

ACTIVE FIRES: SDR QUALITY, REPLACEMENT CODE AND I-BAND PRODUCT

*Louis Giglio¹, Wilfrid Schroeder¹, Evan
Ellicott¹, William Walsh¹, Ivan Csiszar²*

¹University of Maryland, College Park, MD

²NOAA/NESDIS Center for Satellite Applications and
Research, Camp Springs, MD

Outline

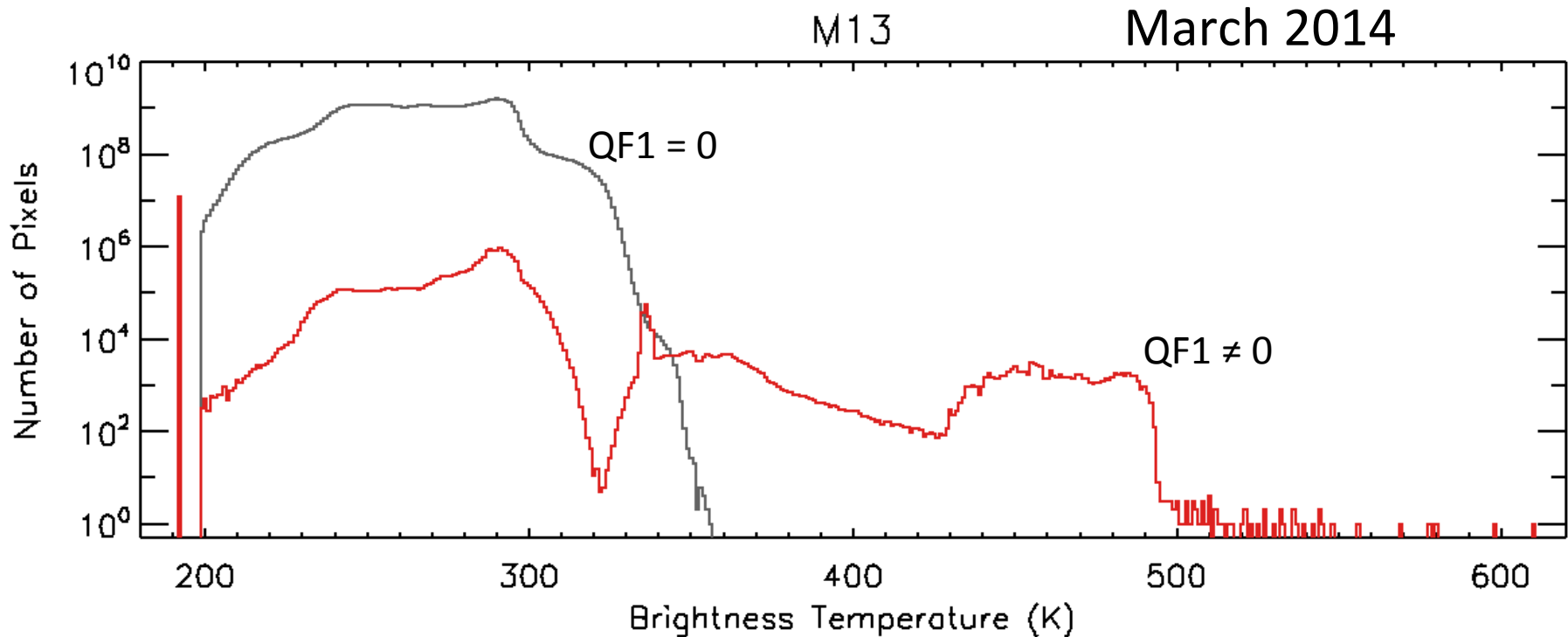
- SDR quality flag issues
- Product status
 - IDPS
 - replacement code (J1)
 - I-band product status
- Validation

SDR QUALITY

Reference Table for QA bits

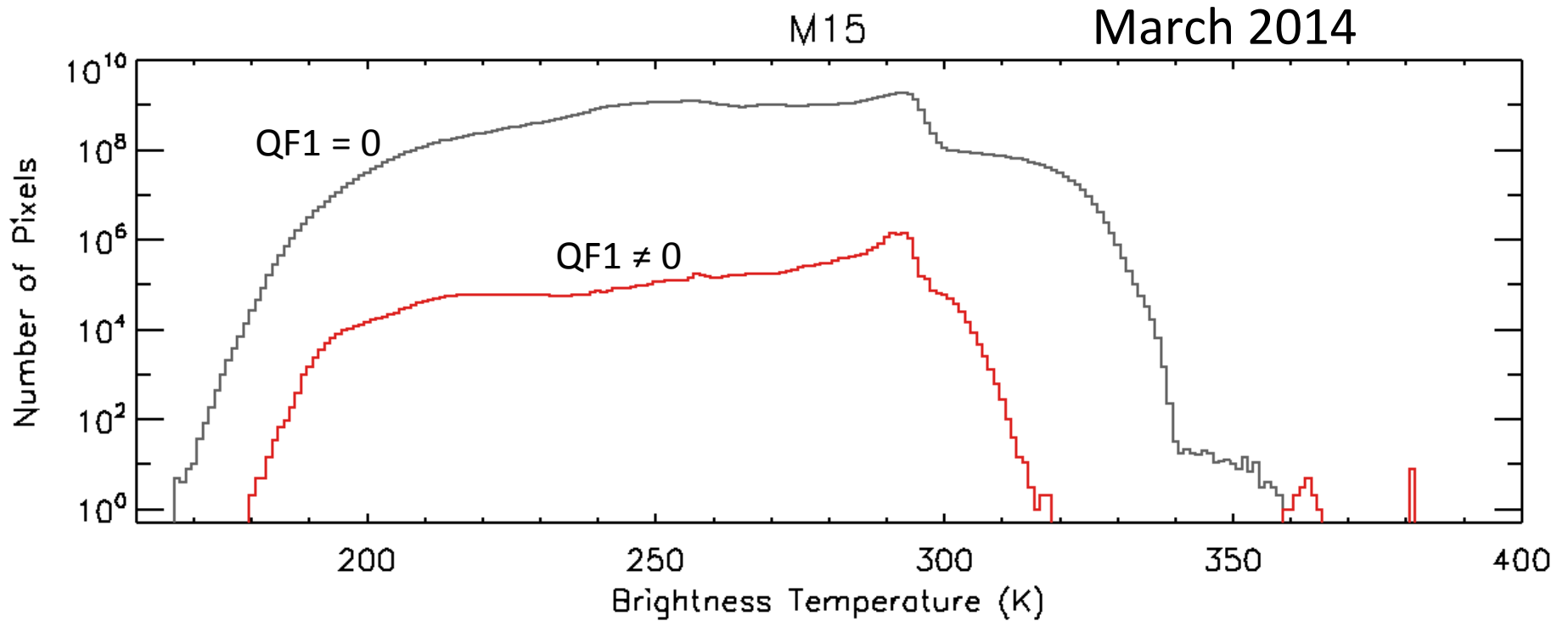
QF1_VIIRSMB	Description	Datum Offset	Data Type	Legend Entries	
ANDSDR 1 byte(s) 768 3200	Quality - Indicates calibration quality due to bad space view offsets, OBC view offsets, etc or use of a previous calibration view	0	2 bit(s)	Name	Value
				Good	0
				Poor	1
				No Calibration	2
				Not Used	3
	Saturated Pixel - Indicates the level of pixel saturation	2	2 bit(s)	Name	Value
				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)	Name	Value
				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)	Name	Value
				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 Saturared - 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 (165 cal data missing)
193	Not used – Radiance out of range
65	Poor – Reflectance or EBBT out of range



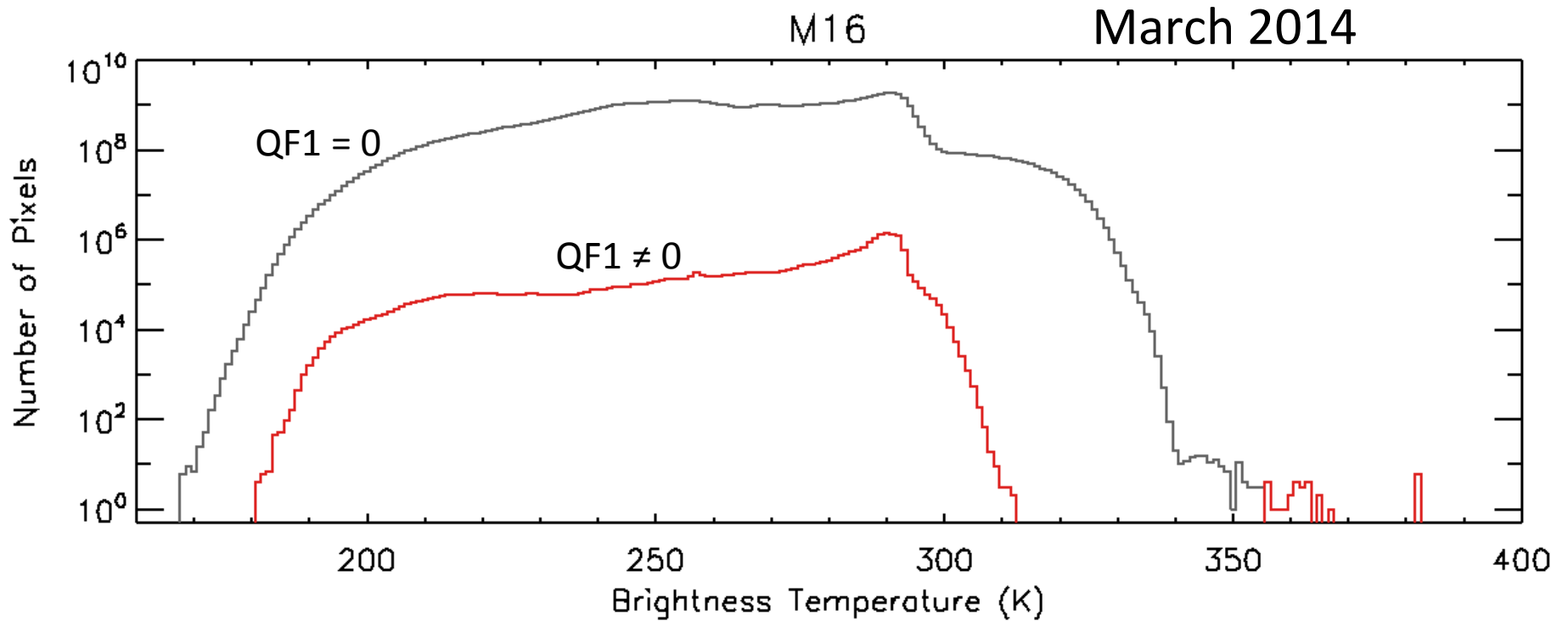
- All pixels > 358 K flagged as having poor calibration
- Partially saturated pixels have high radiance but $T_b = 192$ K
- Mysterious spike in calibration quality near 335 K
- Mysterious “ravine” in calibration quality near 322 K

NB. QF1 $\neq$ 0 curve does not include trim (QF1 = 2) or fill (QF1 $>$ 247).



- Brightness temperatures near 362 K are incorrect
- Gap in brightness temperatures from 365 K – 380 K

NB. QF1 $\neq$ 0 curve does not include trim (QF1 = 2) or fill (QF1 > 247).



- Brightness temperatures near 362 K are incorrect
- Gap in brightness temperatures from 365 K – 380 K

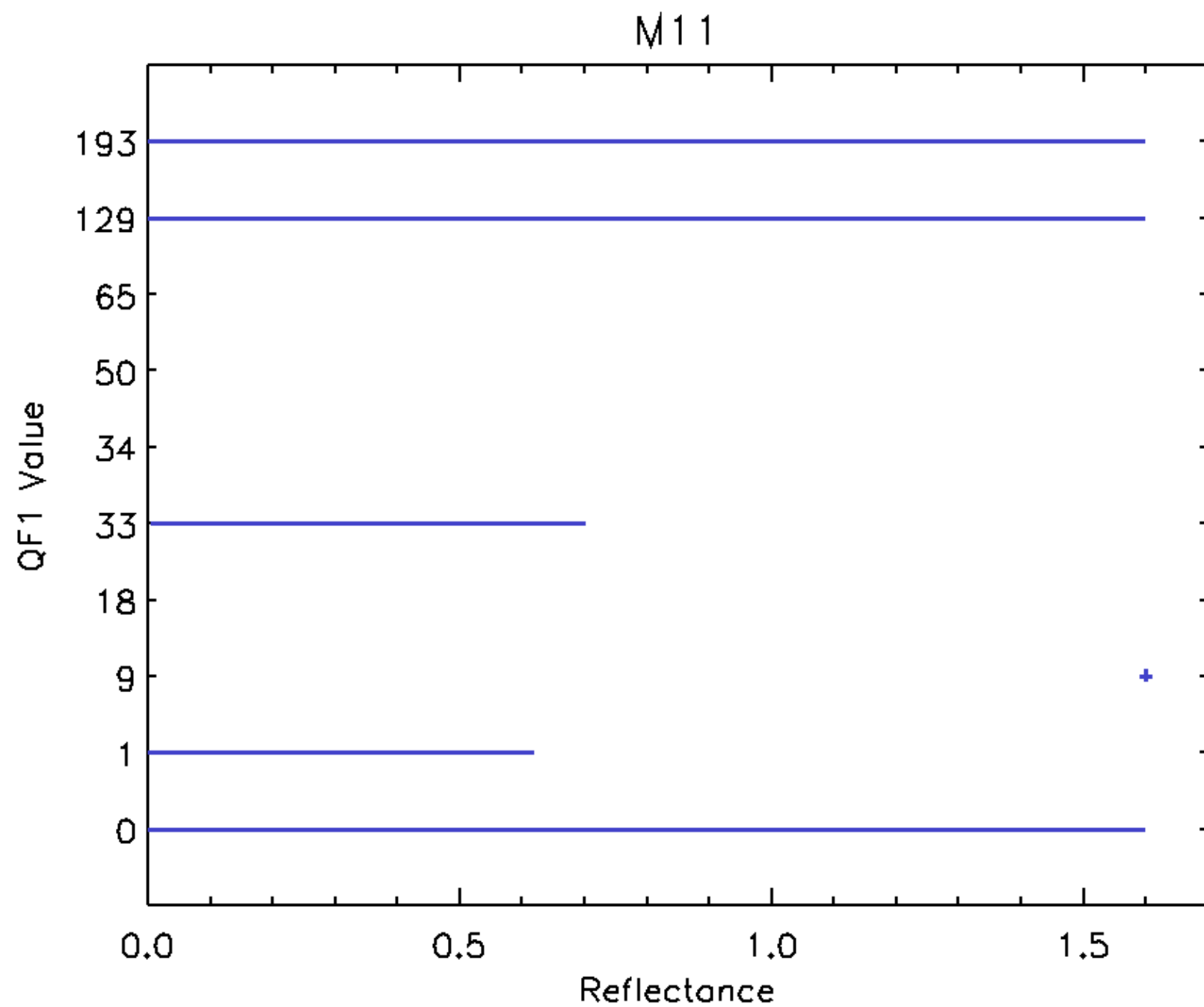
NB. QF1 $\neq$ 0 curve does not include trim (QF1 = 2) or fill (QF1 > 247).

Generic VIIRS SDR Problems

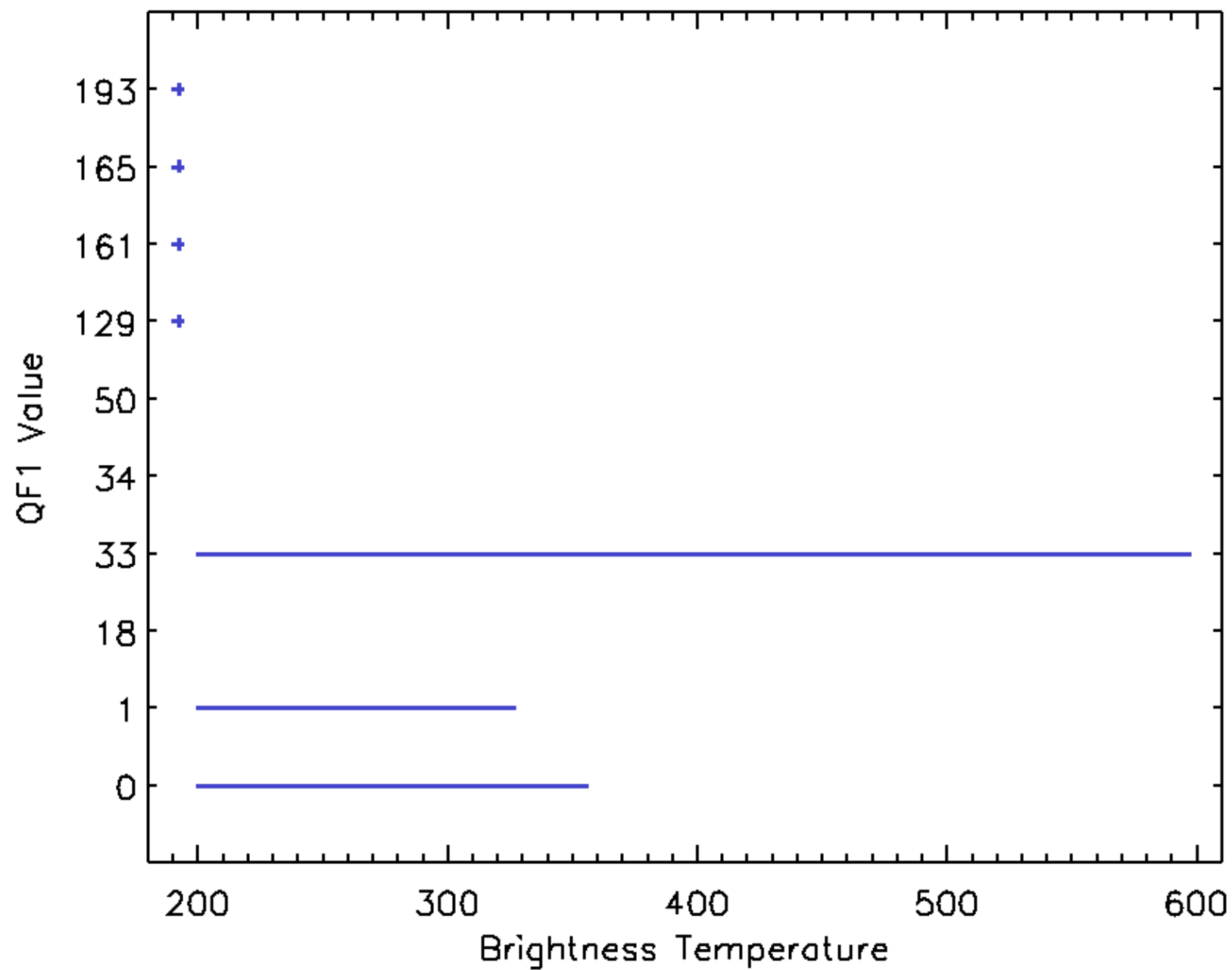
- Non-unique mapping of radiance to brightness temperature near saturation
 - Example: M15 radiance of $20.50 \text{ W m}^{-2} \text{ sr}^{-1} \text{ um}^{-1}$ assigned $T_b = 360.1 \text{ K}, 363.8 \text{ K}, 363.9 \text{ K}, 364.1 \text{ K}, 381 \text{ K}$, etc. within same granule (2014 080 06:55)
- Ongoing confusion between sensor specification and actual sensor capabilities in SDR software lookup tables

Generic VIIRS SDR Problems

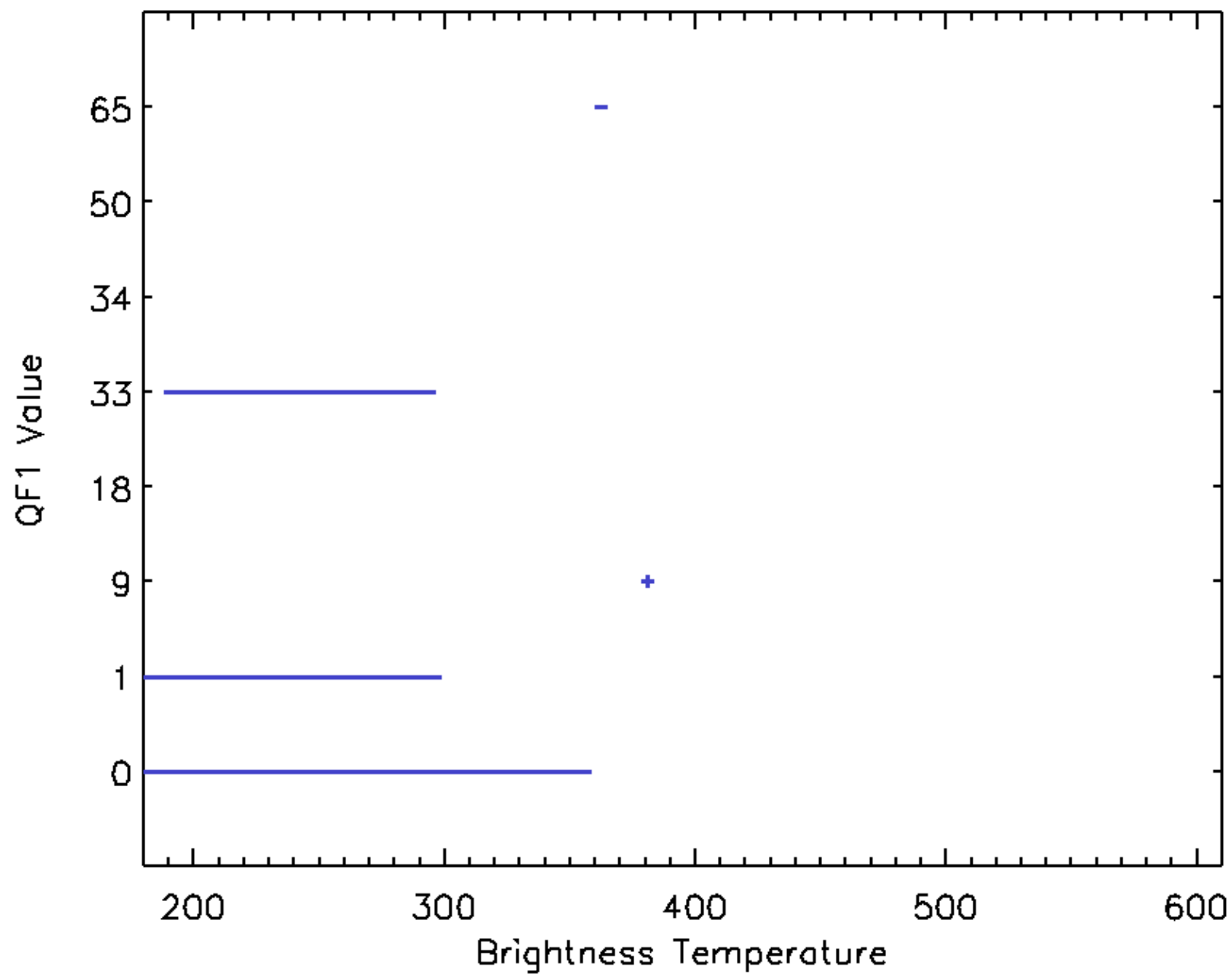
- QF1 bits often set haphazardly
 - M13: All pixels $> 358\text{K}$ flagged as “poor quality, calibration data missing”
 - Reflective bands: River edges and cloud shadows often non-informatively flagged as “poor quality”
 - Reflective bands: Invalid QF1 values of 35 and 163 occur in $\sim 1,000$ pixels/day
 - Currently impossible to reliably filter bad input data via QFs without also considering radiance *and* reflectance/brightness temperature



M13



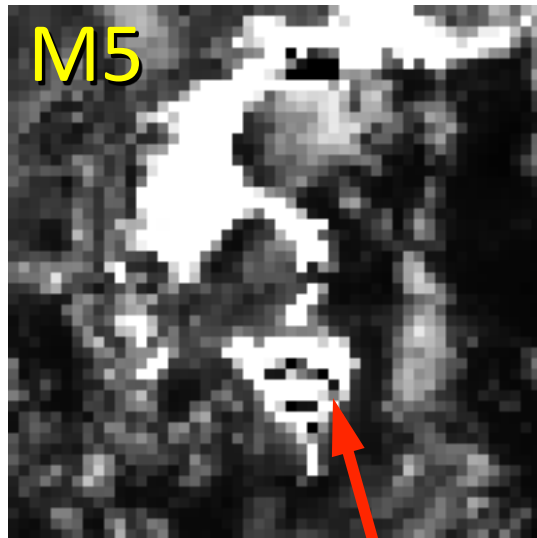
M15



Generic VIIRS SDR Problems

- “Folded” radiance values due to saturation not flagged as invalid
 - Observed in M5 (dual gain), M7 (dual gain), and M11 (single gain)
 - Reflectance values look normal (0.02 – 0.6)
 - QF1 = 0

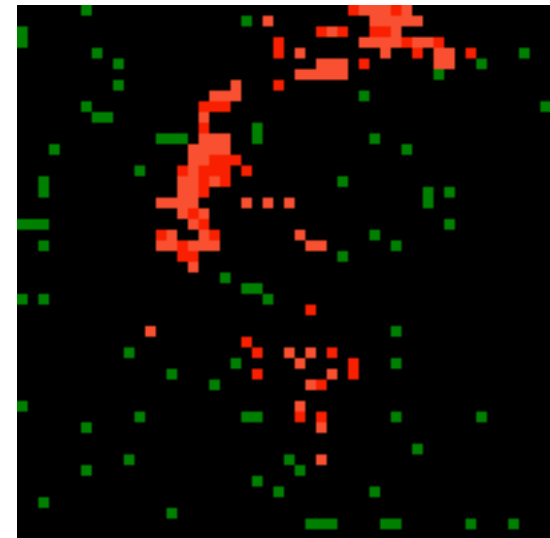
Sun glint example (2014070 16:45)



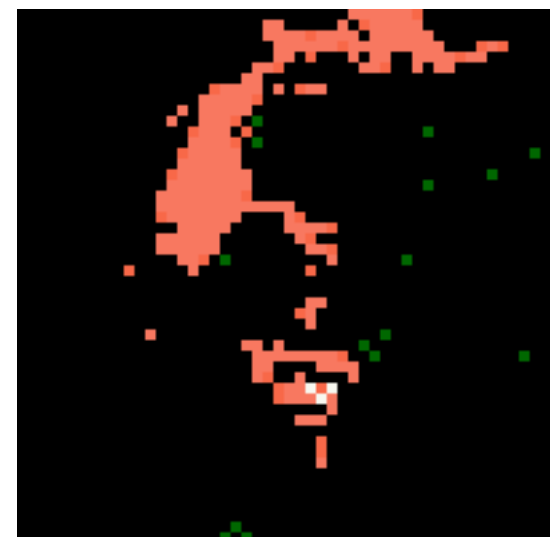
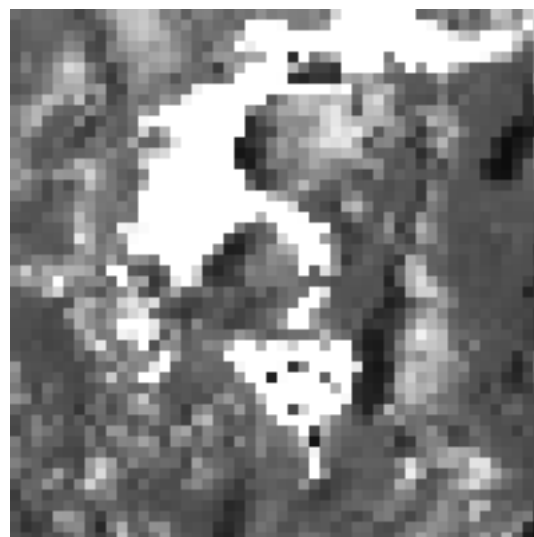
RADIANCE



REFLECTANCE

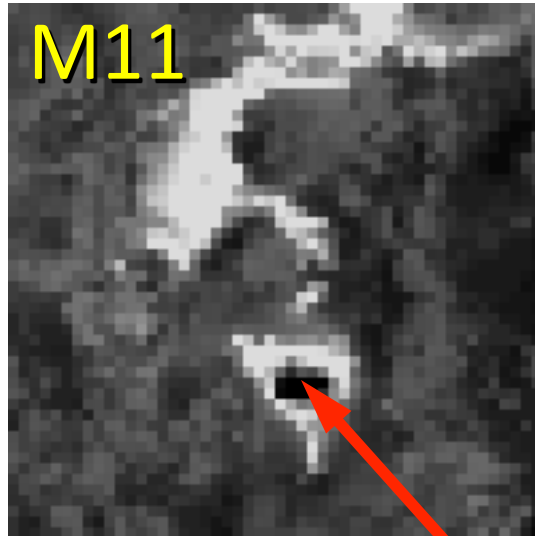


QF1



“Folded” radiance values with $QF1 = 0$

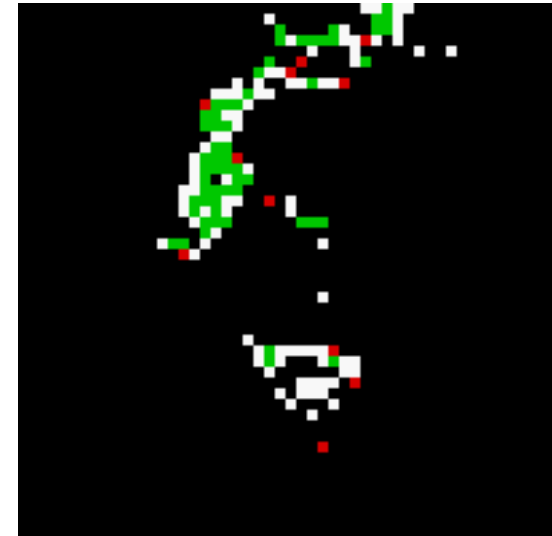
Sun glint example (2014070 16:45)



RADIANCE



REFLECTANCE



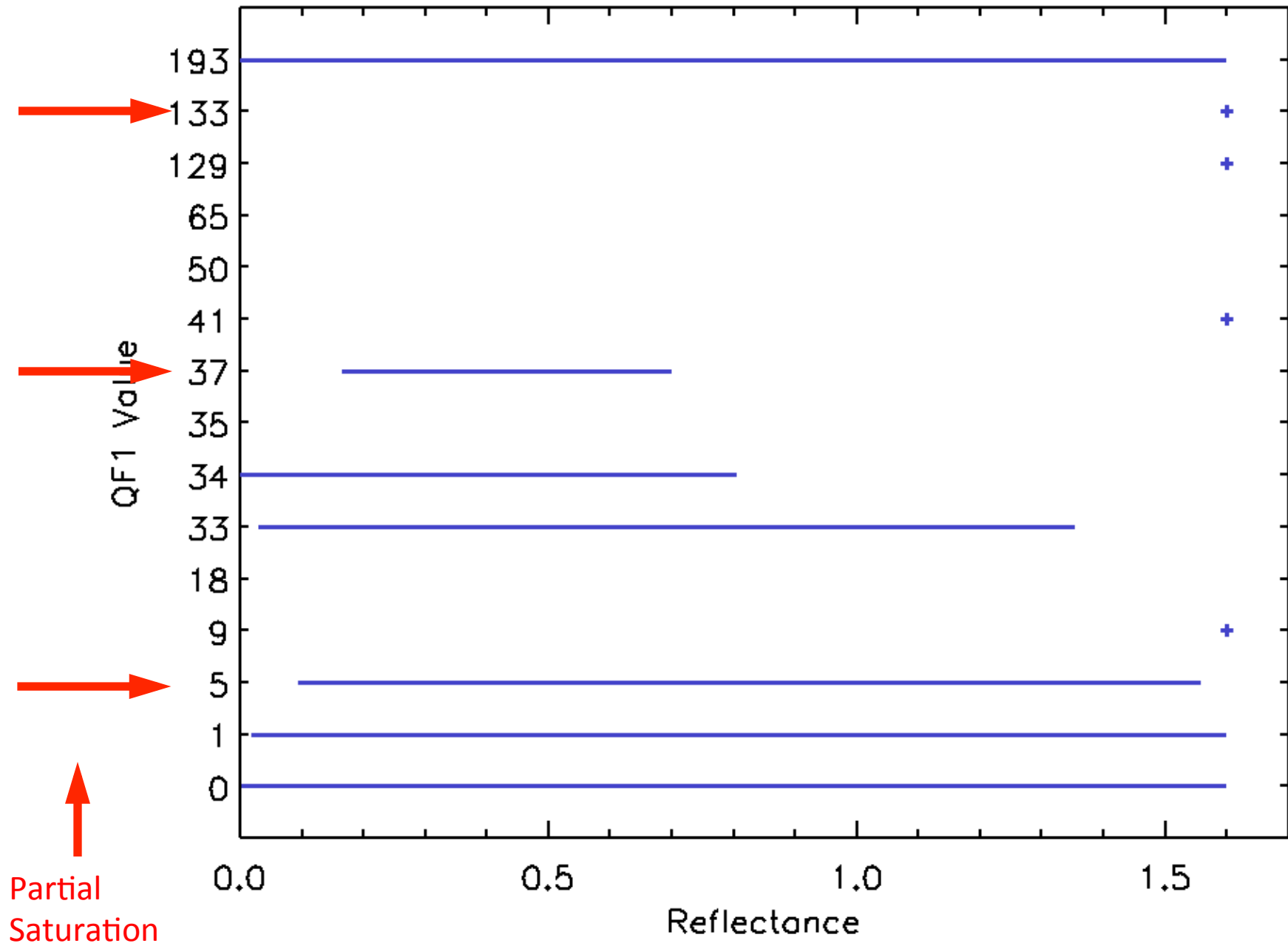
QF1

“Folded” radiance values with $QF1 = 0$

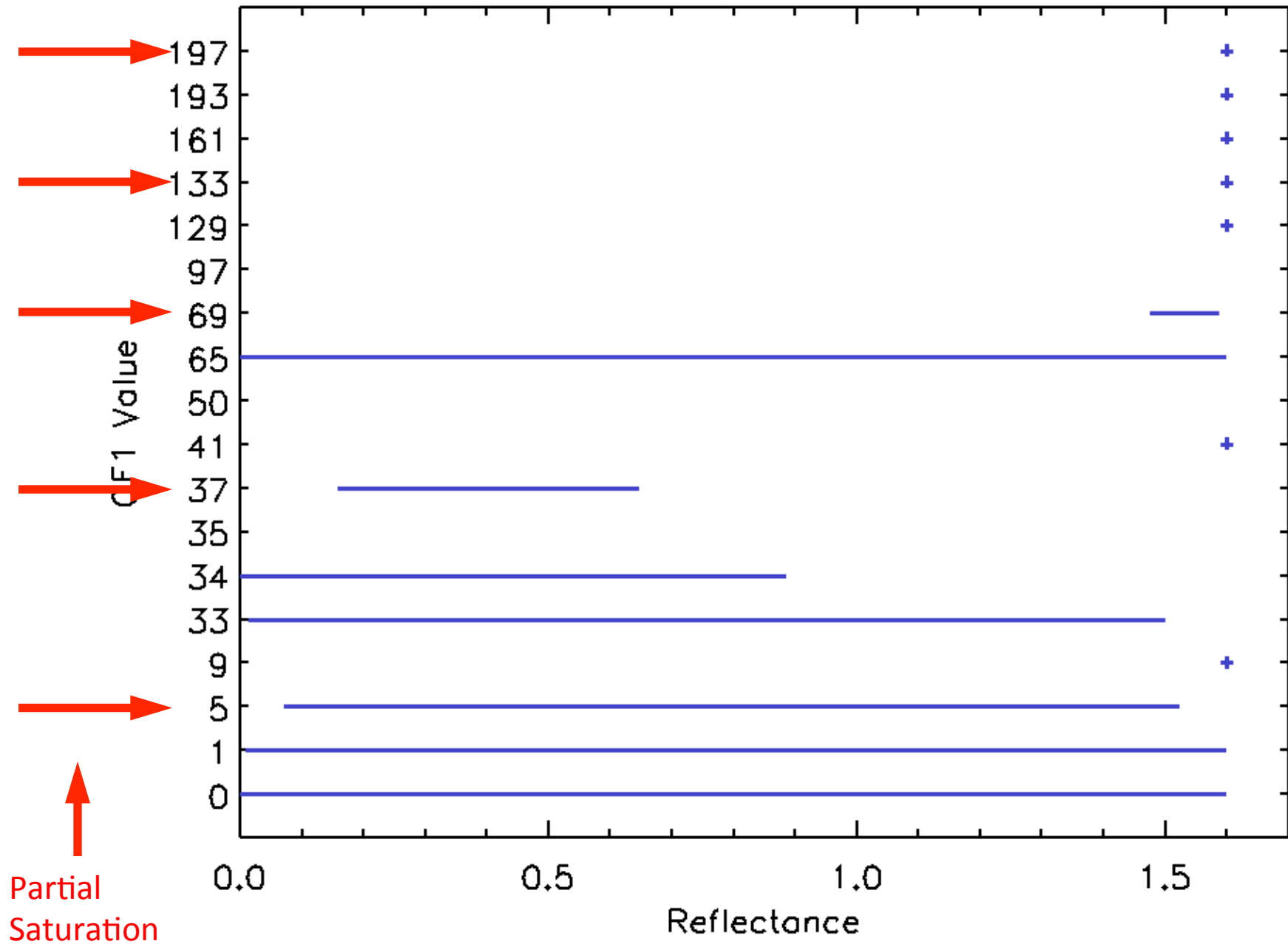
Generic VIIRS SDR Problems

- On-board aggregation bug
 - Affects all non-dual gain bands
 - No reliable method to detect corrupt radiance values arising as a result of this bug

M5 (dual gain)

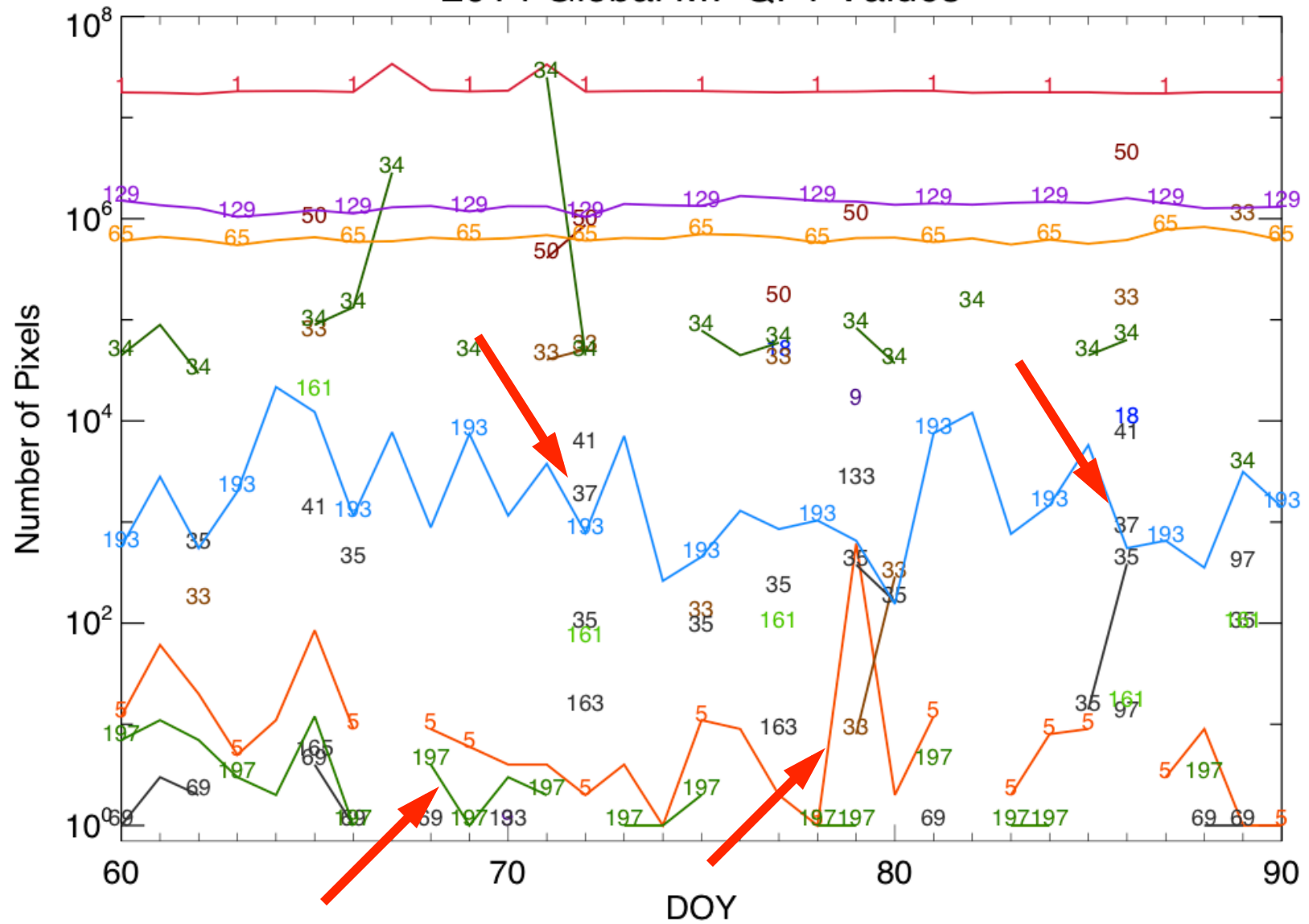


M7 (dual gain)

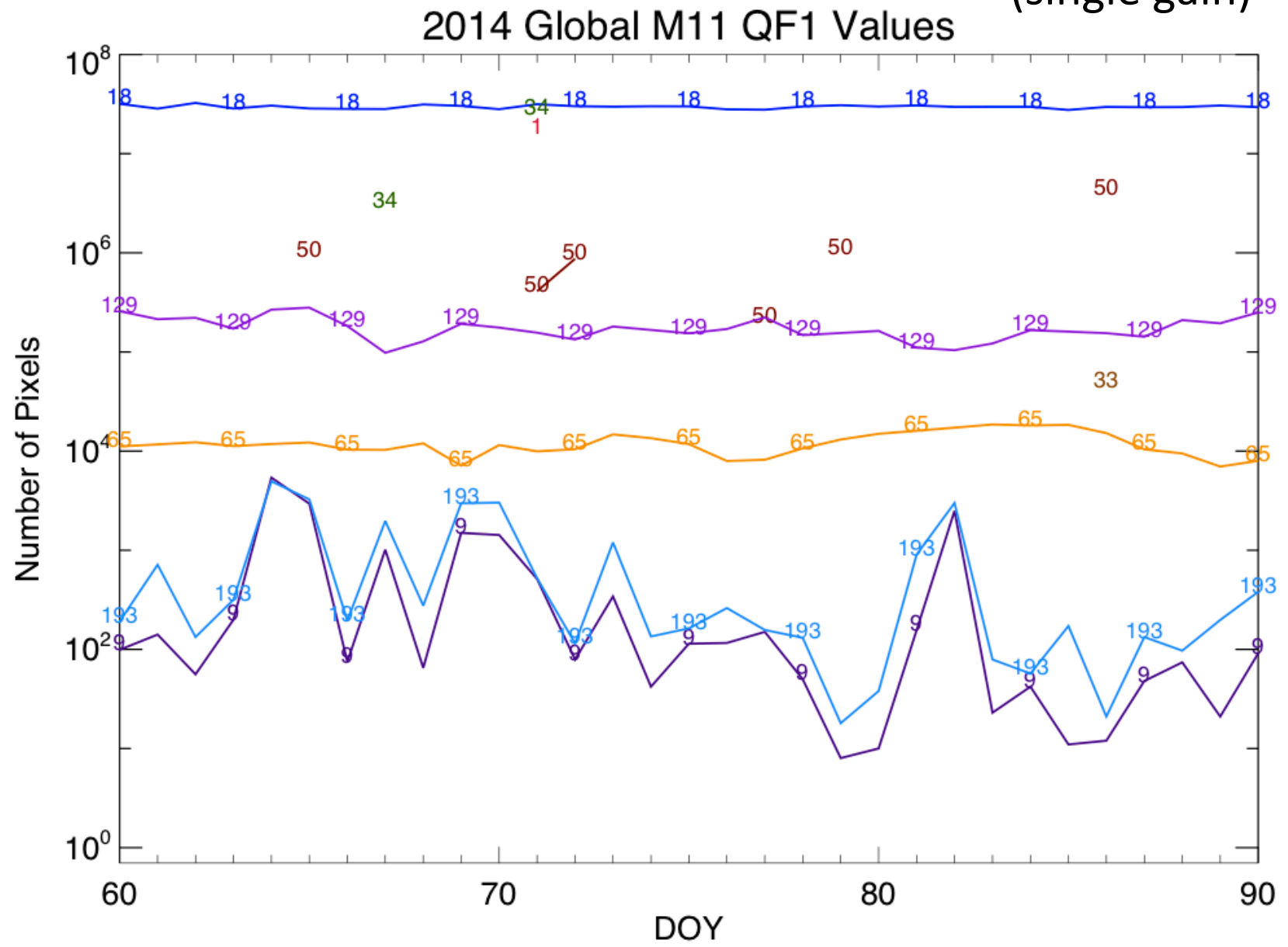


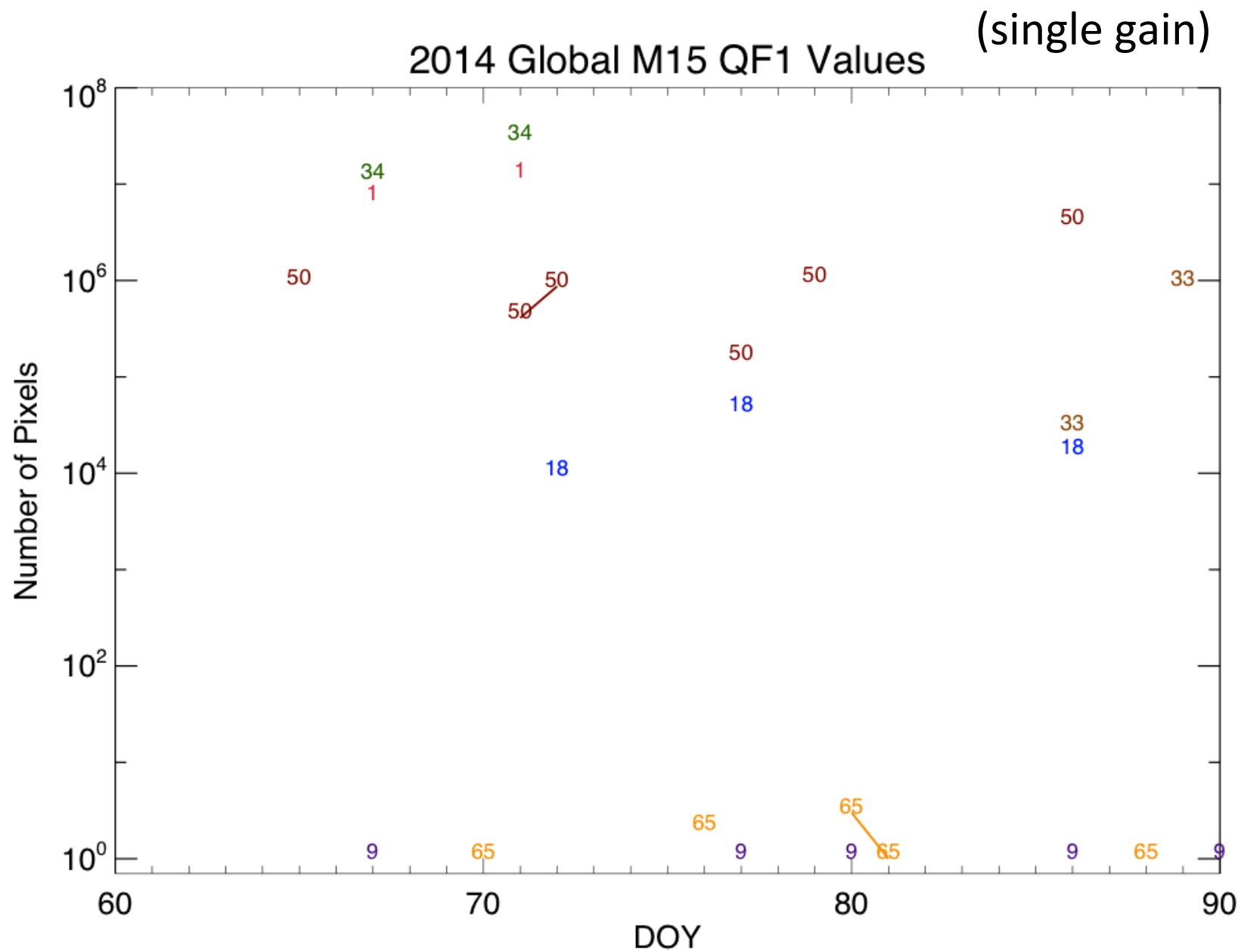
(dual gain)

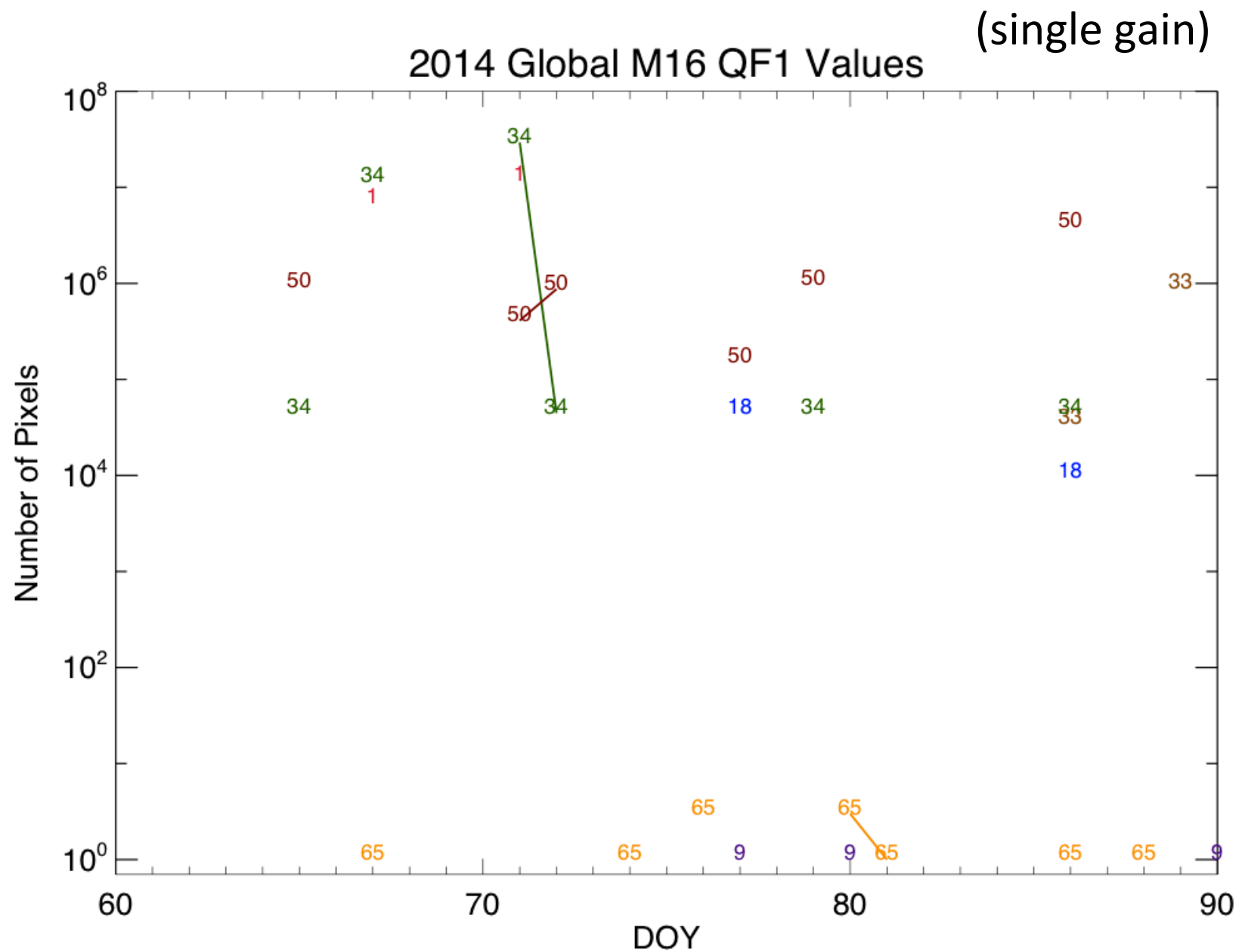
2014 Global M7 QF1 Values



(single gain)







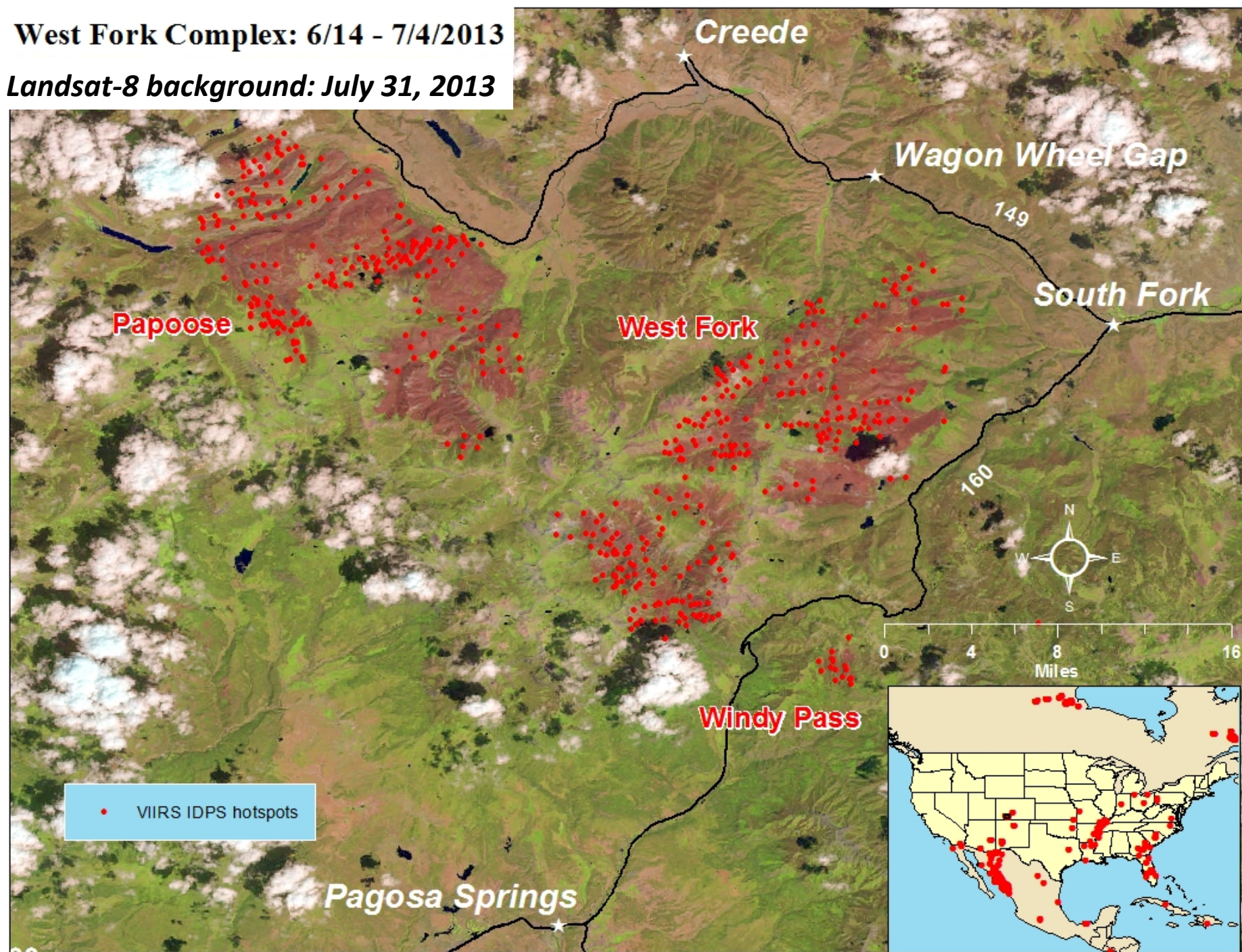
Generic VIIRS SDR Problems

- Disproportionally affect the VIIRS fire product
- Poorly documented outside of the JPSS program
 - In particular, details and dates

PRODUCT STATUS

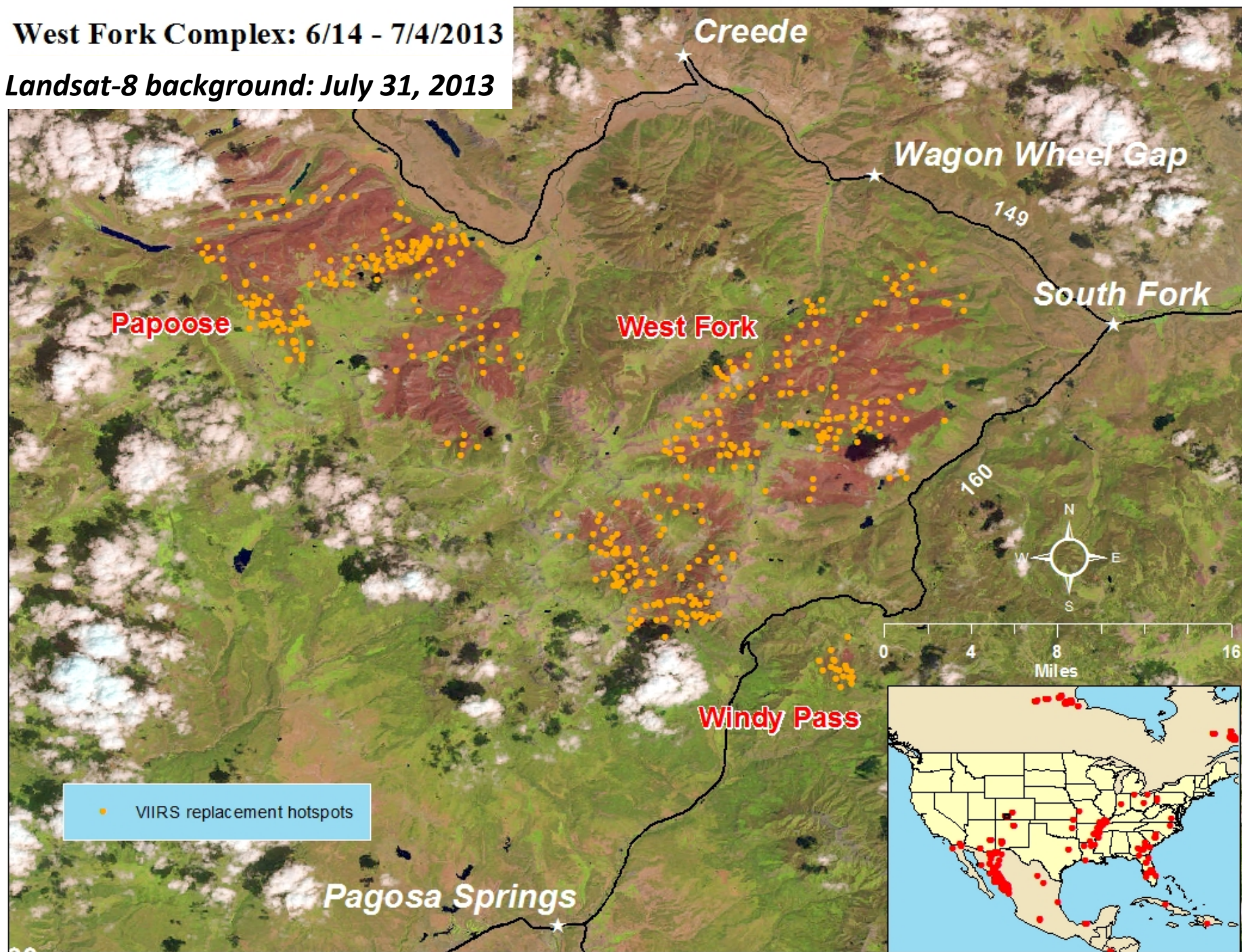
West Fork Complex: 6/14 - 7/4/2013

Landsat-8 background: July 31, 2013



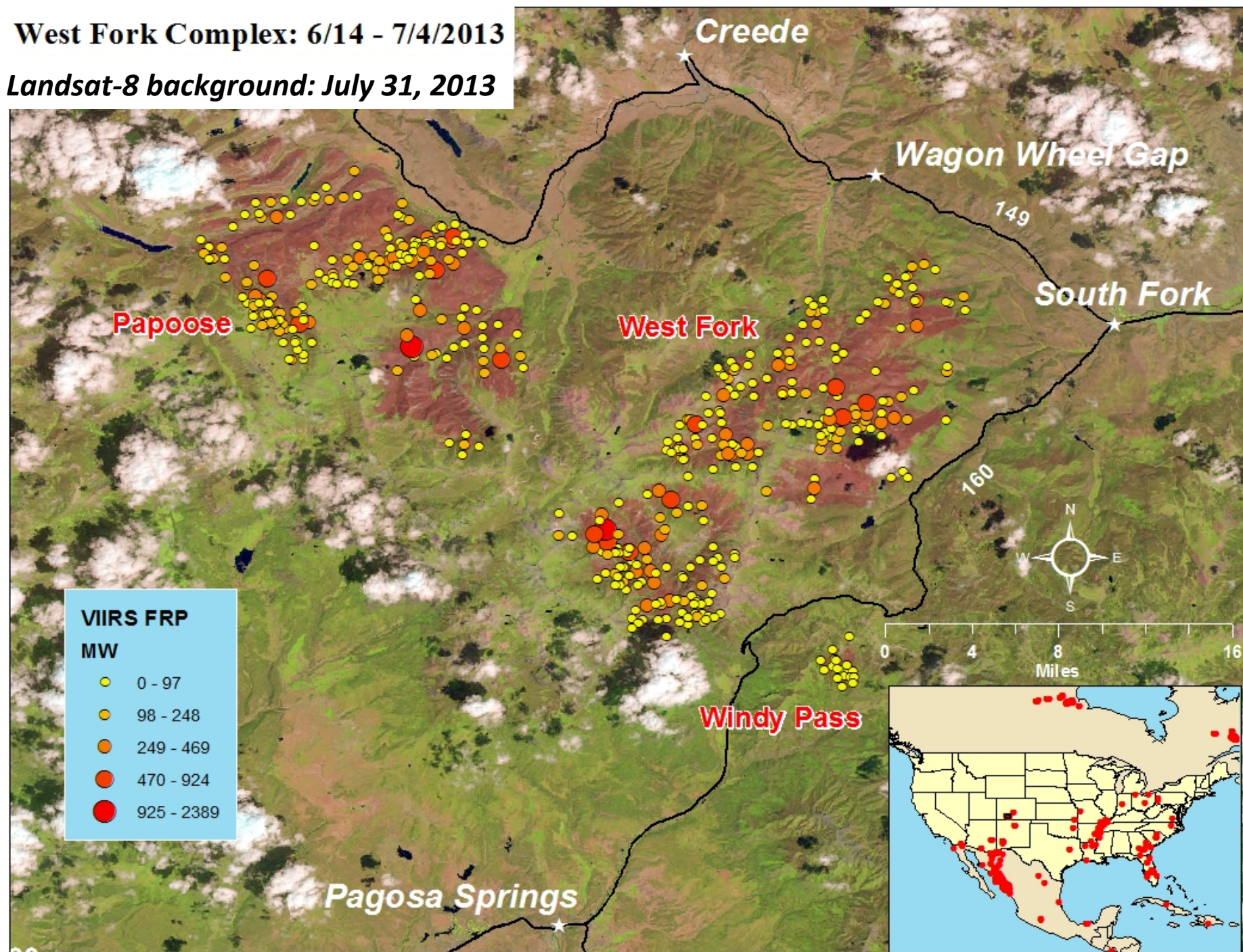
West Fork Complex: 6/14 - 7/4/2013

Landsat-8 background: July 31, 2013

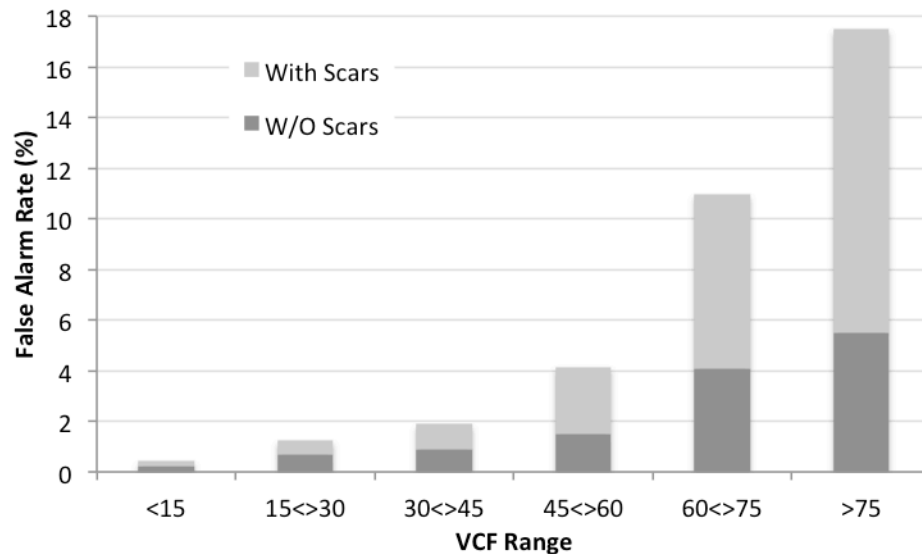


West Fork Complex: 6/14 - 7/4/2013

Landsat-8 background: July 31, 2013



VIIRS 750m Fire Algorithm Update/Refinement: Implementation of MODIS Collection 6 Equivalent

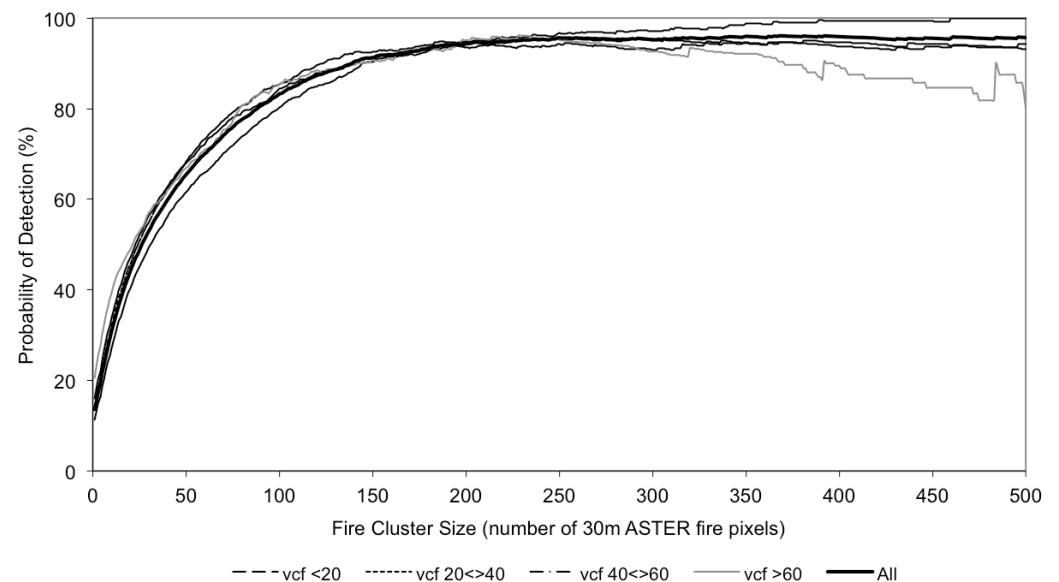


False alarm rates as a function of tree cover

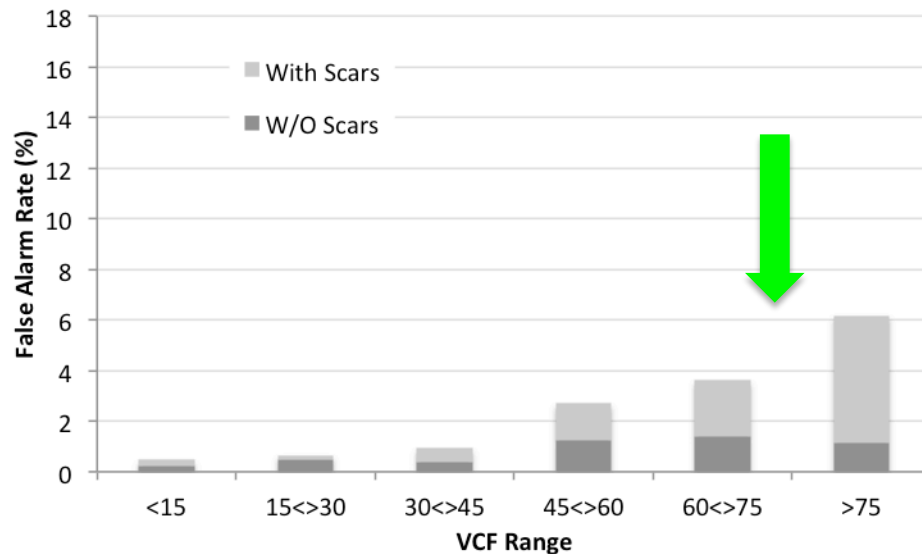
C5

MODIS results based on +2,300 reference ASTER scenes

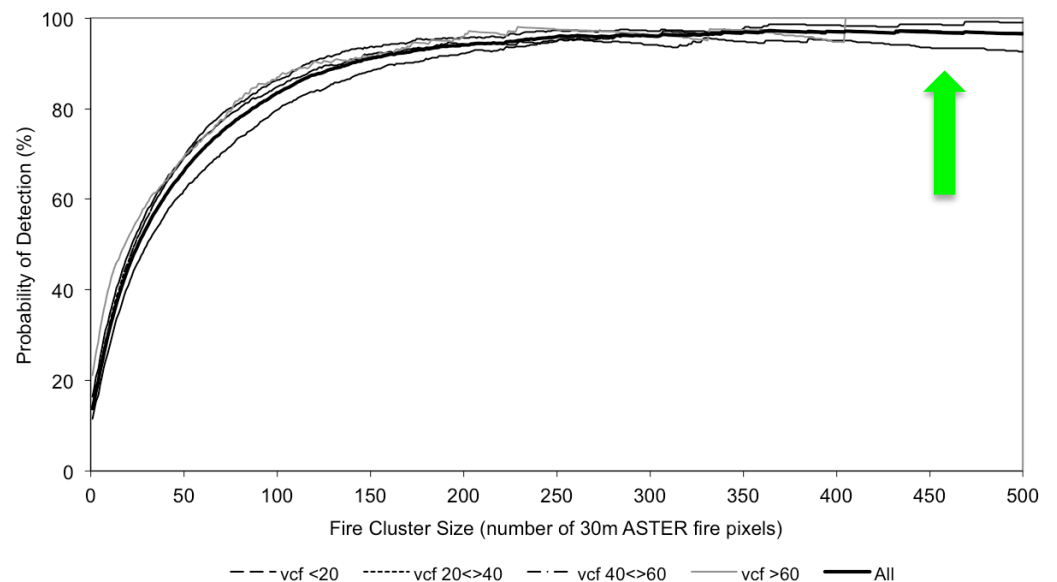
Probability of detection as a function of tree cover



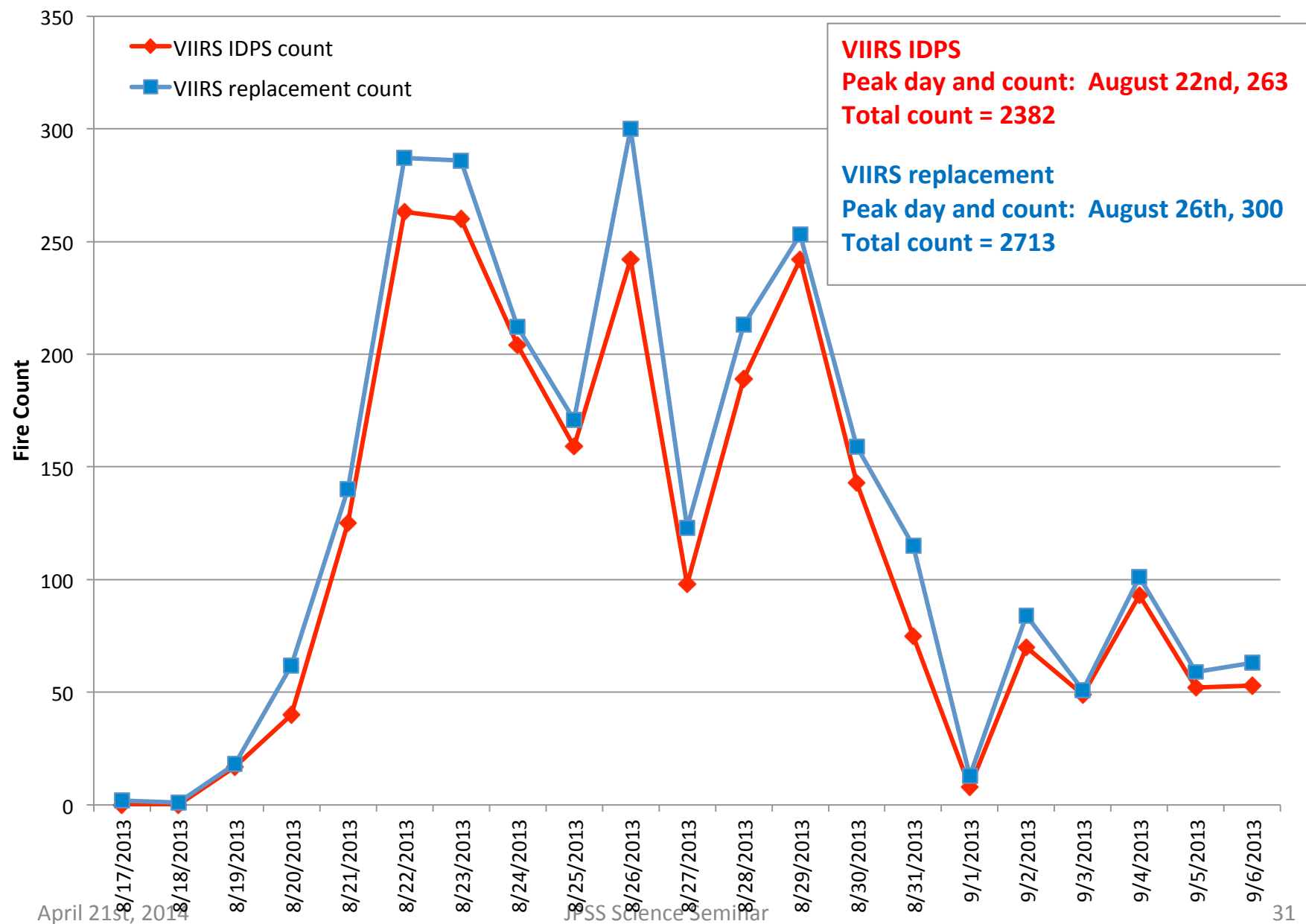
VIIRS 750m Fire Algorithm Update/Refinement: Implementation of MODIS Collection 6 Equivalent



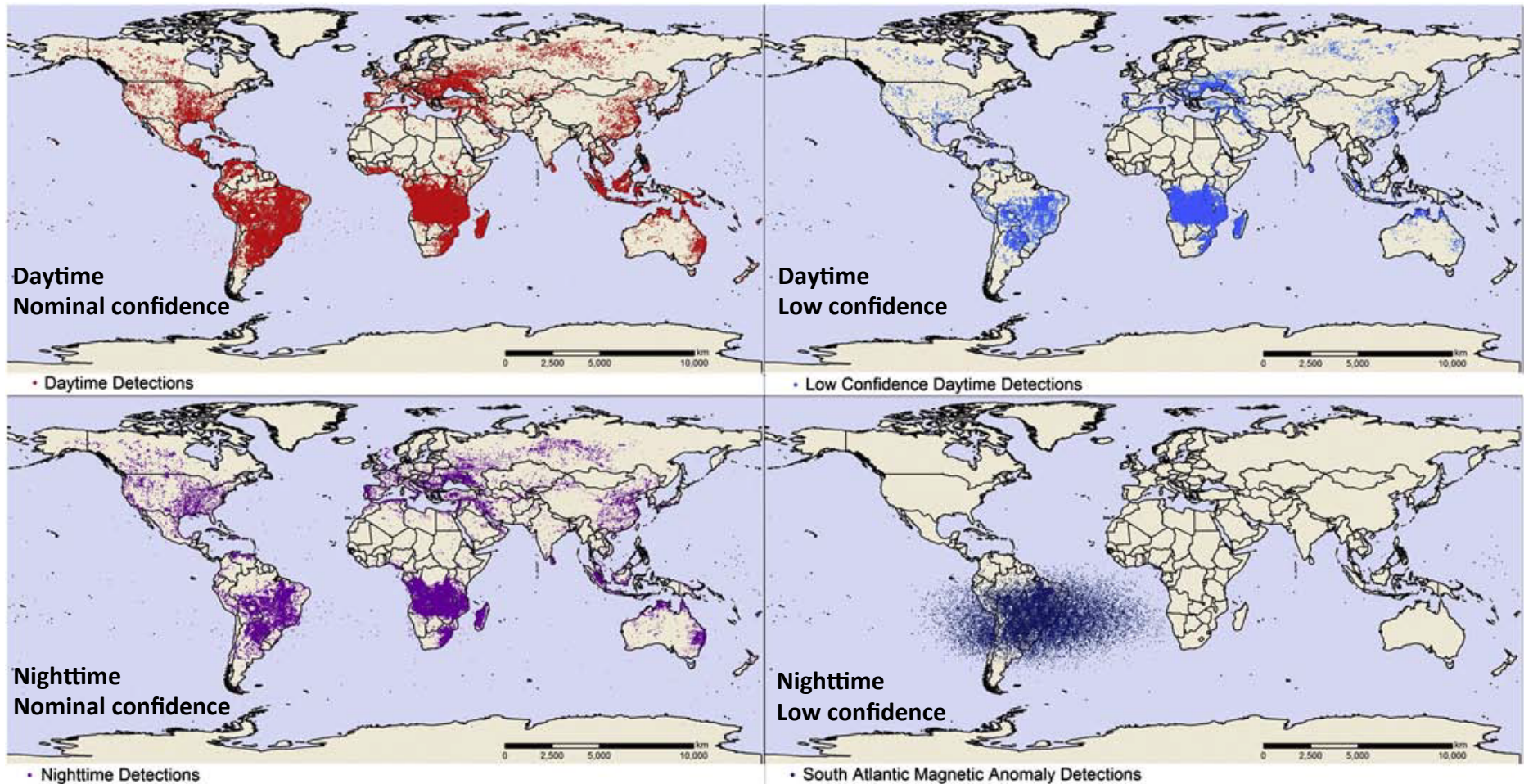
Probability of detection as a function of tree cover



Rim fire, CA: Aug. 17th - Sept. 6th



Global fires from I-band data



VIIRS 375 m fire algorithm output showing the accumulated daytime nominal confidence fire pixels (upper left), low confidence daytime pixels (upper right), nighttime fire pixels (purple; lower left), and SAMA-related low confidence nighttime pixels (dark blue; lower right) during 1–30 August 2013.

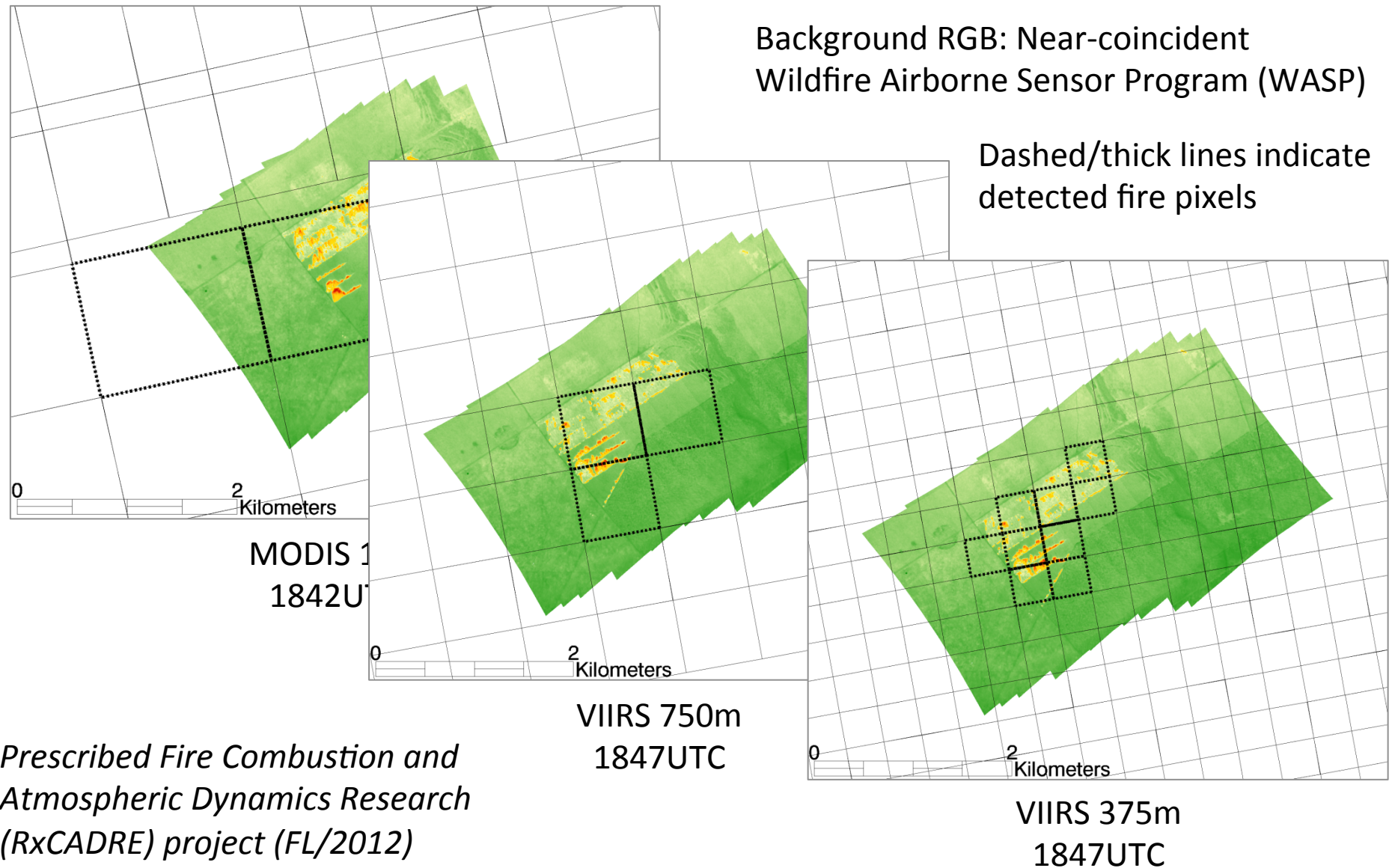
Wilfrid Schroeder, Patricia Oliva, Louis Giglio, Ivan A. Csiszar, The New VIIRS 375 m active fire detection data product: Algorithm description and initial assessment, Remote Sensing of Environment, Volume 143, 5 March 2014, Pages 85-96, ISSN 0034-4257, <http://dx.doi.org/10.1016/j.rse.2013.12.008>.

I-Band Active Fire Detection Algorithm Status

- Fire product being displayed online through proving ground website:
<http://viirsfire.geog.umd.edu/>
- Fire product being generated in pseudo-operational mode (NRT) by US Forest Service and South African partners with very positive results (<http://demo.afis.co.za/>)
- In house I-band algorithm re-processing to use NASA's LandPEATE archive 3110 data for consistent investigation of product performance since sensor activation
- Continue research of I-band SDR anomalies and quality flag idiosyncrasies impacting fire-affected and other unique pixel conditions (e.g.: saturation (complete/partial), radiance folding)
- Continue research exploring potential M and I band hybrid fire algorithm
- I-band science algorithm to be ported to IPOPP Direct Broadcast package (pending NASA funding)
- I-band fire product application development to continue in support of wildland fire diagnostics/forecasting (pending NASA funding)

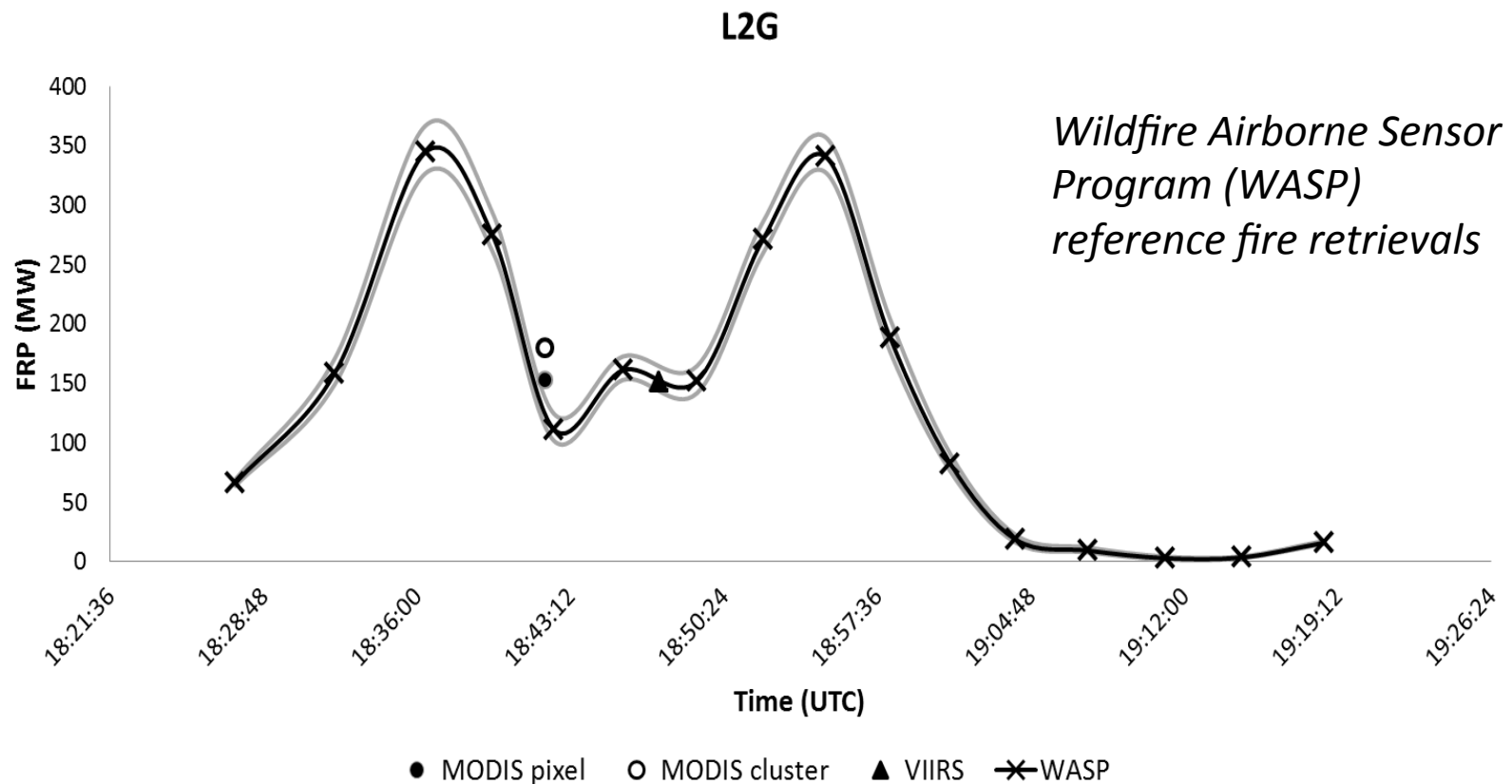
VALIDATION

VIIRS Active Fire Detection and Retrieval (FRP) Validation Using Multiple Near-Coincident Fine Resolution Reference Data Sets



VIIRS Active Fire Detection and Retrieval (FRP) Validation Using Multiple Near-Coincident Fine Resolution Reference Data Sets

Initial results over select sites indicate good overall agreement (<10%) among near-coincident surface-leaving fire retrievals acquired under clear sky conditions



Dickinson et al. [2014]