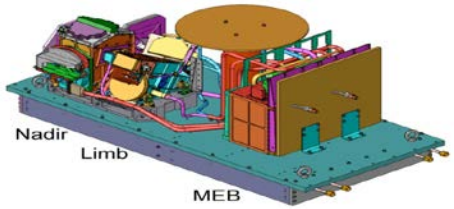
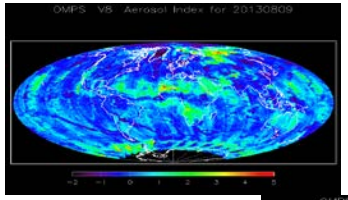
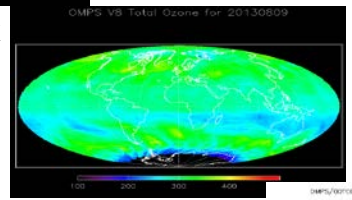
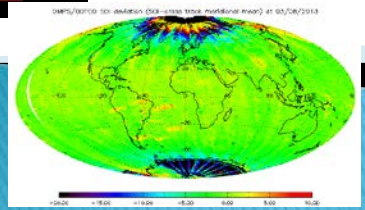




Aerosol Index



Ozone map



So2 index

S-NPP Ozone Mapping Profiler Suite (OMPS) Nadir System Calibration

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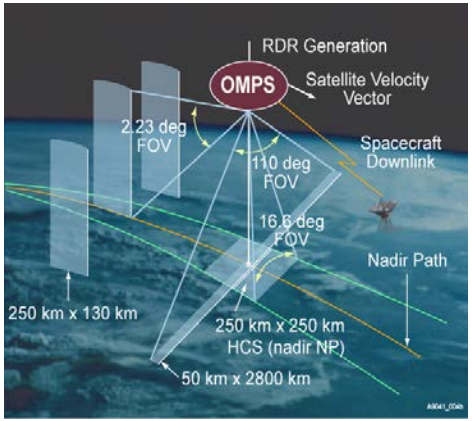
Introduction

- OMPS, as a part of the US (Joint Polar Satellite System) JPSS mission, is flying on the Suomi National Polar-Orbiting Partnership (SNPP) satellite.
- OMPS carries on a long tradition of space borne measurements of O3.
- OMPS consists of advanced hyper-spectral instruments that continue the heritage of the Solar Backscatter Ultraviolet (SBUV and SBUV/2) and Total Ozone Mapping Spectrometer (TOMS).
- OMPS provides improved vertical resolution of O3 data products. OMPS also helps produce better ultraviolet index forecasts.
- The scope of this presentation is limited to the in-flight performance of the OMPS Nadir sensors.

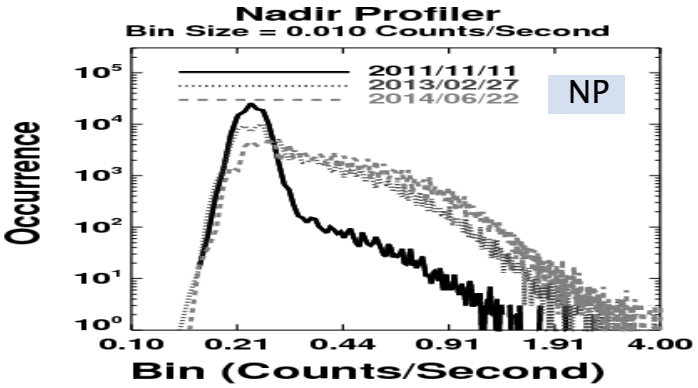
Instrument Overview

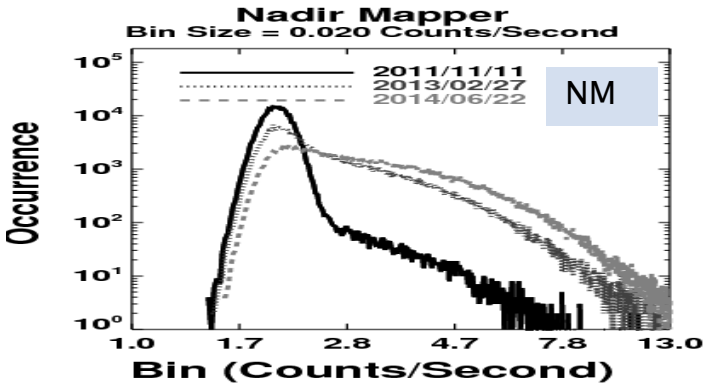
- **Resolution**
  - Provides Total Column ozone data w/ 50x50 km FOV at nadir
  - Provides ozone profiles in a single ground pixel of 250x250 km at nadir
- **Configuration**
  - Push-broom 110 deg. cross-track FOV telescope
  - Two grating spectrometers
    - » NM covers 300 nm to 380 nm
    - » NP covers 250 nm to 310 nm
  - CCD optical detector for each spectrometer
- **Onboard Calibrators**
  - Light-emitting diode provides linearity calibration
  - Reflective solar diffuser maintains calibration stability
- **Products**
  - Provide globe maps every 24 hours of amount of ozone and volumetric concentration in a vertical column of atmosphere with a 4- days revisit

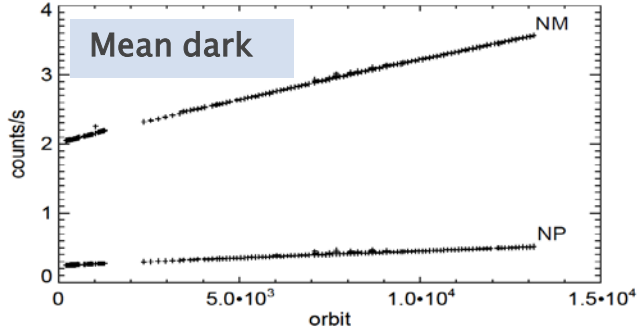


Spatial resolution can be altered to provide a smaller ground FOV that has a higher spatial resolution.

Change in Dark Current, as Expected

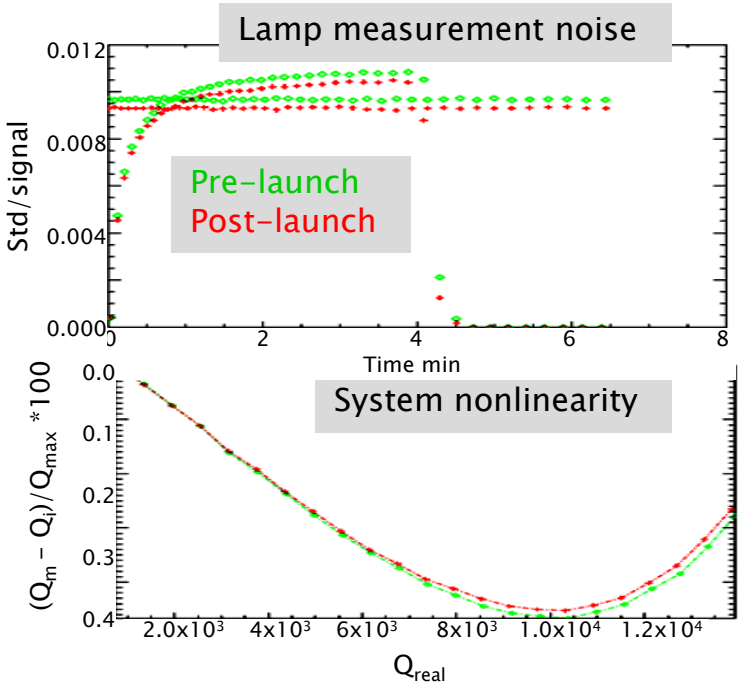






- Dark current results from thermally generated electrons that adds a systematic bias.
- Weekly increase in mean: ~0.6% for NM and 0.8% for NP, resulting in uncertainties ~0.03% for NM and 0.1-0.5 % for NP.

System linearity is stable



It is a linear relationship between the incident photon number and the analog/digital converter (ADC) output.

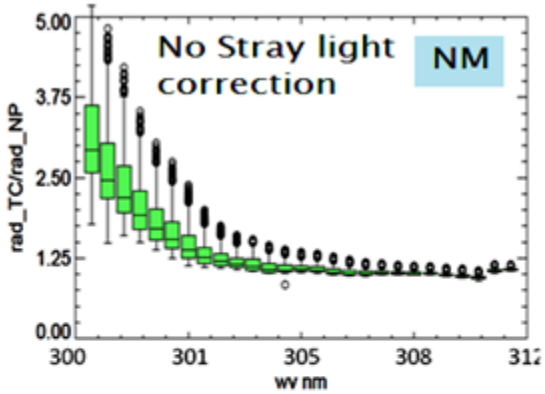
The nonlinearity is about 0.39 for the NM and is 0.32 for the NP.

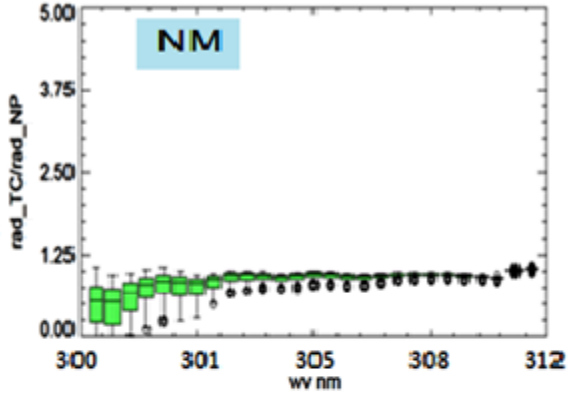
$$\eta = (Q_m - Q_i) / Q_{\max}$$

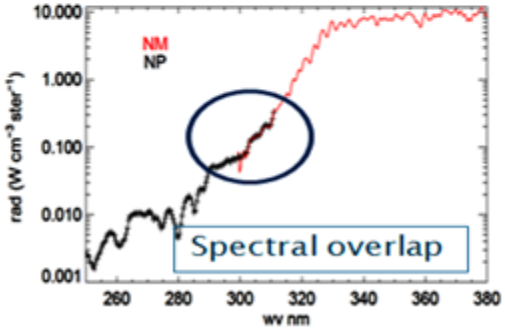
where Q_m is the measured response to a LED measurement input, Q_i is the ideal response to the Q_m, and Q_{max} is the full well response.

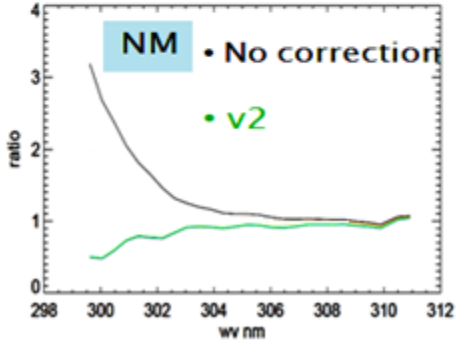
Stray light correction improves EV radiance

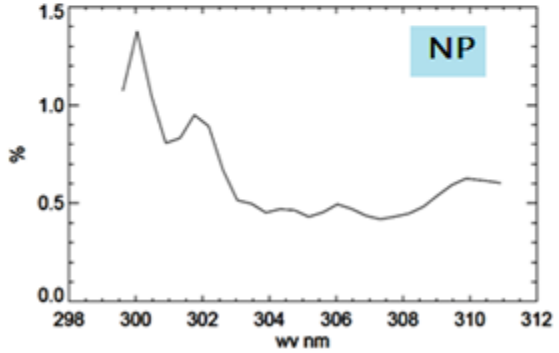
- A comparison was made in radiance between NM and NP (300-310 nm).
- Calibration table was derived by NASA.
- Improvements are up to 2.6% for NM and i.5 % for NP.



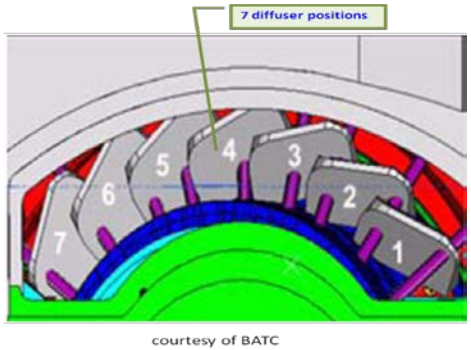




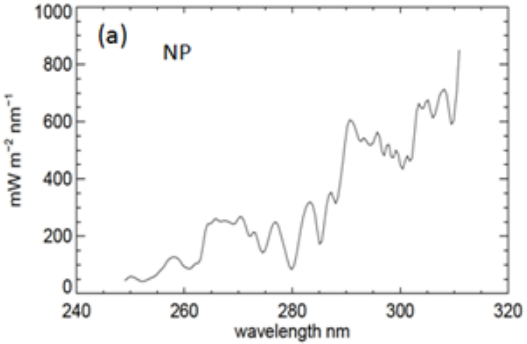


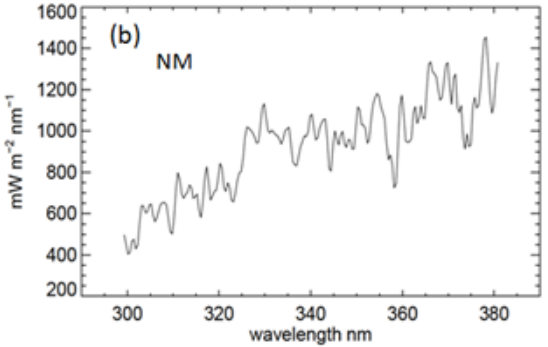


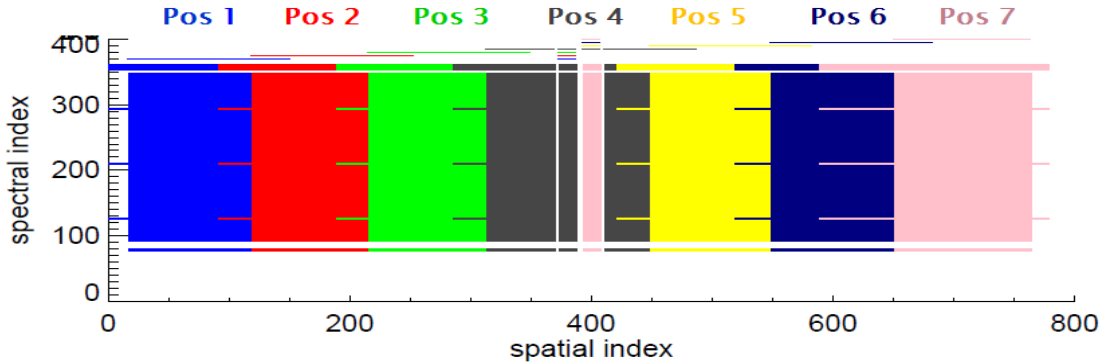
Solar irradiance measurements



courtesy of BATC

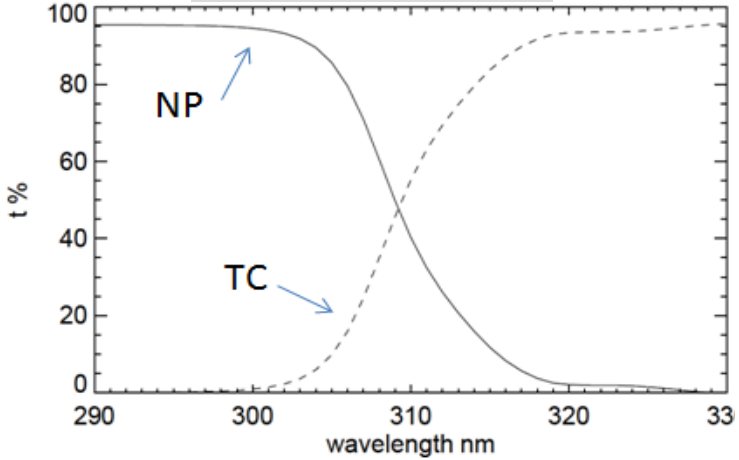




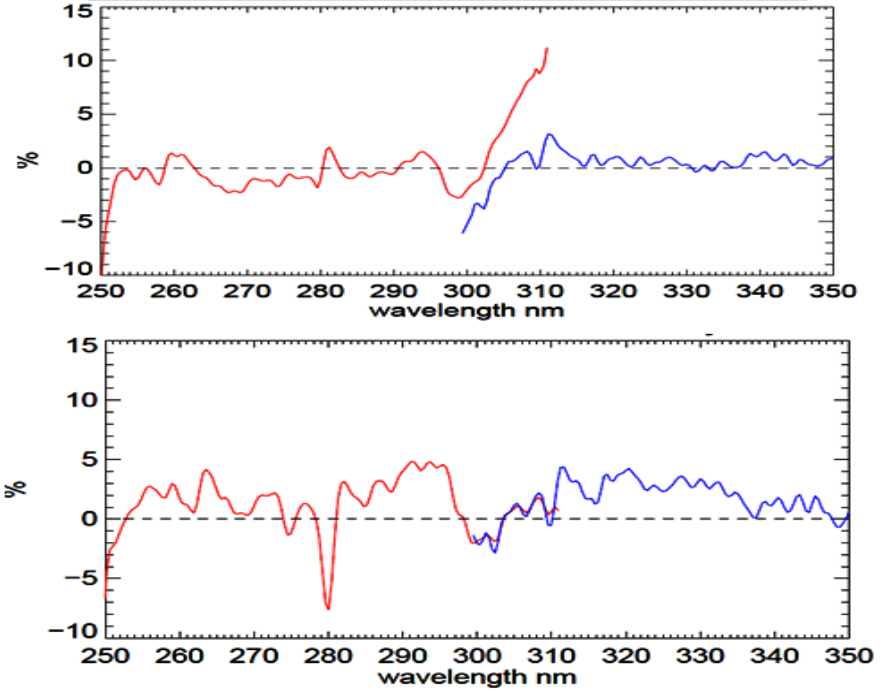


Wavelength changed ~ 0.1 nm from ground to orbit

Percent transmittance

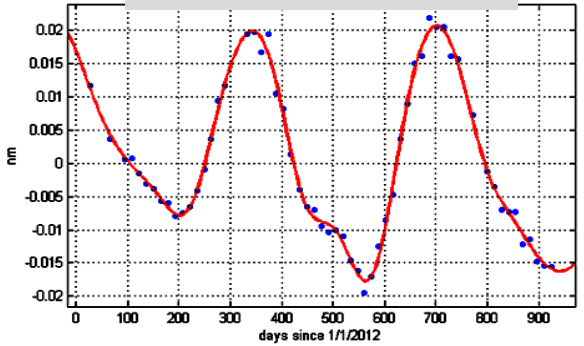


Measured vs. Synthetic Solar Flux

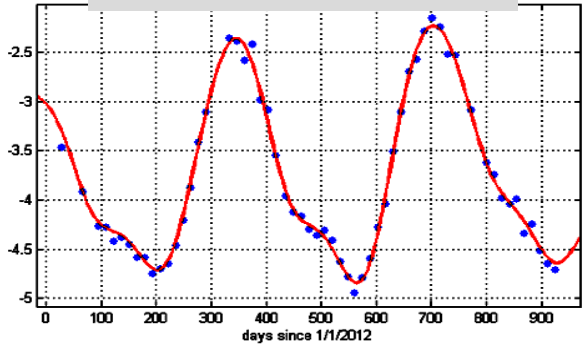


Orbital wavelength changes from solar view

Wavelength variation nm

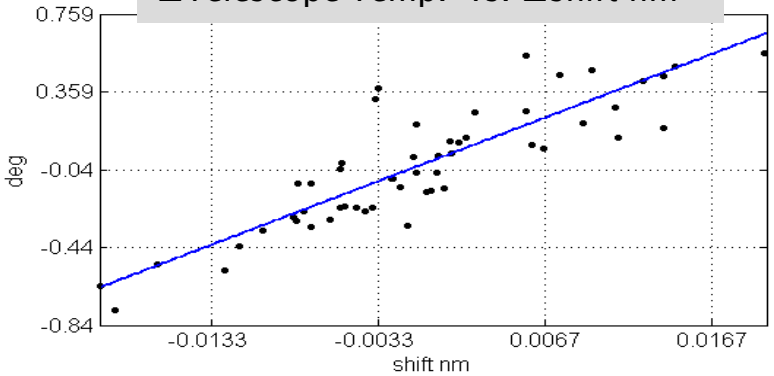


Telescope temperature deg



f(x) =
a1*sin(b1*x+c1) +
a2*sin(b2*x+c2) +
a3*sin(b3*x+c3) +
a4*sin(b4*x+c4)

ΔTelescope Temp. vs. Δshift nm

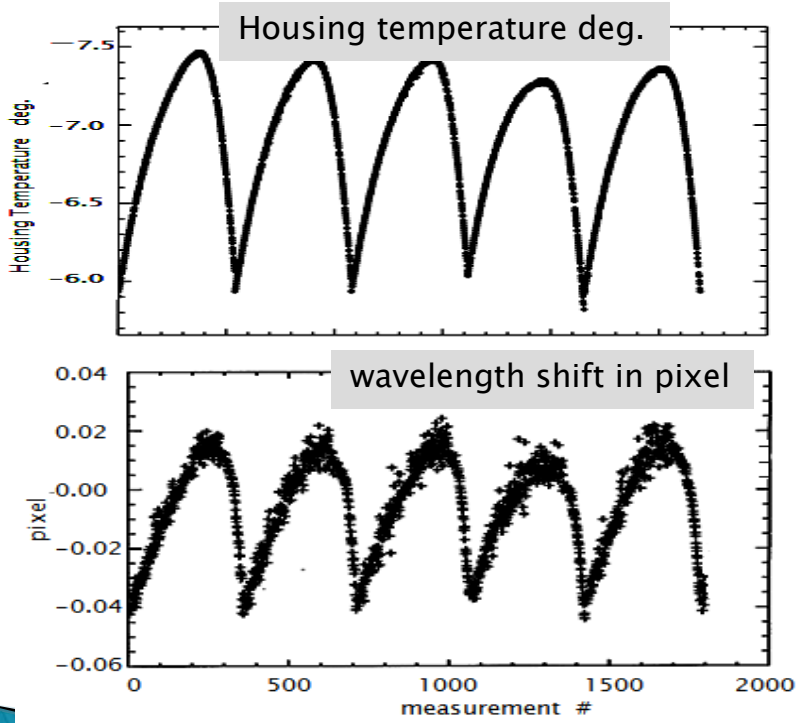


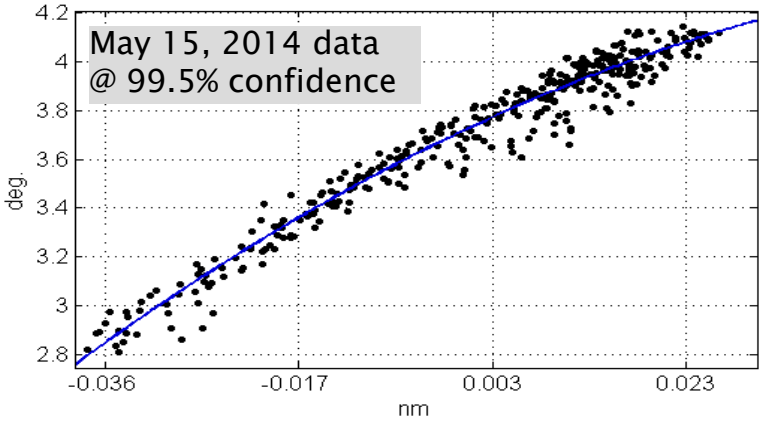
Linear model: f(x) = p1*x + p2

Coefficients (@ 95% confidence bounds):
p1 = 32.68 and p2 = 0.006929

Goodness of fit: SSE: 1.32
R-square: 0.8
RMSE: 0.1549

Intra-orbital wavelength changes from Earth view





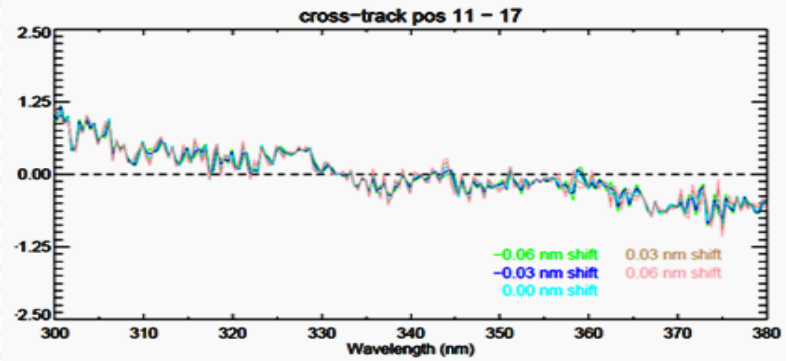
f(x) = p1*x^2 + p2*x + p3
where x is normalized by mean -4.711e-05 (with 95% confidence bounds):

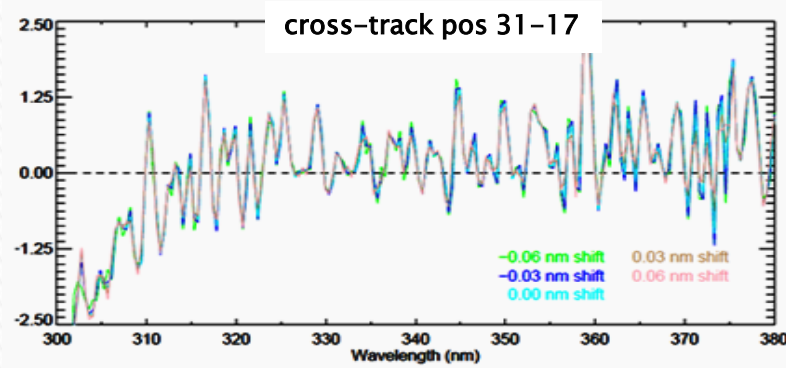
p1 = -0.04109 (-0.04257, -0.03961)
p2 = 0.3395 (0.3377, 0.3413)
p3 = 3.713 (3.71, 3.715)

Goodness of fit: SSE: 32.43
R-square: 0.9641
RMSE: 0.06533

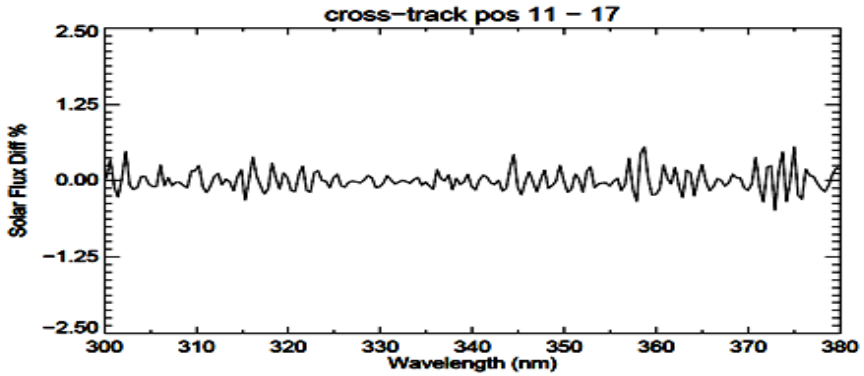
Cross-track position pattern from Solar data

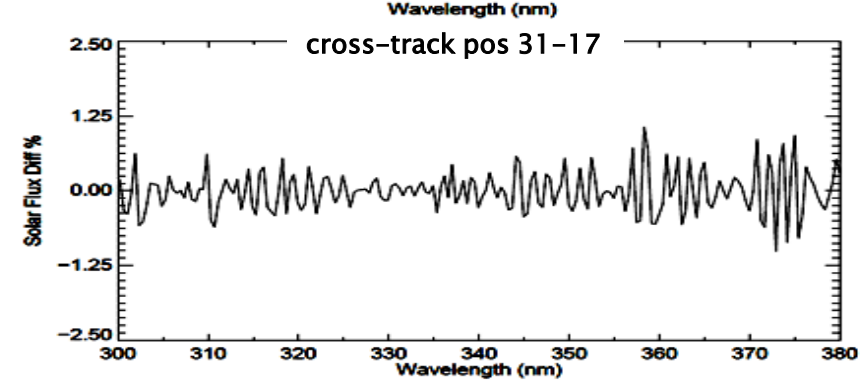
before adjustment





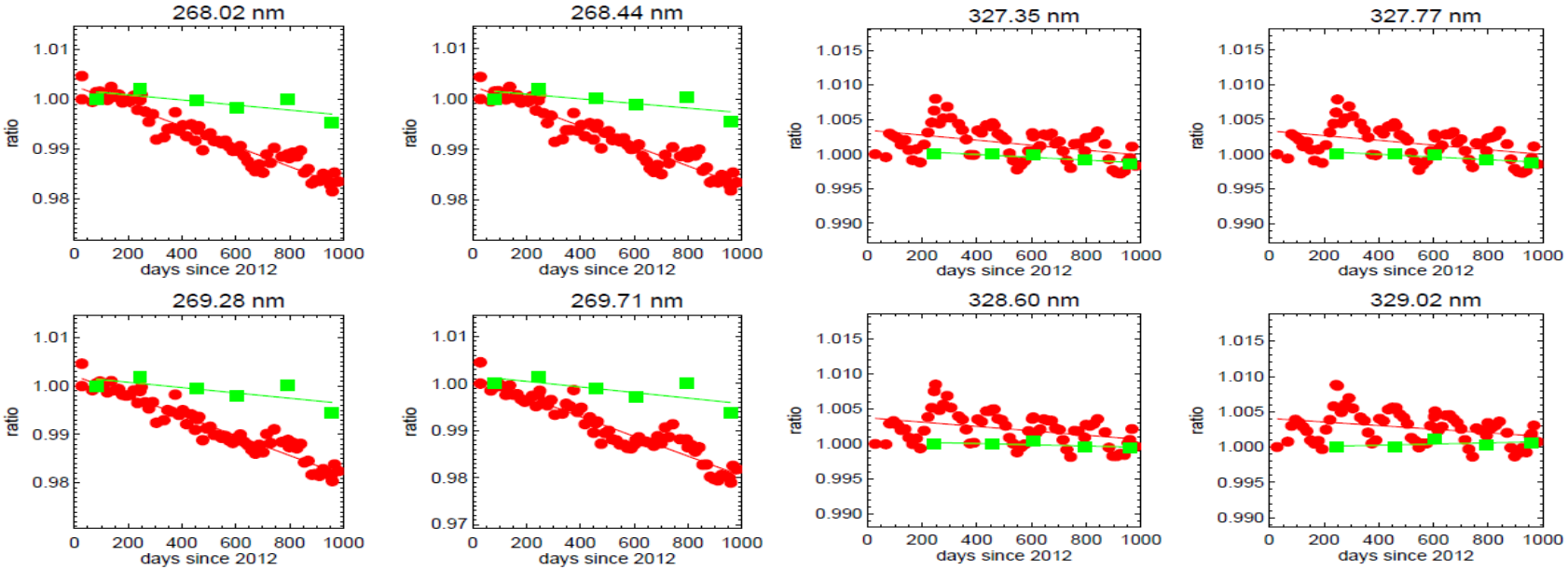
After adjustment



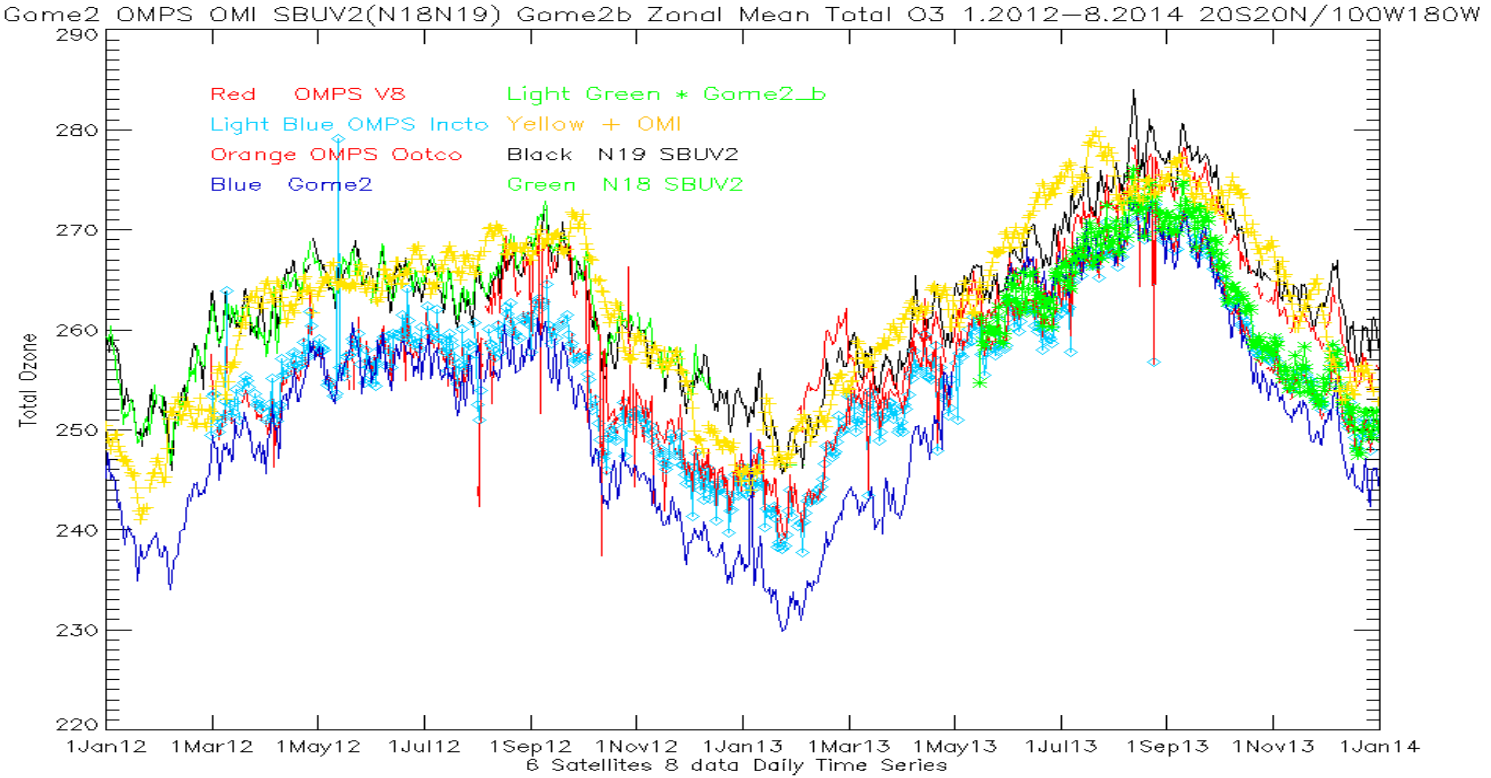


Optical throughput change < 1%

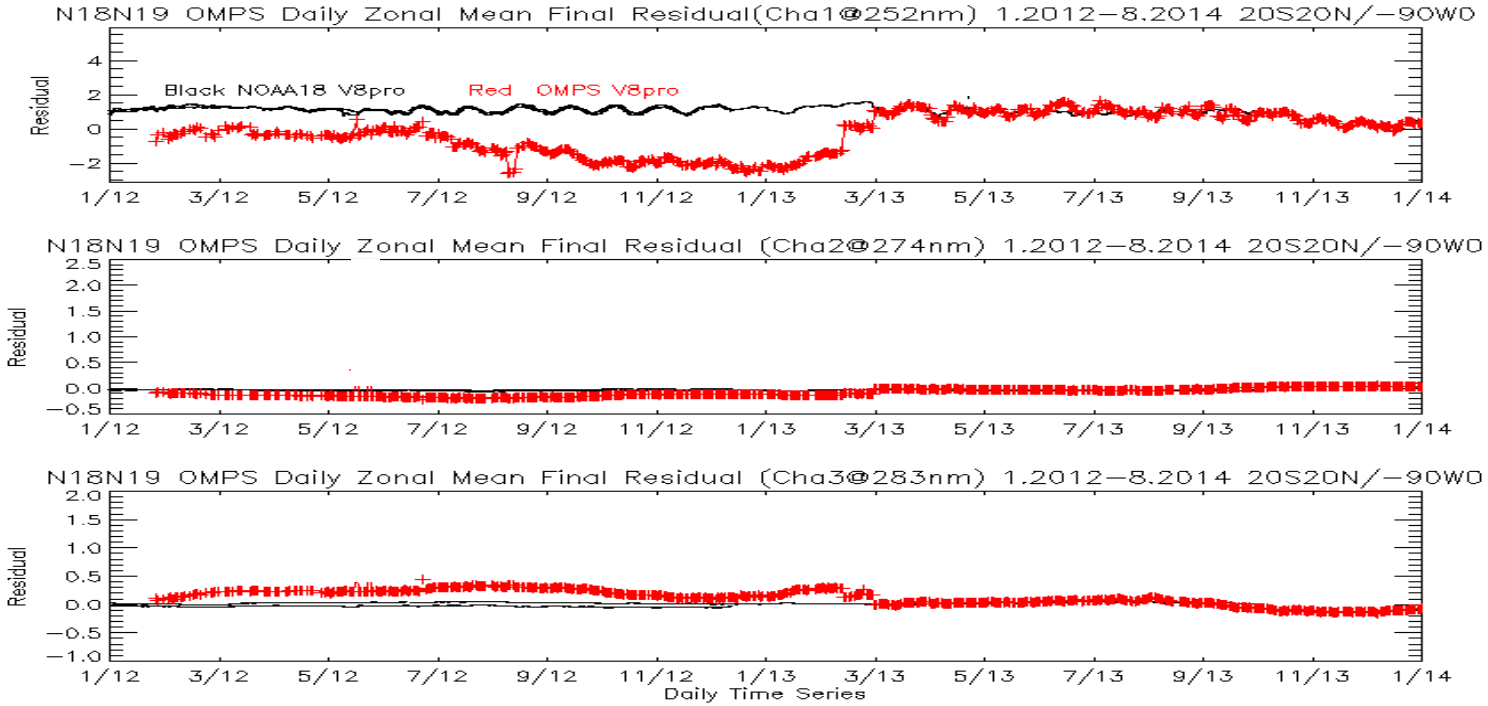
NP Reference Working NM



Comparisons of zonal mean total O3 in time-series



Comparisons of residuals as daily zonal mean time-series



Summary

- Sensors are performing well
  - The sensor orbital performance is stable and generally meets the system requirements and agrees with the prelaunch results.
  - Optical degradation is less than 1% in the nearly 3-year operation.

- Wavelength calibration is under adjustment
  - Determine wavelength shift as a function of temperature.
  - Determine cross-track difference and apply a soft calibration.