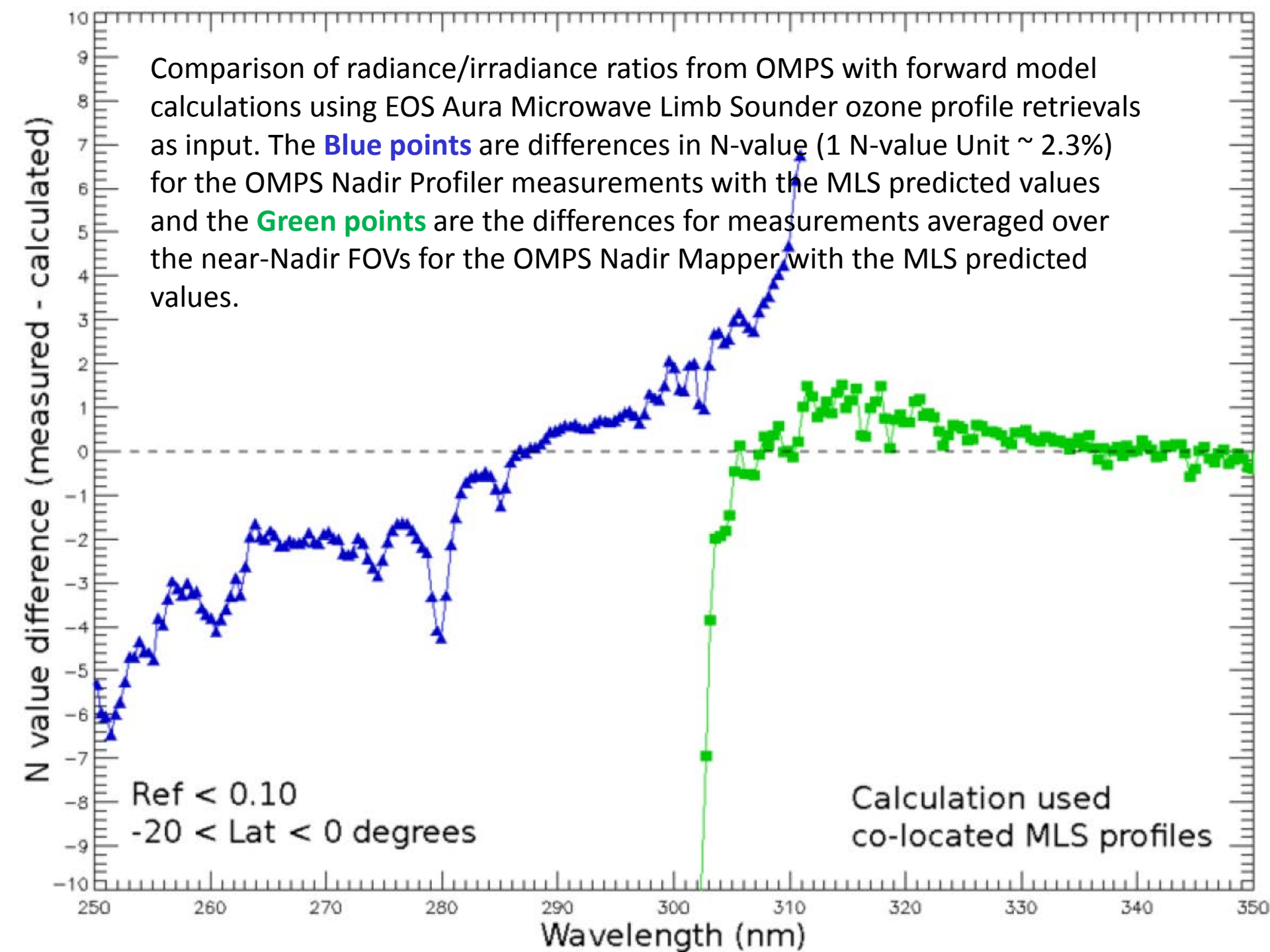
Table 2.1.4 - Ozone Nadir Profile

Attribute	Threshold (1)	Objective
a. Horizontal Cell Size	250 X 250 km (2,9)	50 x 50 km^2 (10)
b. Vertical Cell Size	5 km reporting	
1. Below 30 hPa (~ < 25 km)	10 - 20 km (3)	3 km (0 - Th)
2. 30 - 1 hPa (~ 25 - 50 km)	7 - 10 km (3)	1 km (TH - 25 km)
3. Above 1 hPa (~ > 50 km)	10 - 20 km (3)	3 km (25 - 60 km)
c. Mapping Uncertainty, 1 Sigma (4)	< 25 km	5 km (10)
d. Measurement Range		
Nadir Profile, 0 - 60 km	0.1-15 ppmv	0.01 - 3 ppmv (O - TH) 0.1-15 ppmv (Th - 60 km)
e. Measurement Precision (5)		
1. Below 30 hPa (~ < 25 km)	Greater of 20 % or 0.1 ppmv	10% (0 - TH)
2. At 30 hPa (~ 25 km)	Greater of 10 % or 0.1 ppmv	3%
3. 30 - 1 hPa (~ 25 - 50 km)	5% - 10%	1%
4. Above 1 hPa (~ > 50 km)	Greater of 10% or 0.1 ppmv	3%
f. Measurement Accuracy (5)		
1. Below 30 hPa (~ < 25 km)	Greater of 10 % or 0.1 ppmv	10% (0 - 15 km)
2. 30 - 1 hPa (~ 25 - 50 km)	5% - 10%	5% (15 - 60 km)
3. At 1 hPa (~ 50 km)	Greater of 10 % or 0.1 ppmv	5% (15 - 60 km)
4. Above 1 hPa (~ > 50 km)	Greater of 10 % or 0.1 ppmv	5% (15 - 60 km)
g. Latency	120 min. (6)	15 min
h. Refresh	At least 60% coverage of the globe every 7 days (monthly average) (7)	24 hrs. (7)
i. Long-term Stability (8)	2% over 7 years	1% over 7 years
		v1.4.2, 7/29/11

Notes:

1. The OMPS Limb Profiler instrument was not manifested on NPOESS. Thus, the Ozone Nadir Profile "Threshold" attributes are based upon current estimates using a variant of the SBUV/2 Version 8 algorithm with the Intermediate Product produced by the OMPS Nadir Profiler instrument. (See Note 10.) All of the Ozone Nadir Profile Threshold attributes are "TBR" until further analysis has been completed to determine the specifics of delivering the Ozone Nadir Profile EDR attributes using only the capability provided by this Intermediate Product.
2. The SBUV/2 has a 180 km X 180 km cross-track by along -track FOV. It makes its 12 measurements over 24 Samples (160 km of along-track motion). It is intended to operate the OMPS Nadir Profiler in a mode with this large FOV sub-sampled.
3. The SBUV/2 Version 8 Averaging kernels' Full Width Half Maximum values were used to define these VCS.
4. The IORD-II Mapping "Accuracy" of 25 km was changed to "Uncertainty, 1 sigma" in accordance with user desires as expressed by the OATS and JARG.
5. Values provided by L. Flynn of NOAA/NESDIS along with the two point values from BATC analysis.
6. Relaxed IORD-II Threshold requirement.
7. All OMPS measurements require sunlight, so there is no coverage in polar night areas. The IORD-II included threshold and objective Refresh requirements of 24 hrs for Ozone TC but none for Nadir Profile. This interpretation of the IORD-II Refresh requirement is consistent with the baseline OMPS Cross-track Swath Width design of ~ 250 km (16.7° FOV) for a single orbit plane. This swath width provides a good sample of the full global ozone profile pattern over ~ 7 days. A set of 4 days with 14 orbits/day by 250-km swaths will cover a little over one third of the 40,000 km equator. SBUV/2 has similar coverage over 5 days. The OMPS Nadir Profiler performance is expected to degrade in the area of the South Atlantic Anomaly (SAA) due to the impact of periodic charged particle effects in this region.
8. Long Term Stability is not a critical attribute for achieving operational performance but it is for climate applications.
9. The OMPS and other newer CCD array BUV instruments can be operated to generate products with higher spatial resolution. Numerical weather and air quality models can make good use of this information.

10. The IORD Total Column/Profile EDR had 25 km Mapping Accuracy for both the Threshold and Objective. The Nadir Profile Objective has been changed to 5 km for the following reasons per L. Flynn. The OMPS aggregates pixels to make the current 250X250 FOV in the threshold. We would aggregate 1/5 as many pixels to make the new objective 50X50 FOV. The requested change maintains


Comparison of radiance/irradiance ratios from OMPS with forward model calculations using EOS Aura Microwave Limb Sounder ozone profile retrievals as input. The Blue points are differences in N-value (1 N-value Unit ~ 2.3%) for the OMPS Nadir Profiler measurements with the MLS predicted values and the Green points are the differences for measurements averaged over the near-Nadir FOVs for the OMPS Nadir Mapper with the MLS predicted values.
N value difference (measured - calculated)
Wavelength (nm)
Ref < 0.10
-20 < Lat < 0 degrees
Calculation used
co-located MLS profiles