



Performance of the Suomi-NPP OMPS Limb Profiler



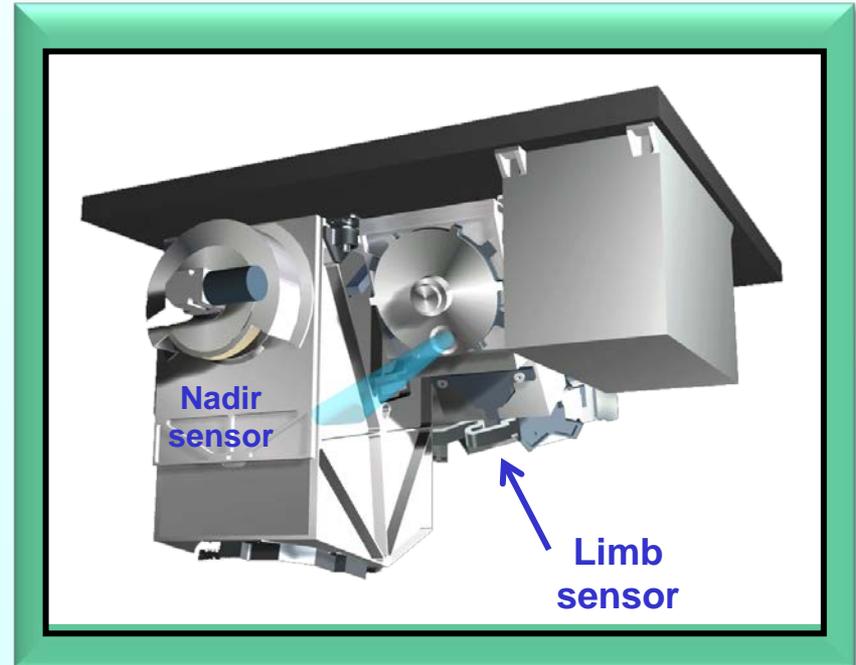
Ghassan Taha¹, Glen Jaross², P.K. Bhartia², and the OMPS calibration team³

1-Universities Space Research Association and NASA GSFC

2-NASA Goddard Space Flight Center

3-Science Systems & Applications, Inc.

OMPS
Ozone Mapping and
Profiler Suite



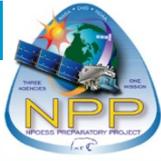
SNPP Launch
October 28, 2011



Courtesy of Ball Aerospace and Technology Corporation



OMPS Limb sensor



Limb Profiler

Heritage: SOLSE / LORE, OSIRIS, SCIAMACHY, GOMOS

Wavelength: 280 –1000 nm

Vertical range: 105 km (5 - 80 km consistently)

Vertical Sampling: 1 km

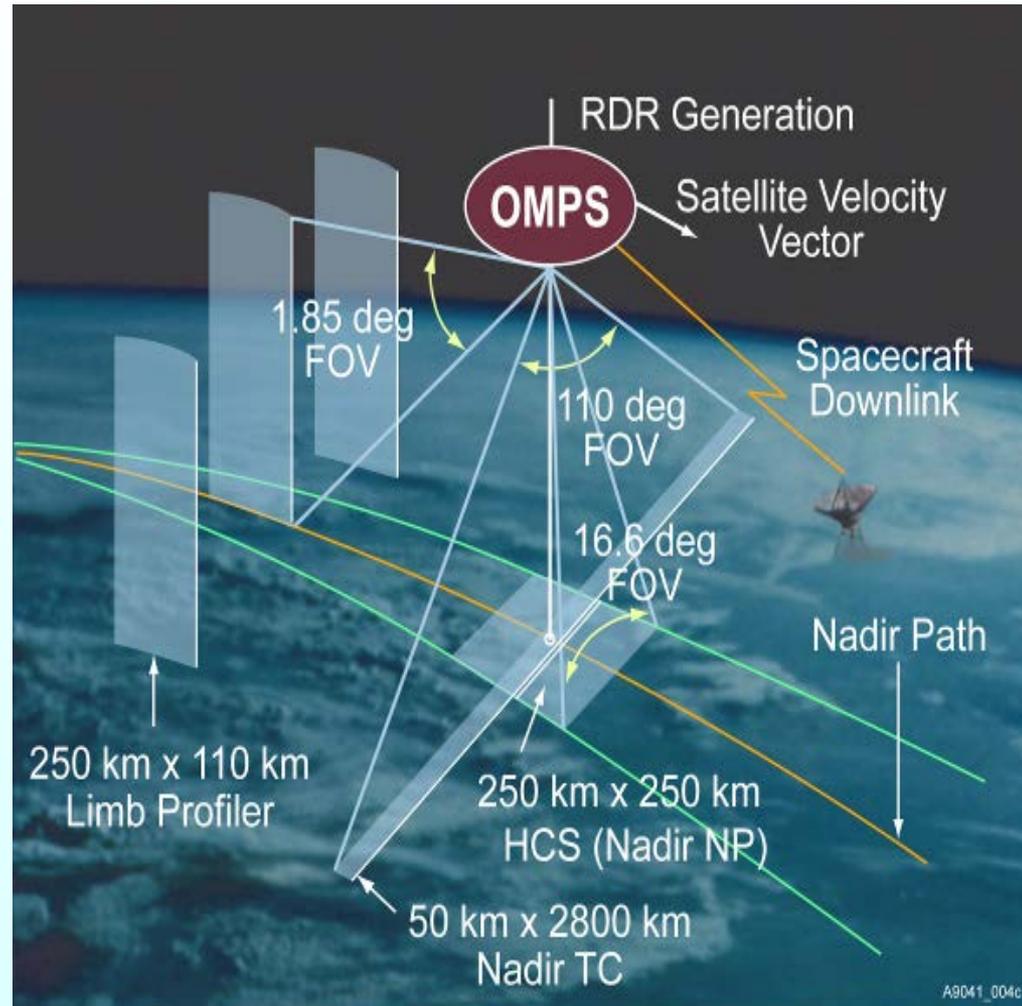
Vertical resolution: ~2 km

Along-track sampling: 125 km

Detector: 0.25 megapixel CCD at -45 °C

Known sensor challenges

- *Pointing*
- *Internal stray light*
- *Gain matching*

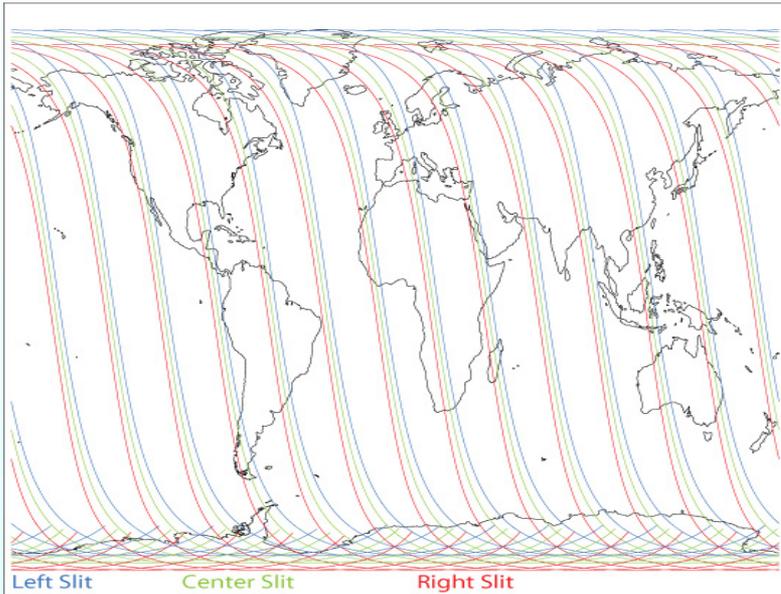




OMPS Limb data coverage



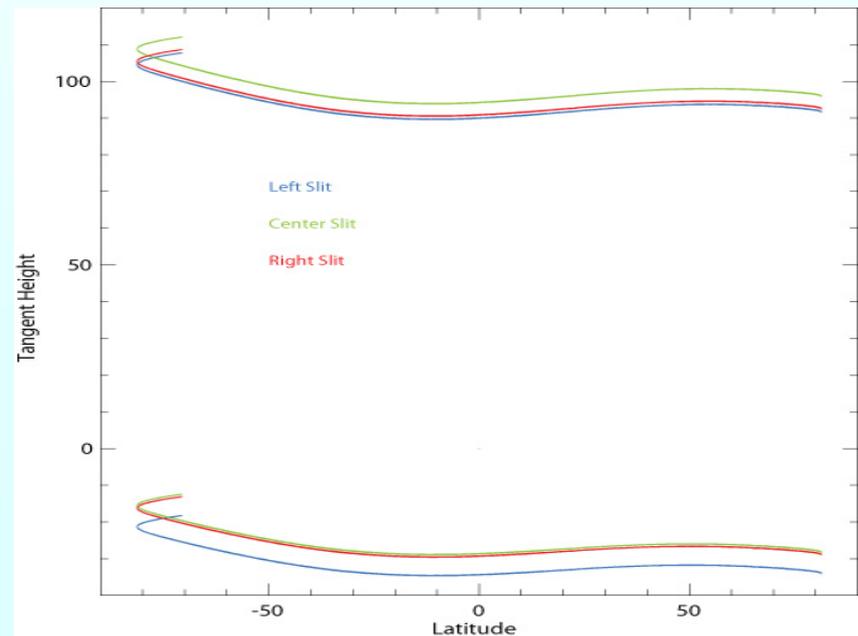
Daily Ground Track (typical)



Local Time at Ascending Node : 1335

Max. solar zenith angle: 100 deg.

Vertical Range

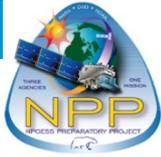


Vertical coverage governed by

- Time of year
- Geodetic pointing of satellite

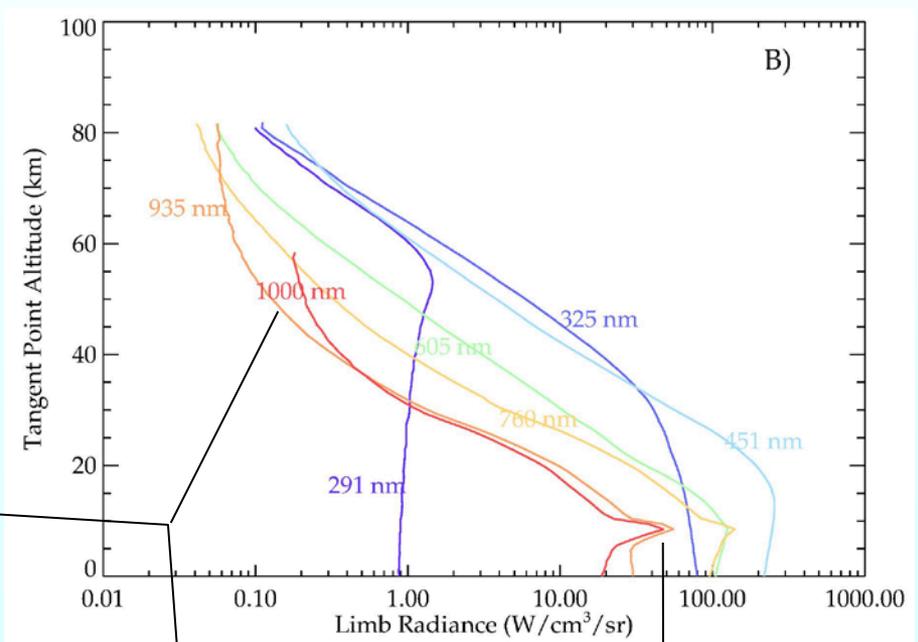
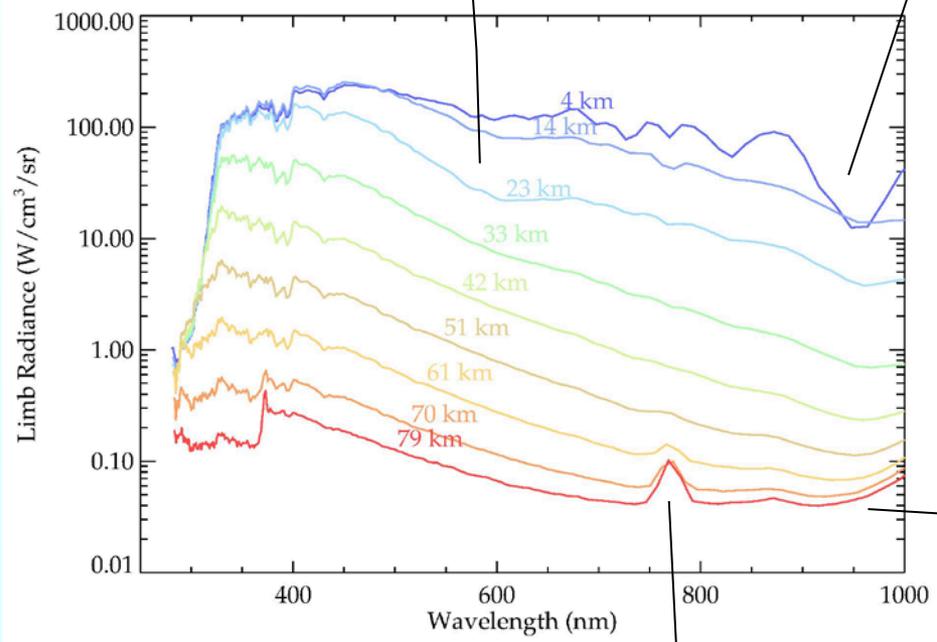


Typical Radiance Profiles



O absorption

H₂O absorption



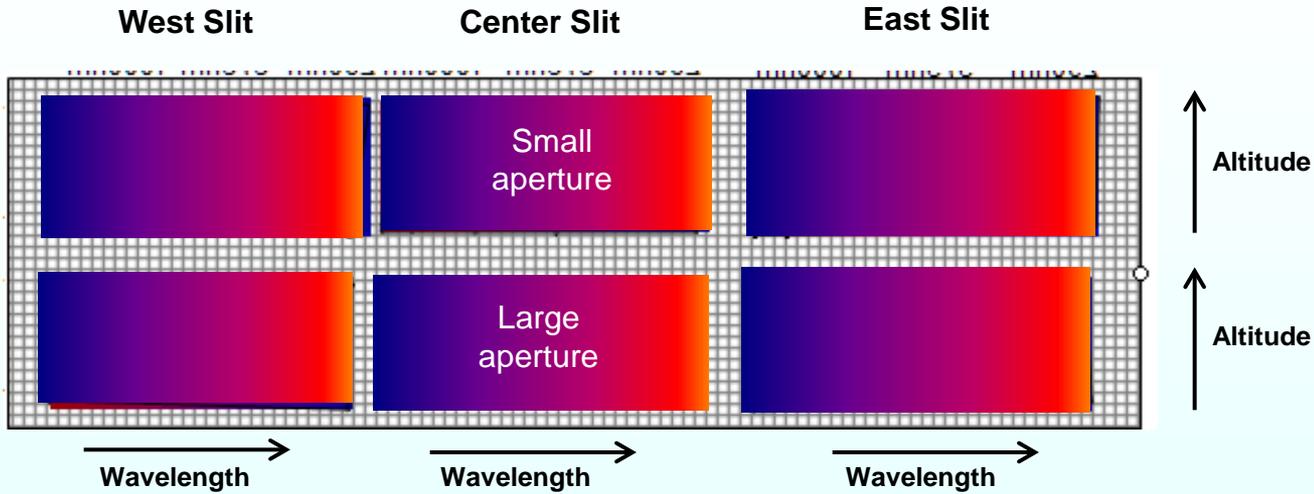
O A-band emission

Stray Light

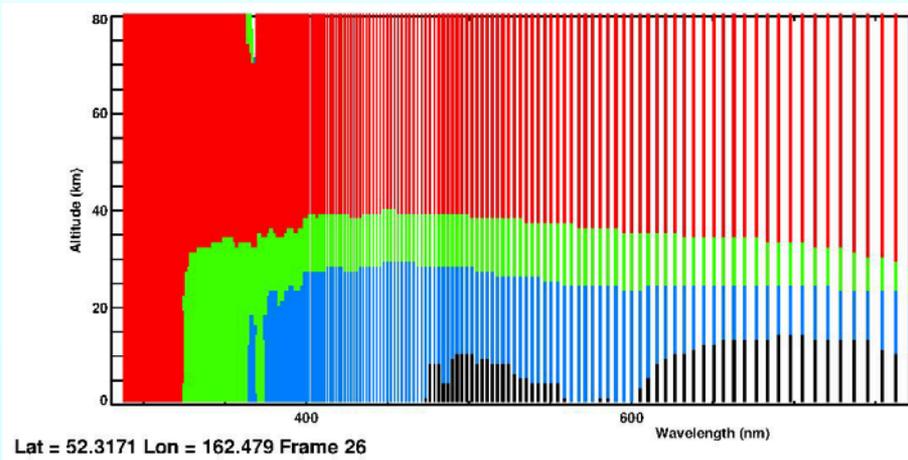
Cloud



6 images collected on CCD detector



Each image collected twice:
Long = 1.25 sec
Short = 0.04 sec
Uploaded sample table
control downloaded
pixels



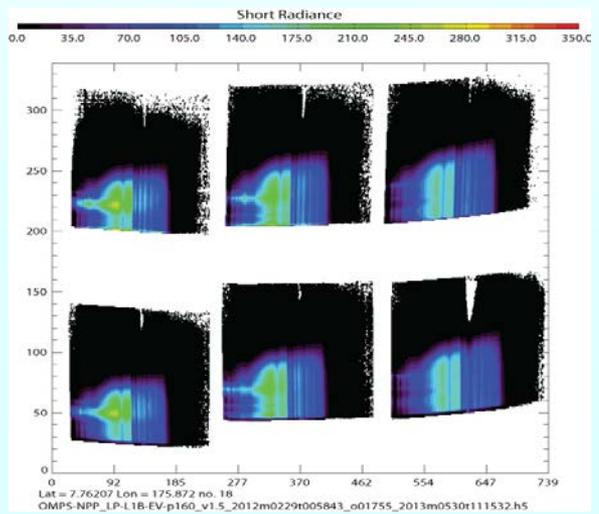
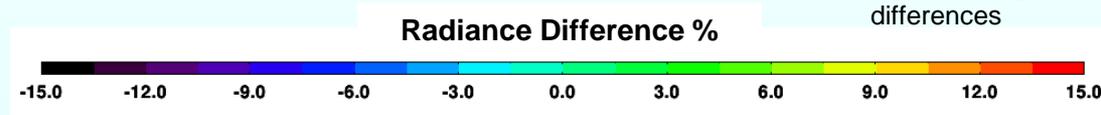
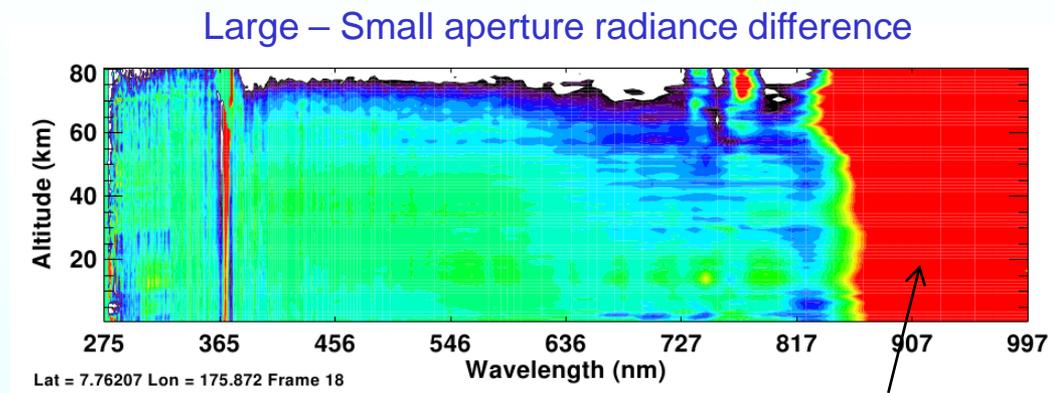
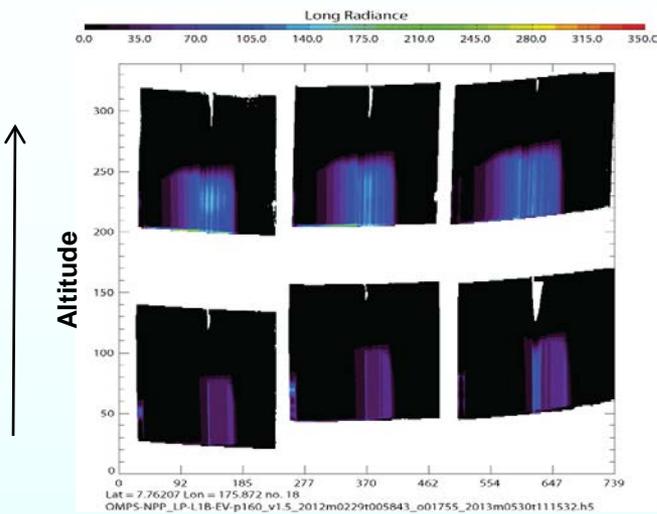
Gain 1 = 140
Gain 2 = 31
Gain 3 = 4.5
Gain 4 = 1

14-bit A/D converter

**Total detector dynamic range $\approx 2 \cdot 10^6$
(need 10^4)**



Radiances from different apertures never match



Small aperture (LG)

Large aperture (HG)

- Solution:
- large aperture only for UV
 - small aperture only for VIS
 - small aperture only for IR

We trade mid-altitude S/N for smoother gain transitions

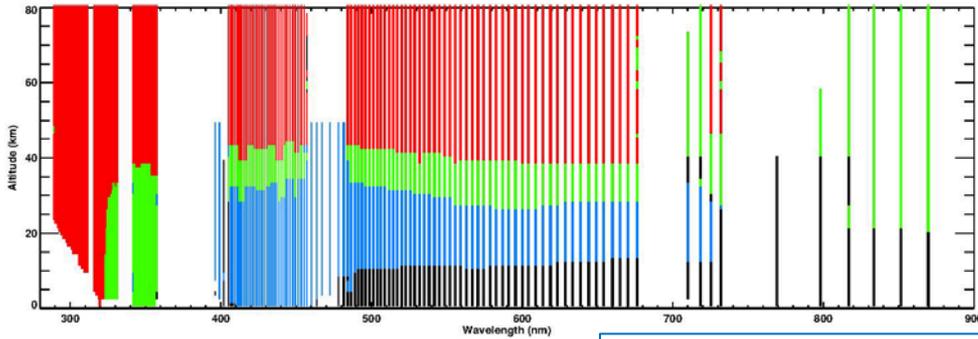




Sample Table and Consolidation



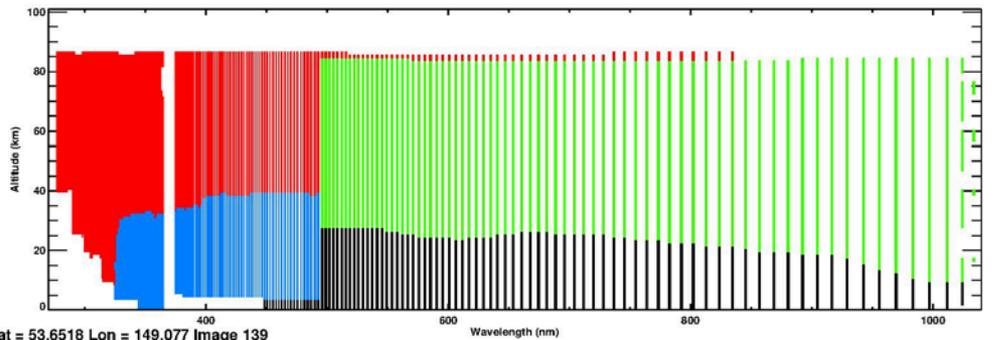
Sept. 14, 2012



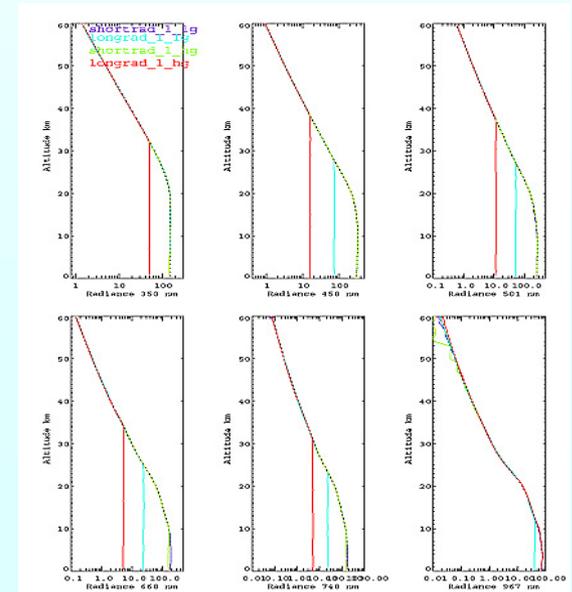
Old Sample Table
Old consolidation scheme

Radiances are gridded and consolidated using the 4 images, so as to maximize signal SNR and avoid signal saturation

Mar. 14, 2014

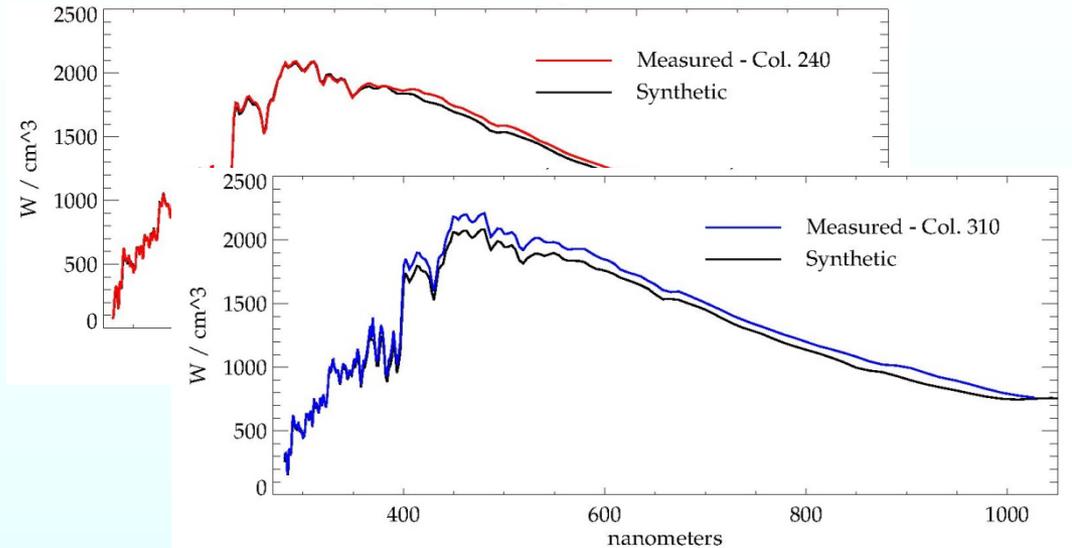


New Sample Table
Large Aperture: UV
Small Aperture: VIS/IR



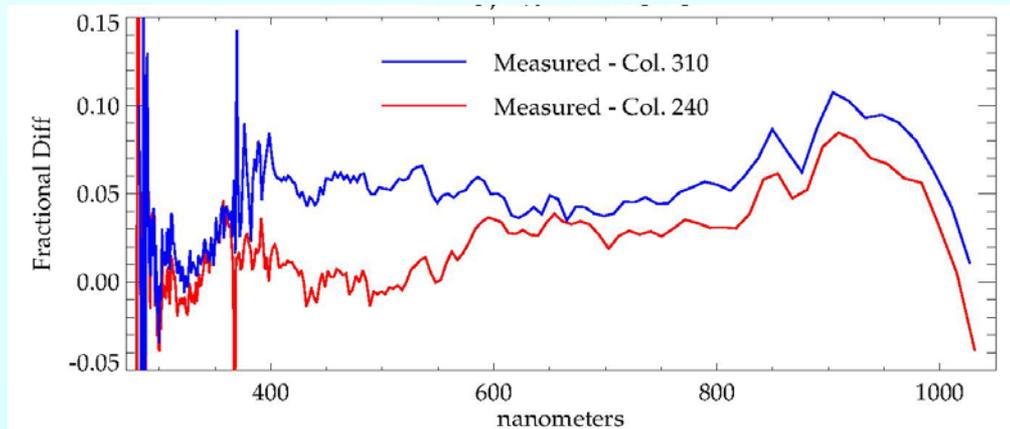


Solar measurements used for spectral calibration and to monitor sensor changes



600 OMPS solar spectra
(1 for each spatial location)
are measured every week

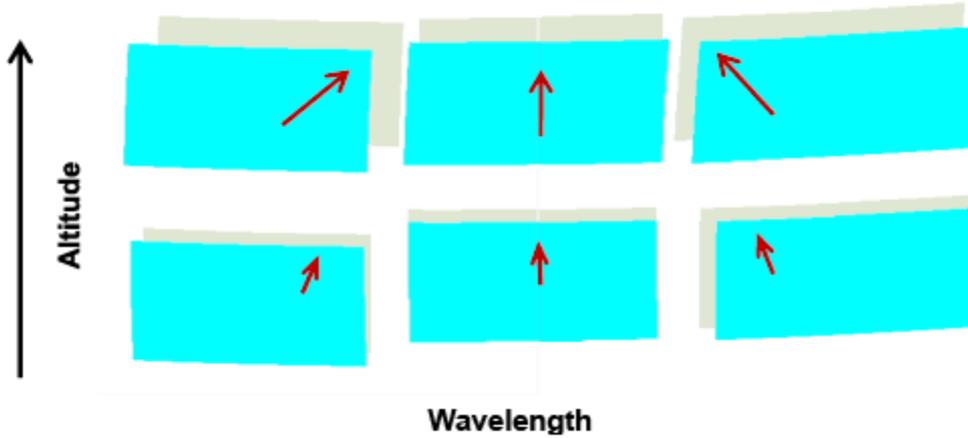
OMPS compared to SUSIM-based spectrum



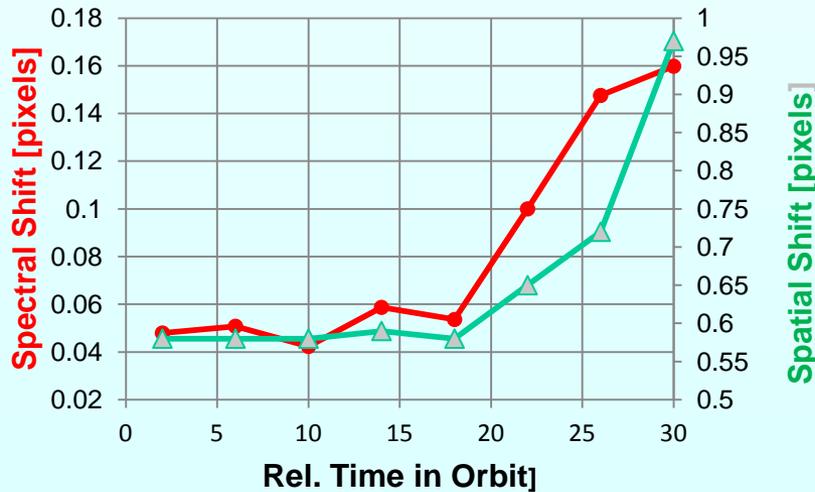
Spatial variations are
indicative of radiance
calibration errors at
different tangent heights



Thermal sensitivity of instrument



Images shift on focal plane as sun heats the sensor. Wavelength and vertical pointing shift every orbit.



Seasonal variation in wavelengths follows the solar azimuth

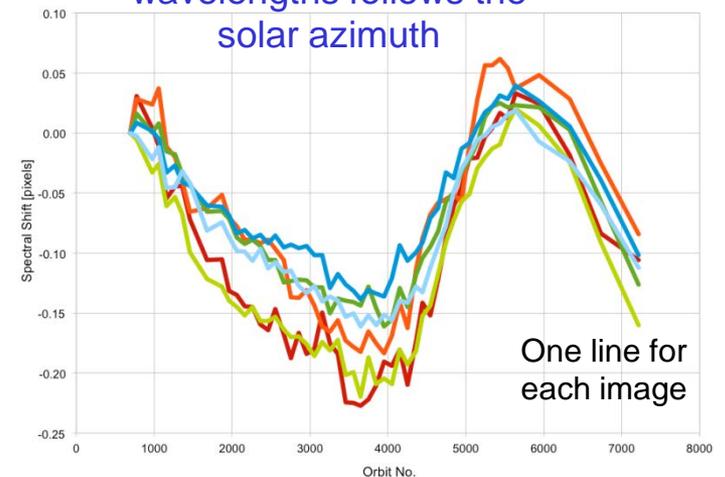
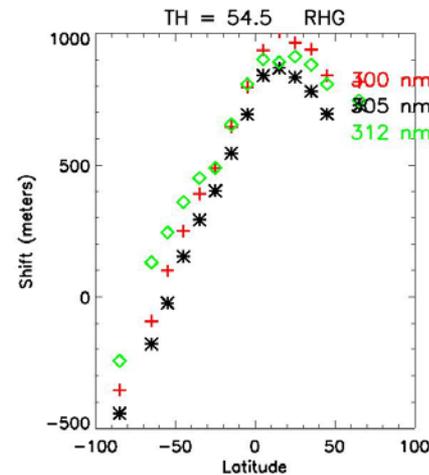
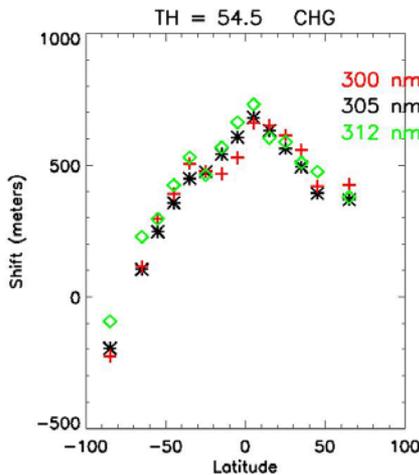
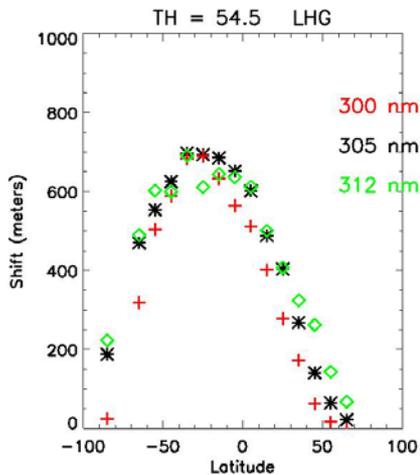
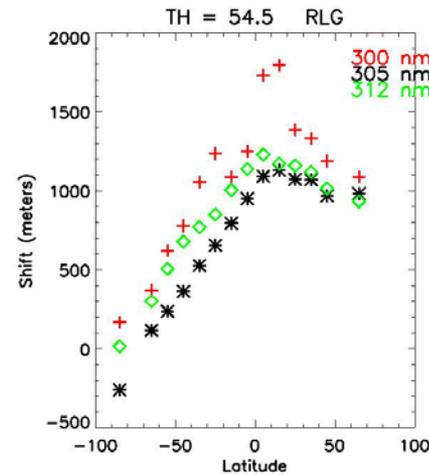
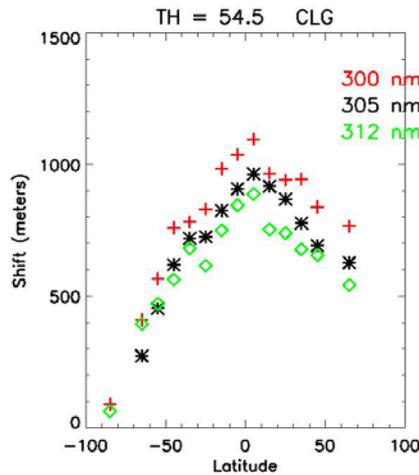
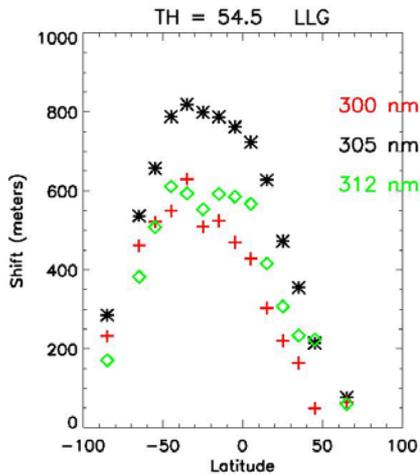




Image tangent height shift



Shift is calculated by comparing to MLS-derived model calculation

Errors are relative to offsets from pre-launch pointing -

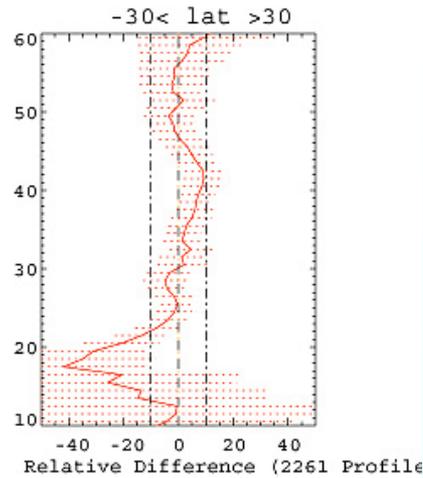
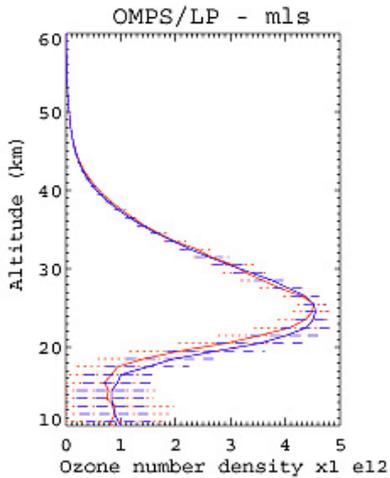
Left: 1450 m

Center: 1750 m

Right: 2600 m



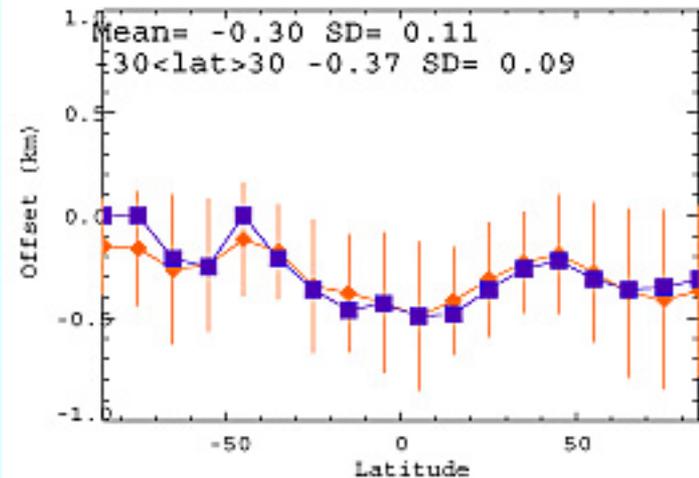
Tangent height offset



Tangent Height offset is estimated through comparison with MLS ozone profile

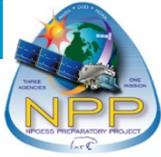
Comparison show clear TH offset signature

Using a full year data (2012), we can derive zonal mean time series of the TH offset ~0.2-0.5 km

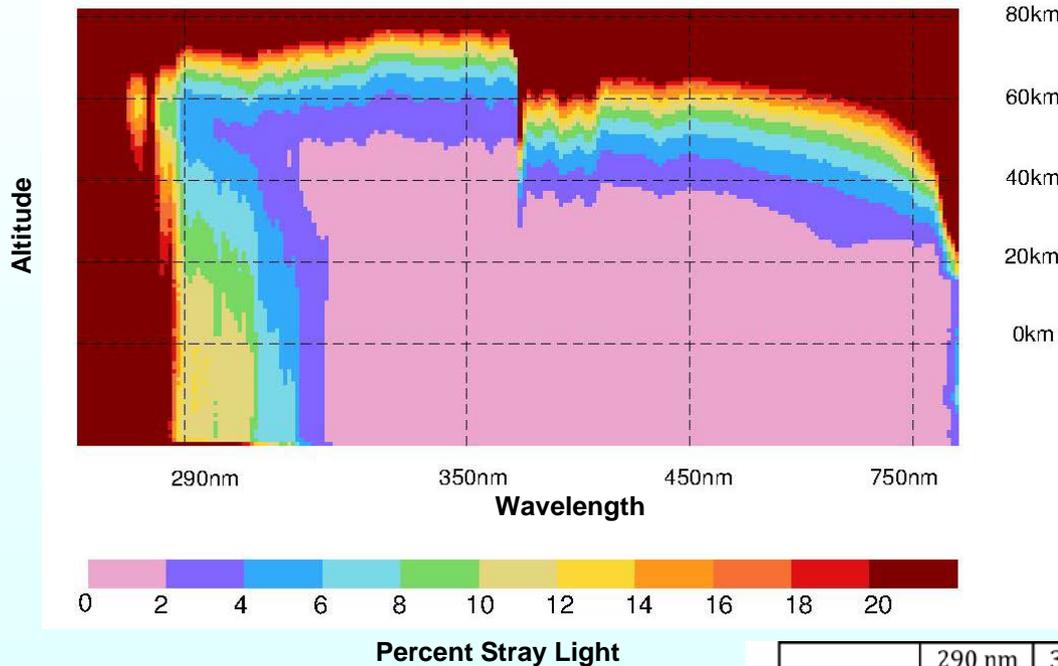




Stray light corrections



Computed stray light as fraction of measured radiance



Stray light corrections based on preflight instrument characterization

Stray light is mainly a high altitude problem

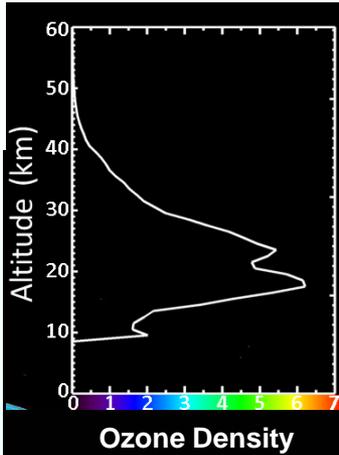
1 μ m has large stray light at all altitudes

Percent Stray Light at 65 km (east, center, west)

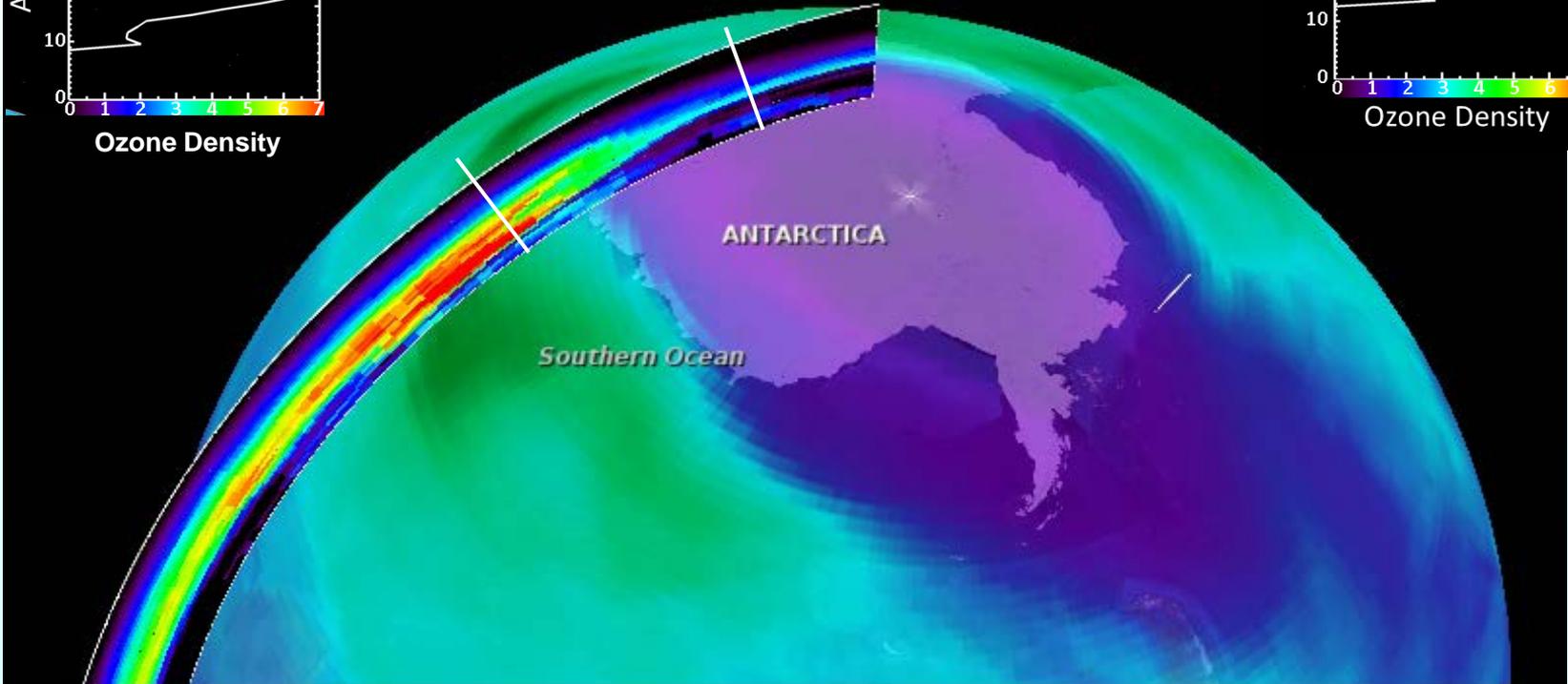
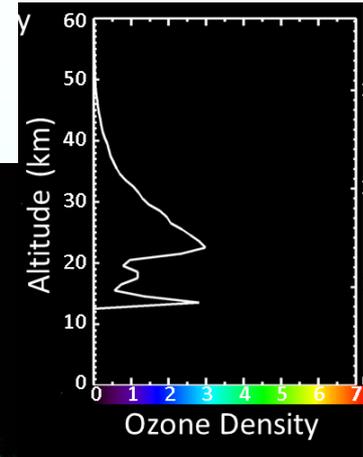
	290 nm	302 nm	310 nm	320 nm	353 nm	500 nm	602 nm	750 nm
Before	9.4	10.4	8.3	7.0	5.1	18.3	23.8	34.2
Correction	10.8	11.3	8.9	7.5	5.8	20.3	26.6	36.7
	13.1	15.7	12.1	11.6	10.7	34.2	45.1	49.9
After	-	0.3	0.3	0.2	0.3	1.6	2.3	4.0
Correction	1.3	1.0	0.6	0.5	0.8	2.0	3.0	-5.1
	1.5	1.1	0.9	0.7	0.6	4.0	5.6	6.6



OMPS Limb data available Nov. 1 at <http://ozoneaq.gsfc.nasa.gov/omps>



October 4, 2012





Extra slides

