



# Integrated Cal/Val System (ICVS) for OMPS

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# Outline



- Calibration principle
- Key performance parameters monitoring
- Solar degradation monitoring
- Instrument health and safety related parameters monitoring
- Summary and future plan

# The NM/NP Calibration Principle

$$Q_{jk}^c = \frac{Q_{jk}^{ADC} - Q_0}{g m_{jk}} - Q_k^s - Q_{jk}^{dark}$$

$Q_{jk}^{ADC}$  : raw counts at the output of the analog-digital-converter

$g$  : non-linearity of the electronics chain

$Q_{jk}^{dark}$  : observed dark

$Q_0$  : zero input response

$m_{jk}$  : relative pixel gain level

$Q_k^s$  : observed smear(contain the offset)

$$L_{jk}^m = \frac{Q_{jk}^r k_{jk}^r}{\tau_{jk}(t)}$$

$L_{jk}^m$  : calibrated earth radiance

$Q_{jk}^r$  : corrected earth radiance counts

$k_{jk}^r$  : pre-launch measured radiance calibration coefficient

$\tau_{jk}$  : sensor response changes

$$E_{jk}^m(t) = \frac{Q_{jk}^i k_{jk}^i}{g_{jk}(\theta, \phi) \rho_{jk}(t) \tau_{jk}(t)}$$

$E_{jk}^m$  : Calibrated solar irradiance

$Q_{jk}^i$  : corrected solar irradiance counts

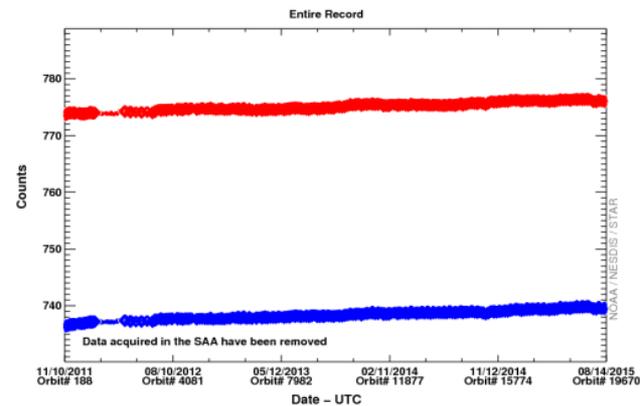
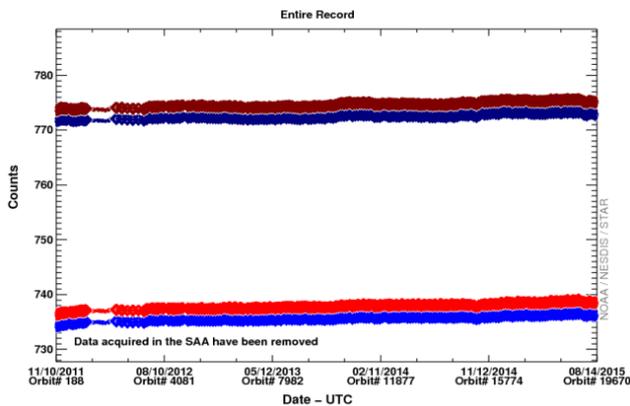
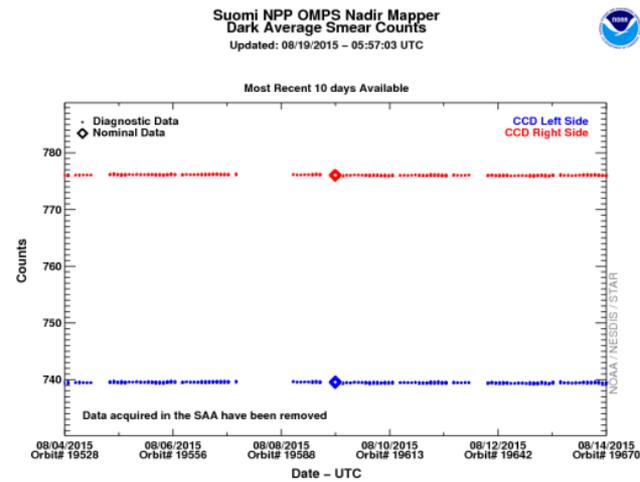
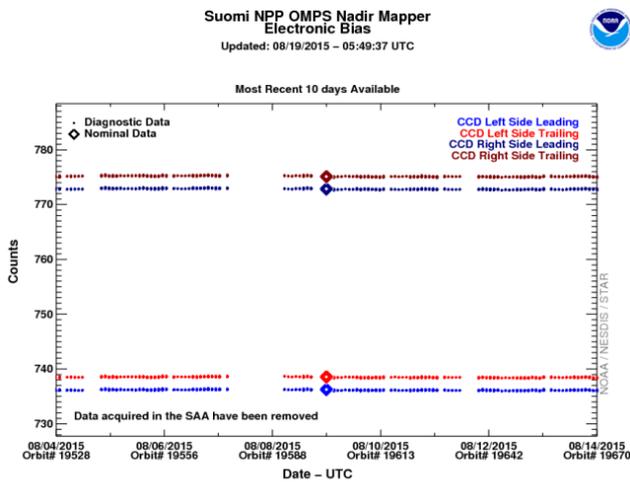
$k_{jk}^i$  : pre-launch measured irradiance calibration coefficient

$g_{jk}$  : goniometric response

$\rho_{jk}$  : long-term solar diffuser reflectivity changes

# Key Performance Parameters

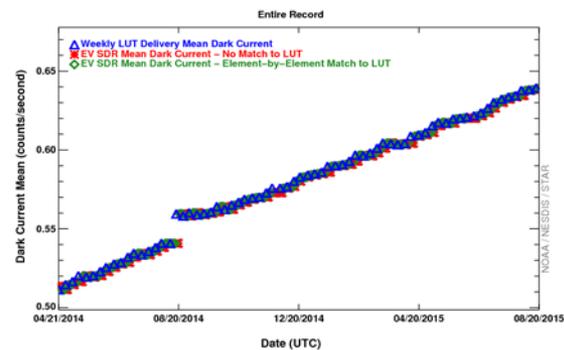
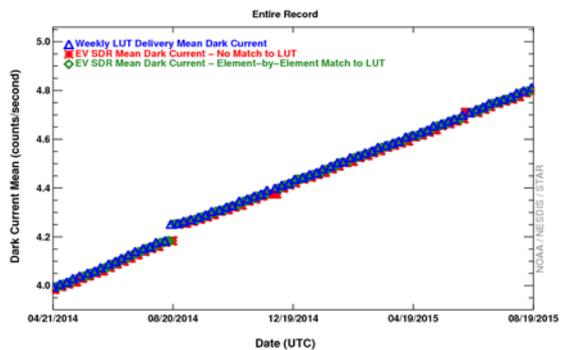
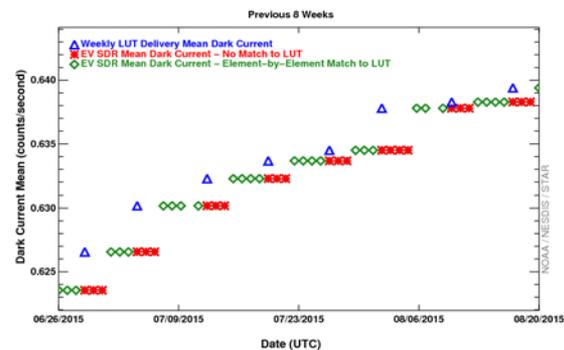
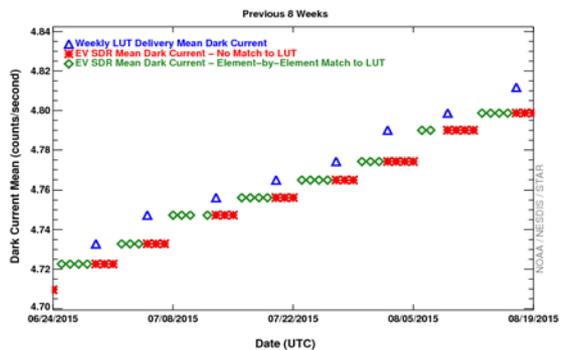
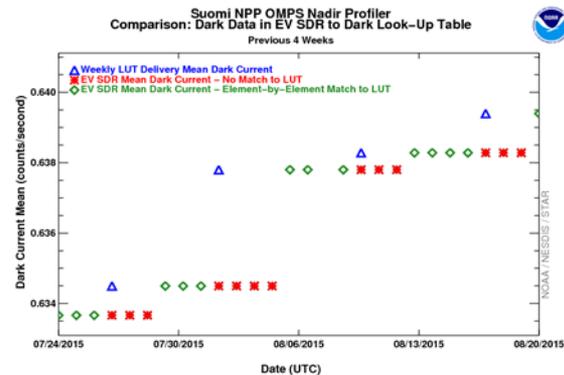
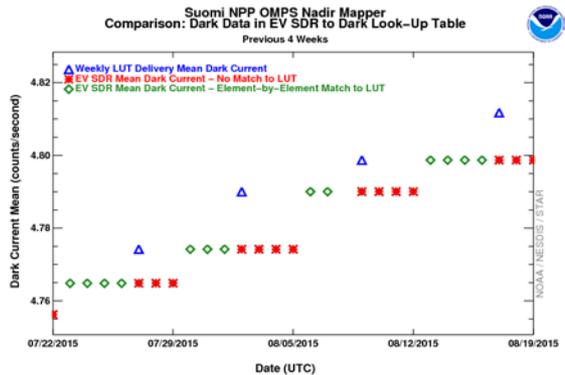
ICVS monitoring of mean value and standard deviation for offset and smear



# NM/NP Dark Current LUT Updates

ICVS monitoring of NM/NP dark current LUT updates:

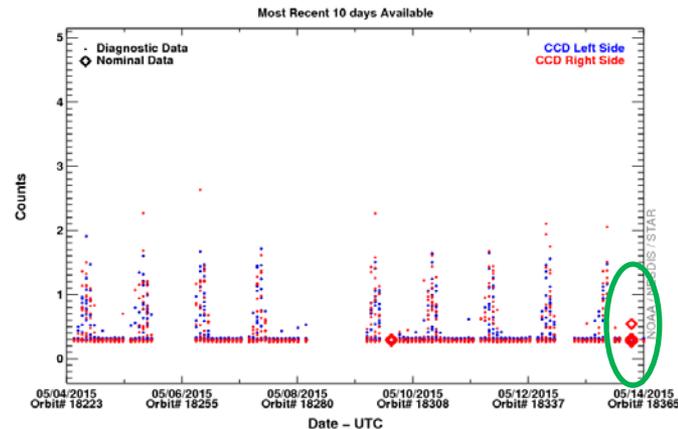
- Timely weekly updates of the dark current LUT for calibration
- Implementation of the weekly dark LUT (transition from red to green) into the Earthview SDR
- Expected steady increase of the dark current



# Expected Anomaly Detection

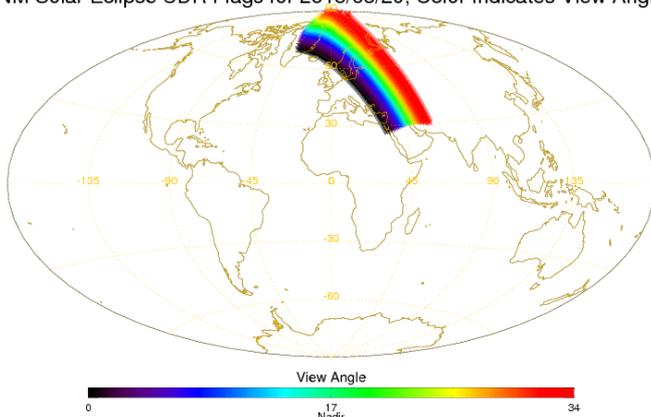
Automated anomaly detection and email warnings are established for radiance and key performance parameters

Suomi NPP OMPS Nadir Mapper  
Dark Smear Counts Standard Deviation  
Updated: 05/19/2015 - 05:27:47 UTC

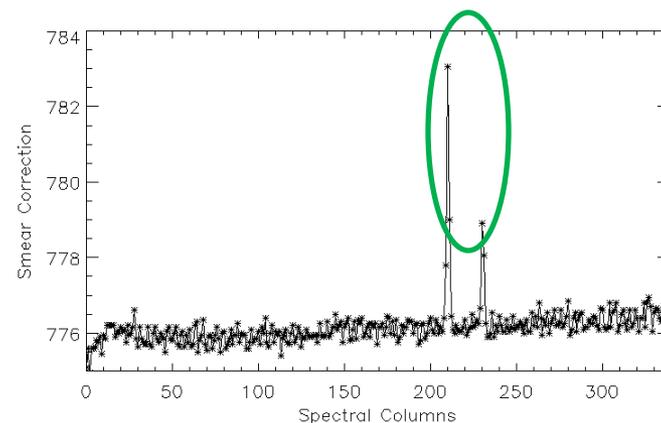


Time series of average OMPS NM dark smear counts for ten days

NM Solar Eclipse SDR Flags for 2015/03/20, Color Indicates View Angle



Solar eclipse as identified by OMPS eclipse flag



Transient in OMPS NP dark smear on orbit 18362 and image 24 for May 14, 2015

# NM Solar Diffuser Sample Table

- OMPS Sensor stability are monitored by observing the changes in the observed solar flux via a reflective working diffuser for short-term monitoring and via a reflective reference diffuser for long term monitoring.
- Nominally, The working diffuser is deployed once every two weeks. The reference diffuser is deployed twice per year.
- The diffuser moves through seven different positions to cover the entire sensor FOV of 110 degree
- Plots on the right are solar calibration sample table which shows the CCD pixels collected during the solar calibration when diffuser moves from positions 1 to 7

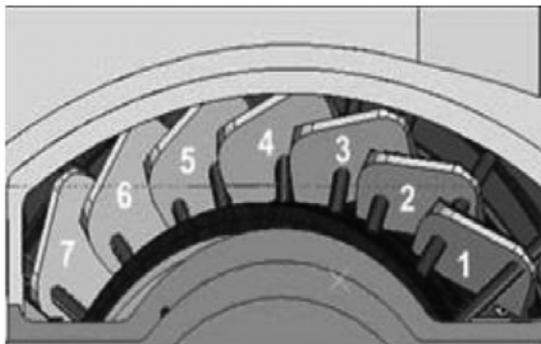
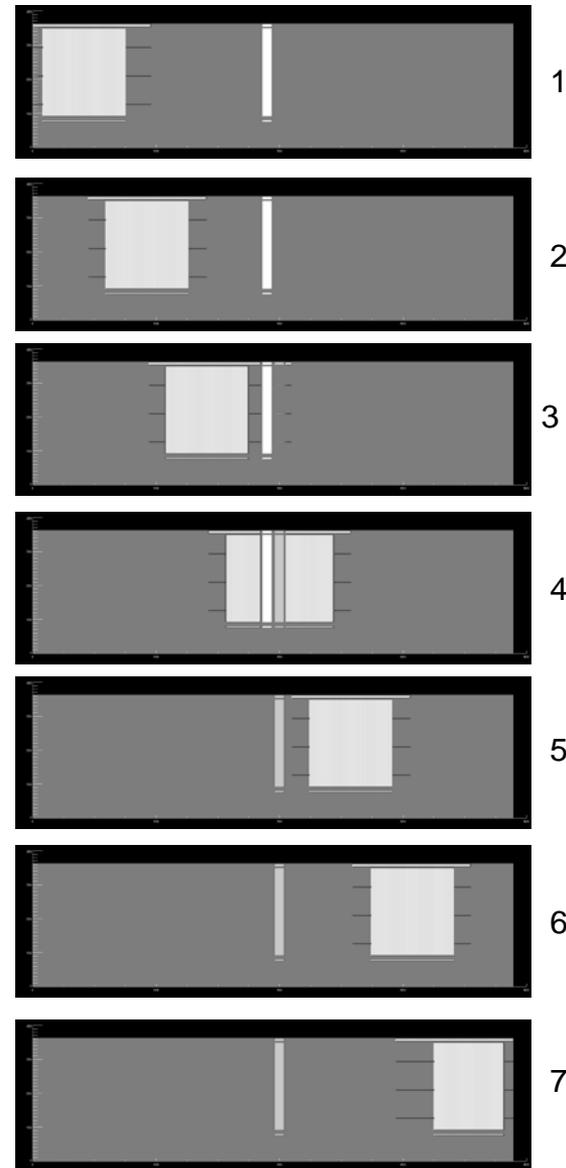
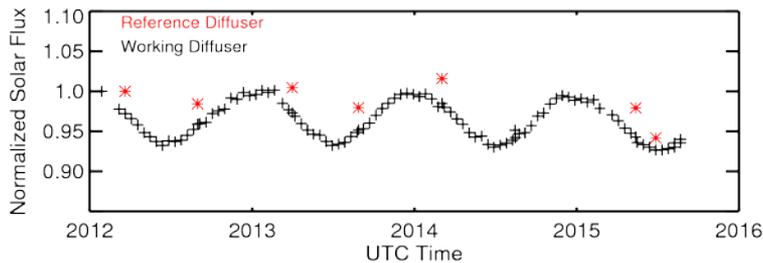


Diagram of seven solar diffuser positions in OMPS Nadir solar measurement

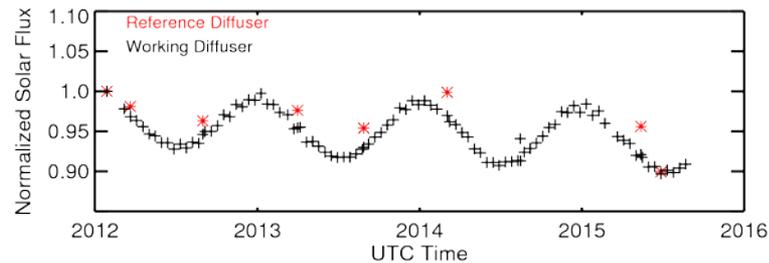


# Normalized Solar Flux for NM and NP

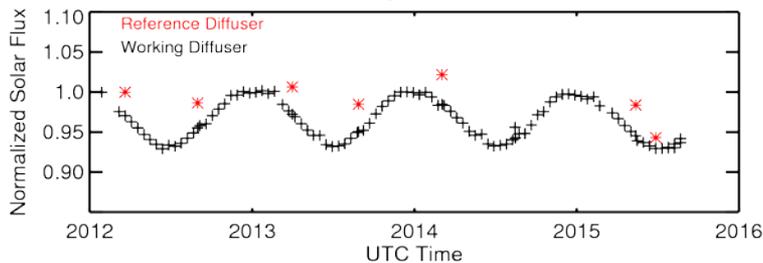
SNPP OMPS NM Diffuser Position 1 Normalized Solar Flux  
Created at 08/24/2015 - 16:04:36 UTC  
Wavelength 303nm



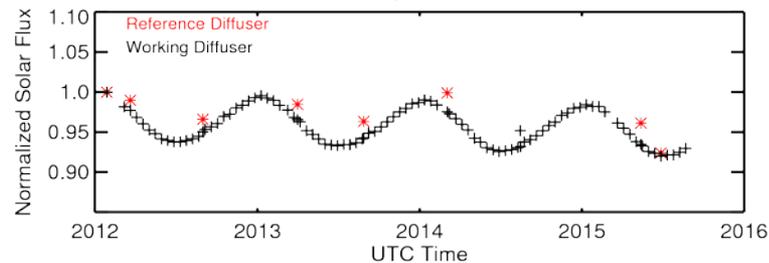
SNPP OMPS Nadir Profiler Normalized Solar Flux  
Created at 08/25/2015 - 16:00:44 UTC  
Wavelength 248nm



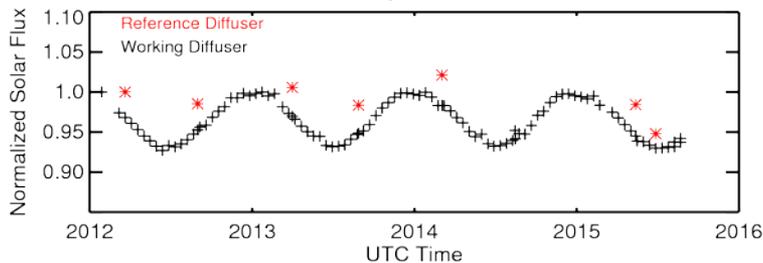
Wavelength 331nm



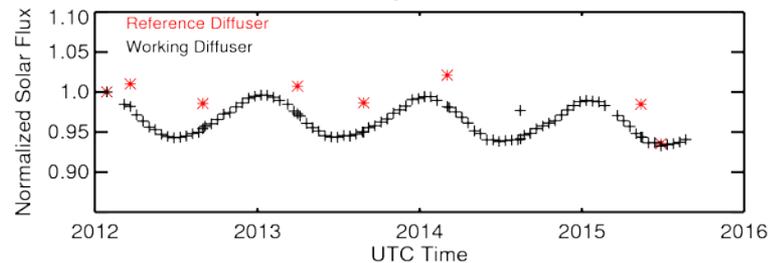
Wavelength 282nm



Wavelength 380nm



Wavelength 303nm

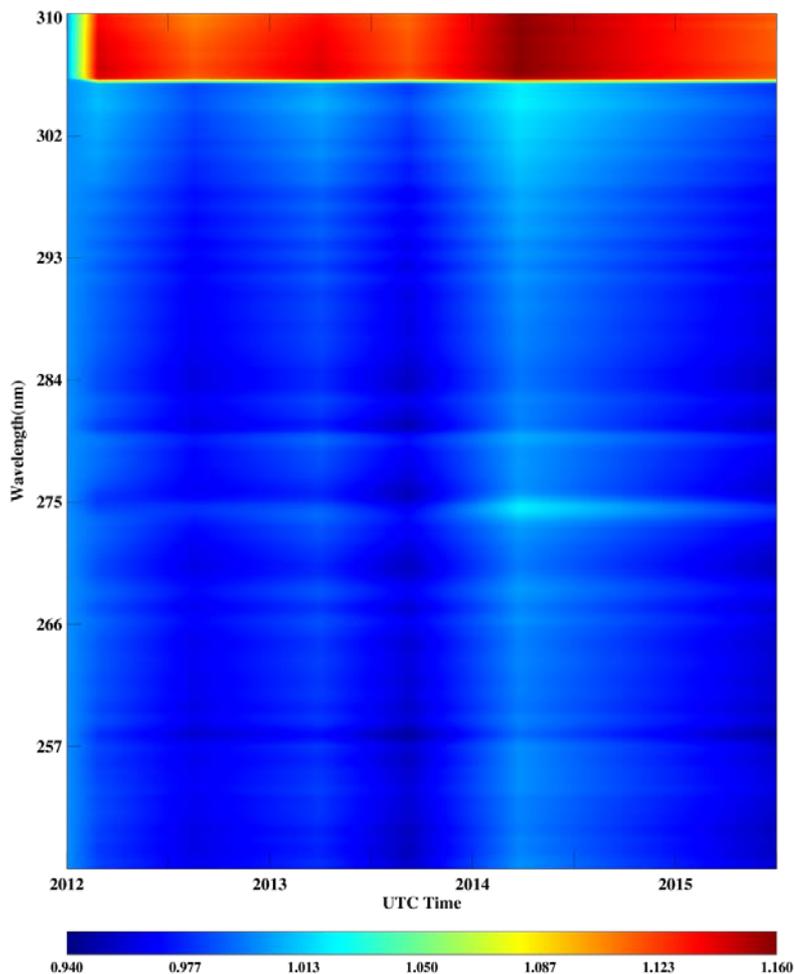


Solar Flux value are normalized by the first day measurement. Solar Flux Measurements show minimal degradation in NM and NP. These plots show the expected patterns of annual cycles associated with the spacecraft orientation

# Normalized Solar Flux from NP Diffuser

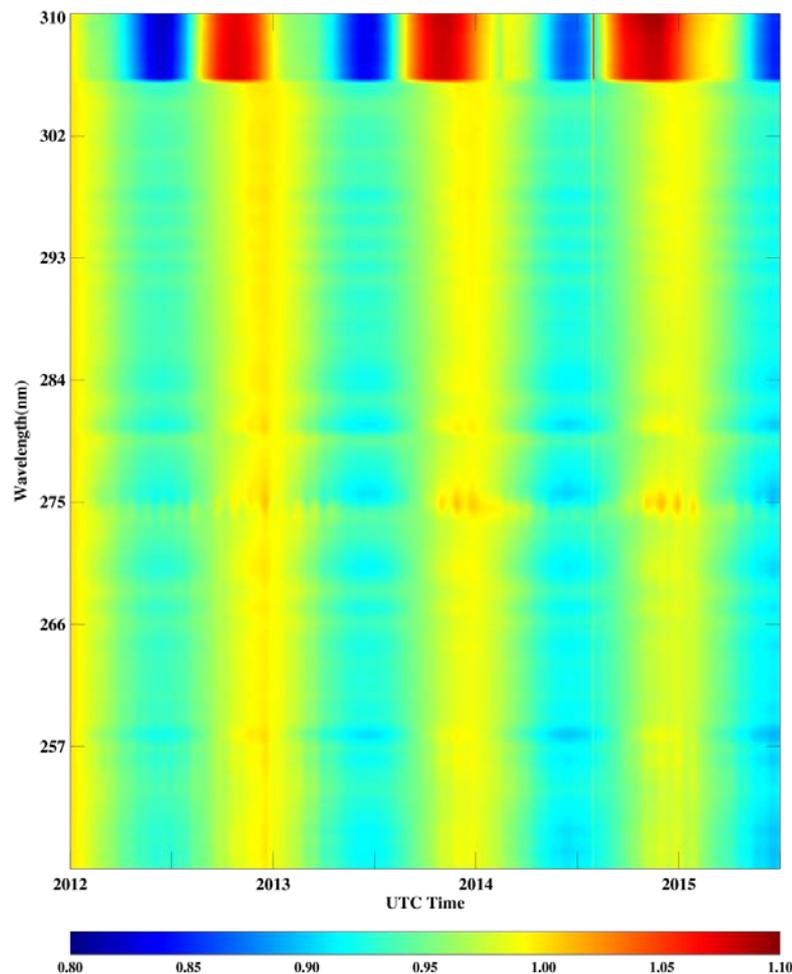
SNPP OMPS Nadir Profiler  
Normalized Reference Diffuser Solar Flux

Created at 07/24/2015 - 23:00:06 UTC



SNPP OMPS Nadir Profiler  
Normalized Working Diffuser Solar Flux

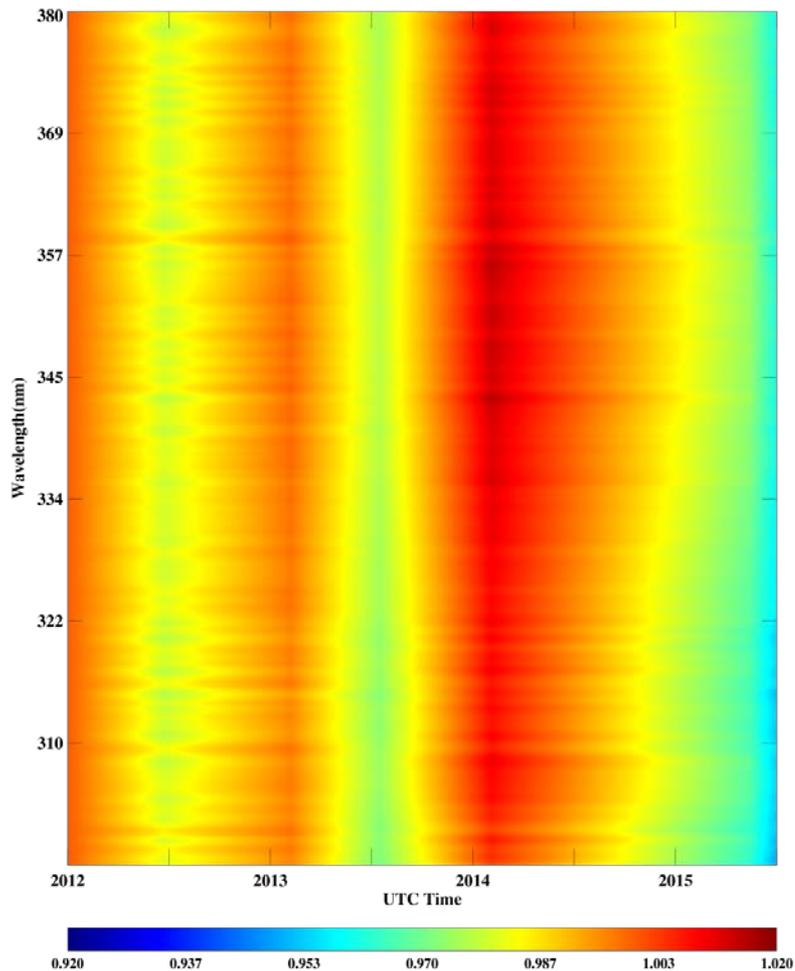
Created at 07/24/2015 - 23:00:16 UTC



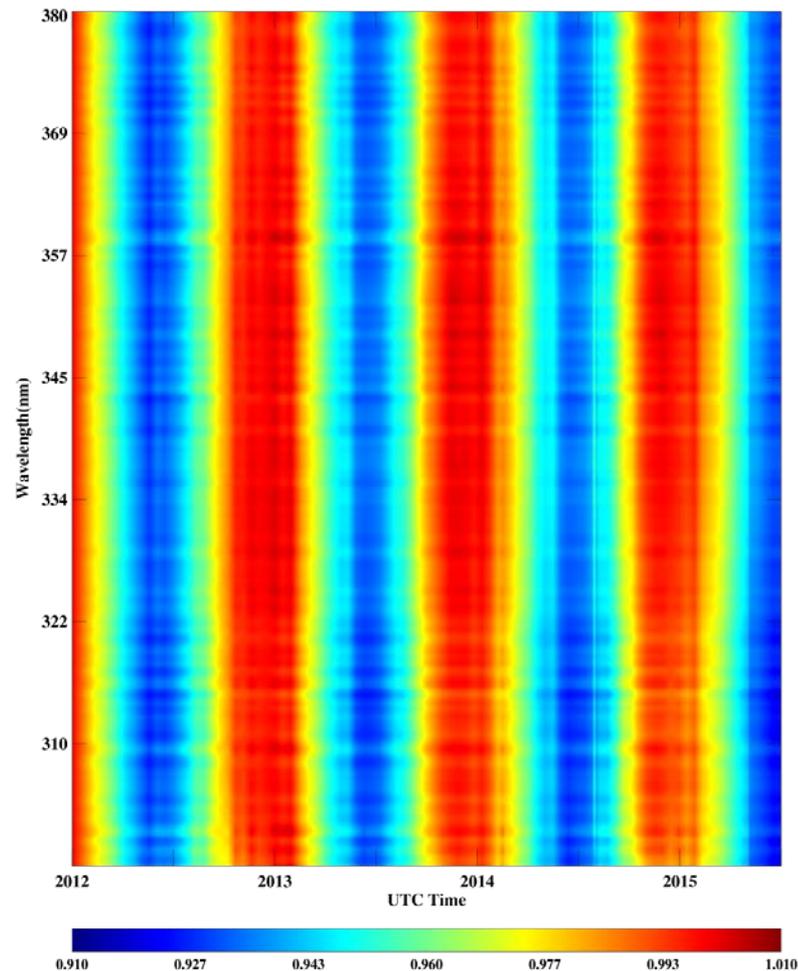
Solar Flux value are normalized by the first day measurement.

# Normalized Solar Flux from NM Diffuser

SNPP OMPS Nadir Mapper Diffuser Position 1  
Normalized Reference Diffuser Solar Flux  
Created at 07/24/2015 - 15:18:46 UTC



SNPP OMPS Nadir Mapper Diffuser Position 1  
Normalized Working Diffuser Solar Flux  
Created at 07/24/2015 - 15:19:08 UTC



Solar Flux from NM diffuser position 1 and normalized by the first day measurement.

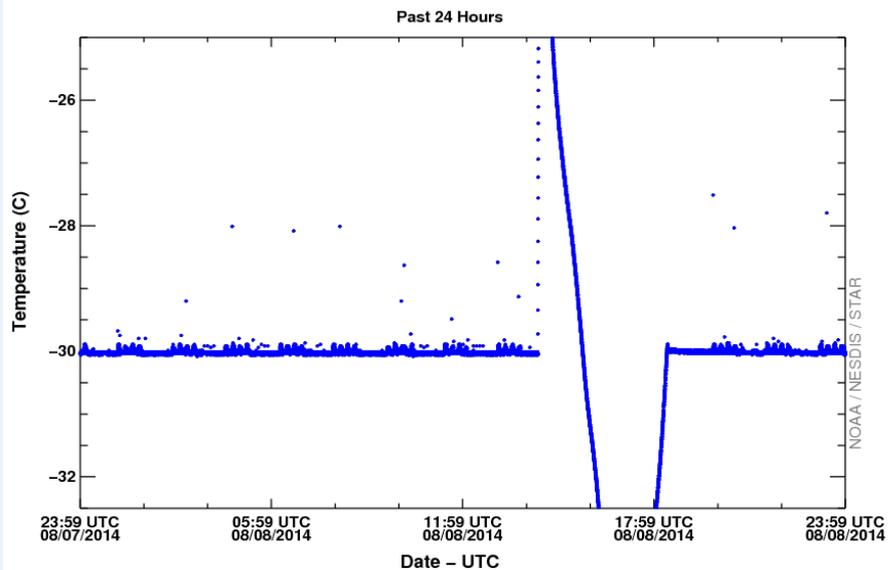


# Health and Safety Related Parameters

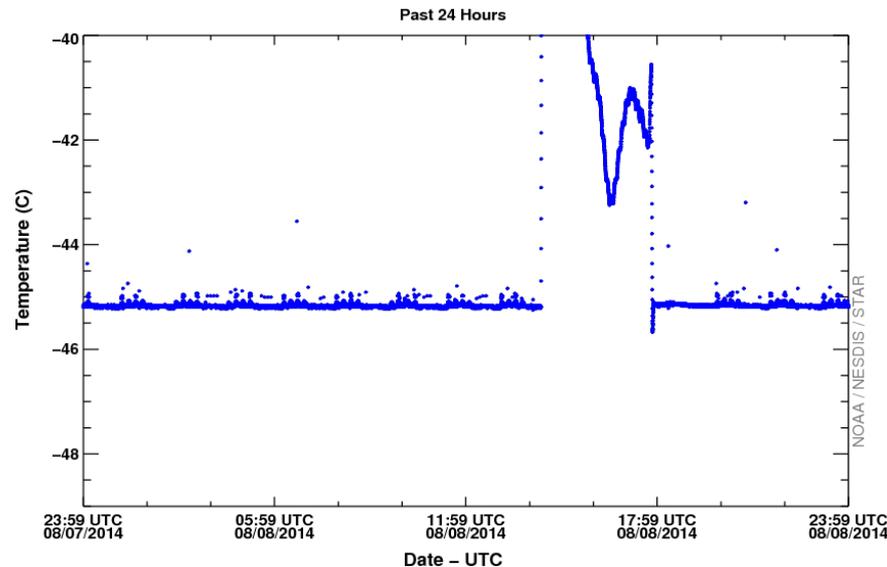


ICVS monitoring of parameters important to instrument health and safety, such as temperatures, electronic voltages and currents, and scan motor encoder output.

Suomi NPP OMPS Nadir Mapper  
Temperature: CCD  
Updated: 08/12/2014 - 05:22:13 UTC



Suomi NPP OMPS Nadir Profiler  
Temperature: CCD  
Updated: 08/12/2014 - 05:22:14 UTC





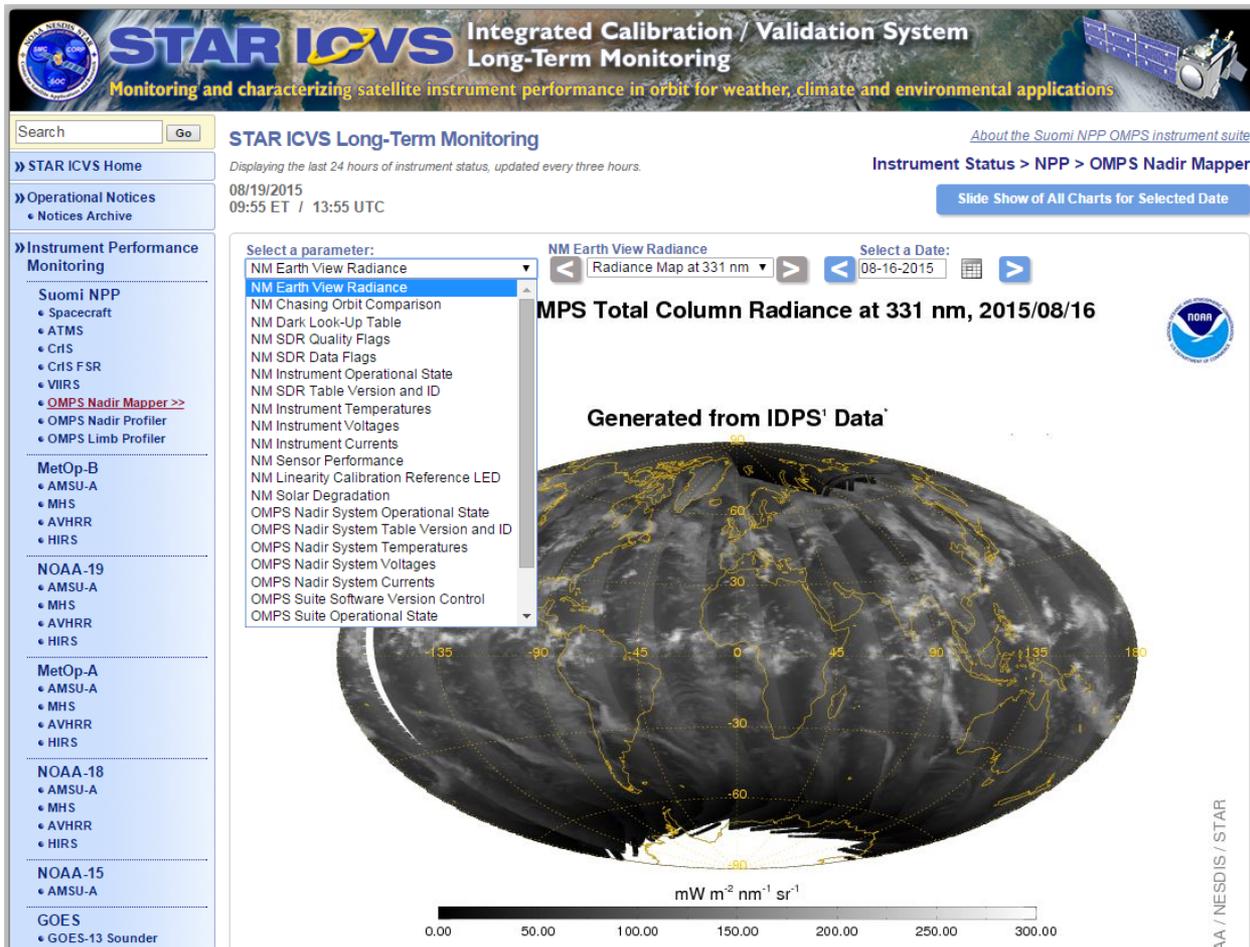
# Introduction



Module	Parameters	Description
OMPS SDR	EV Radiance	Global radiance map
	Sensor Performance	Average and standard of Dark current, offset, smear
	Chasing Orbit Comparison	Reflectance comparison between SBUV/2 and OMPS
	SDR Quality Flags	solar eclipse events
	Dark Look-Up Table	Dark LUT statistics
	Linearity Calibration Reference LED	Reference LED counts statistics: left side, right side, earth view, full frame
	Solar Degradation	Solar flux Working diffuser and reference diffuse
OMPS RDR	SDR Data Flags	Linearity correction, gain correction, bin imager, reorder image
	Instrument Operational State	Fixed coadd count,
	SDR Table Version and ID	Gain correction, linearity correction, sample
	Instrument Temperatures	Housing, window, conduction bar, CCD
	Instrument Voltages	TEC error
	Instrument Currents	TEC, CCD output reset bias, CCD output drain bias
	OMPS Nadir System Operational State	Active Nadir Profile ID
	OMPS Nadir System Table Version and ID	Active timing pattern table version, timingpattern table ID
	OMPS Nadir System Temperatures	Signal board, timing board,telescope, calibration housing, diffuser motor
	OMPS Nadir System Voltages	CCD, signal board, timing board
	OMPS Nadir System Currents	Phase A motor drive, phase B motor drive
	OMPS Suite Software Version Control	Flight software version
	OMPS Suite Operational State	Calibration LED state, active main electronics box side
	OMPS Suite Temperatures	Motor driver board, SBC board, processor interface board
	OMPS Suite Voltages	TEC driver/reference, motor driver, CPE, motor/resolver electronics
	OMPS Suite Currents	Active calibration LED, CPE, TEC total

# Introduction

Near real-time and long-term performance monitoring for SNPP/OMPS since 2011



[http://www.star.nesdis.noaa.gov/icvs/status\\_NPP\\_OMPS\\_NM.php](http://www.star.nesdis.noaa.gov/icvs/status_NPP_OMPS_NM.php)



# Summary and Future Plan



- Comprehensive near real time and long term instrument status and performance monitoring
- Real time support for sensor calibration activities
- Automated anomaly detection and email warnings are established for radiance and key performance parameters
- New parameters will be monitored according to requirements from OMPS SDR team
- J1 proxy data will be tested