

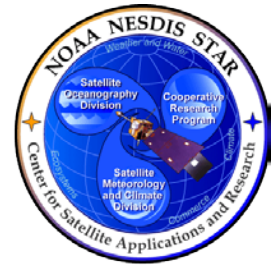


Algorithm Validation

Presented by

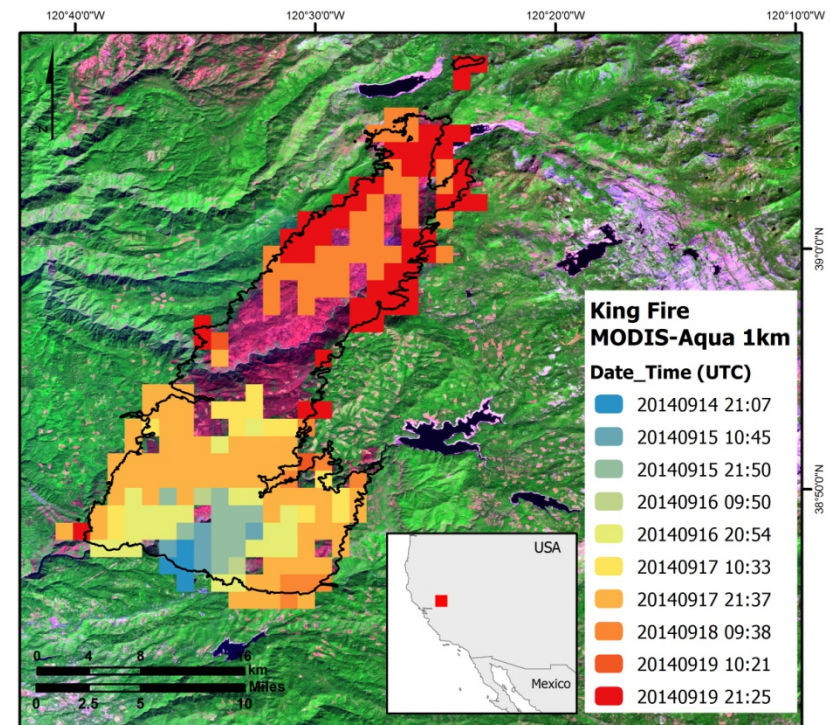
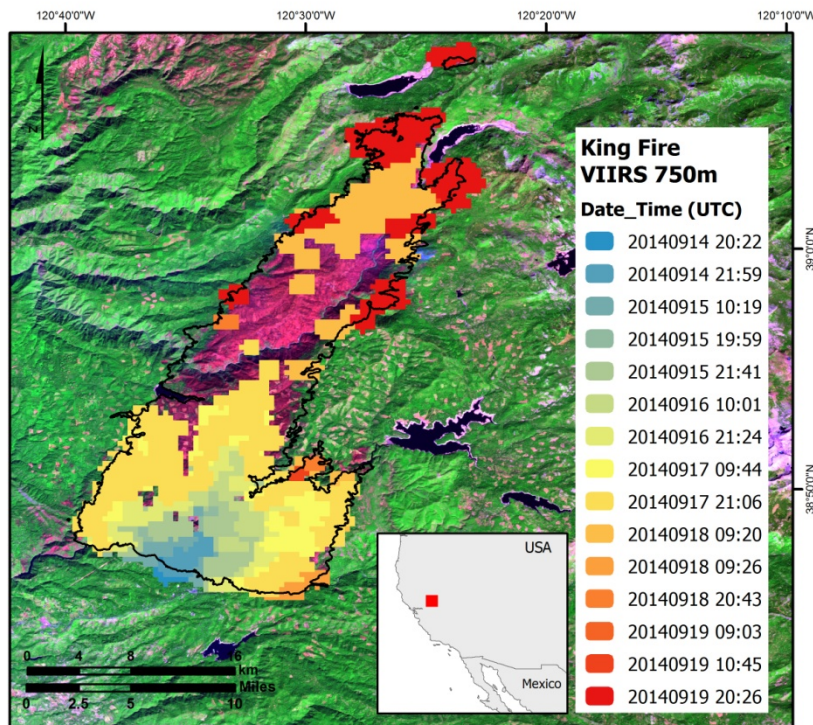
Ivan Csiszar
NOAA/NESDIS/STAR

Algorithm validation and verification approaches



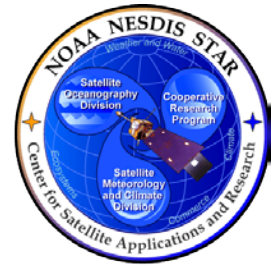
- ▶ Tracing back to MODIS product accuracy
 - Common algorithm
 - Terra MODIS explicitly validated using ASTER
- ▶ Use of independent reference data
 - In situ (validation)
 - Airborne (validation)
 - Spaceborne (30m: validation; 185m: consistency check)
- ▶ Visual evaluation and consistency with IDPS
 - for detections only
- ▶ Consistency between research (NASA) and NRT operational (NOAA) code output
- ▶ Consistency between STAR and NDE (SADIE) output

VIIRS vs. MODIS active fire

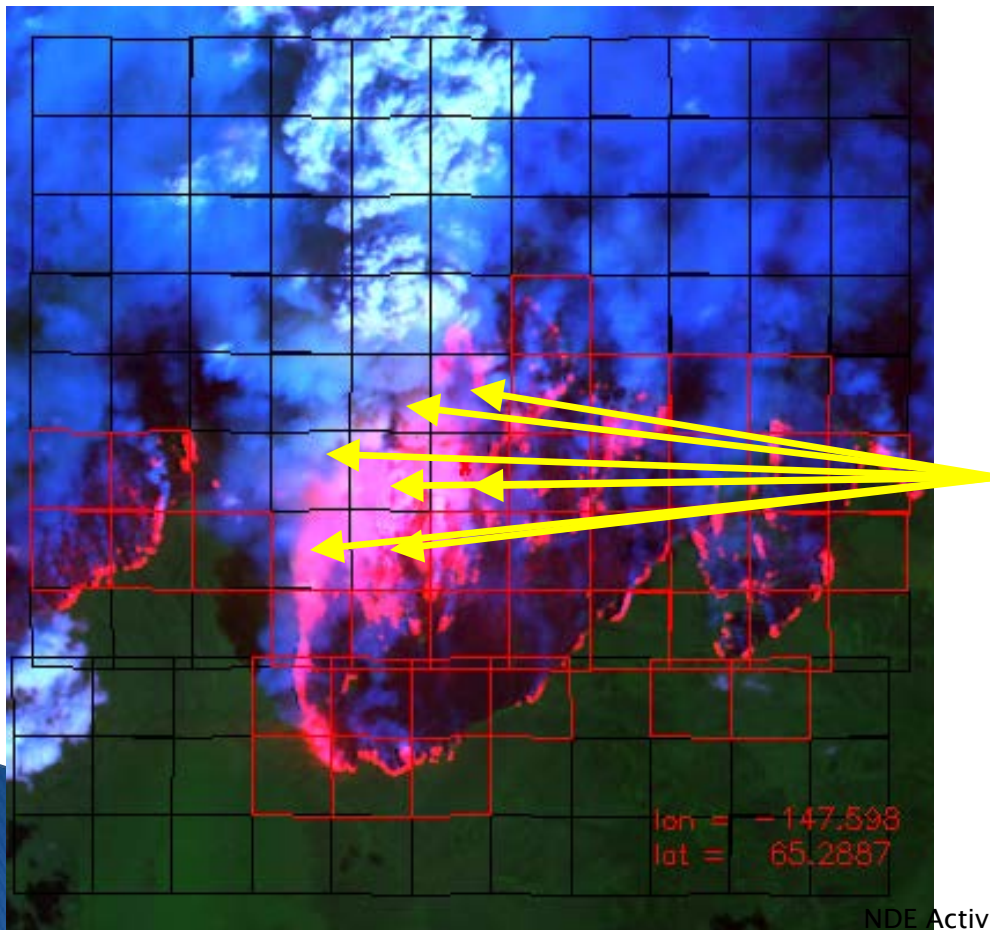


Suomi NPP/VIIRS AF and Aqua/MODIS MYD14 fire detection data produced for the King fire/California on 14–19 September 2014

VIIRS Fire Product Validation: tracing back to MODIS



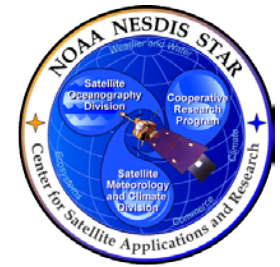
- ▶ 2D fire mask and QA data required for proper consideration of viewing conditions and error quantification



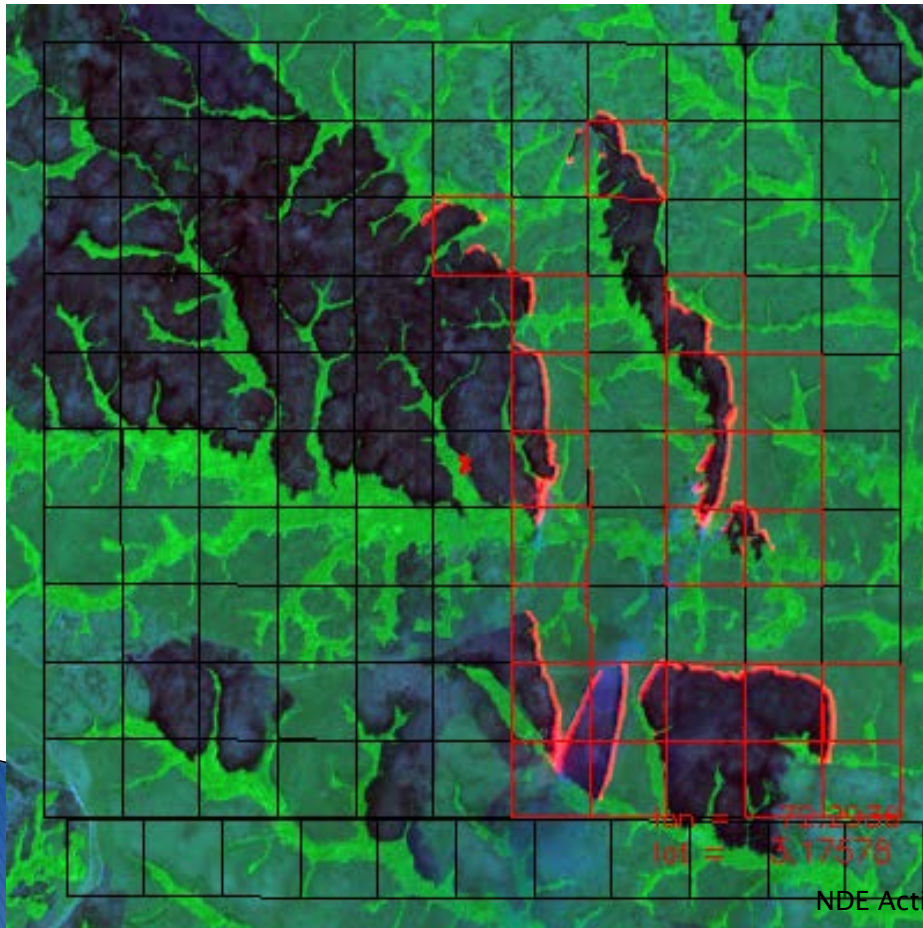
MODIS (1km) omission error of
core fire area due to thick smoke
column

(from CDR)

VIIRS Fire Product Validation: tracing back to MODIS



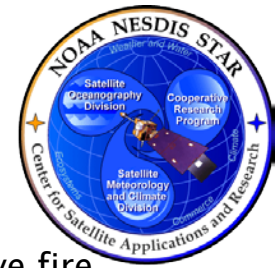
- ▶ Detected fires are predominantly sub-pixel in size
 - *Higher spatial resolution reference data sets required*



MODIS (1 km grid) and ASTER (30 m) coincident mapping of fires in Colombia (72.2936W 3.17578N)
01 Feb 2004 15:18:49 UTC

Time separation between VIIRS and Landsat-class data (>2h) prevents use of those reference data sets for active fire validation

(from CDR)



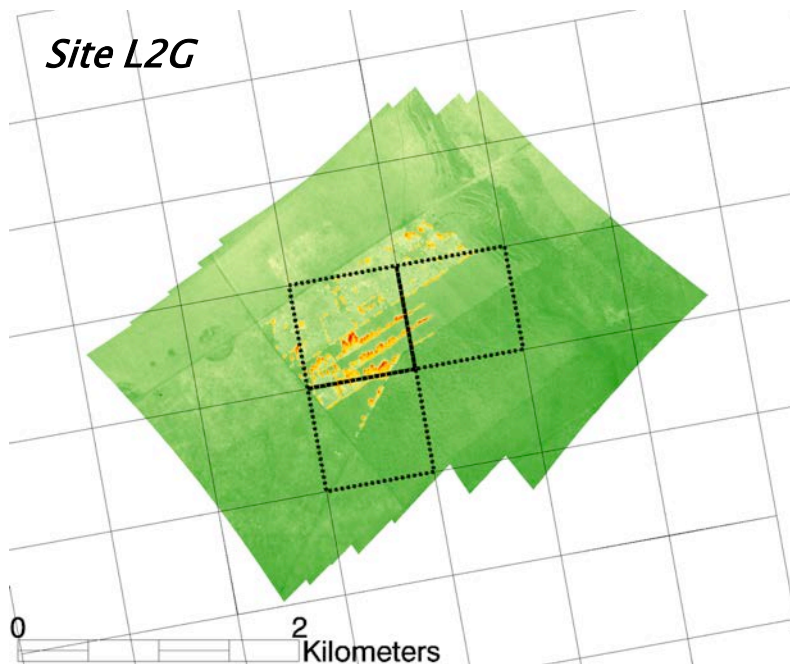
Key relevant publications

- ▶ Morisette, J.T., Giglio, L., Csiszar, I., Justice, C.O. 2005. Validation of the MODIS active fire product over Southern Africa with ASTER data. *International Journal of Remote Sensing*, 26:4239–4264.
- ▶ Morisette, J.T., Giglio, L., Csiszar, I., Setzer, A., Schroeder, W., Morton, D., Justice, C.O. 2005. Validation of MODIS active fire detection products derived from two algorithms. *Earth Interactions*, 9:1–23.
- ▶ Csiszar, I., J. Morisette and L. Giglio, 2006. Validation of active fire detection from moderate resolution satellite sensors: the MODIS example in Northern Eurasia. *IEEE Transactions on Geoscience and Remote Sensing*, vol. 44, no. 7, 1757–1764.
- ▶ Schroeder, W., Prins, E., Giglio, L., Csiszar, I., Schimdt, C., Morisette, J., Morton, D. 2008. Validation of GOES and MODIS active fire detection products using ASTER and ETM+ data. *Remote Sensing of Environment* 112 (2008) 2711–2726.
- ▶ Schroeder, W., M. Ruminski, I. Csiszar, L. Giglio, E. Prins, C. Schmidt, J. Morisette, 2008: Validation Analyses of and Operational Fire Monitoring Product: the Hazard Mapping System. *International Journal of Remote Sensing*, Vol. 29, No. 20, 6059–6066, DOI: 10.1080/01431160802235845.
- ▶ Csiszar, I. and W. Schroeder, 2008: Short-Term Observations of the Temporal Development of Active Fires from Consecutive Same-Day ETM+ and ASTER Imagery in the Amazon: Implications for Active Fire Product Validation. *IEEE Journal of Selected Topics in Earth Observations and Remote Sensing* Vol. 1, No. 4, 248–253. DOI: 10.1109/JSTARS.2008.2011377.
- ▶ Csiszar, I., W. Schroeder, L. Giglio, E. Ellicott, K. P. Vadrevu, C. O. Justice, B. Wind, 2014: Active fires from the Suomi NPP Visible Infrared Imaging Radiometer Suite: Product status and first evaluation results, *J Geophys Res Atmos*, 119, doi:10.1002/2013JD020453.

VIIRS Fire Product Validation: Initial Results from airborne data



Prescribed Fire Combustion and Atmospheric Dynamics Research (RxCadre) experiment in Eglin Air Force Base, FL Nov 2012.

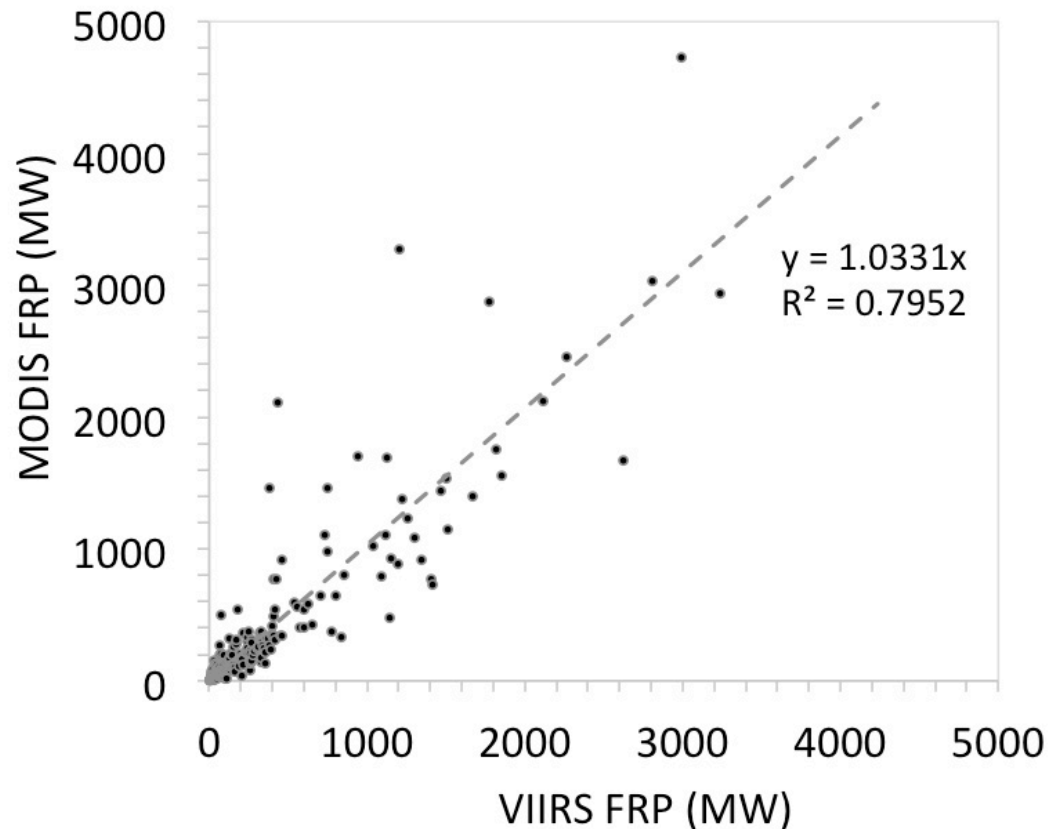


VIIRS (750 m) mapping of 2012
prescribed fire in Florida using airborne
reference data (WASP sensor)

Satellite	Fire	FRP (MW)			Cloud	Time (UTC)		Diff (s)
		WASP	MODIS	Diff		WASP	MODIS	
MODIS	L1G	148	143	5	Yes	19:19:47	19:18:58	49
	L2G	111	167	-55	No	18:42:26	18:42:01	25
	L2F	119	199	-79	No	19:25:56	19:25:05	51
	Mean (SD)		-43 (44)					
VIIRS	L1G	414	158	256	Yes	18:59:24	18:59:54	30
	L2G	152	151	1	No	18:49:08	18:47:22	106
	L2F	487	237	250	Yes	18:29:47	18:28:34	73
	Mean (SD)		169 (146)					

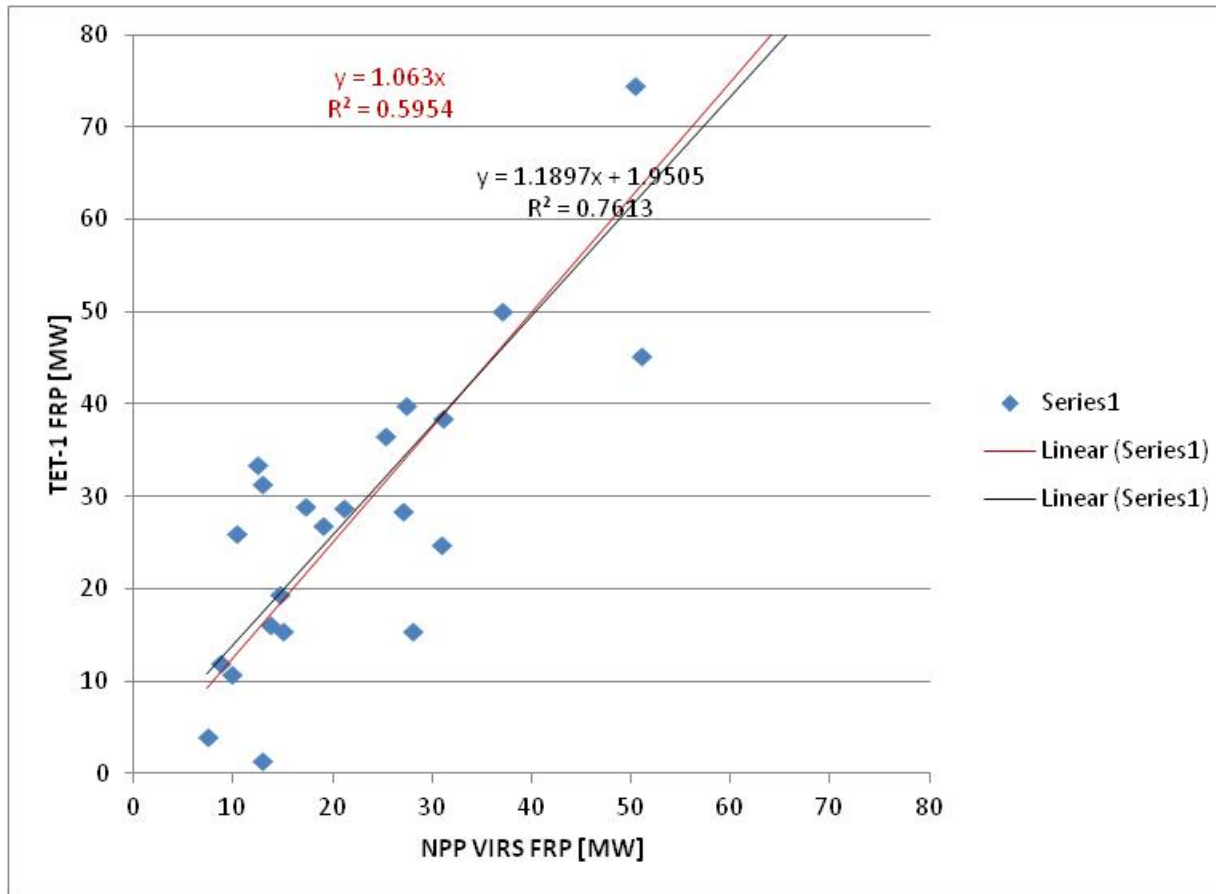
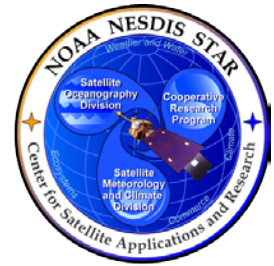
Dickinson et al. [2014]

FRP evaluation using MODIS



MODIS/VIIRS gridded data (0.5 degree) of near-coincident fires (<1km from each other) over different parts of the globe including atmospheric correction of both data sets.

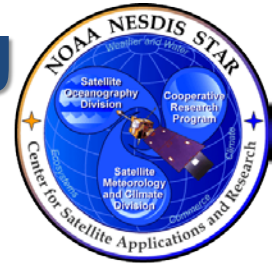
FRP evaluation using DRL TET-1



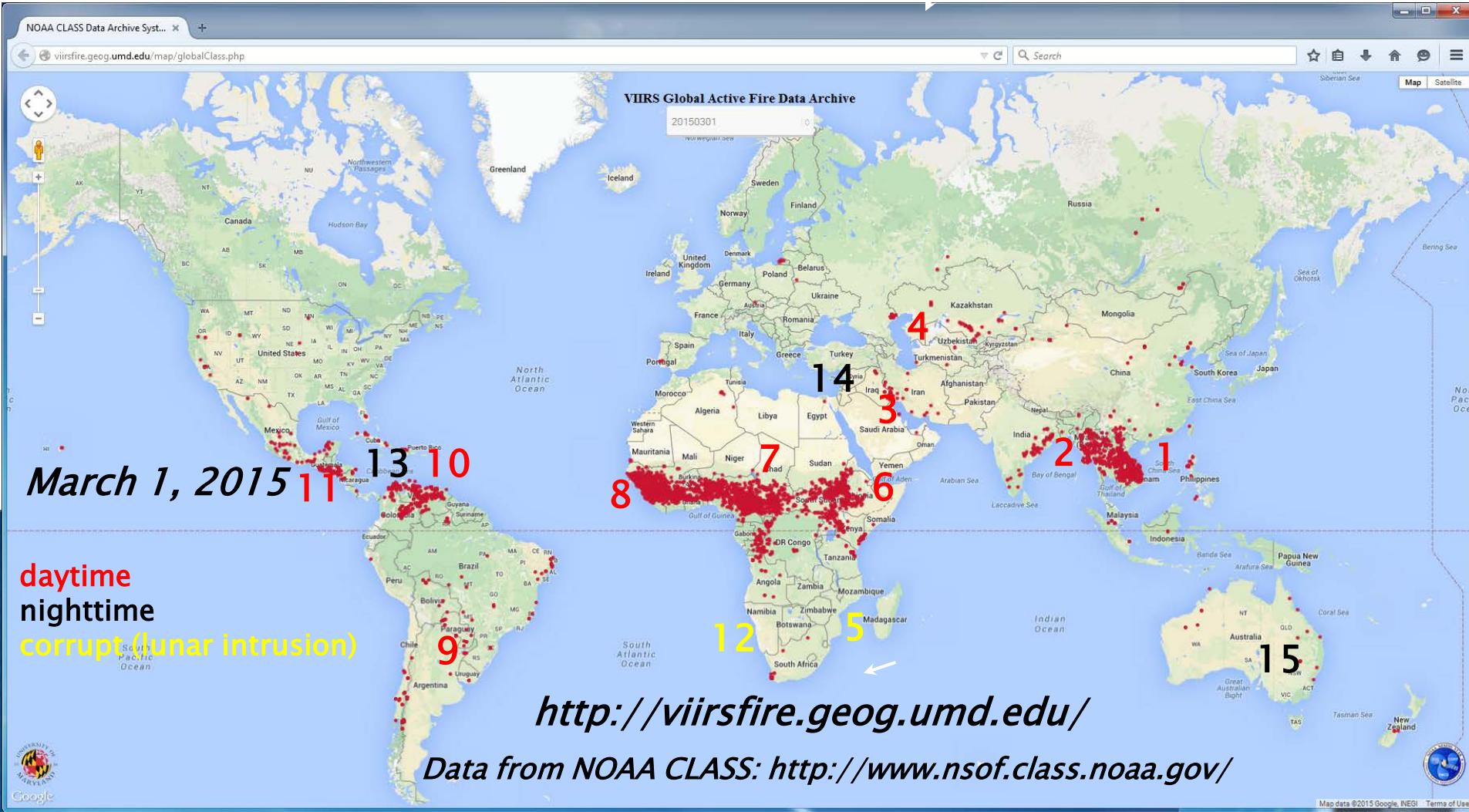
Comparison of FRP retrievals of gas flares in the Middle East on May 9, 12, 15, 18, 24 2015

TET-1: Technology Experiment Carrier-1 by German Aerospace Agency DRL; dedicated 1.85m unsaturated measurements for hotspot characterization

NOAA NDE VIIRS Active Fire Product testing



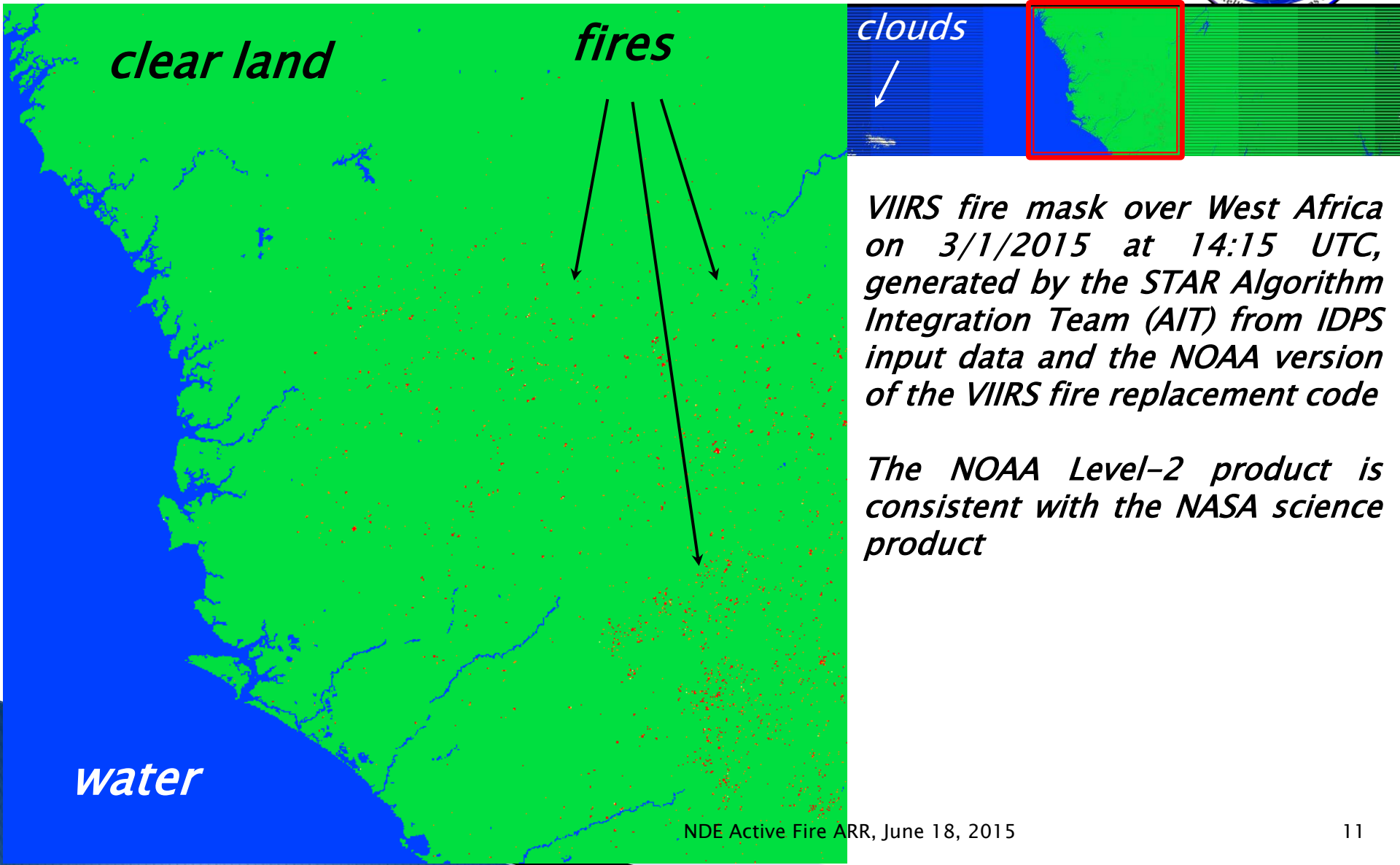
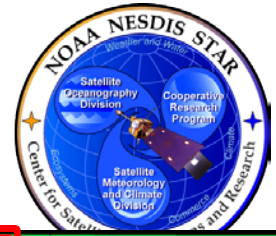
15 granules covering daytime (1–12), nighttime (13–15), land, water and corrupt (5,12) data were tested for overall performance and consistency between the NOAA and NASA output. The global map shown for reference is the current IDPS product.



<http://viirsfire.geog.umd.edu/>

Data from NOAA CLASS: <http://www.nsosf.class.noaa.gov/>

NOAA NDE Active Fire Product



VIIRS fire mask over West Africa on 3/1/2015 at 14:15 UTC, generated by the STAR Algorithm Integration Team (AIT) from IDPS input data and the NOAA version of the VIIRS fire replacement code

The NOAA Level-2 product is consistent with the NASA science product

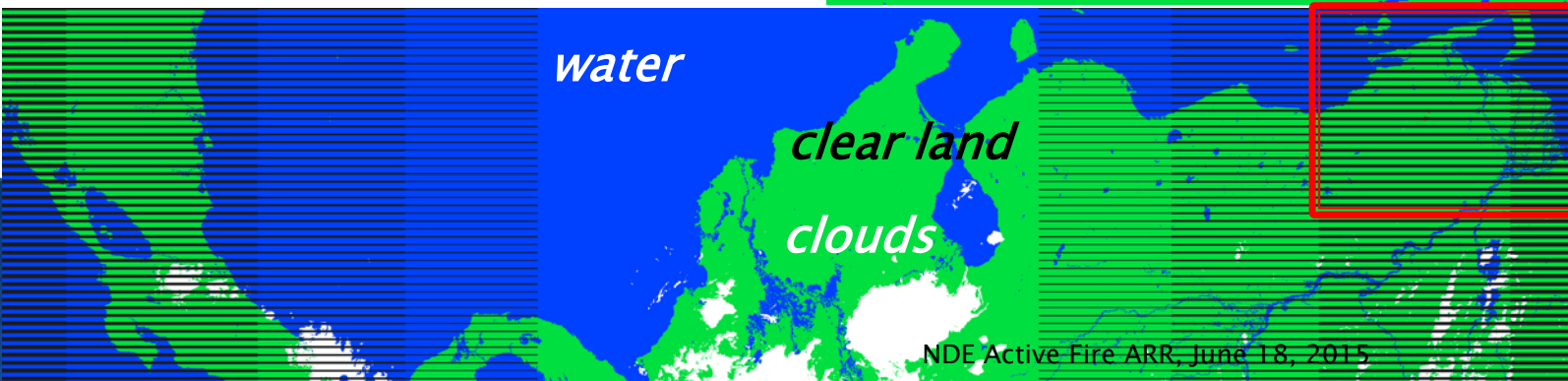
NOAA NDE Active Fire Product



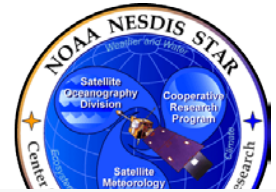
VIIRS fire mask over Central America and North-West South America on 3/1/2015 at 6:33 UTC, generated by the STAR Algorithm Integration Team (AIT) from IDPS input data and the NOAA version of the VIIRS fire replacement code. The horizontal lines are bow-tie deletions in the VIIRS granule.

The NOAA Level-2 product is consistent with the NASA science product

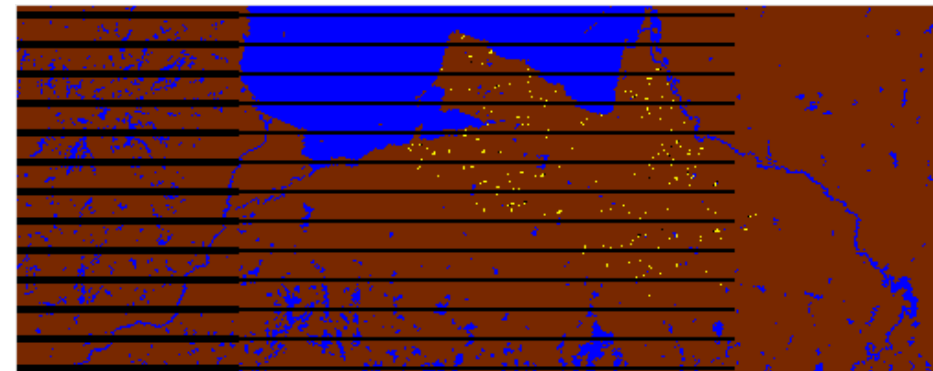
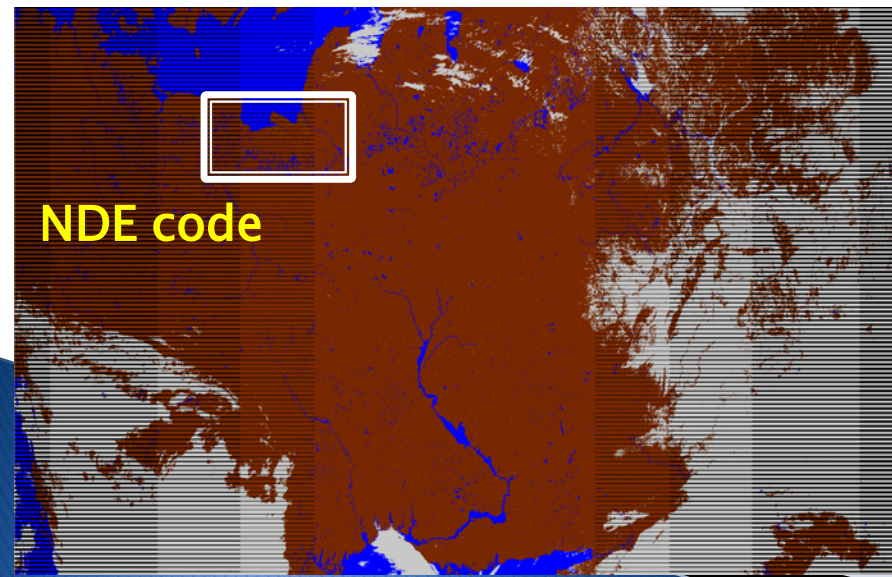
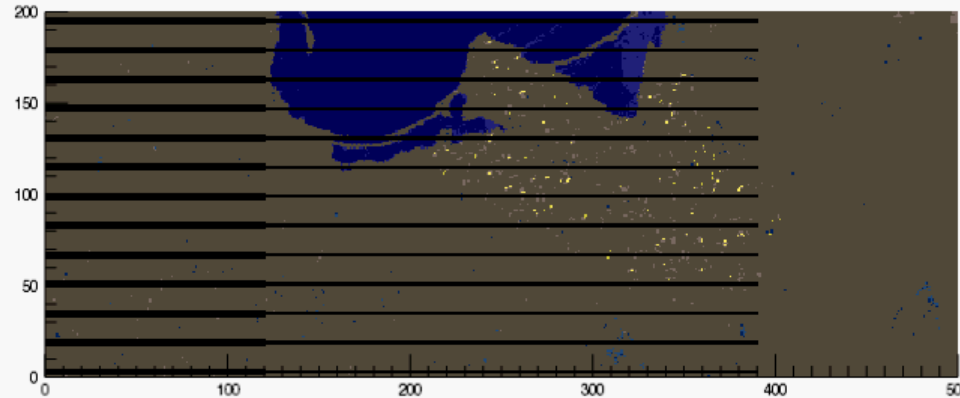
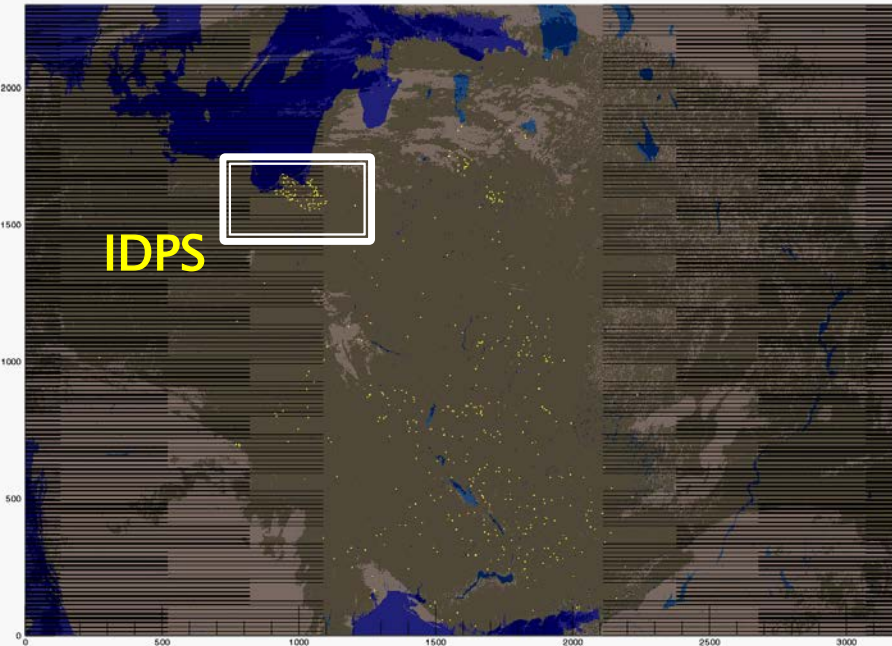
(nighttime) FRP: 4.36 – 212.39 MW



IDPS vs. NDE code

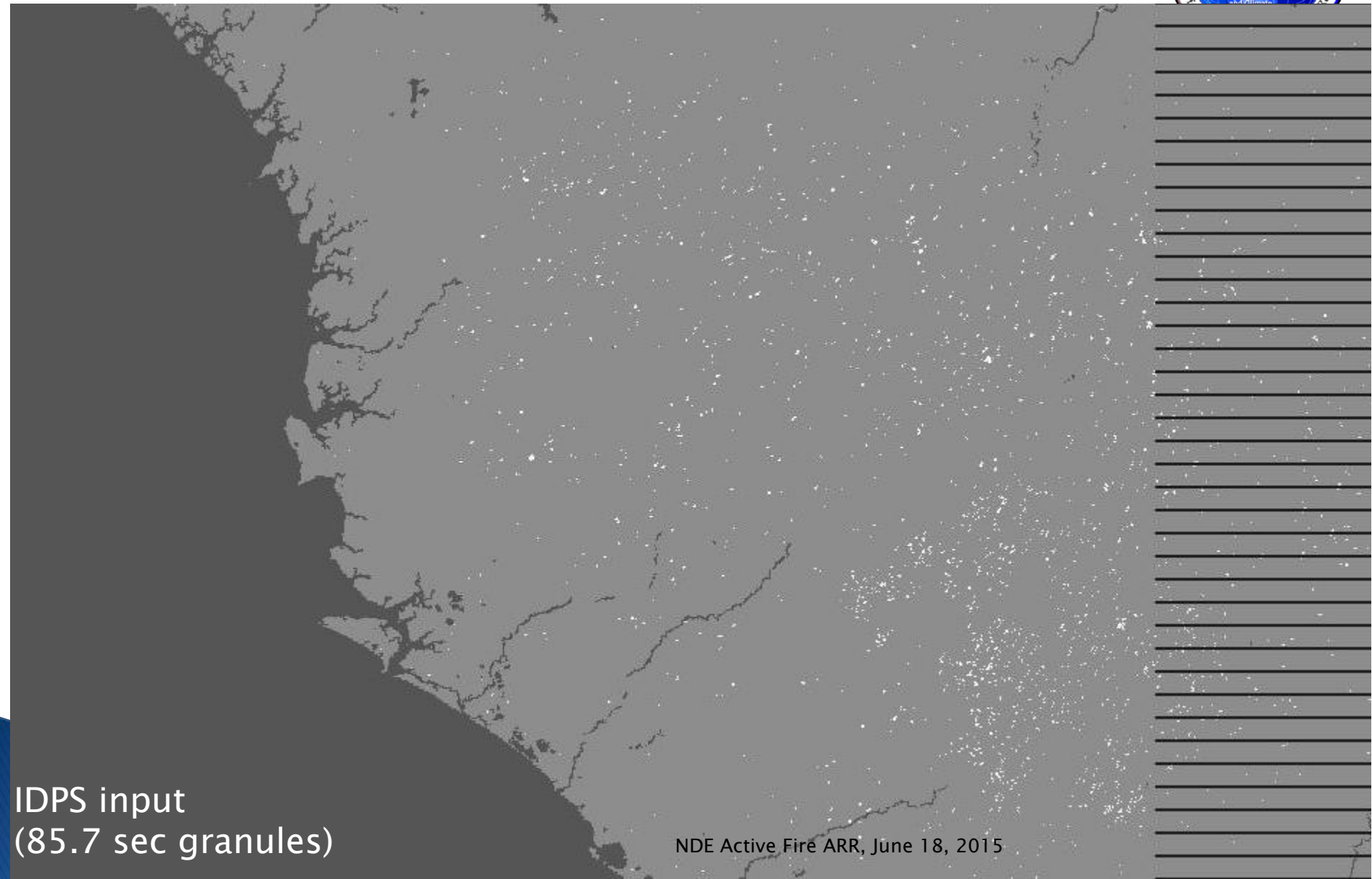


March 10, 2014 10:36-10:40



The JPSS 1 “replacement” code has been delivered NOAA STAR Algorithm Implementation Team (AIT) for integration into NOAA operations.

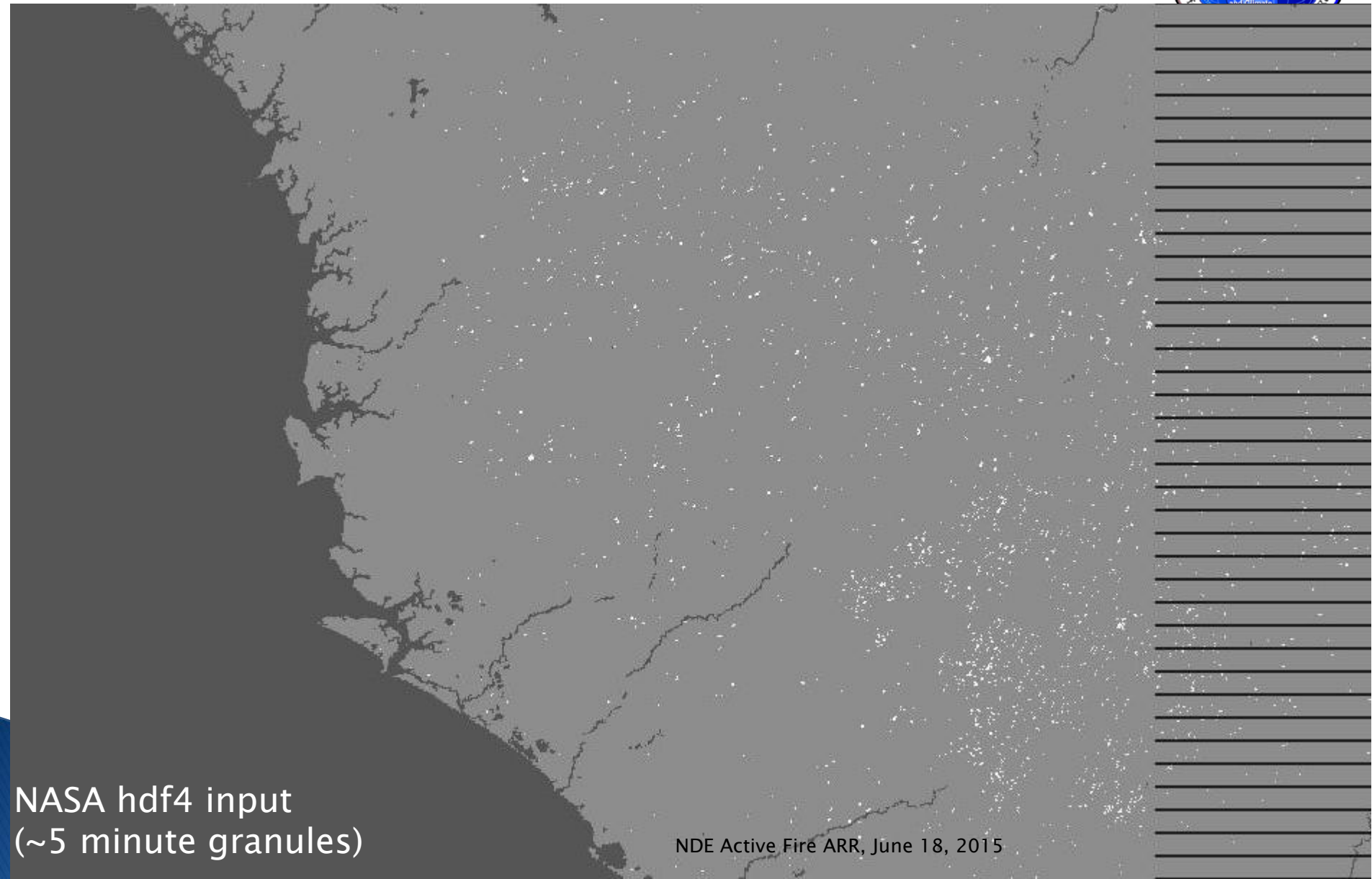
NOAA STAR AIT output



IDPS input
(85.7 sec granules)

NDE Active Fire ARR, June 18, 2015

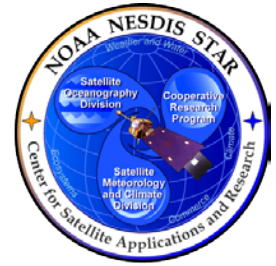
NASA Science Code output



NASA hdf4 input
(~5 minute granules)

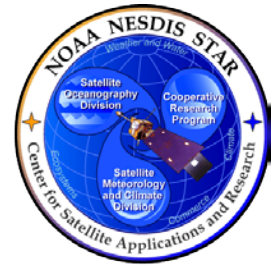
NDE Active Fire ARR, June 18, 2015

STAR vs. NDE (SADIE) output

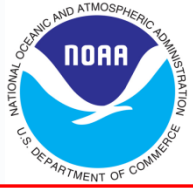


- ▶ A comparison was made for the content of granule AF_20150301_0546405_0548047.nc generated within the STAR testing/development environment and SADIE
- ▶ The only differences found were unique ID parameters and creation time
- ▶ No differences were found in the science content of the output

Validation / verification summary



- ▶ Product accuracy can be traced back to mature and validated MODIS algorithm
- ▶ Explicit validation is ongoing
- ▶ Available results indicate good detection performance
- ▶ Good consistency among FRP estimates from VIIRS, MODIS and TET-1
- ▶ Implementation of science code into NOAA environment (STAR; NDE SADIE) is verified using a global sample of cases over one day
- ▶ Validation and verification continues



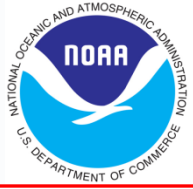
Validated Stage 1 Science Maturity Review for Active Fire

Ivan Csiszar

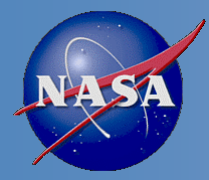
September 4, 2014



Outline



- Algorithm Cal/Val Team Members
- Product Requirements
- Evaluation of algorithm performance to specification requirements
 - Evaluation of the effect of required algorithm inputs
 - Quality flag analysis/validation
 - Error Budget
- Documentation
- Identification of Processing Environment
- Users & User Feedback
- Conclusion
- Path Forward



Active Fire Cal/Val Team



Algorithm Cal/Val Team Members

Name	Organization	Major Task
Ivan Csiszar	STAR	STAR lead, quality monitoring, LTM, international outreach
Wilfrid Schroeder	UMD	Product monitoring and validation, algorithm development
Louis Giglio	UMD	Algorithm development, quality monitoring
Evan Ellicott	UMD	User readiness
William Walsch	UMD	Code development
Krishna Vadrevu	UMD	International outreach
Chris Justice	UMD	Program coordination, user readiness, MODIS continuity, international outreach
Marina Tsidulko	STAR AIT	Code integration, chain testing



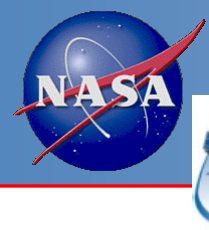
Requirements: L1RD Supplement



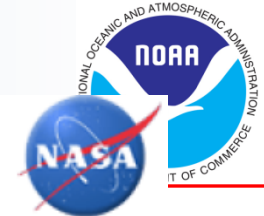
Active Fires		
ATTRIBUTE	THRESHOLD	OBJECTIVE
a. Horizontal Cell Size		
1. Nadir	0.80 km	0.25 km
2. Worst case	1.6 km	
b. Horizontal Reporting Interval		
	HCS	
c. Horizontal Coverage		
	Global	Global
d. Mapping Uncertainty, 3 sigma		
	1.5 km	0.75 km
e. Measurement Range		
1. Fire Radiative Rower (FRP)	1.0 to 5.0 (10) ³ MW	1.0 to 1.0 (10) ⁴ MW
2. Sub-pixel Average Temperature of Active Fire	N/A	N/A
3. Sub-pixel Area of Active Fire	N/A	N/A
f. Measurement Uncertainty		
1. Fire Radiative Rower (FRP)	50%	20%
2. Sub-pixel Average Temperature of Active Fire	N/A	N/A
3. Sub-pixel Area of Active Fire	N/A	N/A
g. Refresh		
	At least 90% coverage of the globe every 12 hours (monthly average)	N/A

 : **Not required for S-NPP**

Current IDP product was designed to meet heritage NPOESS requirements., which have been baselined according to L1RDS S-NPP Performance Exclusions (Appendix D). Spatially explicit fire mask and fire characterization are “uppers” in the JPSS L1RD for J1 and beyond.



VIIRS mapping uncertainty



Overall Uncertainty

Residuals	Error (Nadir)	Spec (Nadir)	Error (EOS)	Spec (EOS)
Track mean	-9 m		-20 m	
Scan mean	-7 m		-46 m	
Track RMSE	73 m	133 m	161 m	500 m
Scan RMSE	61 m	133 m	398 m	500 m

- RMSE: Root Mean Square Error (equivalent to unbiased 1σ)
- Data-days: 632, excluding 18 days right after A/B side switch
- Mean errors are small
- Nadir uncertainties of ~ 70 m (1σ) meet spec of 133 m (1σ) [400 m (3σ)]
- Edge-of-scan (EOS) uncertainties of ~ 400 m (1σ) meet spec of 500 m (1σ) [1500 m (3σ)]

S-NPP requirements explicitly are related to VIIRS SDR mapping accuracy

Considered to be within the VIIRS SDR team's scope; meets requirements



SNPP Validation and Maturity Stages



Validated Stage 1:

Using a limited set of samples, the algorithm output is shown to meet the threshold performance attributes identified in the JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions

Validated Stage 2:

Using a moderate set of samples, the algorithm output is shown to meet the threshold performance attributes identified in the JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions

Validated Stage 3:

Using a large set of samples representing global conditions over four seasons, the algorithm output is shown to meet the threshold performance attributes identified in the JPSS Level 1 Requirements Supplement with the exception of the S-NPP Performance Exclusions



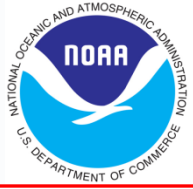
Evaluation of algorithm performance to specification requirements (3-5 slides)



- Findings/Issues from Provisional Review
- Improvements since Provisional
 - Algorithm Improvements
 - LUT / PCT updates
- Cal/Val Activities for evaluating algorithm performance:
 - Test / ground truth data sets
 - Validation strategy / method
 - Validation results



Product Quality metrics



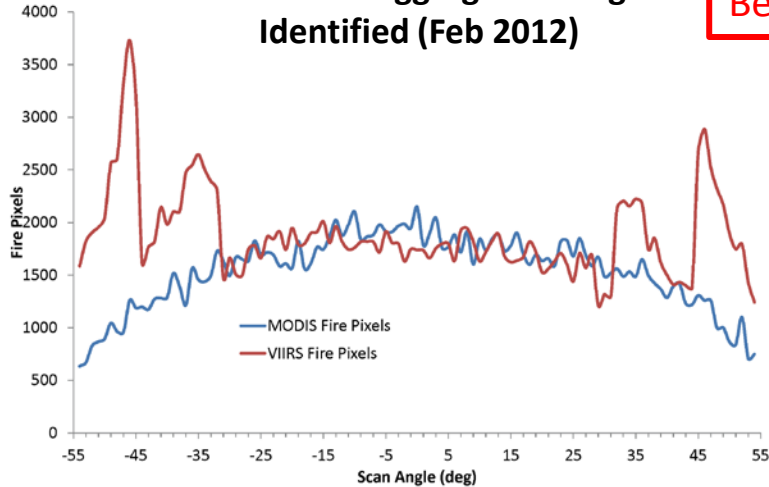
- Estimates of commission / omission errors and **comparison with MODIS**
 - The product performs well in comparison to MODIS and AVHRR
 - Increased resolution and VIIRS mapping geometry improves product quality for off nadir observations and increases spatial coverage
- **VIIRS sensor and SDR performance and quality flagging** (near the high end of the dynamic range) and the **ability to filter bad input data** without compromising detection of valid fire pixels
 - The majority of the work has been analysis of VIIRS SDR quality and work with the SDR team to implement fixes
 - The frequency of the SDR-related detection errors decrease over time as SDR code changes were implemented in IDPS



Comparison with Aqua MODIS



M13 Data Aggregation Bug Identified (Feb 2012)

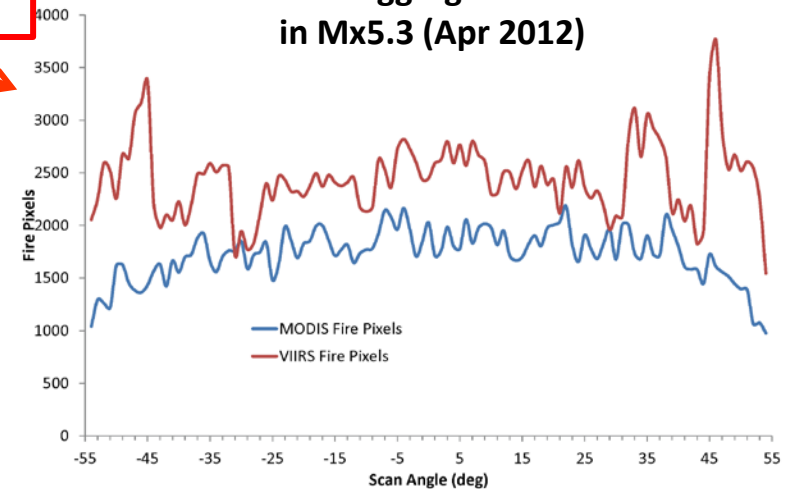


19 Jan - 13 Feb 2012

Beta maturity

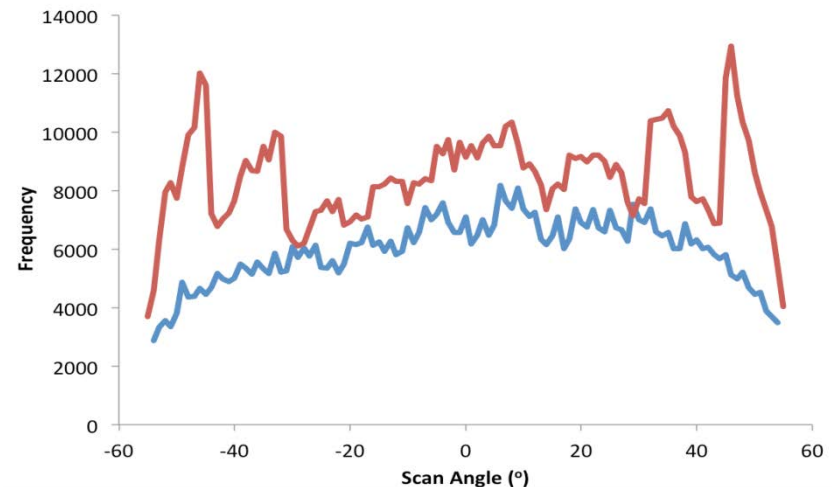


M13 Data Aggregation Revised in Mx5.3 (Apr 2012)



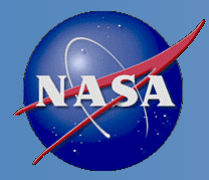
11 May - 10 Jun 2012

The overall features of the Aqua MODIS and S-NPP functional dependence on scan angle remained the same a year later and over a longer time period

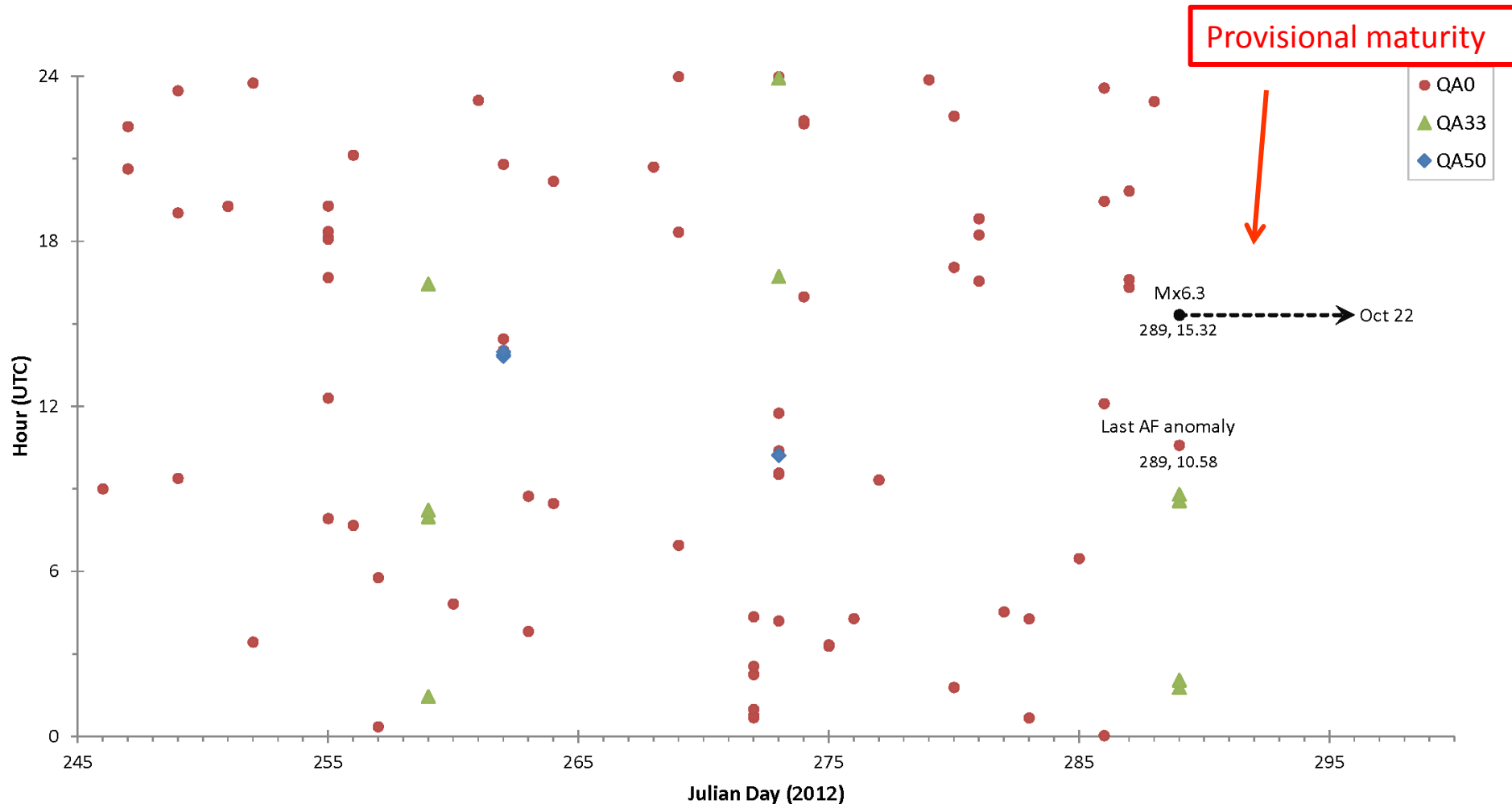


Feb - Jun 2013

(from Provisional Review)



Impact of M13 SDR dual gain fix on active fire product performance



***Effectivity date for Provisional Maturity: October 16, 2012
(first full day after the implementation of IDPS Mx6.3 on October 15)
(from Provisional Review)***



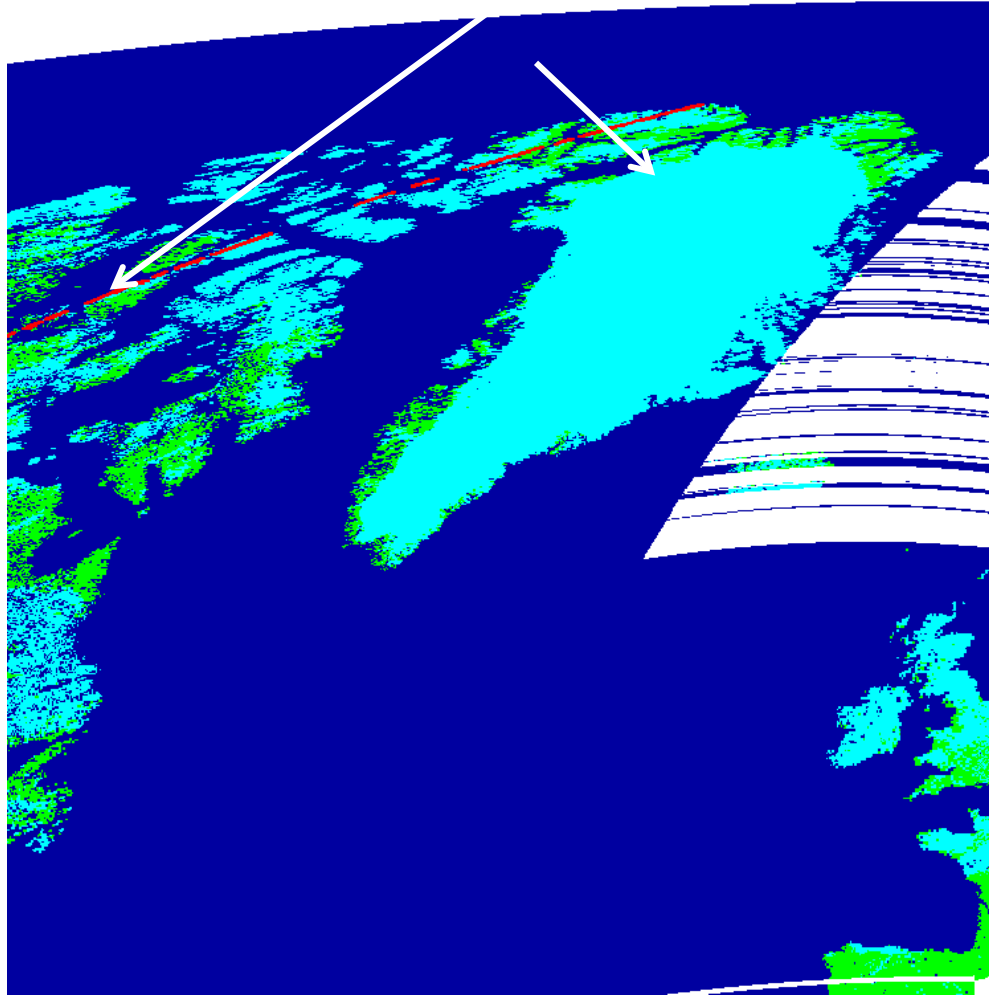
Current and recent VIIRS SDR issues



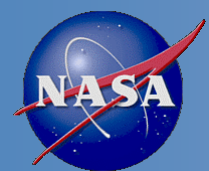
- **Non-unique mapping of radiance to brightness temperature near saturation**
 - DR 7294: Radiance and Reflectance/Brightness Temperature Upper Bounds and Quality Flagging Are Inconsistent
 - Work underway: team provided examples
 - Related issue is handling of actual sensor capabilities in SDR software
- **SDR QF1 is set incorrectly and/or cannot be used for unambiguous filtering of bad input data**
 - 474-CCR-14-1667: VIIRS SDR Multiple Issues/Quality Flags & Calibration) (ADRs 7110, 7111, 7112, 7227, 7313, 7448, 7449
 - Implemented in Mx8.5; initial evaluation presented here
- **“Folded” radiance values due to saturation not flagged as invalid; presence of saturation of input pixels prior to on-board aggregation undetected and not flagged**
 - CCR NJO-2014-007: Flagging sub-pixel saturation within nominal aggregated pixels of single-gain VIIRS bands

Primary quality issue: bad scan lines

July 15 2014 14:33:19 UTC



NPP_VAFIP_L2(Active Fire IP) on 2014196, LPEATE (AS3001)



Reference Table for QA bits



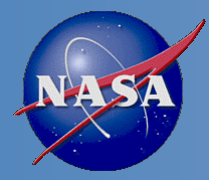
QF1_VIIRSMB ANDSDR 1 byte(s) 768 3200	Description	Datum Offset	Data Type	Legend Entries	
				Name	Value
	Quality - Indicates calibration quality due to bad space view offsets, OBC view offsets, etc or use of a previous calibration view	0	2 bit(s)	Good	0
				Poor	1
				No Calibration	2
				Not Used	3
	Saturated Pixel - Indicates the level of pixel saturation	2	2 bit(s)	None Saturated	0
				Some Saturated	1
				All Saturated	2
				Not Used	3
	Missing Data - Data required for calibration processing is not available for processing	4	2 bit(s)	All data present	0
				EV RDR data missing	1
				Cal data (SV, CV, SD, etc.) missing	2
				Thermistor data missing	3
	Out of Range - Calibrated pixel value outside of LUT threshold limits	6	2 bit(s)	All data within range	0
				Radiance out of range	1
				Reflectance or EBBT out of range	2
				Both Radiance and Reflectance/EBBT out of	3

QA	Definition
5	Poor Cal - Some saturated
18	No Calibration - None Saturated - EV RDR Data Missing
33	Poor Cal - None Saturated - Cal Data Missing
34	No Calibration - None Saturated - Cal Data Missing
50	No Calibration - None Saturated - Thermistor Data Missing
129	Poor Cal - None Saturated - All Data Present - Reflectance or EBBT Out of Range
193	Not used - Radiance out of range
65	Poor - Reflectance or EBBT out of range



(165 cal data missing)

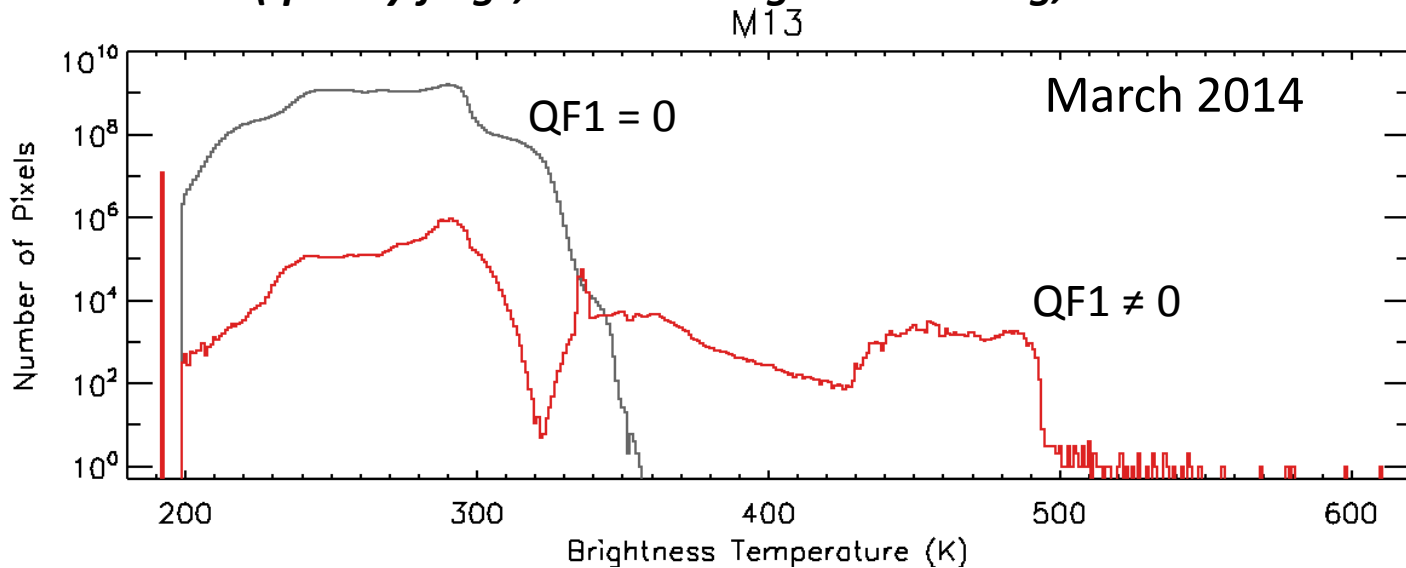




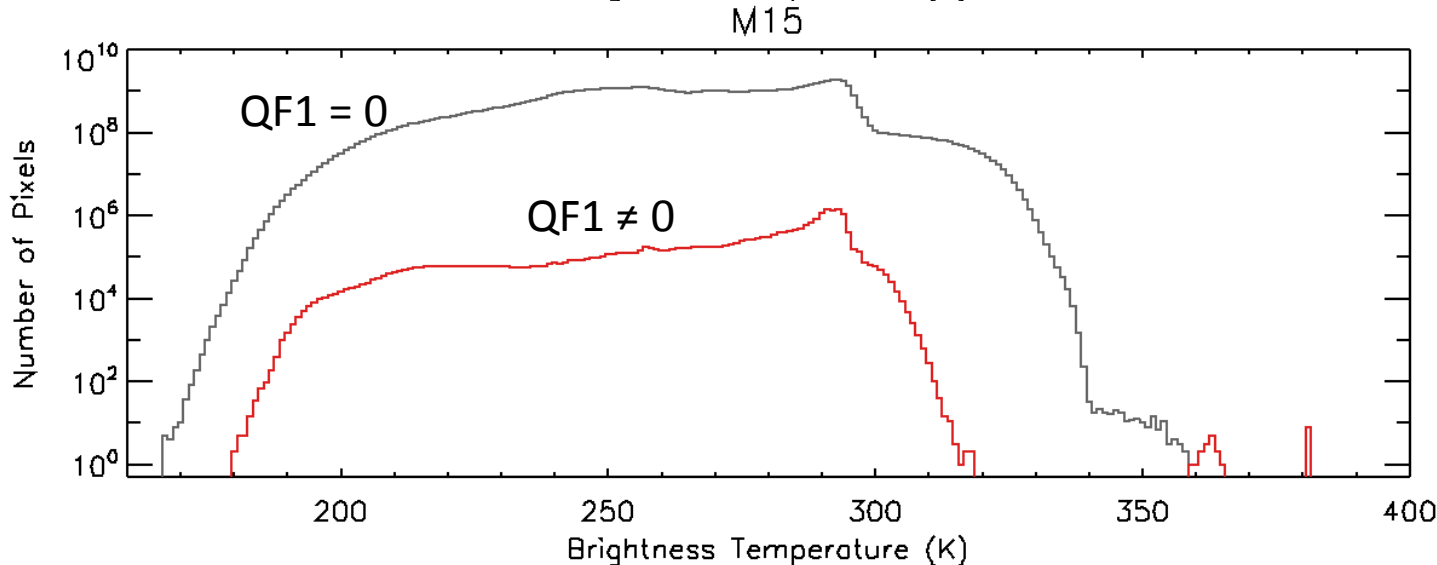
Issues: input SDR quality flagging



Suomi NPP product quality and maturity has been driven by input VIIRS SDR performance (quality flags, calibration gain switching, saturation handling etc.)

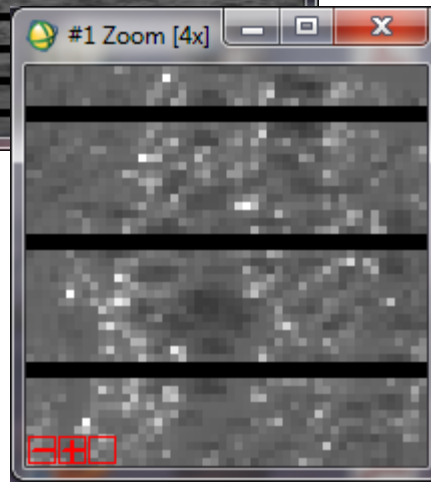
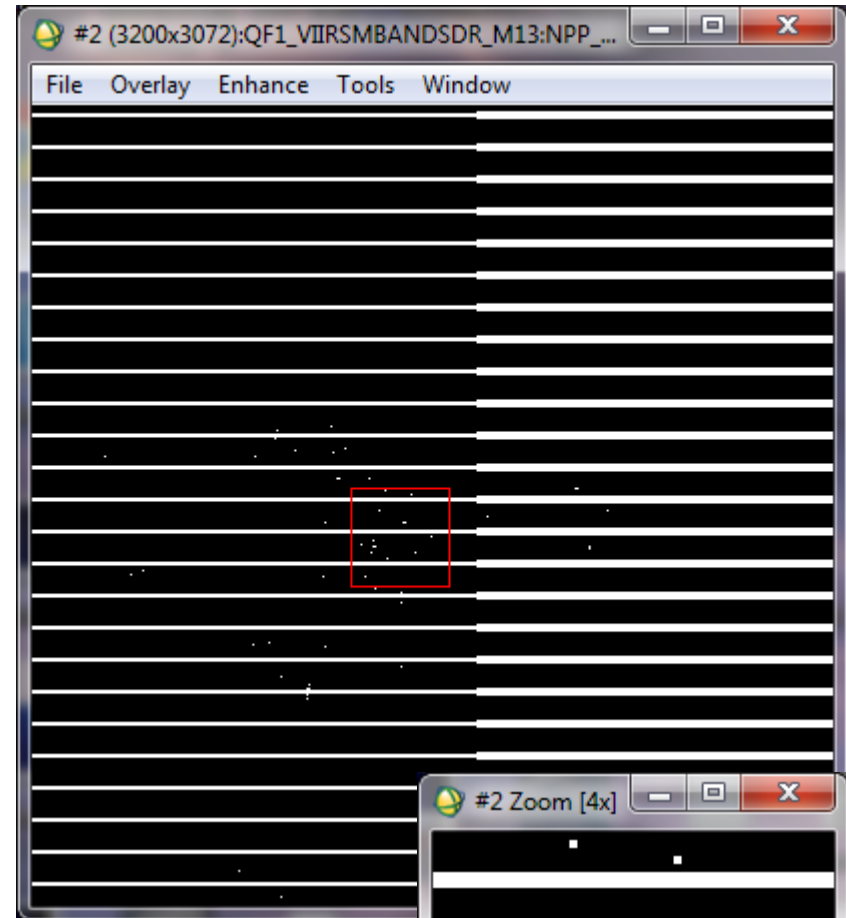


The fire team is preparing for verification by analyzing known granules and cumulative statistics.



These results are based on Mx7.2 processing within LandPEATE.

Quality flagging of TB>358K

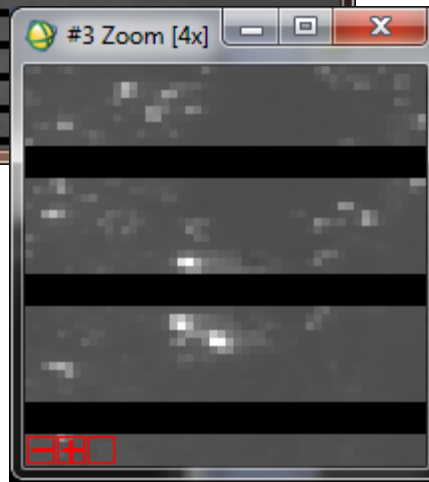
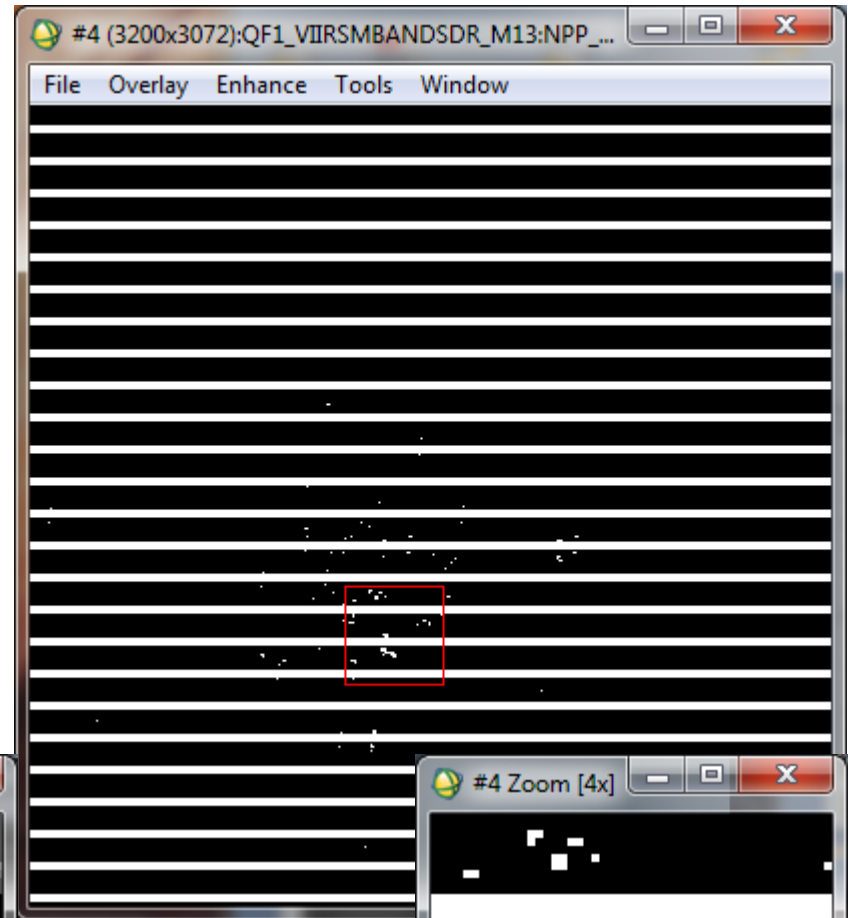
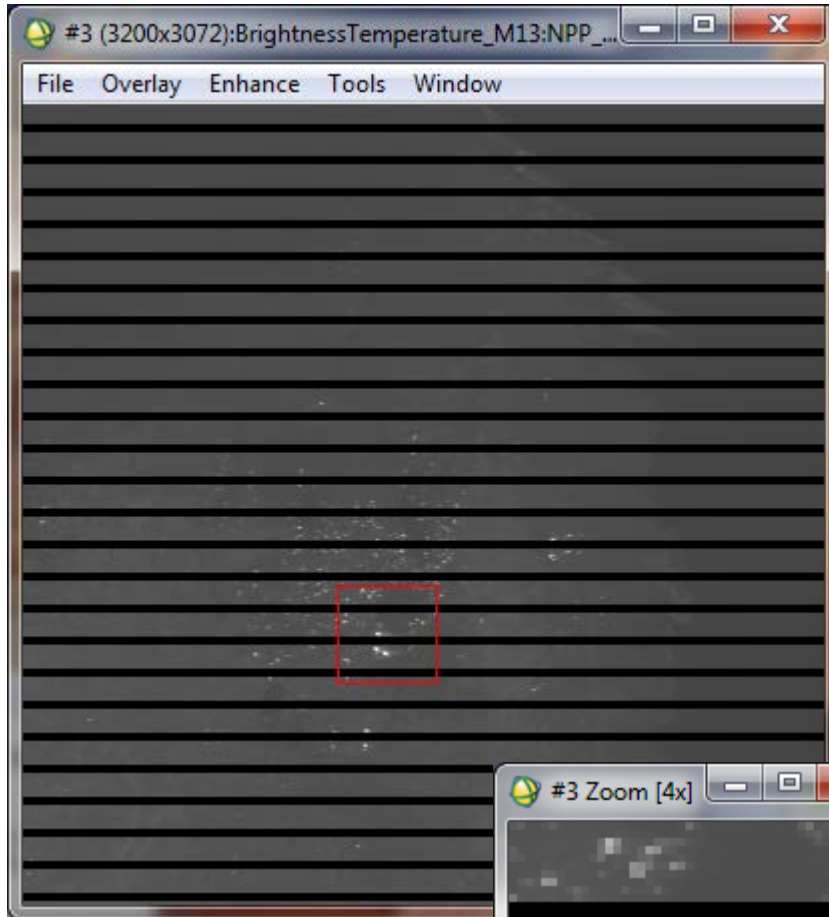


March 12 2014 11:35 UTC
IDPS 7.2 LandPEATE

All pixels with TB>358K
have QF>0 (= not "good")



Quality flagging of TB>358K



March 22 2014 13:20 UTC
IDPS 7.2 LandPEATE

All pixels with TB>358K
have QF>0 (= not "good")



Quality flagging of TB>358K



HDFView

File Window Tools Help

Recent Files /data/data126/SCDR/SVM13_npp_d20140518_t1207327_e1208569_b13238_c20140518182810469177_noaa_ops.h5

May 18, 2014 12:07:32 UTC (IDPS Mx8.3)

Column

Row

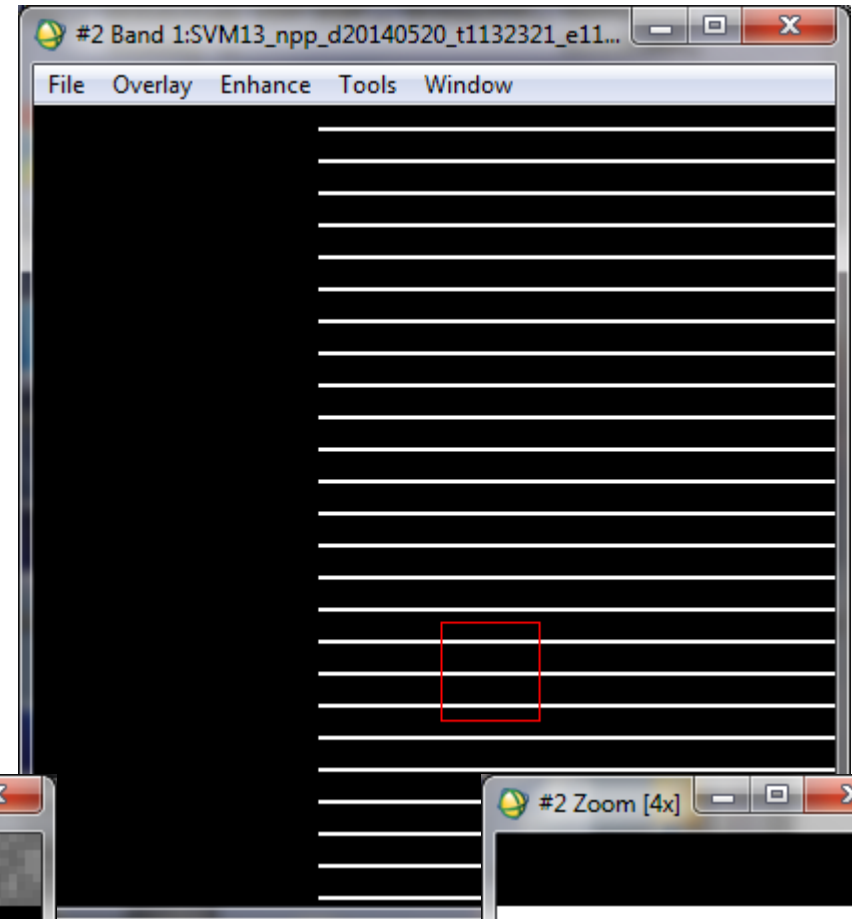
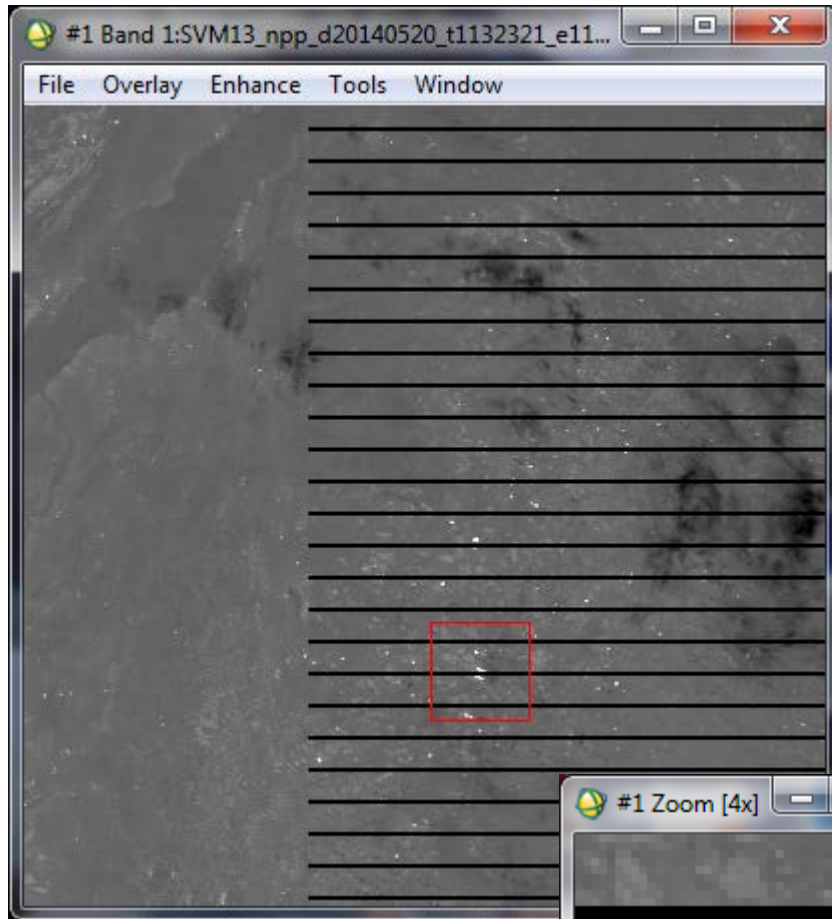
M13 TB

M13 TB QF1

QF1_VIIRSMBANDSDR (19691488)
8-bit unsigned character, 768 x 3200
Number of attributes = 0

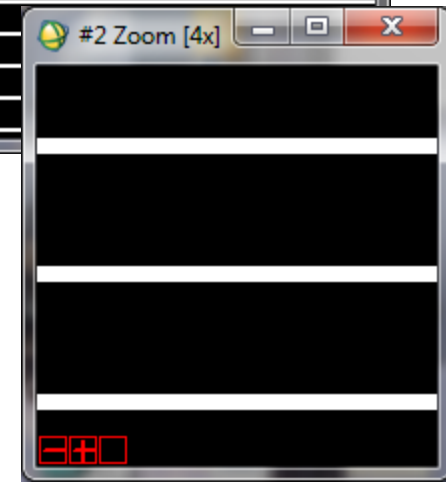
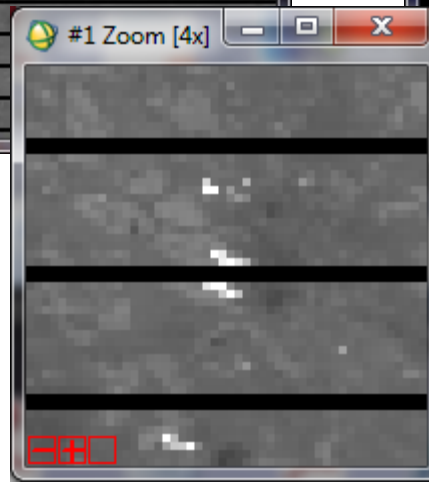


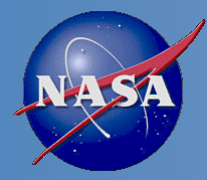
Quality flagging of TB>358K



May 20 2014 11:32:32 UTC
IDPS Mx 8.3

All pixels with TB>358K
have QF=0





Quality flagging of TB>358K



HDFView

File Window Tools Help

Recent Files /data/data126/SCDR/SYM13_npp_d20140520_t1132321_e1133563_b13266_c20140520180611809826_noaa_ops.h5

May 20, 2014 11:32:23 UTC (IDPS Mx8.3)

SVM13_npp_d20140520_t1132321_e1133563_b13266_c20140520180611809826_noaa_ops.h5

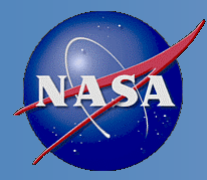
TableView - BrightnessTemperature - /All_Data/VIIRS-M13-SDR_All/ - /data/data126/SCDR/SYM1... M13 TB

	2274	2275	2276	2277	2278	2279	2280	2281
560	399.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
561	05.01205	306.5148	303.1325	302.56735	307.03494	301.57742	299.49677	299.75824
562	02.11877	307.3289	307.5591	301.51904	303.87494	300.77853	299.99323	299.80704
563	01.3421	303.0851	306.55466	306.80432	306.26297	303.33954	302.23776	298.13416
564	02.46655	360.59674	306.0467	302.46646	302.49103	302.85568	342.31995	301.64792
565	08.0328	382.89447	383.86688	305.33386	327.75494	304.79156	302.82913	301.52158
566	04.17755	310.74026	305.77753	303.54672	314.1066	325.9422	317.3676	297.3779
567	07.89536	302.30618	301.75394	301.36383	304.62192	300.2646	298.32266	296.85068
568	14.0913	305.16547	300.57004	300.35852	300.33194	296.1533	297.87183	298.80743
569	16.02295	309.34113	300.75076	298.62732	299.1063	296.48776	296.16928	299.9396
570	07.6536	301.92084	305.95093	308.75565	305.7094	304.1511	299.89053	294.01443
571	14.35486	315.82126	310.62064	302.53183	303.56952	300.89478	304.7929	297.80103
572	15.76273	310.98218	317.7183	316.02057	300.55136	298.33817	297.77277	296.8748
573	11.33395	309.53067	382.37338	370.9009	317.00327	306.72647	296.61612	296.15485
574	16.2609	314.86502	318.99384	374.67255	401.27515	366.50046	342.6849	304.6103
575	399.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
576	399.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
577	12.0205	368.11935	395.4472	393.5534	320.59088	301.76422	301.6172	293.27374
578	17.8956	318.5467	319.42065	353.3608	383.52316	349.9305	300.28433	297.7116
579	09.4184	310.28265	311.66263	314.17978	306.90543	298.48724	297.38904	296.79593
580	01.71426	299.04474	300.3561	304.33322	309.0592	311.76886	304.1711	299.3712
581	00.88632	301.49957	300.63757	302.2908	302.47964	302.14847	301.93365	301.0346
582	01.5813	300.7148	301.04898	310.59293	310.44043	305.2962	309.20016	307.32828
583	99.36246	304.1278	307.4268	302.20883	299.5971	298.4866	300.36572	311.50812
584	04.5367	303.71368	290.8635	294.11224	300.9762	301.94943	299.72818	305.24792
585	05.03888	302.5233	300.9006	300.87573	300.92548	301.87967	300.04324	302.0239
586	98.29675	300.11542	298.60294	301.6068	302.4243	310.07526	303.50534	299.55704
587	01.26236	307.46582	310.344	303.5452	303.01886	313.00522	325.94632	304.19556
588	01.8734	301.77335	303.64206	305.84808	308.60495	302.46616	302.5882	298.58643
589	99.05823	300.11926	300.17007	300.5235	299.8382	301.16925	301.65698	300.22083
590	00.46698	299.938	299.75064	299.88458	300.01794	299.3726	301.64996	301.801
591	399.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
592	399.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
593	01.30396	300.72934	299.72983	299.83392	300.1696	301.03055	301.27927	299.78195
594	97.73492	298.35684	300.12314	300.51663	300.0703	302.58307	302.6318	301.26337
595	96.56354	295.74753	299.80368	299.30917	299.49234	300.26508	299.77795	299.82962
596	95.94208	296.1838	298.38745	299.8343	300.17886	300.70157	300.02026	300.389
597	17.36572	299.25214	298.1607	296.3449	292.43912	293.346	298.98956	299.89896
598	00.05225	301.62253	293.85635	286.192	285.2393	289.5557	291.3471	299.86646
599	03.07944	300.41467	292.16928	282.83905	288.80878	289.36667	297.96558	303.1258
600	04.05258	302.05914	298.63705	295.22174	296.15106	293.96796	301.1677	302.65588
601	03.20038	302.07062	301.17084	302.3332	303.29257	304.7338	300.5225	300.14212
602	02.84918	301.51797	301.6437	301.8687	298.86246	301.84366	302.14136	304.03302

TableView - QF1_VIIRSMBANSDR - /All_Data/VIIRS-M13-SDR_All/ - /data/data126/SCDR/SYM13_npp_d20... M13 TB QF1

	2274	2275	2276	2277	2278	2279	2280	2281	2
559	2	2	2	2	2	2	2	2	2
560	2	2	2	2	2	2	2	2	2
561	0	0	0	0	0	0	0	0	0
562	0	0	0	0	0	0	0	0	0
563	0	0	0	0	0	0	0	0	0
564	0	0	0	0	0	0	0	0	0
565	0	0	0	0	0	0	0	0	0
566	0	0	0	0	0	0	0	0	0
567	0	0	0	0	0	0	0	0	0
568	0	0	0	0	0	0	0	0	0
569	0	0	0	0	0	0	0	0	0
570	0	0	0	0	0	0	0	0	0
571	0	0	0	0	0	0	0	0	0
572	0	0	0	0	0	0	0	0	0
573	0	0	0	0	0	0	0	0	0
574	0	0	0	0	0	0	0	0	0
575	2	2	2	2	2	2	2	2	2
576	2	2	2	2	2	2	2	2	2
577	0	0	0	0	0	0	0	0	0
578	0	0	0	0	0	0	0	0	0
579	0	0	0	0	0	0	0	0	0
580	0	0	0	0	0	0	0	0	0
581	0	0	0	0	0	0	0	0	0
582	0	0	0	0	0	0	0	0	0
583	0	0	0	0	0	0	0	0	0
584	0	0	0	0	0	0	0	0	0
585	0	0	0	0	0	0	0	0	0
586	0	0	0	0	0	0	0	0	0
587	0	0	0	0	0	0	0	0	0
588	0	0	0	0	0	0	0	0	0
589	0	0	0	0	0	0	0	0	0
590	0	0	0	0	0	0	0	0	0
591	2	2	2	2	2	2	2	2	2
592	2	2	2	2	2	2	2	2	2
593	0	0	0	0	0	0	0	0	0
594	0	0	0	0	0	0	0	0	0
595	0	0	0	0	0	0	0	0	0
596	0	0	0	0	0	0	0	0	0
597	0	0	0	0	0	0	0	0	0
598	0	0	0	0	0	0	0	0	0
599	0	0	0	0	0	0	0	0	0
600	0	0	0	0	0	0	0	0	0
601	0	0	0	0	0	0	0	0	0

QF1_VIIRSMBANSDR (19691488)
8-bit unsigned character, 768 x 3200
Number of attributes = 0



Datasets for Mx8.5 evaluation



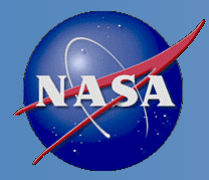
- **IDPS operational data stream**
 - 4/28/14 onward
 - Mx8.4 TTO 5/22/2014 14:40 UTC
 - Mx8.5 TTO 8/13/2014 15:25 UTC
 - STAR SCDR, GRAVITE
- **Mx8.5 Factory Bench Test data from Raytheon**
 - 7/2/2014
 - GRAVITE, recovery of some data from LandPEATE
- **Mx8.5 Integration and Testing data from Raytheon**
 - 7/30/2014 – 8/1/2014; 8/4/2014 – 8/14/2014
 - GRAVITE
- **STAR AIT processing using Mx8.5 for select granules**
 - 7/15/2014



Evaluation method



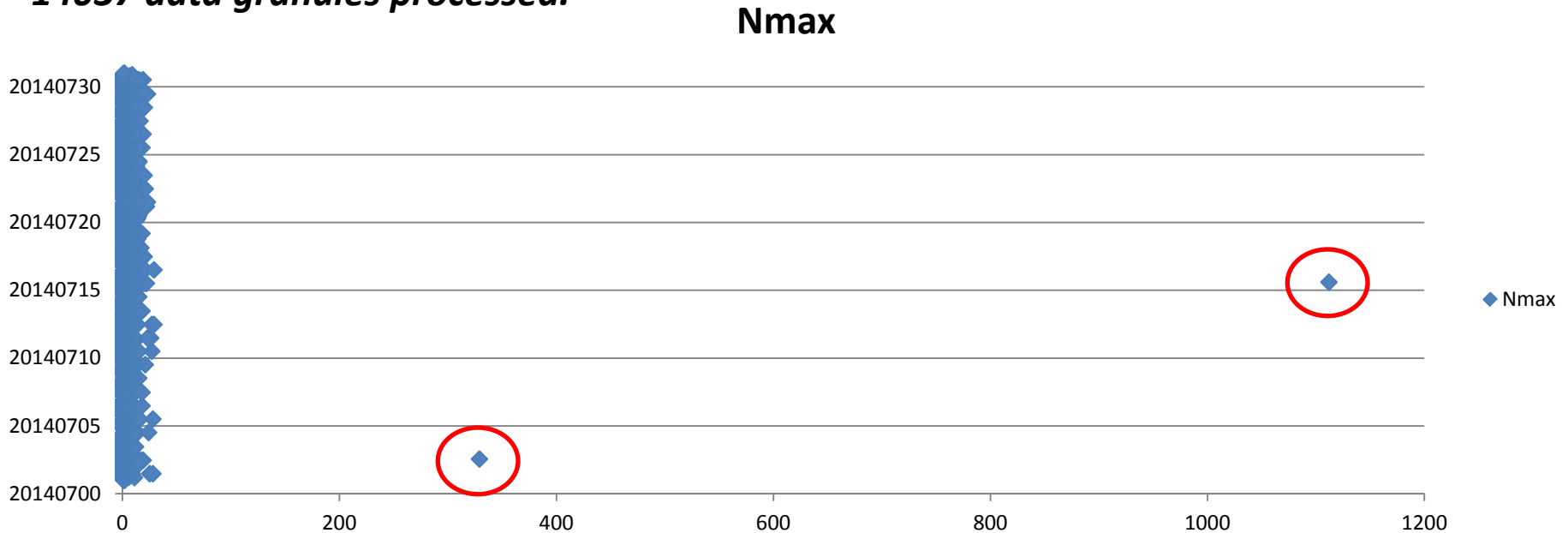
- Search for **spurious detections** in each Active Fire data granule in operational and test data streams
 - Histogram analysis of fire pixels within scan lines
- **Detailed analysis** of granules with spurious detections
 - VIIRS M13/M15 SDR brightness temperature / radiance output and corresponding quality flags
 - Evaluation of differences between Mx8.4 and Mx8.5
- **Statistical analysis** of VIIRS M13/M15 SDR quality flags



IDPS performance

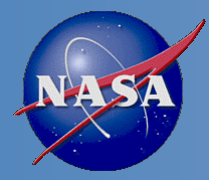


IDPS AVAFO granules from STAR SCDR were processed for April 30 – September 02 2014. Only July 2014 is shown here. No other spurious detections were found out of the total of 14037 data granules processed.



Nmax: maximum number of active fire detections within a single scan line within a granule

Spurious detections: July 02, 2014 13:36:18 – 13:41:59 (Nmax: 329)
 July 15, 2014 14:33:19 – 14:34:41 (Nmax: 1112)



Mx8.4: July 2, 2014 case



HDFView

File Window Tools Help

Recent Files /data/data126/SCDR/SVM13_npp_d20140702_t1336187_e1337429_b13878_c20140702195820942070_noaa_ops.h5

Clear Text

TableView - BrightnessTemperature - /All_Data/VIIRS-M13-SDR_All/ - /data/data126/SCDR/SVM... M13 TB

Table

	0	1	2	3	4	5	6	7
0	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
1	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
2	268.81265	268.81262	269.14615	268.81262	268.81262	268.13126	268.8126	268.13126
3	270.98325	269.60553	269.4475	269.28842	268.9672	268.14478	267.97684	267.63748
4	269.90936	269.90936	268.58844	267.89978	266.8282	265.70575	267.19077	267.89975
5	267.88638	268.05386	266.856	266.14337	266.14337	268.5494	270.58652	270.13132
6	266.1578	265.39532	265.58826	265.58826	266.3446	266.3446	265.20078	265.58826
7	265.43475	264.28345	264.28345	264.47934	264.47934	264.08594	262.6539	261.7936
8	263.807	264.22437	264.22437	263.5955	262.50775	263.16656	262.7295	263.80704
9	263.2511	263.6589	264.45352	263.86008	263.2511	265.41013	266.86392	267.89853
10	265.00272	266.71182	267.07532	267.4334	268.98154	268.81436	268.81436	269.47614
11	269.66672	270.43436	269.51022	269.3527	269.03455	269.19412	268.22037	267.88678
12	268.8741	268.7058	268.70578	268.19382	268.02066	268.02066	268.02066	267.84622
13	267.74014	267.0524	267.0524	266.16373	267.22623	267.909	267.7401	267.7401
14	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
15	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
16	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
17	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
18	457.1118	457.27	457.89975	457.5853	456.7938	458.21246	459.4528	460.67413
19	462.46375	463.08267	464.15475	464.0023	465.51285	466.10925	466.1091	466.55374
20	462.66895	463.5636	462.51868	462.36823	462.3681	462.0664	461.91513	461.45972
21	464.39508	463.94907	464.0979	463.65027	463.35037	463.50027	463.50015	463.35
22	464.44675	463.97507	463.97495	462.70392	463.5004	464.28925	464.13196	464.289
23	459.17206	458.26727	456.89053	456.426	457.81064	458.115	458.11487	458.72025
24	460.13098	457.85273	456.93155	455.40636	455.0979	455.5602	455.40622	456.17227
25	458.13098	457.85273	456.93155	455.40636	455.0979	455.5602	455.40622	456.17227
26	462.85095	463.0135	463.49948	462.52432	463.01312	463.6605	464.14255	464.62195
27	460.0732	459.9135	459.2715	458.78665	460.07278	462.27542	462.43033	461.80823
28	455.89658	455.56494	454.89758	454.7298	455.73062	457.20837	458.0175	458.0174
29	458.06073	458.706	458.86642	458.5449	458.06036	458.38354	458.5446	458.5445
30	455.7	455.7	455.7	455.7	455.7	455.7	455.7	455.7
31	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
32	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
33	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7	-999.7
34	268.6455	268.30487	266.33914	264.7994	264.9975	265.38876	265.58194	266.15213
35	266.4113	266.7686	266.94522	266.4113	266.5906	267.12054	267.8091	267.97824
36	265.1252	265.32083	264.12192	263.28677	265.70712	267.72586	267.54935	266.64615
37	264.6512	263.86694	262.84778	263.26093	264.4576	266.85736	267.03226	267.37817
38	264.40735	265.00595	265.20215	264.80807	264.60864	265.20215	265.00595	265.00595
39	265.24814	266.71146	266.71146	266.53342	266.5334	266.88815	265.99112	265.80753
40	264.43158	265.0385	266.3963	267.13855	266.95514	267.13852	266.20712	265.82397
41	264.64938	266.14963	266.68842	266.68842	267.04092	267.3883	267.04092	266.51013
42	265.58774	266.89575	267.4348	266.89572	265.58774	265.58774	266.5293	266.89572

missing data (bow tie deletion)

incorrect data (bad calibration)

TableView - QF1_VIIRSBANDSDR - /All_Data/VIIRS-M13-SDR_All/ - /data/data126/SCDR/SVM13... M13 TB QF1

Table

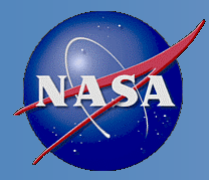
	0	1	2	3	4	5	6	7
0	2	2	2	2	2	2	2	2
1	2	2	2	2	2	2	2	2
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	2	2	2	2	2	2	2	2
15	2	2	2	2	2	2	2	2
16	2	2	2	2	2	2	2	2
17	2	2	2	2	2	2	2	2
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
30	2	2	2	2	2	2	2	2
31	2	2	2	2	2	2	2	2
32	2	2	2	2	2	2	2	2
33	2	2	2	2	2	2	2	2
34	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0

“no calibration”

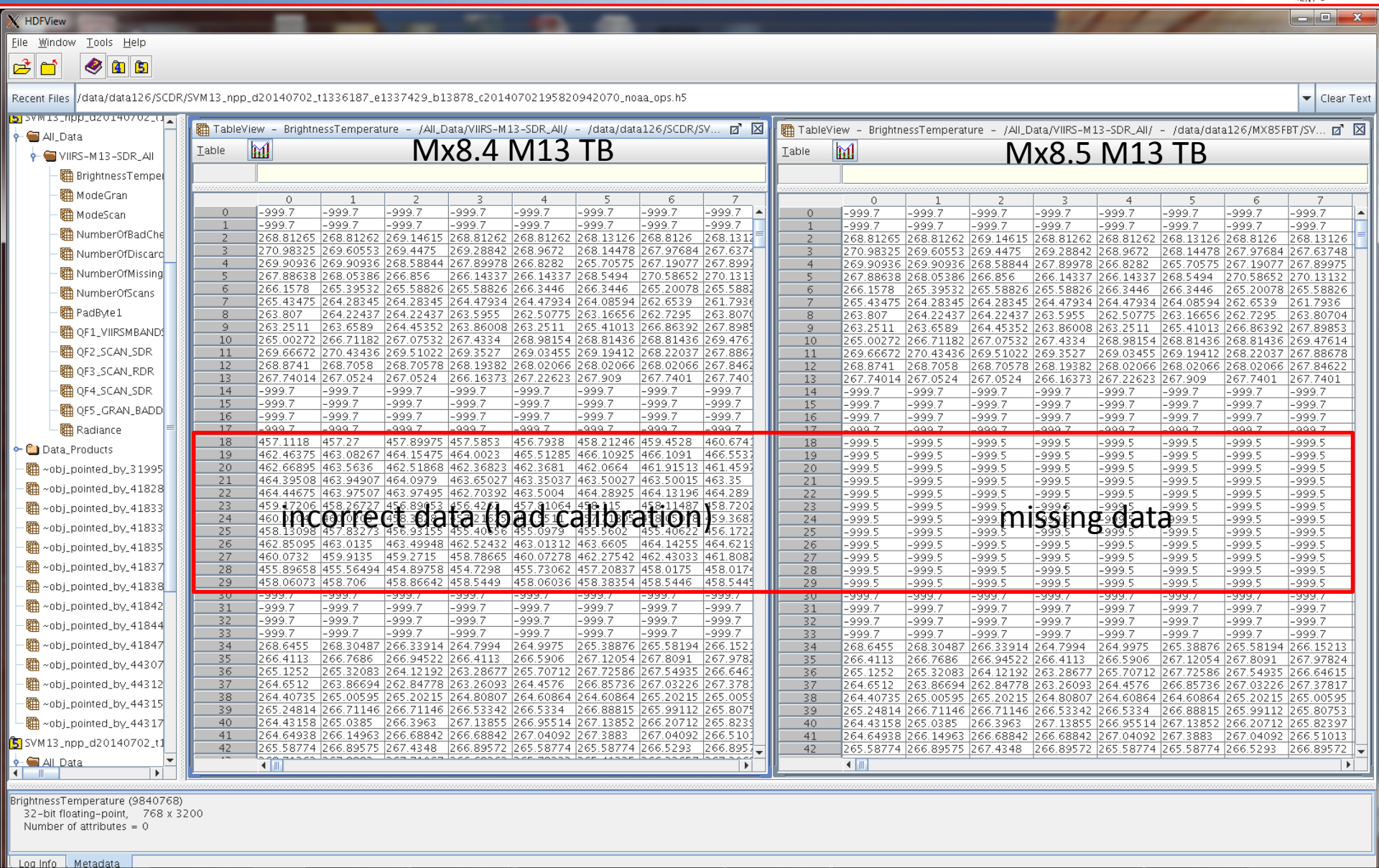
“good”

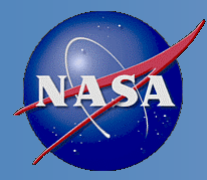
QF1_VIIRSBANDSDR (19691488)
8-bit unsigned character, 768 x 3200
Number of attributes = 0

Log Info Metadata



July 2: Mx8.4 vs. Mx8.5 M13 TB





July 2: Mx8.4 vs. Mx8.5 M13 QF1



HDFView

File Window Tools Help

Recent Files /data/data126/MX85F8T/SVM13_npp_d20140702_t1336187_e1337429_b13878_c20140702183650421253_devl_ops.h5

TableView - QF1_VIIRSMBANDSDR - /All_Data/VIIRS-M13-SDR_All/ - /data/data126/SCDR/SVM13_npp_d20140702_t1336187_e1337429_b13878_c20140702183650421253_devl_ops.h5

Table Mx8.4 M13 TB QF1

27, 7 = 0

	0	1	2	3	4	5	6	7
0	2	2	2	2	2	2	2	2
1	2	2	2	2	2	2	2	2
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	2	2	2	2	2	2	2	2
15	2	2	2	2	2	2	2	2
16	2	2	2	2	2	2	2	2
17	2	2	2	2	2	2	2	2
18	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0
30	2	2	2	2	2	2	2	2
31	2	2	2	2	2	2	2	2
32	2	2	2	2	2	2	2	2
33	2	2	2	2	2	2	2	2
34	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0

“no calibration”

“good”

TableView - QF1_VIIRSMBANDSDR - /All_Data/VIIRS-M13-SDR_All/ - /data/data126/MX85F8T/SVM13_npp_d20140702_t1336187_e1337429_b13878_c20140702183650421253_devl_ops.h5

Table Mx8.5 M13 TB QF1

	0	1	2	3	4	5	6	7
0	2	2	2	2	2	2	2	2
1	2	2	2	2	2	2	2	2
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	2	2	2	2	2	2	2	2
15	2	2	2	2	2	2	2	2
16	2	2	2	2	2	2	2	2
17	2	2	2	2	2	2	2	2
18	34	34	34	34	34	34	34	34
19	34	34	34	34	34	34	34	34
20	34	34	34	34	34	34	34	34
21	34	34	34	34	34	34	34	34
22	34	34	34	34	34	34	34	34
23	34	34	34	34	34	34	34	34
24	34	34	34	34	34	34	34	34
25	34	34	34	34	34	34	34	34
26	34	34	34	34	34	34	34	34
27	34	34	34	34	34	34	34	34
28	34	34	34	34	34	34	34	34
29	34	34	34	34	34	34	34	34
30	2	2	2	2	2	2	2	2
31	2	2	2	2	2	2	2	2
32	2	2	2	2	2	2	2	2
33	2	2	2	2	2	2	2	2
34	0	0	0	0	0	0	0	0
35	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0
37	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0
39	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0
41	0	0	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0

“no calibration”

“no calibration = none saturated
= calibration data missing”

QF1_VIIRSMBANDSDR (12314224)
8-bit unsigned character, 768 x 3200
Number of attributes = 0

Log Info Metadata



July 2: Mx8.4 vs. Mx8.5 AVAFO



HDFView

File Window Tools Help

Recent Files /data/data126/MX85F8T/AVAFO_npp_d20140702_t1336187_e1337429_b13878_c20140702183622989631_dev_ops.h5

AVAFO_npp_d20140702_t1

- All_Data
 - VIIRS-AF-EDR_All
 - ColIndex
 - ColIndex_0
 - Latitude
 - Longitude
 - QF1_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF3_VIIRSAFARP
 - QF4_VIIRSAFARP
 - RowIndex
 - RowIndex_0
 - Data_Products
- SVM13_npp_d20140702_t1
 - All_Data
 - VIIRS-M13-SDR_All
 - BrightnessTemper
 - ModeGran
 - ModeScan
 - NumberOfBadChe
 - NumberOfDiscar
 - NumberOfMissin
 - NumberOfScans
 - PadByte1
 - QF1_VIIRSMBAND
 - QF2_SCAN_SDR
 - QF3_SCAN_RDR
 - QF4_SCAN_SDR
 - QF5_GRAN_BADD
 - Radiance
 - Data_Products
 - obj_pointed_by_31995

TableView - RowIndex_0 - /All...
Table Row
2621, 0 ... 24

	0
2621	24
2622	24
2623	24
2624	24
2625	24
2626	24
2627	24
2628	24
2629	24
2630	24
2631	24
2632	24
2633	24
2634	24
2635	24
2636	24
2637	24
2638	24
2639	24
2640	24
2641	24
2642	24
2643	24
2644	24
2645	24
2646	24
2647	24
2648	24
2649	24
2650	24
2651	24
2652	24
2653	24
2654	24
2655	24
2656	24
2657	24
2658	24
2659	24
2660	24
2661	24
2662	24
2663	24
2664	24

TableView - ColIndex_0 - /All...
Table Column
2621, 0 ... 1862

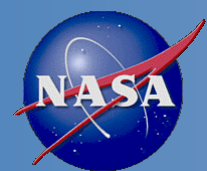
	0
2621	1862
2622	1863
2623	1864
2624	1865
2625	1866
2626	1867
2627	1868
2628	1869
2629	1870
2630	1871
2631	1872
2632	1873
2633	1875
2634	1876
2635	1877
2636	1878
2637	1879
2638	1880
2639	1881
2640	1882
2641	1883
2642	1895
2643	1896
2644	1897
2645	1898
2646	1899
2647	1900
2648	1901
2649	1902
2650	1903
2651	1920
2652	1921
2653	1922
2654	1923
2655	1924
2656	1925
2657	1928
2658	1929
2659	1930
2660	1931
2661	1932
2662	1933
2663	1934
2664	1935

Row

Column

RowIndex_0 (13016)
32-bit integer, 0
Number of attributes = 0

Log Info Metadata



Issues: input SDR quality flagging



MX8.4 SVM13 QF1

	5	9	18	33	50	129	193 Pixels Sampled
7/2/2014						437971	2484633600
7/31/2014			12704	31904	1638400	509317	2489548800
8/5/2014	1	3				225661	2509209600
8/6/2014						276007	2499379200
8/7/2014				44608	972800	199022	44608 2499379200

MX8.4 SVM15 QF1

	2	9	50	65 Pixels Sampled
7/2/2014				
7/31/2014	210944	2		3 2489548800
8/5/2014		36		26 2509209600
8/6/2014				2 2499379200
8/7/2014			972800	2499379200

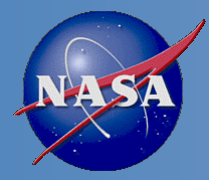
Mx8.5: Bad SDR M13 data properly flagged and no false detections

Mx8.5 SVM13 QF1

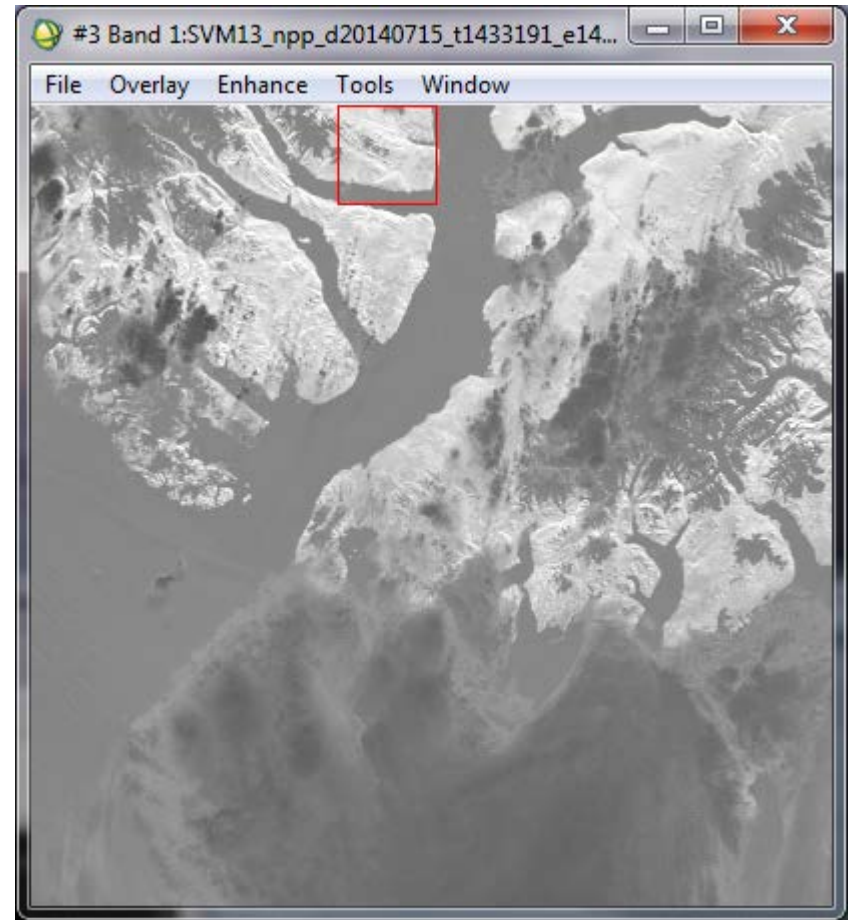
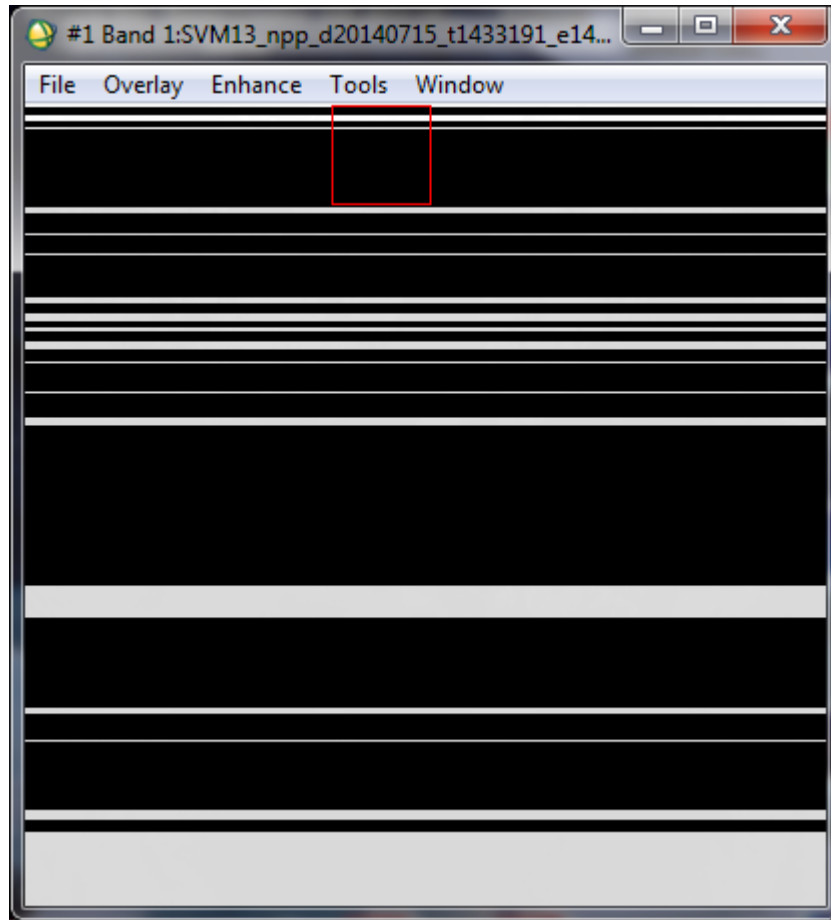
	5	9	33	34	50	129	193 Pixels Sampled
7/2/2014				44608		437971	2487091200
7/31/2014						429358	2484633600
8/5/2014	1	3				237937	3113779200
8/6/2014						276007	2494464000
8/7/2014			44608	44608	972800	205464	44608 2568192000

Mx8.5 SVM15 QF1

	9	18	50	65 Pixels Sampled
7/2/2014				
7/31/2014	2			3 2484633600
8/5/2014	36			26 3113779200
8/6/2014		6208		2 2494464000
8/7/2014			972800	2568192000

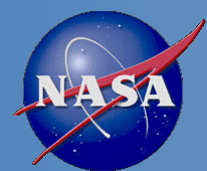


July 15 case: two granules in SCDR



SVM13_npp_d20140715_t1433191_e1434415_b14063_c20140715210319690945_noaa_ops.h5
AVAFO_npp_d20140715_t1433191_e1438577_b14063_c20140715203859029918_noaa_ops.h5

SVM13_npp_d20140715_t1433191_e1434415_b14063_c20140715211948960246_noaa_ops.h5
AVAFO_npp_d20140715_t1433191_e1434415_b14063_c20140715210112628201_noaa_ops.h5



July 15 case: CLASS



CLASS Order1 x National Oceanic and Atmospheric Administration (NOAA) Inbox - ivancs... Index of /all... Joint Polar Sat... JPSSMIS - CCF... EUMETSAT Co... NOAA's Com...

www.nsof.class.noaa.gov/saa/products/resultsVIIRS

Apps Getting Started Imported From Fire... National Oceanic an... Request for Adjustm... NOAA Email on a Pe... Commerce - OCIO S... NCWCP Tenant We...

Data Product Search Results - VIIRS

(click here for a printable listing)

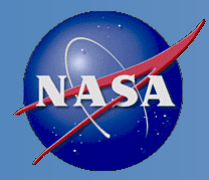
Recently Searched Data Sets: VIIRS GO

Currently you have 69 hits out of 495062 entries.
There are 0 (VIIRS) items in your shopping cart. The shopping cart limit is 100.

Shopping Cart: Goto Cart Update SelectAll DeselectAll Page 3 Jump To Page Prev Next

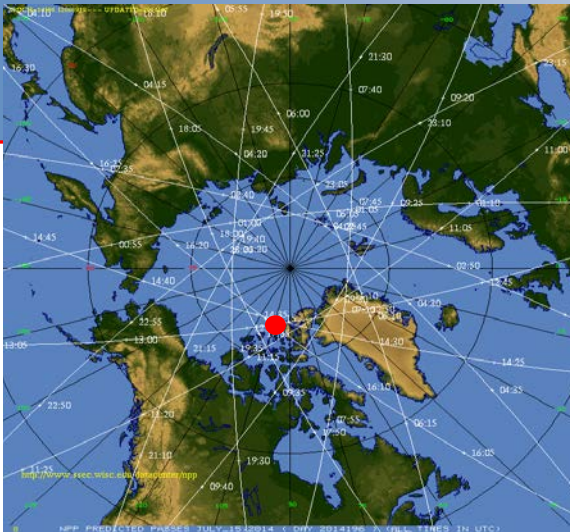
View Details	Shopping Cart	Inventory ID	Satellite	Datatype	Start Date/Time	End Date/Time	Dataset Name	Beginning Orbit Number
21	<input type="checkbox"/>	693215793	NPP	VIIRS Moderate Resolution Band 13 Sensor Data Records (VIIRM13SDR)	2014-07-15 14:31:53.775	2014-07-15 14:33:17.951	SVM13_npp_d20140715_t1431537_e1433179_b1_4063_c20140715210126_571349_noaa_ops.h5	14063
22	<input type="checkbox"/>	693190183	NPP	Application Related Products (VIIRS_ARP)	2014-07-15 14:33:19.180	2014-07-15 14:38:57.791	AVAFO_npp_d20140715_t1433191_e1438577_b1_4063_c20140715203859_029918_noaa_ops.h5	14063
23	<input type="checkbox"/>	693190653	NPP	VIIRS Moderate Resolution Band 13 Sensor Data Records (VIIRM13SDR)	2014-07-15 14:33:19.180	2014-07-15 14:38:57.791	SVM13_npp_d20140715_t1433191_e1438577_b1_4063_c20140715203859_314497_noaa_ops.h5	14063
24	<input type="checkbox"/>	693214303	NPP	Application Related Products (VIIRS_ARP)	2014-07-15 14:33:19.180	2014-07-15 14:34:41.576	AVAFO_npp_d20140715_t1433191_e1434415_b1_4063_c20140715210112_628201_noaa_ops.h5	14063
25	<input type="checkbox"/>	693215753	NPP	VIIRS Moderate Resolution Band 13 Sensor Data Records (VIIRM13SDR)	2014-07-15 14:33:19.180	2014-07-15 14:34:41.576	SVM13_npp_d20140715_t1433191_e1434415_b1_4063_c20140715210126_595073_noaa_ops.h5	14063
26	<input type="checkbox"/>	693212743	NPP	Application Related Products (VIIRS_ARP)	2014-07-15 14:34:42.806	2014-07-15 14:36:06.981	AVAFO_npp_d20140715_t1434428_e1436069_b1_4063_c20140715210212_485625_noaa_ops.h5	14063
27	<input type="checkbox"/>	693213403	NPP	VIIRS Moderate Resolution Band 13 Sensor Data Records (VIIRM13SDR)	2014-07-15 14:34:42.806	2014-07-15 14:36:06.981	SVM13_npp_d20140715_t1434428_e1436069_b1_4063_c20140715210226_370705_noaa_ops.h5	14063
28	<input type="checkbox"/>	693213383	NPP	Application Related Products (VIIRS_ARP)	2014-07-15 14:36:08.210	2014-07-15 14:37:32.386	AVAFO_npp_d20140715_t1436082_e1437323_b1_4063_c20140715210212_485625_noaa_ops.h5	14063

Both the corrupt and correct files are distributed by CLASS? Some production times are different from SCDR.



July 15, 2014 ~14:33-14:34

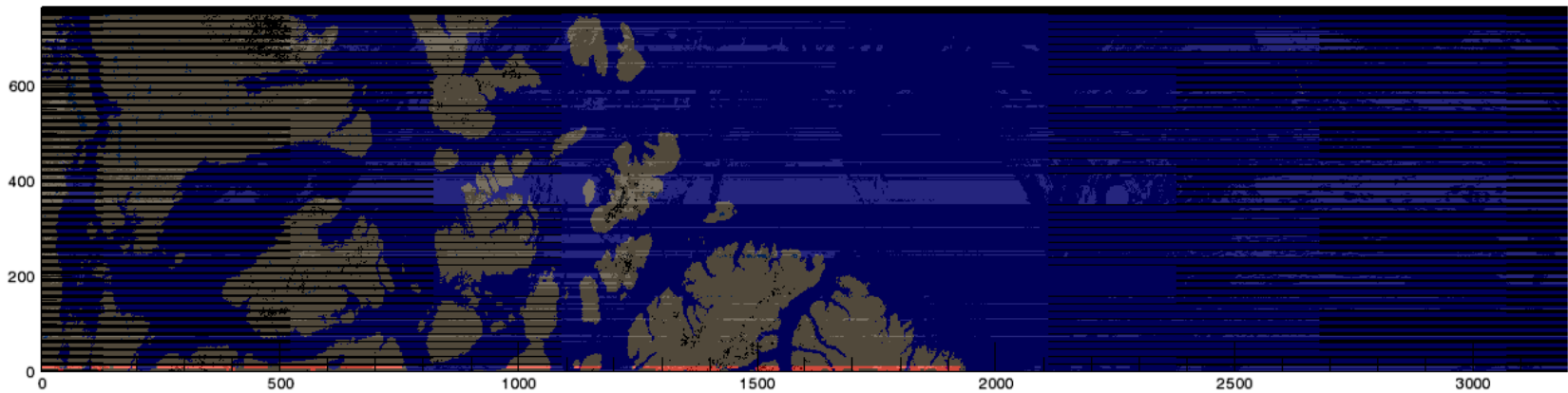
d20140715_t1433174_e1434428_b14063



← Approximate position of Granule's center

Mx8.4 in operational runs

SCDR archive: AF-EDR Granule Version A1M



← multiple fires along boundary

SCDR archive: Granule Version A2

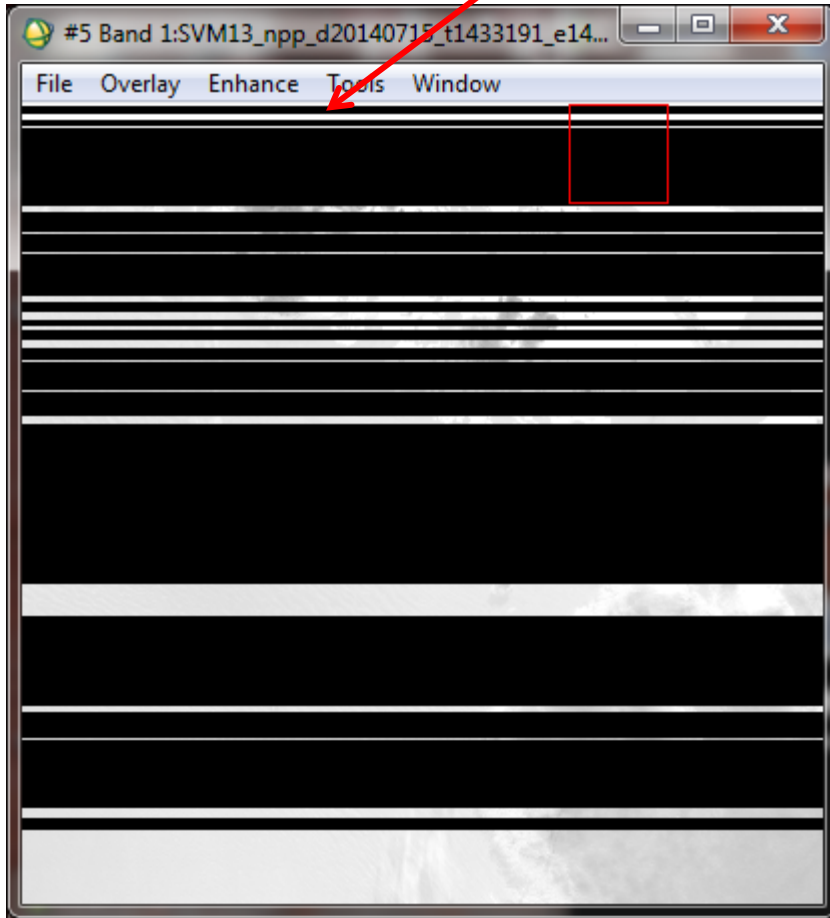
AIT Mx8.5 RDR->SDR->AF EDR run Granule Version A1

AIT Mx8.5 RDR->SDR->AF EDR run Granule Version A2

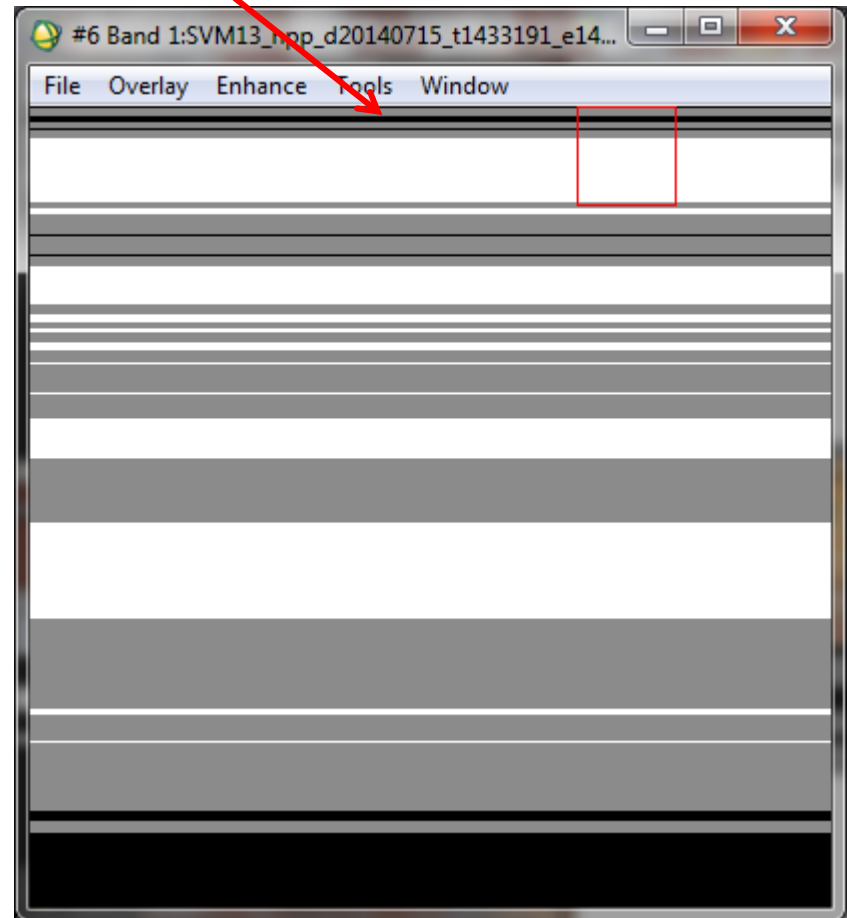
} No fires in AF-EDR

July 15 case: Mx8.4 vs. Mx8.5

M13 TB > 400K



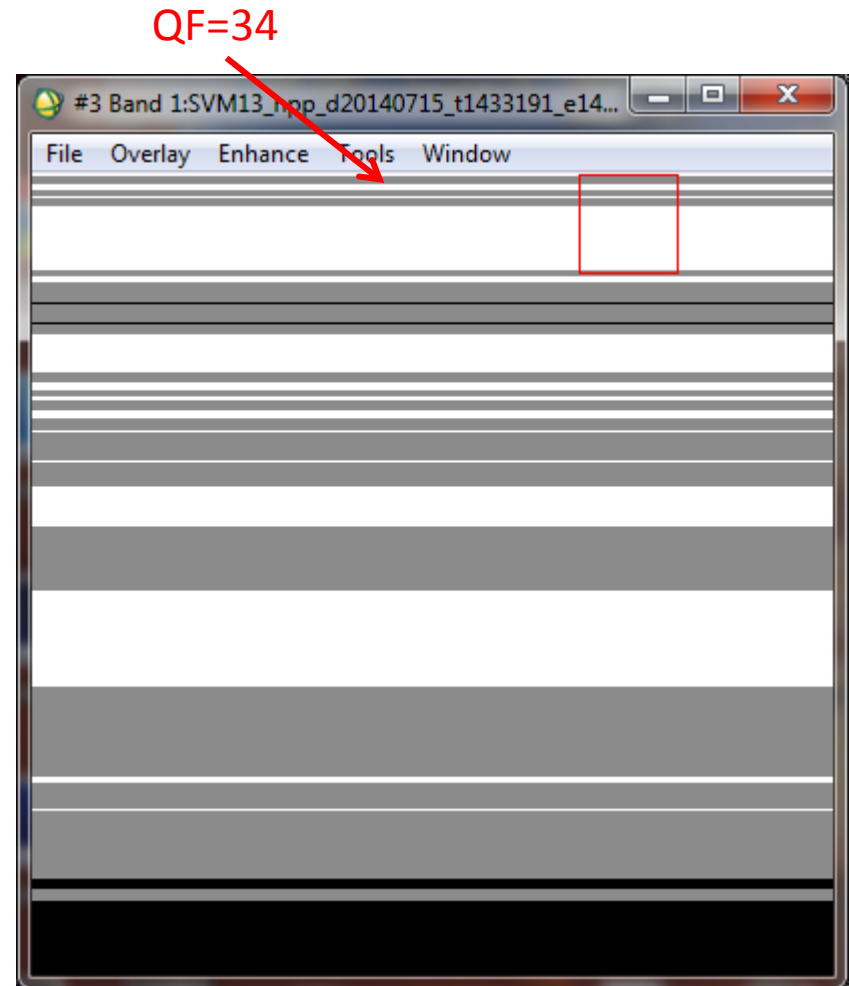
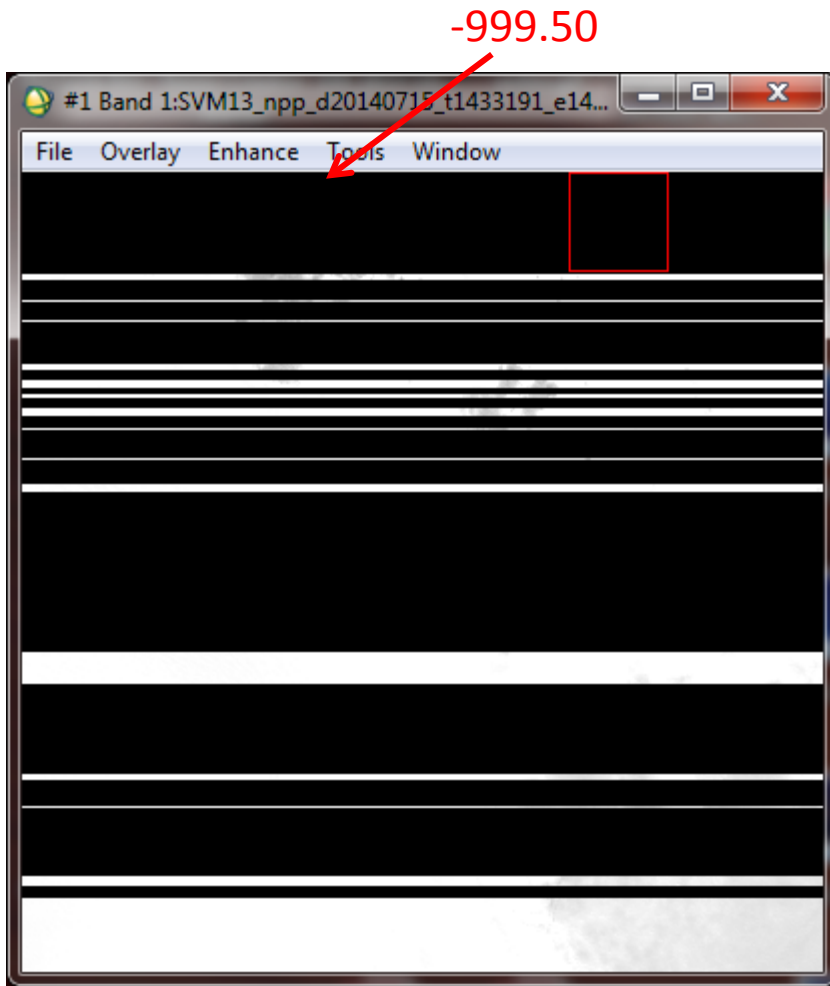
QF=0



IDPS Mx8.4 A1granule version



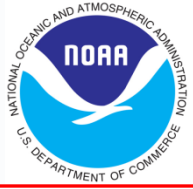
July 15 case: Mx8.4 vs. Mx8.5



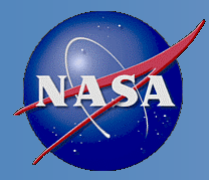
IDPS Mx8.5 code run by STAR AIT



Current SDR input quality summary



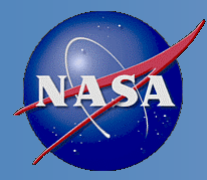
- QF $\neq 0$ for high radiances
 - Appears to be fixed in Mx8.3 (TTO 3/18/2014 18:38 UTC)
- Bad data, QF = 0
 - Two cases analyzed suggest that the changes implemented in Mx8.5 worked
 - Conclusion is based on the total ~ 1 month of data (pre-TTO test datasets, operational IDPS data and STAR AIT test run)
- Radiance – brightness temperature mismatch
 - Not implemented yet, SDR team is working on code change
 - Active Fire EDR team provided examples



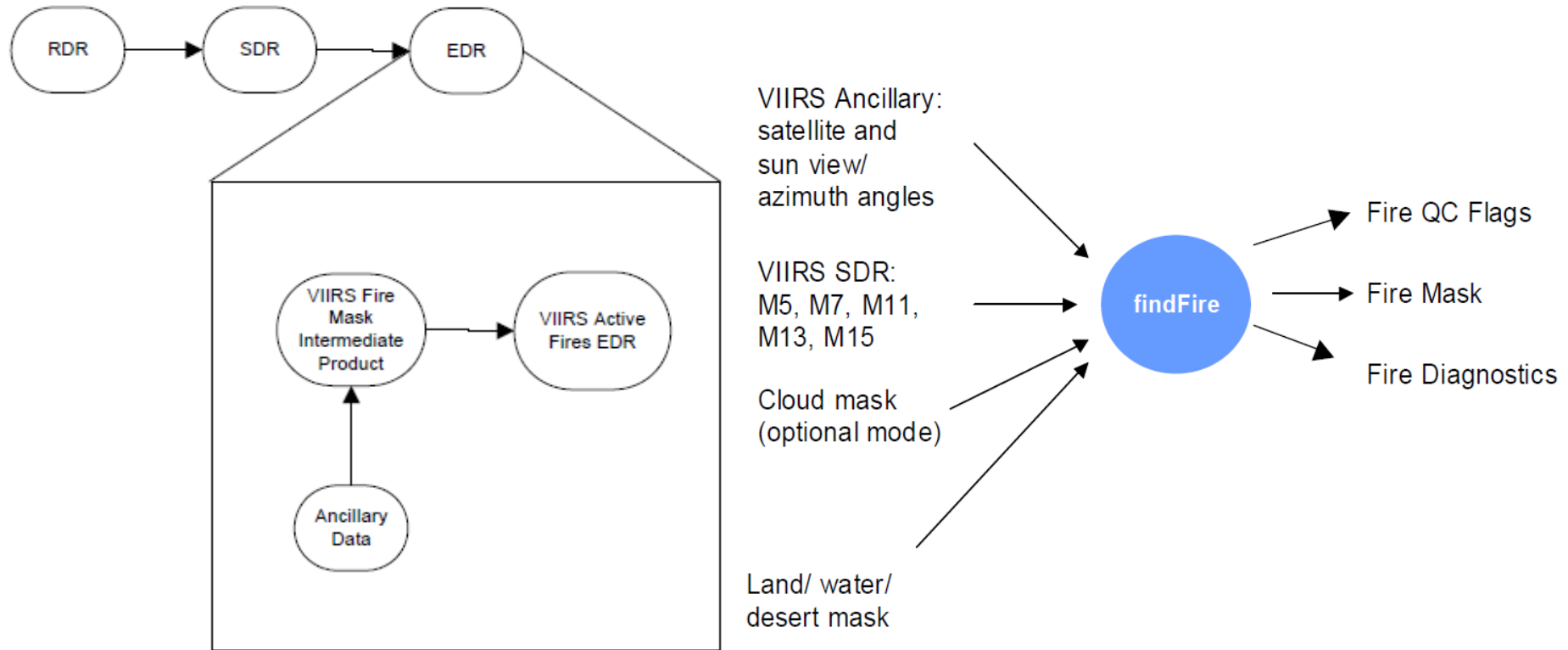
Evaluation of the effect of required algorithm inputs



- Required Algorithm Inputs
 - Primary Sensor Data
 - Ancillary Data
 - Upstream algorithms
 - LUTs / PCTs
- Evaluation of the effect of required algorithm inputs
 - Study / test cases
 - Results

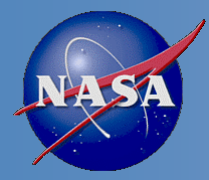


Active Fire ARP Dataflow



OAD VIIRS Active Fires 474-00064 May 14, 2013; Figure 1 (Processing Chain Associated with VIIRS Active Fires ARP)

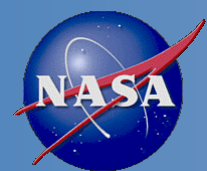
ATBD VIIRS Active Fires 474-00030 April 22, 2011; Figure 5 (Algorithm Context Diagram)



Quality flag analysis/validation



- Defined Quality Flags
 - Variable
 - Description
 - Value
- Quality flag analysis/validation
 - Test / example / ground truth data sets
 - Analysis/validation results
 - Analysis/validation plan for next validated stages



Quality flag analysis/validation



474-00001-04-03_IPSS-CDFCB-X-Vol-IV-Part-3_0200-.pdf - Adobe Acrobat

File Edit View Window Help

Create [Icons]

68 / 164 [Icons] 87% [Icons] Tools Comment

JPSS CDFCB-X Vol. IV Pt. 3 Block 2.0.0

474-00001-04-03-B0200
Effective Date: January 09, 2014
Block/Revision 0200-

Name	Granule Boundary	Dynamic	Min Array Size	Max Array Size
Quality Flag 2	Yes	Yes	0	2457600

Description	Datum Offset	Unscaled Valid Range Min	Unscaled Valid Range Max	Datum Measurement Units	Scaled	Scale Factor Name	Data Type	Fill Values		Legend Entries	
								Name	Value	Name	Value
Fire Test 1 Valid (Indicates whether Test 1 gave a valid result)	0			unitless	No		1 bit(s)			Results not valid	0
Fire Test 2 Valid (Indicates whether Test 2 gave a valid result)	1			unitless	No		1 bit(s)			Results not valid	0
Fire Test 3 Valid (Indicates whether Test 3 gave a valid result)	2			unitless	No		1 bit(s)			Results not valid	0
Fire Test 4 Valid (Indicates whether Test 4 gave a valid result)	3			unitless	No		1 bit(s)			Results not valid	0
Fire Test 5 Valid (Indicates whether Test 5 gave a valid result)	4			unitless	No		1 bit(s)			Results not valid	0
Fire Test 6 Valid (Indicates whether Test 6 gave a valid result)	5			unitless	No		1 bit(s)			Results not valid	0
Input Data Quality (AF quality poor due to bad SDR data in horizontal cell)	6			unitless	No		1 bit(s)			Good SDR Data	0
										Bad SDR Data	1



Quality flags: July 2, 2014 case



HDFView

File Window Tools Help

Recent Files: data126/MX85FBT/AVAFO_npp_d20140702_t1336187_e1337429_b13878_c20140702183622989631_dev_ops.h5

AVAFO_npp_d20140702_t1

- All_Data
 - VIIRS-AF-EDR_All
 - ColIndex
 - Latitude
 - Longitude
 - QF1_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF3_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - RowIndex
 - Data_Products
- AVAFO_npp_d20140702_t1
 - All_Data
 - VIIRS-AF-EDR_All
 - ColIndex
 - Latitude
 - Longitude
 - QF1_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF2_VIIRSAFARP
 - QF3_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - QF4_VIIRSAFARP
 - RowIndex

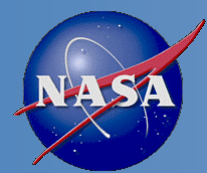
QF4_VIIRSAFARP_0 (16016)
8-bit unsigned character, 0
Number of attributes = 0

Log Info Metadata

129: 10000001
143: 10001111
191: 10111111
159: 10011111
175: 10101111

Mx8.4: (incorrect) SDR quality flags passed through correctly into AF ARP

Mx8.5: no fire detections (correctly), no quality flags



Quality flag analysis/validation



474-00001-04-03_JPSS-CDFCB-X-Vol-IV-Part-3_0200-.pdf - Adobe Acrobat

File Edit View Window Help

Create

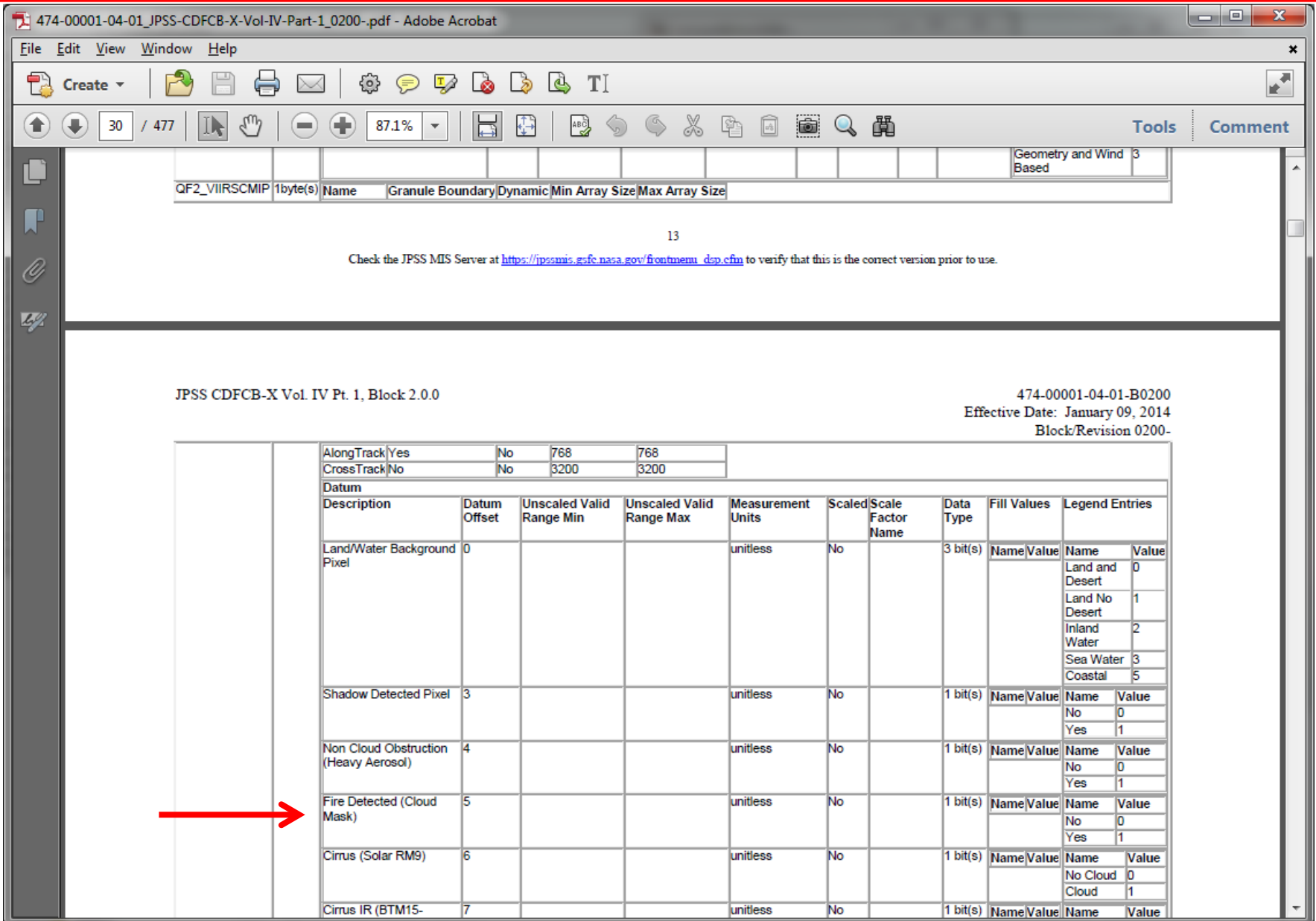
69 / 164 87%

Tools Comment

JPSS CDFCB-X Vol. IV Pt. 3 Block 2.0.0

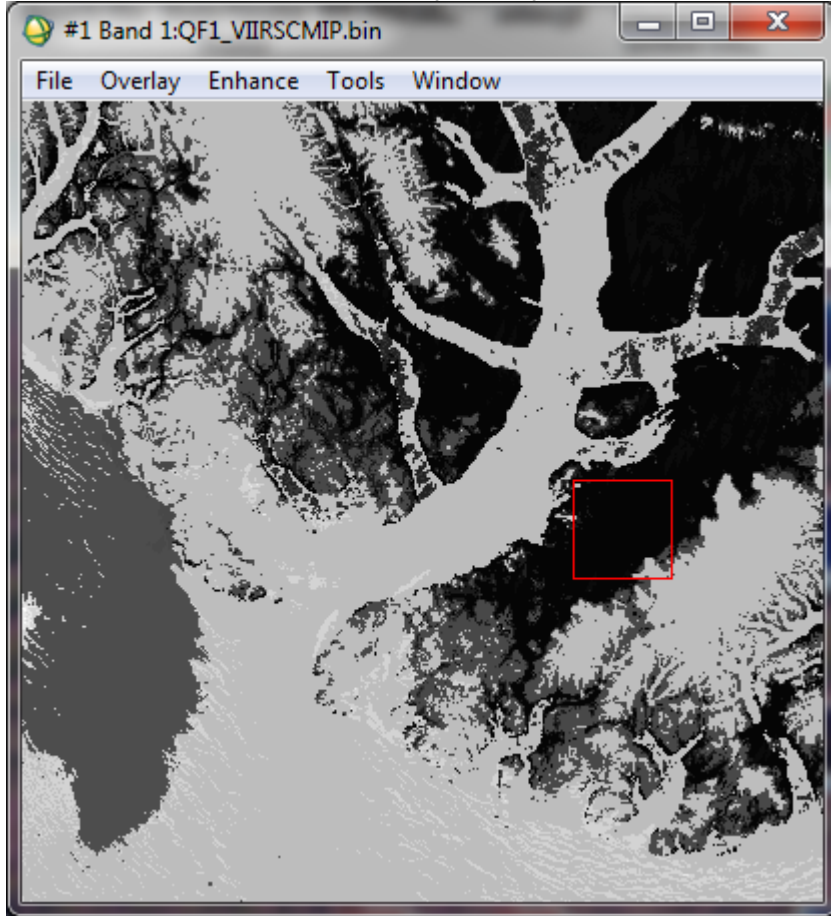
474-00001-04-03-B0200
Effective Date: January 09, 2014
Block/Revision 0200-

		Day/Night (Night = SZA > 85 degrees)	7			unitless	No		1 bit(s)	Name	Value	Name	Value
												Night	0
												Day	1
QF3_VIIRSAFARP	1byte(s)	Name	Granule Boundary	Dynamic	Min Array Size	Max Array Size							
		Quality Flag 3	Yes	Yes	0	2457600							
Datum													
		Description	Datum Offset	Unscaled Valid Range Min	Unscaled Valid Range Max	Measurement Units	Scaled	Scale Factor Name	Data Type	Fill Values	Legend Entries		
		False Alarm Override (likely false alarms due to excessive rejection of legitimate background pixels)	0			unitless	No		1 bit(s)	Name	Value	Name	Value
											No	0	
											Yes	1	
		Water Contamination Override (likely false alarms caused by water contaminated background pixels - Flag will not be triggered for sparse array format since only fire pixels are written to output.)	1			unitless	No		1 bit(s)	Name	Value	Name	Value
											No	0	
											Yes	1	
		Spare	2			unitless	No		6 bit(s)	Name	Value	Name	Value
QF4_VIIRSAFARP	1byte(s)	Name	Granule Boundary	Dynamic	Min Array Size	Max Array Size							
		Quality Flag 4	Yes	Yes	0	2457600							
Datum													
		Description	Datum Offset	Unscaled Valid Range Min	Unscaled Valid Range Max	Measurement Units	Scaled	Scale Factor Name	Data Type	Fill Values	Legend Entries		
		Fire Detection Confidence (Pixel level fire confidence in percent for each of the fire pixels)	0	0	100	unitless	No		unsigned 8-bit char	Name	Value	Name	Value

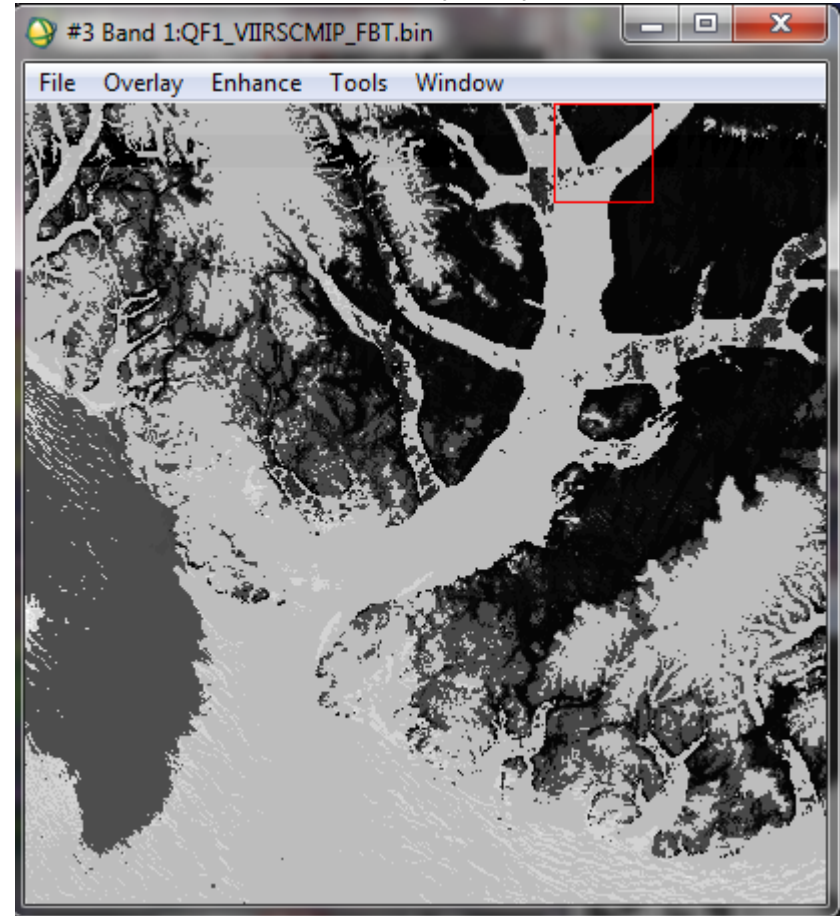


Cloud Mask Byte 1

Mx8.4 (IDPS)



Mx8.5 (FBT)

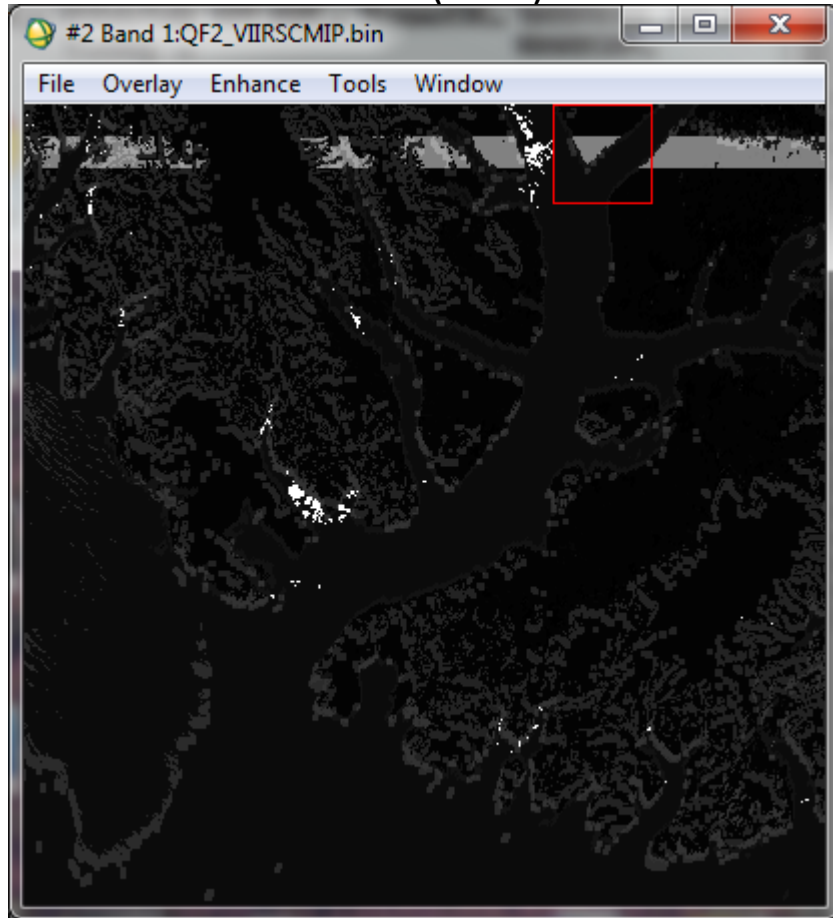


Left: IICMO_npp_d20140702_t1336187_e1337429_b13878_c20140702195750973165_noaa_ops.h5

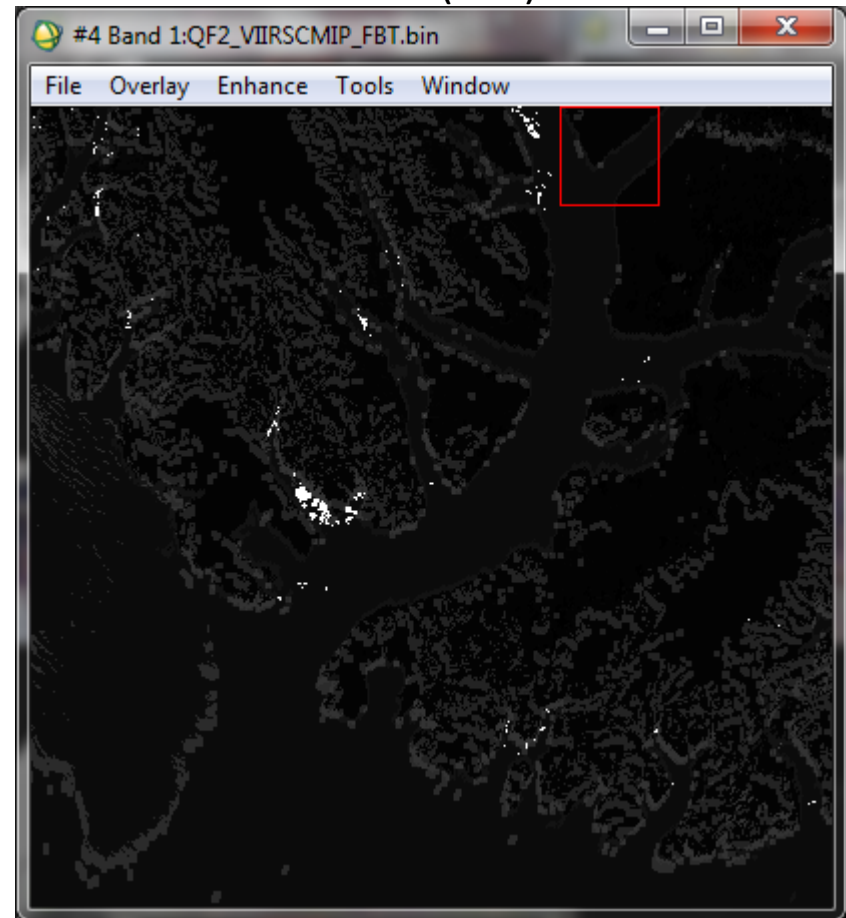
Right: IICMO_npp_d20140702_t1336187_e1337429_b13878_c20140702183650421253_devl_ops.h5

Cloud Mask Byte 2

Mx8.4 (IDPS)



Mx8.5 (FBT)



Left: IICMO_npp_d20140702_t1336187_e1337429_b13878_c20140702195750973165_noaa_ops.h5

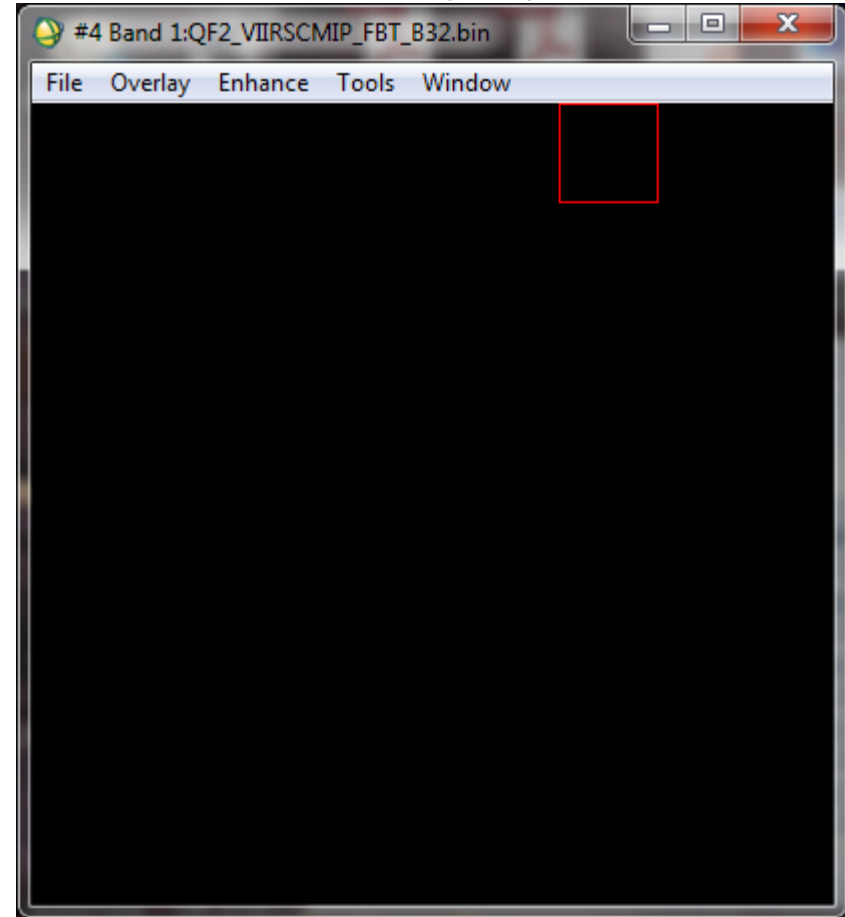
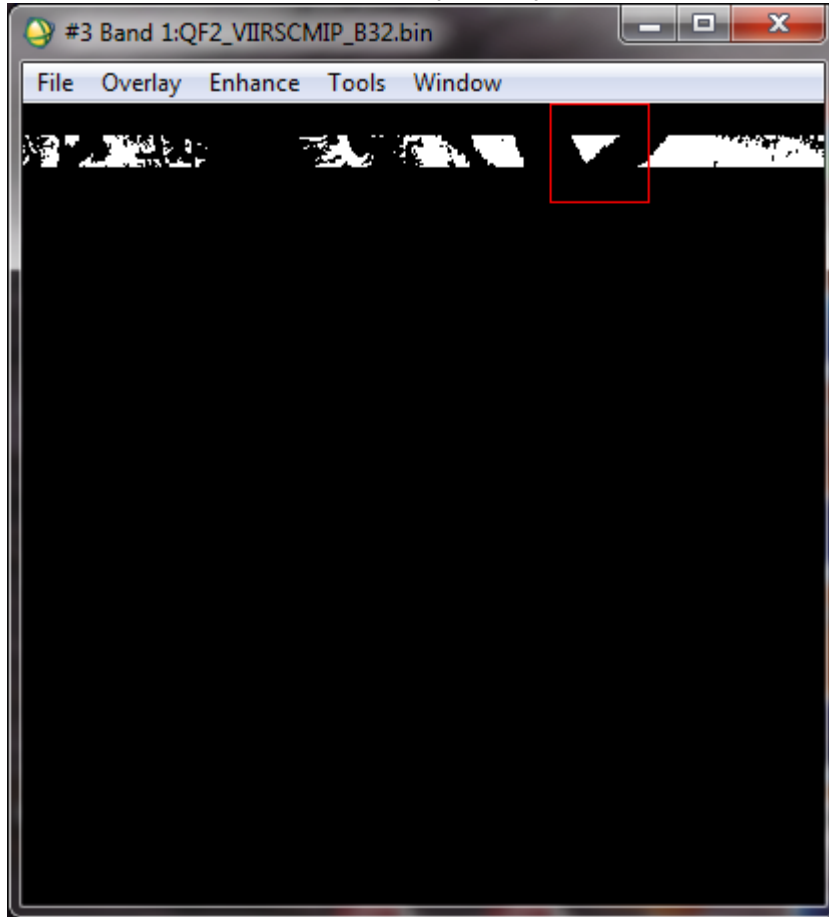
Right: IICMO_npp_d20140702_t1336187_e1337429_b13878_c20140702183650421253_devl_ops.h5¹²



Downstream impacts: Cloud Mask

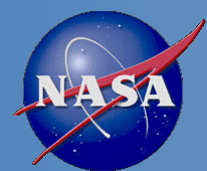


Cloud Mask Byte 2 Bit 6 (Fire Detected [Cloud Mask])
Mx8.4 (IDPS) Mx8.5 (FBT)



Left: IICMO_npp_d20140702_t1336187_e1337429_b13878_c20140702195750973165_noaa_ops.h5

Right: IICMO_npp_d20140702_t1336187_e1337429_b13878_c20140702183650421253_devl_ops.h5¹³



Downstream impacts: Surface Type



474-00001-04-03_JPSS-CDFCB-X-Vol-IV-Part-3_0200-.pdf - Adobe Acrobat

File Edit View Window Help

Create

49 / 164 87%

Tools Comment

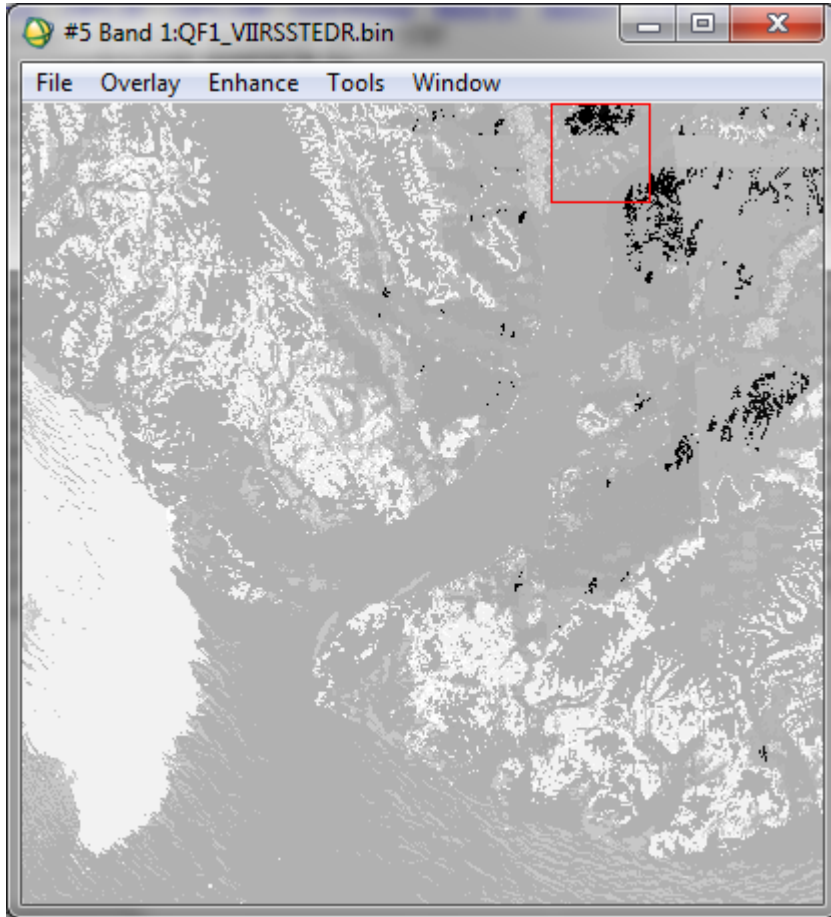
Effective Date: January 09, 2014
Block/Revision 0200-

Table 5.4.6.2-2, VIIRS Surface Type EDR Product Profile - Quality Flags

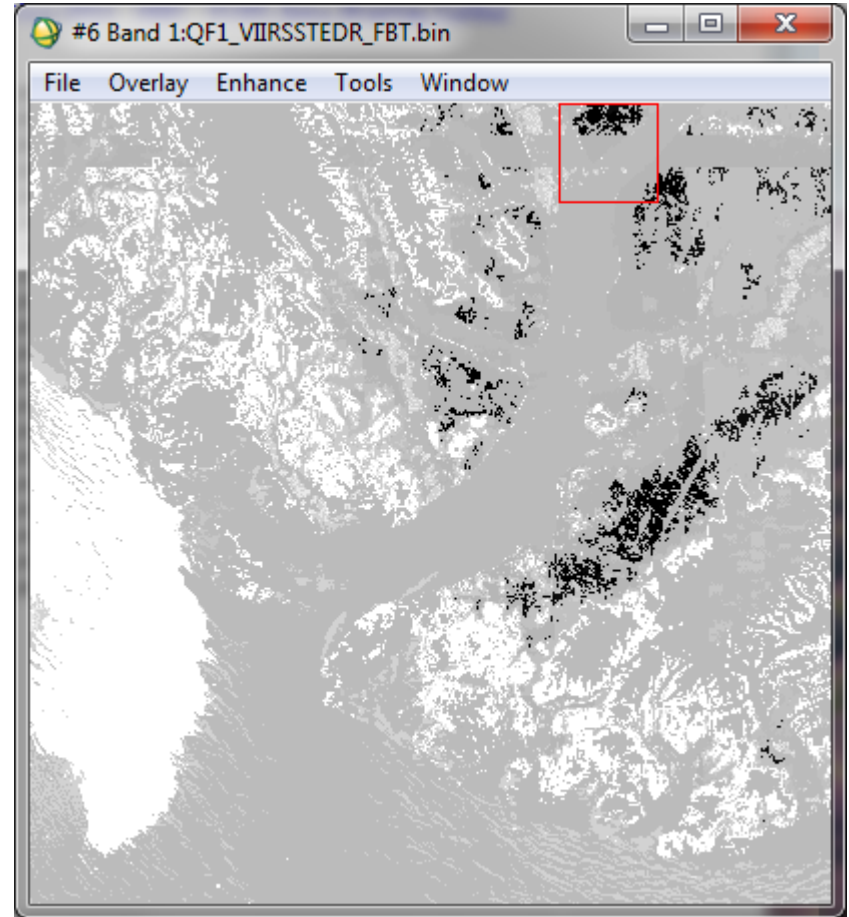
Name	Data Size	Fields									
		Dimensions									
QF1_VIIRSSTEDR	1byte(s)	Name	Granule Boundary	Dynamic	Min Array Size	Max Array Size					
		AlongTrack	Yes	No	768	768					
		CrossTrack	No	No	3200	3200					
		Datum									
		Description	Datum Offset	Unscaled Valid Range Min	Unscaled Valid Range Max	Measurement Units	Scaled	Scale Factor Name	Data Type	Fill Values	Legend Entries
		Fire detected in pixel (from the VIIRS Cloud Mask)	0			unitless	No		1 bit(s)	Name Value	Name Value False 0 True 1
		Snow or Ice in Pixel (fraction detected within the pixel exceeded threshold). Applies up to SZA<=85 deg.	1			unitless	No		1 bit(s)	Name Value	Name Value False 0 True 1
		Vegetation in Pixel (Vegetation fraction detected within the pixel exceeded threshold)	2			unitless	No		1 bit(s)	Name Value	Name Value False 0 True 1
		Cloud Confidence Indicator (Indication of whether 'M' band pixel confidently clear, probably clear, probably cloudy or confidently cloudy)	3			unitless	No		2 bit(s)	Name Value	Name Value Confidently Clear 0 Probably Clear 1 Probably Cloudy 2 Confidently Cloudy 3
		Exclusion - Sun Glint in pixel (as indicated in the VIIRS Cloud Mask)	5			unitless	No		1 bit(s)	Name Value	Name Value False 0 True 1
		Input Data Quality degraded/bad (Quality of Surface Type is degraded or not retrieved due to bad surface reflectance data in horizontal cell)	6			unitless	No		1 bit(s)	Name Value	Name Value False 0 True 1
	7			unitless	No		1 bit(s)	Name Value	Name Value		
QF2_VIIRSSTEDR	1byte(s)	Name	Granule Boundary	Dynamic	Min Array Size	Max Array Size					

Surface Type QF1

Mx8.4 (IDPS)



Mx8.5 (FBT)



Left: VSTYO_npp_d20140702_t1336187_e1337429_b13878_c20140702195757169854_noaa_ops.h5

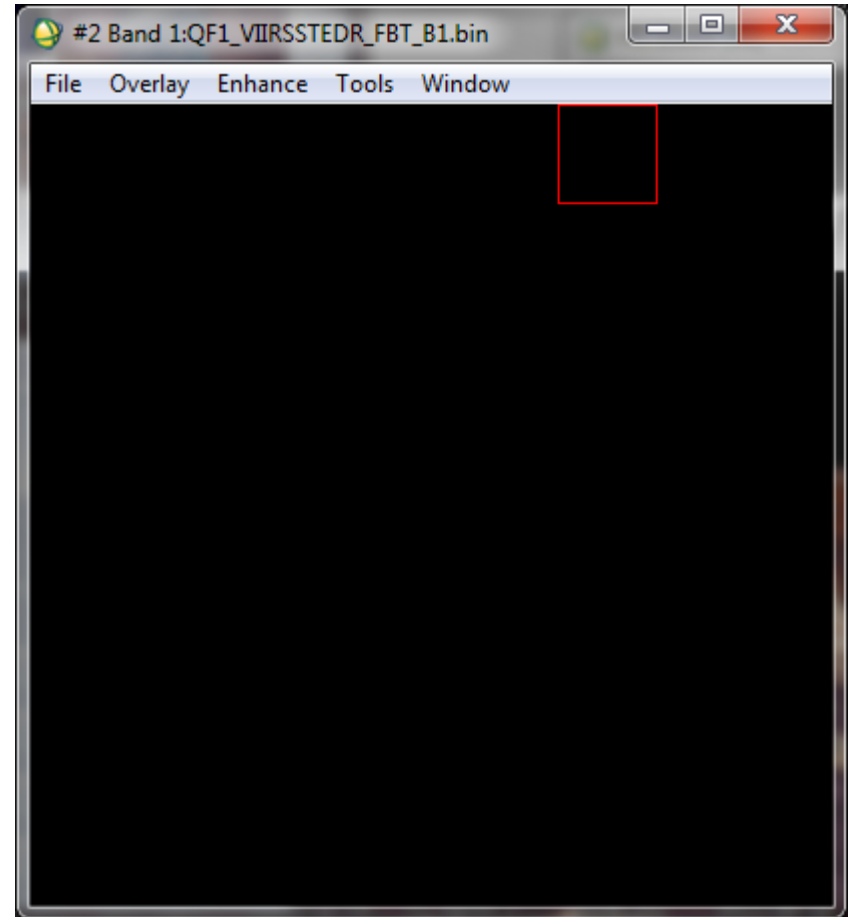
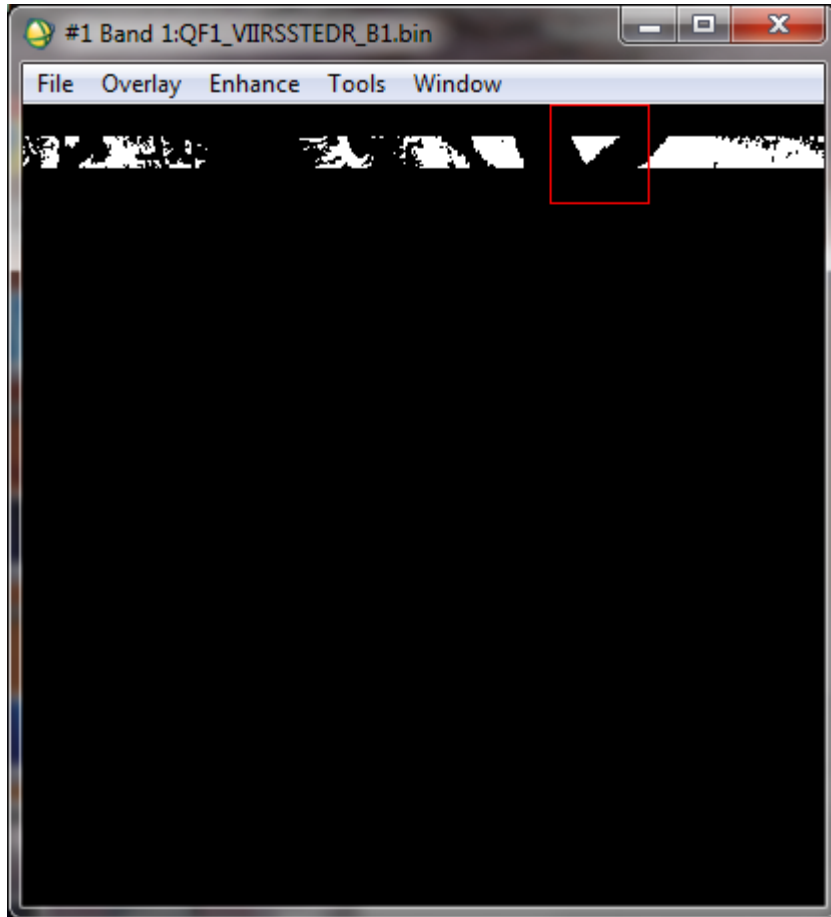
Right: VSTYO_npp_d20140702_t1336187_e1337429_b13878_c20140702183653777297_devl_ops.h5



Downstream impacts: Surface Type



Surface Type QF1 Bit 1 (“Fire detected in pixel [from the VIIRS Cloud Mask]”)
Mx8.4 (IDPS) Mx8.5 (FBT)



Left: VSTYO_npp_d20140702_t1336187_e1337429_b13878_c20140702195757169854_noaa_ops.h5

Right: VSTYO_npp_d20140702_t1336187_e1337429_b13878_c20140702183653777297_devl_ops.h5



Error Budget



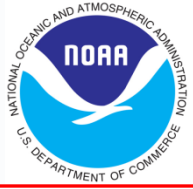
Compare analysis/validation results against requirements, present as a table. Error budget limitations should be explained. Describe prospects for overcoming error budget limitations with future improvement of the algorithm, test data, and error analysis methodology.

Attribute Analyzed	L1RD Threshold	Analysis/Validation Result	Error Summary
Frequency of spurious data due to bad SDR input	Not listed	2 bad granules in Mx8.4 over 4 months No granules found in Mx8.5 over 1 month of data (including the 2 granules that were bad in Mx8.4)	Incremental SDR improvements resulted in overall reduction of errors to virtually none. Statistical sample still limited; continuing systematic monitoring needed.

Formal L1RD requirements for VIIRS horizontal cell size and mapping uncertainty are no listed.

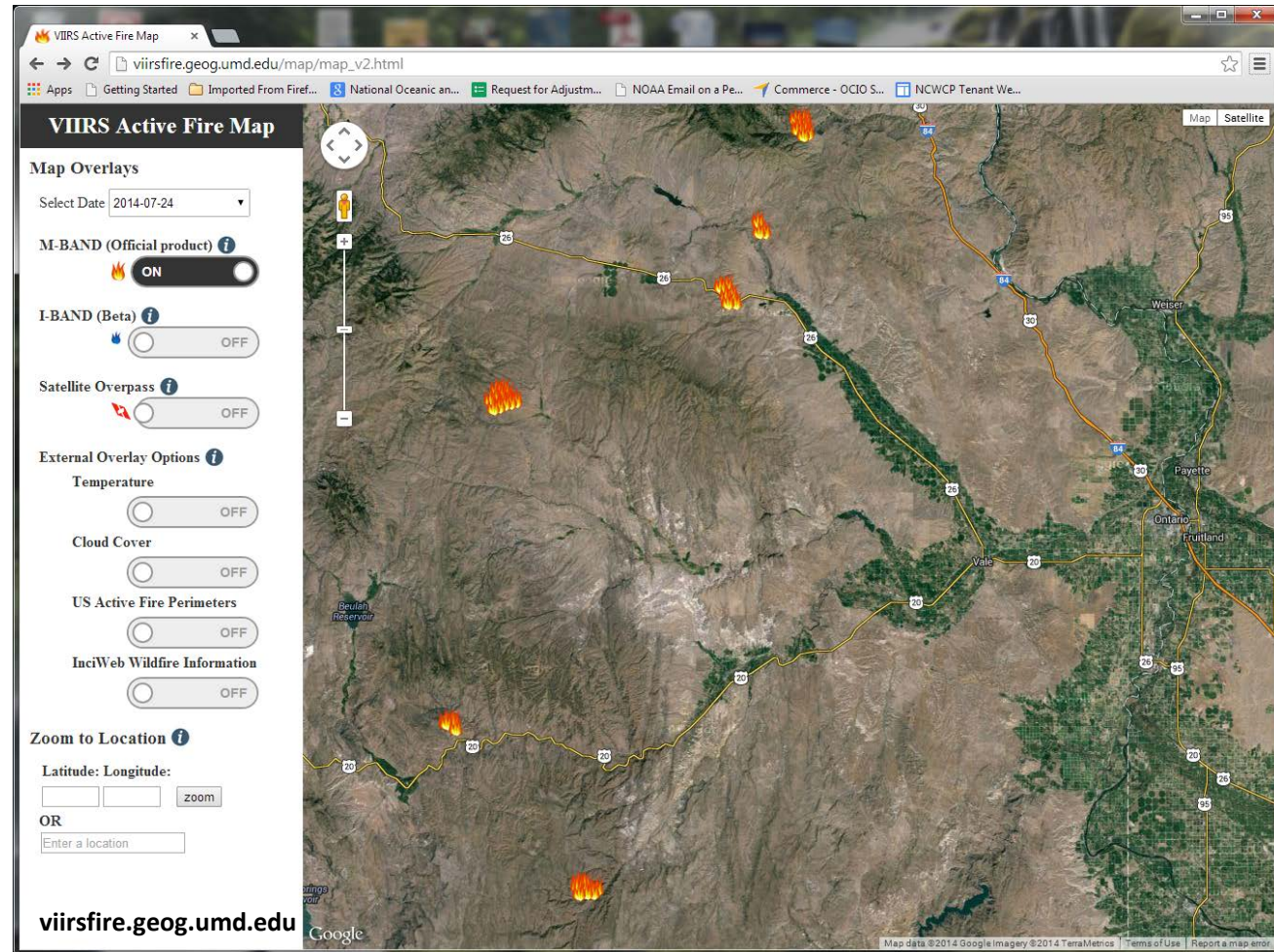


Documentation

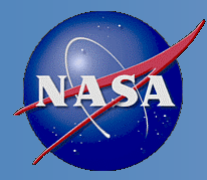


- The following documents will be updated and provided to the EDR Review Board before AERB approval:
 - Current or updated ATBD
 - Some updates in product format description and detection algorithm are needed
 - Current or updated OAD
 - Deemed to be current
 - README file for CLASS
 - Proposed effectivity date is August 13, 2014
 - Will include discussion on quality flag issues
 - Product User's Guide (Recommended)
 - No users' guide will be prepared by the AERB
 - Documentation and peer-reviewed publications are publicly available

- The operational SNPP VIIRS Active Fire product is a sparse array containing locations of pixels flagged as “fire” by the detection algorithm
- The science team is developing a suite of improved products, including fire radiative power to characterize the fire intensity
- End users are engaged through Proving Ground and User Readiness efforts



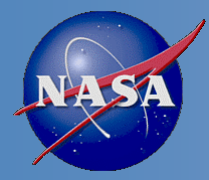
Fire detections from the operational Suomi NPP VIIRS Active Fire product in NW US on July 24, 2014. Data in various user-friendly formats are available from the product evaluation portal at viirsfire.geog.umd.edu.



User Readiness: NOAA Hazard Mapping System



- User acceptance of product:
 - Product is being received routinely in SAB and is **ready for full incorporation into the SAB Hazard Mapping System.**
- Preparation:
 - Scripts written to read/write AFP locations from/to files.
 - VIIRS M13 SDR imagery was incorporated into SAB operations in native satellite projection via McIDAS and also remapped to a common Lambert Conic Conformal projection for the HMS. Remapping routine needed to be tailored for use with VIIRS due to higher spatial resolution in order to retain pixel fidelity
- Usage of products:
 - Active Fire Product is displayed in Hazard Mapping System for evaluation by SAB analysts. It is incorporated with detected fires from numerous other satellite sources (GOES, POES and MODIS) and undergoes additional manual quality control before being merged into a unified daily fire analysis product for North America. The AFP also provides an additional **data source as input for initializing the daily National Weather Service Air Quality smoke forecast.**

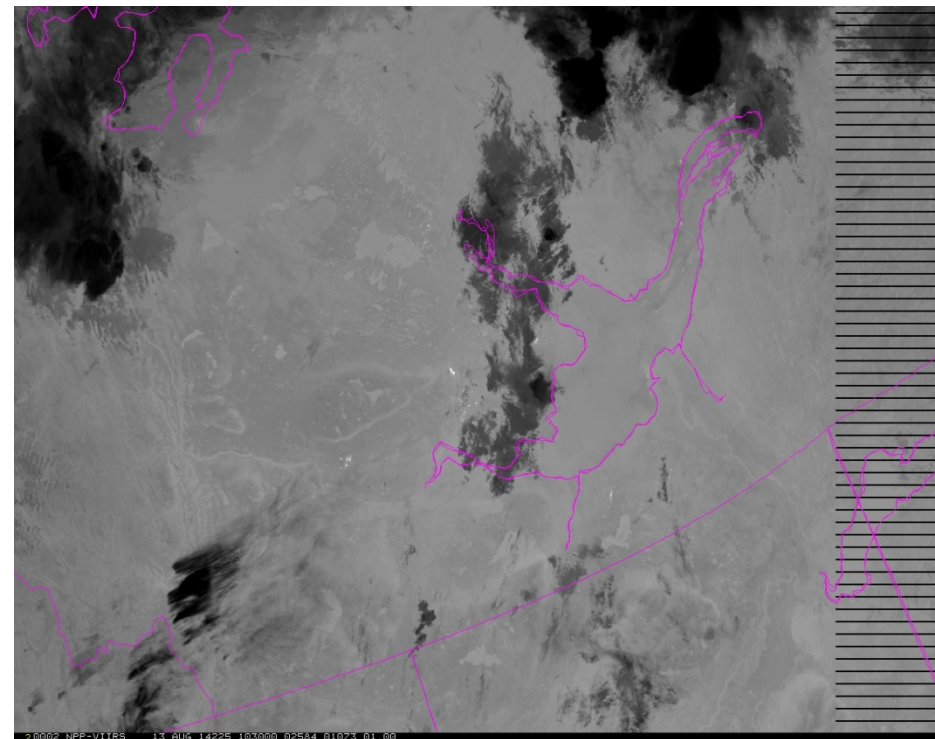
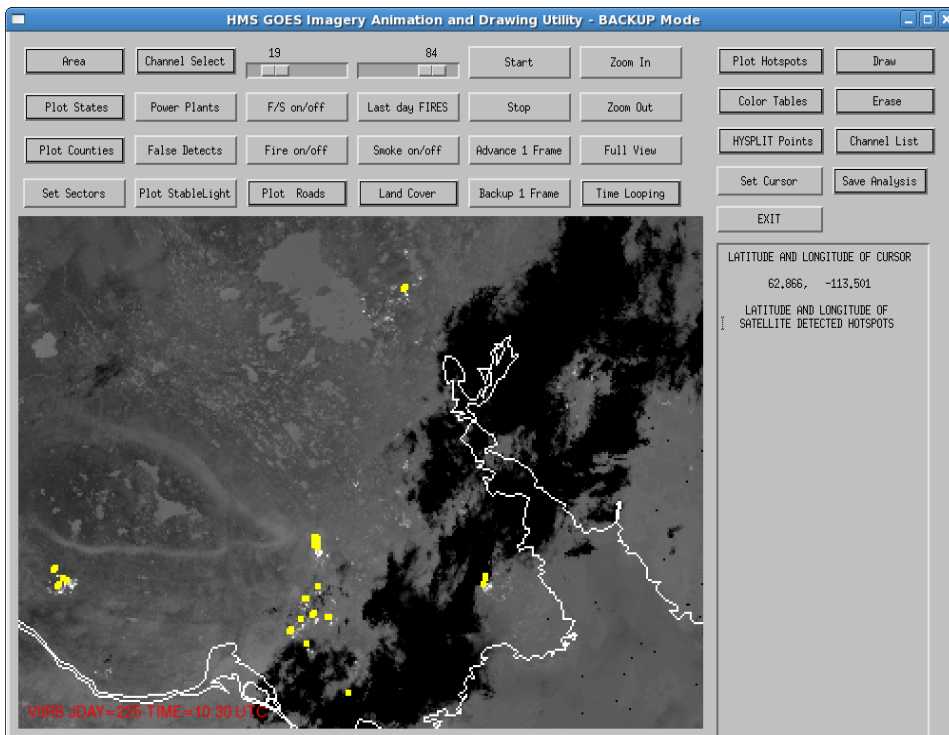


HMS AND McIDAS DISPLAYS



HMS display of VIIRS AFP from 13 August 0850Z and 1030Z images with remapped VIIRS M13 SDR 1030Z image

McIDAS display of 13 August 1030Z M13 SDR image in native satellite projection



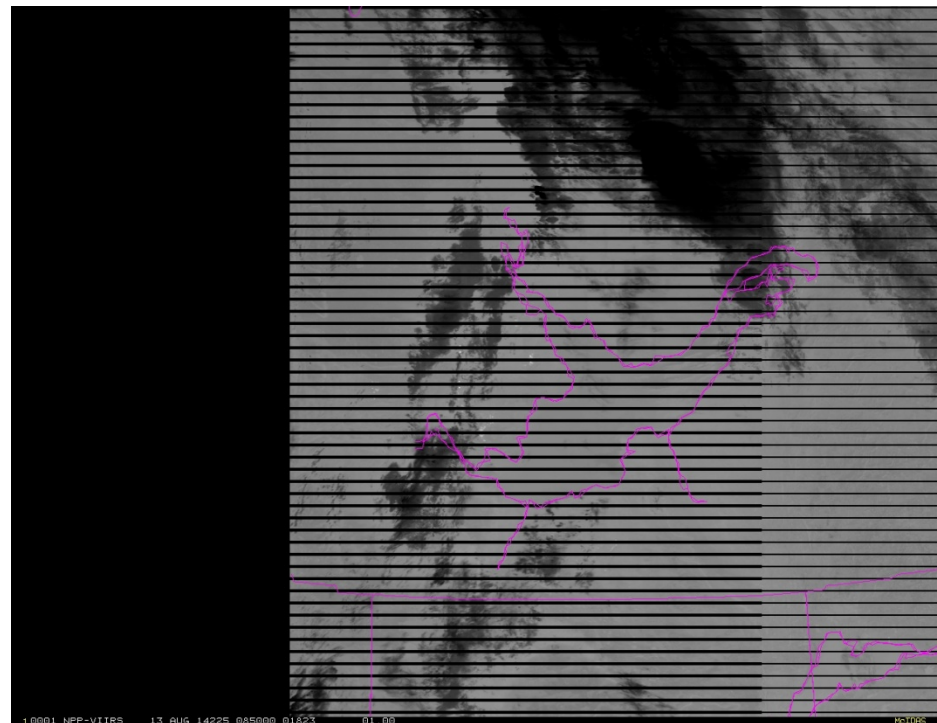
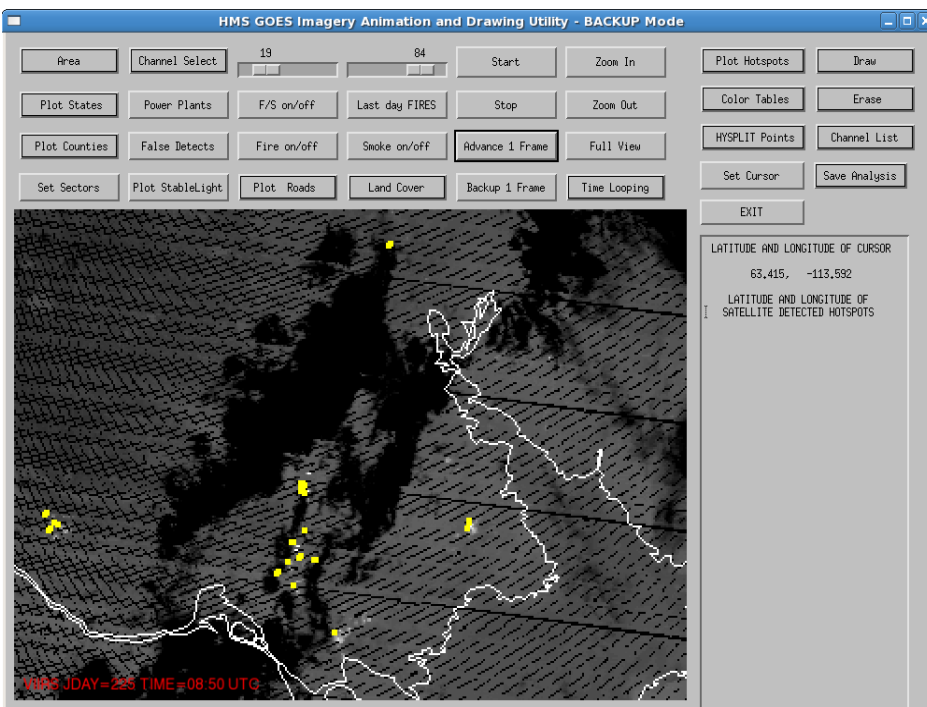


HMS AND McIDAS DISPLAYS



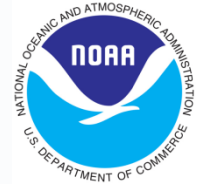
HMS display of VIIRS AFP from 13 August 0850Z and 1030Z images with remapped VIIRS M13 SDR 0850Z image

McIDAS display of 13 August 0850Z M13 SDR image in native satellite projection

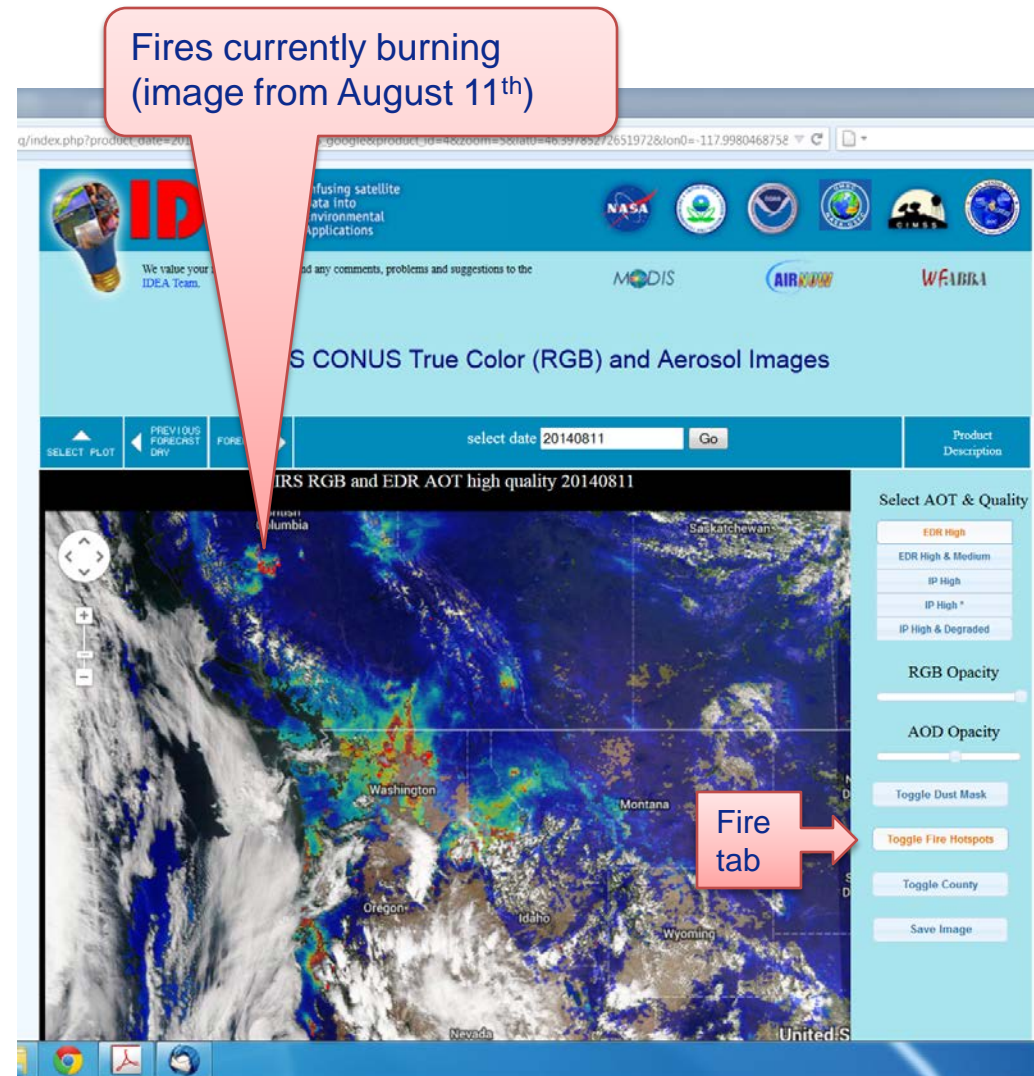




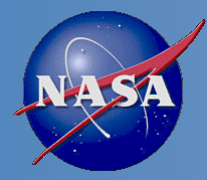
User Readiness: STAR Smoke Analysis system (IDEA)



- User acceptance of product:
 - IDEA (Infusing satellite Data into Environmental Applications) system and ASDA (Automated Smoke Detection and tracking Algorithm) have been using **VIIRS hot spots** generated from DB data since March 2013. NDE products will also be used when available operationally.
 - GBBEPx (Global Biomass Burning Emissions Product – Extended) will also use the product when **FRP** becomes available along with fire detection
- Preparation:
 - Already in use in real time since March 2013
- Usage of products:
 - Air quality forecasters use the IDEA system in their daily forecasting. *This website gets more than one million hits each year.*
 - NWS Alaska and Western regions will use ASDA smoke plumes for incident monitoring and containment activities. *Through new fire and smoke initiative*
 - GBBEPx using fire detection and FRP will generate emissions that will be used by **NCEP's global aerosol model**



<http://www.star.nesdis.noaa.gov/smcd/spb/aq/>



Conclusion



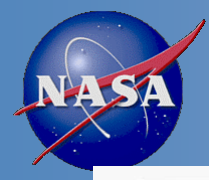
- Based on the available analysis results, the Active Fire team recommends the promotion of the Suomi NPP IDPS Active Fires ARP to Validated 1 maturity status with an effectivity date of **August 13, 2014**.
 - The effectivity date corresponds to the Transition to Operations of IDPS Mx8.5, which includes the implementation of 474-CCR-14-1667: VIIRS SDR Multiple Issues/Quality Flags & Calibration (ADRs 7110, 7111, 7112, 7227, 7313, 7448, 7449)
 - The team will continue systematic monitoring of product quality and will report any issues found immediately.
- The **Suomi NPP Active Fire ARP was declared Operational** by the NESDIS Satellite Products and Services Review Board (SPSRB)



Path Forward



- An automated **long-term monitoring system** is being set up at STAR for quality monitoring and reactive maintenance of the Suomi NPP Active Fire product
- A processing code is available to generate a product that meets the **JPSS 1 requirements** is available
 - Developed as part of a NASA Science Team effort
 - Implemented at STAR
 - NOAA implementation details are being worked on
 - CDR is planned for October 2014
- Continuing efforts towards rigorous **validation** using **independent reference data**



IDPS vs. JPSS “replacement” code

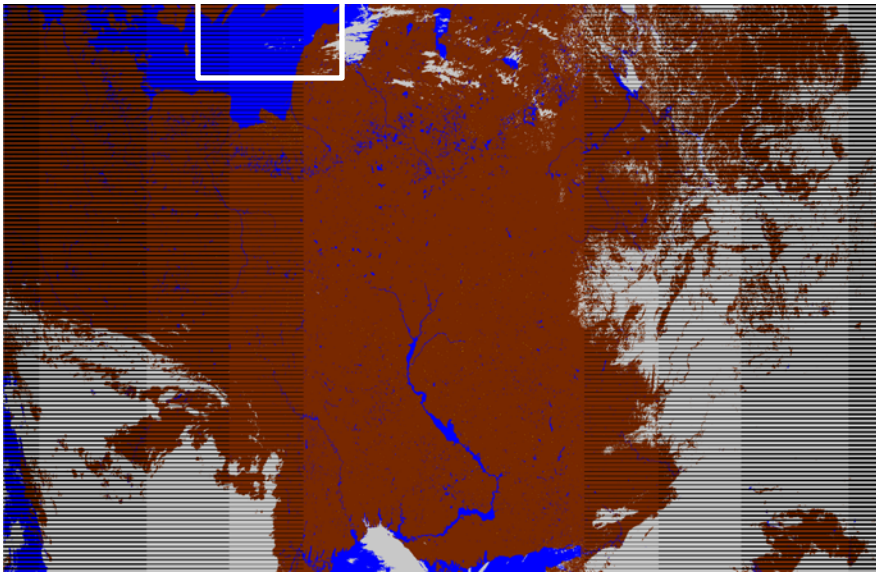
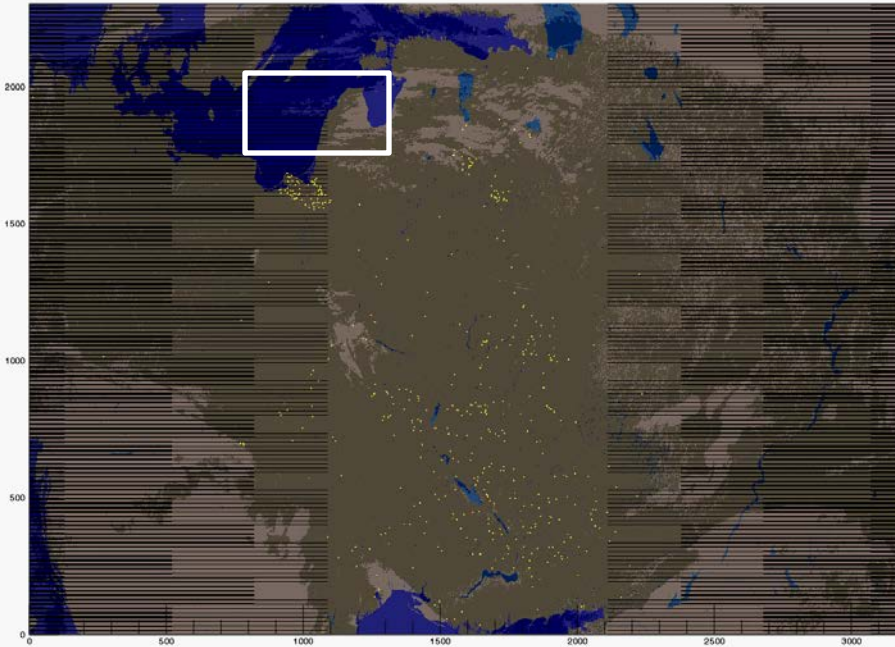


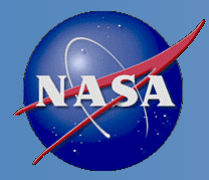
March 10, 2014 10:36-10:40

IDPS operational run
Unpacked from HDF5:
AVAFO* (AF EDR)
IICMO* (CM IP)
Plotted with IDL from binaries:
VIIRS-AF-EDR
VIIRS-CM-IP

Output from replacement code
Plotted with hdfview from HDF4
“fire mask” field

See next slide for comparison of fire pixels



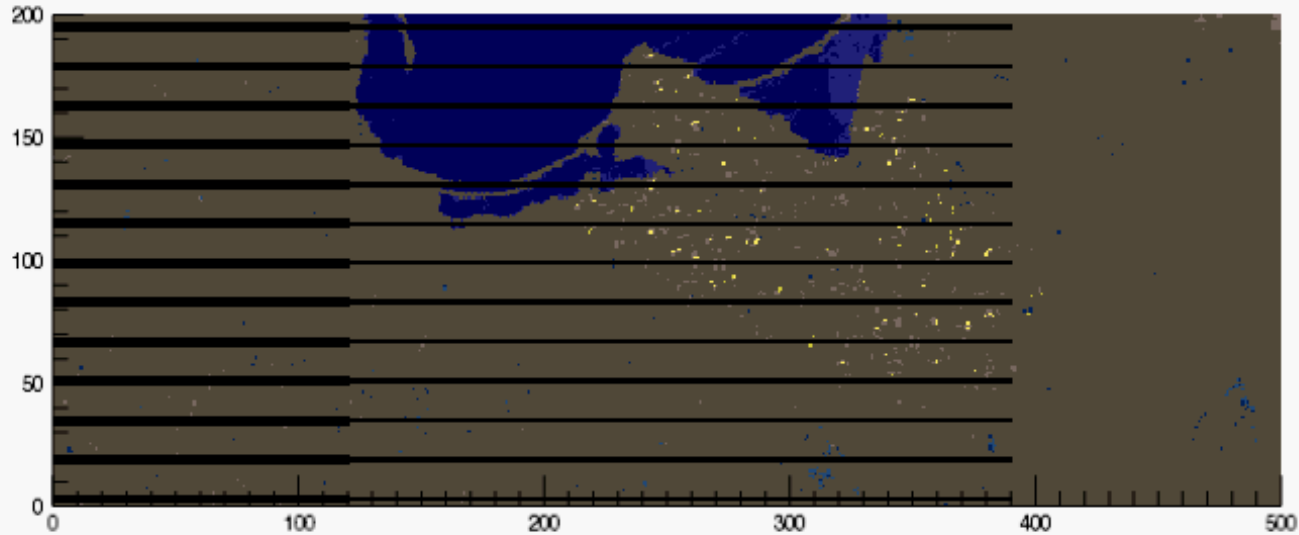


IDPS vs. JPSS “replacement” code



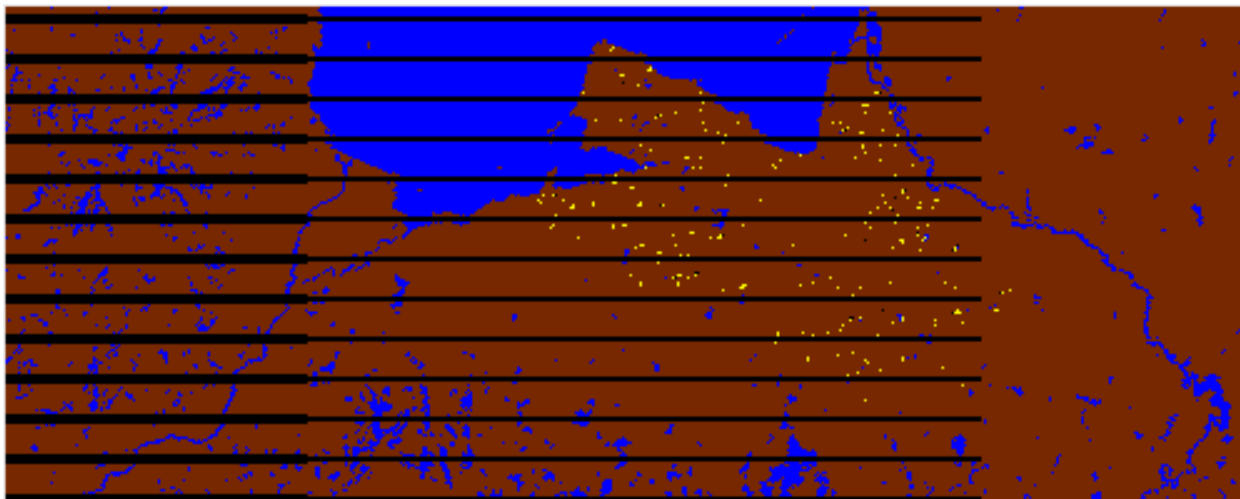
IDPS

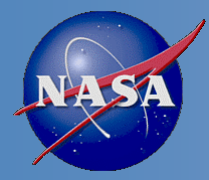
March 10, 2014 10:36-10:40



Yellow – fires
Grey - clouds

Replacement code





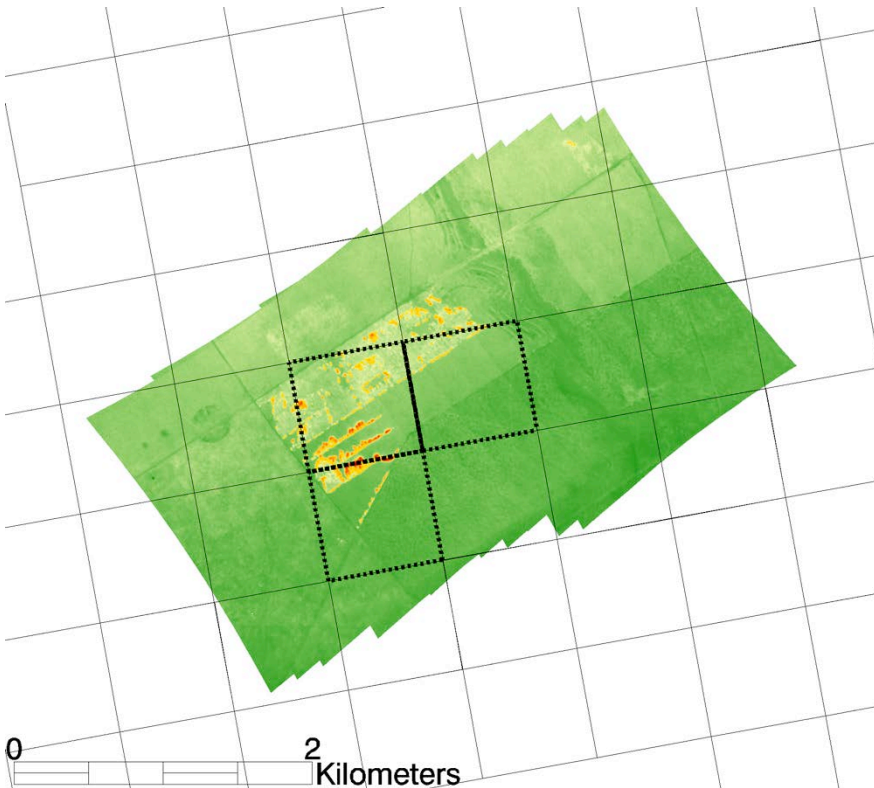
Field Validation Using Coincident Airborne Reference Data



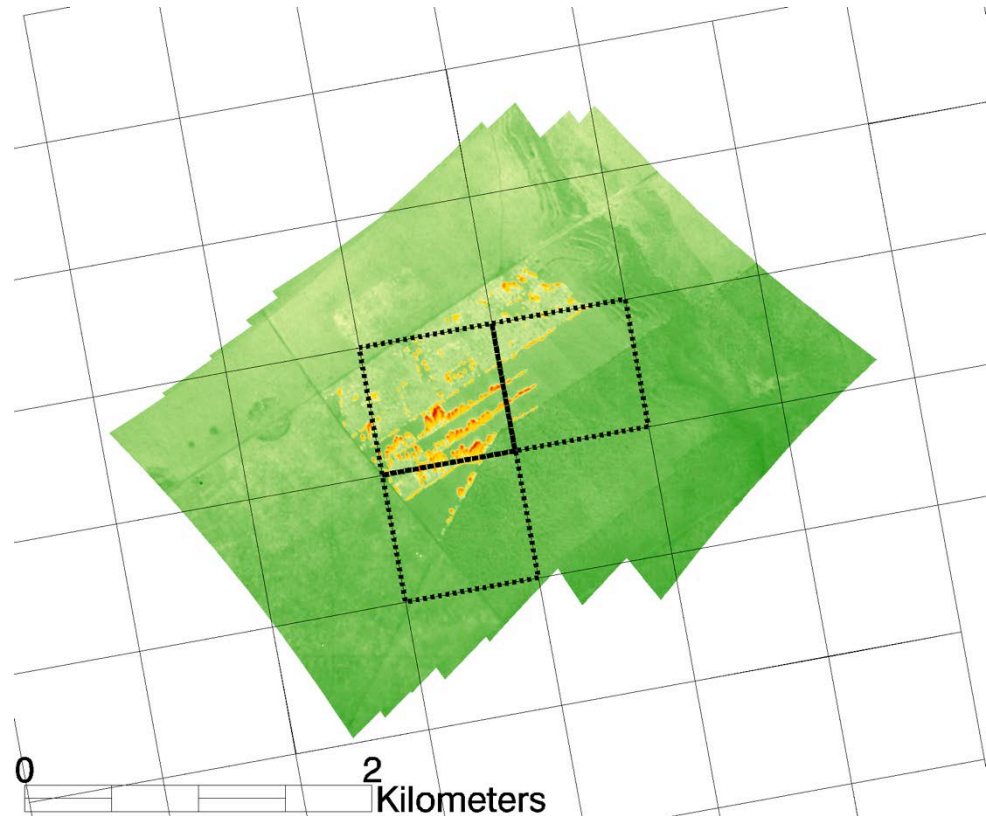
*Prescribed Fire Combustion and Atmospheric Dynamics Research
(RxCadre) experiment at Eglin Air Force Base/FL
1-15 Nov 2012*



Grassland fire 10 Nov 2012 (~16ha flaming/smoldering; 150MW)

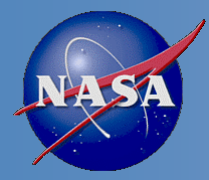


VIIRS 18:47:22 UTC
WASP 18:45:28-18:46:04 UTC



VIIRS 18:47:22 UTC
WASP 18:48:55-18:49:22 UTC

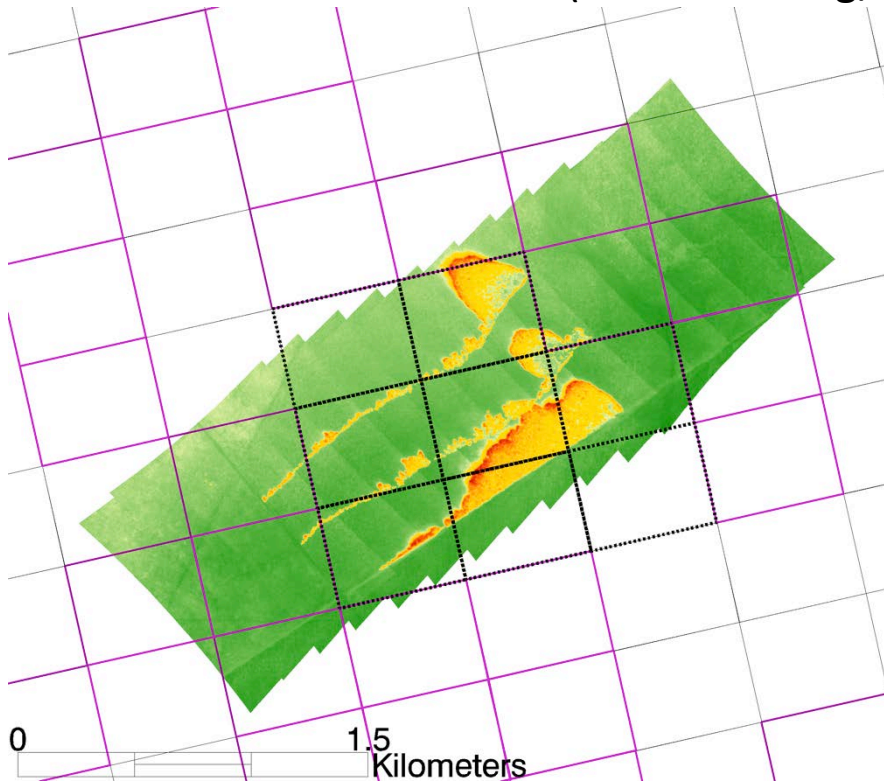




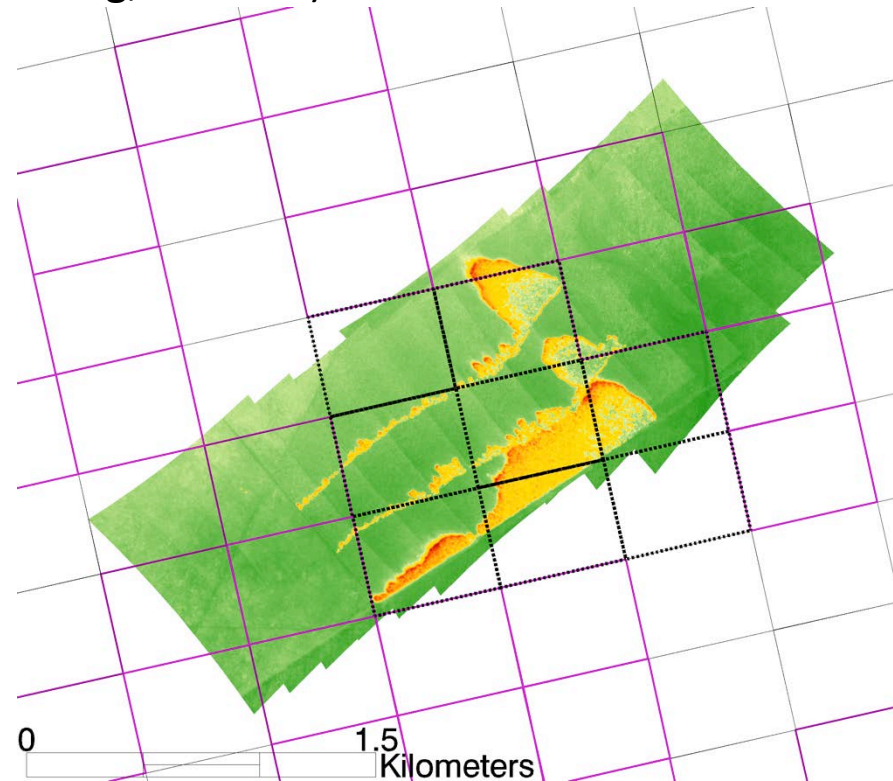
VIIRS 750 m Active Fire Algorithm Validation Using Airborne Reference and Auxiliary (fire mask replacement code) Input Data



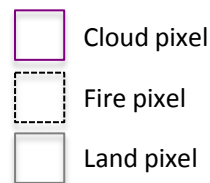
Pine forest understory fire 11 Nov 2012
(≈ 28 ha flaming/smoldering; 236MW)



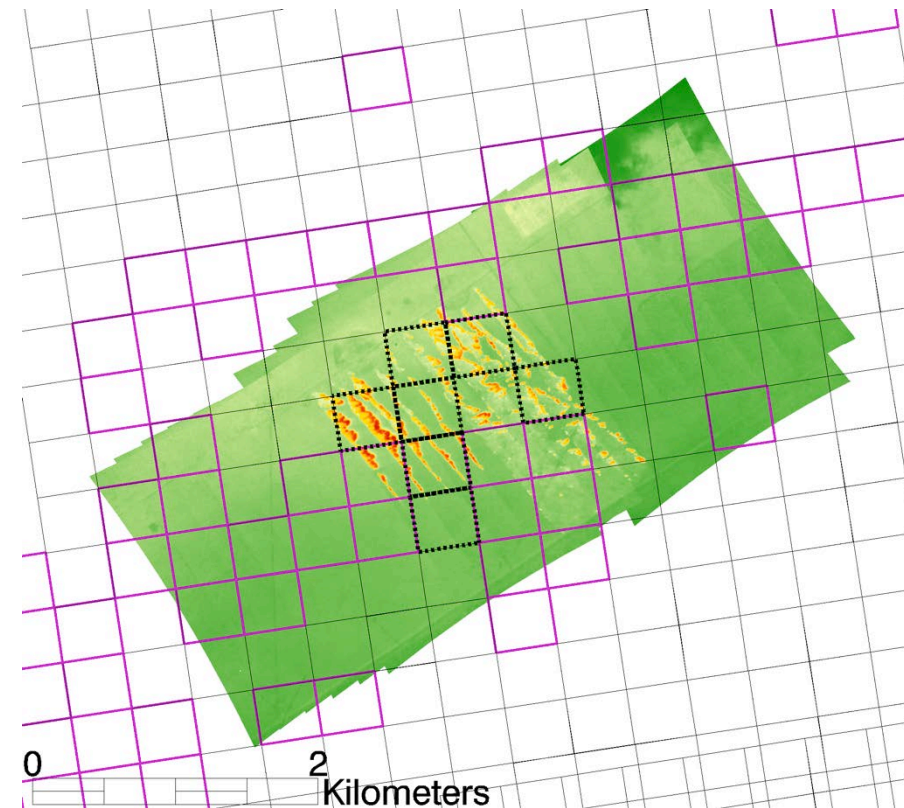
VIIRS 18:28:34 UTC
WASP 18:25:39-18:26:06 UTC



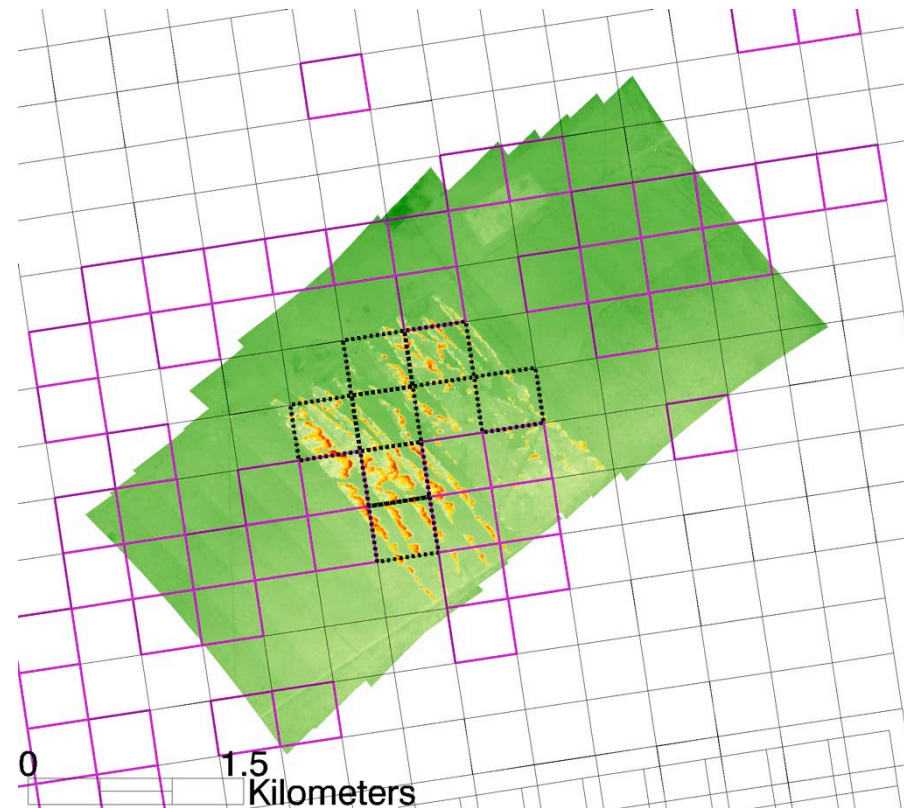
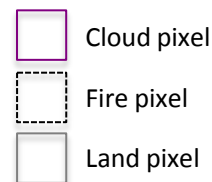
VIIRS 18:28:34 UTC
WASP 18:29:30-18:30:06 UTC



Grassland fire 04 Nov 2012 (~35ha flaming/smoldering; 158MW)



VIIRS 18:59:54 UTC
WASP 18:58:55-18:59:43 UTC



VIIRS 18:59:54 UTC
WASP 19:03:05-19:03:44 UTC