Suomi NPP OMPS EV SDR Provisional Product Review

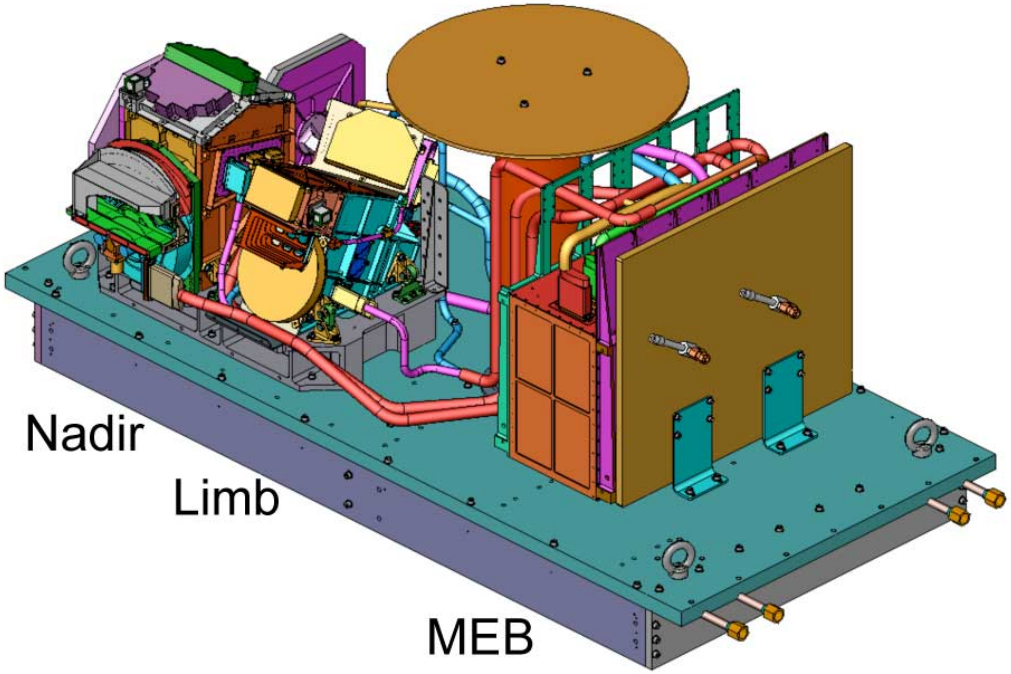
Fred Wu, OMPS SDR Team

NOAA/NESDIS/STAR

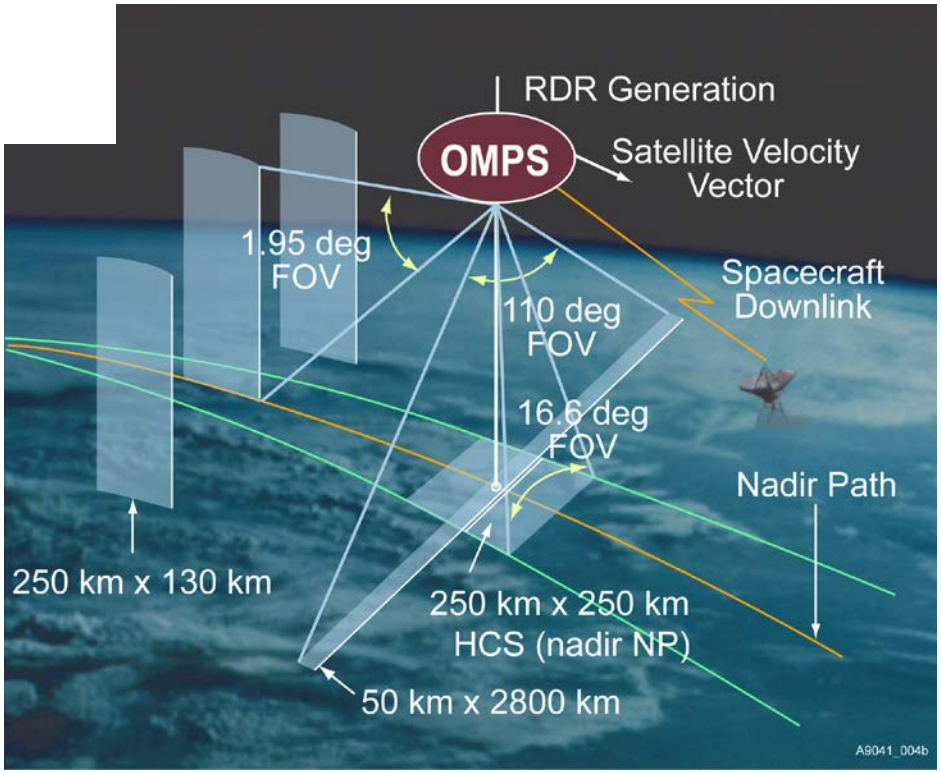
October 23, 2012

OMPS

Ozone Mapper Profiler Suite



Global and daily monitoring of three dimensional distribution of ozone and other constituents



Nadir Mapper

Grating spectrometer, 2-D CCD
110 deg. cross track, 300 to 380 nm spectral, 1.1nm FWHM bandpass

Nadir Profiler

Grating spectrometer, 2-D CCD
Nadir view, 250 km cross track, 270 to 310 nm spectral, 1.1 nm FWHM bandpass

Limb Profiler

OMPS Products

IDPS produces 18 types of Data Record from OMPS nadir instruments:

- 9 RDRs
- 6 SDRs
  - 2 Calibration SDR
  - 2 Calibration SDR GEO
  - 2 Earth View (Science) SDR – focus of the review
- 2 EDRs and 1 IP

Team Members' Roles & Responsibilities

Name	Organization	Task
X. Wu	NOAA/NESDIS/STAR	SDR Team Lead
L. Flynn	NOAA/NESDIS/STAR	EDR Team Lead
G. Jaross	SSAI	Technical Lead
S. Janz	NASA/GSFC	Instrument
M. Caponi	Aerospace	Algorithm Manager
N. Baker, M. Denning, T. Kashita, W. Thomas	DPA/DPE	DPA/DPE
C. Pan	UMD	SDR Team Lead Support
B. Sen, M. Novicki, W. Li	NGAS	Calval
S. Miller, W. Johnsen, J. Cram, W. Ibrahim, M. Montgomery-Seaman, P. Smit, D. Stuhmer, N. Anderson, D. Cumpton, N. Emmert	RTN/CGS	Algorithm
R. Buss	RTN/O&S	Data quality
S. Lipscy, K. Brownsberg	BATC	Instrument

Milestones

- 2011-10-28: Launch
- 2012-01-27: Door open, 1st image
- 2012-03-12: Beta status for EV SDR (45 days after door open)
- 2013-03: Scheduled Provisional (15 months after launch)
  - Now to review the status and identify the path to the goal

Criteria for Provisional Maturity

Provisional
Product quality may not be optimal
Incremental product improvements are still occurring as calibration parameters are adjusted
Version control is in affect
General research community is encouraged to participate in the QA
Users are urged to consult the SDR product status documents prior to use of the data in publications
Ready for operational evaluation

Milestones Toward Provisional

- Instruments performance
- Version track and baseline
- SDR quantity (production)
- SDR quality (cal/val)

Instrument Performance – NM

Requirement	Specification/Prediction Value	On-Orbit Performance
Non-linearity	< 2% full well	< 0.46%
Non-linearity Knowledge	< 0.5%	~0.1%
On-orbit Wavelength Calibration	< 0.01 nm	average ~0.01 nm RMS
Stray Light NM Out-of-Band + Out-of-Field Response	≤ 2	average ~± 2%
Intra-Orbit Wavelength Stability	<0.02 nm	< 0.013 nm
SNR	>1000	> 1000 from SV and EV
Inter-Orbital Thermal Wavelength Shift	<0.02 nm	<0.013 nm
CCD Read Noise	<60 –e RMS	< 25 –e RMS
Detector Gain	>46	~42
Absolute Irradiance Calibration Accuracy	< 7%	5%
Absolute Radiance Calibration Accuracy	< 8%	< 5%

Instrument Performance – NP

Requirement	Specification/Prediction Value	On-Orbit Performance
Non-linearity	< 2% full well	< 0.46%
Non-linearity Knowledge	< 0.5%	~0.1%
On-orbit Wavelength Calibration	< 0.01 nm	
Stray Light NM Out-of-Band + Out-of-Field Response	≤ 2	average ~± 2%
Intra-Orbit Wavelength Stability	<0.02 nm	< 0.013 nm
SNR	>1000	> 1000 from SV and EV
Inter-Orbital Thermal Wavelength Shift	<0.02 nm	<0.013 nm
CCD Read Noise	<60 –e RMS	< 25 –e RMS
Detector Gain	>43	~45
Absolute Irradiance Calibration Accuracy	< 7%	1~10% , average: ~7%
Absolute Radiance Calibration Accuracy	< 8%	< 5%

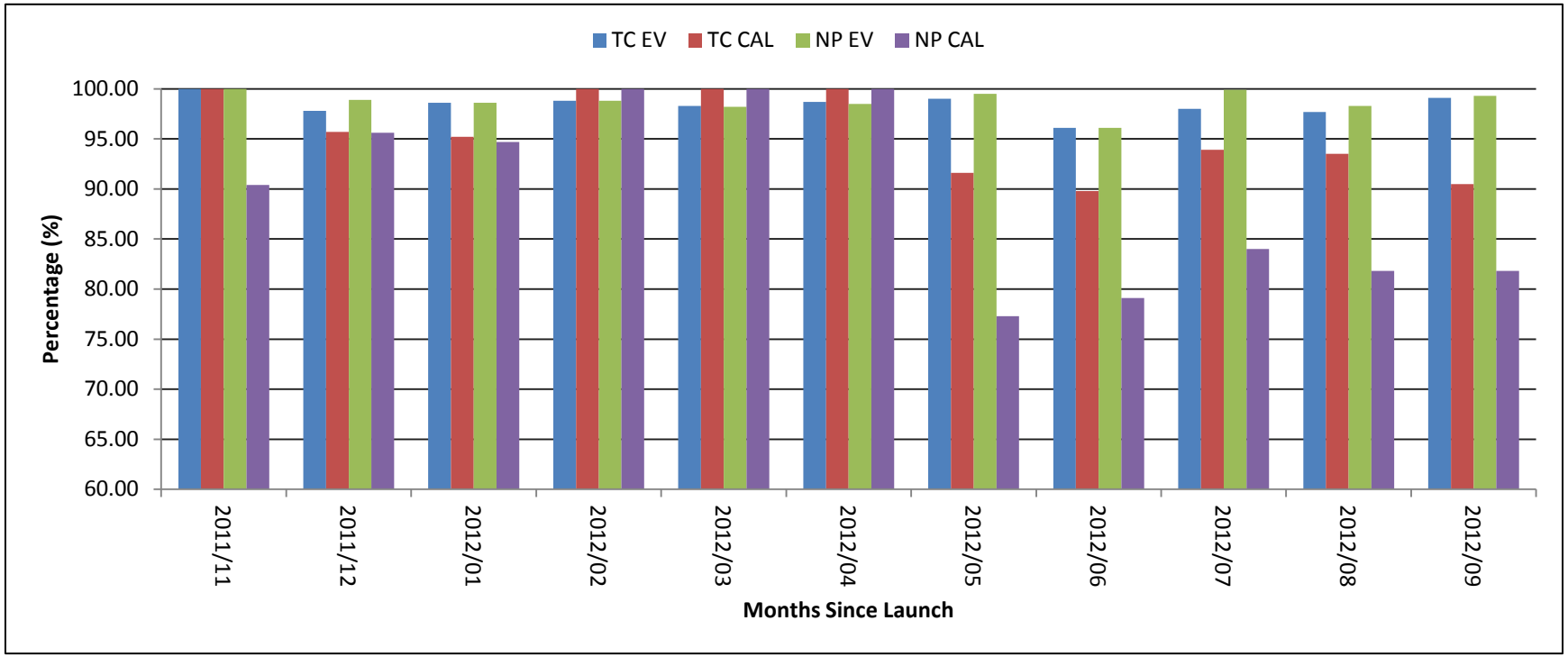
C. Pan

Version Track and Baseline

- Software version follows IDPS Build number (currently Mx6.3).
- One code change was implemented successfully without impact on data
  - Mx6.3, Aug 2012, severe CAL and EV SDR.
- Two calibration updates were implemented successfully with the expected impacts on data
  - Day 1 solar, May 2012
  - Wavelength scale, June 2012
- Operational status is tracked at the Satellite Operation Center (SOC, http://ozoneaq.gsfc.nasa.gov/omps).

Percent of OMPS RDR

correctly retrieved from CLASS to PEATE since launch



- Most important to users.
- Not necessarily the only way to evaluate

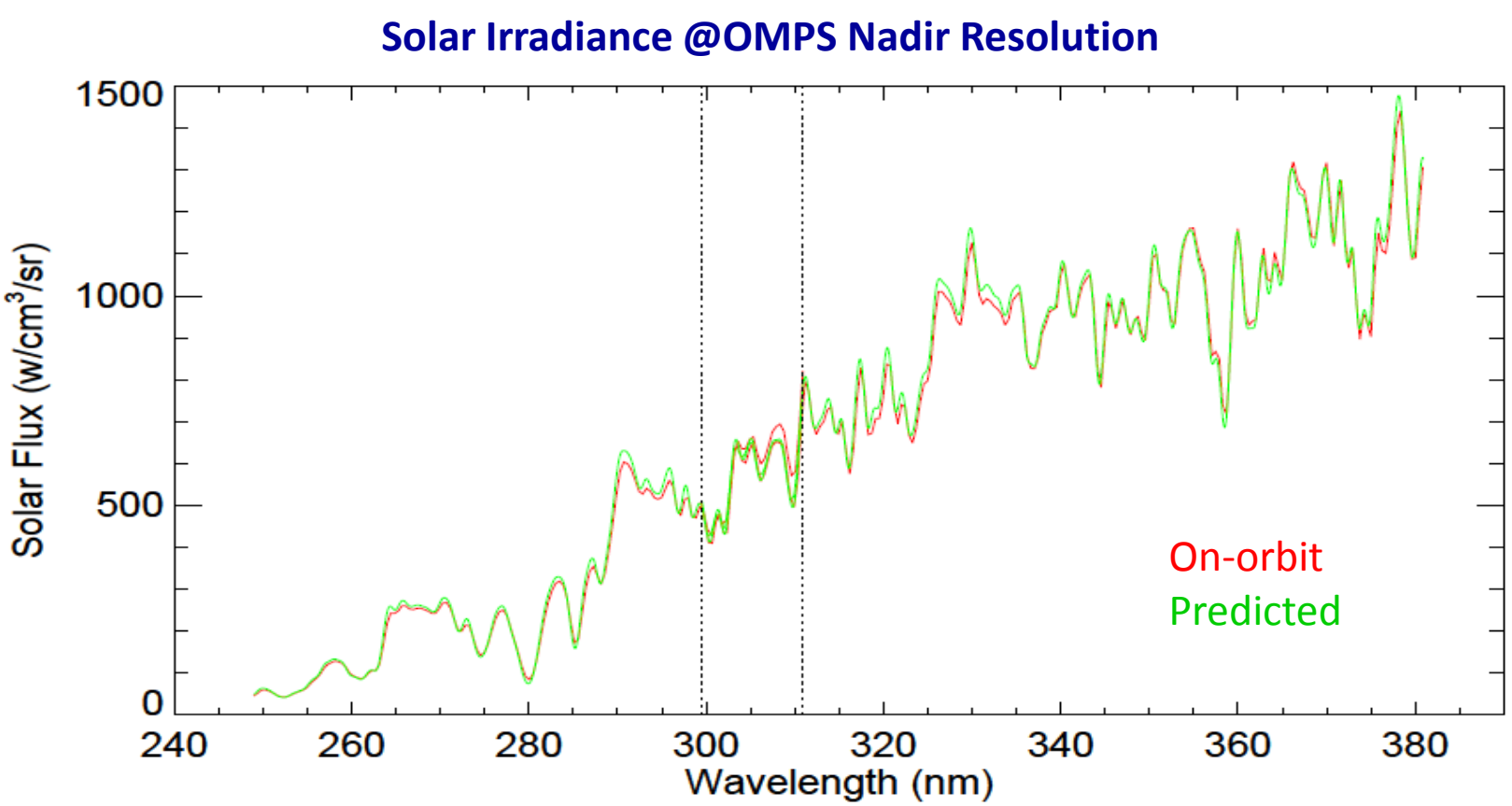
R. Mundakkara

OMPS Progress since Beta

1. Update the Darks
2. Update the Day 1 Solar
3. Update the wavelength scale
4. Optimize performance in SAA
5. Correct for stray light
6. Correct for errors in smear
7. Monitor nonlinearity
8. Enhance product in high resolution

Completed – Non-critical – Critical to Provisional

On-orbit Observed Solar Flux

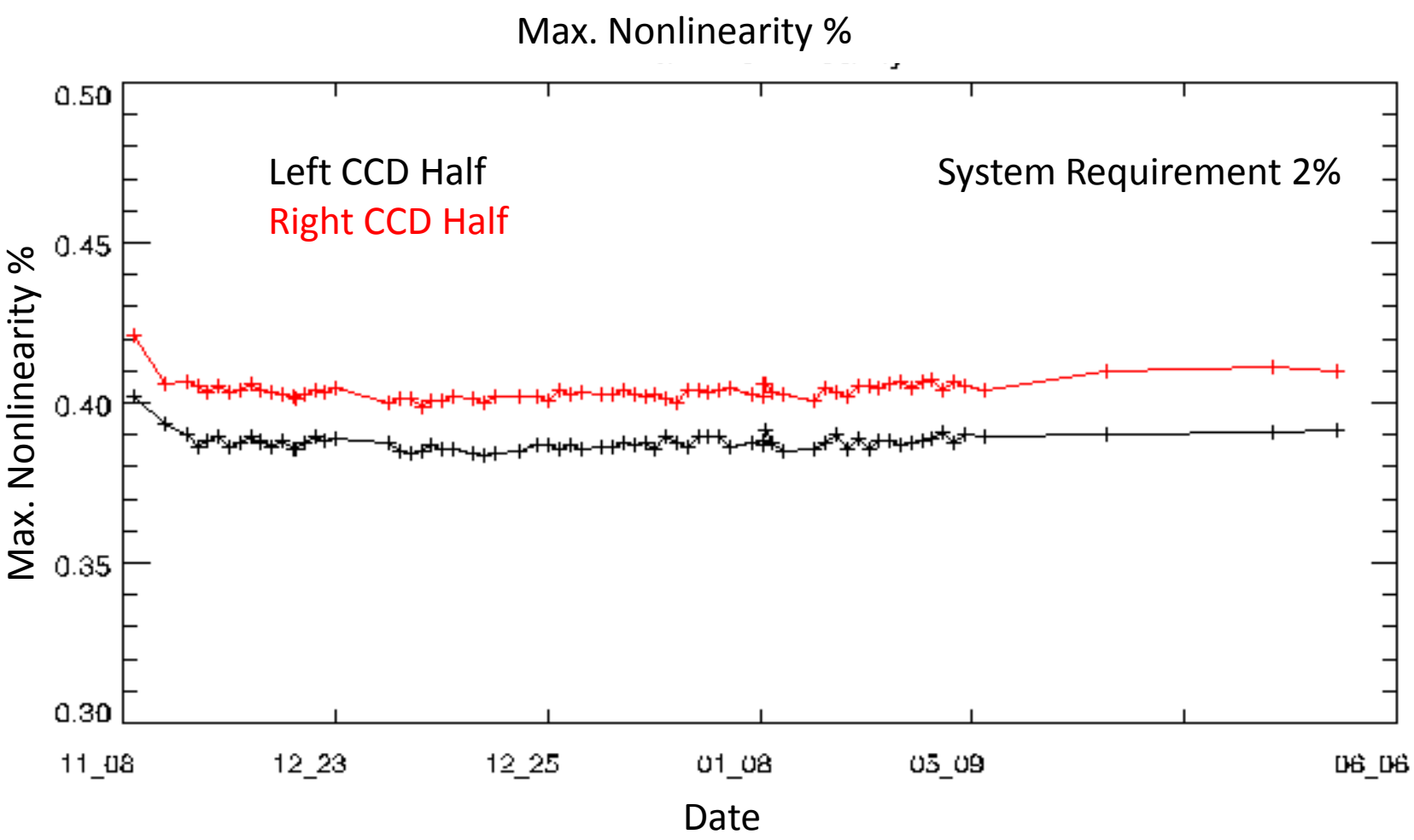


Observed solar irradiance is within ~2% of predicted synthetic solar spectra:

- NM is on average ±4% with small scale variations
- NP is less than 2% on average with several percent variations

C. Pan

On-orbit Linearity Performance



Measurement GMT changed 3 times: Nov. 08 – Mar. 09; May 29 – June 06; July 4-current
OMPS linearity is **exceptionally** stable

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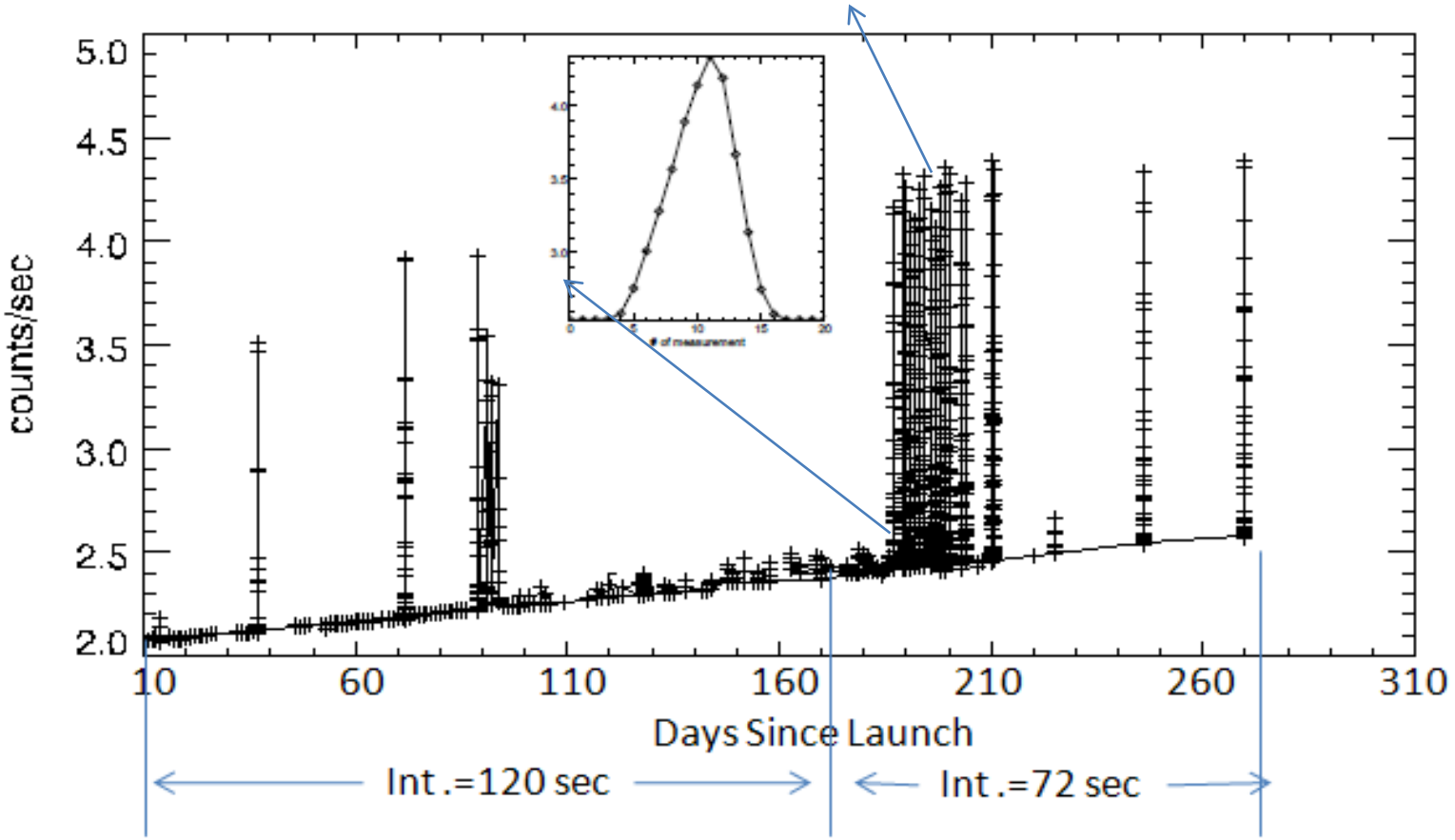
On-orbit Dark Current Performance



Dark measurement is established by optimizing various diagnostic dark cal. activities

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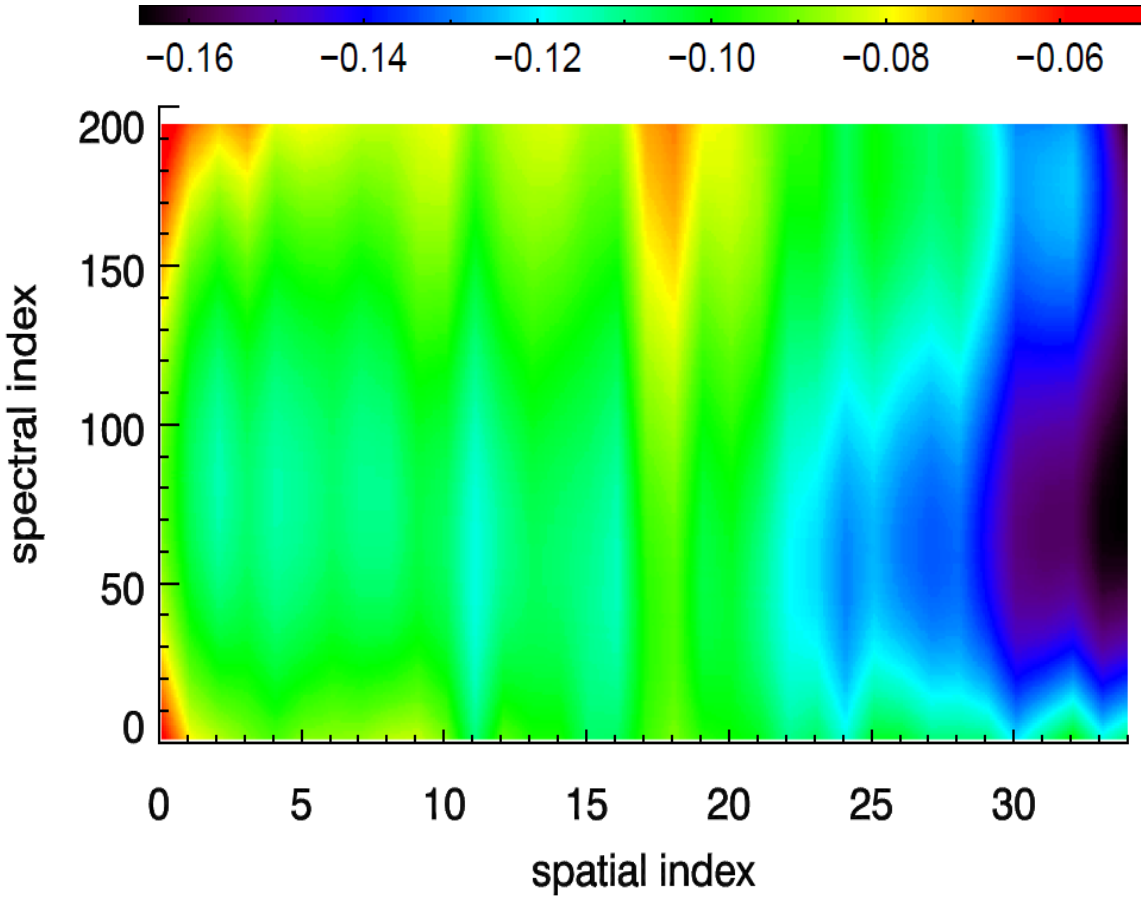
Wavelength Shifts from Ground to Orbit



Ozone Channel Wavelength Shift

Wavelength (nm)	averaged_shift (nm)
253.092	-0.058
272.835	-0.092
283.021	-0.114
288.140	-0.092
291.989	-0.086
297.992	-0.094
301.862	-0.109
306.171	-0.136
312.838	-0.114
317.855	-0.117
330.795	-0.118
339.967	-0.115
380.024	-0.093

Wavelength changed less than 0.16 nm from ground to orbit.

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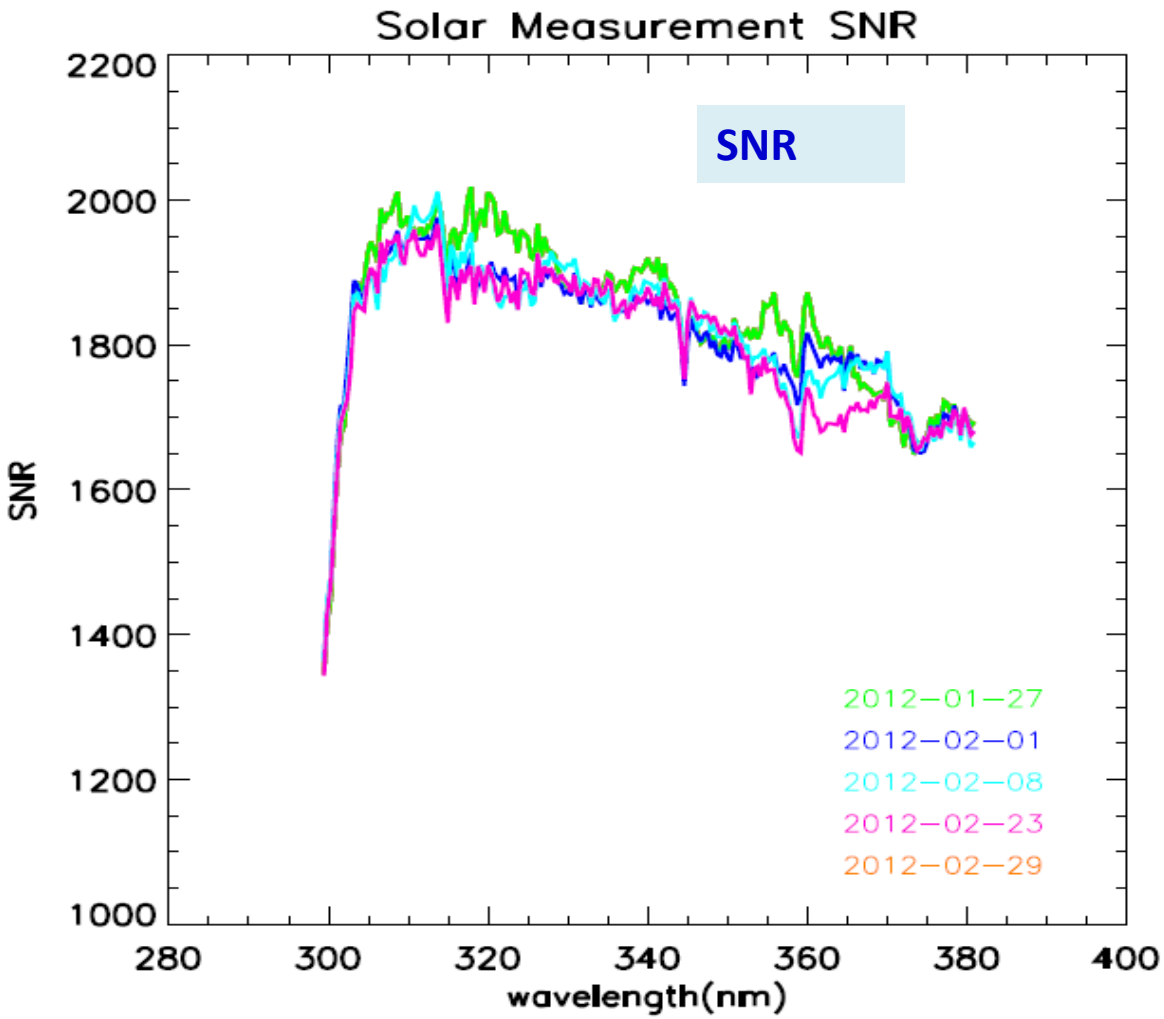
OMPS SNR Verification



Solar measurement SNR meets the system requirement of 1000

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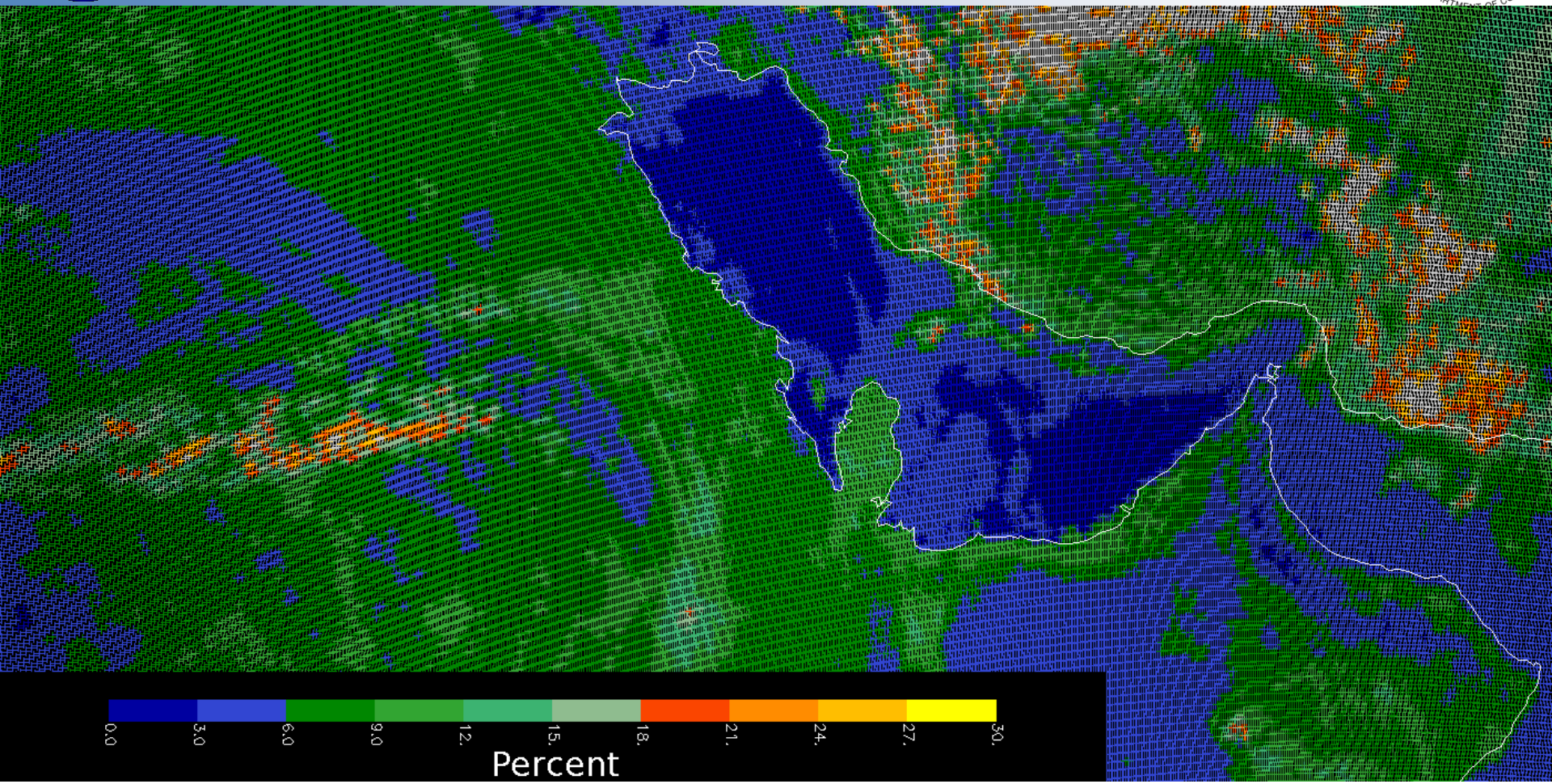
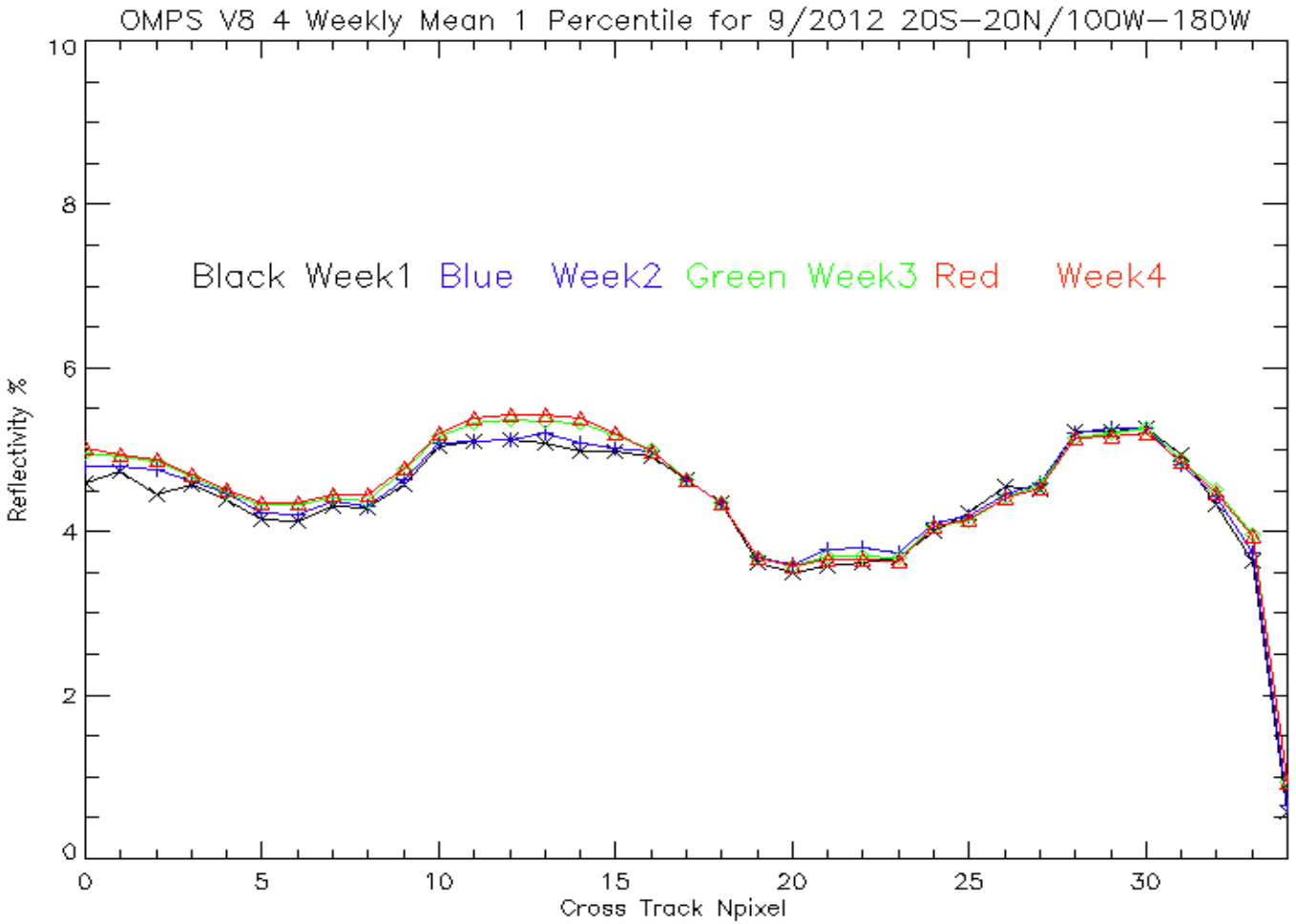
OMPS Geolocation



This image shows the effective reflectivity for the 380-nm Channel for part of an orbit of small Field-of-View (5 KM X 10 KM at Nadir) made by the OMPS Nadir Mapper in a special diagnostic mode. The Qatar peninsula sticking into the Persian Gulf in the middle of the picture lies along the nadir view of the orbital track and gives a preliminary assurance of the geolocation at better the 5 KM.

C. Seftor

OMPS Products are stable



L. Flynn & W. Yu

OMPS SDR-Related DR Status

DR Summary (YTD):
37 new SDR related DRs submitted
25 closed, including DRs submitted in previous years
19 SDR related DRs open, all have expected completion dates
Critical SDR DRs: 4

DR #	Short Description
4951	Large error in TLE geo calculation
4927	FT document 474-00181 need update
4914	OMPS TC and NP GEO
4907	TC needs Stray light correction
4906	Cal RDRs truncated
4879	NP and TC Darks need to be updated
4823	The NP stray light needs to be corrected.
4818	Smears in error - Smears show negative and unexpected values
4799	Inconsistent structure between OAD and EV SDR
4749	OMPS darks have negative values
4693	Cal SDR strategy study
4676	Radiance error associated with aggregation
4673	Correction for different linearity slope Tup for CCD2
4672	Linearity correction update for xml file
4671	OMPS Data quality threshold tables non existence for SDR
4627	Quantization introduced by linearity correction error - Cal SDR
4615	Transient filter issue
4602	Spatial pixel mismatch in Cal SDR
4536	Sample table to include extra pixel to monitor stray light

M. Caponi

Milestones Toward Provisional

- Instruments performance
  - Very good in general. A few evaluations to be completed.
- Version track and baseline
  - Established
- SDR quantity (production)
  - Reasonable, to be further evaluated separately
- SDR quality (cal/val)
  - Subject to the resolution of 3 critical issues (4 DR's): Darks; Stray light; and Smear

Lesson Learned from Suomi NPP OMPS

- Test IDPS early and fully
  - OMPS has often been given lower priority that does have effects.
- Provide science support for IDPS consistently
  - Transition to STAR
- Consider OMPS Special Needs
  - Highly versatile, designed for flexible operations not common to other instruments
  - Some metrics critical to other instruments may not be as important for OMPS
  - Did not focus on critical needs such as flexibility.

OMPS SDR Path Forward

- Transition critical capability to STAR
  - Enabling STAR to support IDPS
- Update Darks
  - CCD degradation has not been accounted for since Feb. 29.
- Correct for error in smear
- Correct for stray light for both NM & NP

Criteria for Provisional Maturity

Provisional		Explanation for the Provisional Maturity Assessment
Product quality may not be optimal		Correct for errors in smears (DR 4818) Correct for stray light (DR 4823 & 4907)
Incremental product improvements are still occurring as calibration parameters are adjusted		Update Darks LUT to correct for CCD degradation (DR 4799 & 4879)
Version control is in affect		Software version follows IDPS build number (currently MX 6.3). Operation status is tracked at the SOC (http://ozoneaq.gsfc.nasa.gov/omps).
General research community is encouraged to participate in the QA		Available from CLASS since March 12, 2012.
Users are urged to consult the SDR product status documents prior to use of the data in publications		A Readme file will be provided with the Provisional Release, as did with Beta Release, that contains the known caveats
Ready for operational evaluation		ATBD is up to date and calibration uncertainty will meet the requirements.

Summary

- OMPS instrument performance is excellent
- OMPS EV SDR from IDPS has not taken full advantages of that performance
- Recommend to resolve three critical issues before OMPS EV SDR becomes Provisional:
  - Darks
  - Smear
  - Stray light