Suomi National Polar-orbiting Partnership

VIIRS Active Fire Product: Current Status and Developments

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**Presenting*

Outline

- Suomi NPP and VIIRS AF
- Early Cal-Val
- AF product goes Beta
- PGRR
- What's next

VIIRS review

- Launched last fall. Now sits 824 km above Earth's surface.
- Post launch checkout…some minor delays
  - Svalbard
  - Degradation visible and NIR (M7) radiances
- Thermal doors opened January 18th and first fire detection images produced the following day

VIIRS review

- VIIRS represents **continuity** with NASA EOS **MODIS**, NOAA **AVHRR,** and DMSP OLS missions (also international missions such as ATSR)

- AF product includes location (lat/lon) of fire pixels
  - The algorithm is a hybrid **thresholding and contextual** algorithm
  - Uses radiometric signals from 4m and 11m bands (M13 and M15, respectively).
  - Uses additional bands and a suite of tests for **internal cloud mask** and the rejection of **false alarms**.
  - Current IDPS product is based on the **MODIS Collection 4**
  - No spatially explicit fire/clear land/cloud/water mask

VIIRS Heritage: MODIS and AVHRR

VIIRS			MODIS Equivalent			AVHRR-3 Equivalent			OLS Equivalent		
Band	Range (um)	HSR (m)	Band	Range	HSR	Band	Range	HSR	Band	Range	HSR
DNB	0.500 - 0.900								HRD PMT	0.580 - 0.910 0.510 - 0.860	550 2700
M1	0.402 - 0.422	750	8	0.405 - 0.420	1000						
M2	0.436 - 0.454	750	9	0.438 - 0.448	1000						
M3	0.478 - 0.498	750	3 10	0.459 - 0.479 0.483 - 0.493	500 1000						
M4	0.545 - 0.565	750	4 12	0.545 - 0.565 0.546 - 0.556	500 1000						
I1	0.600 - 0.680	375	1	0.620 - 0.670	250	1	0.572 - 0.703	1100			
M5	0.662 - 0.682	750	13 14	0.662 - 0.672 0.673 - 0.683	1000 1000	1	0.572 - 0.703	1100			
M6	0.739 - 0.754	750	15	0.743 - 0.753	1000						
I2	0.846 - 0.885	375	2	0.841 - 0.876	250	2	0.720 - 1.000	1100			
M7	0.846 - 0.885	750	16	0.862 - 0.877	1000	2	0.720 - 1.000	1100			
M8	1.230 - 1.250	750	5	SAME	500						
M9	1.371 - 1.386	750	26	1.360 - 1.390	1000						
I3	1.580 - 1.640	375	6	1.628 - 1.652	500						
M10	1.580 - 1.640	750	6	1.628 - 1.652	500	3a	SAME	1100			
M11	2.225 - 2.275	750	7	2.105 - 2.155	500						
I4	3.550 - 3.930	375	20	3.660 - 3.840	1000	3b	SAME	1100			
M12	3.660 - 3.840	750	20	SAME	1000	3b	3.550 - 3.930	1100			
M13	3.973 - 4.128	750	21 22 23	3.929 - 3.989 3.929 - 3.989 4.020 - 4.080	1000 1000 1000						
M14	8.400 - 8.700	750	29	SAME	1000						
M15	10.263 - 11.263	750	31	10.780 - 11.280	1000	4	10.300 - 11.300	1100			
I5	10.500 - 12.400	375	31 32	10.780 - 11.280 11.770 - 12.270	1000 1000	4 5	10.300 - 11.300 11.500 - 12.500	1100 1100	HRD	10.300 - 12.900	550
M16	11.538 - 12.488	750	32	11.770 - 12.270	1000	5	11.500 - 12.500	1100			

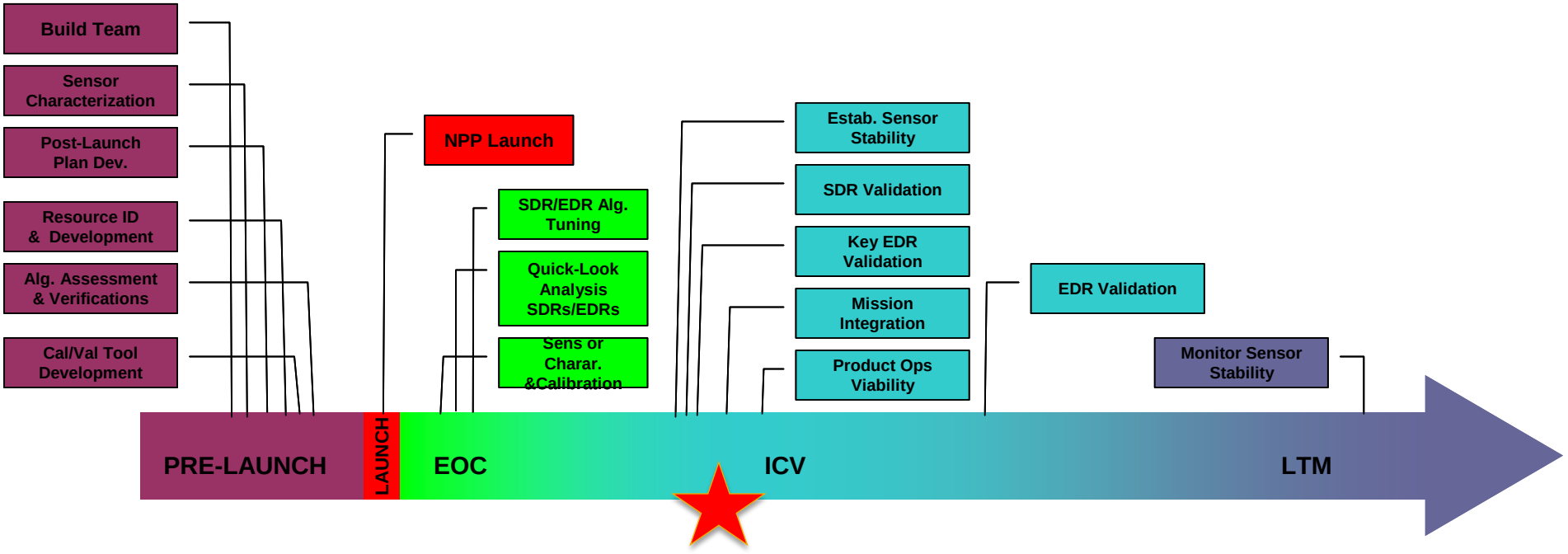
I. Csiszar (NOAA), W. Schroeder, L. Giglio, E. Ellicott and C. Justice (UMD)

Cal/Val

Four Phases of Cal/Val:

1. Pre-Launch; all time prior to launch – Algorithm verification, sensor testing, and validation preparation
2. Early Orbit Check-out (first 30-90 days) – System Calibration & Characterization
3. Intensive Cal/Val (ICV); extending to approximately 24 months post-launch – xDR Validation
4. Long-Term Monitoring (LTM); through life of sensors

Cal/Val



We Are Here

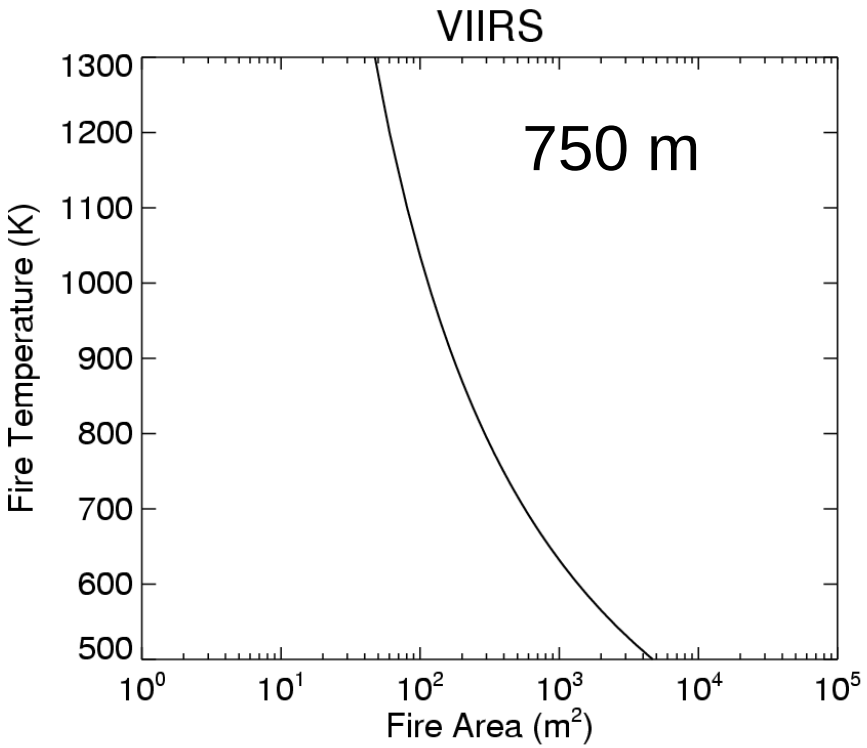
AF Evaluation

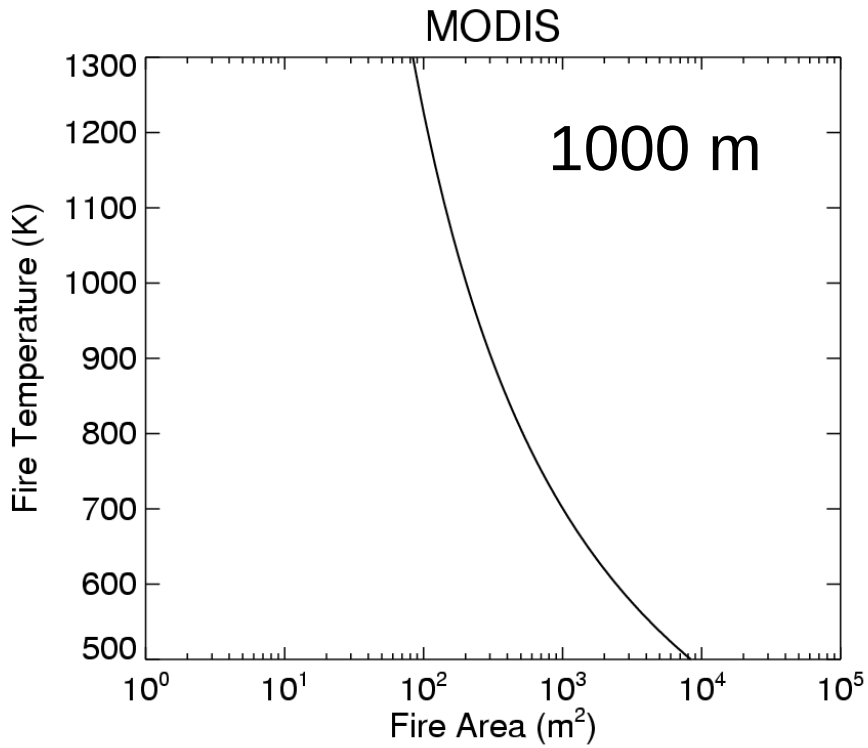
- **No sufficient reference data are available** to determine commission and omission errors
- Current quantitative evaluation is based on **correlative analysis with Aqua MODIS**
- **MODIS performance is well characterized** using moderate resolution (Landsat-class) reference data

VIIRS vs. MODIS

- Aqua and NPP have **similar overpass times (1:30pm)**
  - Sampling of the diurnal fire cycle is similar
- Saturation levels of the primary bands allow **unsaturated radiance measurements** for most fires
  - Bands 21/22 for MODIS and M13 for VIIRS
- Processing **algorithms are compatible**
  - Current VIIRS algorithm is based on MODIS (C4)
  - Differences can be resolved and the impact can be minimized
- Primary driver of differences is **spatial sampling**
  - Pixel size
  - Variations along scanline (aggregation schemes)
  - Variations within pixels (line-spread function, aggregation)
  - Differences in swath width (VIIRS has no gaps at low latitudes)

VIIRS vs. MODIS

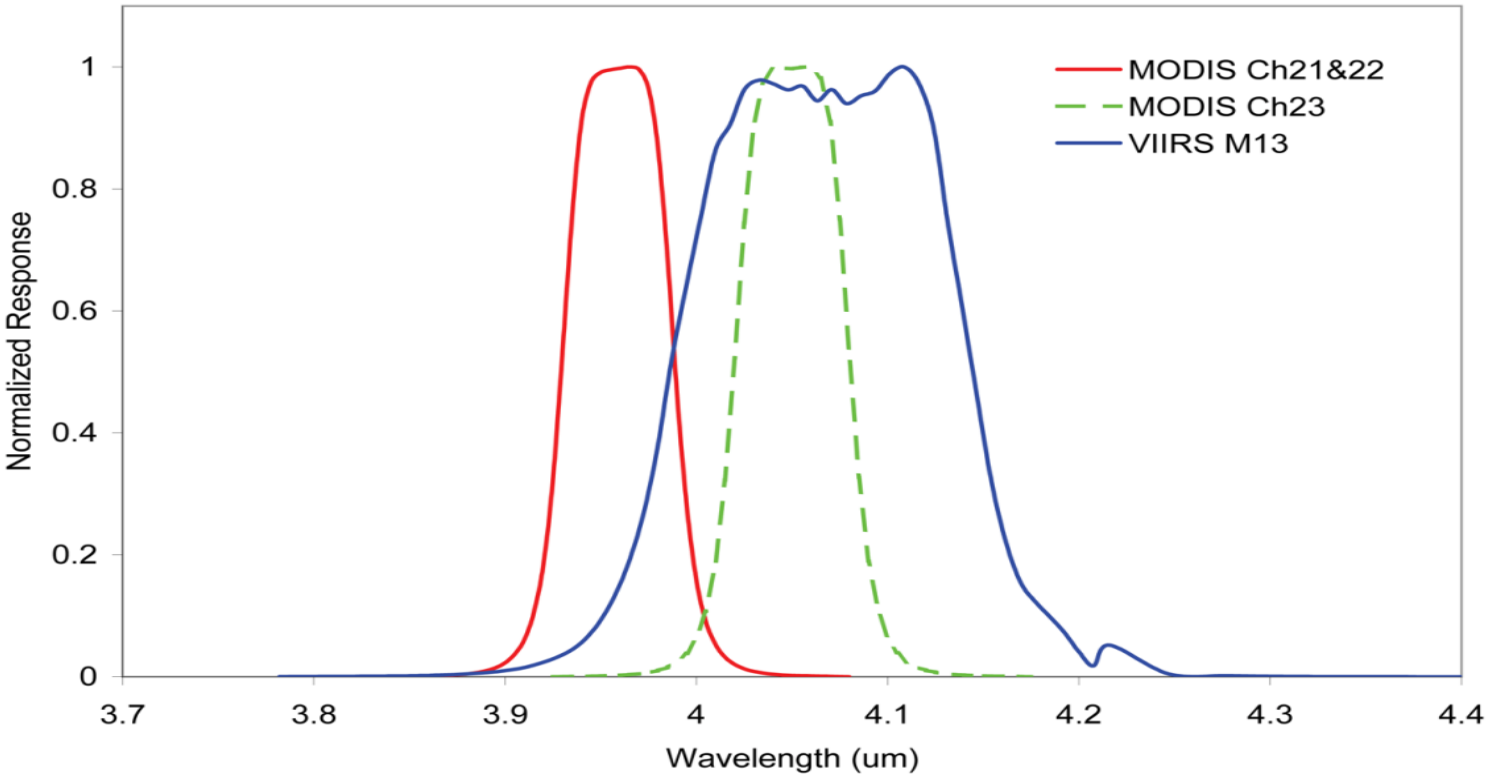




90% probability of detection; boreal forest; nadir view

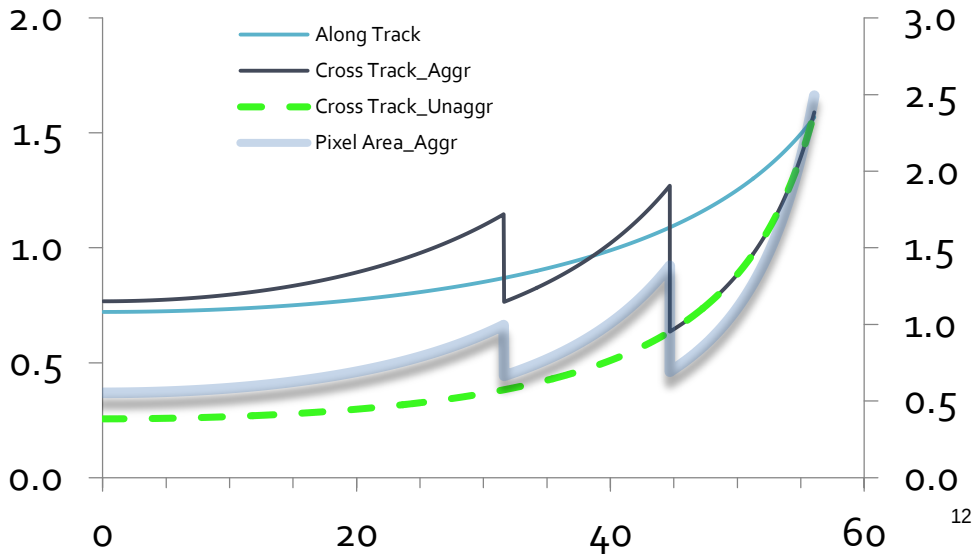
VIIRS vs. MODIS

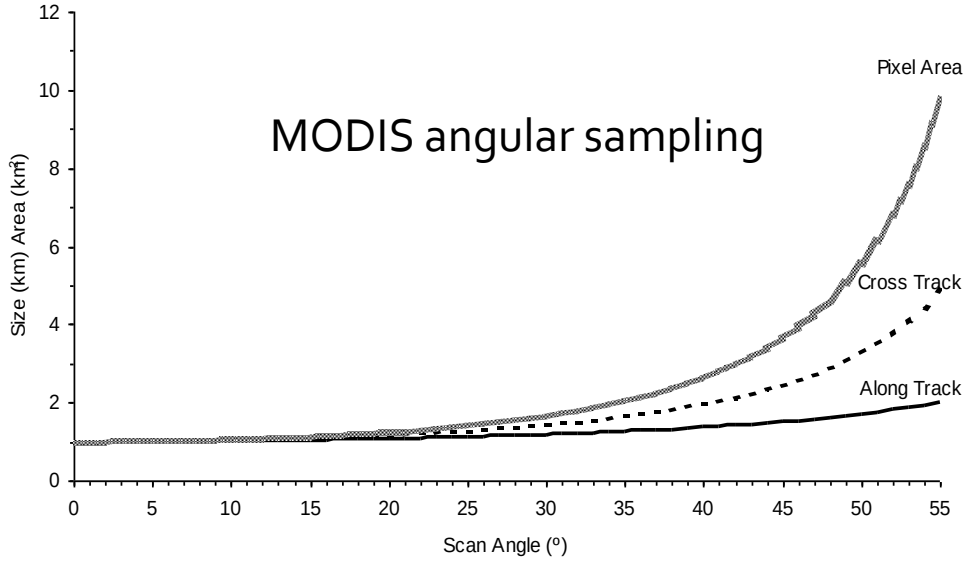
Some differences in **spectral placement**



Spectral response curves for MODIS channels 21-23, and VIIRS chanel M13

VIIRS vs. MODIS





AF Evaluation

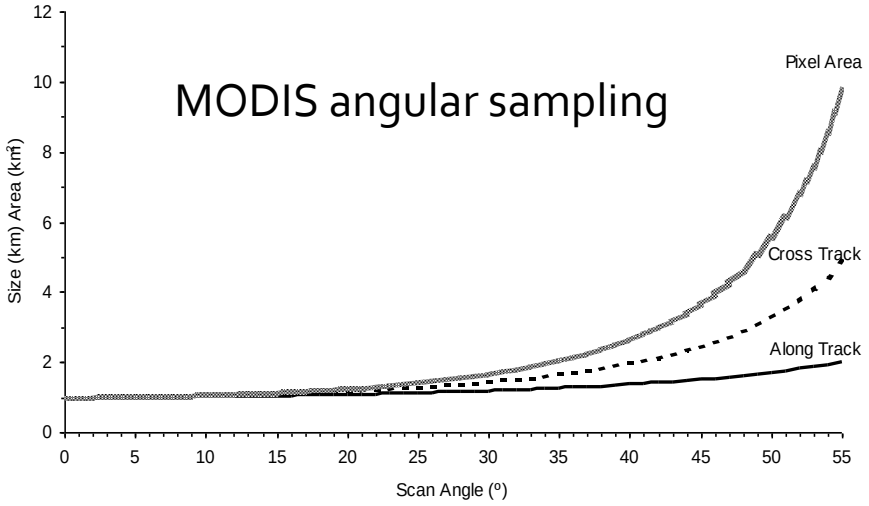
- **24/7 script for data visualization**
  - Designed for qualitative assessment of fire data
  - Used to identify major anomalies in data
- **VIIRS x Aqua/MODIS intercomparison**
  - Qualitative assessment of VIIRS using near-coincident Aqua/MODIS data
  - Verify active fire product consistency on a per-pixel and/or grid basis
- **Detailed data inspection tool**
  - Used to assess quality of individual bands and the corresponding QA flags
- **Collection and analysis of in-situ and airborne data**
  - Explicit validation
- **M13 SDR feedback**
  - Aggregation, low/high gain

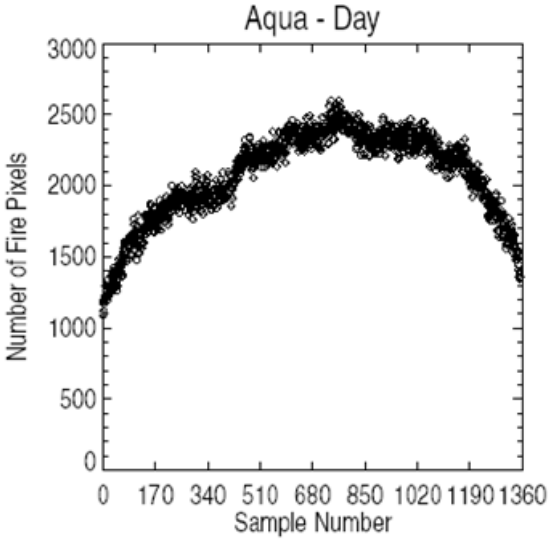
Product Anomalies (DRs)

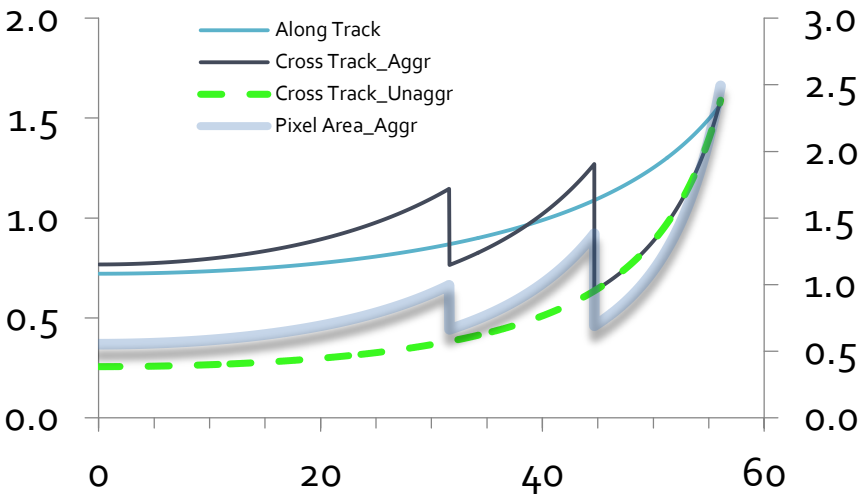
Anomalies identified include:

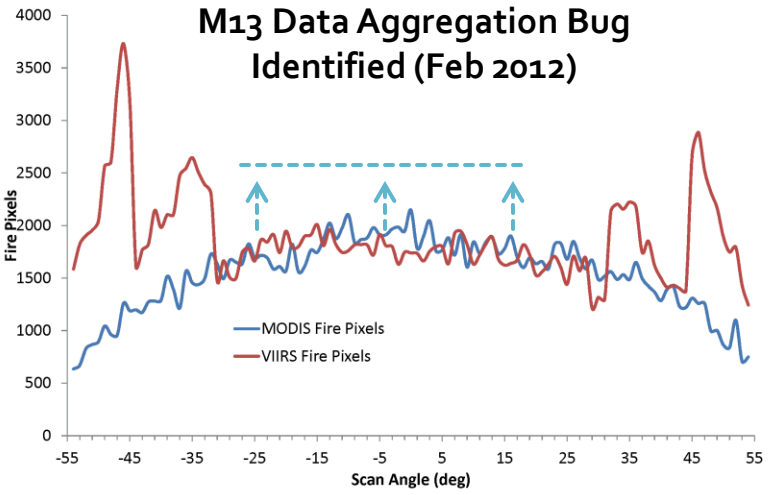
- M13 aggregation
- Spurious fire pixels coinciding with the terminator.
- Corrupted M13 BT values (>450K) and corresponding spurious fire detections along single scans.
- Alternating omission of fire pixels between successive scans.

M13 aggregation anomaly

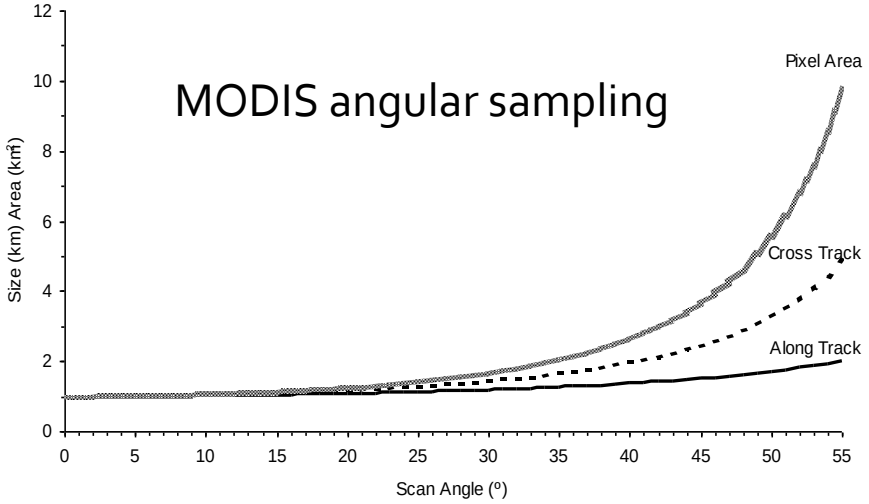


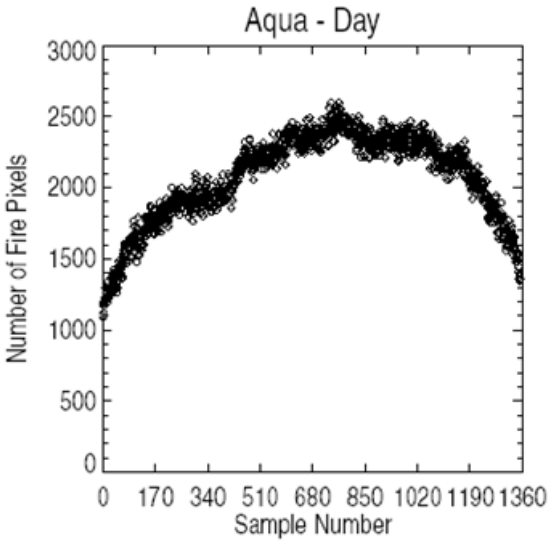


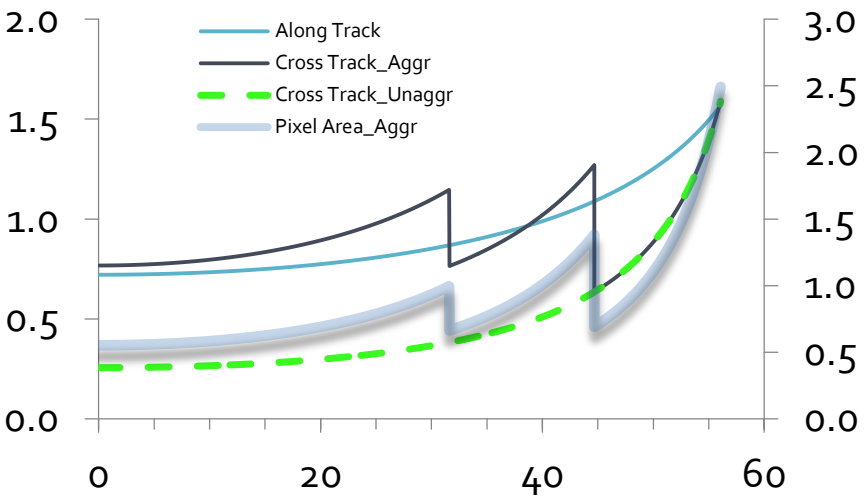


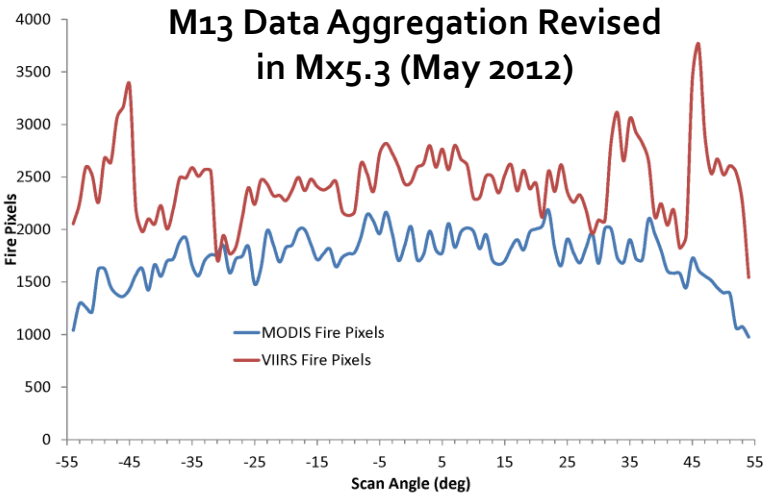


VIIRSxMYD14 Fire Detection Frequency (**19 Jan <> 13 Feb**)





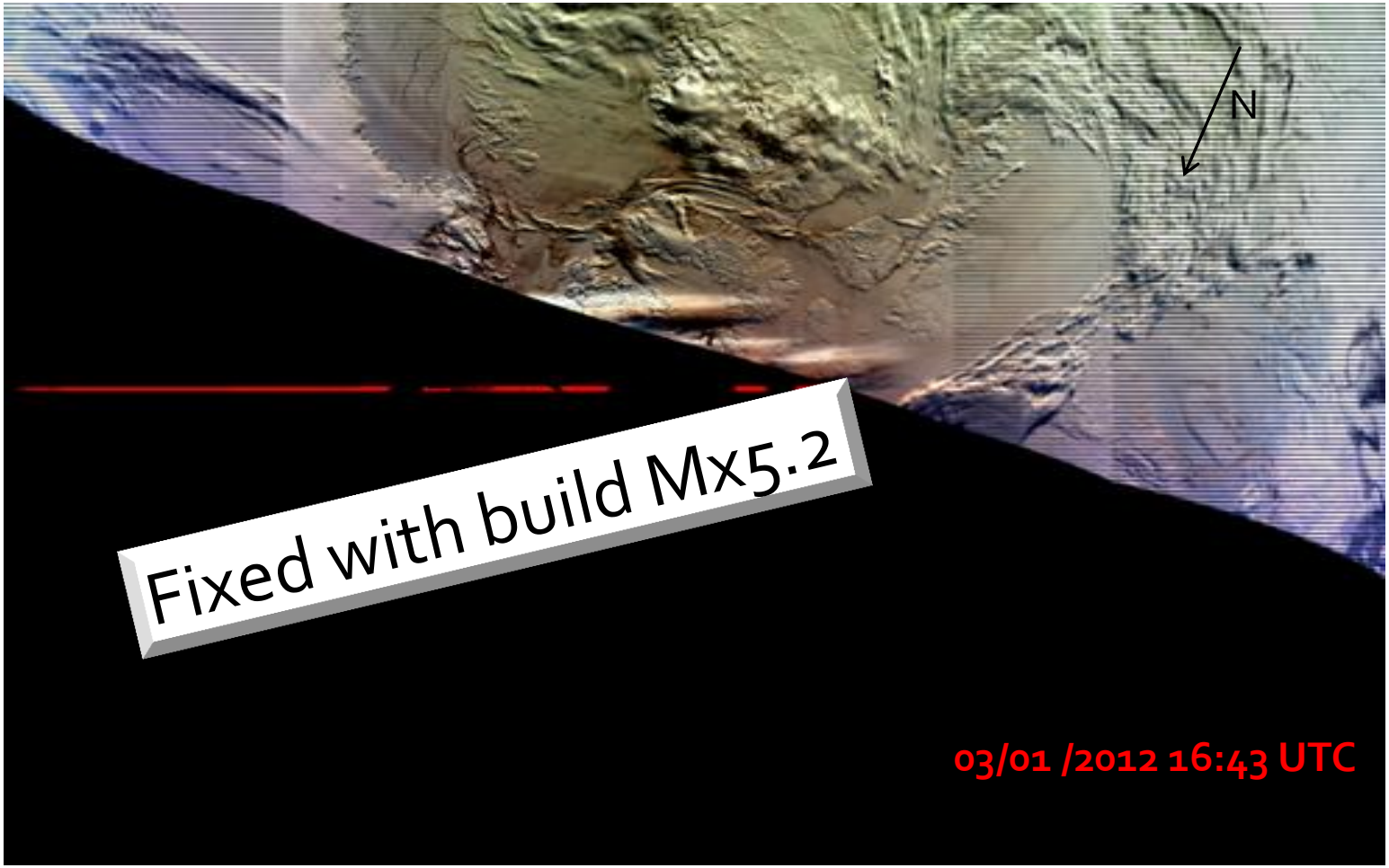




VIIRSxMYD14 Fire Detection Frequency (**11 May <> 10 Jun**)

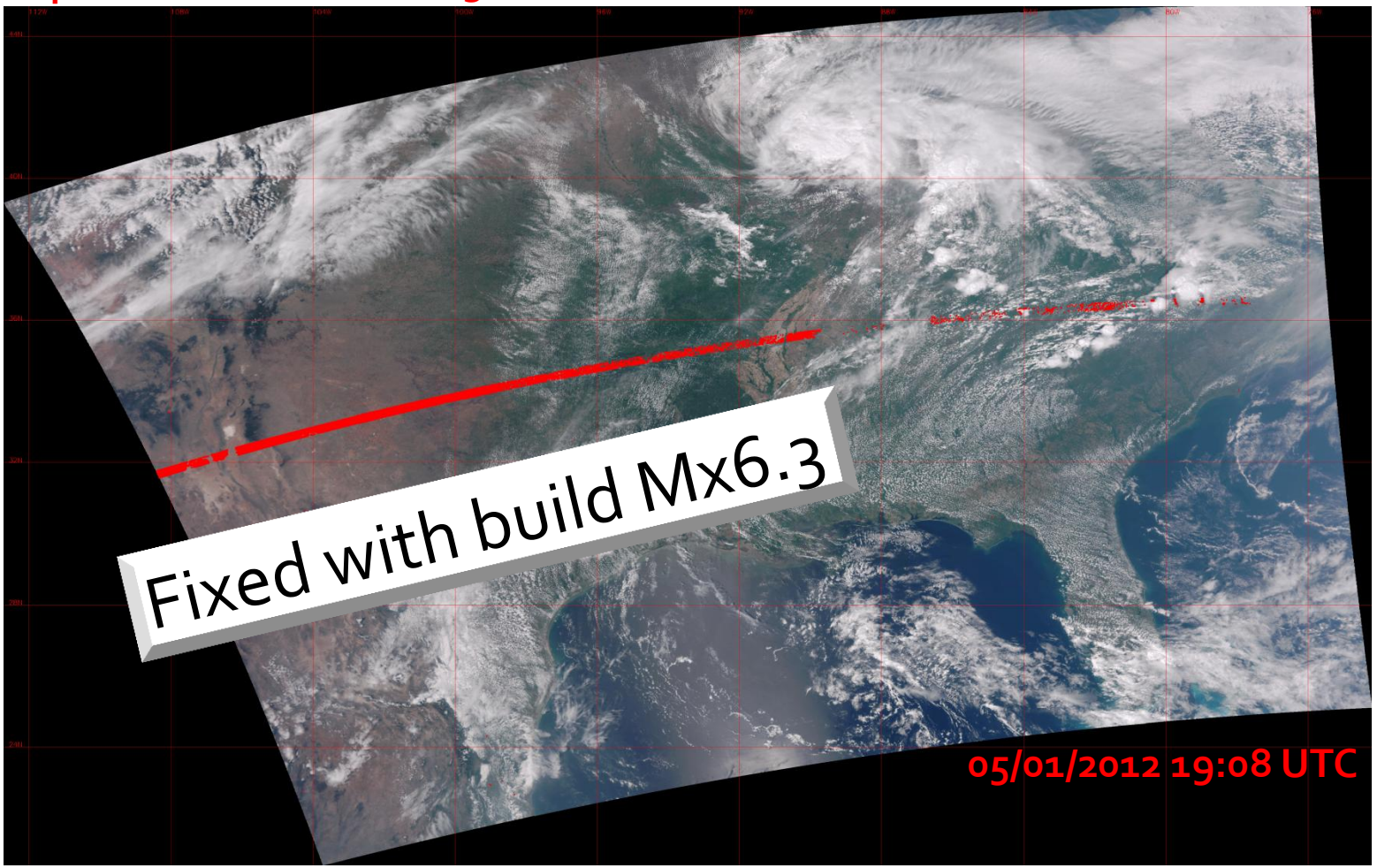
Spurious detections

Spurious fires along the terminator

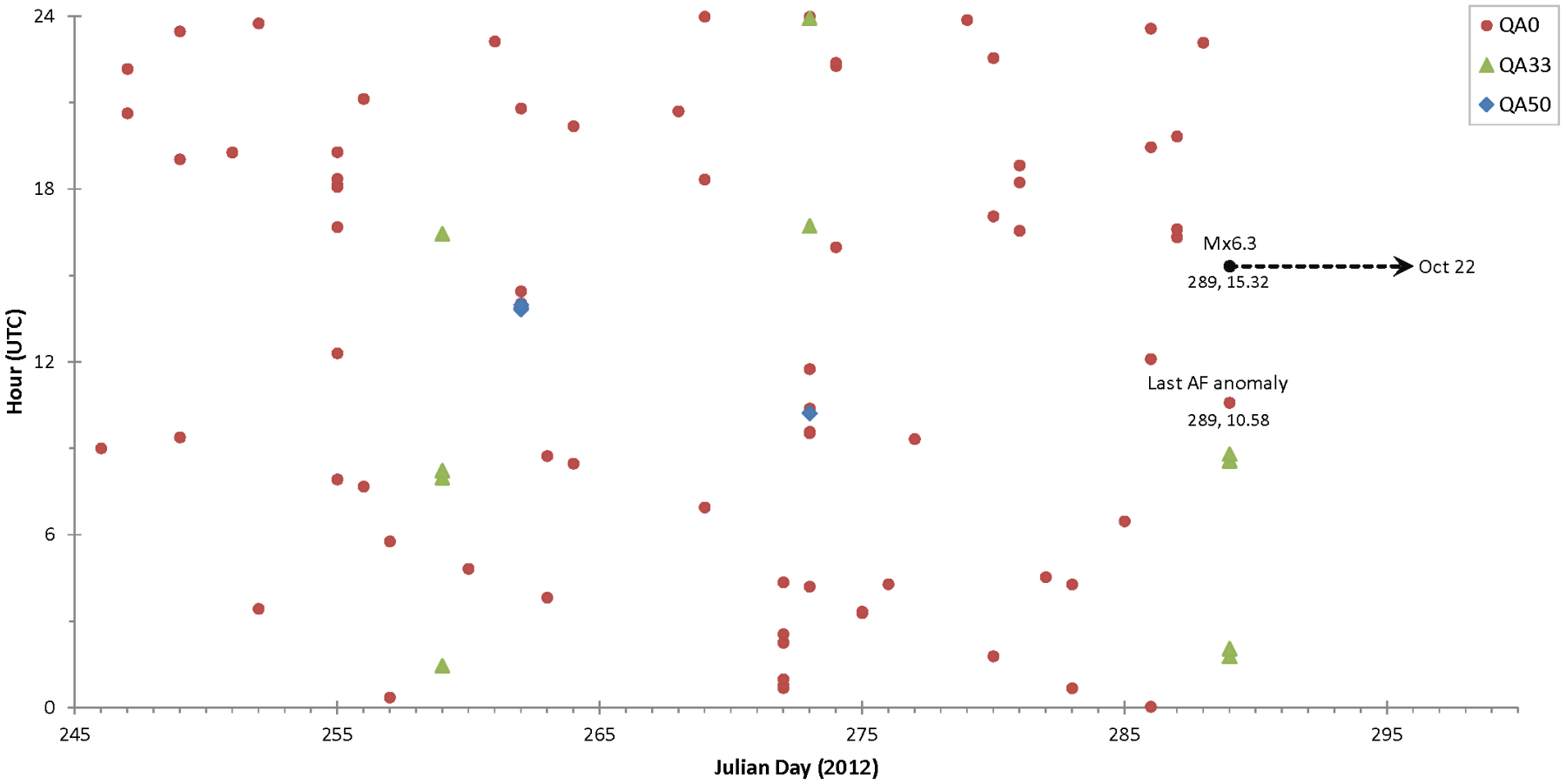


Spurious detections

Spurious fires due to M13 data anomalies



Spurious detections



AF product goes Beta

NOAA HOME WEATHER OCEANS FISHERIES CHARTING SATELLITES CLIMATE RESEARCH COASTS CAREERS NOAA

VIIRS ARP Release, Beta Data Quality
Last Updated: 10/22/2012
Read-me for Data Users

ETADATA
»GO

The Joint Polar Satellite System (JPSS) Algorithm Engineering Review Board approved the release of the Visible Infrared Imager Radiometer Suite (VIIRS) Active Fires Application Related Product (ARP) to the **public with a Beta level quality as of 03 May 2012**. Beta quality is defined as:

- Early release product
- Initial calibration applied
- Minimally validated and may still contain significant errors (additional changes are expected)
- Available to allow users to gain familiarity with data formats and parameters
- Product is not appropriate as the basis for quantitative scientific publications, studies and applications

Tutorial for ordering Suomi NPP data in CLASS:
A tutorial for ordering data through CLASS can be found at Data Access. The tutorial references Suomi NPP data but is applicable to all data types. If you have any questions please email CLASS Help Desk.

Proving Ground & Risk Reduction

- **Significance: The VIIRS Active Fire product is critical for disaster and resource management.**

- Product is expected to be used by **real-time resource and disaster management; air quality monitoring; ecosystem monitoring; climate studies** etc.

- The **JPSS PGRR program's primary objective** is to maximize the benefits and performance of SNPP data, algorithms, and products for downstream operational and research users (gateways to the public)

Proving Ground & Risk Reduction

- The goals of VIIRS AF data proving ground project is the development of a near-real-time enhanced VIIRS AF product delivery system to NOAA end users.

- To be demonstrated –
- **VIIRS active fire algorithm improvement and evaluation**
- **Near real-time data visualization and evaluation**

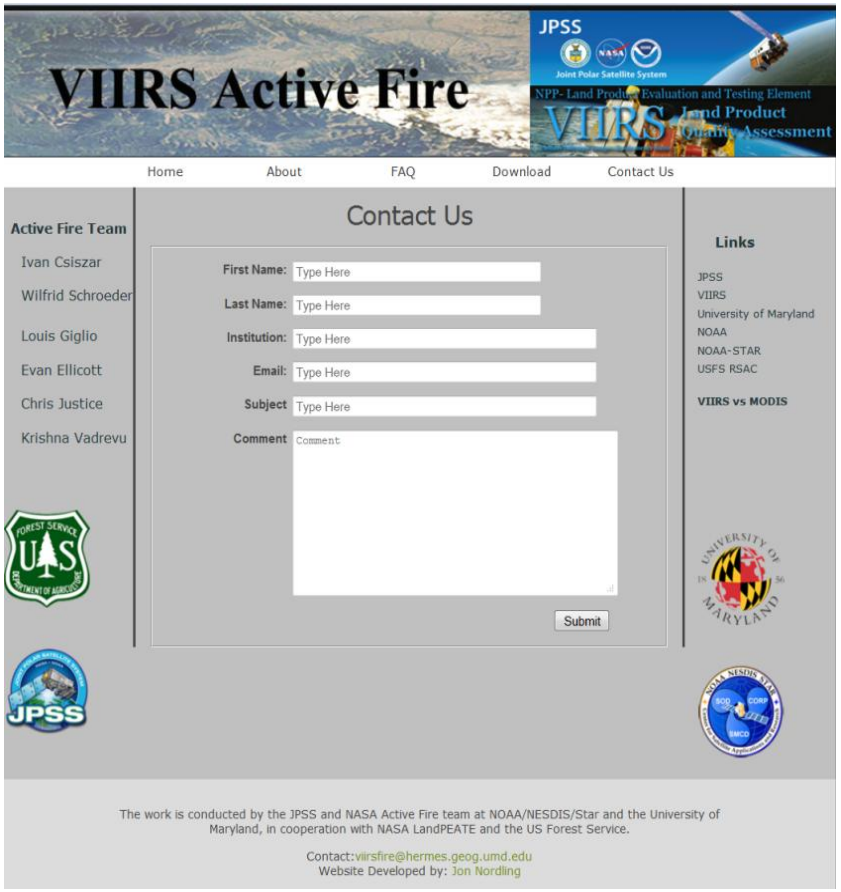
- Ivan Csiszar – *NOAA/NESDIS/STAR*
- Evan Ellicott, Louis Giglio, Krishna Vadrevu, Christopher O. Justice – *Geographical Sciences, UMD*
- Wilfrid Schroeder – *CICS, UMD*
- Brad Quayle – *RSAC*
- Peter Roohr – *NOAA NWS Office of Science and Technology*

Proving Ground & Risk Reduction

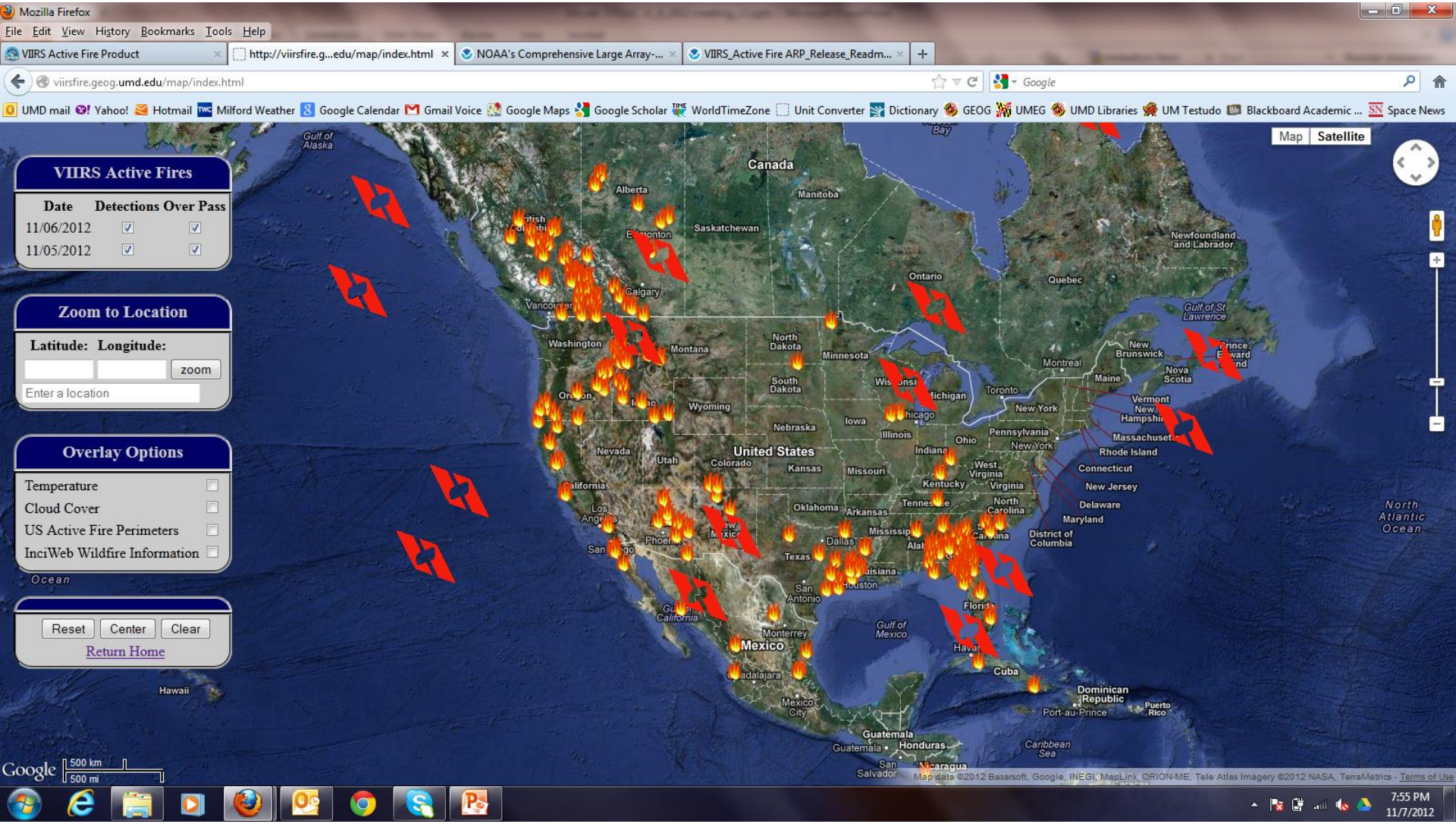
- The system is also a testbed for evaluating enhanced and experimental algorithms
- Background information and VIIRS-MODIS comparisons are also included to help product evaluation

http://viirsfire.geog.umd.edu

Proving Ground & Risk Reduction



Screen shot of the data delivery interface on the VIIRS Active Fire website


Mozilla Firefox
File Edit View History Bookmarks Tools Help
VIIRS Active Fire Product
http://viirsfire.g...edu/map/index.html
NOAA's Comprehensive Large Array-...
VIIRS_Active Fire ARP_Release_Readm...
viirsfire.geog.umd.edu/map/index.html
UMD mail Yahoo! Hotmail Milford Weather Google Calendar Gmail Voice Google Maps Google Scholar WorldTimeZone Unit Converter Dictionary GEOG UMEG UMD Libraries UM Testudo Blackboard Academic ... Space News
VIIRS Active Fires
Date
Detections
Over Pass
11/06/2012
11/05/2012
Zoom to Location
Latitude:
Longitude:
zoom
Enter a location
Overlay Options
Temperature
Cloud Cover
US Active Fire Perimeters
InciWeb Wildfire Information
Reset
Center
Clear
Return Home
Map
Satellite
Canada
United States
Mexico
Gulf of Alaska
Hawaii
Google
500 km
500 mi
Map data ©2012 Basarsoft, Google, INEGI, MapLink, ORION-ME, Tele Atlas Imagery ©2012 NASA, TerraMetrics - Terms of Use
7:55 PM
11/7/2012

Timestamp	Date	Ascii	TIFF	KMZ
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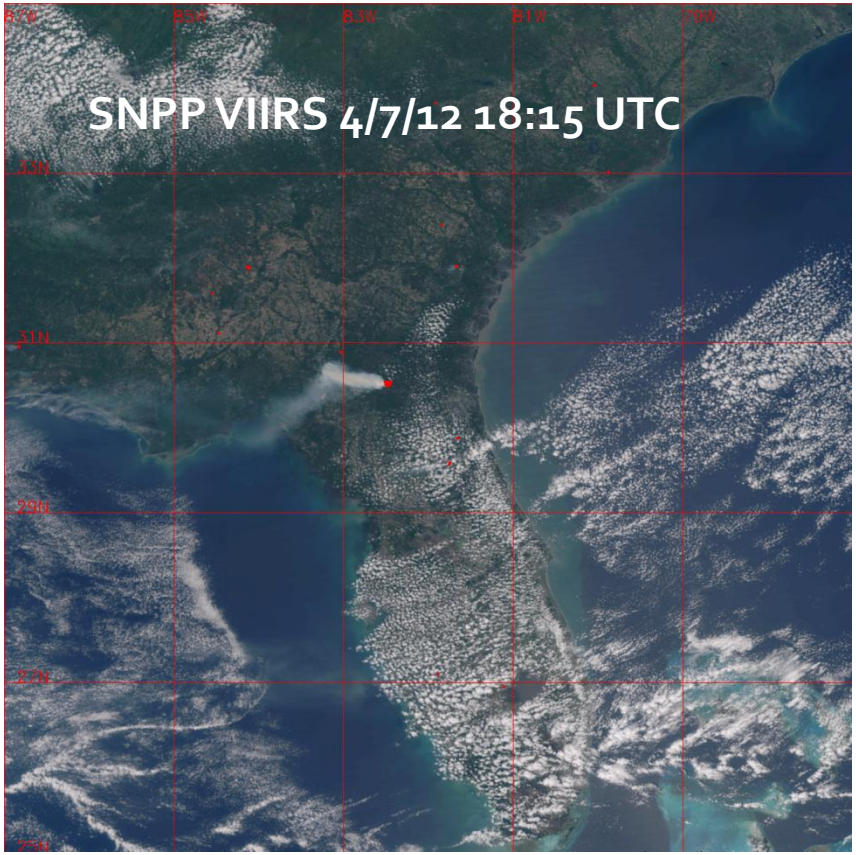
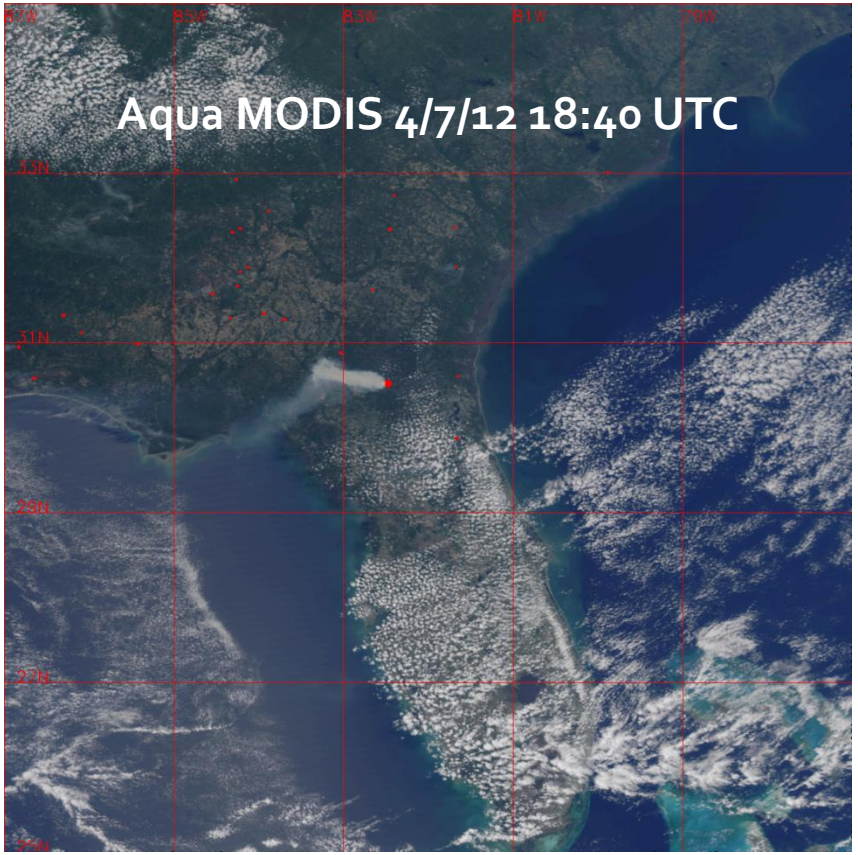
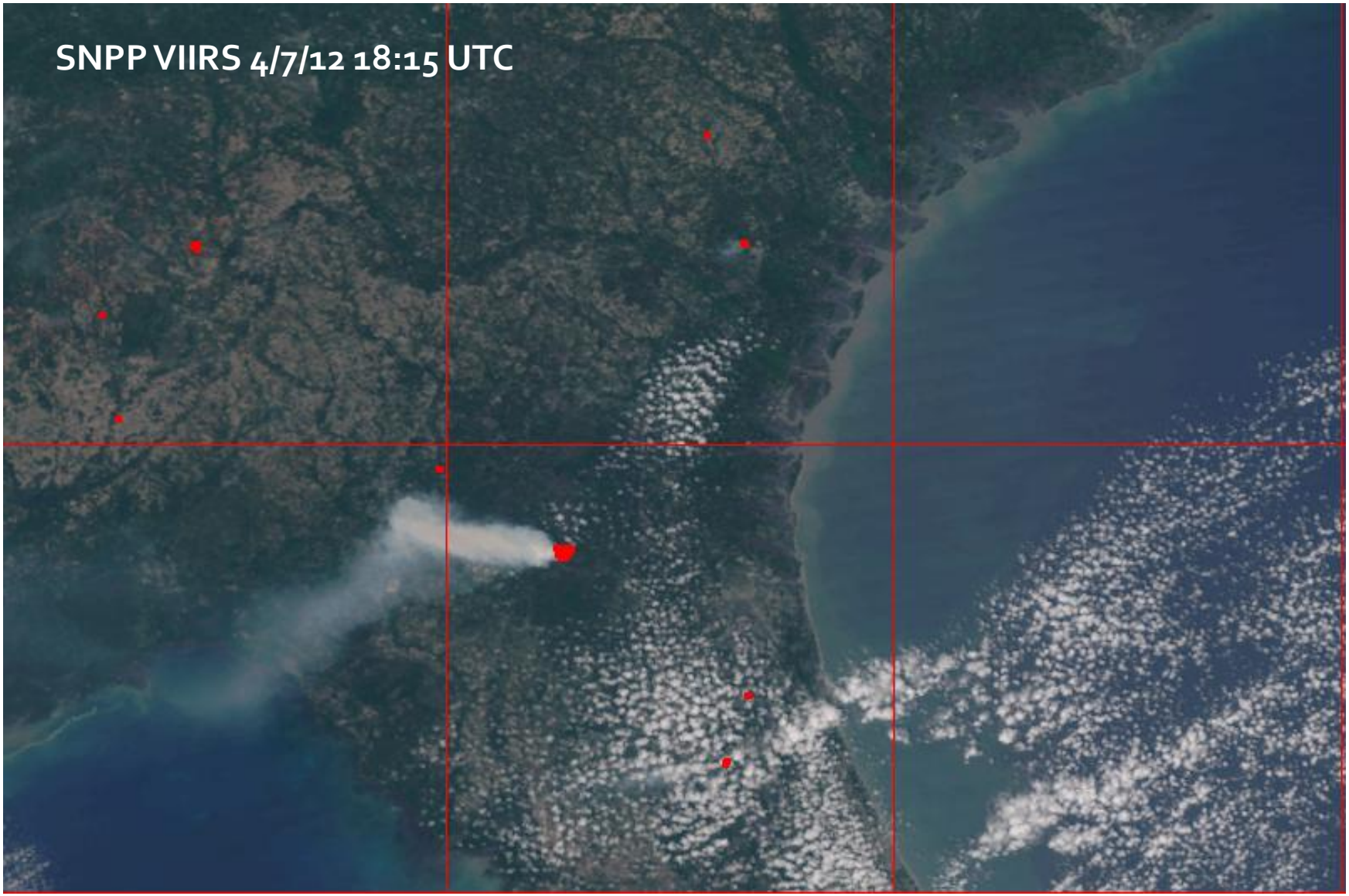
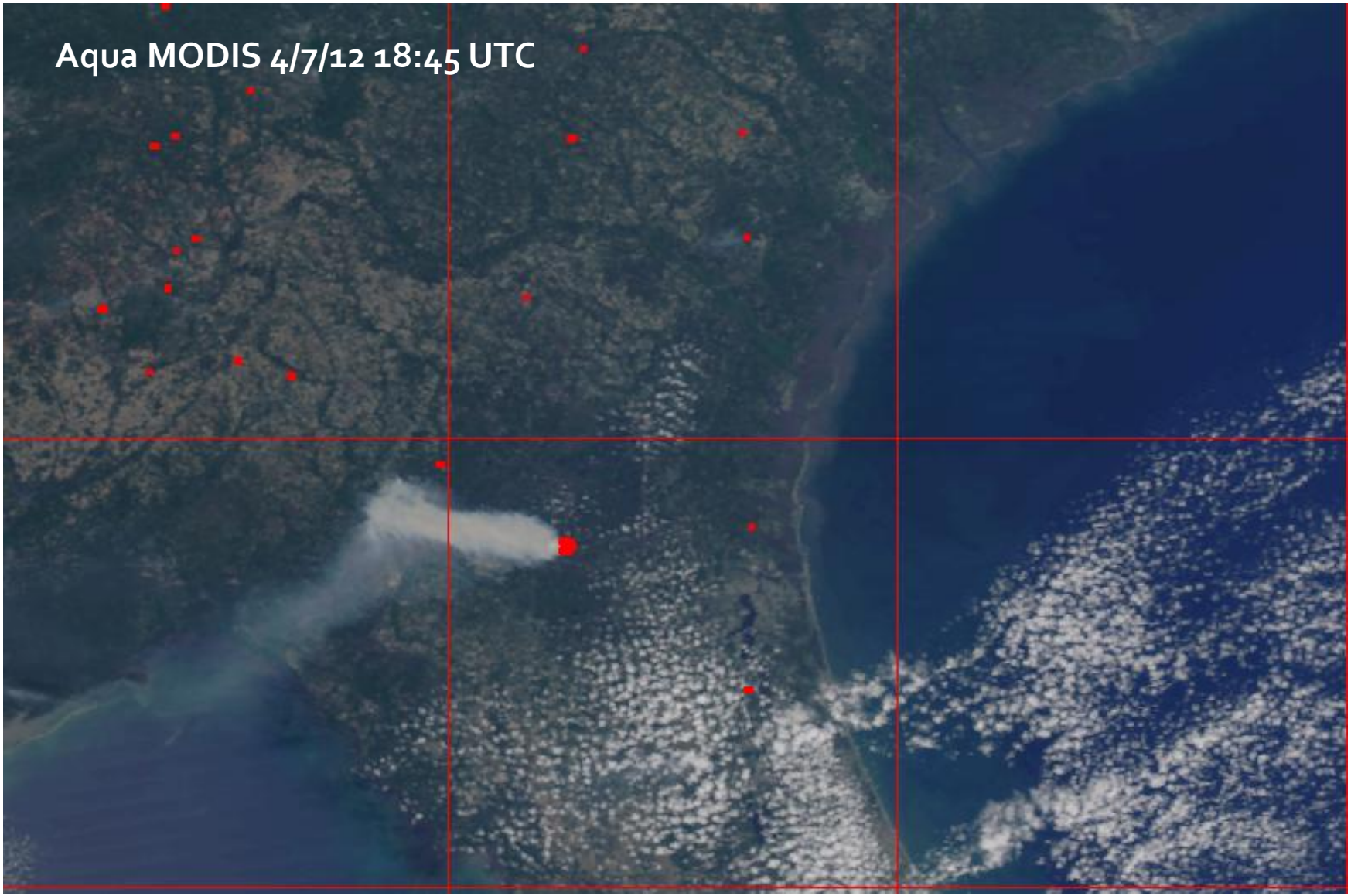
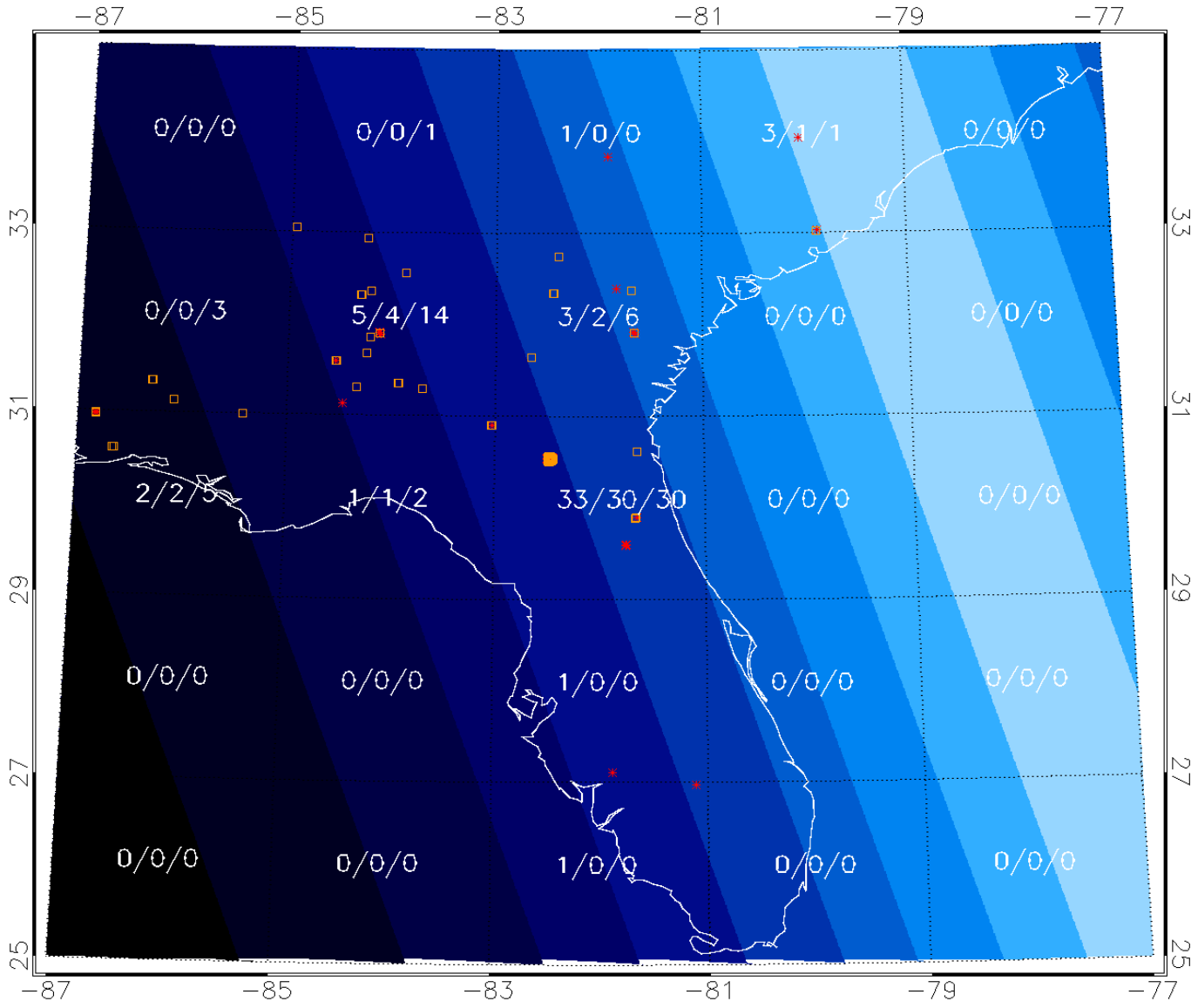
County Line






SNPP VIIRS 4/7/12 18:15 UTC


Aqua MODIS 4/7/12 18:45 UTC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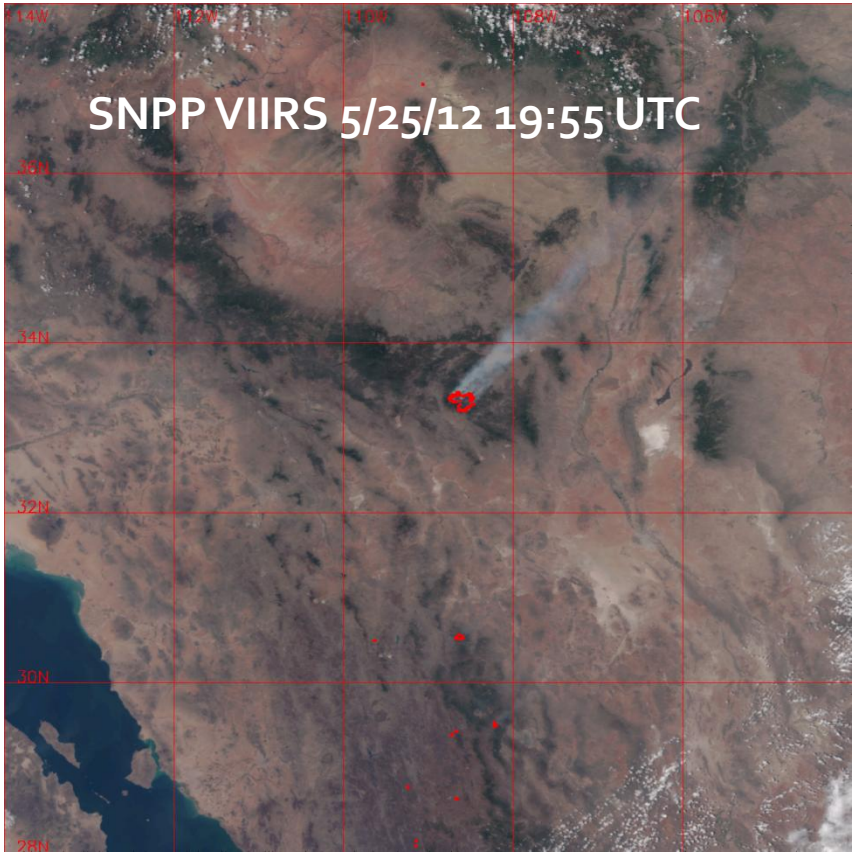
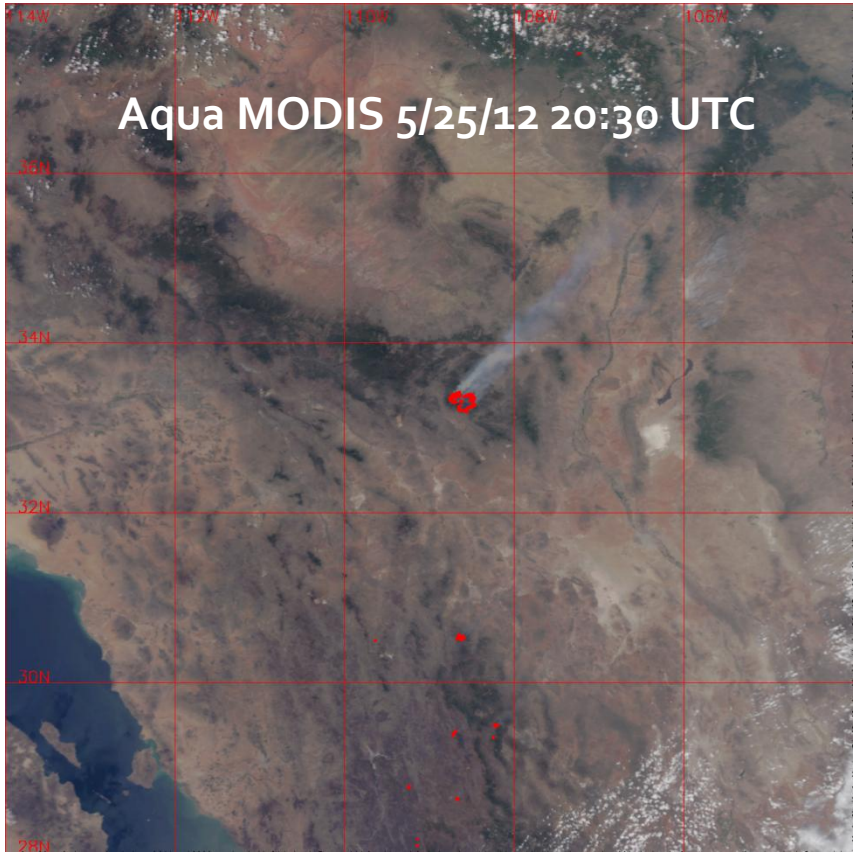
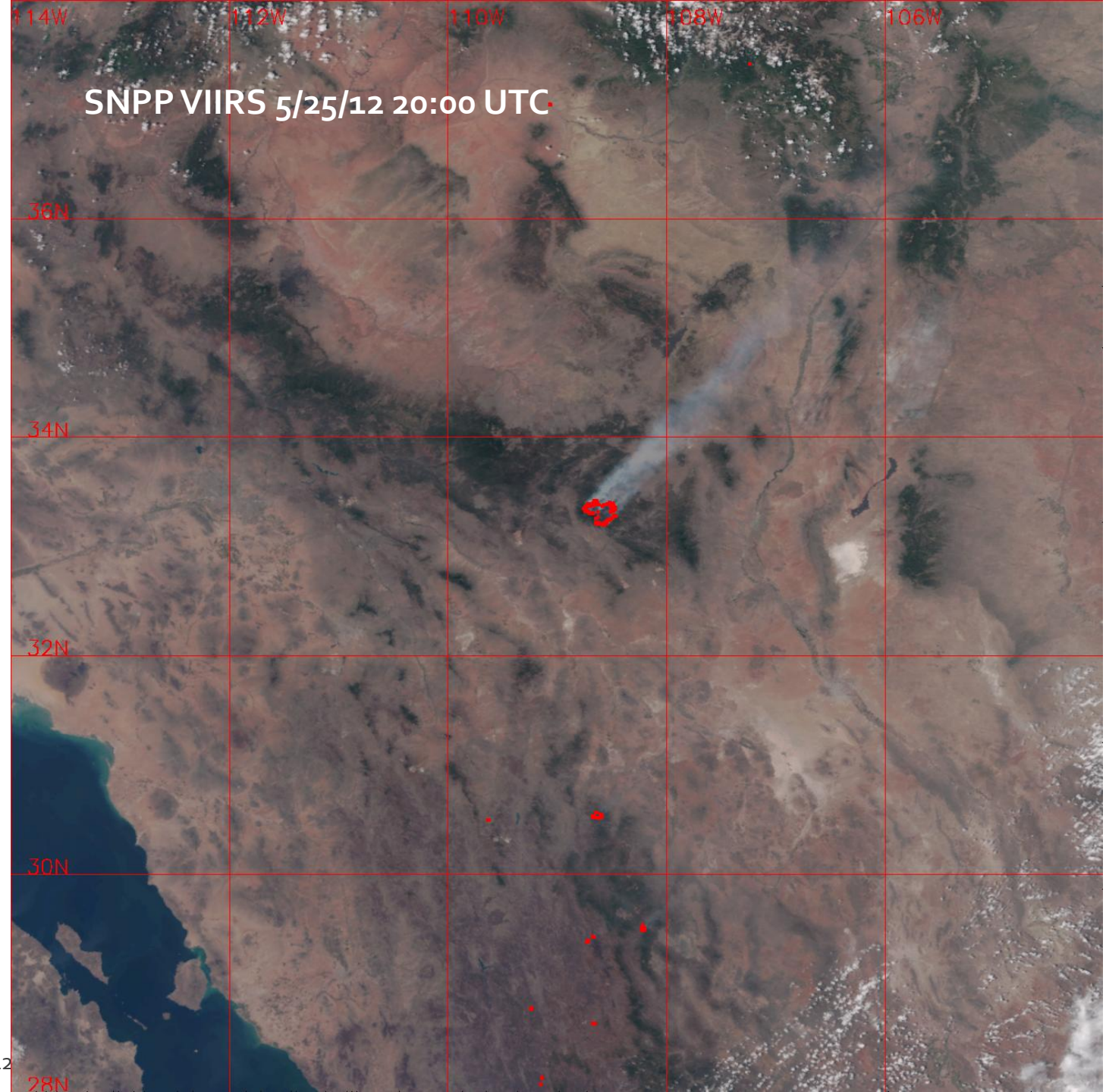
VIIRS Scan Angle (deg)
0
5
9
14
19
24
28
33
38
42

Whitewater-Baldy



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106W
36N
34N
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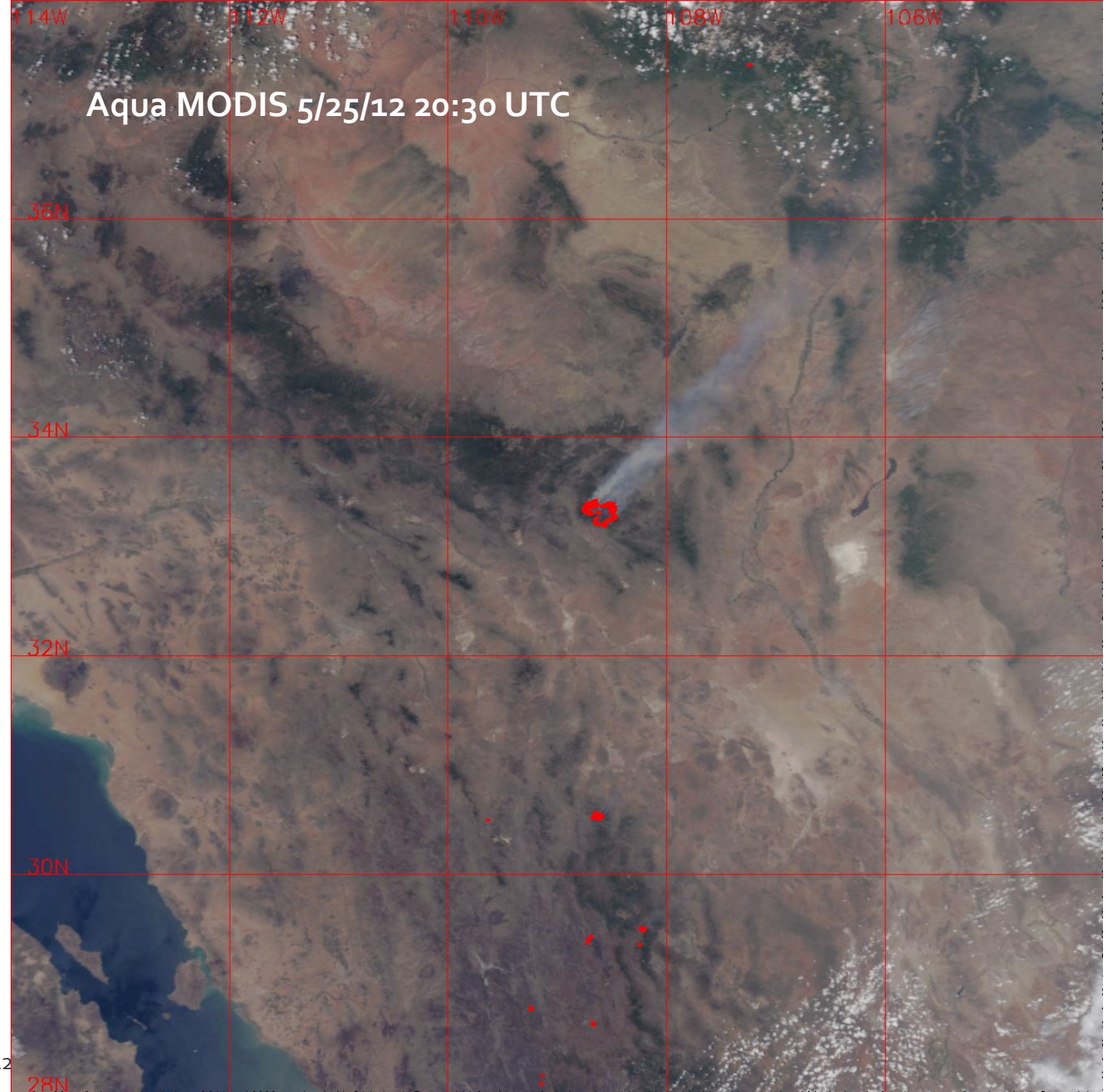
28N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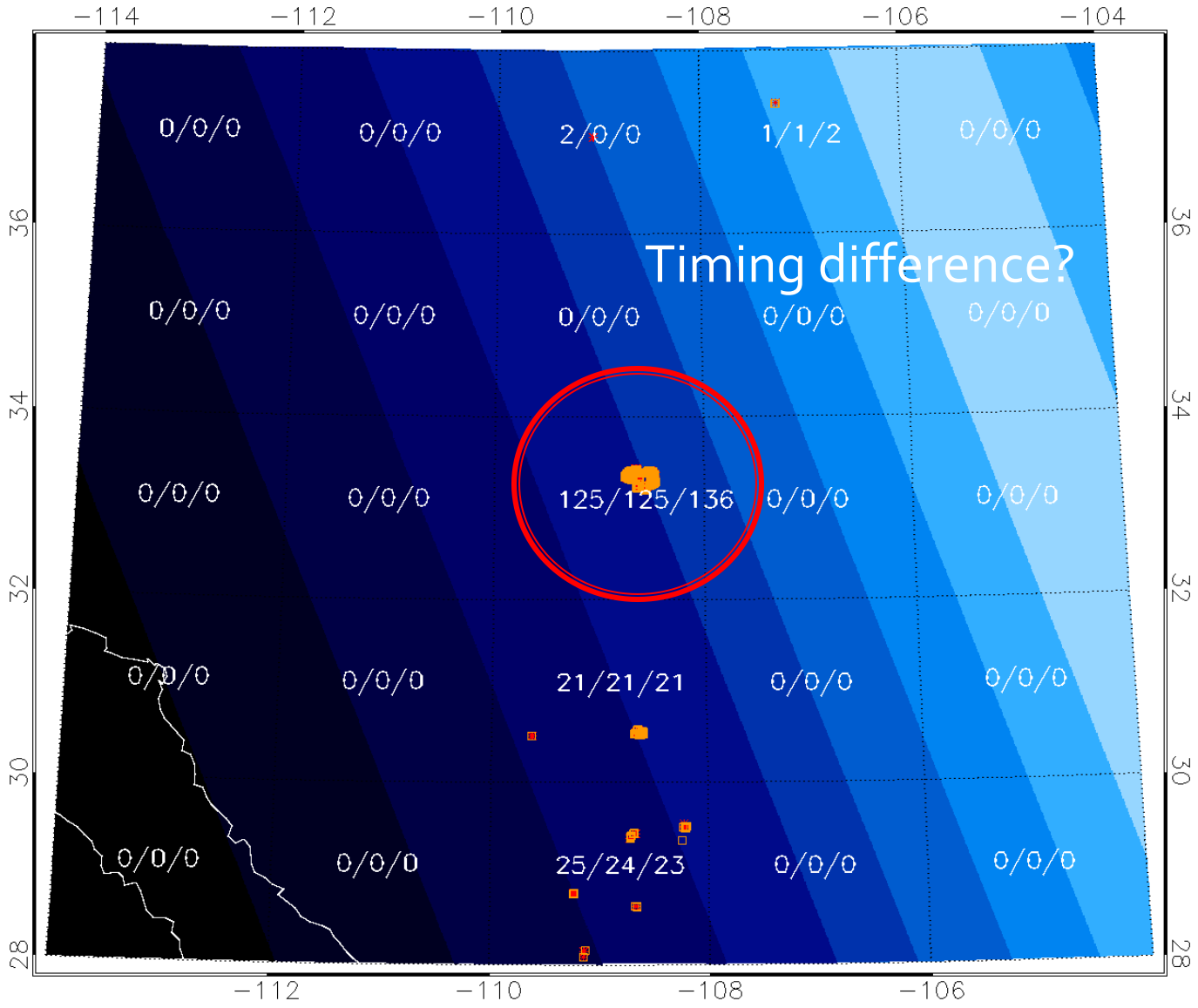
106W
36N
34N
32N
30N
28N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21/21/21
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0/0/0
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25/24/23
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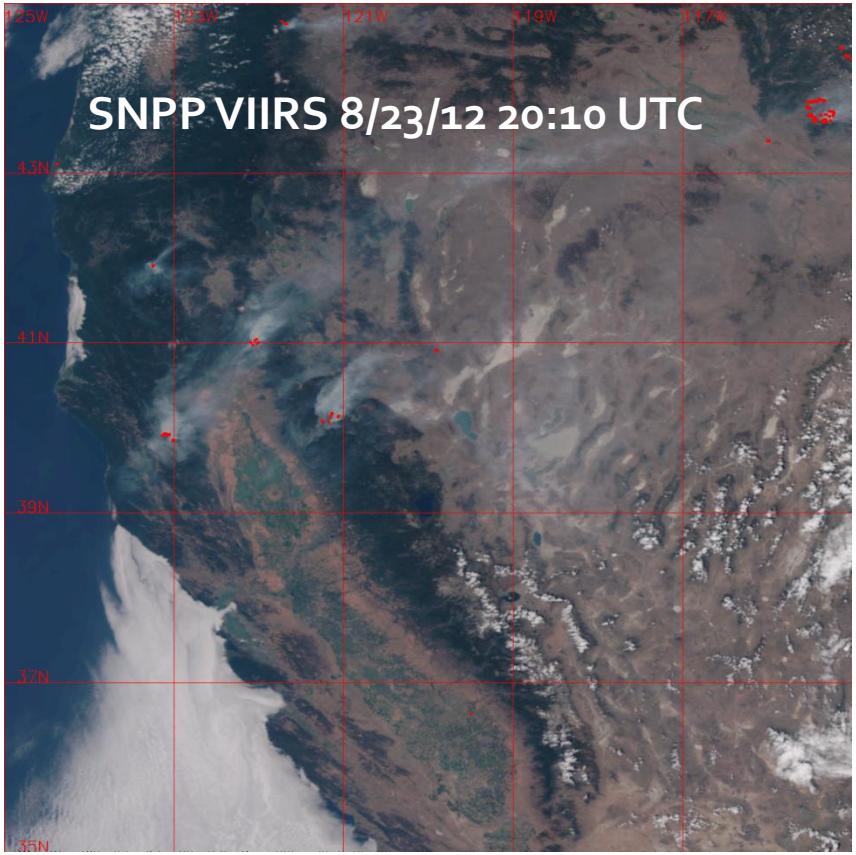
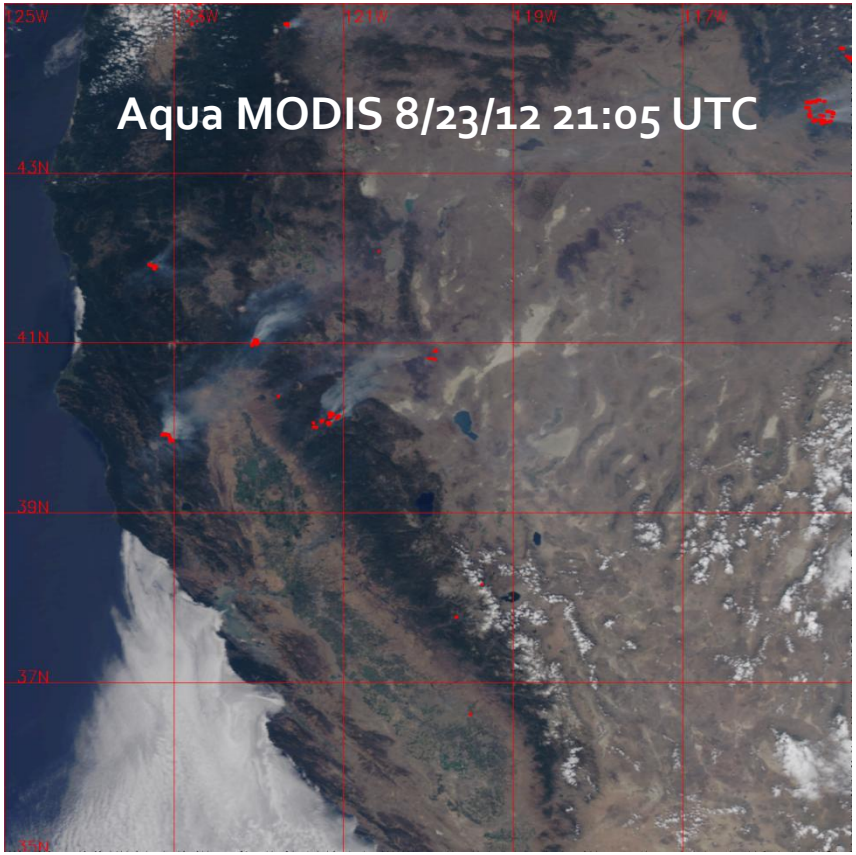
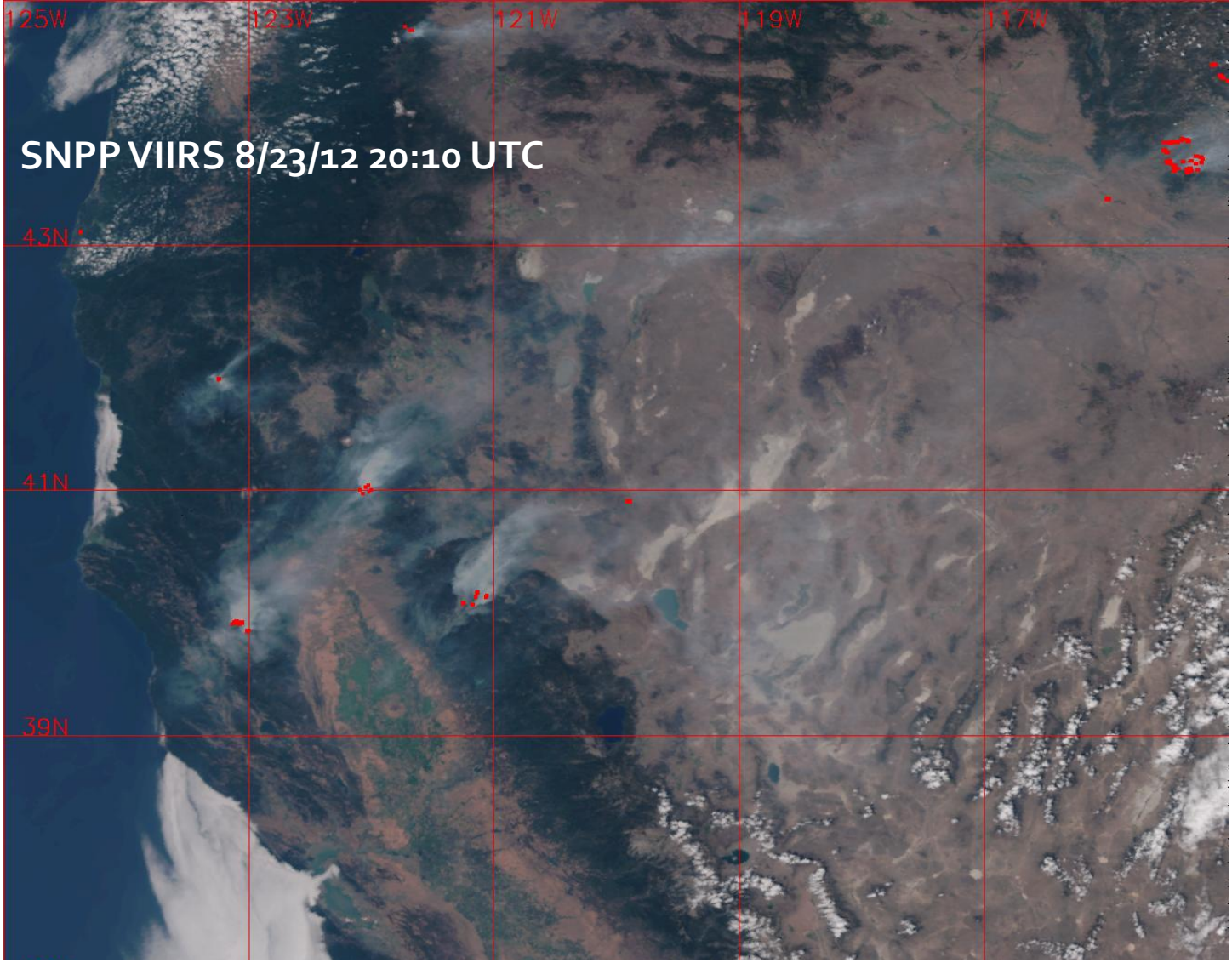
0/0/0
Timing difference?
VIIRS Scan Angle (deg)
0
5
10
14
19
24
29
34
38
43

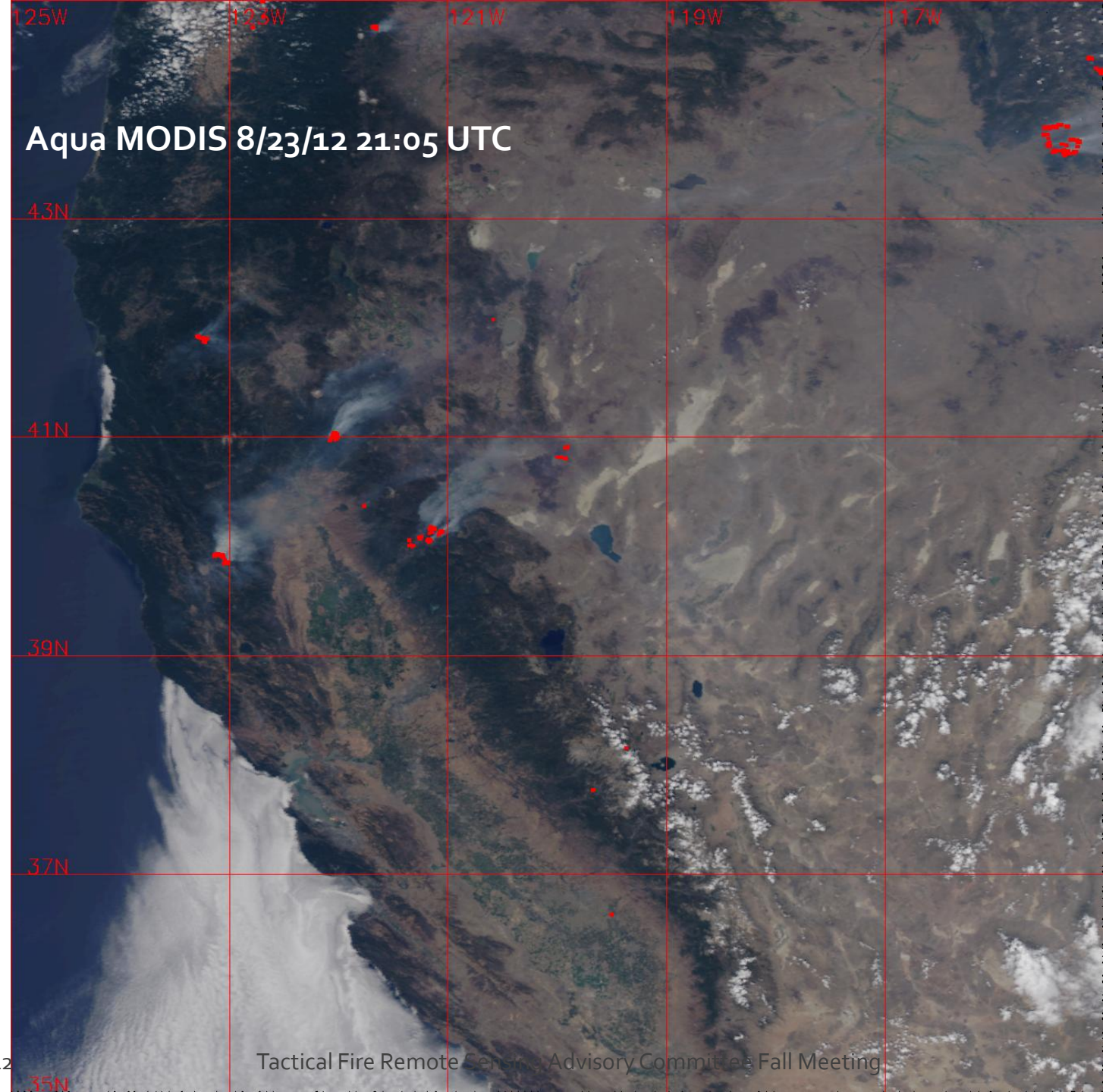
Western U.S.

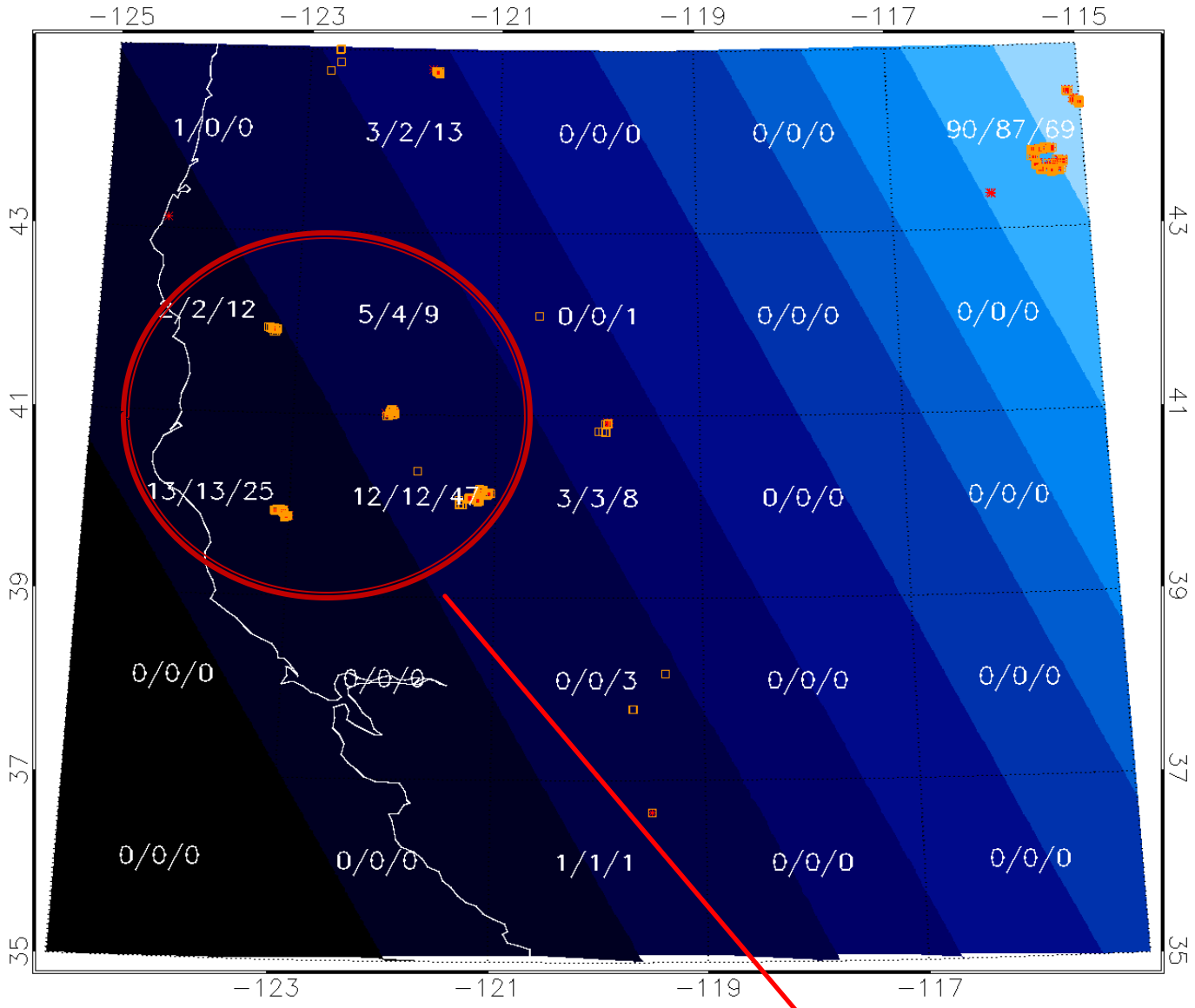

SNPP VIIRS 8/23/12 20:10 UTC
125W
123W
121W
119W
117W
43N
41N
39N
37N
35N


Aqua MODIS 8/23/12 21:05 UTC
125W
123W
121W
119W
117W
43N
41N
39N
37N
35N

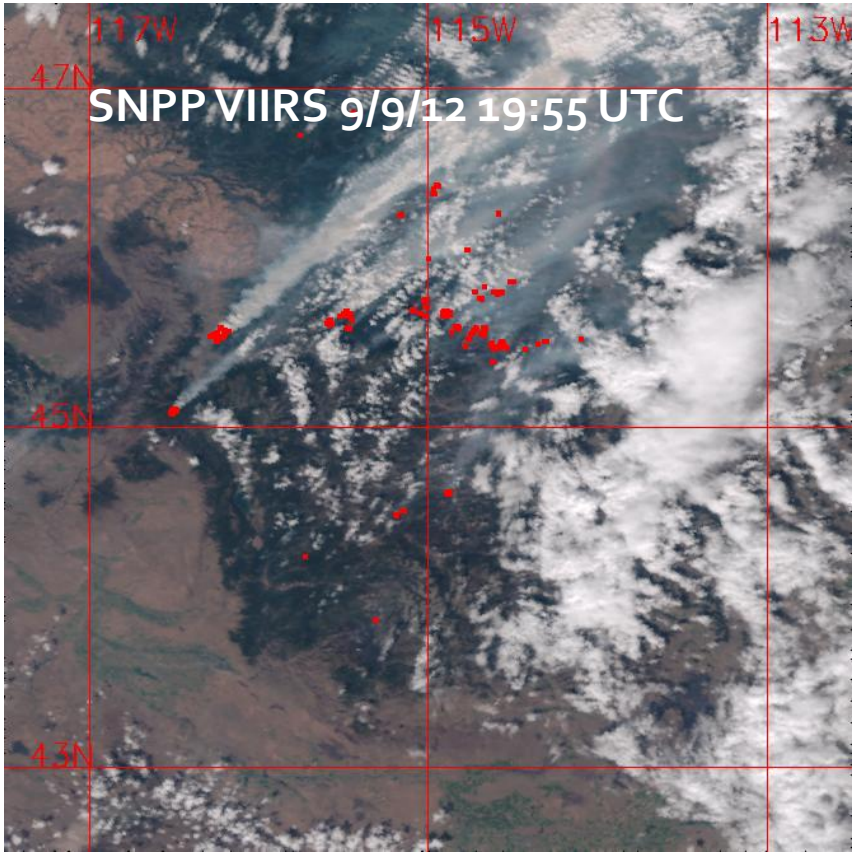


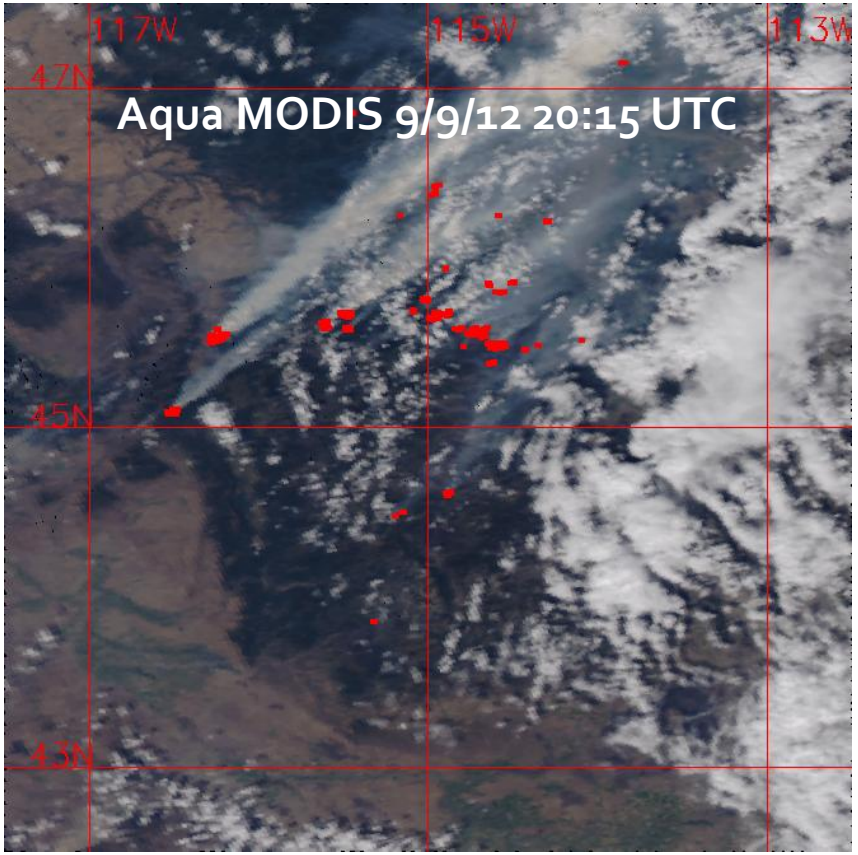
The larger fires in **California** observed in the images include the **Fort Complex, Bagley, North Pass, Chips, and Rush**. In **Oregon**, the **Waterfalls 2** fire can be seen near the top-left portion of the image. And to the east, in **Idaho**, the **Trinity Ridge** and **Halstead** fires can easily be seen.

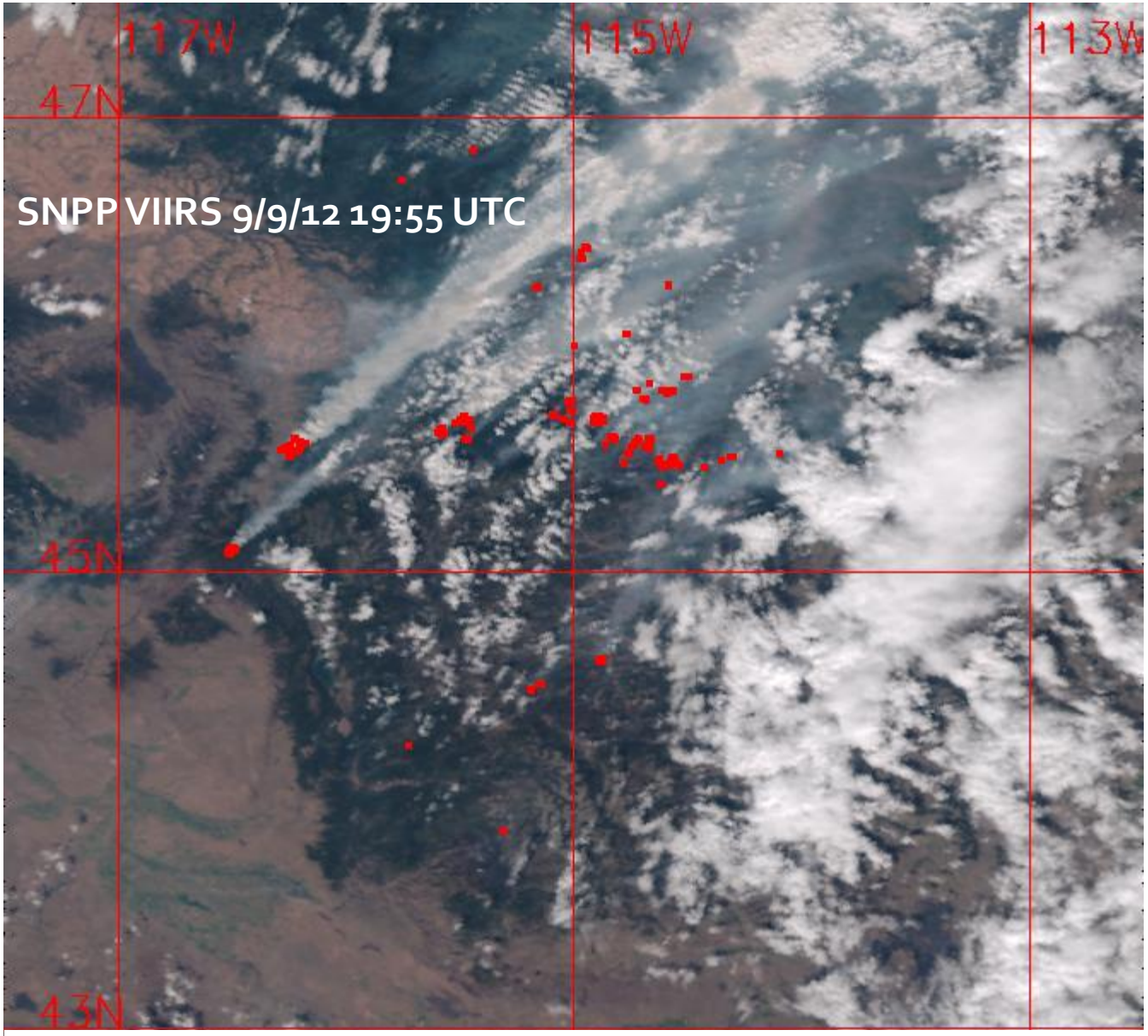

Aqua MODIS 8/23/12 21:05 UTC
125W
123W
121W
119W
117W
43N
41N
39N
37N
35N


−125
−123
−121
−119
−117
−115
43
41
39
37
35
1/0/0
3/2/13
0/0/0
0/0/0
90/87/69
2/2/12
5/4/9
0/0/1
0/0/0
0/0/0
13/13/25
12/12/47
3/3/8
0/0/0
0/0/0
0/0/0
0/0/0
0/0/3
0/0/0
0/0/0
0/0/0
0/0/0
1/1/1
0/0/0
0/0/0
VIIRS Scan Angle (deg)
18
22
25
29
33
37
40
44
48
51

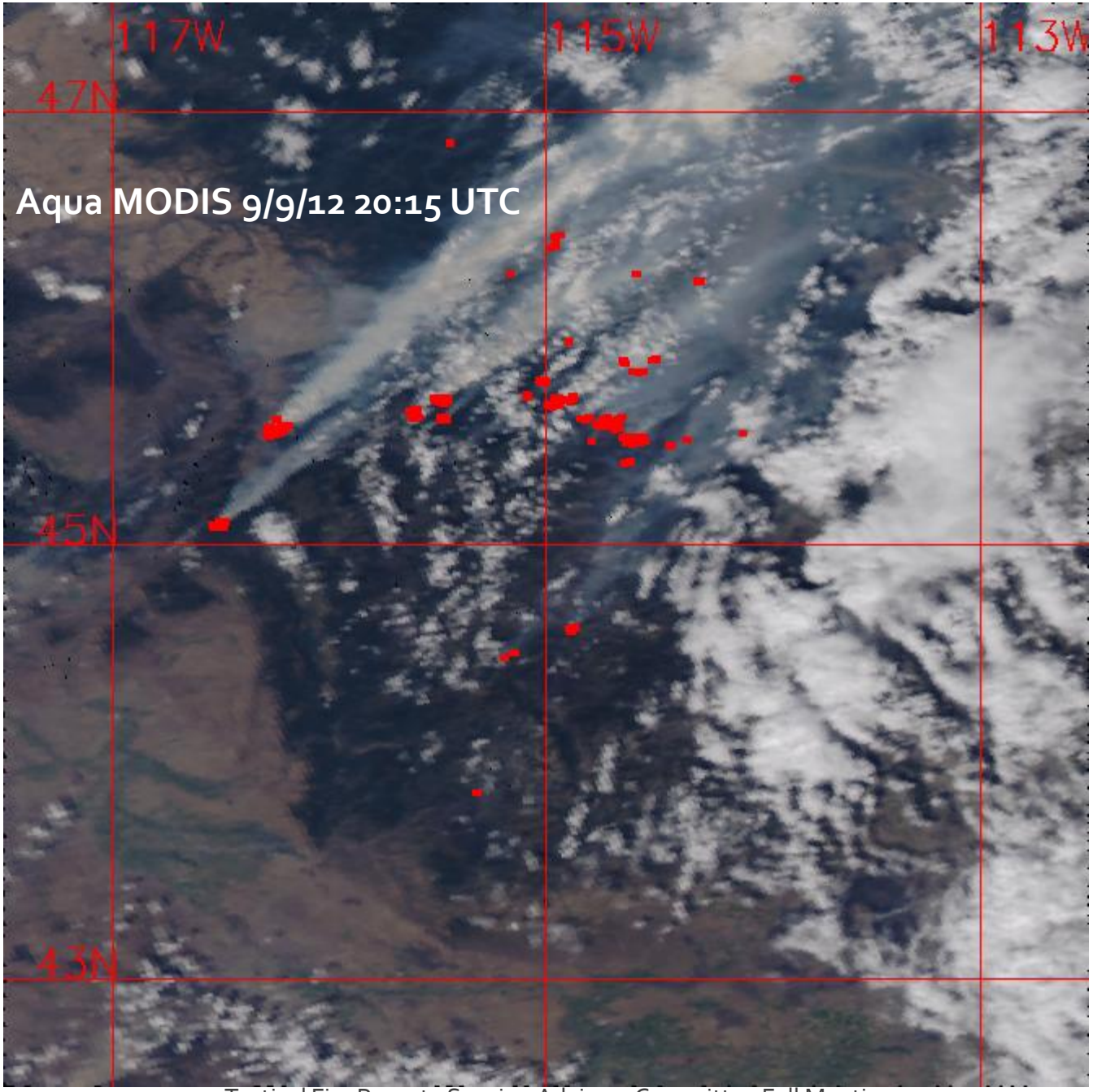
Idaho

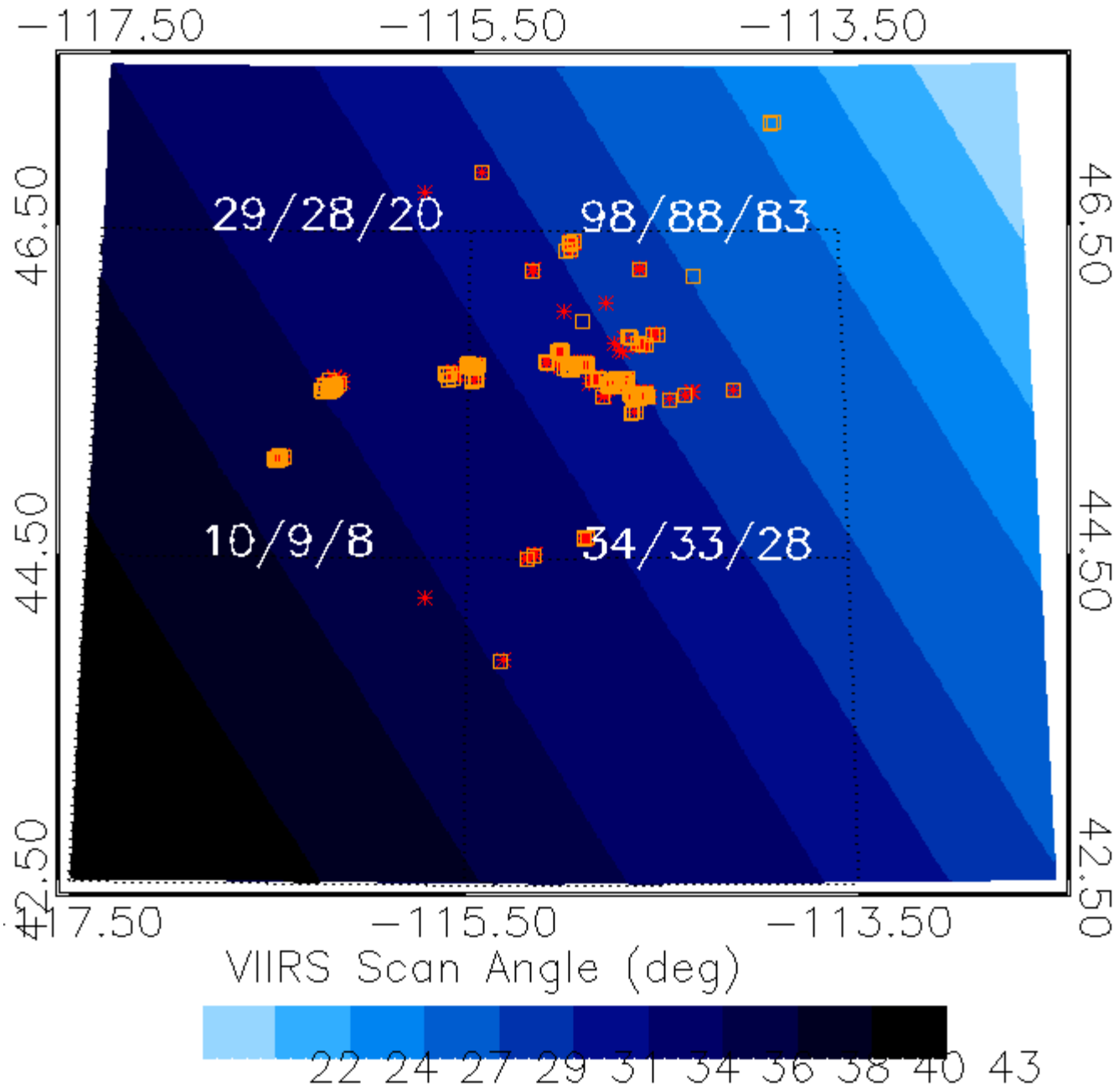

117W
115W
113W
47N
45N
43N
SNPP VIIRS 9/9/12 19:55 UTC


117W
115W
113W
47N
45N
43N
Aqua MODIS 9/9/12 20:15 UTC



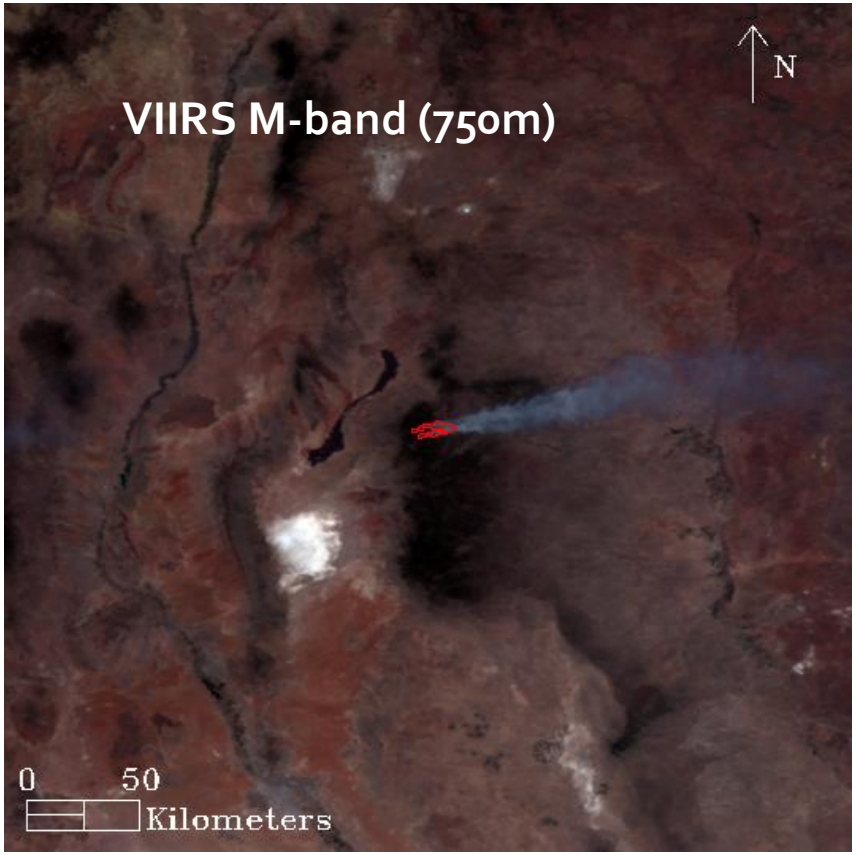
Wesley, Sheep, McGuire, Porcupine, Mustang, Halstead and Trinity Ridge.

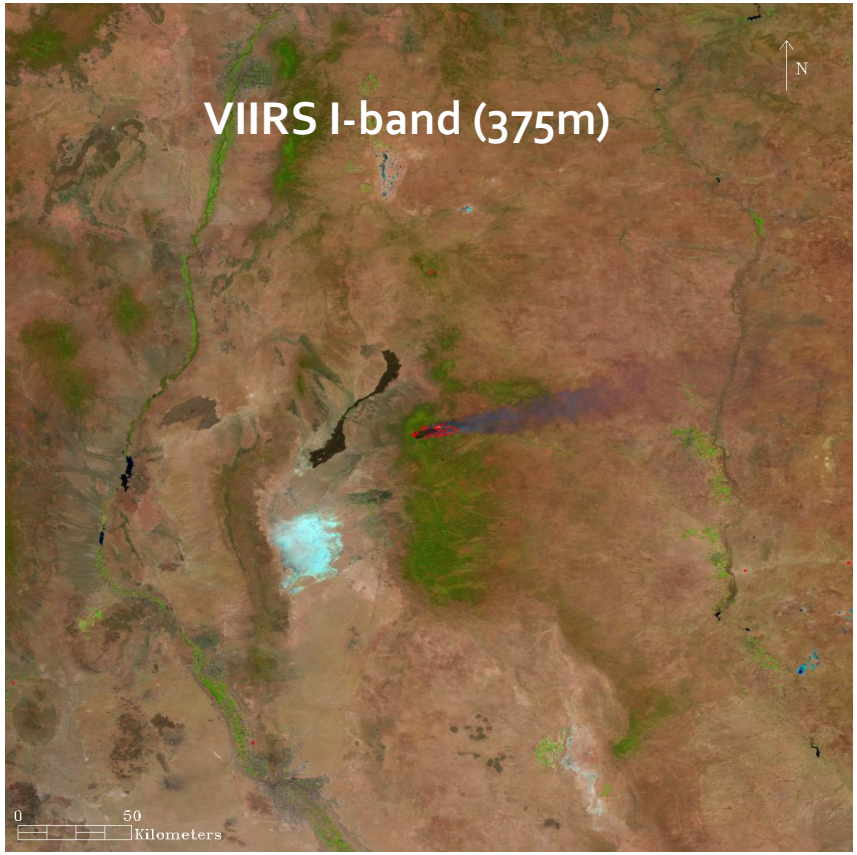

117W
115W
113W
47N
45N
43N
Aqua MODIS 9/9/12 20:15 UTC


−117.50
−115.50
−113.50
46.50
44.50
42.50
29/28/20
98/88/83
10/9/8
34/33/28
VIIRS Scan Angle (deg)
22 24 27 29 31 34 36 38 40 43

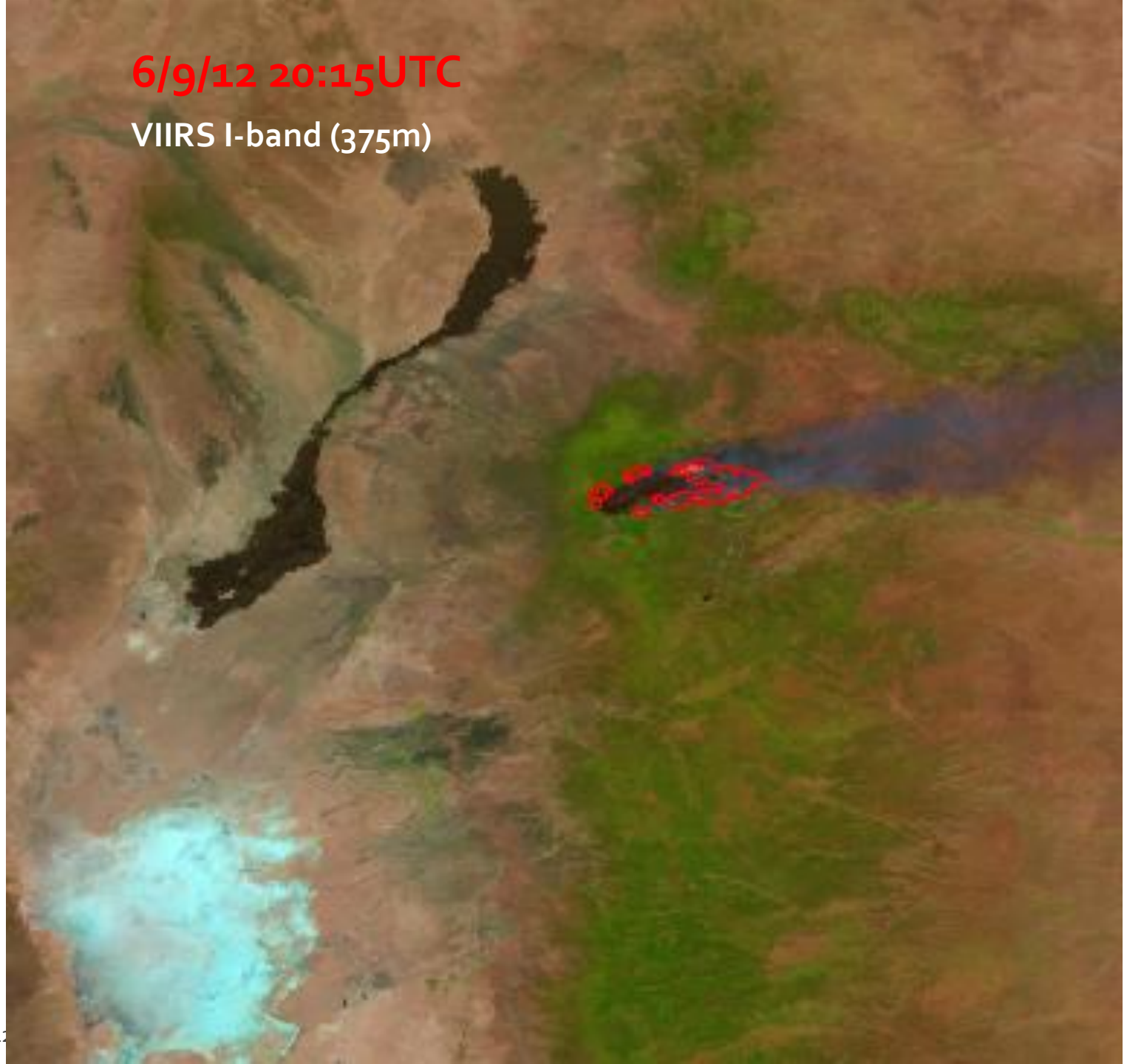
I-band

Little Bear - 6/9/12 20:15UTC





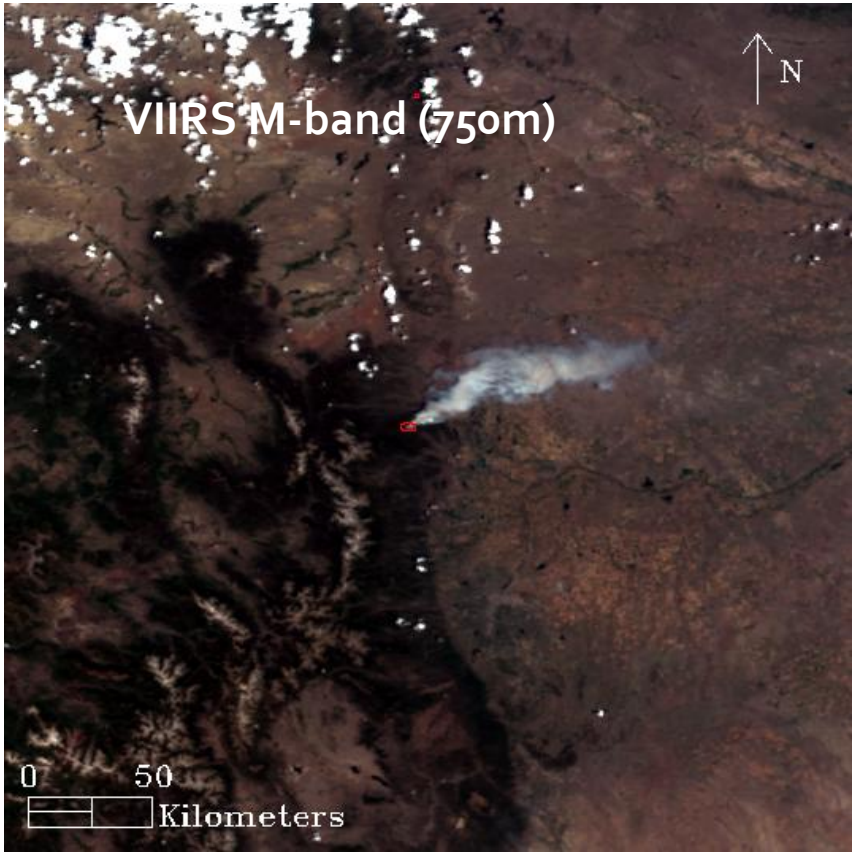

VIIRS M-band (750m)

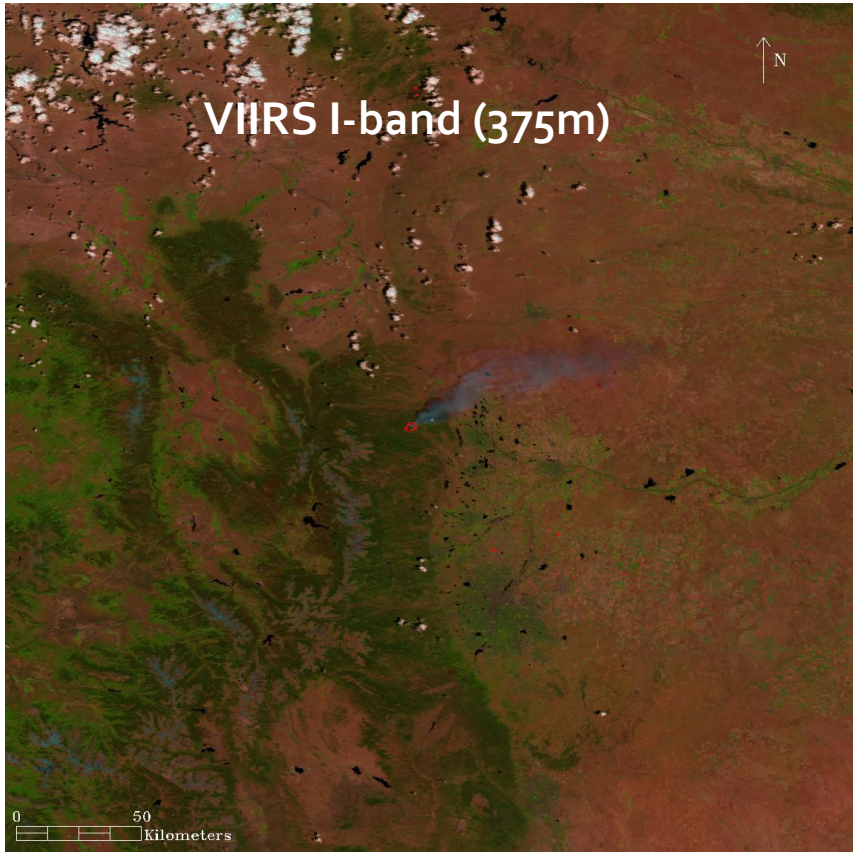

6/9/12 20:15UTC
VIIRS I-band (375m)

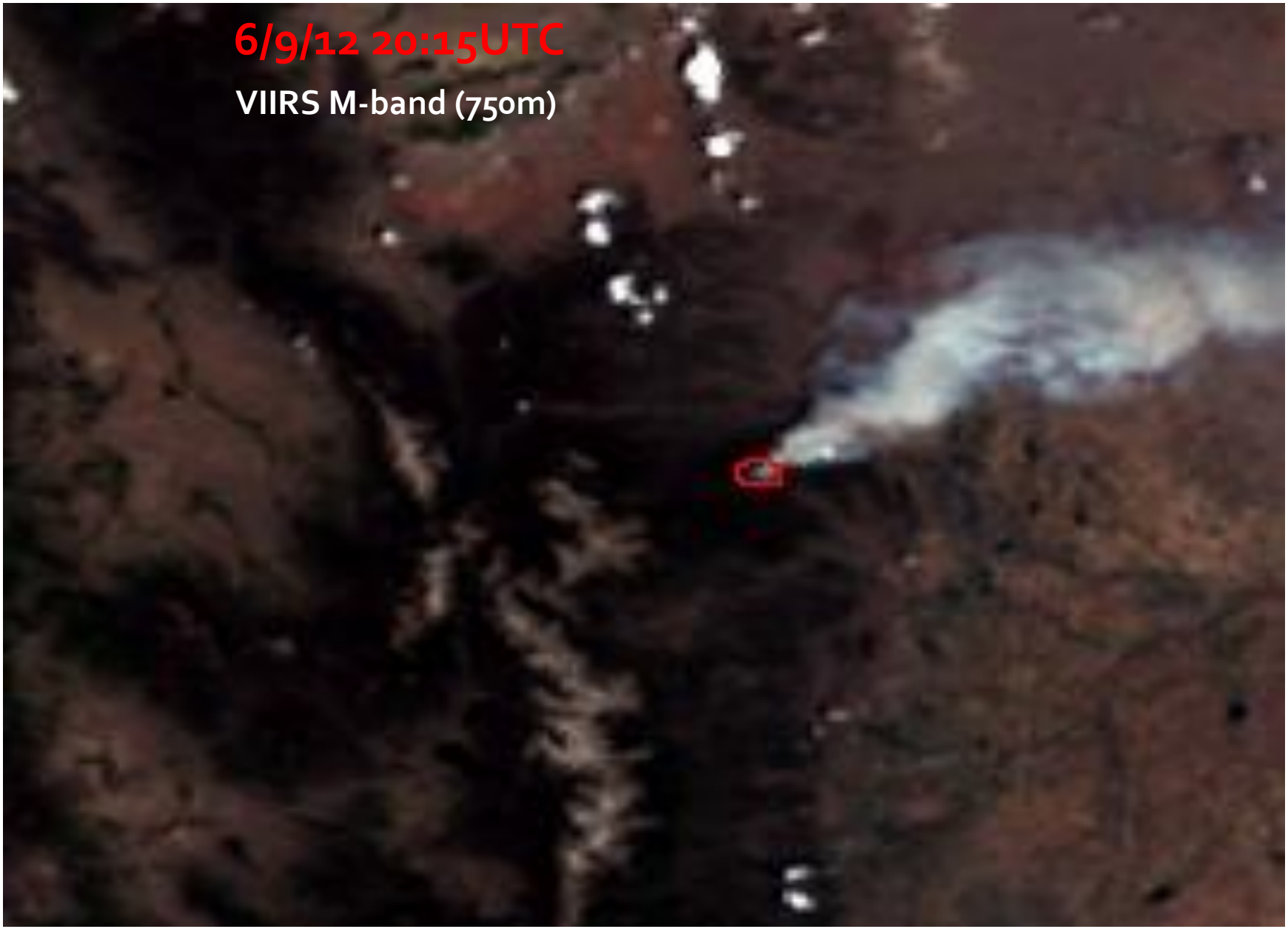

6/10/12 20:00UTC
VIIRS I-band (375m)

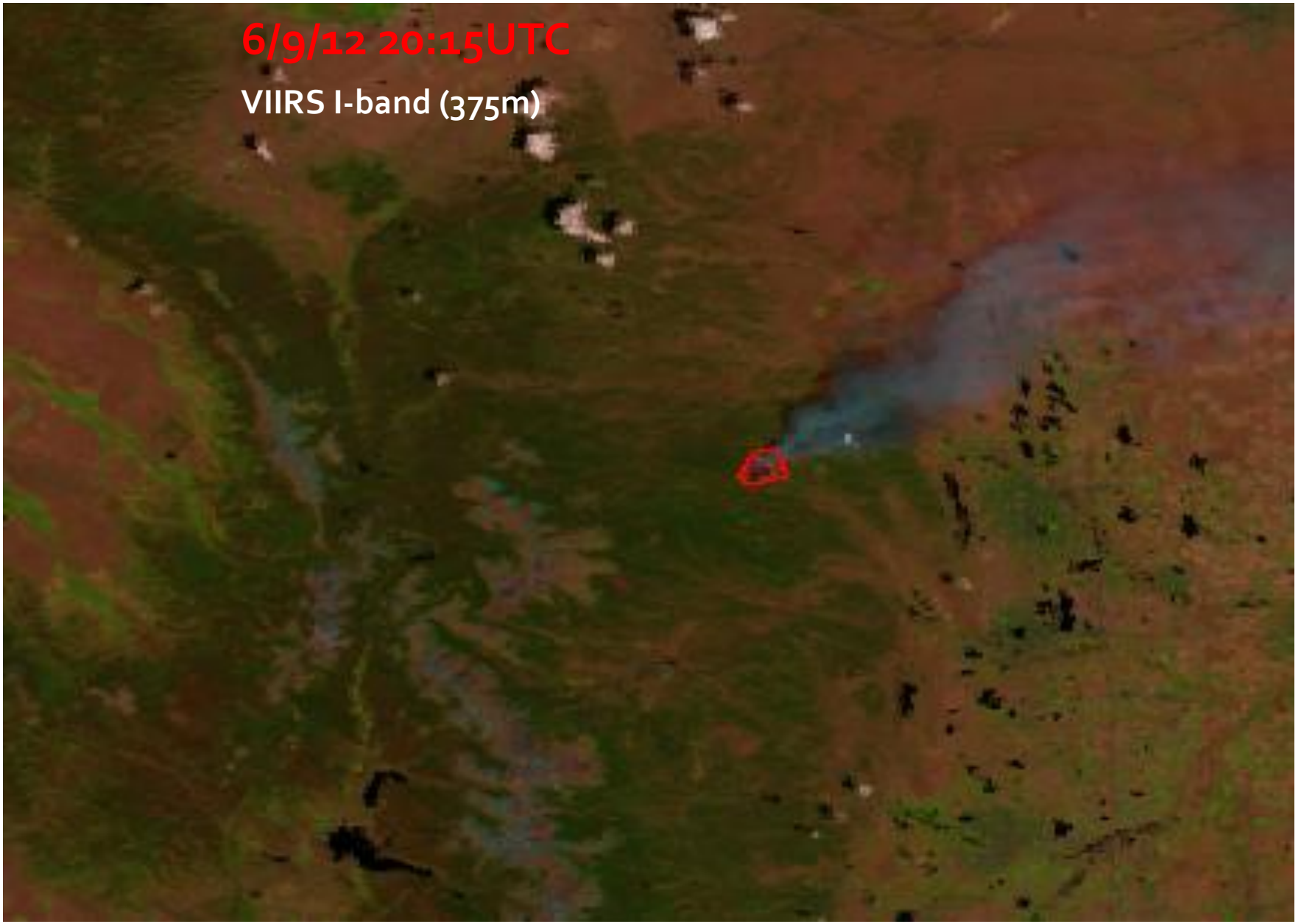
I-band

High Park - 6/9/12 20:15UTC

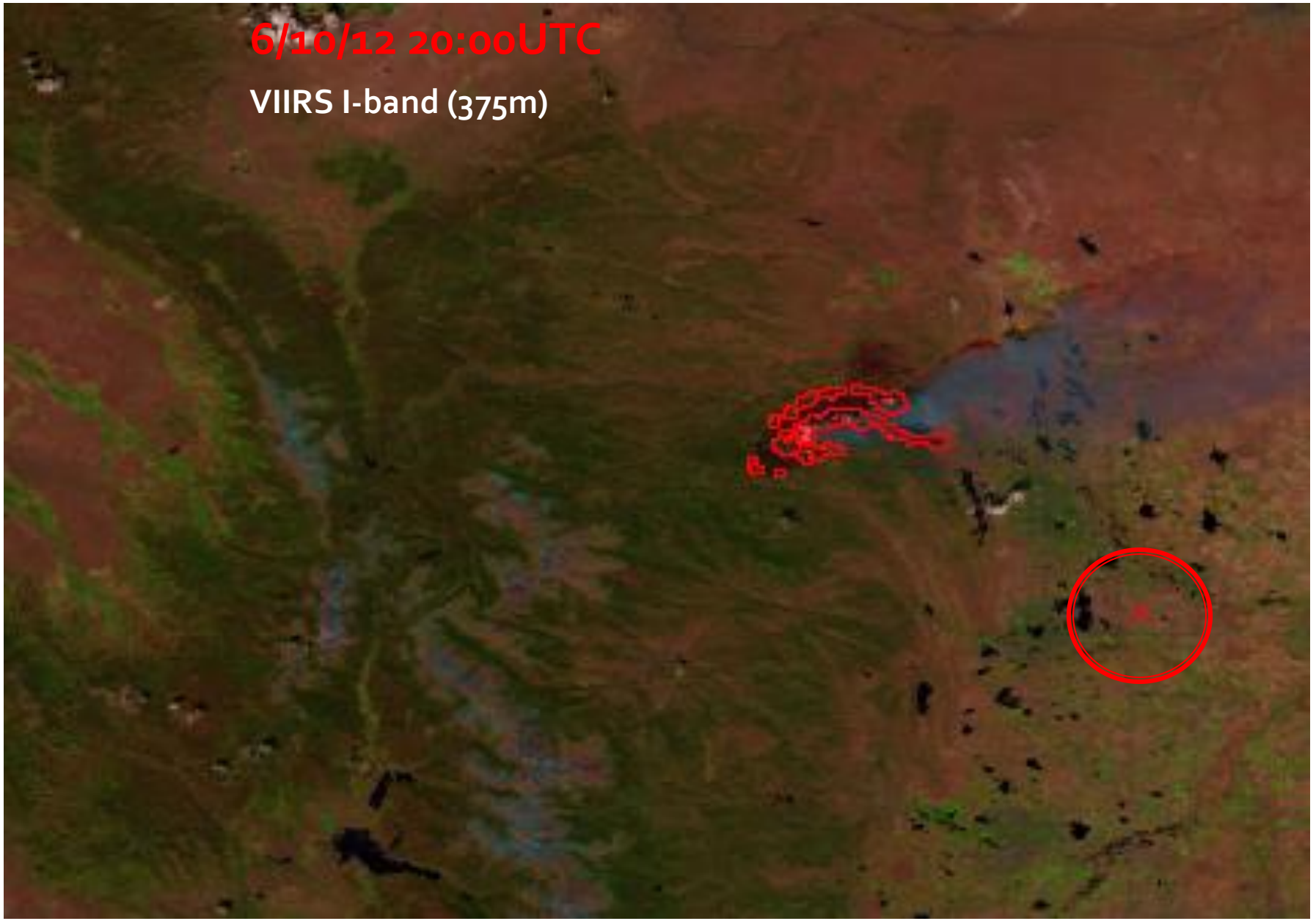





6/9/12 20:15UTC
VIIRS M-band (750m)

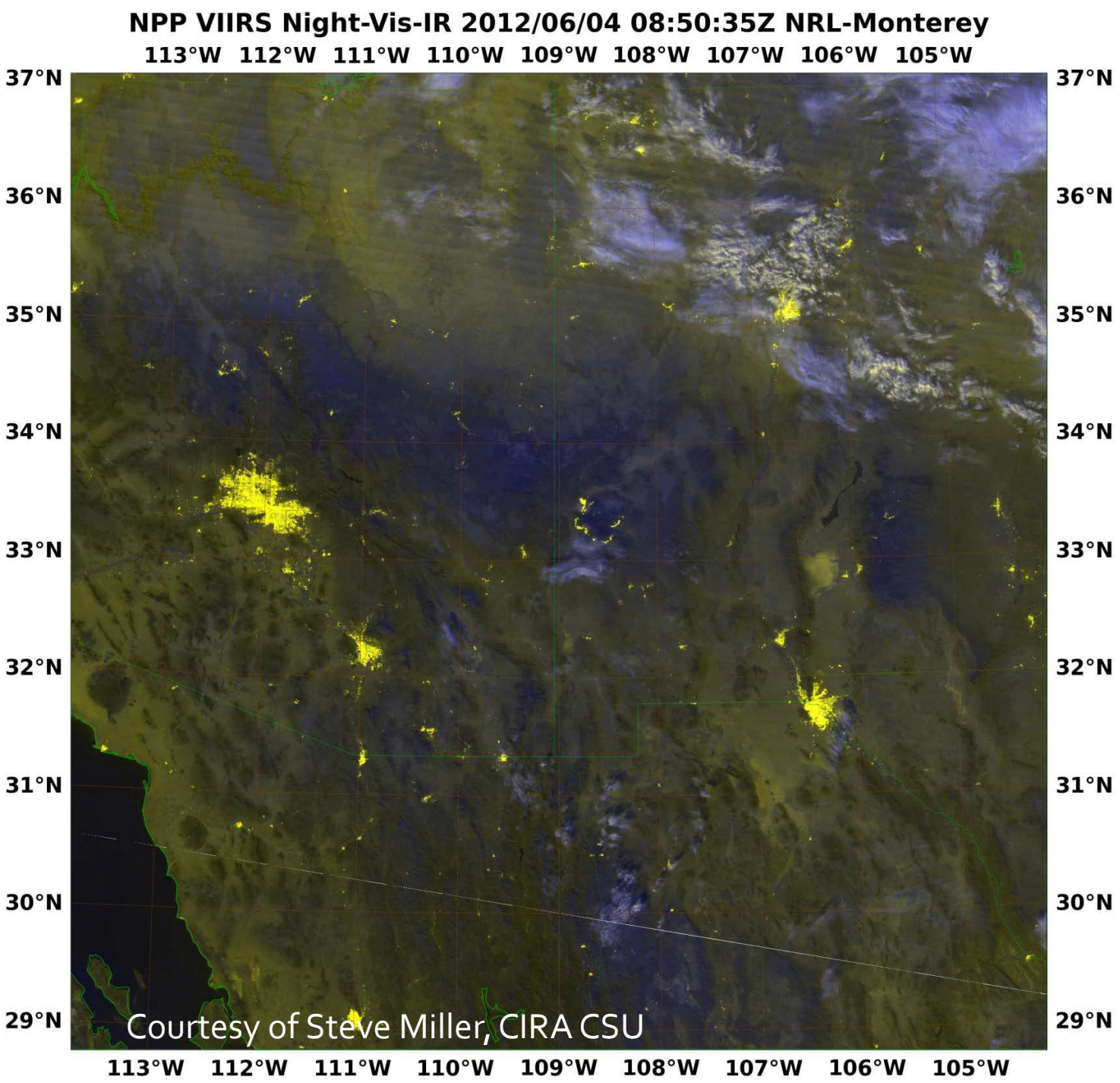

6/9/12 20:15UTC
VIIRS I-band (375m)

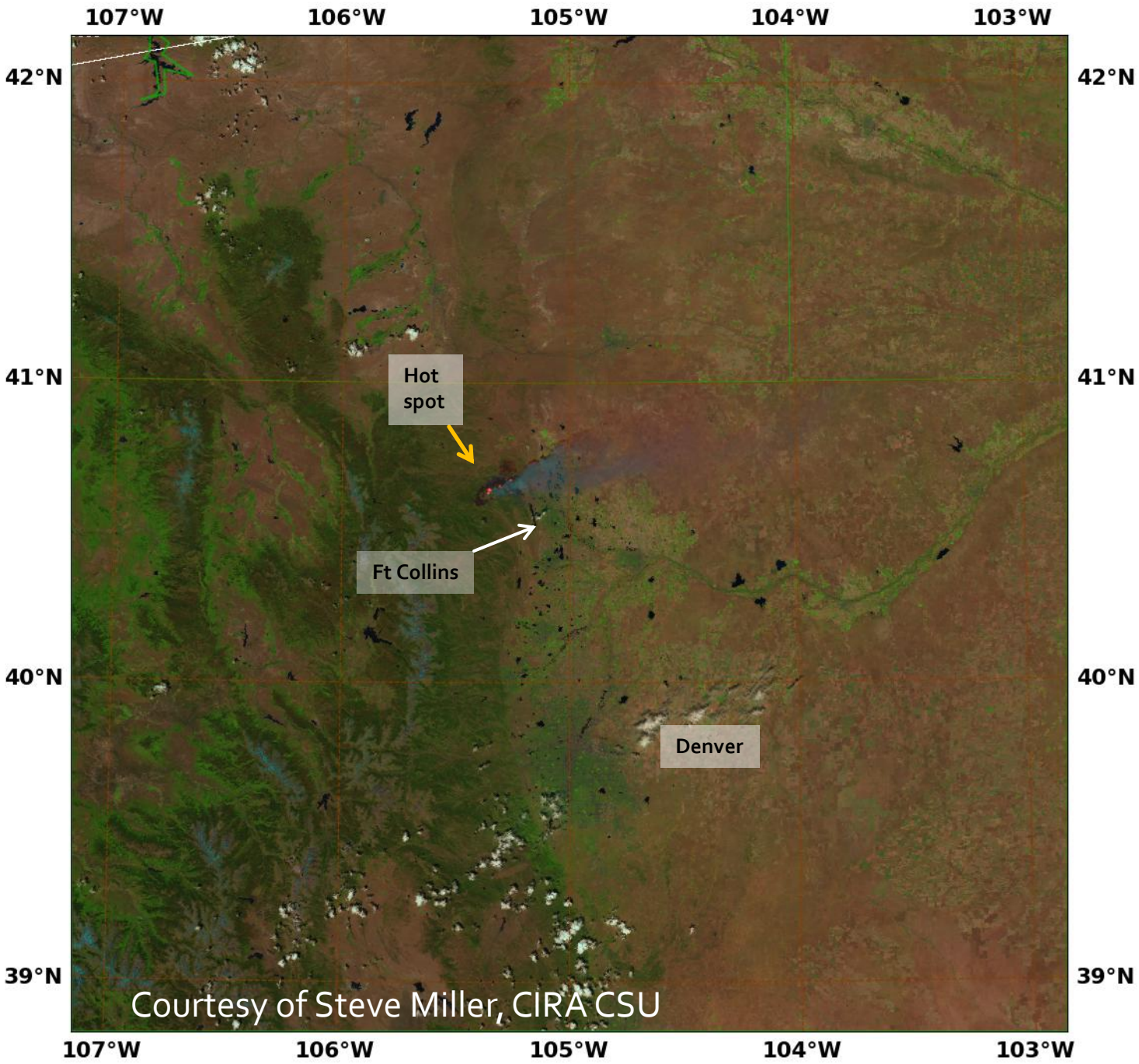

6/10/12 20:00UTC
VIIRS M-band (750m)


6/10/12 20:00UTC
VIIRS I-band (375m)

DNB

- Legacy of the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS)
- The DNB is a **broad band channel** in the VIS and NIR spectral range.
- It operates with **three different gains** to optimize the sensitivity independent of illumination.
- Attention needed - More susceptible to false alarms precisely when MWIR-based algorithms are least likely to produce false alarms.


NPP VIIRS Night-Vis-IR 2012/06/04 08:50:35Z NRL-Monterey
113°W 112°W 111°W 110°W 109°W 108°W 107°W 106°W 105°W
37°N
36°N
35°N
34°N
33°N
32°N
31°N
30°N
29°N
Courtesy of Steve Miller, CIRA CSU


NPP VIIRS NaturalColor 2012/06/10 19:59:25Z NRL-Monterey
107°W
106°W
105°W
104°W
103°W
42°N
41°N
40°N
39°N
Hot spot
Ft Collins
Denver
Courtesy of Steve Miller, CIRA CSU

Looking Forward

- The VIIRS "C6" code, a VIIRS-adapted version of the current MODIS Collection 6 (C6) algorithm, has been delivered to NASA's Direct Readout Laboratory (DRL).

- Over the next few weeks the DRL will test the new code and deliver the package to its alpha-testers, including the US Forest Service Remote Sensing Applications Center (RSAC). VIIRS active fire detections, as well as new products such as fire mask and fire radiative power (FRP), could be available to end-users within several weeks.

Looking Forward

- L1/EDR:
  - "NOAA has endorsed the inclusion of an Active Fires EDR based on **strong community interest in providing continuity of validated MODIS-based fire products** (geolocation of fire detections, FRP, and a full fire mask) consistent with the recommendations of the NOAA-NASA Land Science Team."