



# JPSS DPA Program Planning Meeting VIIRS SDR Team

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VIIRS SDR Leads  
September 18, 2012





# Overview of VIIRS SDRs



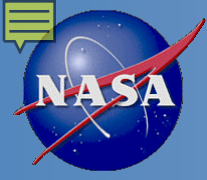
- SDRs = L1b = calibrated, geolocated radiance, reflectance and brightness temperature
- 22 types of SDRs
  - 16 moderate resolution (MOD),
    - 11 Reflective Solar Bands (RSB)
    - 5 Thermal Emissive Bands (TEB)
  - 5 imaging resolution (IMG),
    - 3 RSB; 2 TEB
  - 1 Day Night Band (DNB) imaging, broadband
- 6 non-gridded geolocation products
  - DNB, IMG, IMG terrain corrected, MOD, MOD terrain corrected, MOD unaggregated
- 2 gridded geolocation products
  - MOD, IMG

	Band No.	Driving EDR(s)	Spectral Range (um)	Specification						Prelaunch		On Orbit	
				Horiz Sample Interval (km) (track x Scan)		Band Gain	Ltyp or Ttyp (Spec)	Lmax or Tmax	Spec SNR or NEdT (K)	Measured SNR or NEdT (K) (2)	Measured SNR or NEdT (K) (1)	Measured SNR or NEdT (K) (2)	
				Nadir	End of Scan								
Reflective Bands	M1	Ocean Color Aerosol	0.402 - 0.422	0.742 - 0.259	1.60 x 1.58	High	44.9	135	352	616.8	578	588.9	
						Low	155	615	316	1092	974	1045.78	
	M2	Ocean Color Aerosol	0.436 - 0.454	0.742 - 0.259	1.60 x 1.58	High	40	127	380	622.4	564	572.02	
						Low	146	687	409	1118	975	1010.76	
	M3	Ocean Color Aerosol	0.476 - 0.498	0.742 - 0.259	1.60 x 1.58	High	32	107	416	690	611	628.46	
						Low	123	702	414	1111	1003	988.54	
	M4	Ocean Color Aerosol	0.545 - 0.565	0.742 - 0.259	1.60 x 1.58	High	21	78	362	581.1	522	534.96	
						Low	90	667	315	963.2	846	856.51	
	I1	Imagery EDR	0.600 - 0.680	0.371 - 0.387	0.80 x 0.789	Single	22	718	119	240.7	215	214.07	
	M5	Ocean Color Aerosol	0.662 - 0.682	0.742 - 0.259	1.60 x 1.58	High	10	59	242	366.6	321	336.13	
Low						68	651	360	827.9	673	631.26		
M6	Atmosph. Correct.	0.739 - 0.754	0.742 - 0.776	1.60 x 1.58	Single	9.6	41	199	415.2	355	368.4		
I2	NDVI	0.846 - 0.885	0.371 - 0.387	0.80 x 0.789	Single	25	349	150	304.1	251	264.01		
M7	Ocean Color Aerosol	0.846 - 0.885	0.742 - 0.259	1.60 x 1.58	High	6.4	29	215	519.8	435	457.54		
					Low	33.4	349	340	845.6	636	631.24		
Emissive Bands	S/WMIR	M8	Cloud Particle Size	1.230 - 1.250	0.742 x 0.776	1.60 x 1.58	Single	5.4	165	74	273	233	221
		M9	Cirrus/Cloud Cover	1.371 - 1.386	0.742 x 0.776	1.60 x 1.58	Single	6	77.1	83	253	231	227
		I3	Binary Snow Map	1.580 - 1.640	0.371 x 0.387	0.80 x 0.789	Single	7.3	72.5	6	172	149	149
		M10	Snow Fraction	1.580 - 1.640	0.742 x 0.776	1.60 x 1.58	Single	7.3	71.2	342	714	550	586
		M11	Clouds	2.225 - 2.275	0.742 x 0.776	1.60 x 1.58	Single	0.12	31.8	10	25	21.8	22
		LWIR	I4	Imagery Clouds	SST	3.550 - 3.930	0.371 x 0.387	0.80 x 0.789	Single	270	353	2.5	0.4
Single	270								353	0.396	0.13	0.13	0.13
Low	380								634	0.423			
LWIR	I5	Cloud Imagery	SST	10.500 - 12.400	0.371 x 0.387	0.80 x 0.789	Single	270	336	0.091	0.06	0.06	0.05
							Single	300	343	0.07	0.03	0.03	0.03
							Low	300	340	0.072	0.04	0.03	0.03

(1) The Aerospace Corporation (2) NASA NICSE

HSI uses 3 in-scan pixels aggregation at Nadir

Source: VIIRS user's guide. On orbit values (last two columns for March 8, 2012) are updated based on the Murphy table for RSB, provided by Aerospace; TEB values are provided by STAR and NASA.



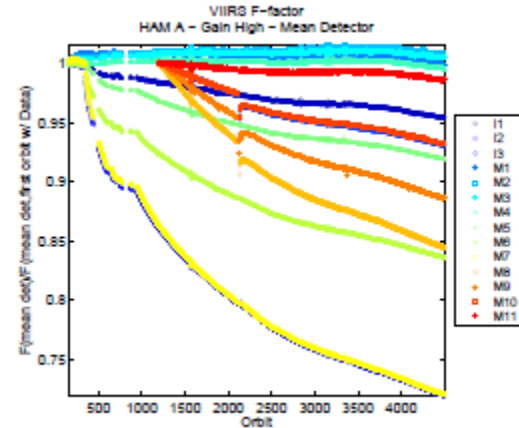
# Team Members' Roles & Responsibilities



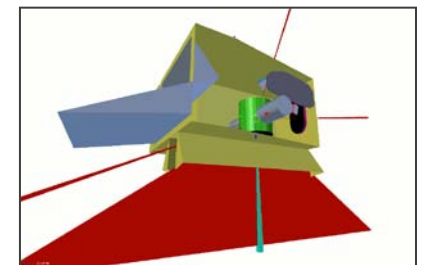
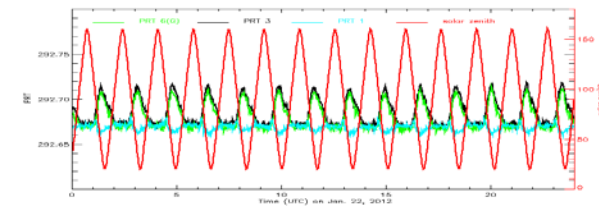
SDR	Name	Organization	Funding Agency	Task
Lead	Changyong Cao	NOAA/NESDIS/STAR	NJO	Lead VIIRS SDR Team
Lead	Frank Deluccia	The Aerospace Corp.	NASA	Lead VIIRS SDR Team
Org. lead	Mark Liu	NOAA/NESDIS/STAR	NJO	STAR lead/TEB cal/val
Org. lead	J. Xiong/R. Wolfe	NASA/VCST	NJO and Flight	VCST lead
Org. lead	Chris Moeller	U. Wisc.	NJO	SDR impact/RSR
Org. lead	Bill Johnsen	Raytheon	NJO	
Org. lead	Lushalan Liao	NGAS	NJO	

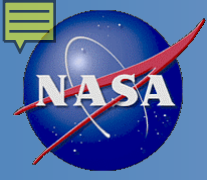
SDR	Name	Organization	Funding Agency	Task
member	Blonski, Shao, Uprety, Pogo, Bai, Hu, Carey, et al.	NOAA/NESDIS/STAR	NJO	SDR cal/val support, DRAT, SNO&vicarious
member	Oudrari, Wu , Lei, McIntire, Schwarting, Nishihama, Lin, Chiang, et al.	NASA/VCST	NASA/NOAA	Manuver, intercal, SDR cal/val support
member	Rausch, Moyer + 10 Staff (see backup slide)	Aerospace	NASA/NOAA	SDR Cal/Val Support
member	Mills, Chu, et al.	NGAS	NOAA/NASA	SDR Cal/Val Support

- Provided leadership to the VIIRS SDR cal/val team
  - Completed all VIIRS SDR cal/val tasks
  - Achieved Beta Maturity (VIIRS SDR), working towards Provisional
- Anomaly investigations
  - Discovered VIIRS RTA degradation anomaly on 5 December 2011
    - Fully supported subsequent Anomaly Resolution Team activities
  - Performed laboratory measurements in late December 2011 that revealed root cause of VIIRS RTA degradation to be tungsten contamination of RTA mirror coatings
  - Developed degradation monitoring and LUT/stripping verification capabilities using the Antarctic Dome C site (see backup)
  - Developed solar diffuser monitoring/ degradation modeling capabilities
  - VIIRS radiometric degradation modeling and impact on SNR, dynamic range, and spectral performance
- Other anomalies
  - NPP SCC and CDP reset anomalies
  - VIIRS RTA/HAM sync loss
  - Discovered Blackbody PRT#3 & 6 anomaly shortly after launch, investigated correlation with solar zenith angle(see backup) using newly developed 3D model
  - Analyzed blackbody performance during WUCD



Courtesy of the Aerospace Corp.

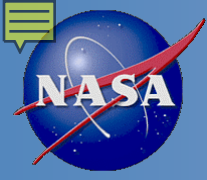




# FY-12 Accomplishments



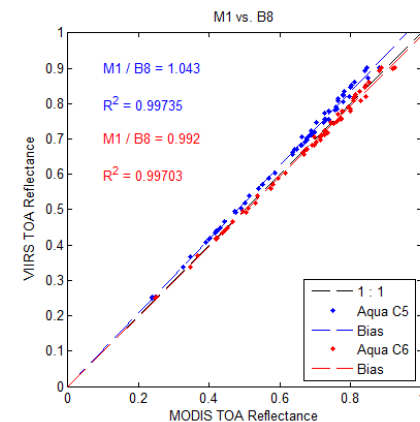
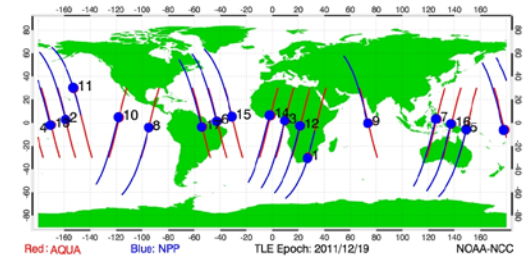
- IDPS Calibration Support
  - Successfully accomplished operational calibration of the VIIRS Reflective Solar Bands (RSB) and provide continuing leadership and operational support in this key technical area critical to SDR performance (see backup)
  - Developed and implemented major code change providing scan-by-scan update of RSB F factors and DNB Low Gain Stage (LGS) gain (ADR 4386) (see backup)
  - Provide high quality F LUTs (without predict-ahead) to Ocean Color/Chlorophyll (OCC) team on a weekly basis to support improved evaluation of OCC algorithm performance (see backup)
  - Discovered that the Thermal Emissive Band (TEB) calibrated response (F factor) modulations that occur each orbit correlate with a periodic spatially dependent change in effective OBC BB temperature (see backup)
  - Provide continuing successful operational calibration of the Day Night Band (DNB)
- IDPS Code Algorithms Support
  - Discovered and resolved numerous VIIRS SDR IDPS code errors and issues via DR and algorithm update process (see DR list)
  - SDR code corrections and improvements
  - Extensive analysis of quality flag and FILL value behavior with nominal and non-nominal conditions
  - Look-up-Table updates

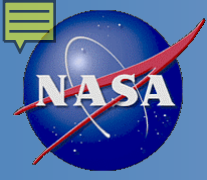


# FY-12 Accomplishments



- Developed VIIRS SDR calibration knowledge base on NCC wiki site (<https://cs.star.nesdis.noaa.gov/NCC/VIIRS>), with:
  - Daily SNO & SNOx and orbital track prediction
  - VIIRS SDR user's guide, RSR, IDL code
  - Standardized calibration & performance parameters
  - Image gallery
  - Event log in MySQL database
  - Conference presentations
- SNO & SNOx cross comparisons
  - Found good agreement with Aqua/MODIS in the TEB bands, but recently confirmed temperature dependent biases for M15 and possibly M14
  - Found good agreement with N19/AVHRR thermal infrared bands
  - Discovered Aqua/MODIS collection 5 vs. 6 bias issue
- Cross compared VIIRS with CrIS
  - Found good agreement in general
  - Investigating BT dependent bias in M15 (with CrIS team)

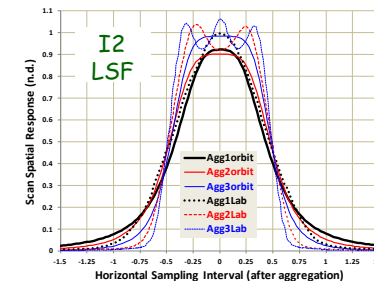
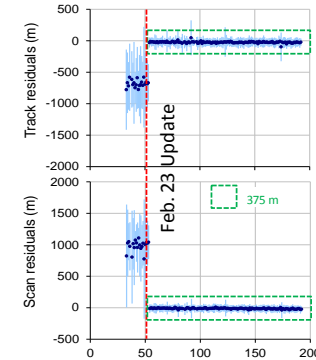
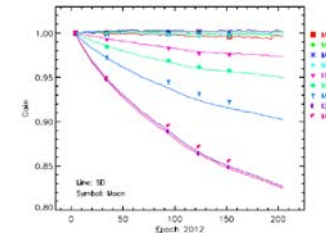
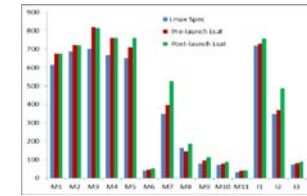




# FY-12 Accomplishments

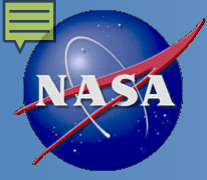


- Instrument performance evaluation
  - VIIRS early performance assessment
- S-NPP spacecraft maneuvers and OBC-BB WUCD operations
- Achieved excellent geolocation; completed BBR and LSF cal/val
- JPSS J1 support
  - ✓ White paper on jitter requirement analysis and a list of improvements for VIIRS HW and SW
- Other
  - ✓ SDSM Out-of-band leak impact assessment
  - ✓ Supported effort to switch VIIRS electronics to A-side.



Courtesy of NASA VCST



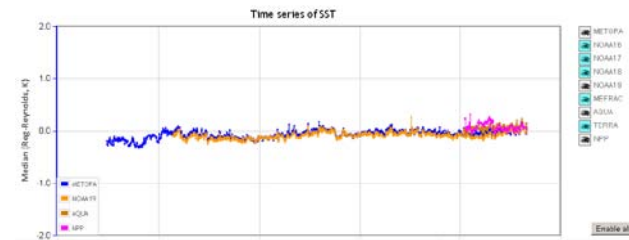


# FY-12 Accomplishments



## Data Quality Evaluation

- Developed daily global quickview image
- Band M6 analog saturation identified and documented; mitigation strategy devised.
- Band M13 dropouts documented; caused by gain state anomaly
- High contrast scenes indicate cross talk and ghosting is minimal in VisNIR band imagery
- VIIRS detector and mirror side striping are minor; image quality excellent
- VIIRS TEB calibration anomaly identified and mitigated for WUCD exercises
- VIIRS terminator threshold too low; replaces good quality SDR earth scene data with fill values



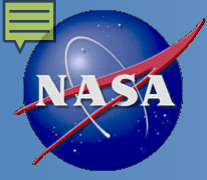
## EDR impact studies

- Quantified VIIRS Beta level TEB spectral radiance biases characterized  $< 0.2$  K (M13-M16),  $0.5$  K (M12).
- Evaluated WUCD exercise impact on VIIRS TEB calibration documented  $< 0.2$  K.
- Evaluated HAM RVS TEB biases verified  $< 0.1$  K.
- Investigated RTA degradation anomaly impact on RSR and TOA reflectance.
- Supported feasibility study for aircraft based lunar measurements.
- Maiden flights of EMAS instrument on ER-2 aircraft in support of VIIRS Cal/Val.



Courtesy of U. Wisc.





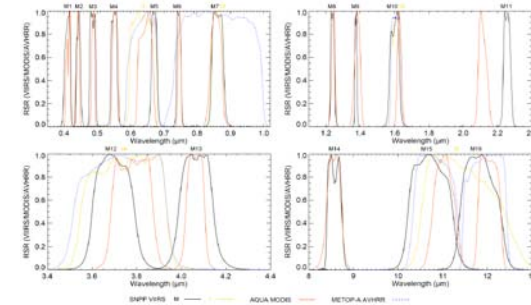
# FY-12 Accomplishments



## VIIRS RSR

Processed and publicly released several RSR versions

Advising science community on use of VIIRS RSR for EDR evaluation and research.

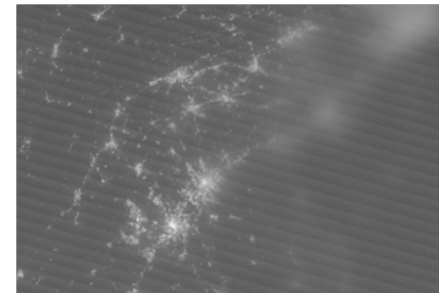


- Day/Night Band (DNB) calibration and stray light correction.

- A correction algorithm was implemented for stray light that dramatically improved imagery from DNB SDR

- DNB geolocation corrections

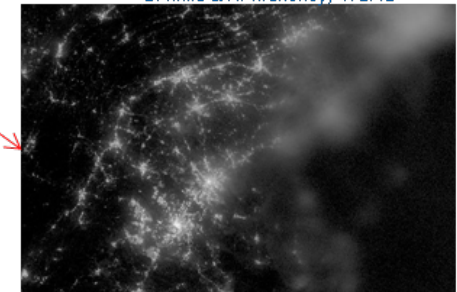
- Developed software to perform automatic image matching between spectrally disparate DNB and landsat imagery.



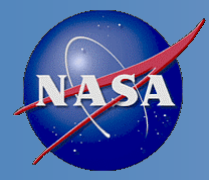
Mid Atlantic,  
6/30/12  
uncorrected SDR

*S. Mills & R. Mahoney, NGAS*

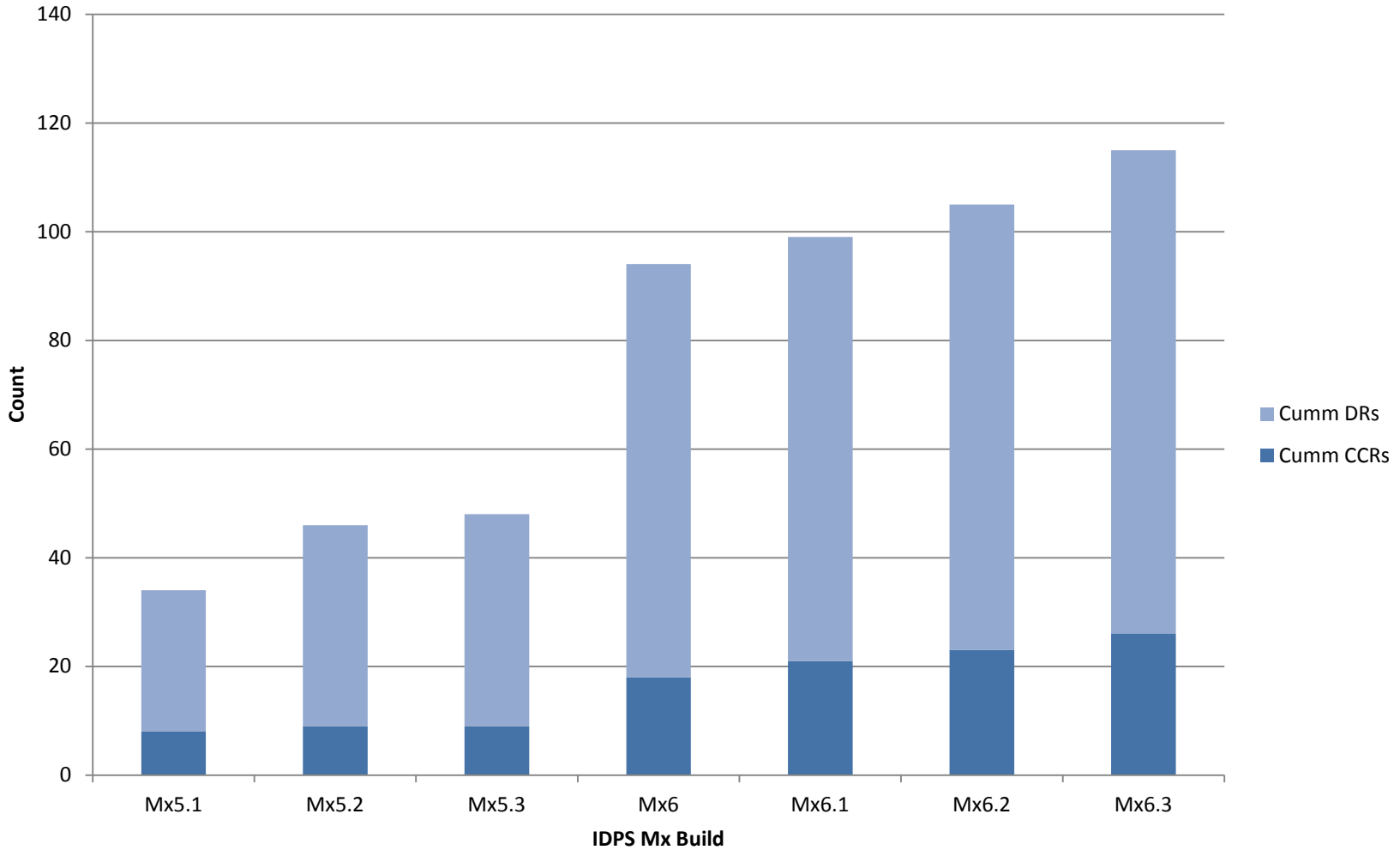
SDR with  
stray light  
correction  
applied.



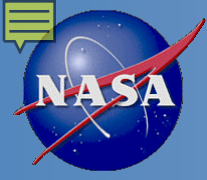
Courtesy of NGAS



# VIIRS Operational Algorithm Updates CCRs and DRs



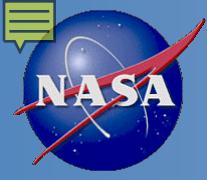
Courtesy of William Johnsen, Raytheon



# FY12 Accomplishments: DRs (180)



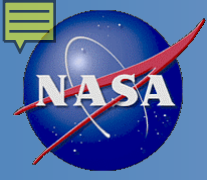
DR number	Status	Description
4277	IDPS code revised	Increase RSB solar zenith angle cutoff from 85° to 89°
4382	IDPS code revised	SD Module Applies Incorrect Calibration Coefficients for DG Bands
4383	IDPS code revised	Errors in ProSdrViirsSolDiffStructs.h
4384	Document revised	Solar Diffuser Transmittance Screen PC - Documentation Errors
4385	Document revised	SDSM Transmittance Screen PC - Documentation Errors
4388	Document revised	Solar Diffuser equations in ATBD in error
4393	IDPS code revised	DCR Fill Values Corrupt Calculation of RSB Measured Radiance and F Factor in SD Module
4405	IDPS code revised	Incorrect RTA Temperature Used in Code for TEB Calibration
4406	IDPS code revised	Incorrect Cavity Temperature Used in Code for TEB Calibration
<b>4412</b>	<b>Procedure revised</b>	<b>VIIRS SDR Fast Track LUT Changes</b>
4415	Document revised	Incorrect Field Names for Solar Diffuser History in IDFCB
4417	IDPS code revised	Error in Calculation of Standard Deviation of SD Measured Radiance
4423	IDPS code revised	Telescope/HAM timestamp reversal
4424	IDPS code revised	Incorrect Criterion for Outlier Removal in Fitting Computed F Factors



# FY12 Accomplishments: DRs



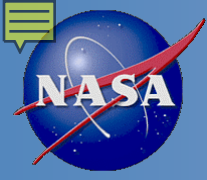
DR number	Status	Description
4425	IDPS code revised	Incorrect Calculation of Average H Factor Standard Deviation
4427	IDPS code revised	Transformation of Solar Vector from Instrument Frame to Solar Diffuser Frame Not Performed in GEO Code
4428	IDPS code revised	Rotation Matrix in LUT Used by SDSM Code Not Updated from Design to Measured Values
4431	IDPS code revised	Wrong Sign for Azimuth in Transformation Used in H Factor Calculation
4432	IDPS code revised	Incorrect Calculation of Interpolated Vectors for Last Scan in SDSM Code
4437	IDPS code revised	Negative voltage from SDSM detectors converted to fill values
4439	IDPS code revised	Detector versus super sequence number
4440	Document revised	Error in control book description of VIIRS SDR BB Thermistor PC
4441	Document revised	Error in XML specification of VIIRS SDR BB Thermistor PC XML in ADL 3.1 and earlier
4443	Document revised	VIIRS-SDR-TELE-COEFFS-LUT ..... Correction of Documentation and Extraneous Values
4450	IDPS code revised	Add OBC BB Temperature Tuning Parameter
4465	Procedure revised	Solar Diffuser Aggregation History File Not on GRAVITE, NSIPS or CLASS



# FY12 Accomplishments: DRs



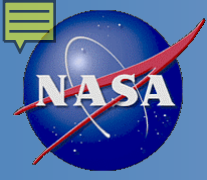
DR number	Status	Description
4469	IDPS LUT updated	Initial RSB F-LUT Update
4476	IDPS LUT updated	Dual Gain Anomaly LUT Needs to be Updated
4485	IDPS LUT updated	Anomalous Degradation in VisNIR Response
4498	Code change scheduled	F Factors Calculated by Code Are Incorrect
4499	Code change scheduled	Night Time Sensor Mode Missing Packet Counts are misleading
4500	CCR in work	M8 Quality Flags has erroneous good quality
4501	CCR in work	LWIR bands not marked invalid
4503	Document revised	Review of revised VIIRS OAD
4509	Code change scheduled	VIIRS OBC IPs anomalous dates/timestamps
4531	IDPS LUT updated	SDSM Screen Transmittance Table Reversed in both Azimuth and Elevation
4535	IDPS LUT updated	First on-orbit VIIRS SDR/Geolocation LUT update
4540	IDPS LUT updated	Second F-LUT Update
4541	IDPS LUT updated	Second H Table Update
4542	IDPS LUT updated	VIIRS VisNIR/SWIR RSR LUT Update



# FY12 Accomplishments: DRs



DR number	Status	Description
4543	IDPS code revised	<b>M13 Low Gain SDR Calibration mismatch with High Gain SV</b>
4544	IDPS code revised	Moderate TrimTable array has wrong dimensions
4549	Document revised	Documentation of VIIRS SDR RSR PC
4553	IDPS LUT updated	Third F-LUT Update
4554	IDPS LUT updated	Third H Table Update
4555	IDPS LUT updated	M6 mirror side banding
4563	IDPS code revised	VIIRS M13 SDR aggregation in temperature domain
4568	IDPS LUT updated	M13 LG Calibration Coefficients Incorrect
4572	DR Open	VIIRS Band I5 Integration Time Documentation
4574	Revision requested	Documentation Table for VIIRS I-bands Samples Dropped Internally
4575	IDPS LUT updated	Fifth F and H LUT update
4586	IDPS code revised	<b>Modified CAL Code and LUTs for Scan-by-Scan Update of RSB F Factors</b>
4587	IDPS LUT updated	VIIRS OBC-BB temperature limit in SDR code
4589	CCR in work	Improved SDSM Screen Transmission LUT

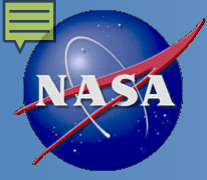


# FY12 Accomplishments: DRs



DR number	Status	Description
4590	IDPS LUT updated	6th F and H LUT update
4591	IDPS LUT updated	Update delta C LUT and G coefficients
4599	IDPS LUT updated	Serial Number 7 F and H LUT updates
4600	IDPS LUT updated	8th weekly submission of F LUT and H LUTs
4603	Problem investigated	VIIRS DNB HGS saturation, agg. 29 -32
4604	Code change scheduled	SD history aggregate F factor & dF/dt always default for high gain of dual gain bands
4605	CCR in work	SD aggregated history file, anomalies in Fscan, C-coefficients, h-Factor & temperatures
4606	IDPS LUT updated	Update of On-Board and Ground DNB Offset Tables
4609	Code change scheduled	SD Aggregation history dF/dt units in microseconds
4610	IDPS LUT updated	Update of DNB Calibration Coefficients
4612	Document revised	Out-of-Bound Values in VIIRS-SDR-RADIOMETRIC-PARAM-LUT
4613	Document revised	Out-of-Bound Values in VIIRS-SDR-TELE-COEFFS-LUT
4620	CCR in work	Dual Gain calibration OBC gain states mismatch
4623	CCR in work	VIIRS DNB stray light around terminator crossing





# FY12 Accomplishments: DRs



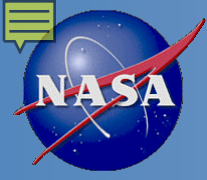
DR number	Status	Description
4624	IDPS LUT updated	9th Submission of F and H LUT Updates
4625	IDPS LUT updated	10th Update of F and H LUTS
4626	Procedure revised	DNB SDR missing for 1 orbit after VROP 702
4629	IDPS LUT updated	Second on-orbit VIIRS SDR/GEO LUT DNB update
4630	IDPS code revised	Fill value in VIIRS OBC-IP OMM telemetry mf_ham_blkhd
4631	Code change scheduled	missing initialization for GAIN_BB
4633	DR Open	Fill values in G-ring attributes for short granules
4635	IDPS LUT updated	2nd Update of DNB Offset Tables
4636	IDPS LUT updated	2nd Update of DNB Gain Table
4640	IDPS LUT updated	11th update submission of F LUT and H LUT
4648	Code change scheduled	Overaggressive fill on calibration errors
4649	IDPS LUT updated	12th F and H LUT Update
4654	Procedure revised	VIIRS Solar Diffuser History AUX product production frequency incorrect
4655	Code change scheduled	Dual Gain Bands Cal Sequence Anomaly



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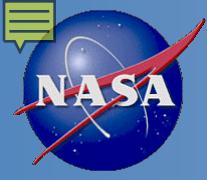
DR number	Status	Description
4660	IDPS LUT updated	RADIOMETRIC-PARAM-LUT update
4663	CCR in work	Modified Operational Code for Increased RSB Calibration Autonomy
4664	IDPS LUT updated	13th submission of F and H LUT tables
4666	Problem investigated	Unexpected data gaps
4667	Code change scheduled	Problem in SdsmCalculator's destructor
4668	IDPS code revised	Code problem in SdsmCalculator::CalcSolarVec
4669	Code change scheduled	Code issue in SolarDiffuserBuffer.cpp::storeObcip
4670	IDPS code revised	Moon in Space View code error for RSB calibration
4674	Procedure revised	Fast-track approval of Predicted-F LUTs
<b>4675</b>	<b>Beta status approved</b>	<b>Approval of VIIRS SDR Beta Quality</b>
4683	IDPS LUT updated	SN 014 F and H LUT Updates
4684	Code change scheduled	DN_obc_750M_SG_outlier_mask and DN_obc_750M_DG_outlier_mask need initialization
4688	IDPS LUT updated	Third Update of DNB Offsets
4689	IDPS LUT updated	Third Update of DNB Gains



# FY12 Accomplishments: DRs



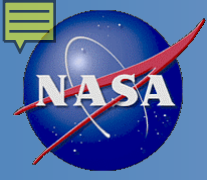
DR number	Status	Description
4690	PCR Open	"poor" setting in DG anomaly not doc in EDR PR
4691	IDPS LUT updated	SN015 F and H LUT updates
<b>4698</b>	<b>Problem investigated</b>	<b>M6 roll over should be flagged as saturated</b>
4703	IDPS code revised	Add mirror side to VIIRS geolocation products
4710	Problem investigated	WUCD Needs to be Flagged
4711	IDPS LUT updated	SN016 F and H LUT Updates
4716	Problem investigated	Day-Night Band Stray Light
4717	Completed	Orbital limit, reasonableness and consistency checks
4721	IDPS LUT updated	SN017 F and H LUT Updates
4726	DR Open	VIIRS LUT Limit Documentation in CDFCB Contains Errors
4735	IDPS LUT updated	SN018 F and H LUTs
4737	IDPS LUT updated	Scan Encoder Electronics (SCE) A-side missing in geolocation parameter LUTs
4739	IDPS LUT updated	SN019 VIIRS F and H LUT Updates
4742	Problem investigated	Erratic solar eclipse flag



# FY12 Accomplishments: DRs



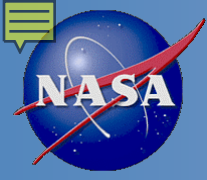
DR number	Status	Description
4743	Code change scheduled	Modifying Calibration Sector Data in OBCIP
4744	Code change scheduled	Additional Telemetry Required for Calibration Included into OBCIP
4745	Code change scheduled	Include M16A and M16B to OBCIP
4753	IDPS LUT updated	Fourth Update of DNB Offsets
4754	IDPS LUT updated	Fourth Update of DNB Gains
4755	Code change scheduled	LunarCal triggers fewer than expected flags in SDR and EDR and may cause processing anomalies downstream
4756	IDPS LUT updated	SN020 update of F and H LUTs
4759	Code change scheduled	Determine Scan Encoder Electronics Side in Geolocation products
4761	IDPS LUT updated	SN021 F and H LUTs
4763	IDPS LUT updated	Fifth Update of DNB Offsets
4764	IDPS LUT updated	Fifth Update of DNB Gains
4767	Problem investigated	Create a VIIRS GEO QF when HAM/RTA sync is lost and for sector rotation
4768	Procedure revised	Process Definition Needed for Checkout of VIIRS-SDR-PREDICTED-F-LUT



# FY12 Accomplishments: DRs



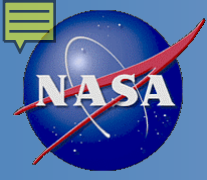
DR number	Status	Description
4772	Problem investigated	Flag Needed for Anomalous Cal Sector Gain Sequences
4776	Problem investigated	Sector Rotation caused erroneous geo results
4777	Problem investigated	Sector Rotation to pick up moon did not set qual to no-cal
4780	Problem investigated	OBC BB Thermistor Weights Need to be Selectable by Band/Detector/HAM Side
4781	Problem investigated	SWIR F factor behavior after SCC reset/sun point event not understood
4782	IDPS LUT updated	SN022 F and H LUTs
4783	IDPS LUT updated	SN023 F and H LUTs
4784	IDPS LUT updated	F LUTs for new Scan-by-scan Calibration
4785	Problem investigated	Incorrect Units in CDFCB, VIIRS DNB Stray Light PC
4788	Problem investigated	Errors in CDFCB, Table 3.2.1.4.37-1, VIIRS SDR Radiometric Parameters PC ranges
4791	IDPS LUT updated	Second post-launch SDR Dual Gain Anomaly (DGA) LUT update
4795	Problem investigated	SDR/CAL needs special treatment when HAM/RTA sync is lost
4805	Problem investigated	Modified algorithm for replacing and flagging missing calibration data



# FY12 Accomplishments: DRs



DR number	Status	Description
4809	IDPS LUT updated	SN024 F and H LUTs
4810	IDPS LUT updated	2nd Installment of new scan by scan F LUTs
4816	IDPS LUT updated	Sixth Update of DNB Offsets
4817	IDPS LUT updated	Sixth Update of DNB Gains
4820	CCR in Work	OBC-IP Outlier Mask Issues
4822	IDPS LUT updated	SN025 F and H LUTs
4824	IDPS LUT updated	SN026 F and H LUT Update
4825	IDPS LUT updated	SN027 F and H LUT update
4826	IDPS LUT updated	SN028 F and H LUT
4827	IDPS LUT updated	3rd Installment of Scan-by-scan LUTs
4828	IDPS LUT updated	4th Scan-by-scan F LUT Update
4829	IDPS LUT updated	SN005 Scan-by-Scan F LUT update
4830	IDPS LUT updated	SN006 Scan-by-scan F LUT update
4833	Problem investigated	Updated RSB Calibration Coefficients LUT
4839	Problem investigated	VIIRS SDR Pixel Level QF1 "NOT USED" Triggered



# FY12 Accomplishments: DRs



DR number	Status	Description
4853	IDPS LUT updated	Seventh Update of DNB Offsets
4854	IDPS LUT updated	Seventh Update of DNB Gains
4863	IDPS LUT updated	Scaled 007 DNB C COEFFS LUT for Mx6.2
4864	IDPS LUT updated	Predicted LUTS for Mx6.2
4865	IDPS LUT updated	SN029 F and H LUT updates for Mx5.3.
4872	IDPS LUT updated	SN_003 Predicted F LUTs and SN030 H LUT
4873	IDPS LUT updated	SN004 Predicted F LUTs and SN031 H LUT
4874	IDPS LUT updated	SN005 Predicted F LUTs and SN032 H LUT
4876	Problem investigated	Time span mismatch for terrain-corrected VIIRS geolocation data
4883	Problem investigated	Metadata configuration in MX6.2 changed from previous build
4884	IDPS LUT updated	SN006 F LUT and SN033 H LUT Update
4885	IDPS LUT updated	SN007 F LUT and SN034 H LUT update
4886	Problem investigated	SN008 F LUT and SN035 H LUT update
4887	Problem investigated	SN009 F LUT and SN035 H LUT update
4890	Problem investigated	VIIRS DNB geolocation residual error recommendation

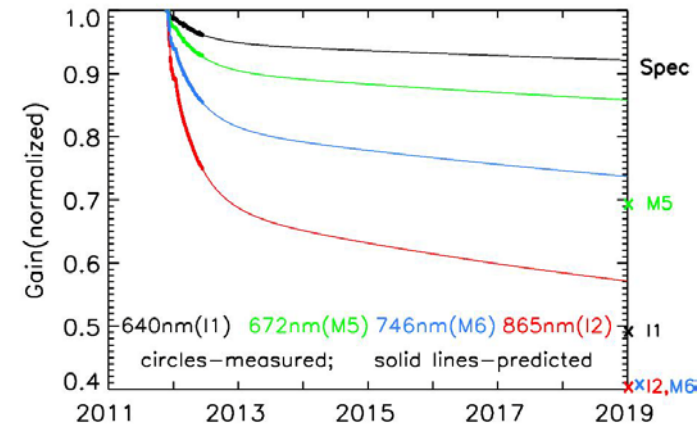




# Scientific Advancements



- Root cause determination of RTA degradation anomaly via laboratory measurements of RTA witness samples in varying UV environments
- Discovered spatial non-uniformity of OBC BB effective temperature as cause of TEB calibrated response (F factor) modulation over each orbit
- RTA reflectance degradation model
  - VCST team has developed a 4-mirror model, crucial to the sensor performance long-term monitoring and impact assessments.
- Relative spectral response (RSR) modeling
  - VCST team is in the process of developing a model to simulated the temporal RSR modulation, that could be used to determine the need for RSR updates in the SDR operational code.



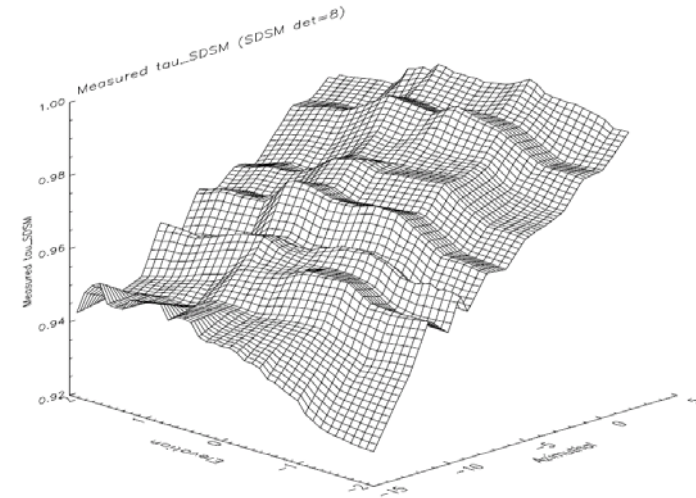
Courtesy of the Aerospace and NASA VCST



# Scientific Advancements

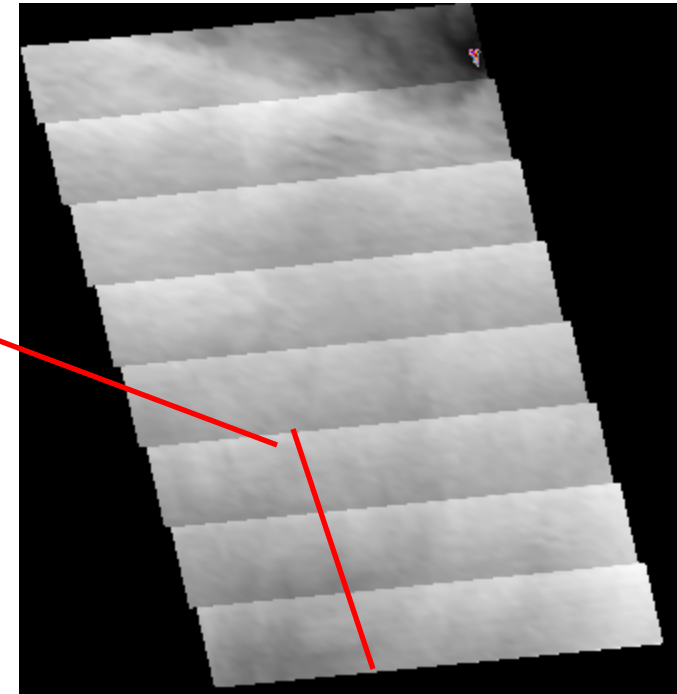
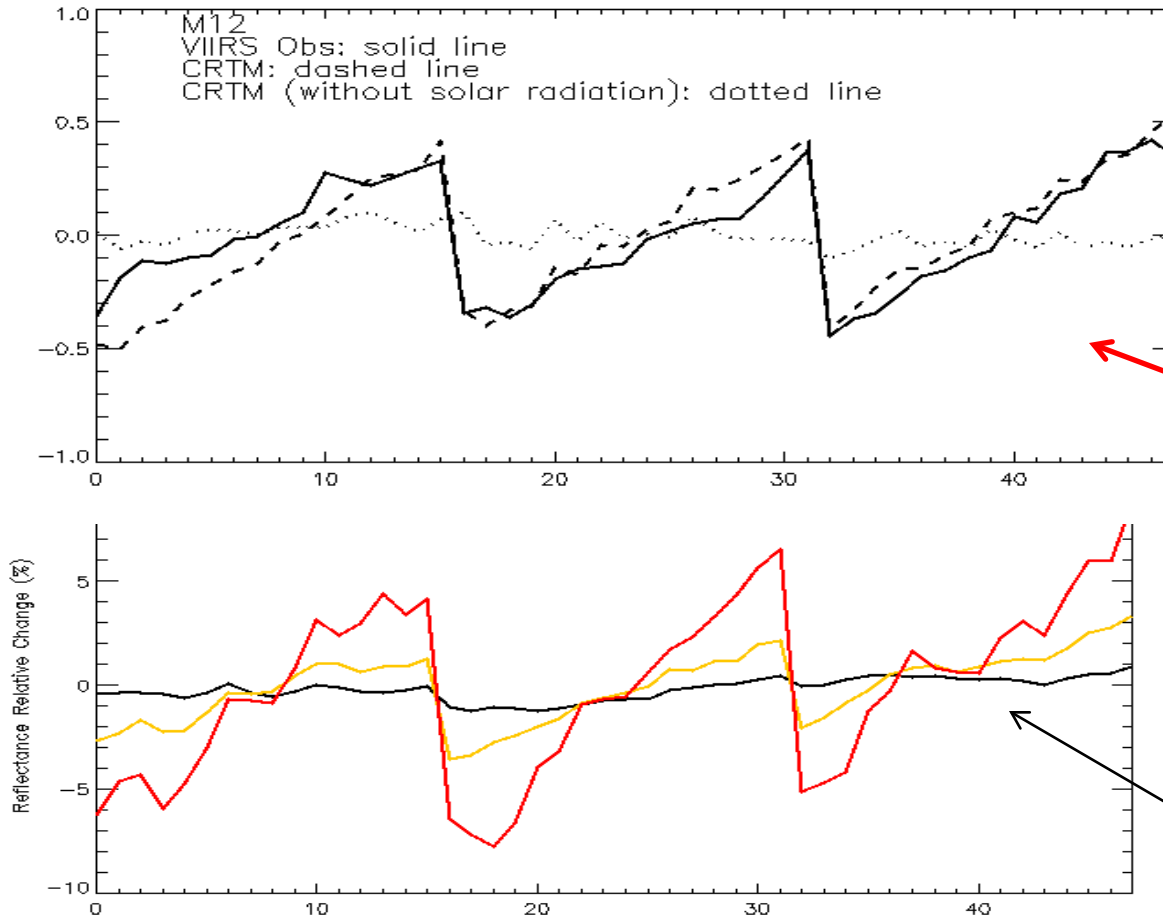


- Yaw data processing
  - Yaw data has been used to generate high quality SDSM screen transmission, enhancing the SDR calibration quality
  - Yaw maneuver also provided valuable data to enhance the solar diffuser BRDF characterization. These results are being used to investigate the higher degradation rate of change observed around June 24<sup>th</sup> 2012.
- Roll maneuver and lunar calibration strategies data process methodologies
  - Improved strategies and methodologies developed for different lunar calibration tasks.
- Day night band (DNB) calibration
  - VCST has developed an innovative method to determine bias and gain ratios for DNB bands using calibration view data. This approach, if adopted, could keep valuable science data otherwise lost during the monthly VROPs events.
- Enhancement of the dual gain anomaly flagging algorithm:
  - Use of “dn” instead of “DN” has allowed to save a significant amount of good quality SDR digital counts normally flagged as poor quality in the previous algorithm.



Courtesy of NASA VCST

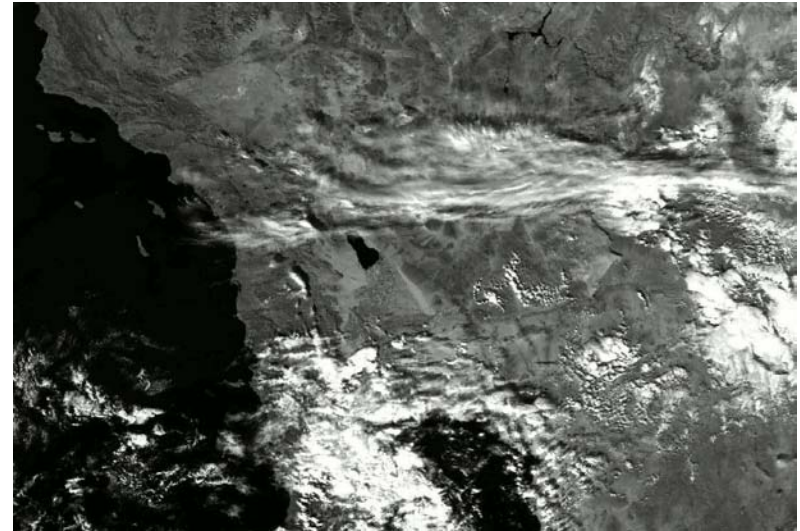
## VIIRS and CRTM Modeling for M12 Striping Investigation



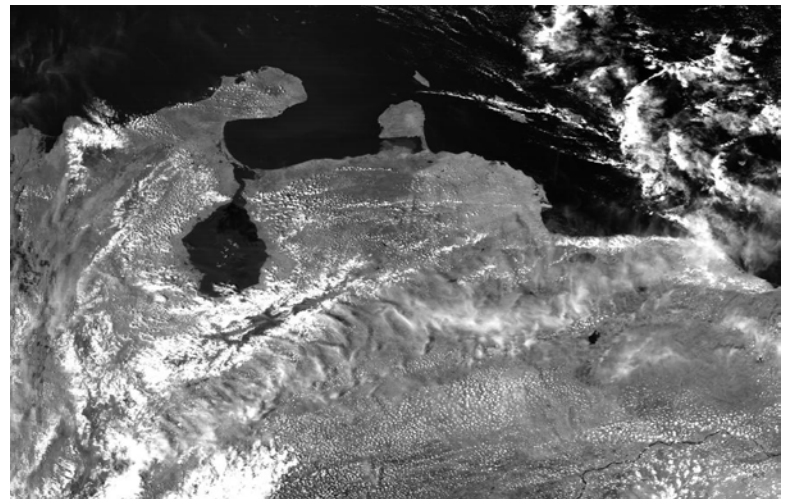
The STAR team applied the CRTM to simulate the VIIRS SDR data. It is found that the M12 striping reported by the SST EDR team is caused by the difference in VIIRS azimuth angles among detectors.

## New method to verify VIIRS geolocation at SNOx

- STAR team used the SNO prediction to investigate the geolocation consistency between the VIIRS and MODIS. The differencing animation image on the upper right not only shows cloud movement, but also geolocation discrepancy for land features.
- The VIIRS geolocation discrepancy was reported.
- After the VIIRS new geolocation LUT was implemented, the “land movement” issue was resolved (see lower-right image).
- The VIIRS geolocation error is generally less than 100 meter (Wolfe et. al., Apr. 17, 2012).



Differencing image shows geolocation discrepancies for land features (20:55 Dec. 20, 2011)



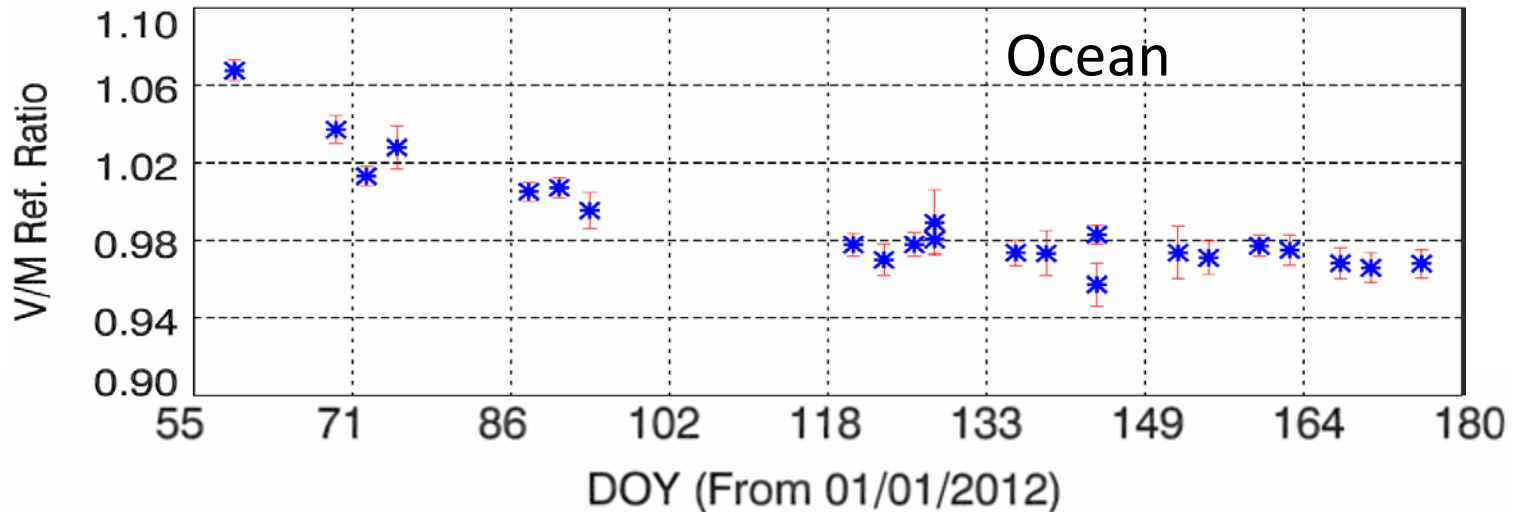
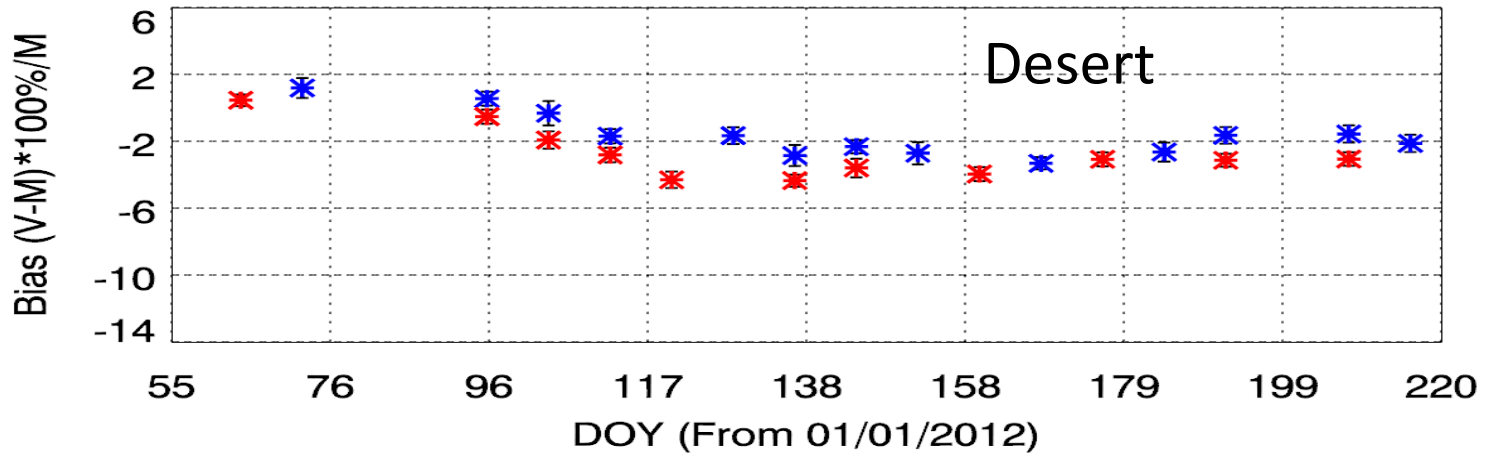
Animation image at 18:05 Feb. 25, 2012



# Scientific Advancements

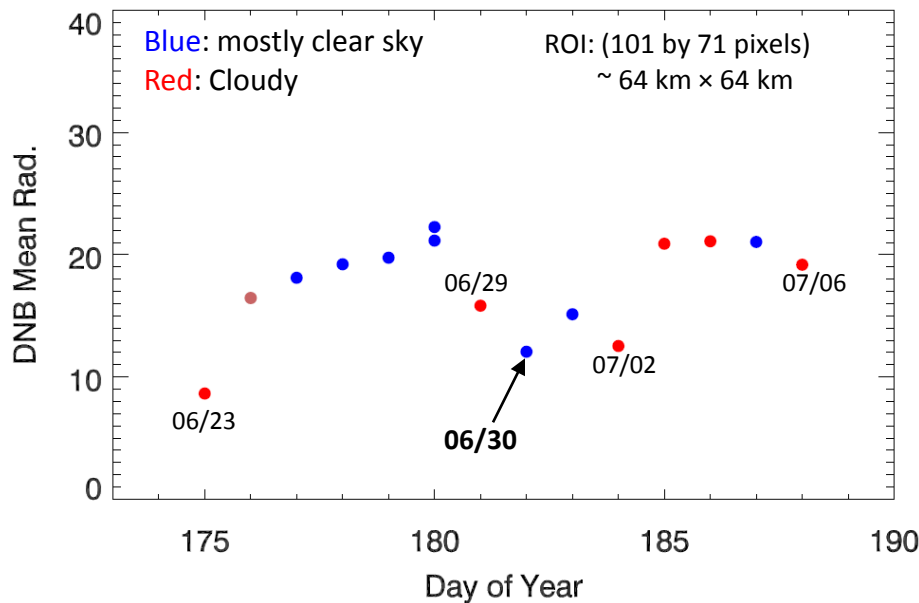


New method to compare VIIRS and Aqua/MODIS at SNOx  
VIIRS M1 and MODIS B8 (Collection 6)

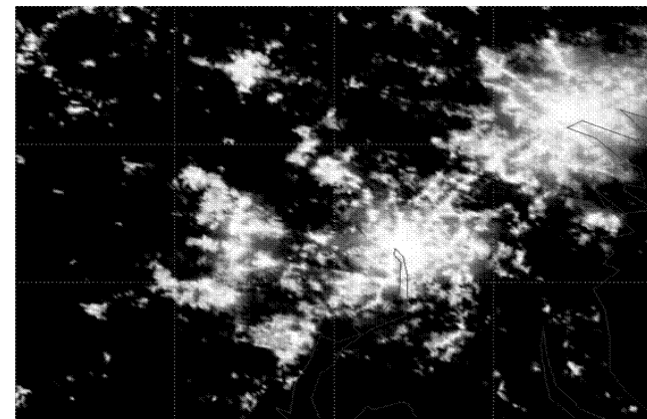
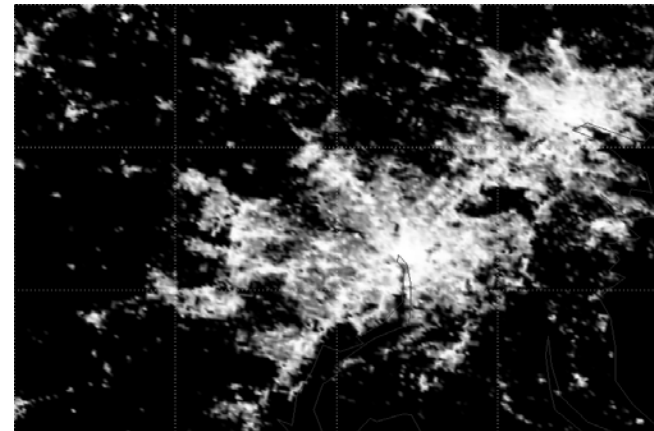




- Despite the straylight effect, the Day/Night Band has been used to detect a major power outage in the Washington, DC on the night of June 29, 2012.
- An analysis of the data after the storm showed that most areas had power restored within 3 days.

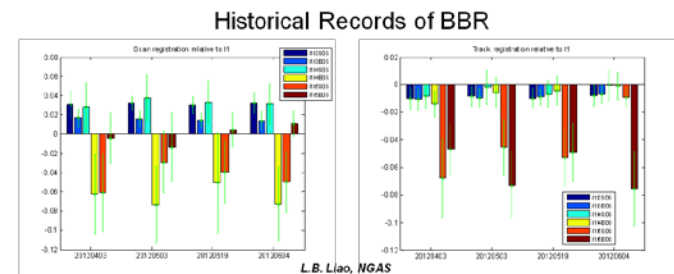
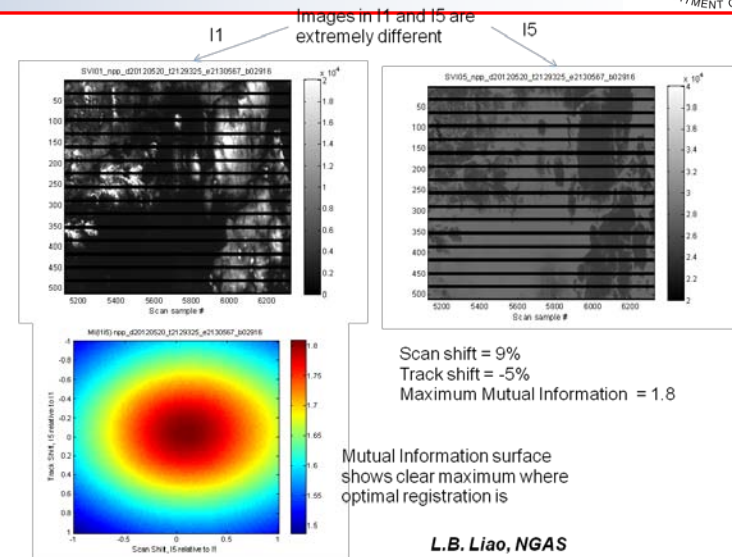


VIIRS DNB radiance time series before and after the power outage (6/29) shows that most of the power was restored in three days.



VIIRS DNB of the Washington/Baltimore area on June 26<sup>th</sup> (top) and June 30<sup>th</sup>. The suburbs west of DC and Baltimore, in particular show dark areas.

- DNB is used to study air glow.
  - The capability of imaging the earth surface using air glow is unique to DNB and was unexpected.
  - Gravity waves in the upper atmosphere can be clearly seen in these night-glow images. This opens up a whole new area of research.
  - Details of this are to be published in Proceeding of the National Academy of Science in the paper “Suomi NPP satellite brings to light a new frontier of night time environmental sensing capabilities,” by Steve Miller of Colorado State Univ. with Steve Mills of NGAS as co-author.
- New technique utilizing the principle of mutual information maximization was developed to automatically measure BBR between bands with extremely different spectral characteristics.
  - To be published.



Courtesy of NGAS





# Scientific Advancements

other



- Achieved excellent geolocation accuracy needed by operational community
- Developed method to estimate BBR with lunar calibration data
- Developed methods to estimate LSF/MTF from VIIRS images of land target
- Developed methods to analyze jitter requirements/impacts on MTF, BBR and pointing
- Publications
  - Authored /co-authored numerous publications and presented at conferences
  - SPIE Volume, IGARSS



# Issues, Challenges, Setbacks



## **RTA degradation**

- RTA degradation anomaly challenged the RSB calibration team to maintain RSB calibration uncertainty and stability within requirements/desirements.
- F-factor trend change
- Ongoing RTA degradation anomaly is modulating VIIRS VisNIR and SWIR RSR.

## **Scan Sync Loss**

### **Operational code:**

- Uncertainties/errors in IDPS processing software/code may still exist
- Gain mismatch fix
- Multiple files and missing files are still being found
- Automated calibration for the solar bands

### **Process and coordination:**

- Need to streamline reporting and meetings

## **NIST support: Flight vs. Ground**

- Instrument spec vs. science enhancements
- SDR science peer review process
- Using standardized SOW
- MOU and reporting processes and procedures

## **Early VIIRS SDR data and reprocessing**

## **OBC-BB Thermistors variation:**

- F-factor variation during WUCD
- F-factor orbital Variations

## **DNB Stray light Issue**

## **SC Counter overflow anomaly & SBC anomaly (1394)**

## **SDSM Spectral Leak**

## **A-side vs. B-side**



# Issues, Challenges, Setbacks



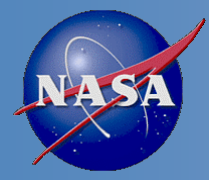
- **Geolocation accuracy near spacecraft maneuvers** needs to be better understood (not as accurate)
- **BBR, LSF, and the moon**
  - Accurate assessment of BBR for bands saturated by the moon
  - Additional analyses is needed for better spatial characterization (BBR and LSF) using lunar and ground targets (for all agg modes) – challenging
- **Other**
  - Digital Elevation Model (DEM) and Land/Water (L/W) mask need to be updated
  - Occasional short high frequency attitude oscillations (~1 per orbit for ~2 minutes)
  - Within orbit thermal correction may be needed with additional LUT (mitigation planned via MODIS style correction)
- **DNB geolocation needs to be terrain correction**
- **M13 low gain calibration points**
- **Resources and funding support to sustain NPP post-launch Cal/Val activities (to compete with J1+ VIIRS pre-launch Cal)**
- **Instrument and spacecraft maneuver**
- **Transition to operations**
- **J1, J2 and beyond**



# FY-13 Schedule and Milestones



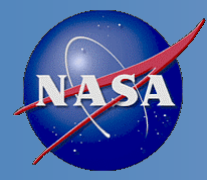
- Task 1: VIIRS SDR Team Management and Coordination (ongoing)
  - Continued support to the DRAT process
  - Lead the VIIRS SDR team
  - Organize sensor evaluation
  - Document performance and progress; recommend changes and updates to software and LUTs
  - Maintain and update the calibration knowledge base on the web
  - Coordinate interactions with other teams (CrIS, EDR) and NIST
  - Reporting and meetings/telecons
  - Taking assigned actions by AERB, DRAT, DPA, PDA, ADP
- Task 2: Update VIIRS SDR Algorithm Theoretical Basis Document (ATBD)
  - Many sections of the ATBD are either out of date or contain erroneous information and need to be updated or rewritten. This include but not limited to the calibration equations (144 calibration equations!)
  - Quality flags need to be updated



# FY-13 Schedule and Milestones



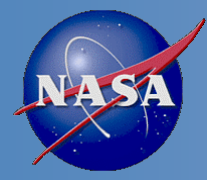
- Task 3: VIIRS SDR calibration and validation, cross sensor calibration
  - Routine online SNO predictions and dissemination
  - Continue inter-comparisons with MODIS, CrIS, and AVHRR (including MetOp-B)
  - Mitigation of sensor degradation (version control of F and H LUTs)
  - Collaborate with NASA on lunar calibration
  - Instrument performance matrix and monitoring
  - Collaborate with EDR teams and help general users
  - Image data (including DNB) analysis and evaluation
  - Cal/val using vicarious calibration sites
  - Deliverables (Sept 2013)
    - Reports on instrument performance,
    - Technical reports and journal papers
    - Revised user's guide
    - Extended image gallery
    - Sub-version control of F and H LUTs



# FY-13 Schedule and Milestones



- Task 4: JPSS-1 VIIRS Pre-launch Test Support
  - Coordination with prelaunch test segment of the flight project through NASA instrument scientists and managers
  - Coordination of NIST SOW and participation
  - Provide feedback to flight wrt VIIRS onorbit performance and issues
  - Prelaunch test data analysis
  - Participate in TIM with vendor and flight
  - Support anomaly resolution and waiver analysis
  - Mature and fine-tune J1 spectral test program
  - Deliverables
    - Technical reports on findings and results
    - Weekly and monthly reports
  
- Task 5: NGAS VIIRS SDR Science Transition
  - Transition DNB software to improve straylight reduction and geolocation for operational use



# FY-13 Schedule and Milestones

## Other



- Task 6 Calibration algorithm enhancements & LUT
  - Full automation of RSB calibration targeted for Mx7 IDPS code release in April 2013
  - Improvement of TEB radiometric performance with implementation of ADR 4780 code change in Mx7
  - Data analysis for LUT development
  - Gravite, ADL etc.
  - Ongoing cal/val
  
- Task 7 Special Sensor Calibration and Operation Support
  - Support planning and scheduling of various calibration maneuvers.
  - Perform data analysis for special calibration and operation activities (e.g. on-orbit lunar observations).
  - Provide documentation review and support for sensor performance evaluation and anomaly resolution.
  - Serve as the POC of VIIRS SDR team with the NPP Operation Team.
  - Prepare and present the VIIRS SDR team with results derived from special test data analysis





# FY-13 Schedule and Milestones



- Task 8 VIIRS On-orbit Calibration Support
  - Evaluate sensor OBC functions and their on-orbit performance.
  - Derive key SDR calibration parameters using data collected from instrument OBC.
  - Help identify and address issues that are critical for SDR algorithm and look-up-table (LUT) improvements.
  - Calibration and Validation Review Support
  - Deliverables:
    - Document and report the findings to the VIIRS SDR team.
- Task 9 Aircraft campaigns
  - SDR aircraft based Cal/Val exercise to assess VIIRS (and CrIS) radiometric performance
- Time lines:
  - October 2012: MX6.3 implementation
  - Late fall 2012: VIIRS SDR provisional status review
  - 2013: VIIRS SDR calibrated/validated review
  - 2013-14: transition to operations
  - Summer 2013: J1 prelaunch testing and data analysis



# Path Forward (FY-13 thru FY-17)

(assume “FYxx” runs from April 1, 20xx to March 31, 20xx+1)



	Suomi NPP	JPSS J1
FY13	Complete ICV, VIIRS SDR provisional, ATBD, cross calibrated/validated, continue routine cal/val and LTM, aircraft	Prelaunch testing and data analysis, Requirements analysis and ground test plan review
FY14	Transition to operations	Prepare and analyze ground test data, Complete prelaunch tests and data analysis
FY15	Operational cal/val and long-term monitoring	Analyze ground test data and prepare for launch, Instrument delivery and spacecraft level tests
FY16	Operational cal/val and long-term monitoring	Analyze ground test data and prepare for launch and post-launch activities, J1 launch
FY17	Operational cal/val and long-term monitoring	J1 postlaunch check out and intensive cal/val



# Summary



- The VIIRS SDR team has done a great job supporting S-NPP VIIRS postlaunch cal/val
  - Extra effort ensured RSB meet specification
  - Resolved TEB calibration issues
  - Improved DNB image quality
  - Supported the improvement of the IDPS
  - Provided feedback to flight for future models
  - Disseminated results to the scientific community
- Will continue working with EDR teams to address instrument performance issues
- Will coordinate more closely with flight and NIST for J1 prelaunch tests
- Will address issues and challenges as identified