Suomi NPP OMPS EV SDR Task Overview

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Suomi NPP SDR Product Review
NOAA Center for Weather and Climate Prediction (NCWCP)
5830 University Research Park, College Park, Maryland
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Outlines

- OMPS SDR Team
- Resolution of Issues from Provisional
- OMPS SDR Cal Val Activities Since Provisional
- OMPS SDR DR Status
- Justification for OMPS EV SDR to be Validated
- Path Forward
- Summary

OMPS SDR Team

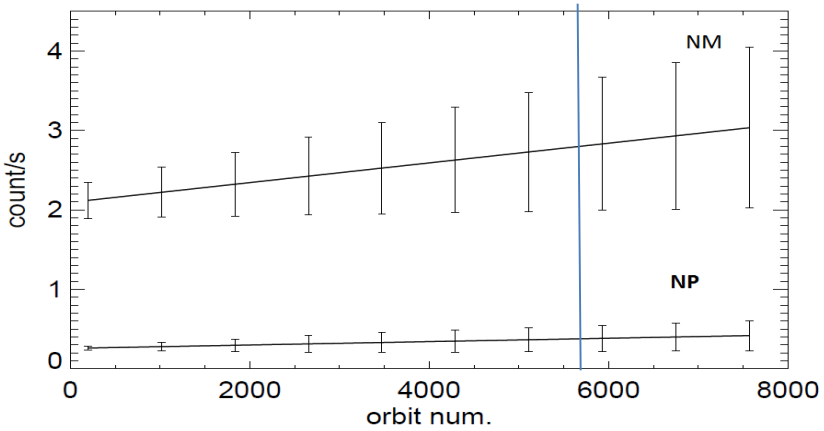
PI Name	Organization	Primary Roles
Fred Wu	NOAA/STAR	Budget and coordination; Instrument and product performance monitoring; J1 code development; TVAC data analysis; SDR algorithm.
Glen Jaross	NASA	Instrument scientist; TVAC data acquisition and analysis; SDR algorithm.
Bhaswar Sen	NGAS	G-ADA test for IDPS operations; TVAC data analysis; SDR algorithm.
Maria Caponi	Aerospace	Algorithm changes coordination; DR and issues tracking
Daniel Cumpton	Raytheon	IDPS operations

Resolution of Issues from Provisional

- Review Panel Findings (24 Oct 2012):
  - 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:
    - Update Darks
    - Resolve Negative Smear
    - Stray Light Correction for NM
- Follow-up Actions:
  - Discussed path forward with AERB in Nov 2012.
  - Resolved issues.
  - Provisional since 1 Mar 2013 (Mx6.6).

Critical Issue #1 – Darks Update

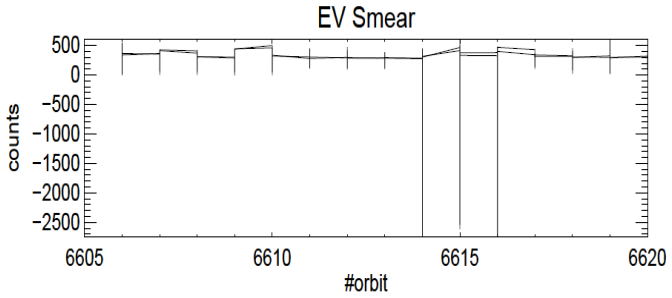
- Routine update of the dark current
  - Implemented weekly update
    - Since 21 Dec 2012 for NM and 7 Feb 2013 for NP
    - All updates have been successful, including holidays but except for the three weeks when the government was shut down
  - Work is under way to automate the process by transitioning the operation to GRAVITE

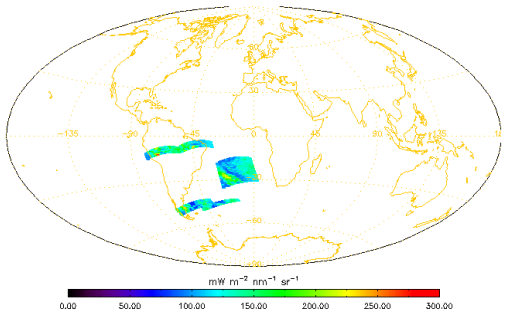


Details in Pan's presentation

Critical Issue #2 – Negative Smear

- Occasional negative smear was observed
  - Identified the root cause in Feb 2013
    - SAA DARKS was used inadvertently
    - When the predicted SAA intensity is 20% of its normal maximum.
    - Which causes negative smear.
  - Implemented the correction in May 2013
    - CCR 0952 was approved in March 2013.
    - Correction was implemented as part of Mx6.7 in May 2013.
  - Can also be caused by the fixed bias (DR7315 for NM and DR4818 for NP).
    - Rare event, minimal impact, low priority.





Critical Issue #3 – NM Stray Light

- Implement stray light correction for NM
  - Correction was recommended in Feb 2013
  - Interim correction in July as part of Mx7.0
  - Complete correction in Aug as part of Mx7.2
- Stray light correction for NP
  - Approved 6 Nov 2013
  - To be implemented in Mx8.3
- Details in Jaross presentation

OMPS Cal Val Tasks Since Provisional

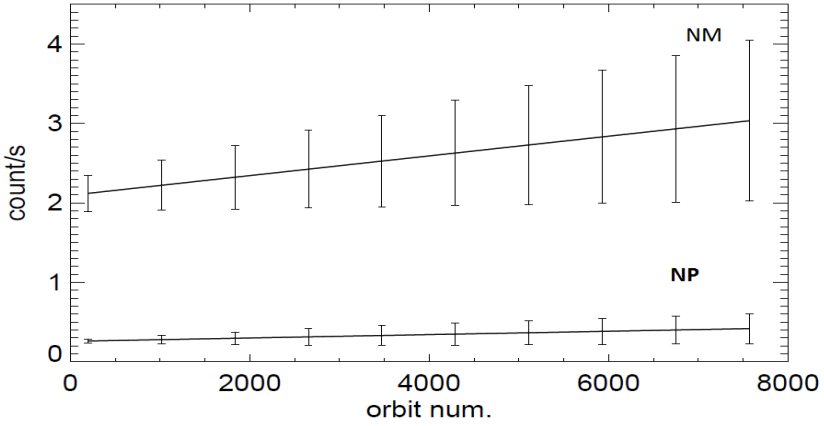
- Resolved the issues and reached Provisional
- Improved SDR algorithm and software
- Characterized and continue monitoring OMPS instrument and SDR performance
- Implemented radiometric and spectral calibration
- Documented the progress

SDR Algorithm and Software

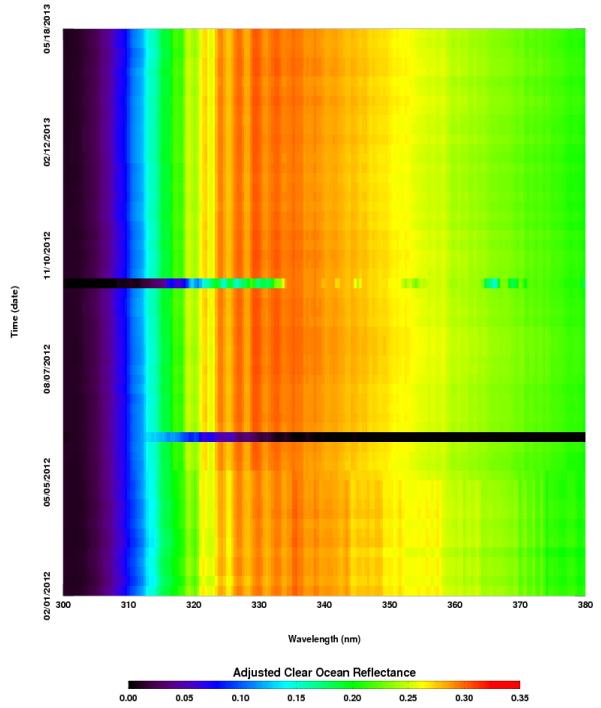
- Stray light correction for NM
  - Planned pre-launch, based on radiance
  - Post-launch, the SDR team concluded that a count-based correction is superior.
  - Modification of the code (CCR-13-0883), LUT, and ATBD was completed.
- Stray light correction for NP
  - Not planned pre-launch but recognized as necessary post-launch
  - Approved as CCR-13-1249 (to be implemented with Mx8.3).
- Details in Jaross presentation.

Instrument and SDR Performance

- Characterize and monitor OMPS nadir instrument performance – Pan presentation.



- Characterize and monitor OMPS nadir SDR performance – Wu presentation.



Radiometric and Spectral Calibration

- Improved the radiometric calibration of OMPS nadir instruments
  - Routine update of dark current
  - Inhibited the SAA dark
  - Stray light correction
- Improved the spectral calibration of OMPS nadir instruments
  - Wavelength registration – details in Flynn presentation

Documentation – Peer Reviewed

Flynn, L., and co-authors, 2013: Accepted by JGR (2013JD020467R).

Jaross, G., and co-authors, 2013: Submitted to JGR (2013JD020482R).

Pan, C.; Kowalewski, M.; Buss, R.; Flynn, L.; Wu, X; Caponi, M.; Weng, F, "Performance and Calibration of the Nadir Suomi-NPP Ozone Mapping Profiler Suite From Early-Orbit Images," *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, vol.6, no.3, pp.1539,1551, June 2013 doi: 10.1109/JSTARS.2013.2259144.

Seftor, C., and co-authors, 2013: Submitted to JGR (2013JD020472R)

Wu, X., and co-authors, 2013: Submitted to JGR (2013JD020484R)

Documentation - Other

- Presentations in this review
  - Pan: OMPS nadir instrument performance
  - Jaross: Stray light correction
  - Flynn: Wavelength registration
  - Wu: OMPS nadir SDR evaluation
  - Long: NOAA user feedback
  - Yang: NASA user feedback
- OMPS SDR User's Guide (to be delivered)
- OMPS ATBD
- Error budget

OMPS SDR DR Status

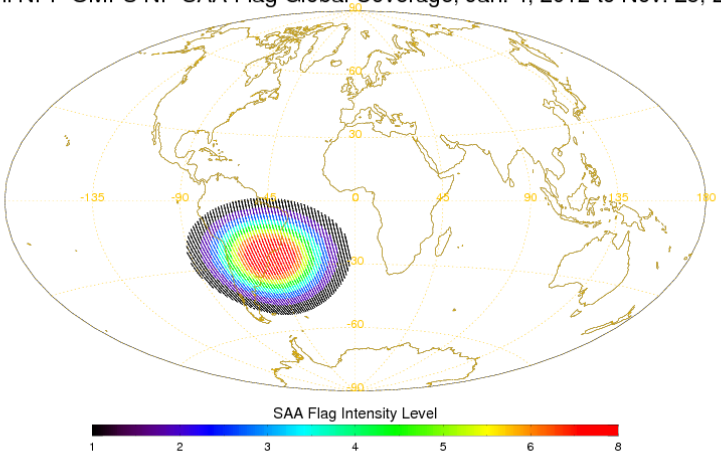
- 12 DRs remain open since Provisional:
  - All are related (one indirectly) to CAL SDR that will be closed or resolved after the CAL SDR operation is transitioned to GRAVITE.
- 122 DRs were submitted since Provisional:
  - 90 were associated with NM & NP DARKS GRN-PI update, for which CCR have been implemented.
  - 12 led to CCRs
    - Ten were approved
    - One (CCR-13-1416) to be reviewed by AERB
    - One withdrawn (version description document will be included in documentation and configuration managed).
  - 20 are in progress
    - Three are associated with J1 requirements
    - 17 are not critical for validated maturity
- Details in backup slides.

OMPS SDR Processing Status (1)

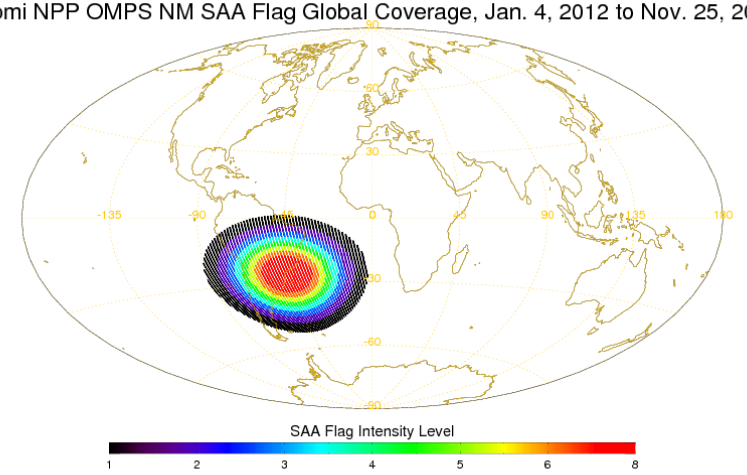
- IDPS
  - Current version Mx8.0
- ADL
  - Code updated to Mx8.1 (to be operational Feb 2014).
  - Capable of parallel processing or re-processing of SDRs.
- Quality Flag
  - SAA and SolarEclipse: Work well.
  - OutDatedCal: Need to update the CDFCB (DR7480, PCR 36737)
  - LinearCorrection: Corrected with Mx6.2.
  - QualityEarth: Obsolete.
  - SunGlint: Need investigation (not used).

SAA Flag Location and Frequency

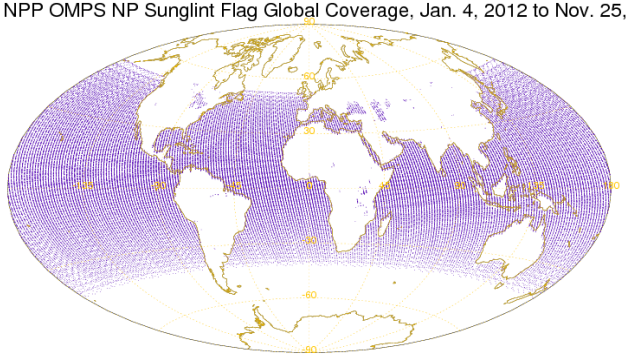
Suomi NPP OMPS NP SAA Flag Global Coverage, Jan. 4, 2012 to Nov. 25, 2013



Suomi NPP OMPS NM SAA Flag Global Coverage, Jan. 4, 2012 to Nov. 25, 2013



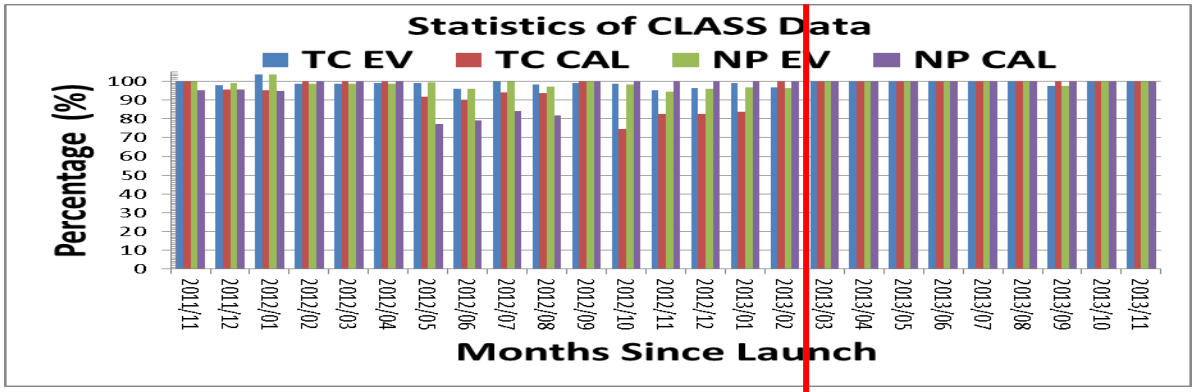
Suomi NPP OMPS NP Sunglint Flag Global Coverage, Jan. 4, 2012 to Nov. 25, 2013



NP Sun glint (NM similar)

OMPS SDR Processing Status (2)

- Data Completeness
  - One incident (Orbit 5856, 12 Dec 2012) of missing RDR:
    - 1 NM, 2 NP, and 2 LP granules of RDR were not delivered to CLASS.
    - Corresponding SDR were available.
    - Root cause: S/C diary not available at the time of RDR packaging.
    - WR was rejected because it happened only once with minor impact (not on SDR).
  - One incident of duplicate orbit:
    - 27 Jun 2013, due to a cold restart of DDS.
  - One incident due to CrIS Full Resolution test
    - 2013-03-12. Revealed the deficiency in handling swath with some packets missing. PCR34944 is being worked at low priority.



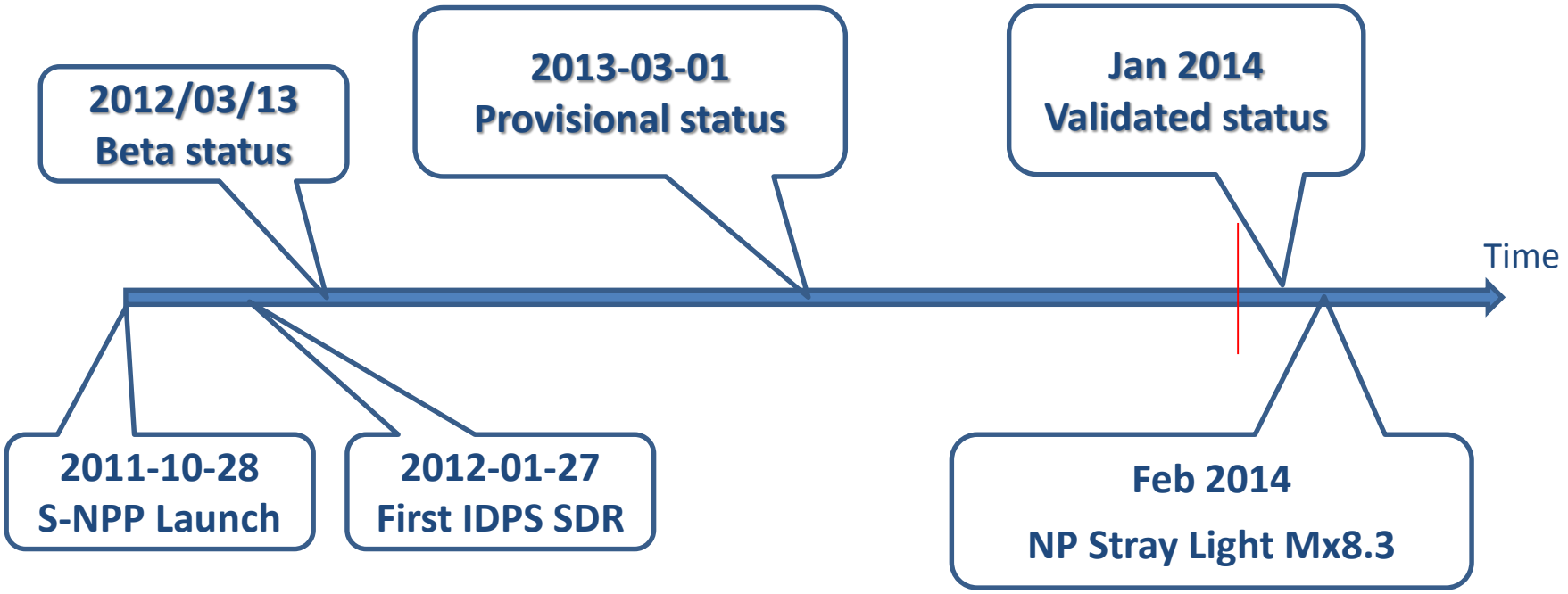
Justification for OMPS EV SDR to be Validated

- Requirements (Performance Since Provisional)
  - Instrument: **meeting specifications with adequate margins.**
  - SDR: **stable (quality and quantity)** and free of major errors.
- SDR software
  - IDPS has been producing satisfactory products.
  - Incremental improvements are planned and will continue.
- Documentation
  - 7 presentations in this meeting
  - 5 Journal papers
  - ATBD
  - SDR User's Guide (to be provided)
  - Error Budget table
- Applications:
  - **Information contents are sufficient to make positive impacts**.
  - Soft calibration is necessary, which can be applied to validated SDR.

Instrument Performance (to be elaborated by Pan)

Parameters	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	NM: average ~ 0.01 nm RMS
Stray Light NM Out-of-Band + Out-of-Field Response	For NM ≤ 2	average ~ ± 2%
Intra-Orbit Wavelength Stability	Allocation (flow down from EDR error budget) = 0.02 nm	< 0.013 nm
SNR	1000	> 1000 from SV and EV
Inter-Orbital Thermal Wavelength Shift	Allocation (flow down from EDR error budget) = 0.02 nm	0.013 nm
CCD Read Noise	60 –e RMS	< 25 –e RMS
Detector Gain	43 (for NP) 46 (for NM)	45 (for NP) 42 (for NM)
Absolute Irradiance Calibration Accuracy	< 7%	average ~ 7% (5% for NM, 1~10% for NP)
Absolute Radiance Calibration Accuracy	< 8%	< 5%

IDPS OMPS SDR Cal Val Milestones



Path Forward

- Suomi NPP
  - Instrument and SDR performance monitoring, characterization, and improvement.
  - Support instrument cal/val (e.g., orbit adjustment, anomaly resolution)
  - Complete documentation (Users' Guide)
  - SDR software improvements
    - Stray light correction
    - Wavelength registration
  - Transition CAL SDR operation to GRAVITE.
- JPSS J1
  - Analyze TVAC data and derive LUT for J1.
  - Develop science code for J1
    - More wavelength and higher data rate for EV SDR
    - New algorithm for CAL SDR
  - Test data (high resolution data from S-NPP)

Summary

- With accomplishments achieved and efforts in progress, the OMPS nadir EV SDRs are found to have
  - Characterized for on-orbit sensor performance
  - Defined SDR product uncertainties over a range of representative conditions
  - Calibration parameters adjusted accordingly, pending soft calibration that can be applied to validated SDRs
  - Plan for later improved version
  - Strong versioning with documentation
  - Been ready for use in applications and scientific publication
- Request to declare that OMPS nadir EV SDR be Validated

BACKUP – LIST OF DR

12 DRs Open Since Provisional

DR #	Algorithm	Brief description	Status
4818	NP SDR	OMPS Fixed bias impact on smear and/or radiance	To be closed - Issue corrected
4693	TC and NP SDR	CAL SDR Strategy Study	To be closed - Resolved with transition to Gravite
4676	TC and NP EV SDR	Radiance error associated with aggregation of the two center macropixels	To be closed - Resolved with transition to Gravite
4673	TC and NP CAL SDR	Correction for different linearity slope Tup for CCD 2- Primary and redundant.	To be closed - Resolved with transition to Gravite
4672	TC and NP CAL SDR	Linearity correction update xml file basline	To be closed - Resolved with transition to Gravite
4671	TC and NP SDR and EDR	OMPS DQTT (DATA quality threshold tables) not existent for SDR and TBD for EDR	To be investigated - TBD
4627	TC and NP CAL SDR	Quantization introduced by linearity correction error	To be closed - Resolved with transition to Gravite
4615	TC and NP CAL SDR	Transient filter	To be closed - Resolved with transition to Gravite
4602	TC and NP CAL SDR	Spatial pixel mismatch	To be closed - Resolved with transition to Gravite
4318	OMPS TC, NP SDR CAL SDR	Subroutine Wave Monitor uses spectral range to bound spatial index	To be closed - Resolved with transition to Gravite
4317	TC and NP CAL SDR	Bias calculation error	To be closed - Resolved with transition to Gravite
4316	TC and NP CAL SDR	Lamp data mapping error	To be closed - Resolved with transition to Gravite

12 DRs Led to CCRs

DR #	CCR #	Description	AERB DATE	STATUS
4536	12-0625	Sample table update to include extra pixel colum	3-Oct	Implemented
4906	12-0691	RDR truncation needs correction	10-Oct	Implemented
4955	12-0736	TC EDR CTP modifications	21-Nov	Implemented
5034	13-0822	OMPS Version System Reference for OMPS GND-Pis	6-Feb	Withdrawn – Replace as document in MIS system
5000	13-0827	SDR provisional assignment	7-Mar	Implemented
5048	13-0931	TC and NP Provisional assignment	17-Apr	Implemented
7058	13-0952	SAA LUT update to inhibit SAA darks	1-May	Implemented
4907	13-0883	TC SL correction	8-May	Implemented
7266	13-1115	TC SL temporary table update	1-Jul	Implemented
7259	13-1192	Wavelength shift adjustment	28-Aug	To be implemented in 8.1
4823	13-1249	NP SL correction	6-Nov	To be implemented in 8.3
7372	13-1315	Request for S-NPP Orbital Inclination adj maneuver	6-Nov	Approved
7386	13-1416	HR Measurements in Nominal Mode	9-Dec	CCR Opened - Expected to be submitted by Dec 20

20 DRs in Progress

DR #	Algorithm	Brief description
7480	TC and NP SDR	QF error in CDFCB
7451	TC SDR	OMPS NM Wavelength Scale
7450	NP SDR	OMPS NP Wavelength Scale
7401	TC and NP SDR	Raise Character Limit of the Version Number portion of the OMPS tables Filenames
7387	TC SDR	TC Straylight LUT update
7386	TC SDR	Nominal measurements in High Resolution mode
7372	TC SDR	Maneuver for Beta angle consistency in OMPS reference diffuser measurements
7358	NP SDR	G-ADA has duplicate algorithm input configuration files for OMPS SDR binaries
7341	NP SDR	NP EV SDR pre-processor to ingest high-resolution data
7340	TC SDR	TC EV SDR pre-processor to ingest high- resolution data
7335	NP SDR	Spectrum adjustment for Solar activity variations
7315	TC SDR	OMPS Fixed bias impact on smear and/or radiance - TC SDR
7260	NP SDR	Impact of wavelength scale shift characterization for the OMPS NP SDR
7210	TC SDR and EDR	OMPS Anomaly 03/12/13-Missing Packets
7059	TC and NP EV SDR	Missing Data in SDS and CLASS
7015	TC and NP EV SDR	CDFCB suggestions for version field clarification
5034	TC and NP EV SDR	OMPS Version Reference Document
5008	NP SDR and EDR	NP SDR (and EDR) fails for Sample Table with extra pixel column
4978	TC SDR and EDR	TC EDR fails for Sample Table with extra pixel column
4927	TC and NP SDR	FT document 474-00181 and 148 need update