COMPARE SENSOR DATA RECORD FROM NADIR INSTRUMENTS OF OZONE MAPPING PROFILER SUITE, GOME-2 METOP-A/B, NOAA-19 SBUV/2 AND CRTM SIMULATIONS

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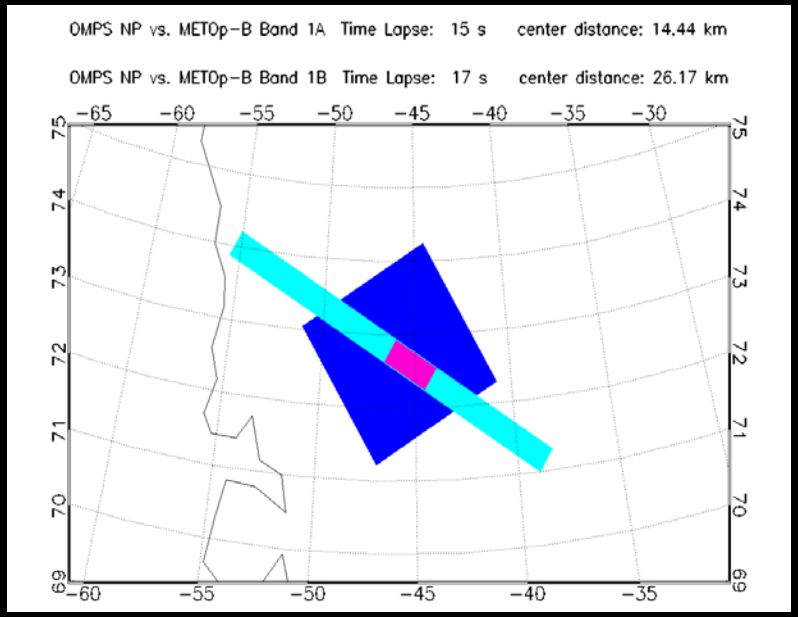
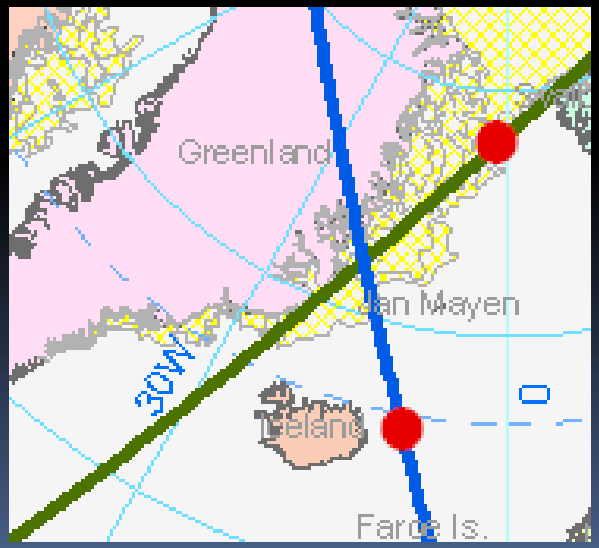
Outline

- Comparison with GOME-2 L1B
  - Analysis of influence factors such as homogeneity, distance, time lapse, SZA etc.
  - Long-term trending of SNO comparison (OMPS vs. GOME-2)
- Comparison with CRTM Simulations
- Comparison with SBUV/2

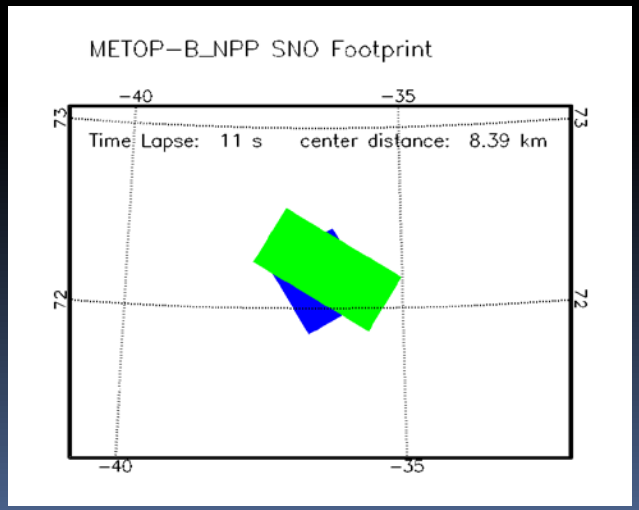
SNO Method

Simultaneous Nadir Overpass (SNO): Predictions for OMPS and METOp-A/B have been conducted at NOAA/NEDIS/STAR operationally. It predicts OMPS and METOp-A/B overpass locations and times, temporal and spatial distance between the two instruments, as well as solar zenith angles.

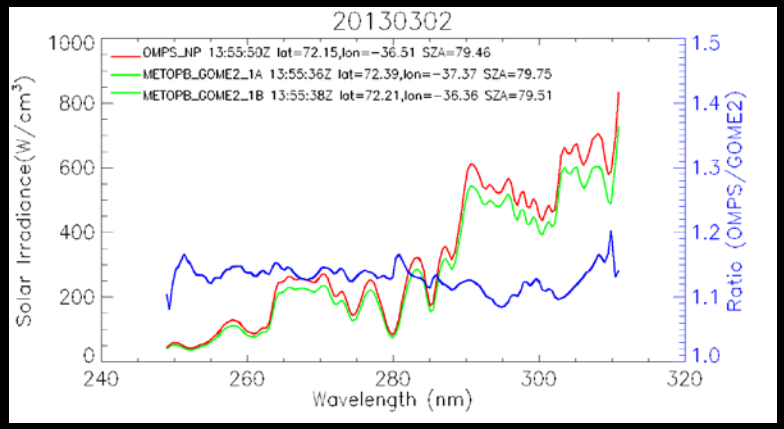




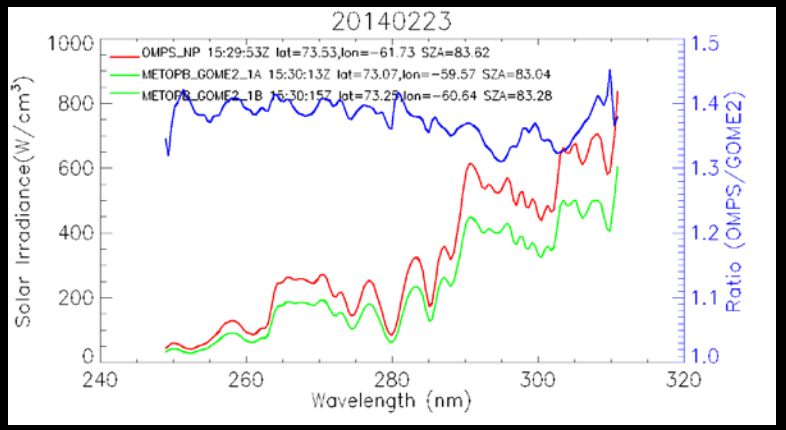
Courtesy of Changyong Cao

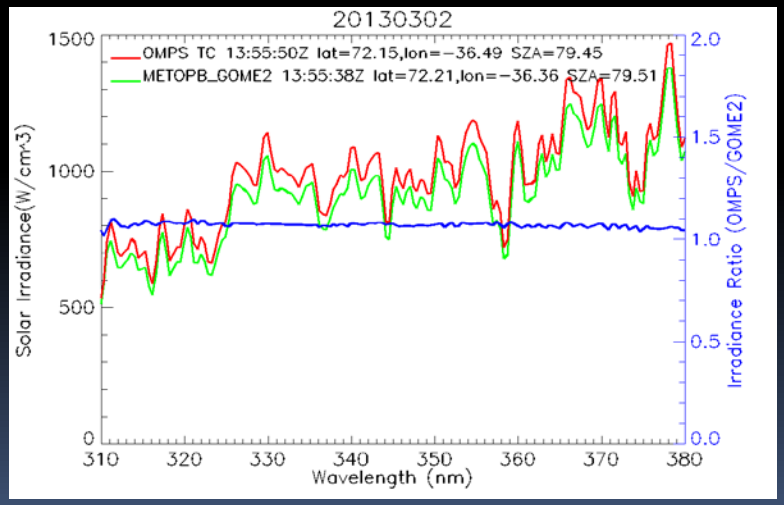


Solar Irradiance (GOME-2 METOp-B vs. OMPS NM/NP)



NP





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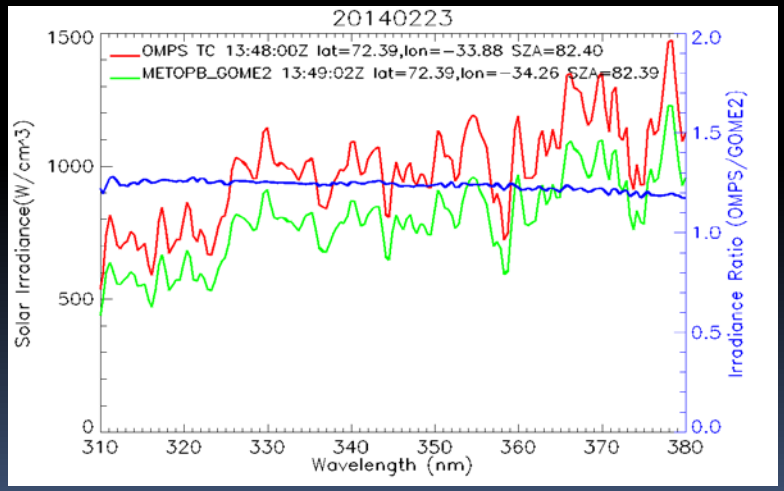
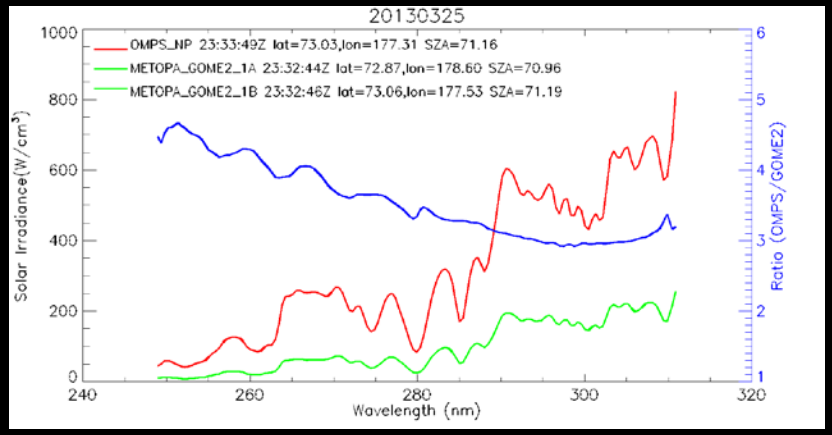
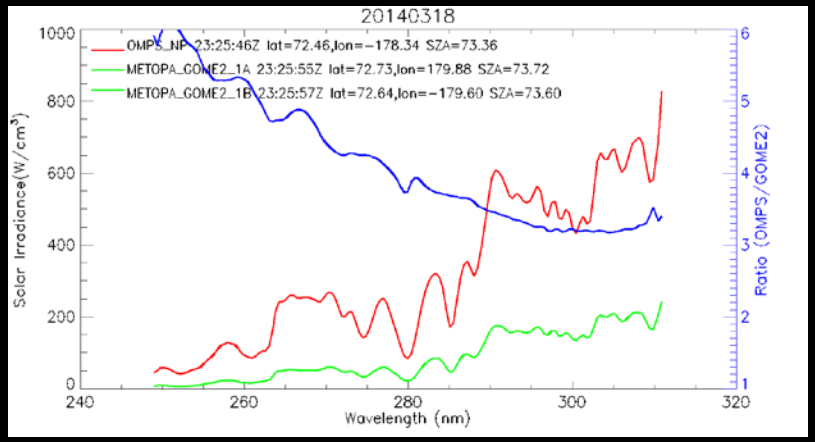


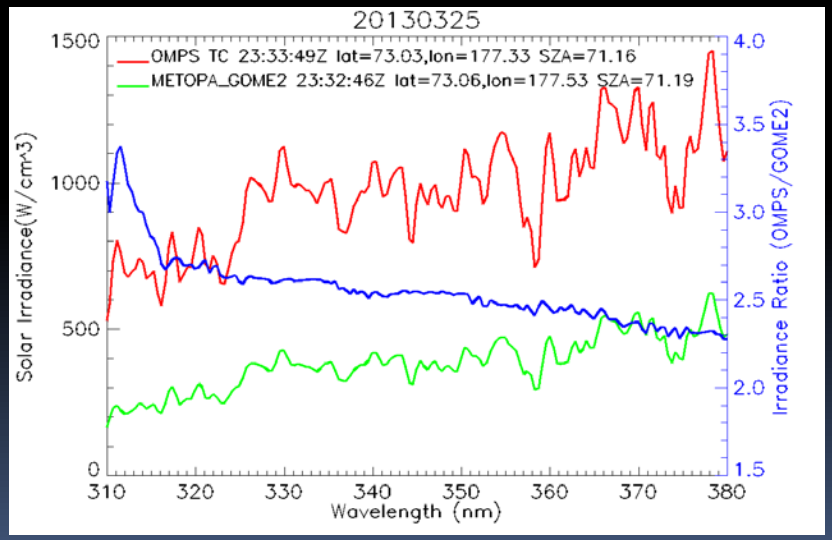
During past 12 months, solar irradiance signals of GOME-2 on METOp-B have degradated about 20% at band 1A and 1B, and about 10% at band 2B.

Solar Irradiance (GOME-2 on METOp-A vs. OMPS NM/NP)

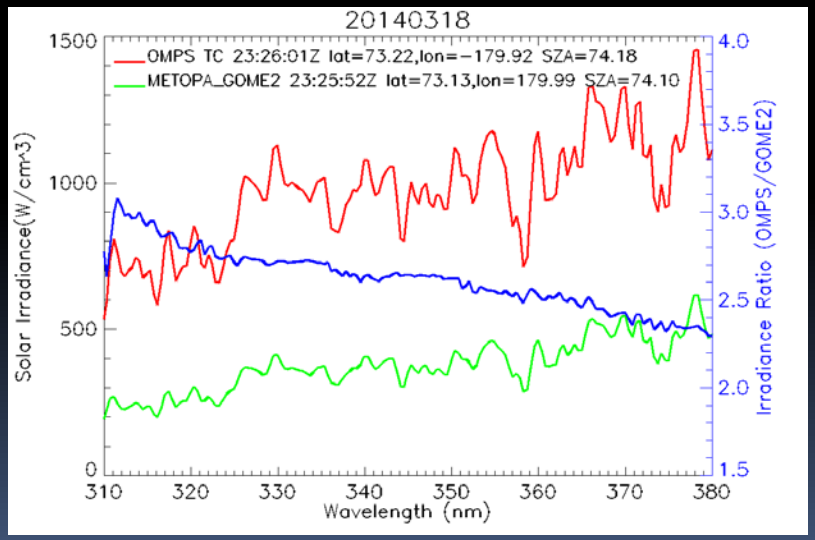


NP



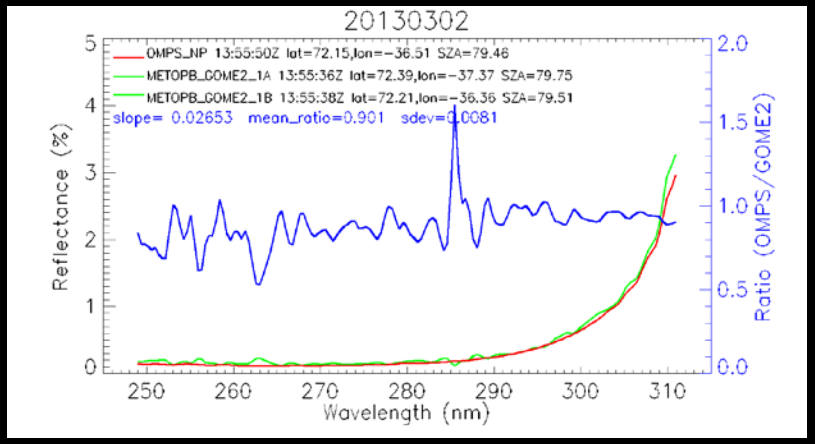


NM

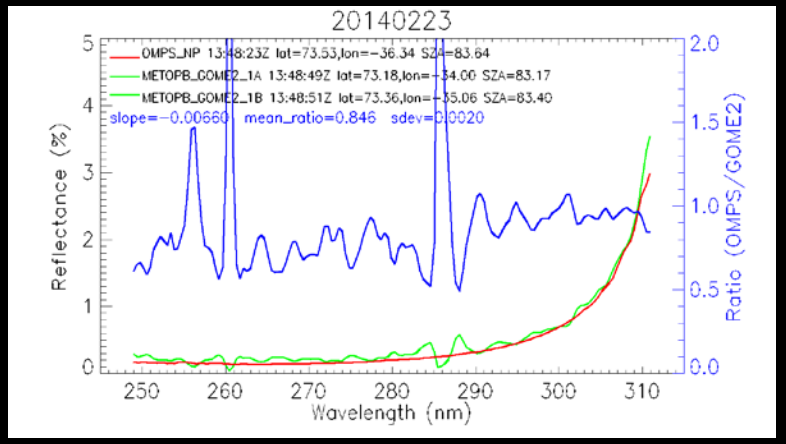


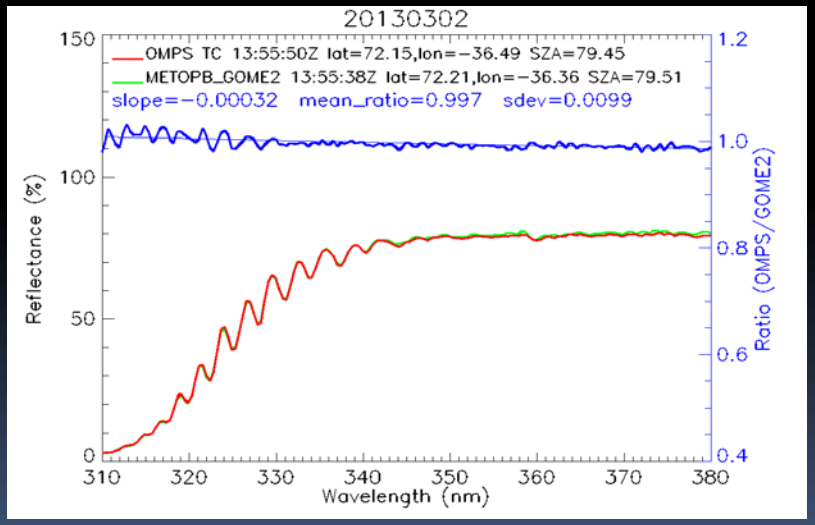
During past 12 months, solar irradiance signals of GOME-2 on METOp-A have degradated much more at band 1A and band 1B than at band 2B.

EV Reflectance (GOME-2 METOp-B vs. OMPS NM/NP)

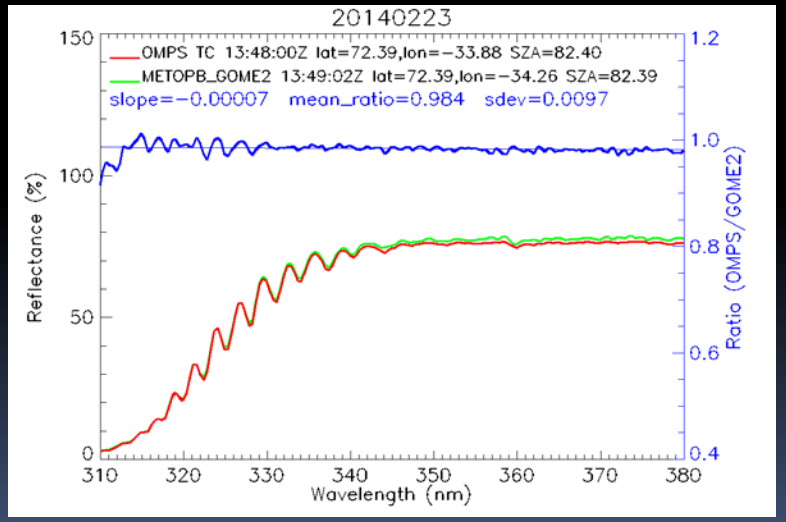


NP



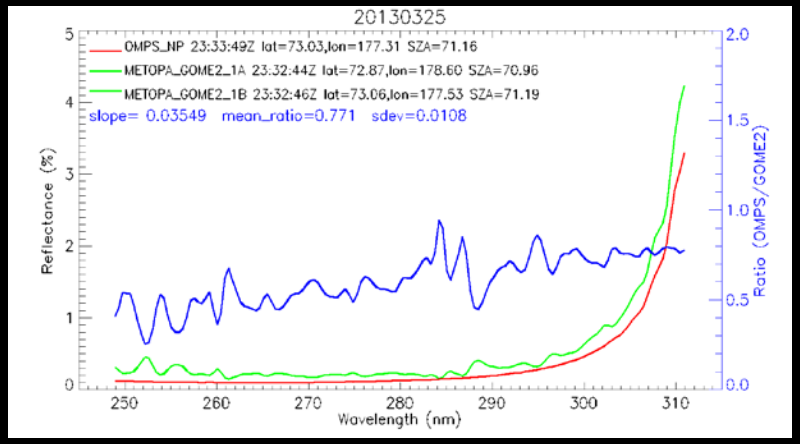


NM

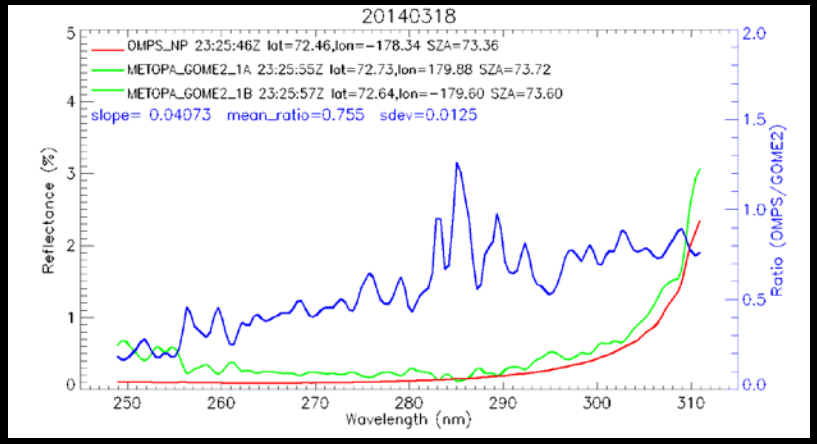


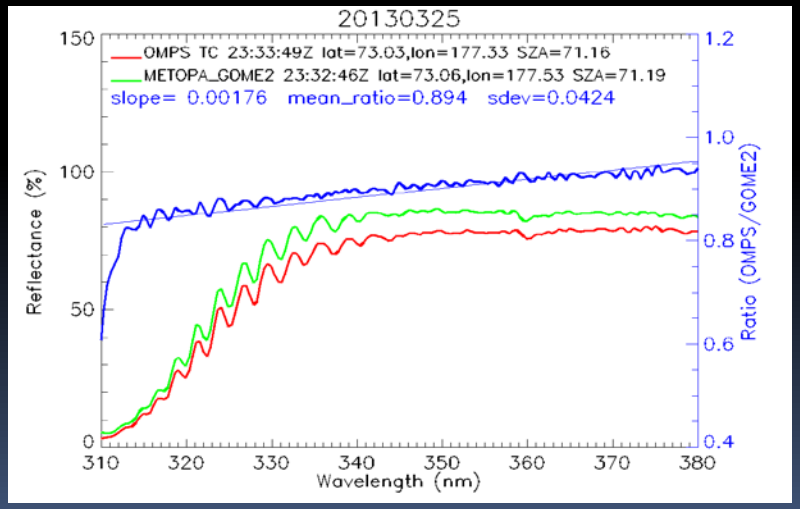
Large reflectance differences between OMPS NP and GOME-2 are found at around 286nm.

EV Reflectance (GOME-2 METOp-A vs. OMPS NM/NP)

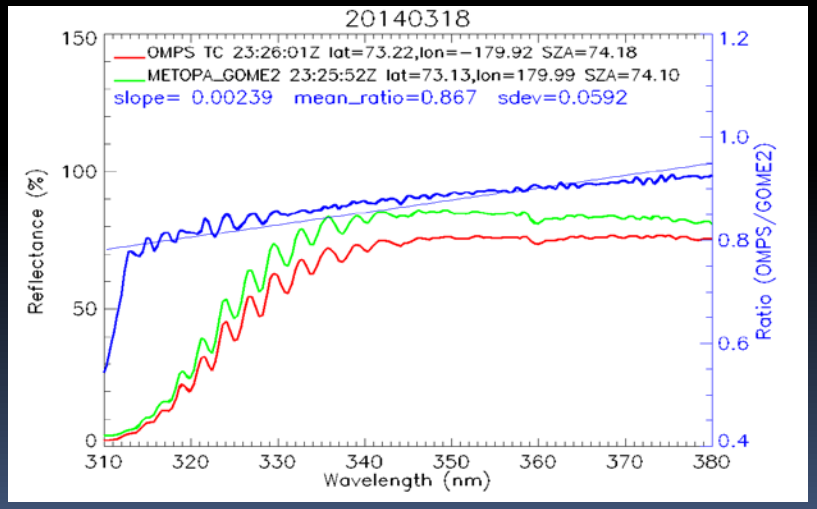


NP



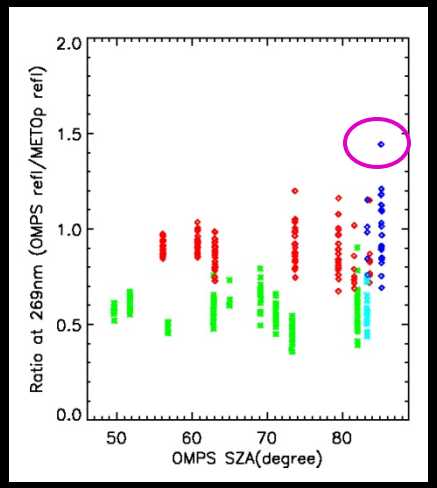


NM

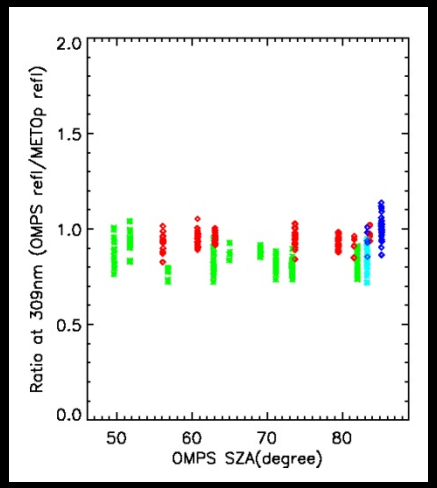


Fortunately reflectance shows much better agreement between OMPS and GOME-2 on both METOp-A and METOp-B than radiance in past 12 months.

Factors of SZA and Reflectance at 309nm (NP 1)



SZA

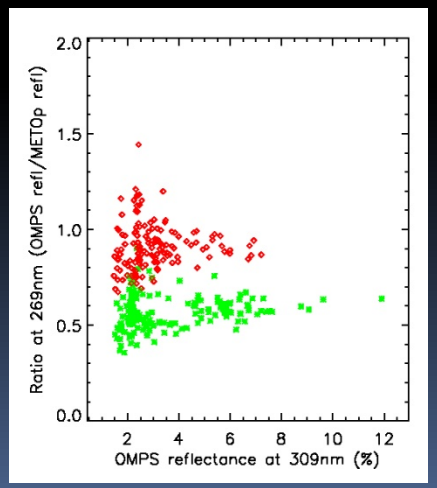


◊◊◊◊-----METOp-B, NH

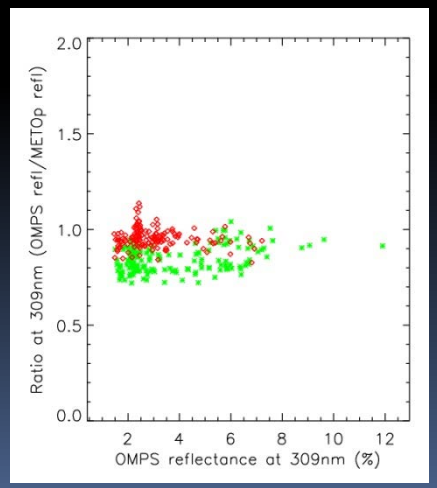
◊◊◊◊-----METOp-B, SH

****-----METOp-A, NH

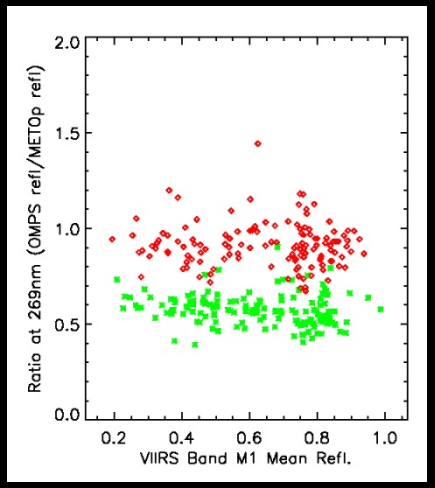
****-----METOp-A, SH



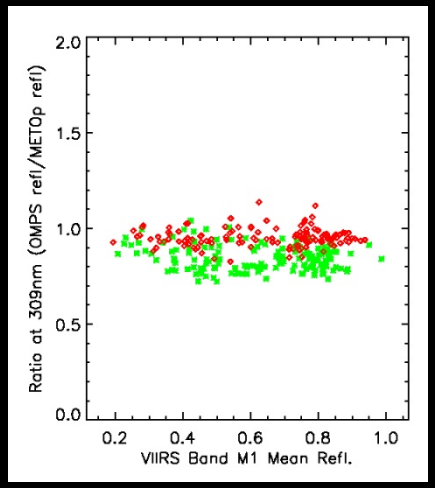
Refl_309nm

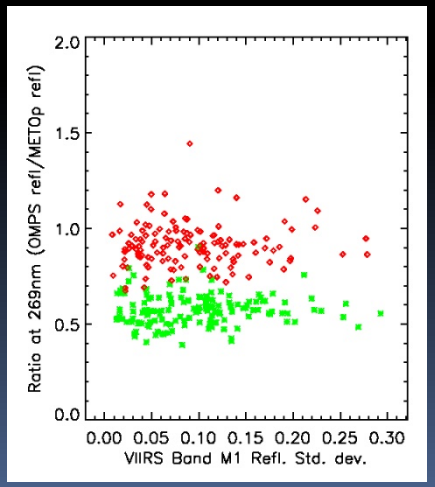


Homogeneous Tests by VIIRS Band M1(NP 2)

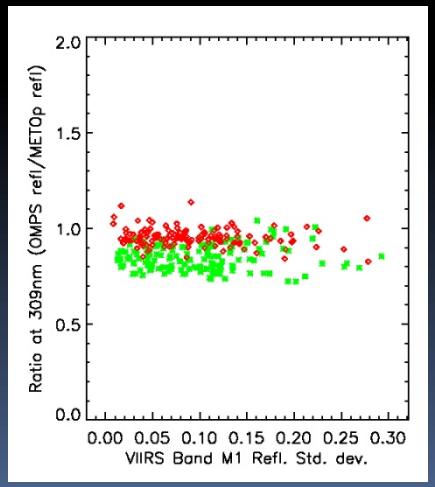


M1 refl. mean

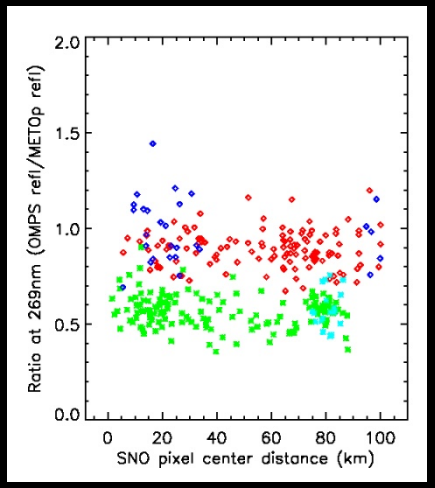




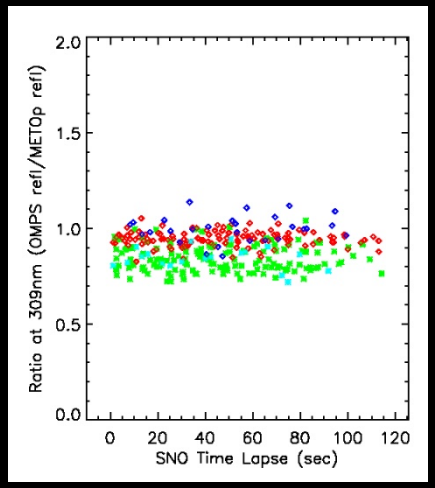
M1 refl. Std. dev.

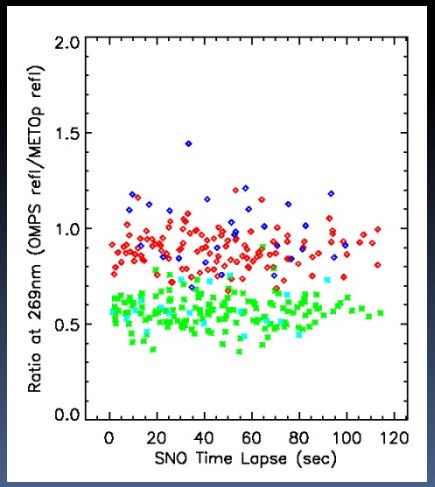


Factors of Temporal and Spatial Distance (NP 3)

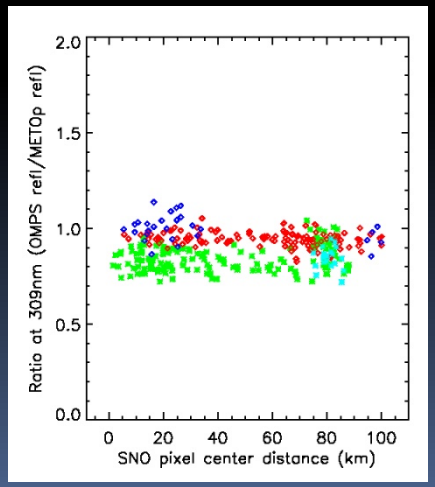


Temporal

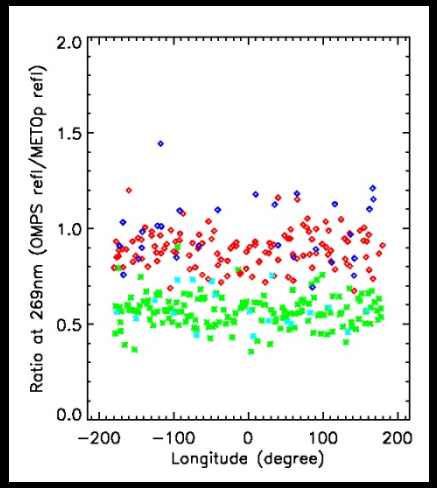




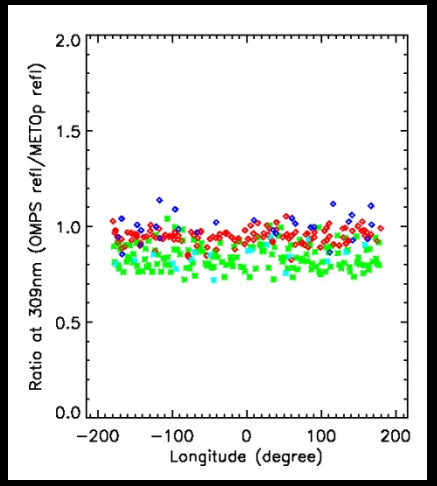
Spatial

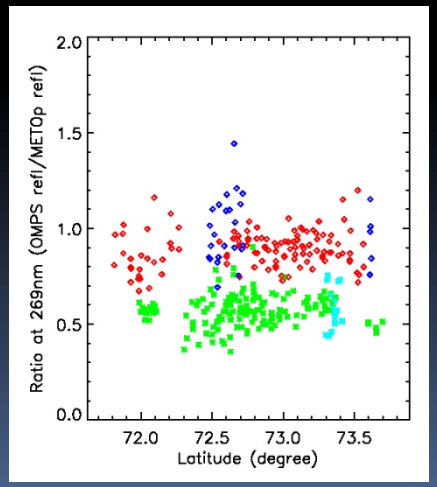


Factors of Geolocations (NP 4)

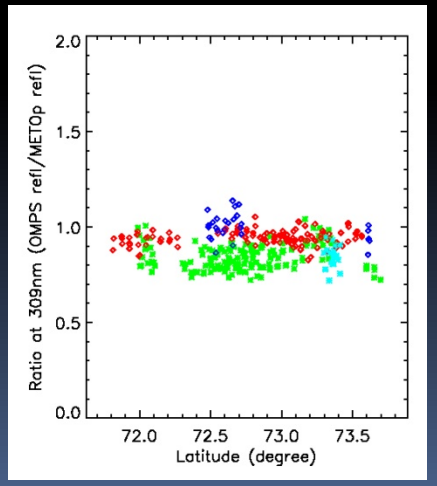


Longitude



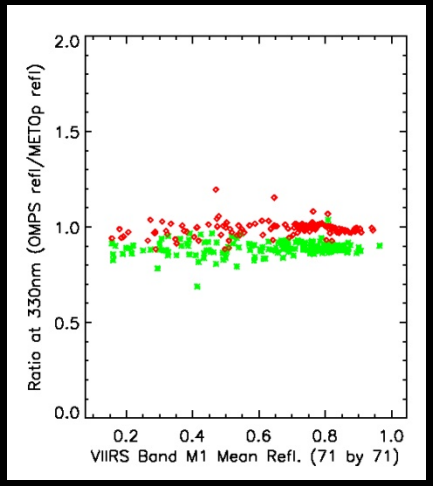


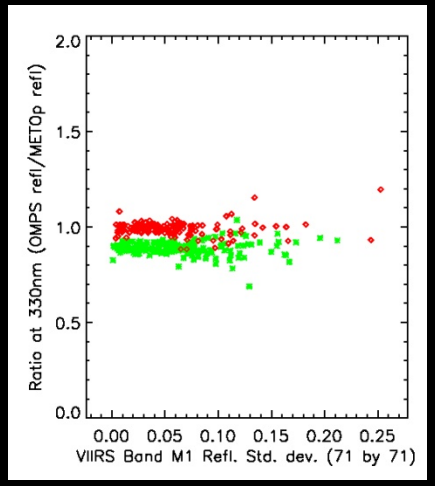
Latitude



Homogeneous Tests by VIIRS, Geolocations (NM 1)

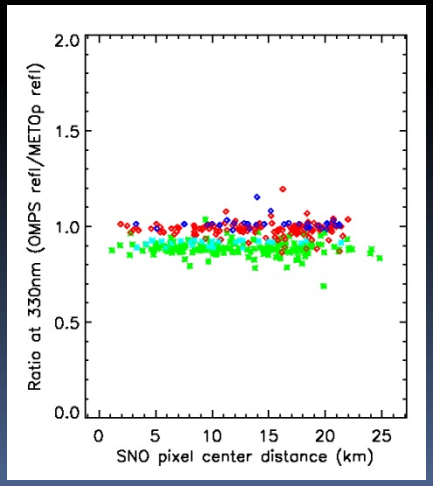
M1 refl. mean

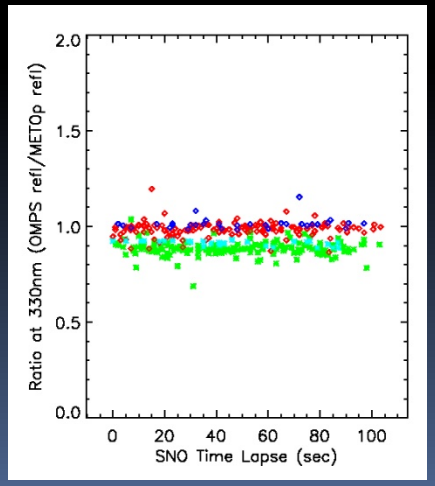




M1 refl. Std. dev.

Spatial

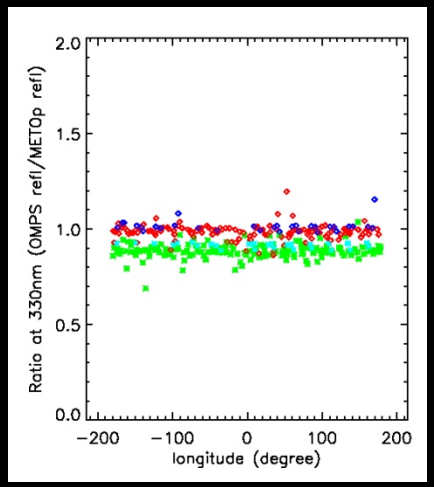


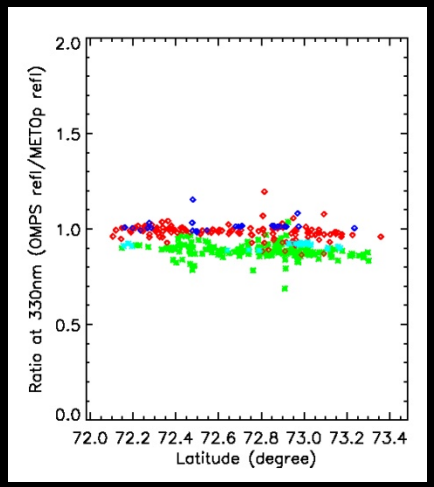


Temporal

Factors of Geolocations, SZA, and Reflectance at 380nm (NM 2)

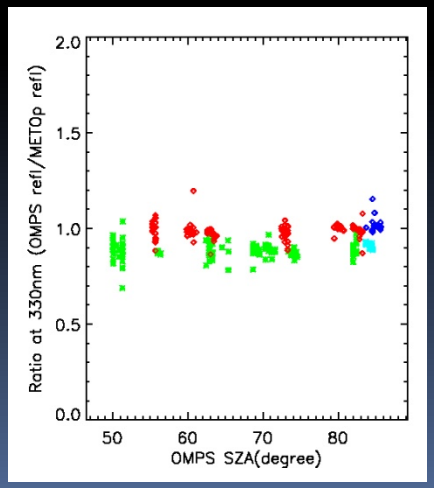
Longitude

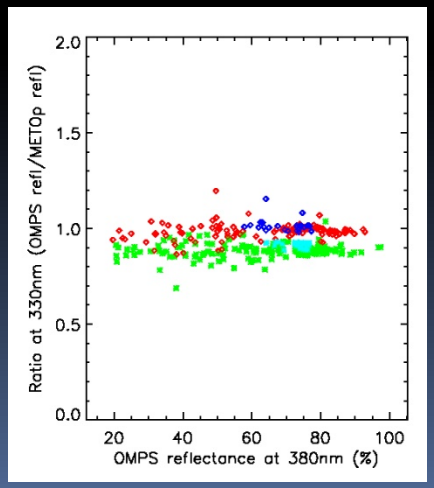




Latitude

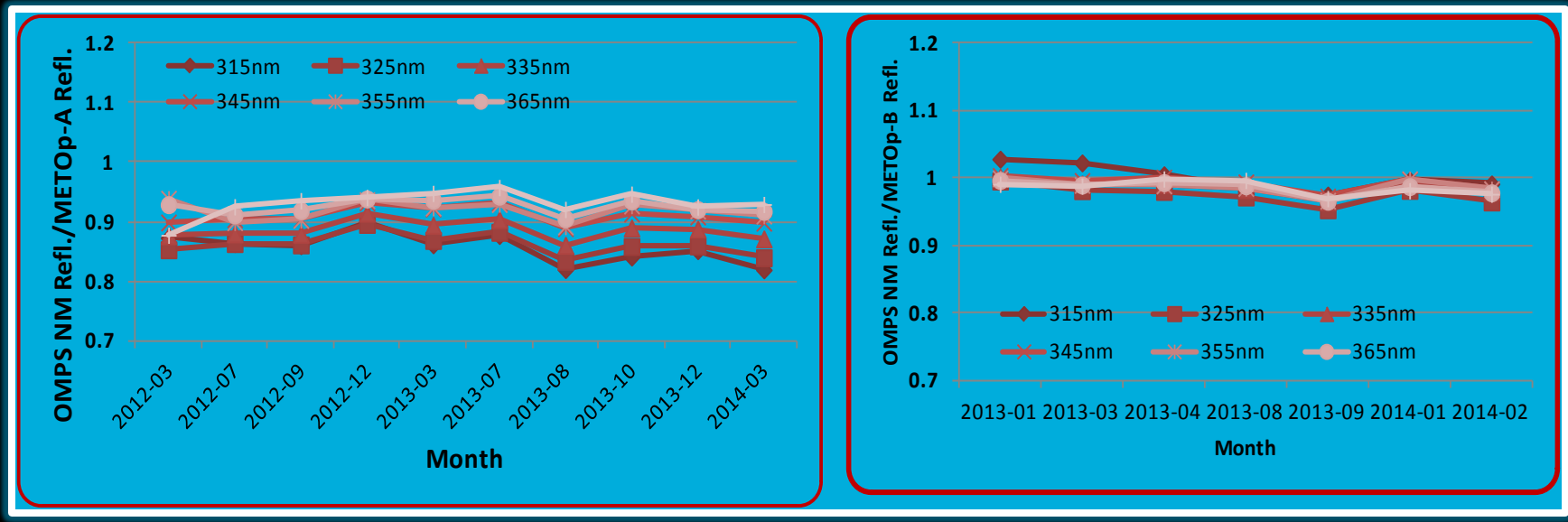
SZA





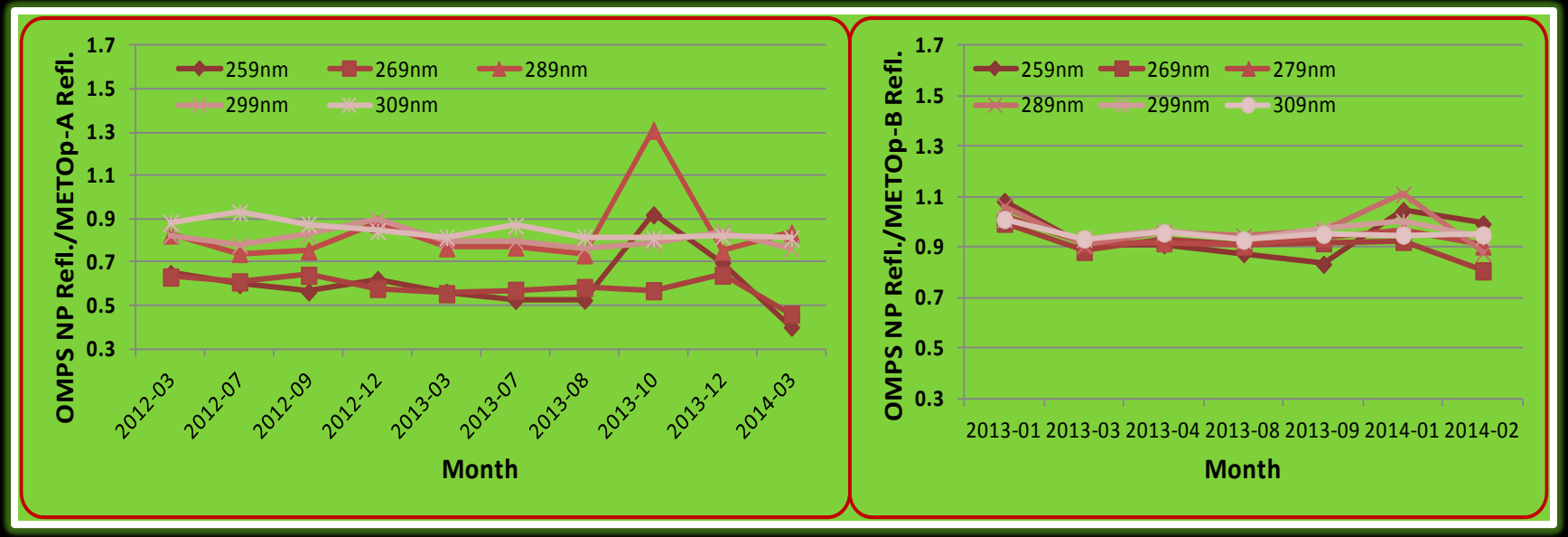
Refl_380nm

OMPS NM versus GOME-2 METOp-A (left) and METOp-B (right) at SNO



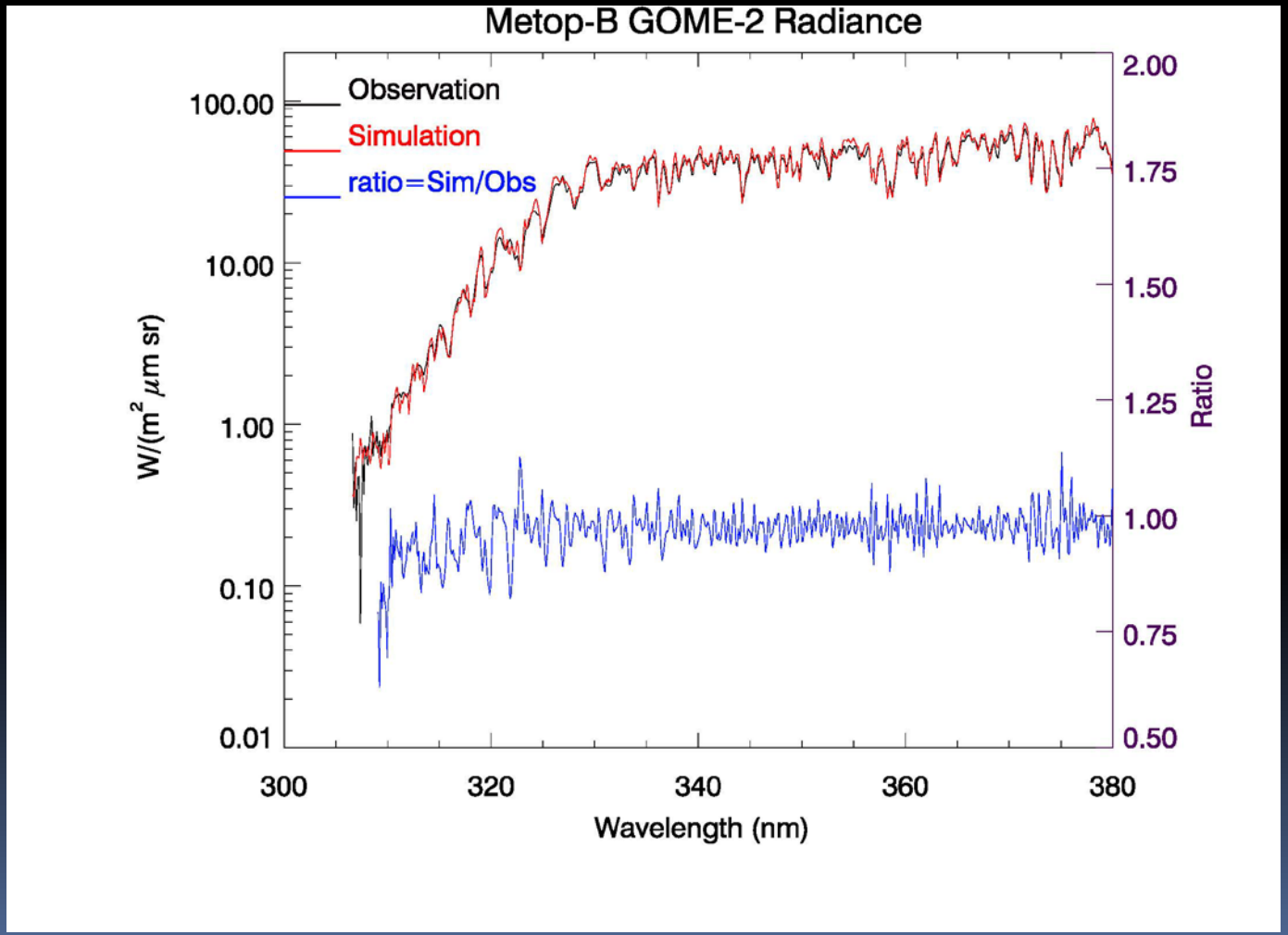
- The comparisons between OMPS and GOME-2 confirmed that the signals of GOME-2 on METOp-A have been degradated for both the earthshine and solar measurements by more then 50% after more than seven years in orbit. Since METOp-B was launched in September 2012, the comparisons show much better agreement.
- Also, the comparisons demonstrate that the GOME-2 has degraded more at shorter wavelengths than at longer wavelengths, which leads to the current 10-15% discrepancy in reflectance for shorter wavelengths.

OMPS NP versus GOME-2 METOp-A (left) and METOp-B (right)

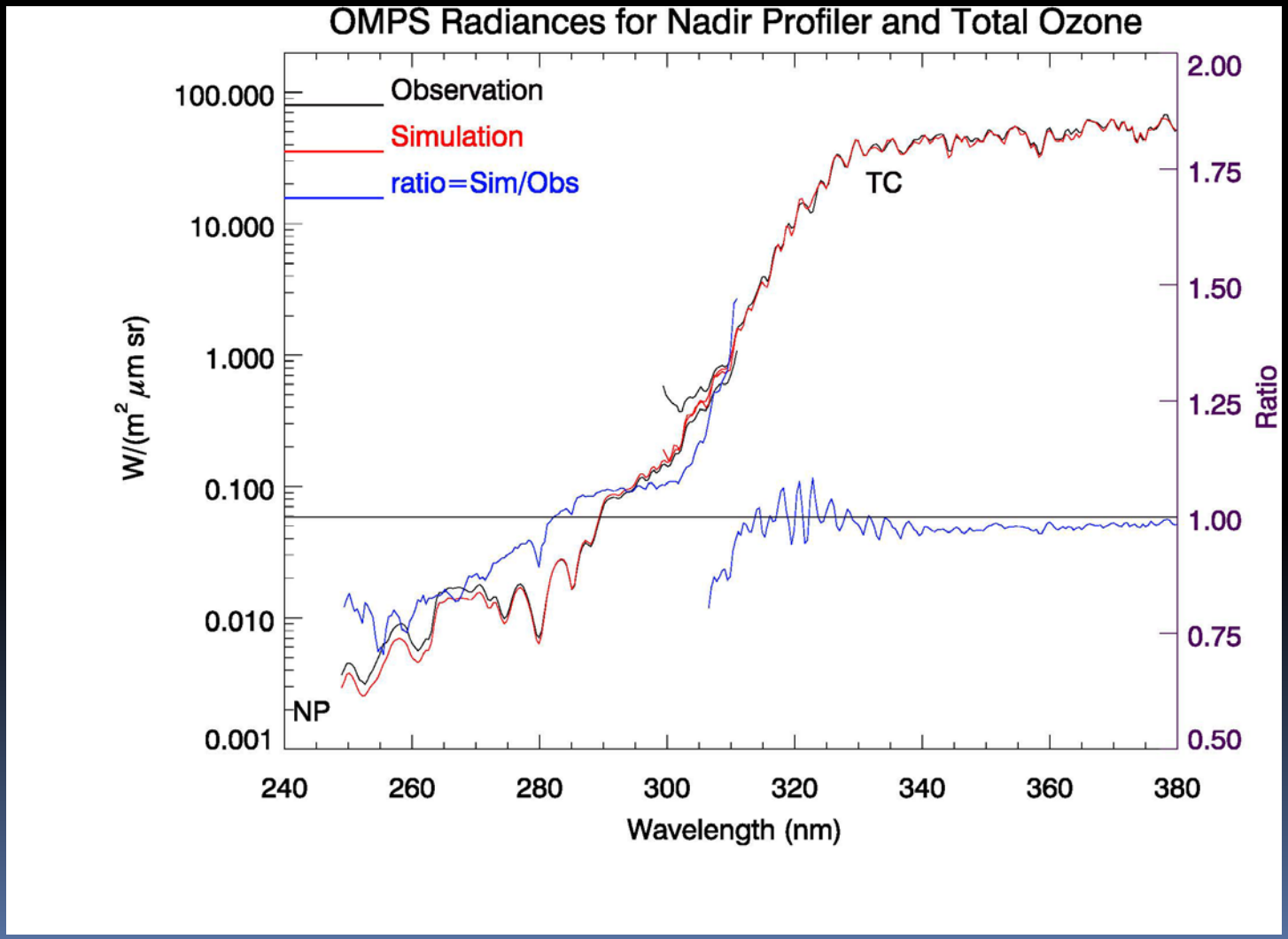


Despite the large FOV difference, the reflectance discrepancies between OMPS NP and band 1B of GOME-2 on METOp-B are within ~10%. For METOp-B band 1A, the discrepancies are a bit larger.

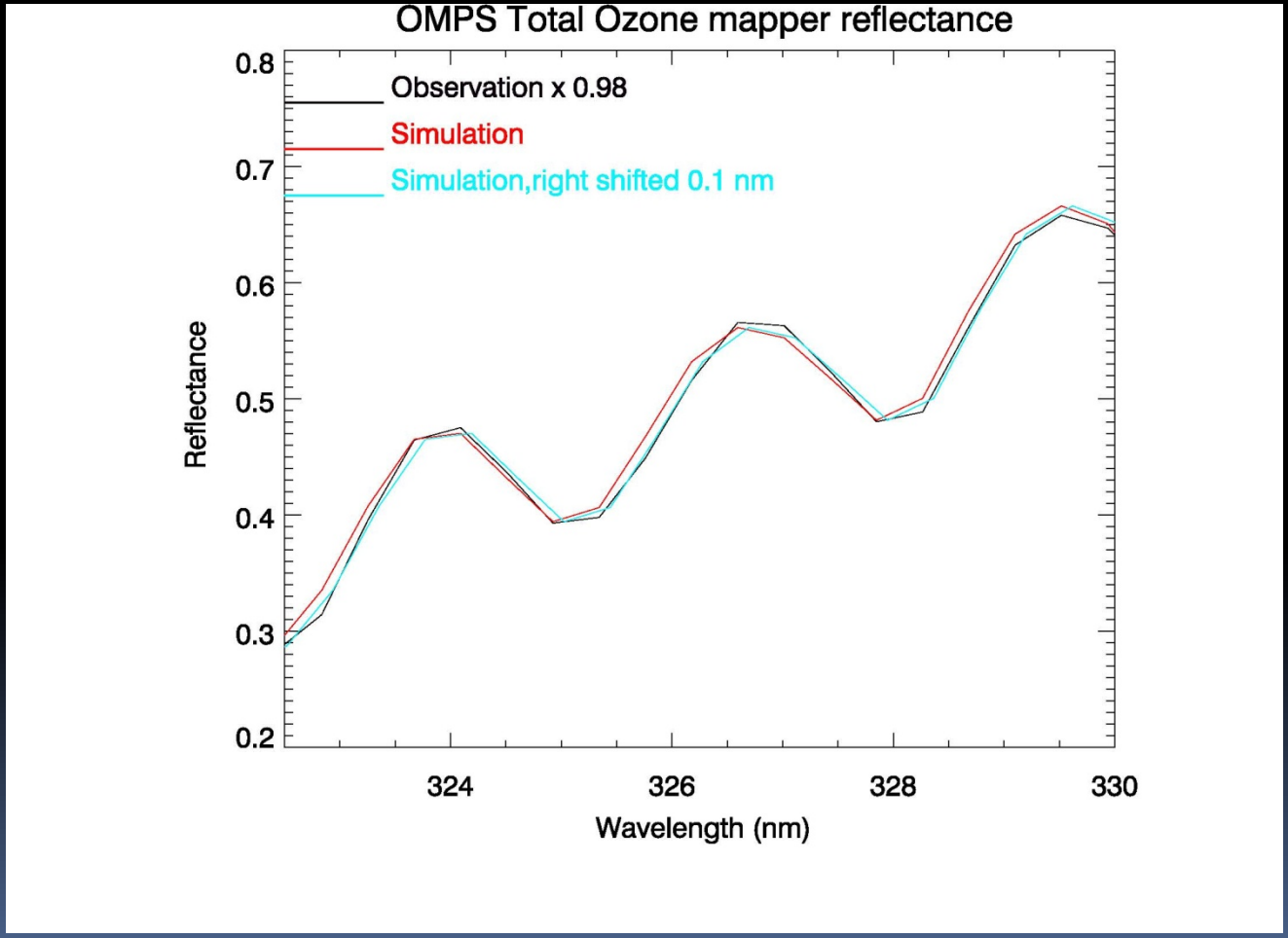
CRTM Simulated GOME-2 METOp-B EV Radiance



CRTM Simulated OMPS NM/NP EV Radiance

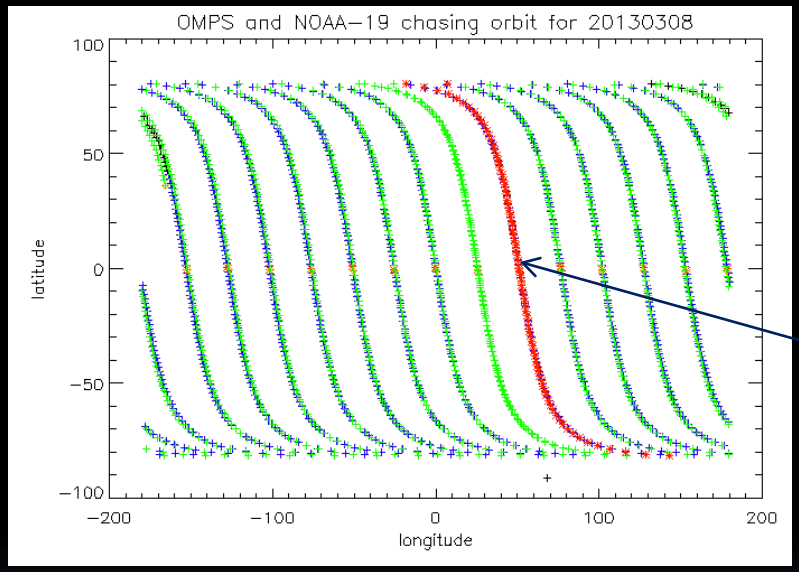


CRTM Simulated OMPS NM Reflectance



Suomi-NPP and NOAA-19 Chasing Orbits

Periodically, the polar orbits of the Suomi-NPP and NOAA-19 spacecraft geographically and temporally align.



This allows measurements from the NOAA-19 Solar Backscatter Ultraviolet Instrument (SBUV/2) and Suomi-NPP OMPS NM/NP to be directly compared.

We define a chasing orbit as: equatorial crossing longitudes within 0.05 degrees, equatorial crossing times within 20 minutes

Chasing Orbit Comparisons on ICVS

Suomi-NPP OMPS NM/NP and NOAA-19 SBUV/2 chasing orbit comparisons are available on the NOAA/STAR Integrated Calibration/Validation System (ICVS) website: http://www.star.nesdis.noaa.gov/icvs/

OMPS Equator crossing date	OMPS crossing time	SBUV/2 crossing time	OMPS crossing longitude(degrees)	SBUV/2 crossing longitude(degrees)
01/28/2012	08:12:21	08:19:03	78.16	78.19
03/29/2012	04:05:05	04:12:34	139.83	139.86
04/10/2012	08:44:08	08:51:56	70.05	70.03
04/22/2012	13:23:10	13:31:14	0.27	0.23
07/16/2012	23:37:28	23:46:17	-153.42	-153.37
08/10/2012	10:37:13	10:45:50	41.77	41.78
08/22/2012*	16:57:48	17:06:35	-53.39	-53.37
09/03/2012	23:18:22	23:27:17	-148.54	-148.51
10/10/2012	20:01:21	20:10:59	-99.30	-99.34
10/23/2012	05:45:07	05:55:30	114.60	114.57
11/16/2012	21:49:31	22:00:05	-126.49	-126.48
11/29/2012	05:51:38	06:02:15	112.98	113.02
12/23/2012	23:37:18	23:48:30	-153.42	-153.44
01/05/2013	07:39:20	07:50:30	86.08	86.11
01/17/2013*	17:22:54	17:34:30	-59.80	-59.83
01/30/2013	03:06:48	03:18:26	154.25	154.24
02/11/2013	12:50:40	13:02:17	8.29	8.34
02/24/2013	00:16:00	00:28:08	-163.02	-163.05
03/08/2013	09:59:52	10:11:51	51.03	51.07
03/20/2013	21:25:13	21:37:34	-120.28	-120.27
04/02/2013	08:50:31	09:03:13	68.42	68.37
04/27/2013	05:59:31	06:12:16	111.22	111.26
05/09/2013*	17:24:43	17:37:43	-60.05	-60.02
05/22/2013	04:49:53	05:03:07	128.69	128.70
06/03/2013*	16:15:00	16:28:24	-42.55	-42.54
08/30/2013	08:39:03	08:53:51	71.68	71.68
09/11/2013	21:45:53	22:00:43	-124.98	-124.94
10/07/2013	01:40:57	01:56:21	176.33	176.33
11/01/2013	05:35:52	05:51:36	117.70	117.71
11/13/2013	20:24:00	20:40:06	-104.28	-104.30
11/26/2013	11:12:20	11:28:28	33.69	33.71
12/09/2013	03:42:19	03:58:48	146.25	146.23
01/28/2014	21:41:51	21:59:15	-123.38	-123.42
02/10/2014*	14:11:43	14:29:07	-10.78	-10.77
04/28/2014	08:25:02	08:43:56	76.35	76.31

*: Data may be affected by SAA

Using max(Δlongitude) = 0.05 degrees and max(Δtime) = 20 minutes, there are 35 chasing orbit comparisons since Jan. 28, 2012

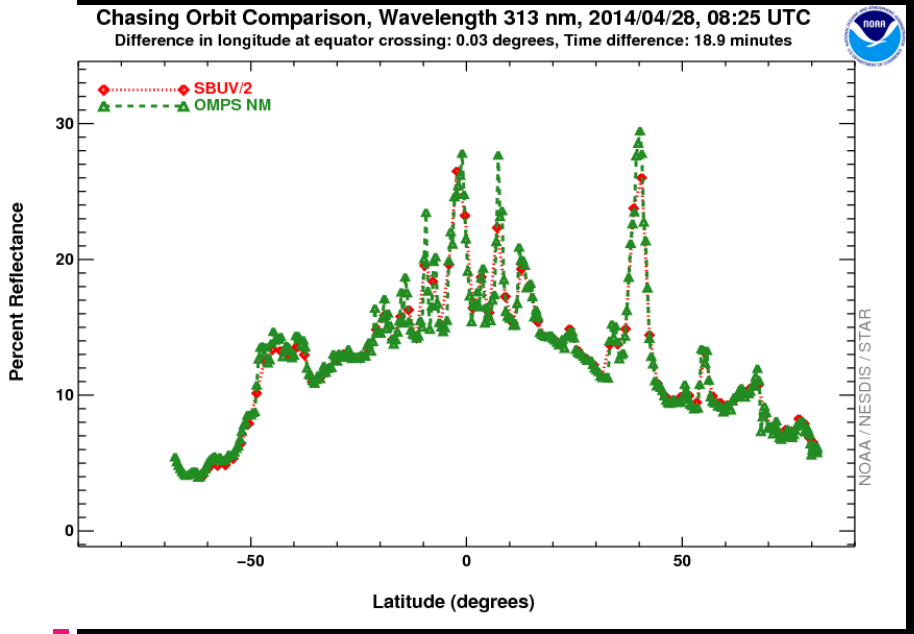
Data Adjustments

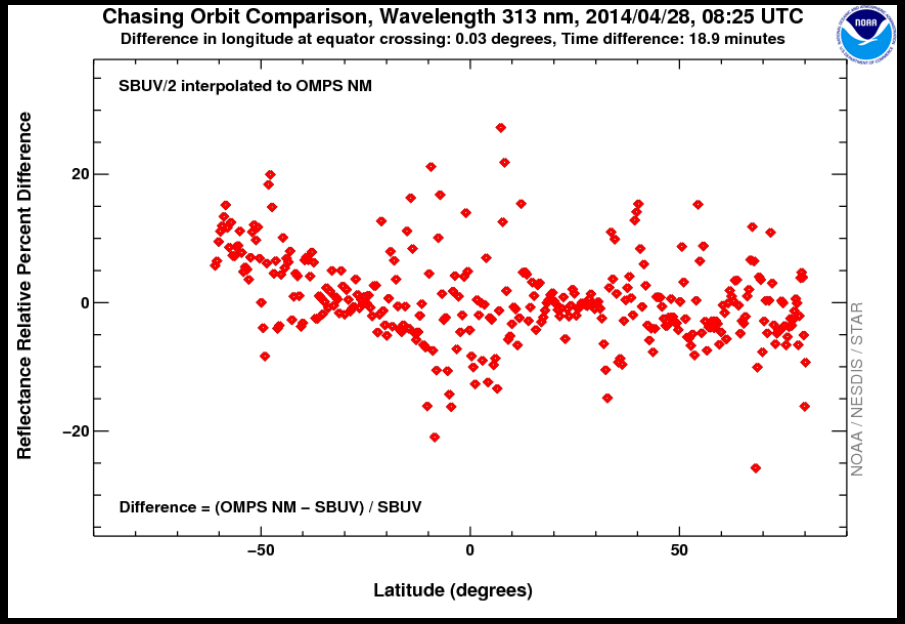
To provide more accurate OMPS-SBUV/2 comparisons:

- The SBUV/2 measurement solar zenith angle and latitude for each channel are interpolated given the SBUV/2 channel scanning scheme
- The NM data are spatially averaged to better match the SBUV/2 spatial footprint (NM cross-track nadir pixel width: ~ 50 km, SBUV/2: ~160 km)
- For relative difference comparisons, the SBUV/2 data are spatially interpolated to match the OMPS latitudes
- All measurements are converted to reflectance (albedo)

Most recent Chasing Orbit: April 28, 2014

OMPS Nadir Mapper:





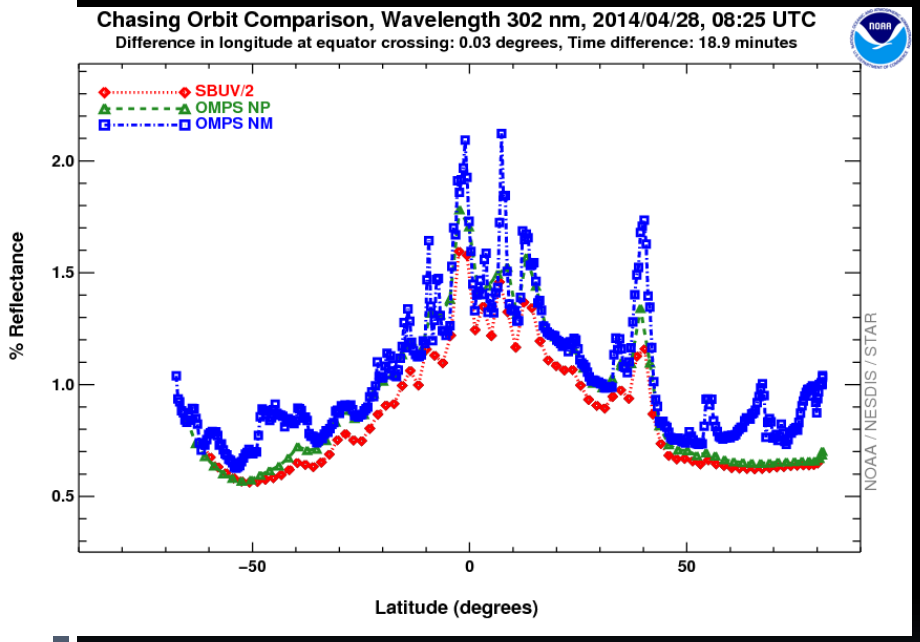
Reflectance

OMPS NM Difference Relative to SBUV/2

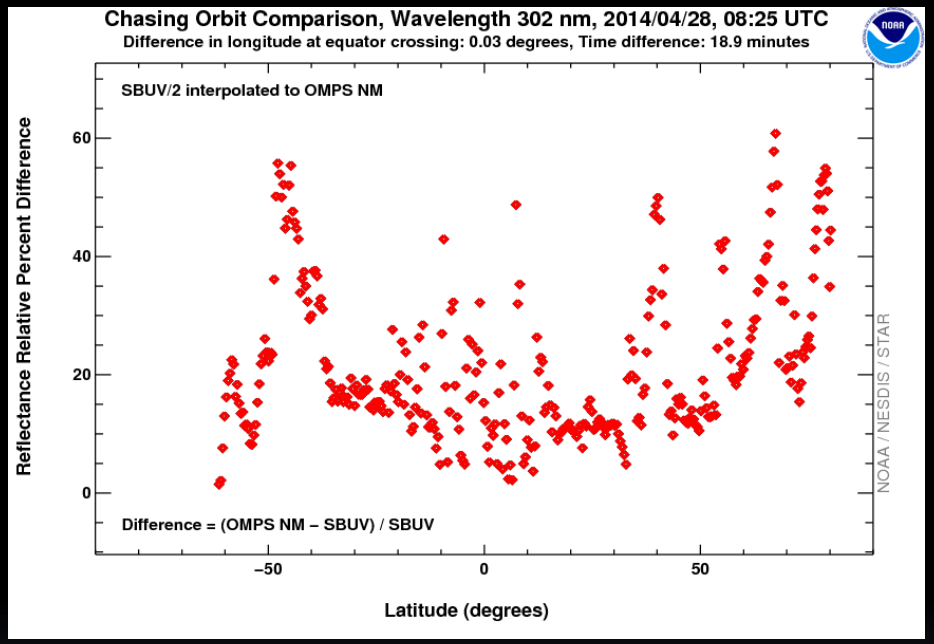
Differences generally within +/- 10%: true for SBUV/2 channels 8-12 (306 nm – 343 nm)

Most recent Chasing Orbit: April 28, 2014

OMPS Nadir Mapper @ SBUV/2 Channel 7 (302 nm):



Reflectance

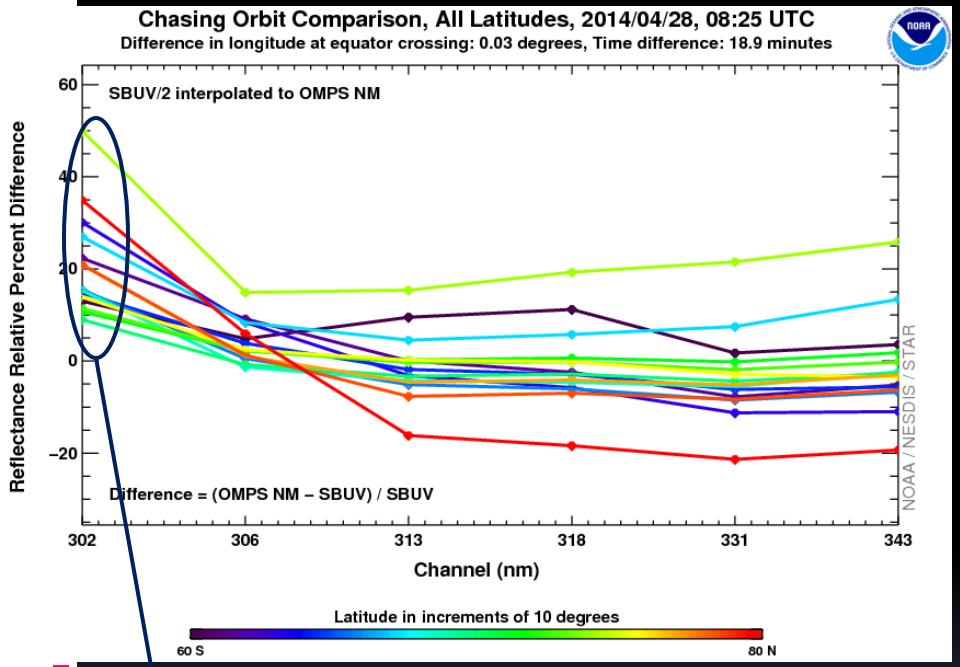


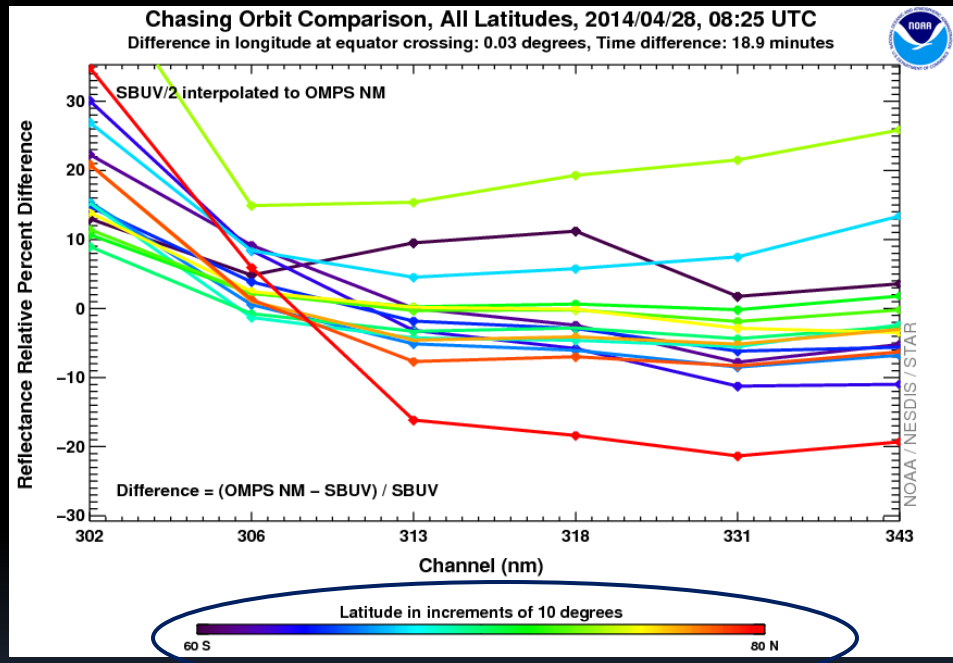
OMPS NM Difference Relative to SBUV/2

Large differences: thought to be due to NM stray light contamination, for which a correction will be implemented soon

Most recent Chasing Orbit: April 28, 2014

OMPS Nadir Mapper, all channels:



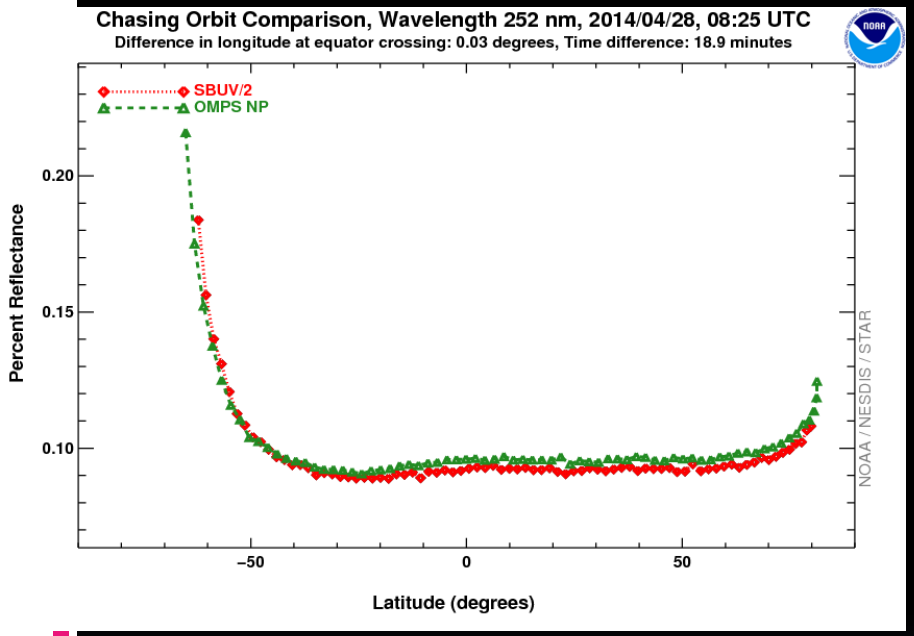


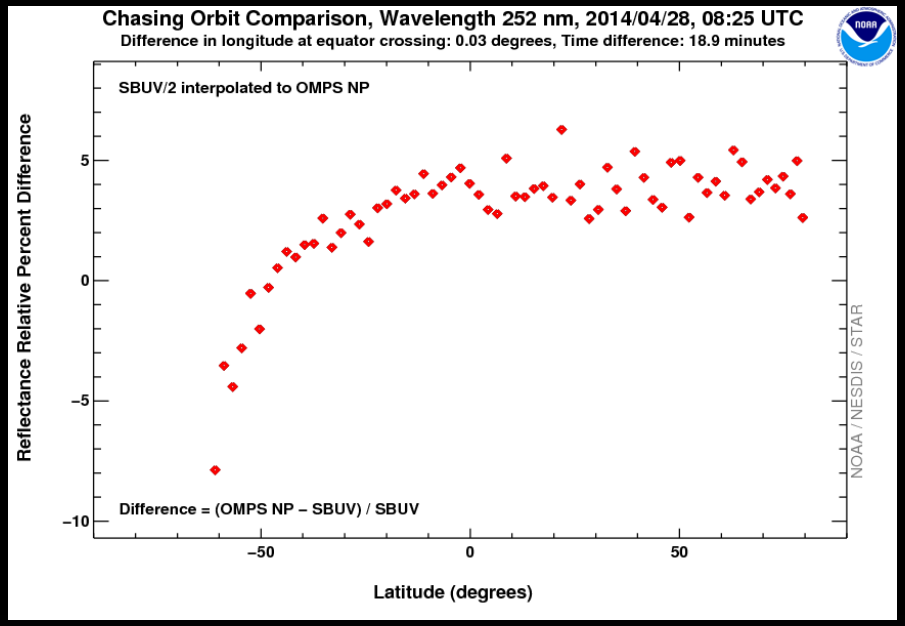
As mentioned before, large differences @ SBUV/2 Channel 7 (302 nm)

Color indicates latitude

Most recent Chasing Orbit: April 28, 2014

OMPS Nadir Profiler:





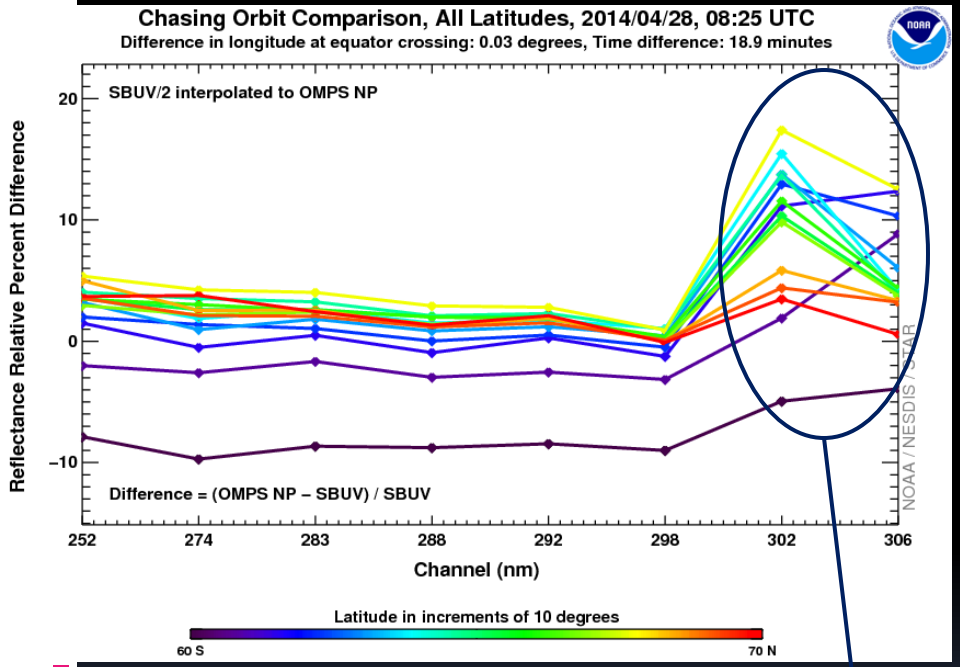
Reflectance

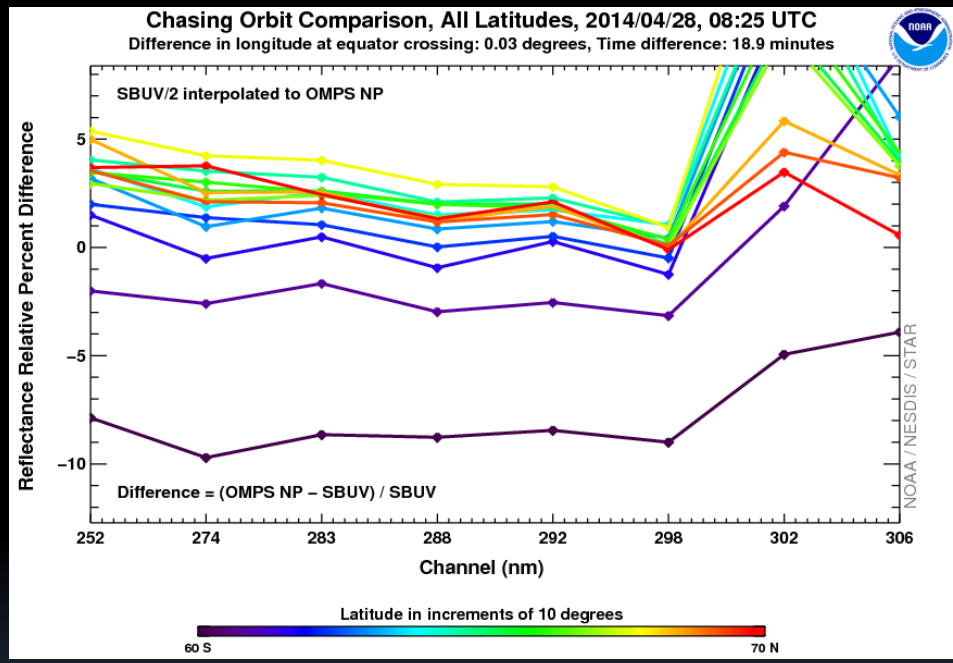
OMPS NP Difference Relative to SBUV/2

Differences within +/- 10%: true for SBUV/2 channels 1-6 (252 nm – 298 nm)

Most recent Chasing Orbit: April 28, 2014

OMPS Nadir Profiler, all channels:





Large differences @ SBUV/2 Channels 7 and 8 (302 and 306 nm)

Thought to be due to NP stray light, as well as a shift in the dichroic filter. Corrections will be implemented for these issues.

Chasing Orbit Results

Results from April 28, 2014 are typical of results from other recent chasing orbits:

- NM, 306 – 343 nm: differences generally within +/- 10%
- NM, 302 nm: large differences (10-50%), thought to be due to stray light contamination, for which a correction will be implemented
- NP, 252 – 298 nm: differences within +/- 10%
- NP, 302 - 306 nm: larger differences (10-15%), thought to be due to dichroic shift and stray light, for which corrections will be implemented

Provided differences are relative to SBUV/2 measurements

Conclusions

- Comparisons with radiance from other sensors or radiative transfer model provide additional means of evaluating OMPS SDRs.
- None of the sensors needs to be perfect or superior. The assumption is that there errors are independent of each other so proper interpretation of the differences may reveal issues on either side.
- These tools will be further developed and used for S-NPP & J1.