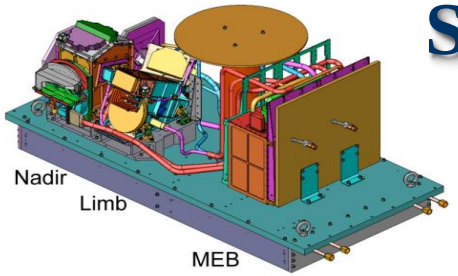
Improvements to Ozone Mapping Profiler Suite (OMPS) Sensor Data Record (SDR)



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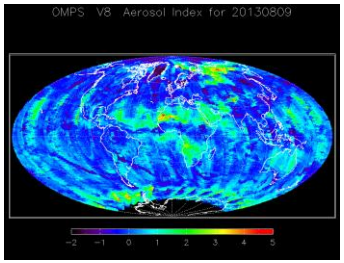
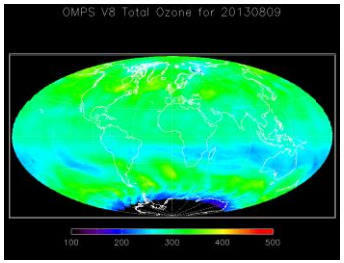
* 1 ESSIC, University of Maryland, College Park, MD 20740; 2 NOAA NESDIS/STAR, College Park, MD 20740; 3 ERT, College Park, MD 20740

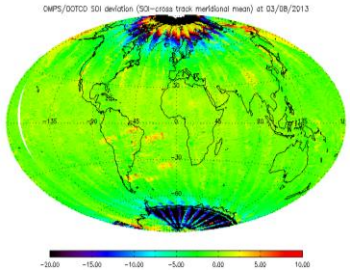


Aerosol Index



Ozone map

The AMS 97TH Annual Meeting
22 – 26 January 2017
Seattle, WA



So2 index

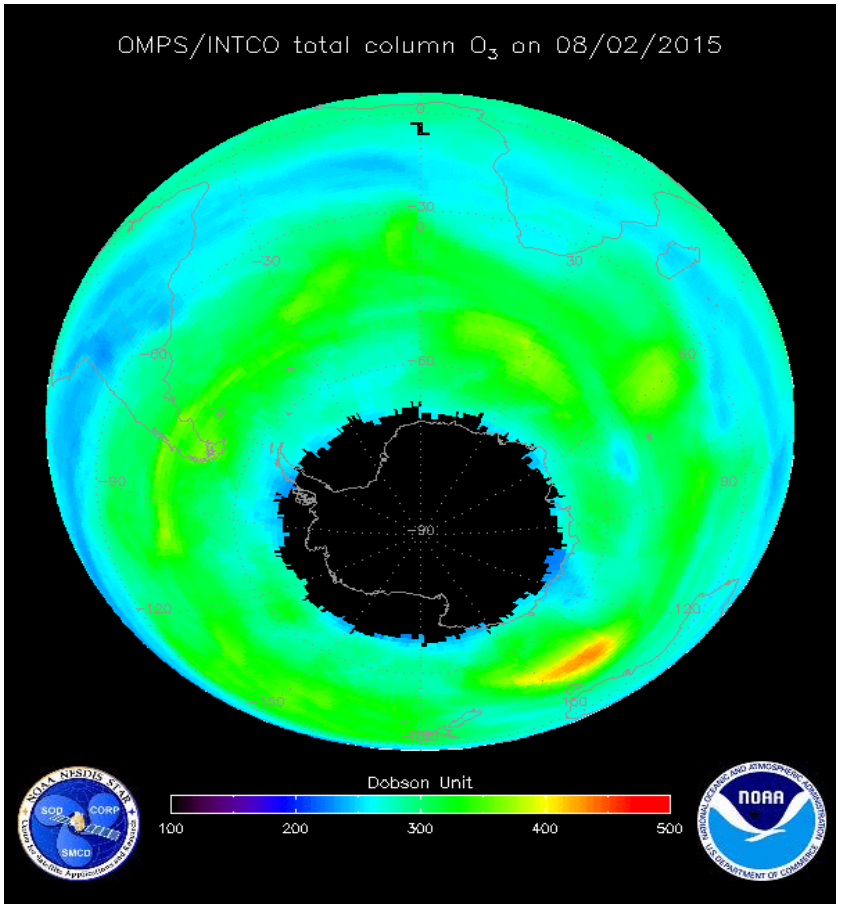
Background

• OMPS is one of five instruments on board the SNPP satellite launched in Oct. 2011. The second OMPS onboard JPSS-1 satellite will launch in Summer 2017.

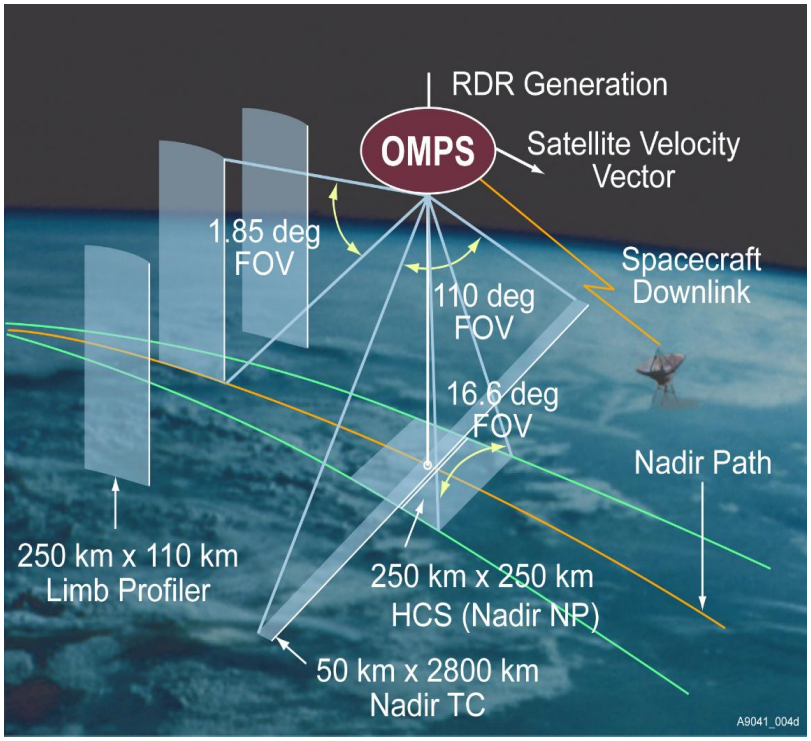
• The OMPS heritage sensors are SBUV/2 and TOMS. OMPS provides ozone total column and vertical profile data that continues ozone daily global data with higher calibration accuracy and higher spatial and spectral resolution since 2012.

Onboard Calibrators

- Light-emitting diode provides linearity calibration
- Reflective solar diffusers maintain calibration stability

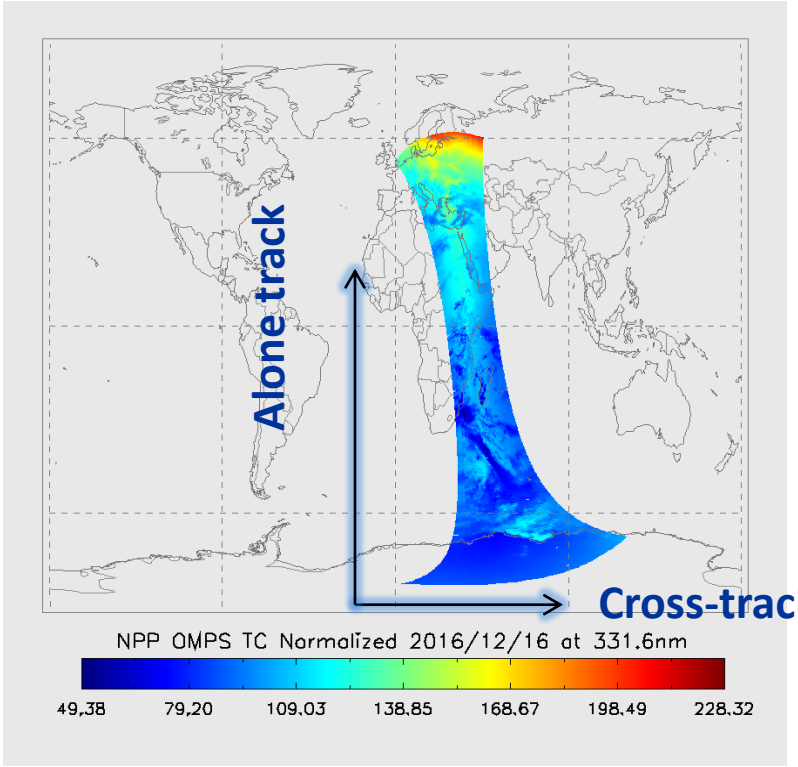


Scanning Characteristics



Two UV imaging spectrometers in Nadir system: NM covers 300 - 380 nm; NP covers 250 - 310 nm

Measure back scattered earth radiance, as well as solar irradiance. On-orbit calibration maintains high quality SDRs



One orbit measured NM/TC normalized radiance (N-value) at 331.6 nm from NM Spatial resolution 50 km (35 IFOVs) in the cross-track direction

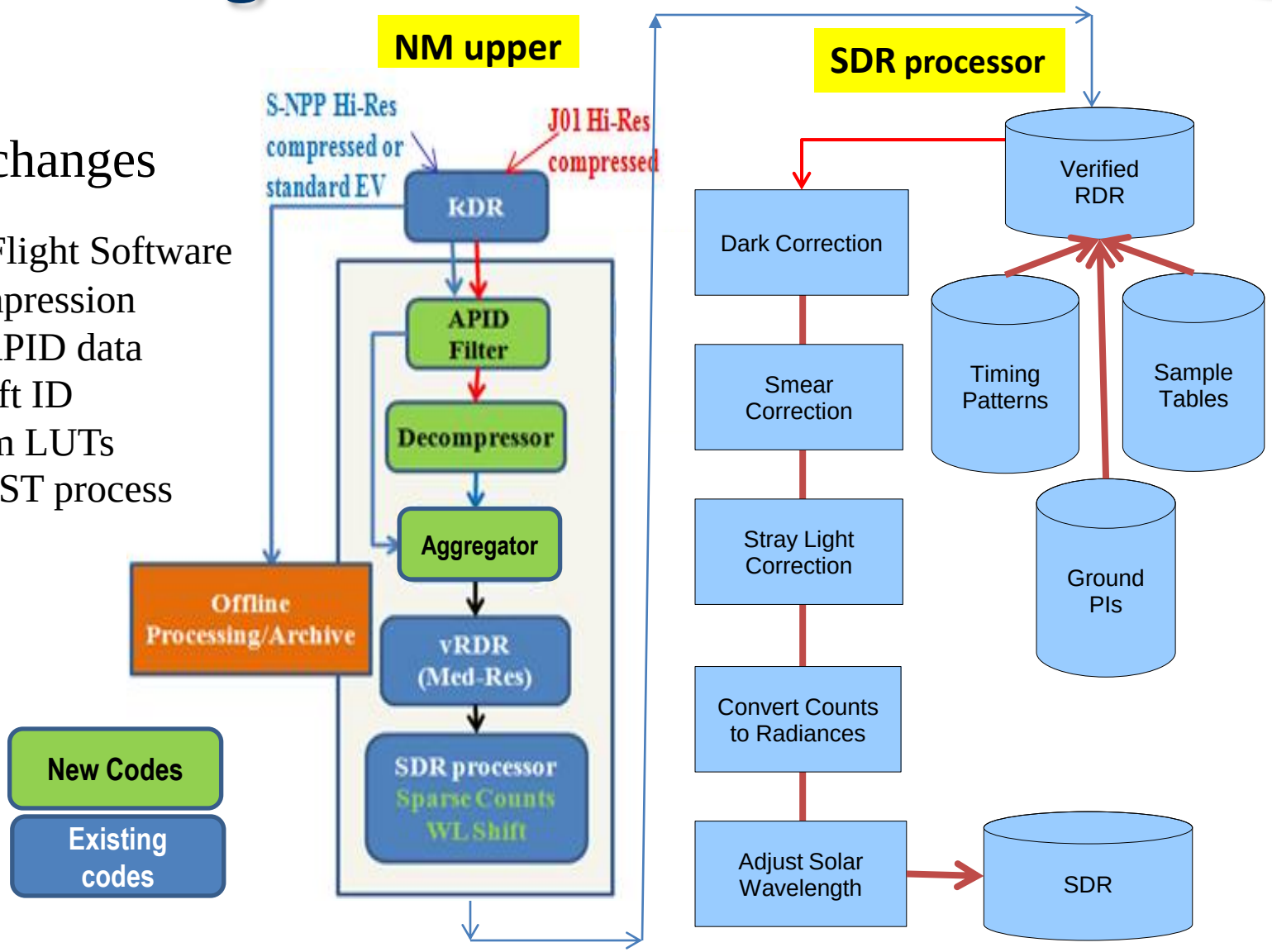
Improvements to SDRs

- Higher spatial resolution data is requested by OMPS users
  - SNPP OMPS acquires higher spatial science data weekly
  - The JPSS-1 will provides the ozone vertical profile data at 50 km x 50 km beginning at launch and 17 km x 17 km ozone total column data afterwards.
- On-orbit Spectral variation causes about 1.0% errors in ozone retrieval
  - Analysis of in-flight data shows the sensor spectral wavelength variation exceeded performance required 0.02 nm. An empirical wavelength correction has been applied to NM Sensor.
  - JPSS-1 OMPS missions will likely exhibit similar orbital variations that can be corrected using a similar methodology.
- JPSS-1 OMPS instrument designed changed for a better on-orbit performance

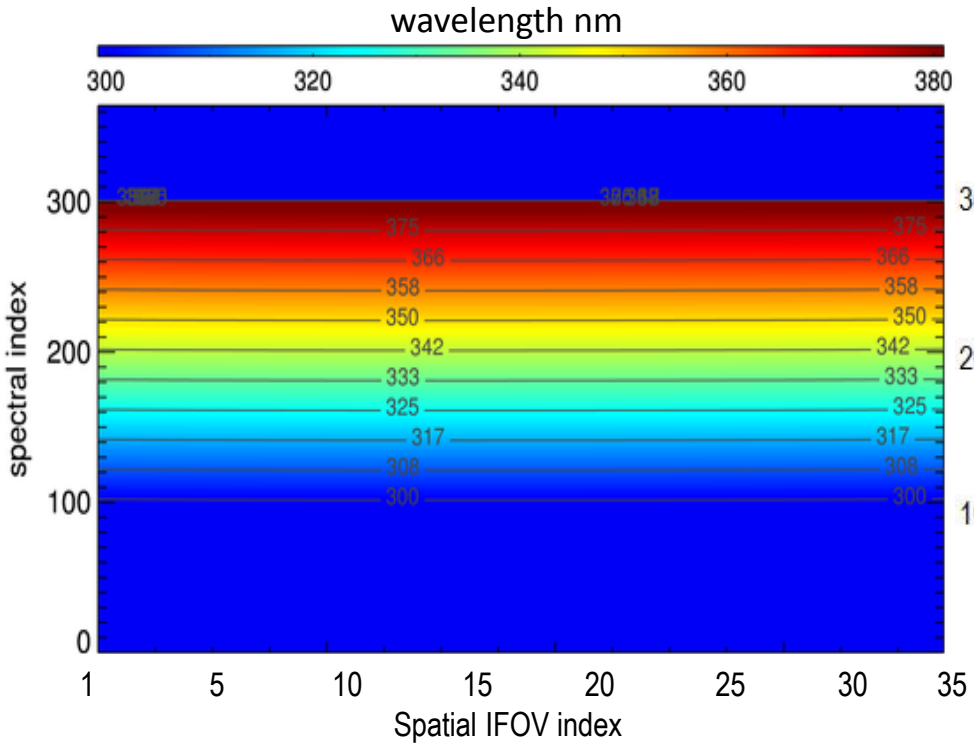
Algorithm Enhancement

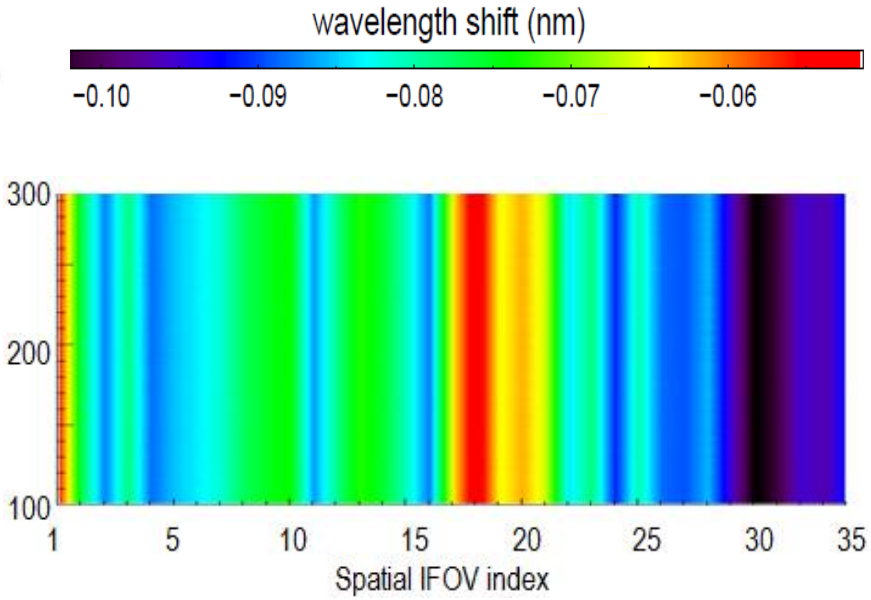
Major changes

- Upgraded Flight Software
- Rice decompression
- Four new APID data
- J1 spacecraft ID
- J1 algorithm LUTs
- NM sparse ST process

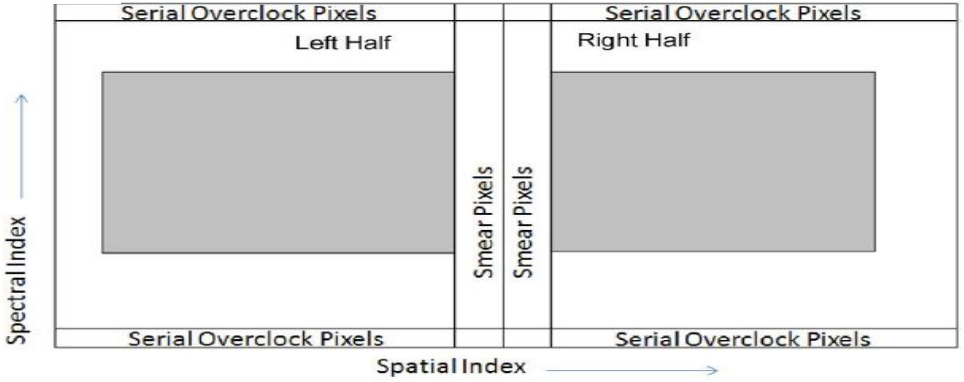


Wavelength Registration

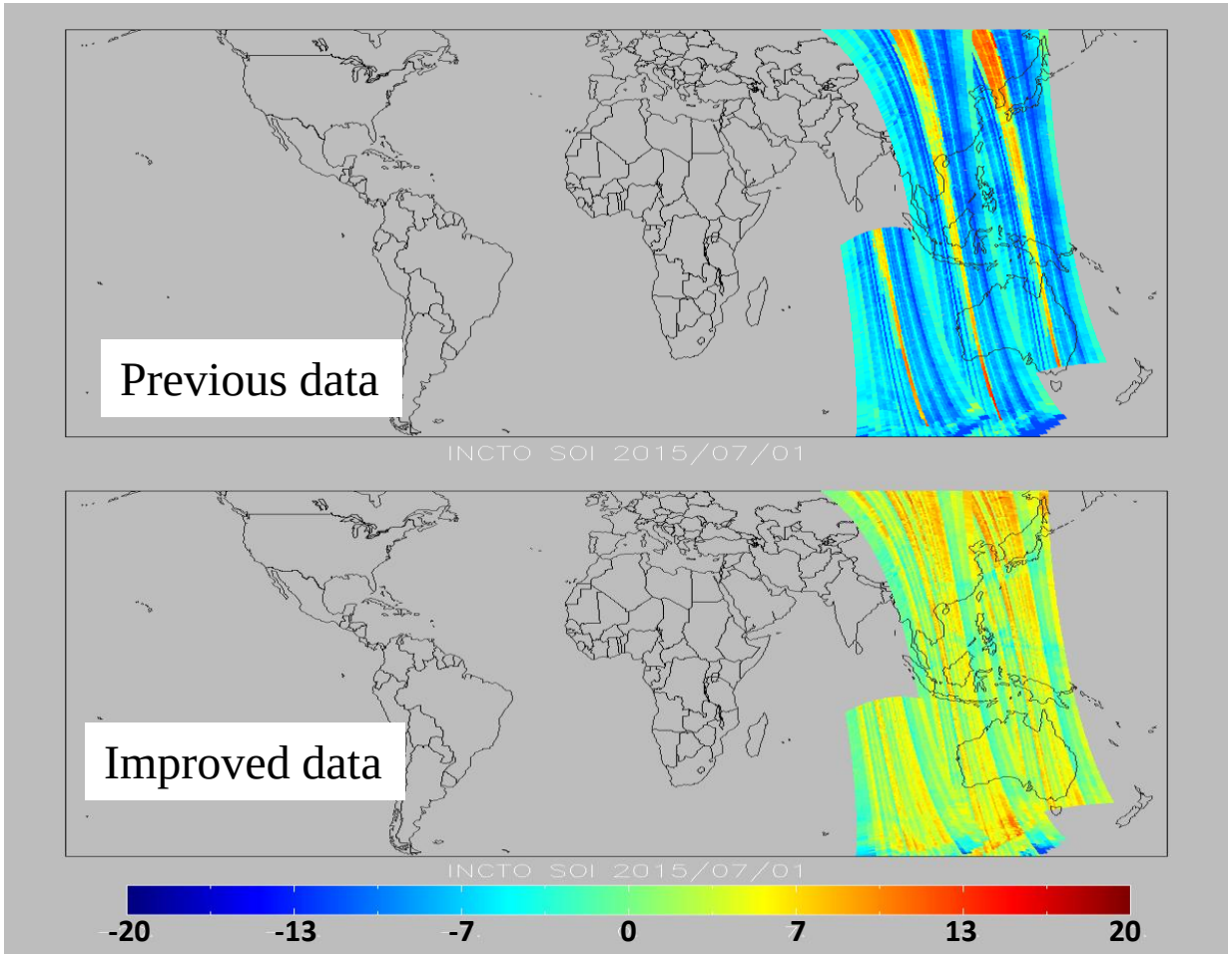




- Spatial and spectral 2-D CCD
- Photosensitive region has 35 spatial EV cells and 196 spectral channels
- Split frame transfer, two halves identical CCD.



SO2 Index



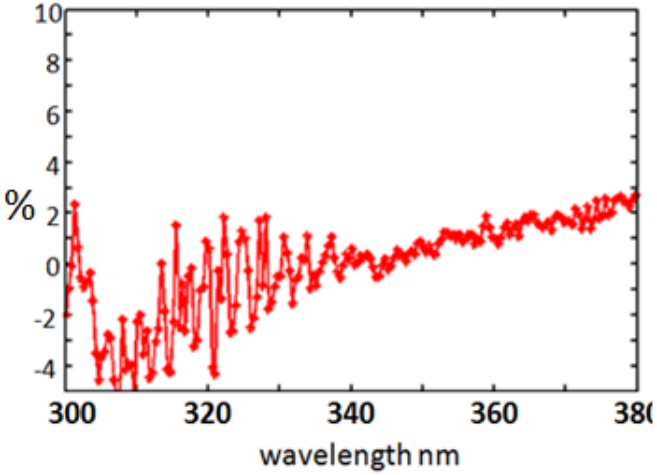
- SO2 index cross-track IFOV variation
- Residual error are caused by EDR V7 TOZ algorithm
- Data comes from OMPS NM EDR products INCTO SO2 2015/07/01

NM Radiance/Irradiance

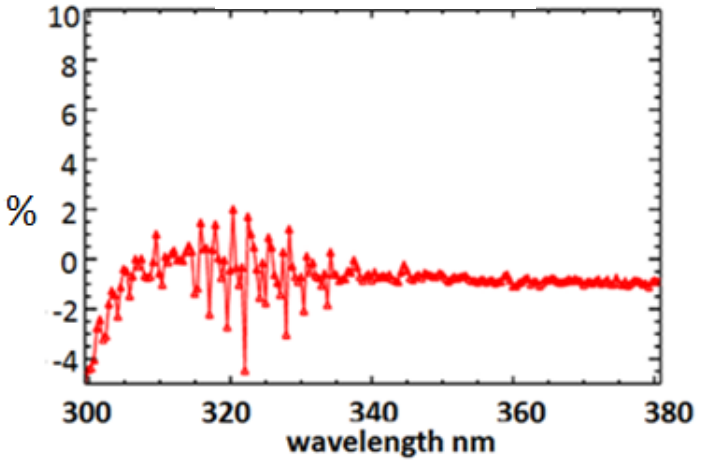
Radiance error is the percent difference between OMPS and MLS flying on Aura.

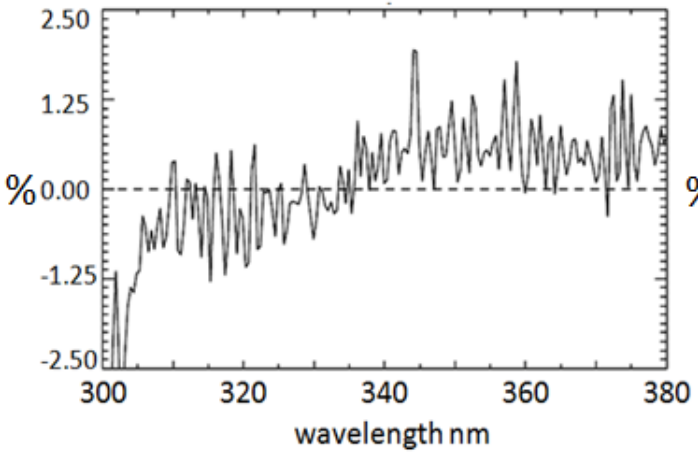
Irradiance error is the percent difference between observed solar flux and modeled solar synthetic flux.

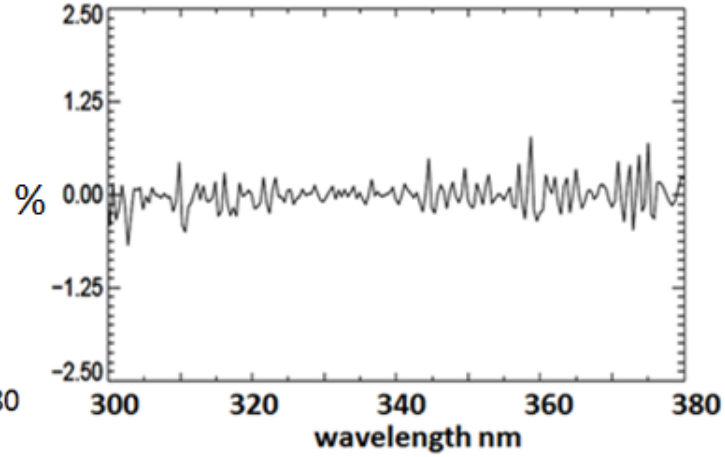
Previous data



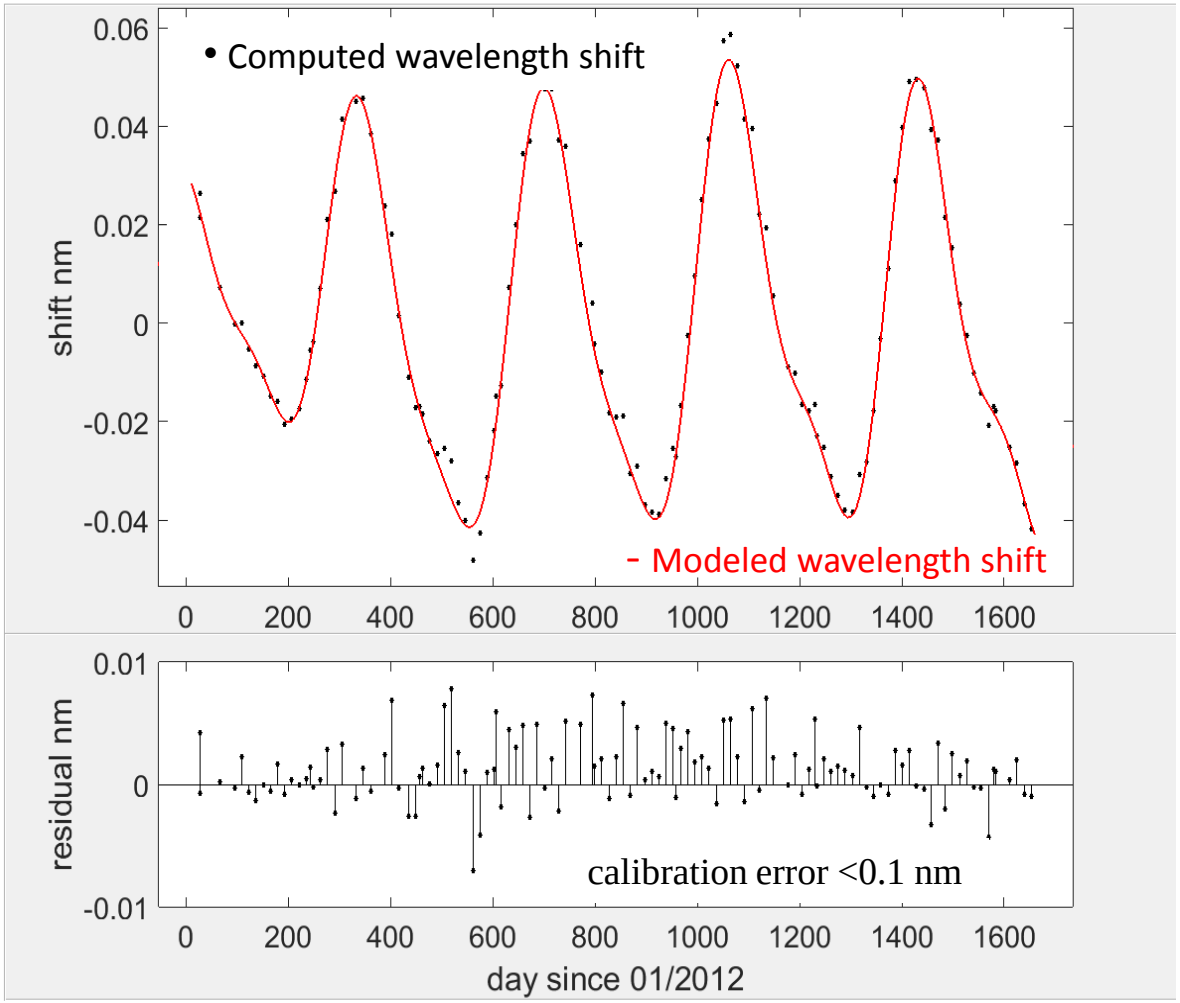
Improved data







Wavelength Correction



- Modeling Equation:

  f(x) = a1*sin(b1*x+c1) +
  a2*sin(b2*x+c2) +
  a3*sin(b3*x+c3) +
  a4*sin(b4*x+c4)
  X: mission time (days)
  F(x): wavelength shift

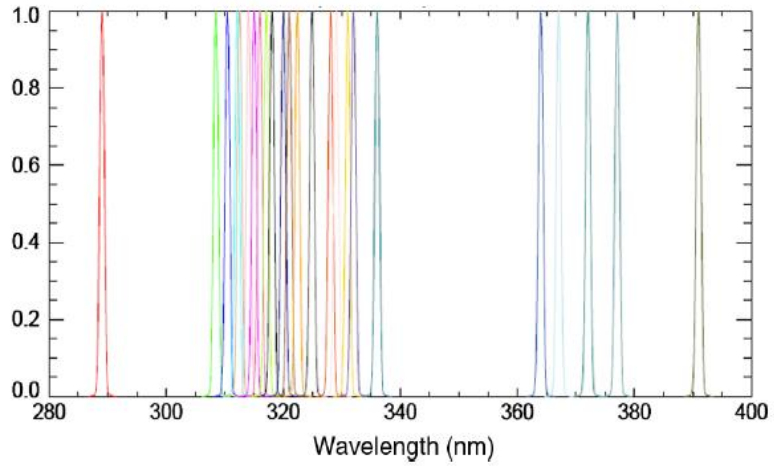
- Correlation with thermal gradients (housing temperature change)

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

Solar Irradiance Calibration



$\bar{I}(\lambda_0)$: slit-averaged values

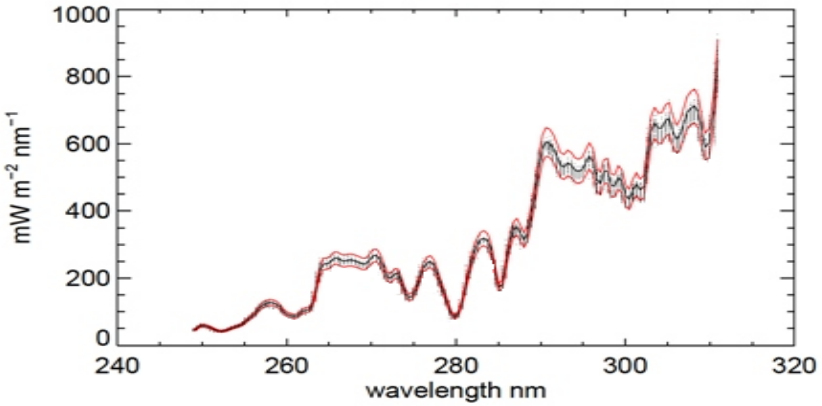
λ_0: central slit wavelength

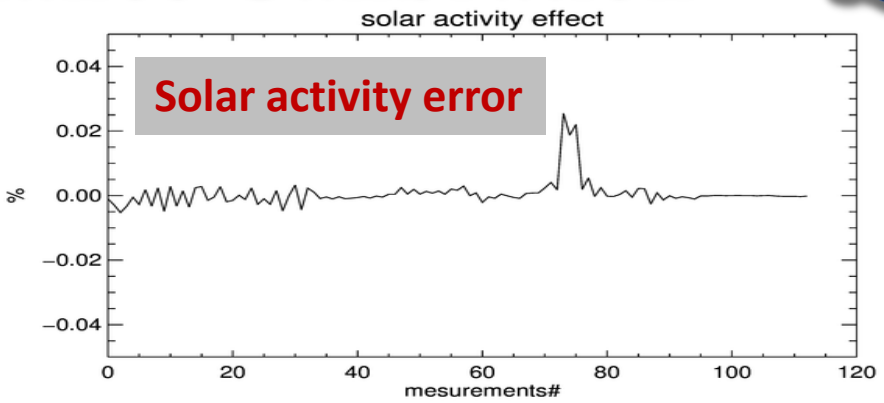
λ: wavelength

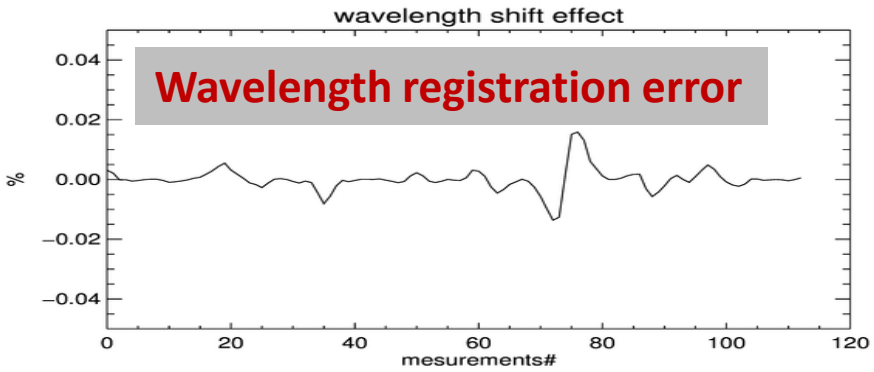
$S(\lambda)$: spectral response function (slit function)

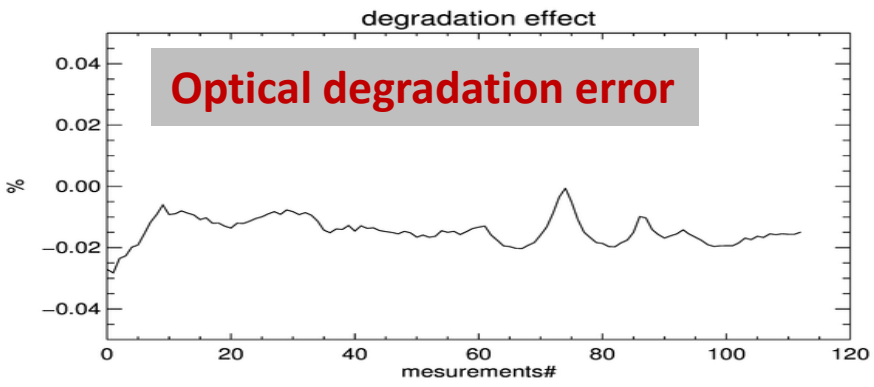
$I(\lambda)$: monochromatic irradiance

$$\bar{I}(\lambda_0) = \frac{\int I(\lambda) S(\lambda) d\lambda}{\int S(\lambda) d\lambda}$$



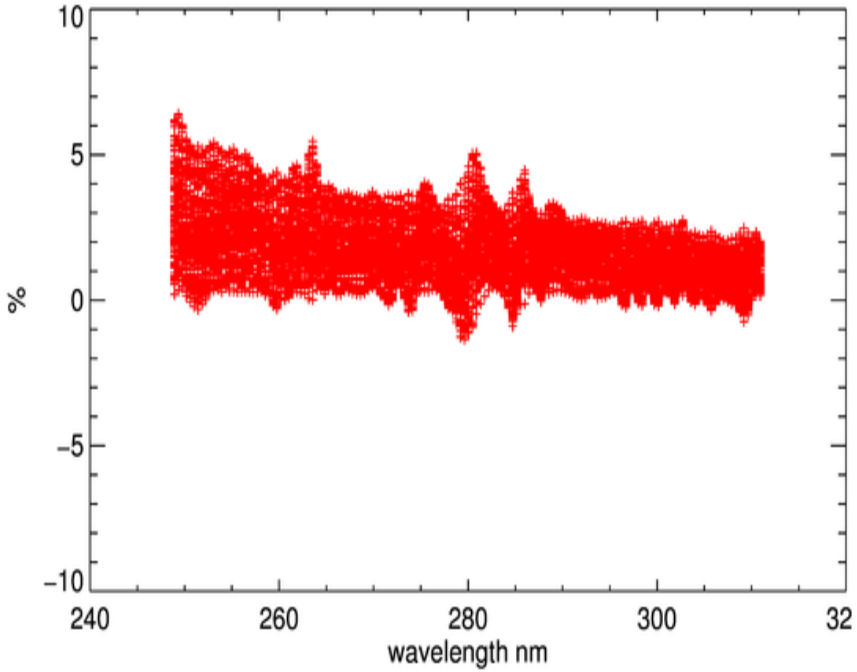




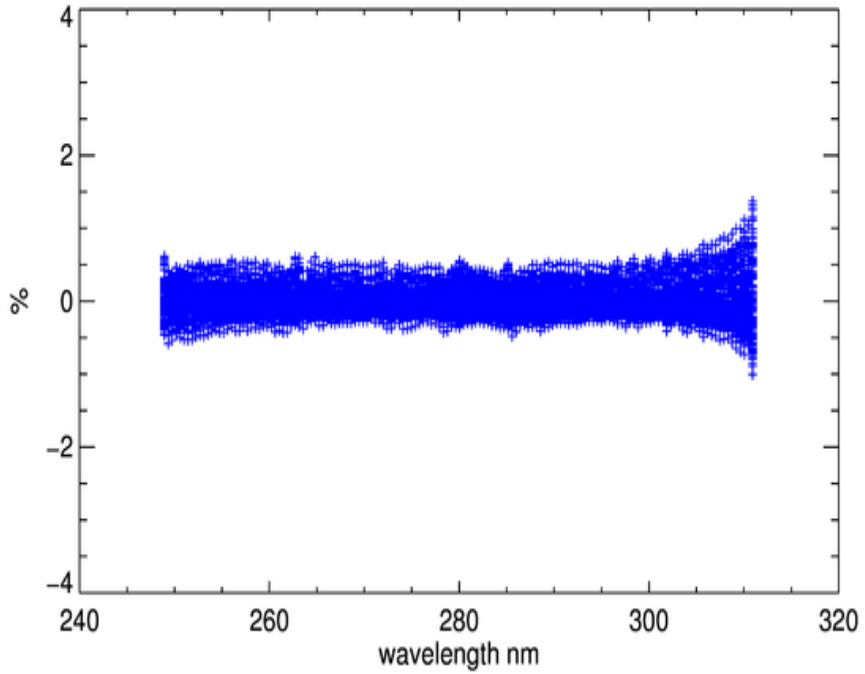


Solar Irradiance Errors

Before

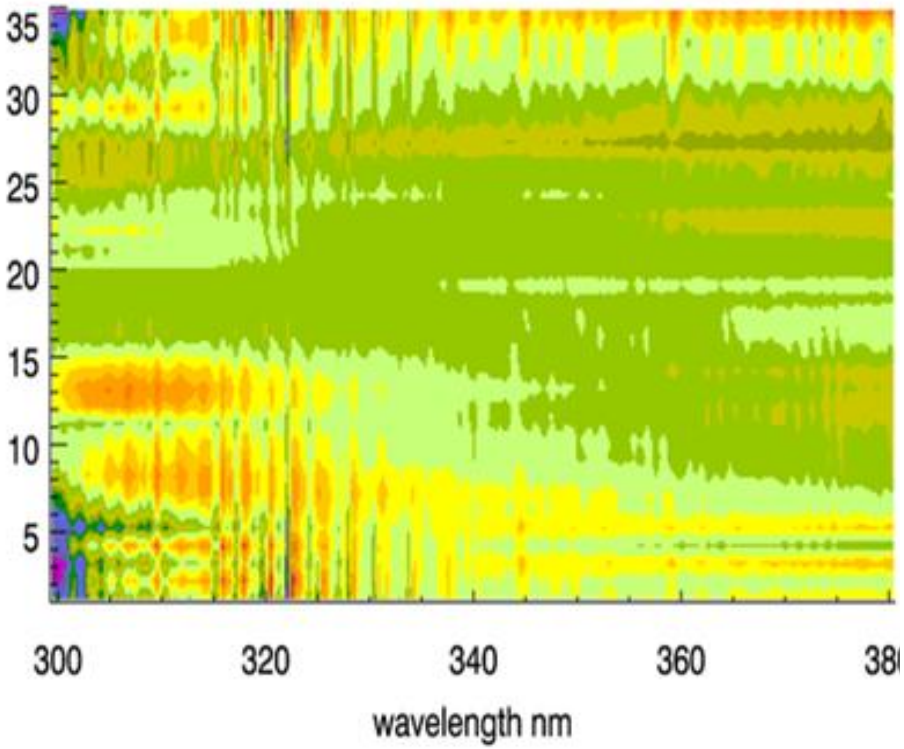


After

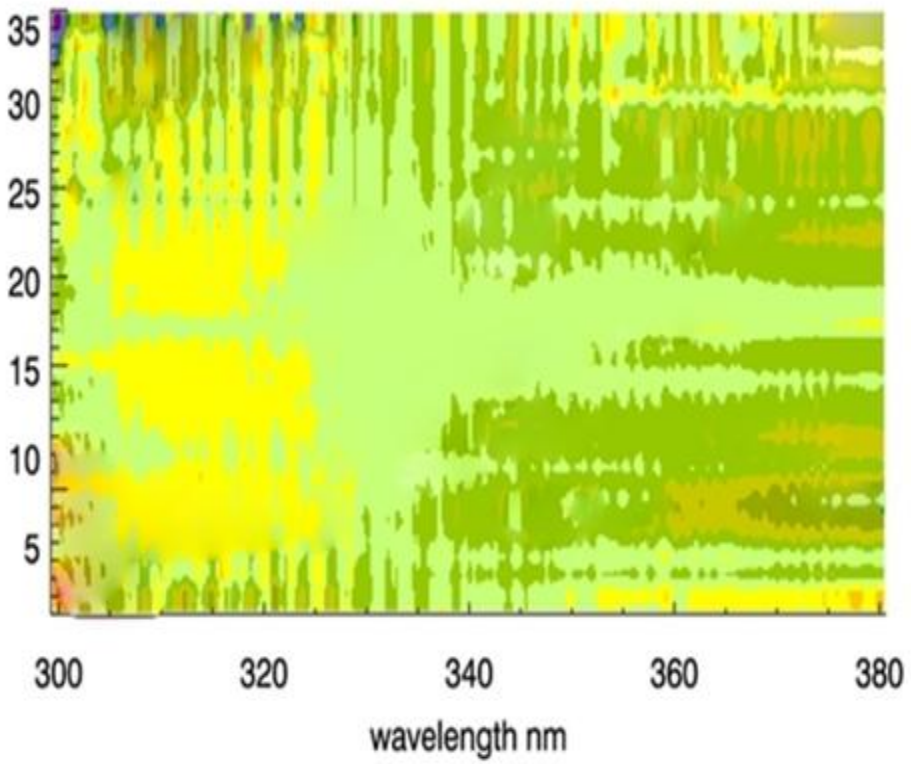


Normalized Radiance Error

Previous Error



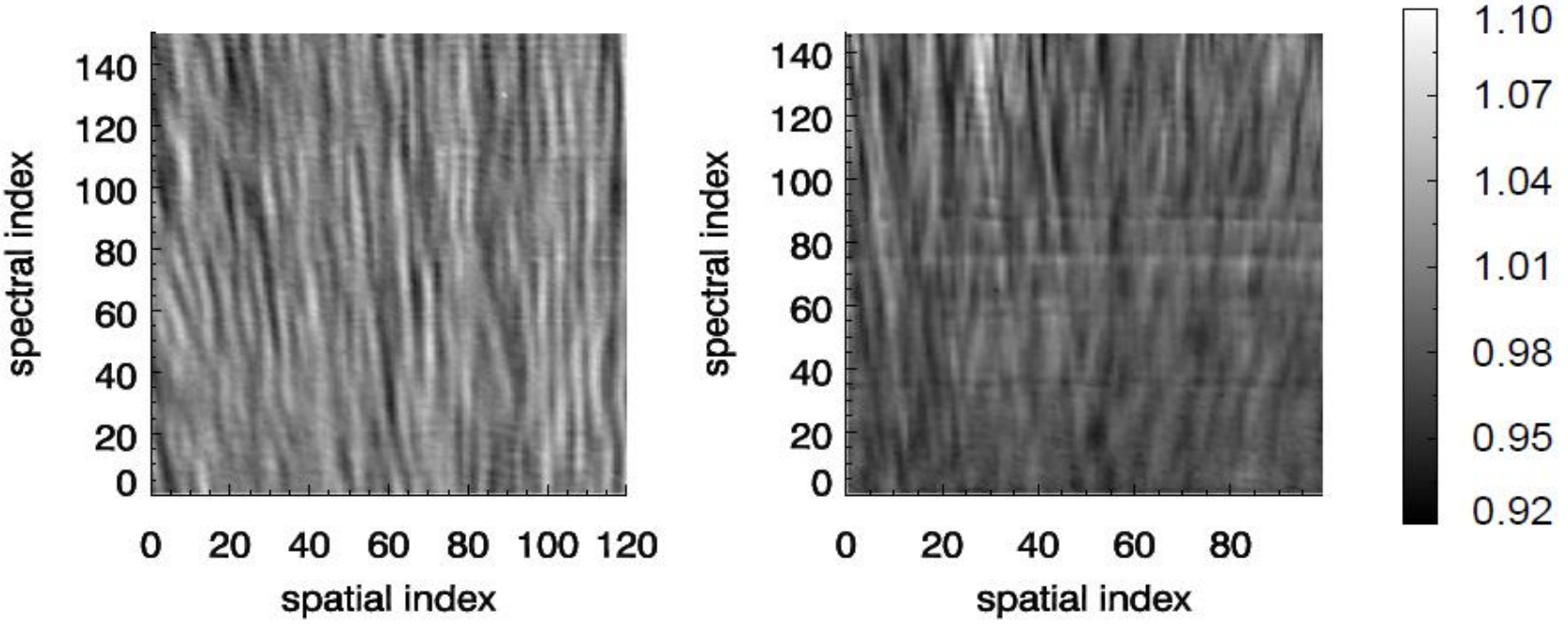
Current Error



Normalized Radiance Error %

J1 Instrument Re-Design

- The Limb Profiler will not be present for JPSS-1
- NM slit redesigned to reduce irregular edges
- Optical mounts redesigned to improve boresight stability
- Modified optical alignment permits wavelengths up to 420nm to be measured
- Reflective quasi-volume diffusers (QVD) maintains calibration stability



Ratios of solar flux measurements NM (left @solar position 4) and NP (right)

Summary

- OMPS in-flight performance has been greatly improved through sensors' on-orbit spectral calibration.
- The calibration lessons learned from the SNPP OMPS present reasonable and feasible opportunities for improving the future JPSS-1 OMPS data products.
- JPSS-1 OMPS is expected to provide science data with higher fidelity compared to the SNPP OMPS

Any Questions ?

… THANK YOU …