VIIRS Fire Product Status

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The New Visible Infrared Imaging Radiometer Suite (VIIRS)

- On board Suomi-NPP
  - 13:30 & 1:30 local overpass

- 16 bands @ 750 m resolution (including dual-gain MIR)
- 5 bands @ 375 m resolution (including MIR)

- Active fire product builds on MODIS Collection 4 algorithm
  - 750 m fire detection (baseline product)
  - FRP + fire mask + MODIS C6 algorithm updates (revised requirements – under implementation)
  - Alternative 375 m fire detection being developed

The New Visible Infrared Imaging Radiometer Suite (VIIRS)

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			

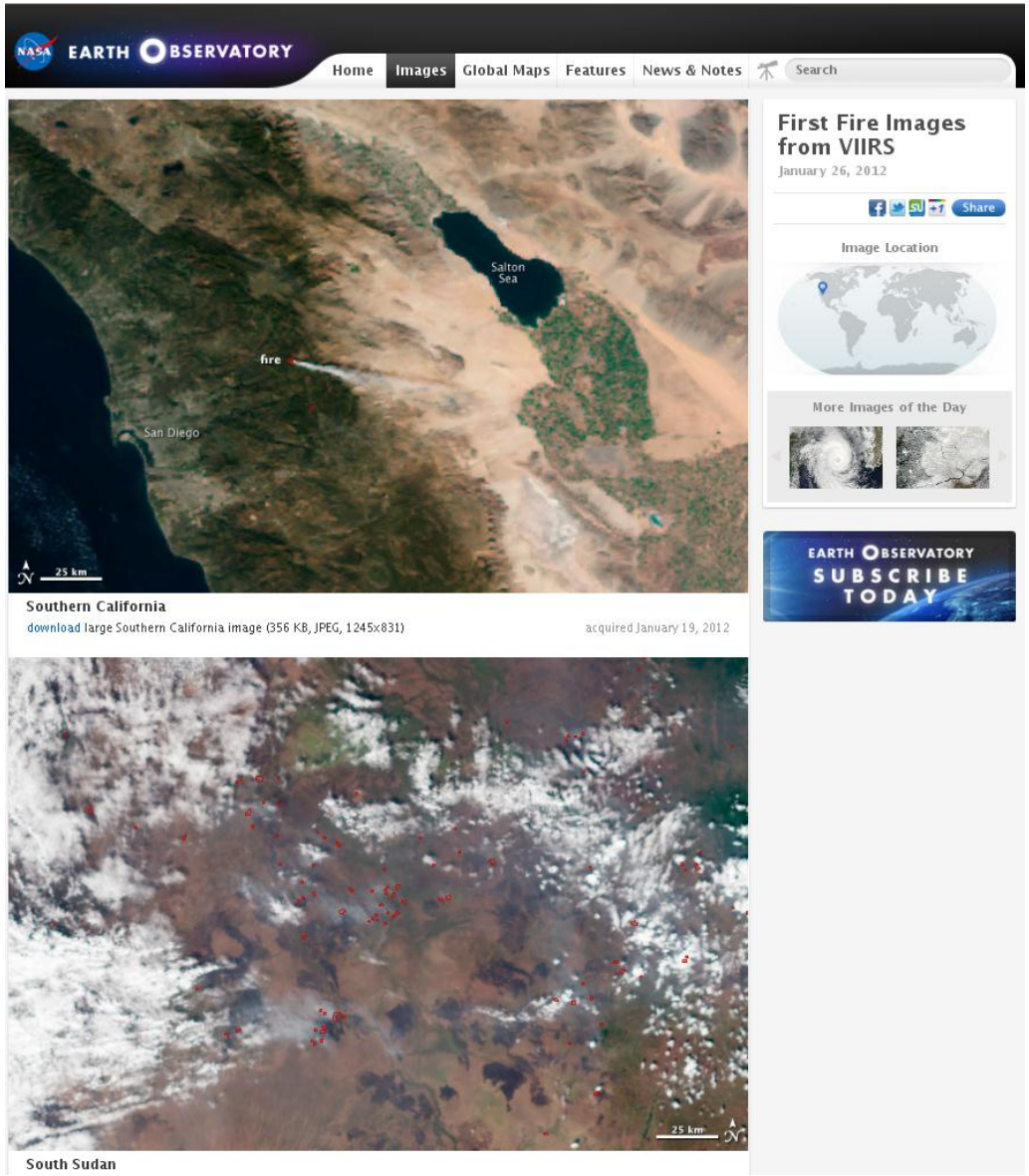
T_{sat} 367 K

T_{sat} 634 K

T_{sat} 363 K

T_{sat} 380 K

First Light



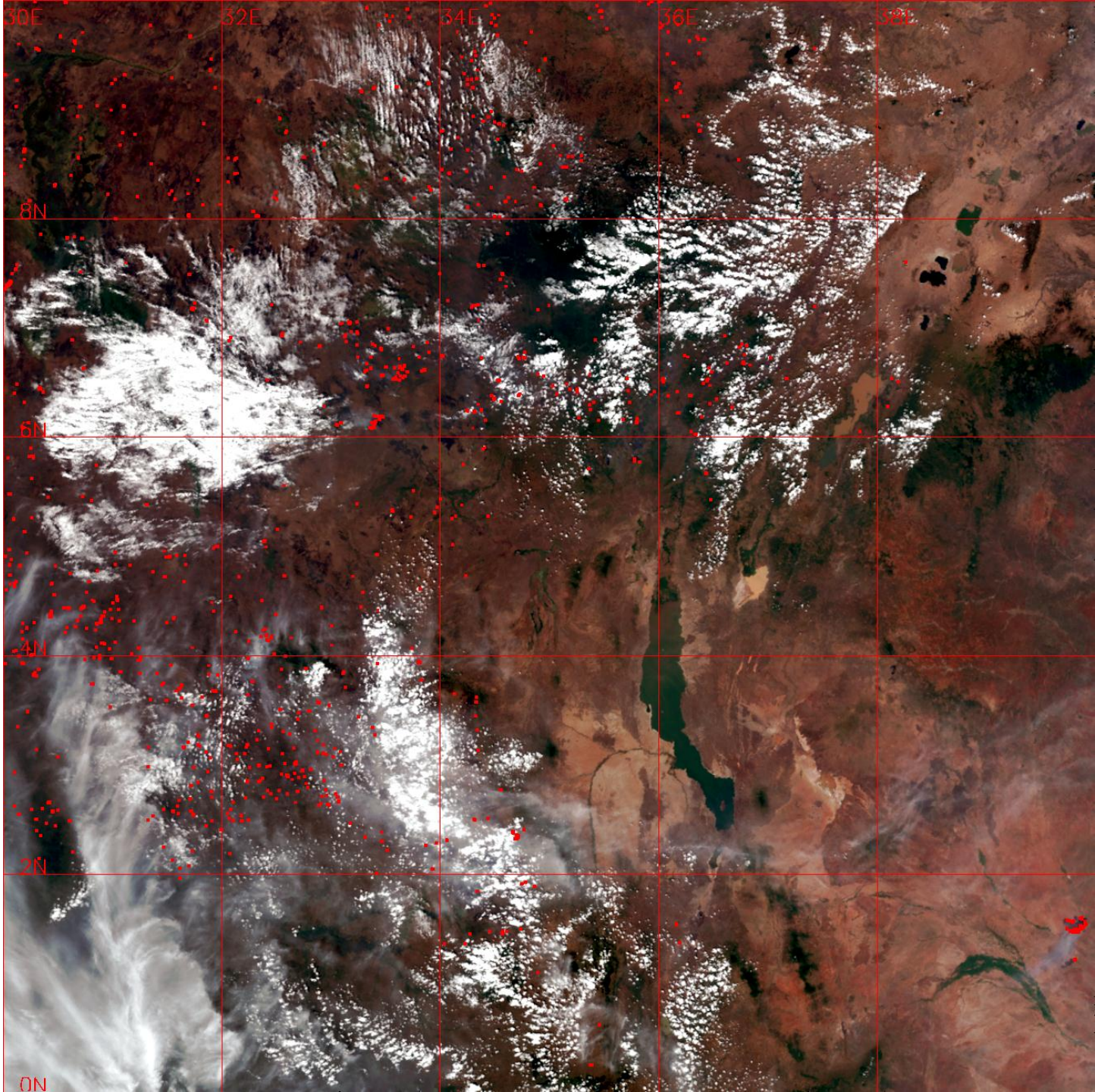
First light images for VIIRS active fire detection product posted on NASA Earth Observatory

Images were produced by the NPP Active Fire team at UMD approximately 18h after activation of cooler doors following first visually confirmed fire detections over Easter Africa

http://earthobservatory.nasa.gov/IOTD/view.php?id=77025&src=ve

First light NPP VIIRS 750m fire data

M5-M4-M3 RGB
+
IDPS Active Fire ARP

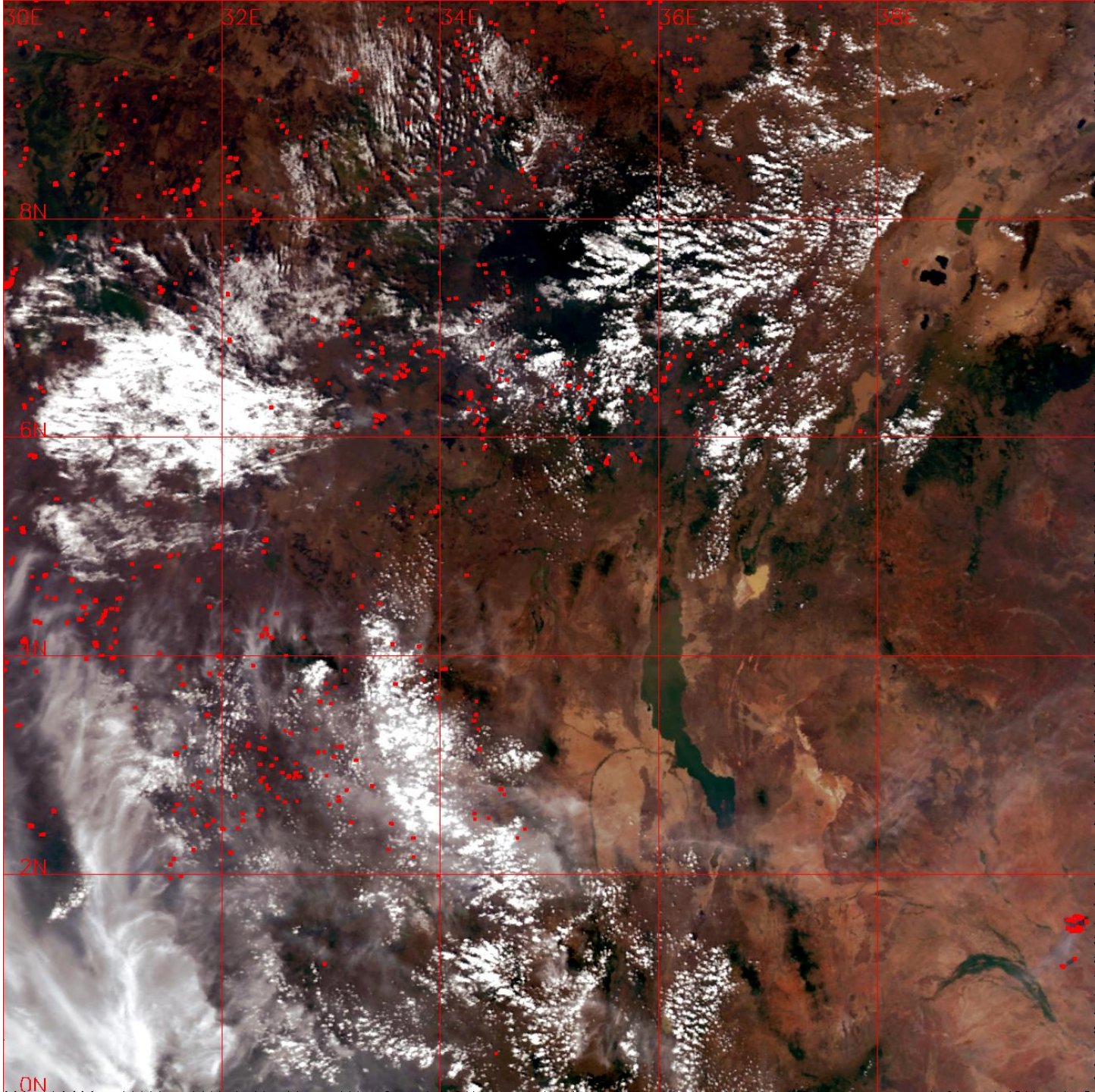


January 19, 2012
~11:05 UTC

…followed by
1km
Aqua/MODIS
5min later

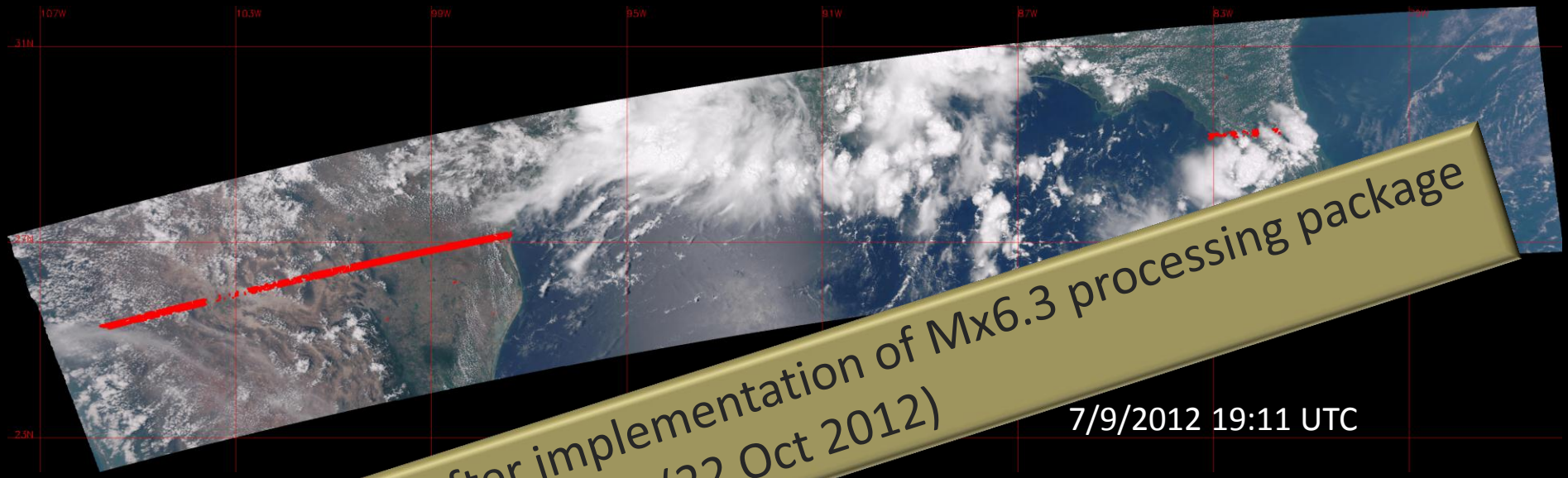
Band 1-4-3 RGB
+
MYD14

January 19, 2012
~11:05 UTC

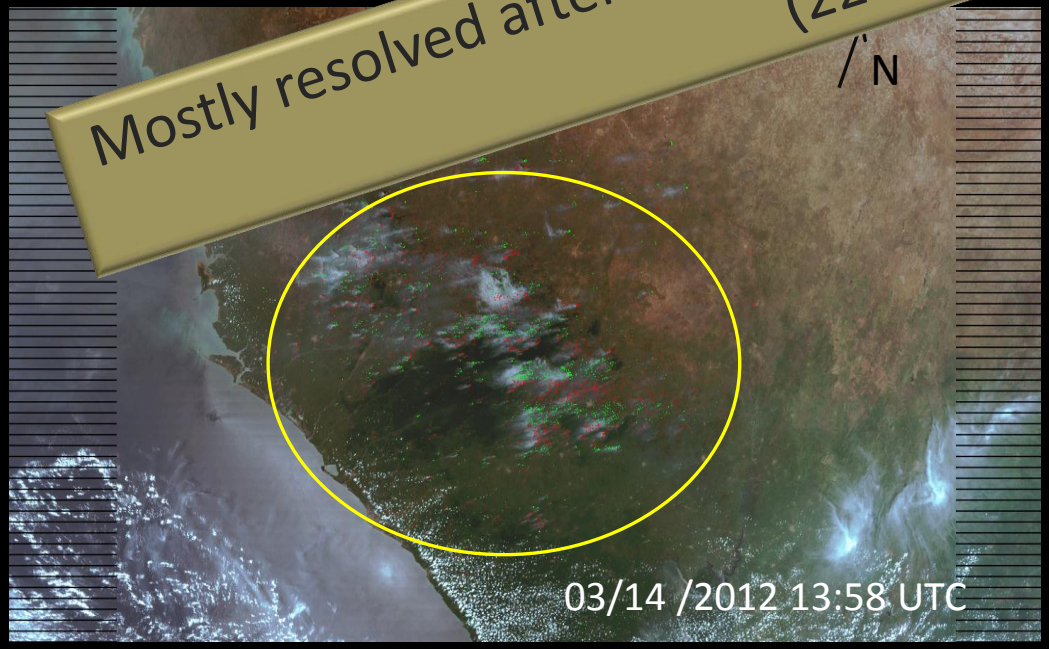


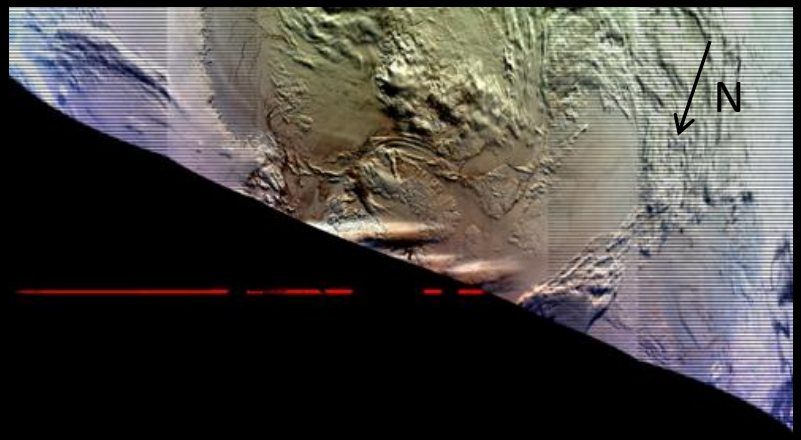
Spurious Fire Pixels

Main Variations



Mostly resolved after implementation of Mx6.3 processing package (22 Oct 2012)

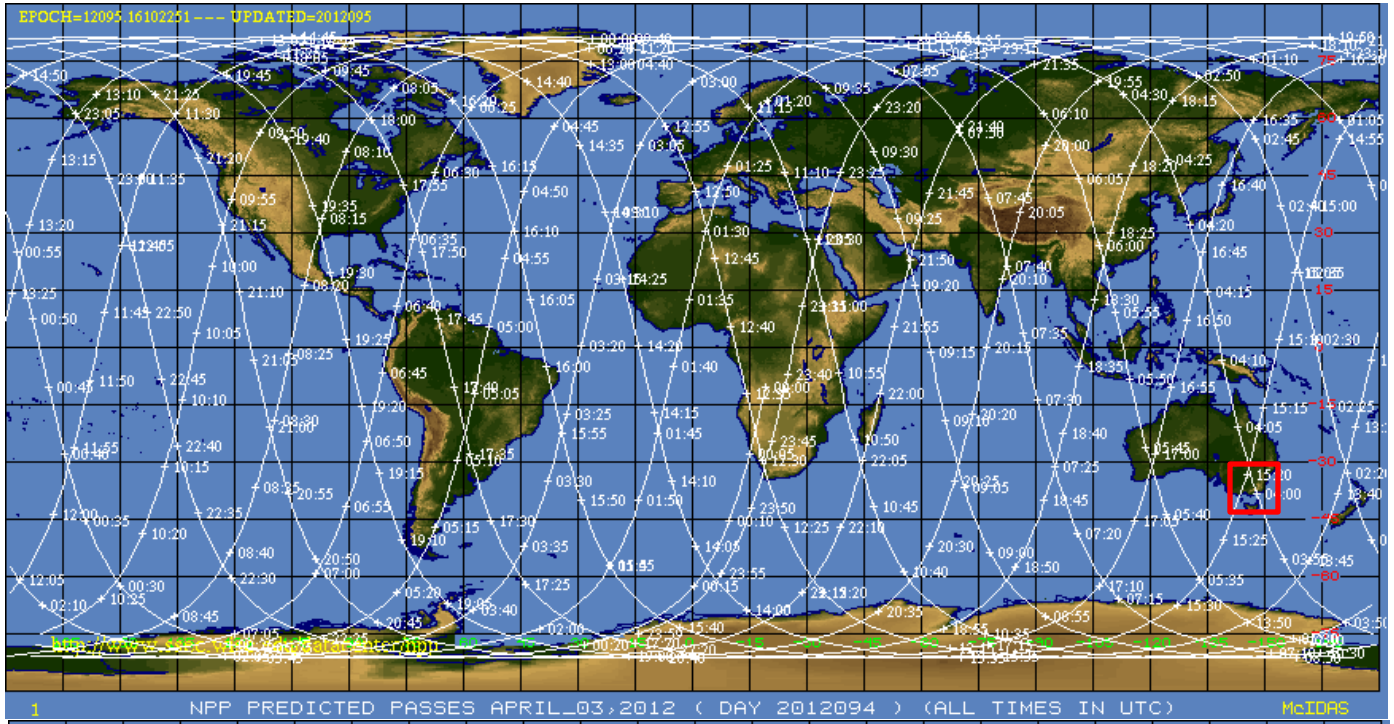




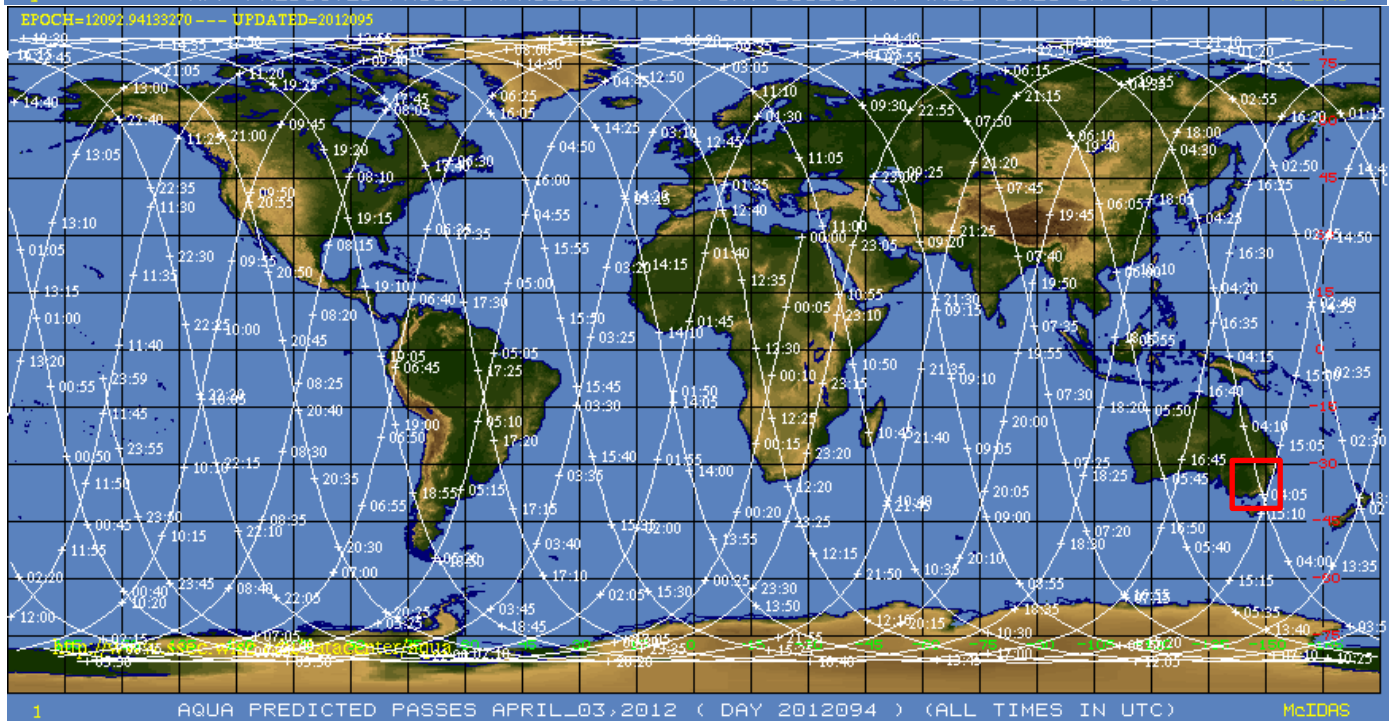
NPP

Satellite orbit tracks

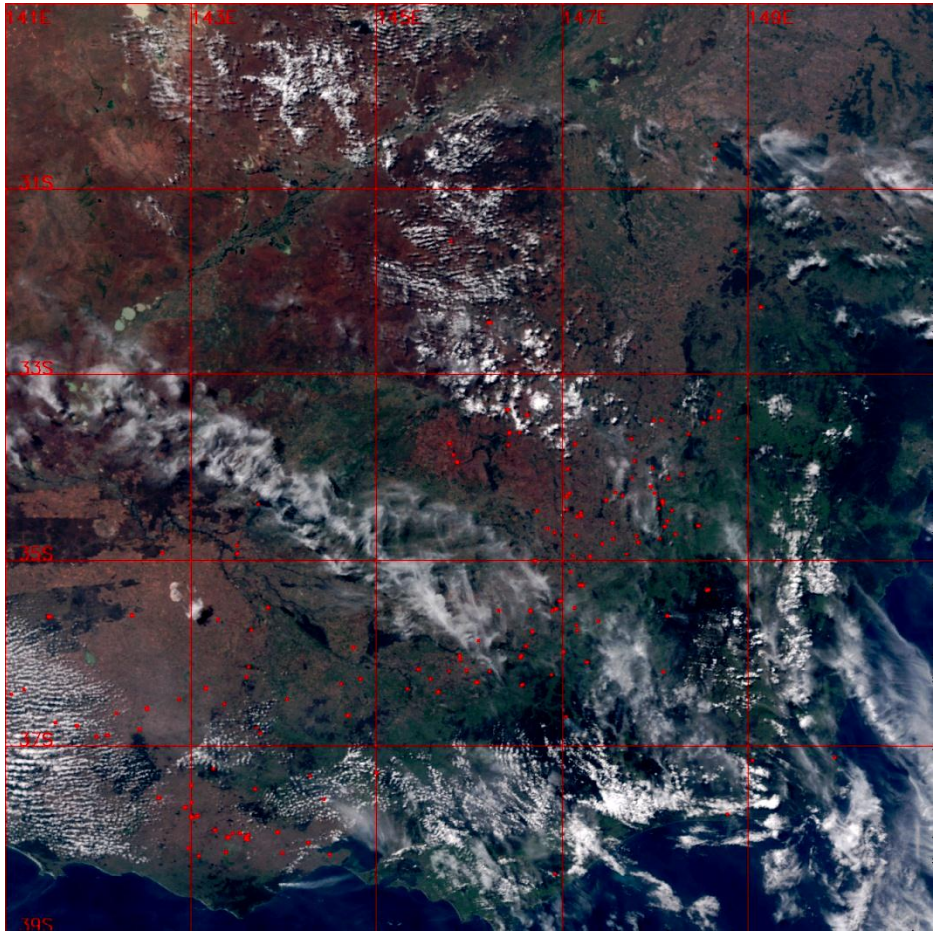
April 3, 2012



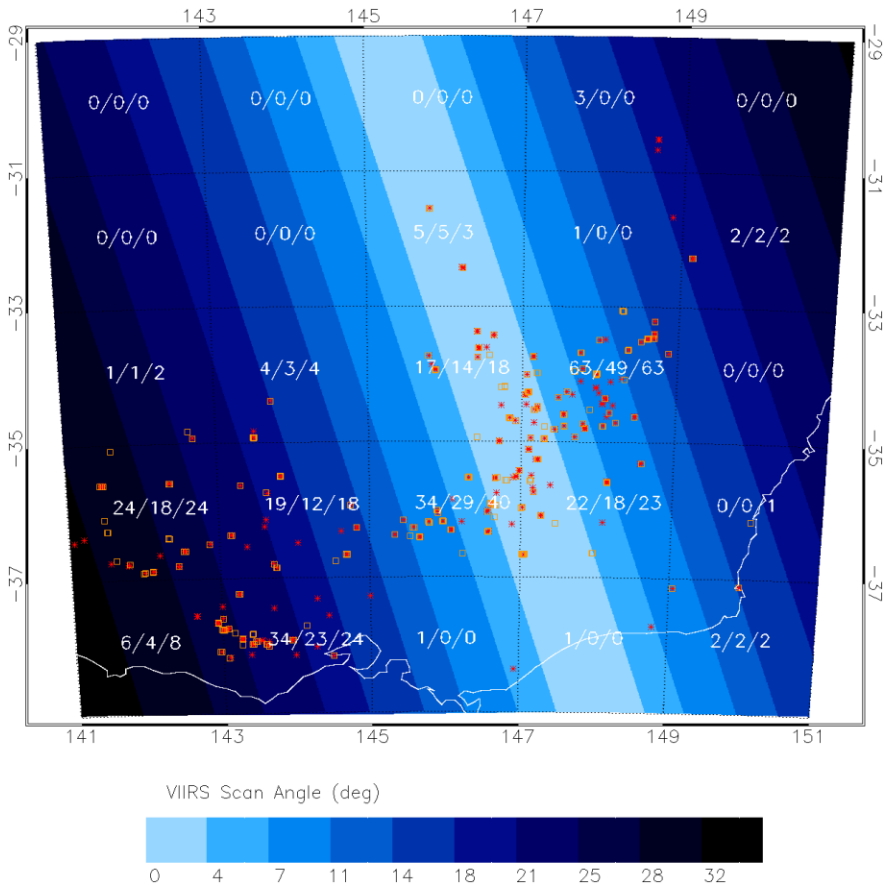
Aqua



MODIS and VIIRS fire detections at nadir: post-launch on-orbit data

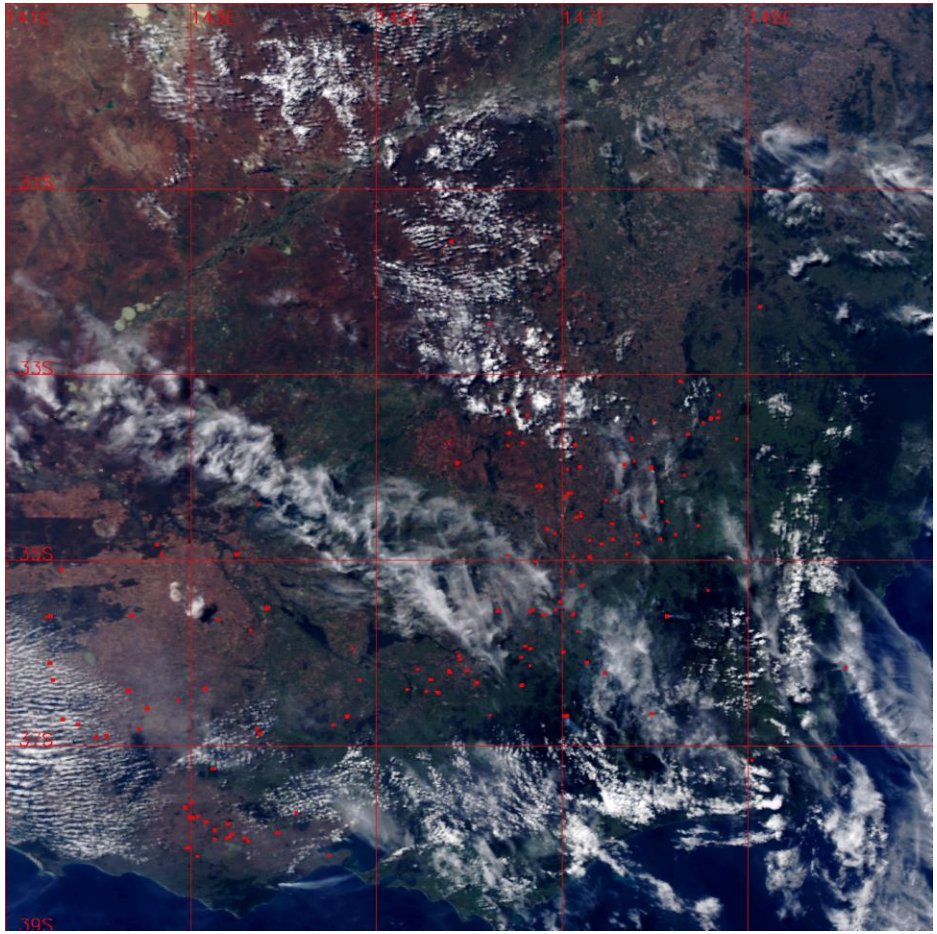


VIIRS 03 April 2012 03:55UTC
(SE Australia)

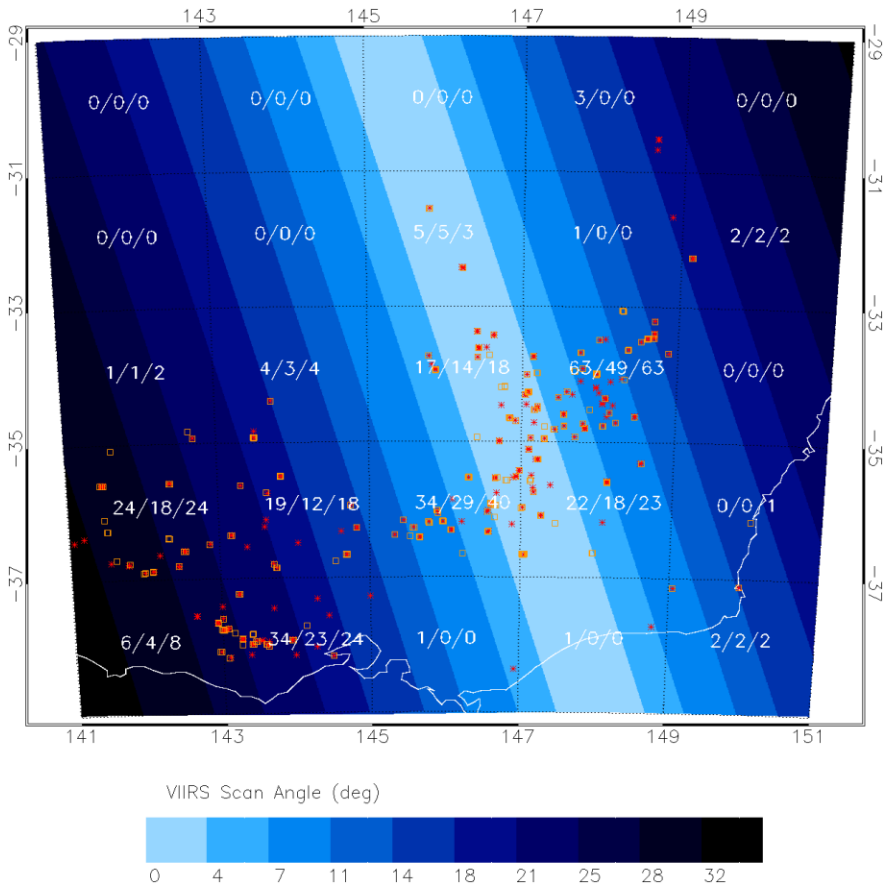


Gridded statistics: AA/BB/CC
AA – number of VIIRS fire pixels (red symbols)
BB – number of VIIRS fire pixels with overlapping Aqua/MODIS fire pixels
CC – number of Aqua/MODIS fire pixels (orange symbols)

MODIS and VIIRS fire detections at nadir: post-launch on-orbit data



MODIS 03 April 2012 04:05UTC
(SE Australia)



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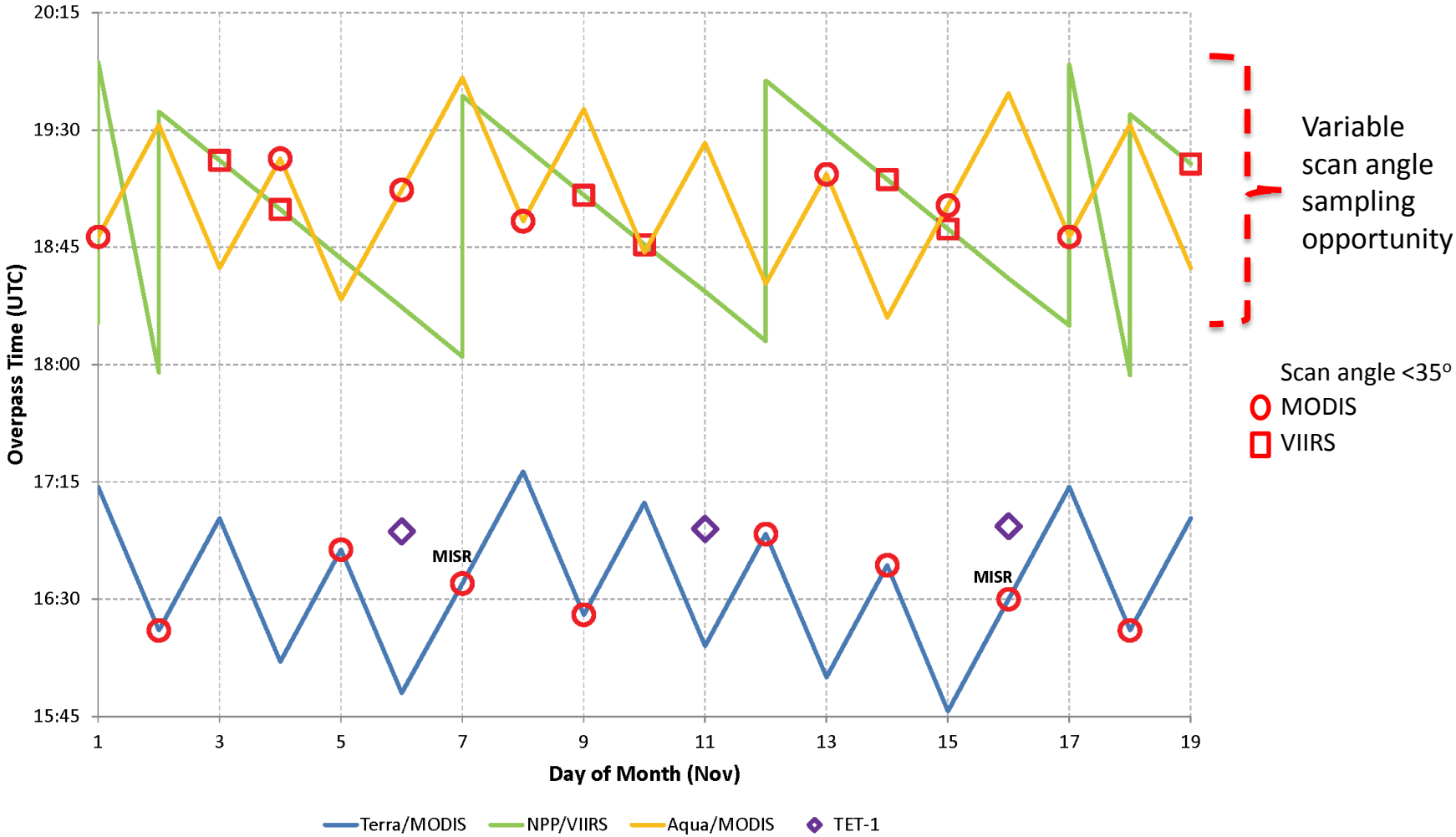
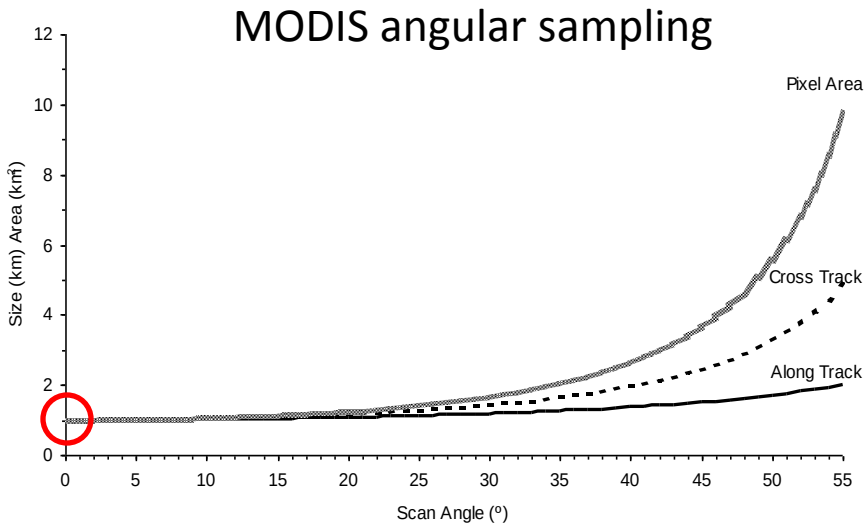
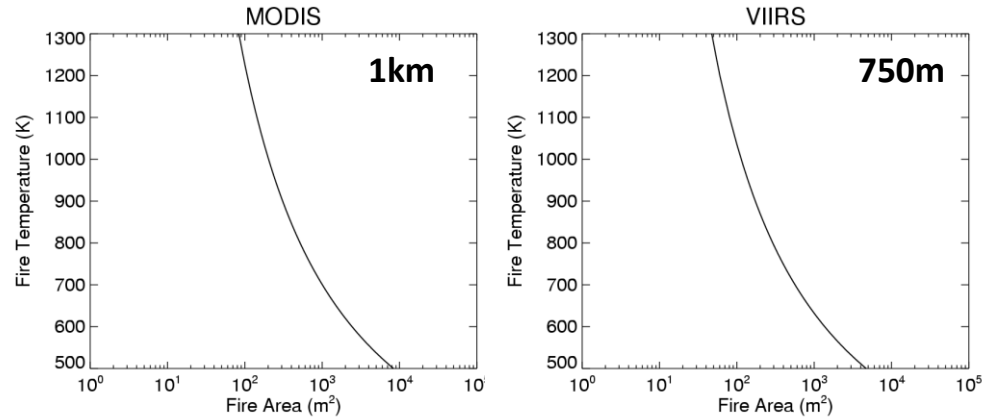
VIIRS x MODIS Data Intercomparison: Spacecraft Overpass Times

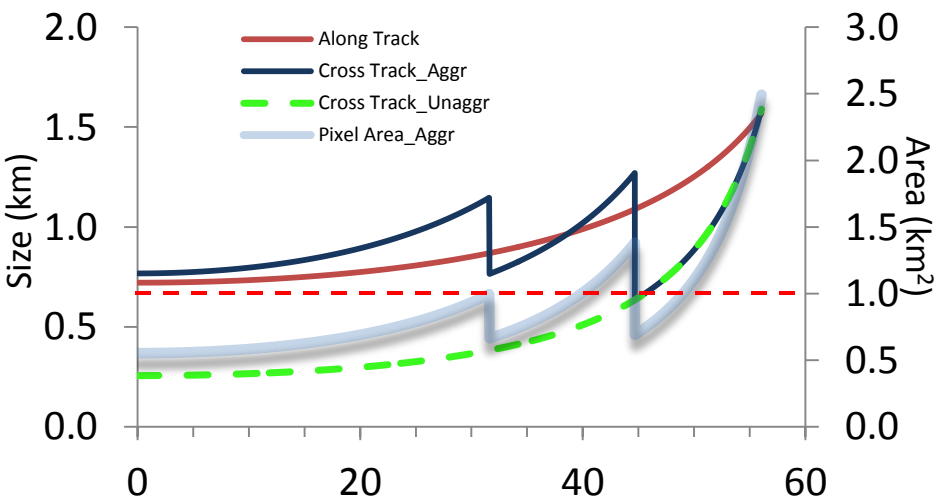


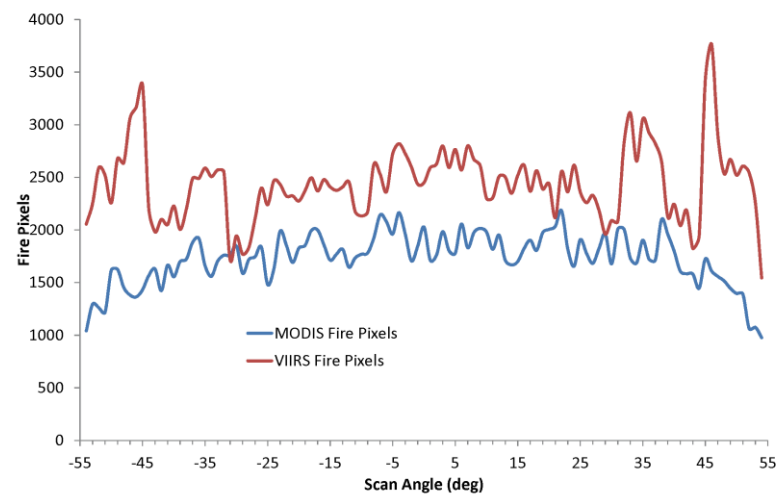
Sample orbit data for RxCadre experiment in Florida/Nov 2012

Aqua MODIS vs. Suomi NPP VIIRS







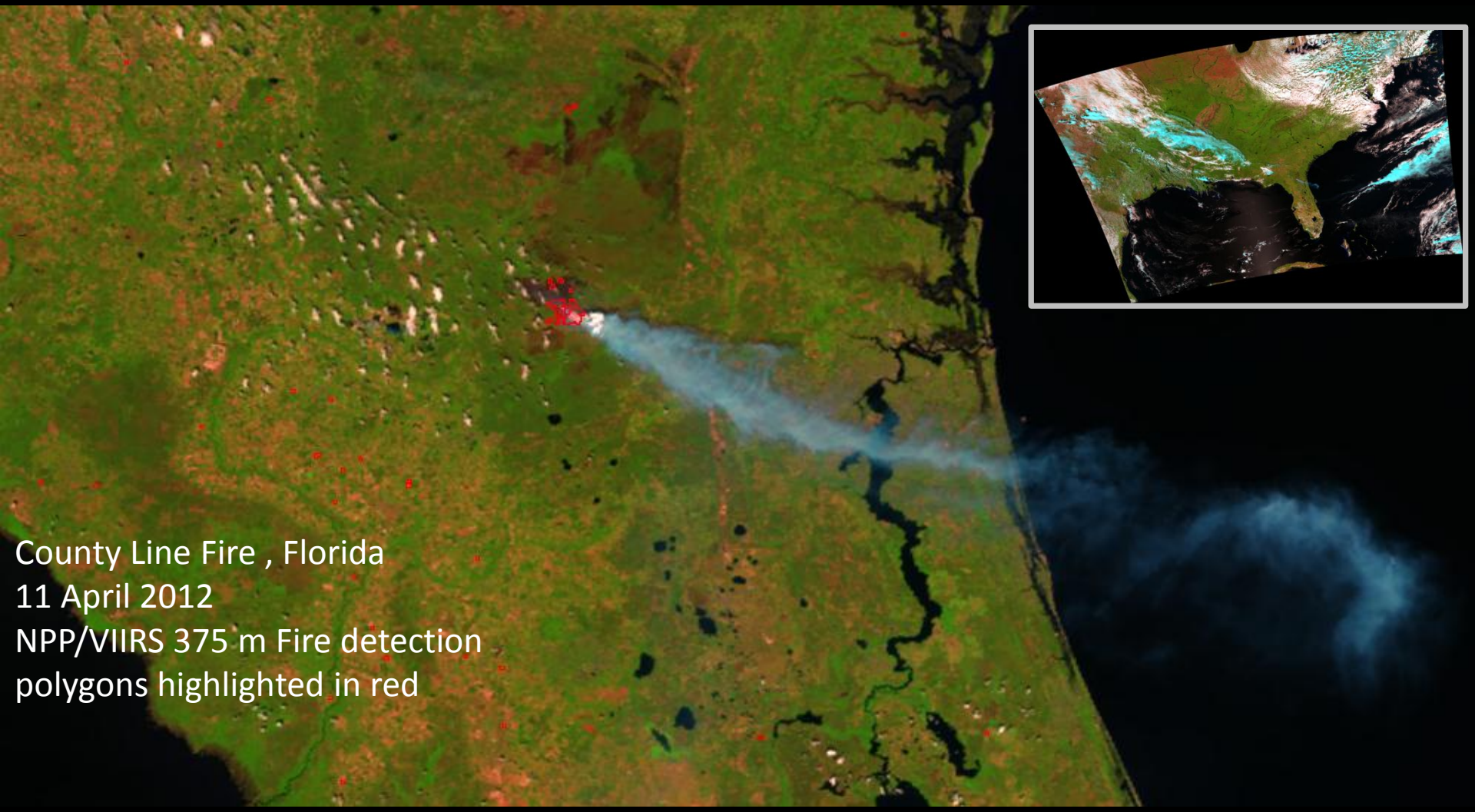


Compatible orbital segments are determined by pixel sizes

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

New NPP/VIIRS Active Fire Data

VIIRS 375m data

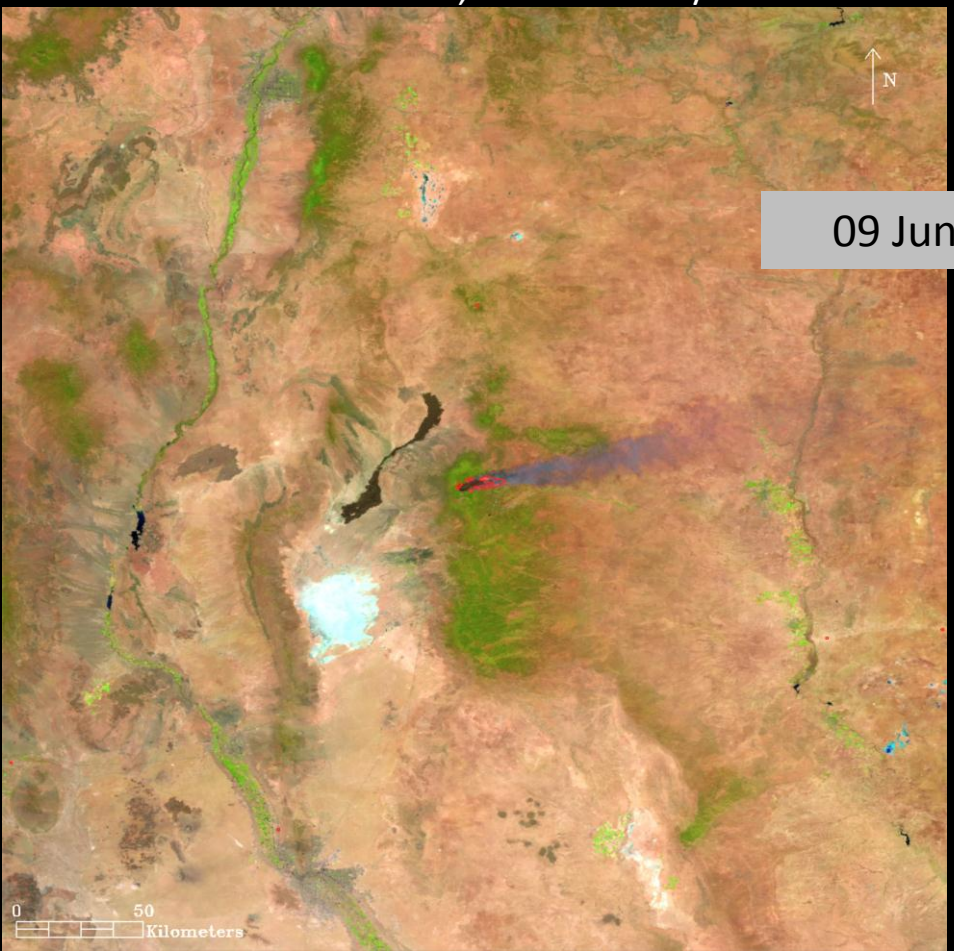


Fire Detection Applications

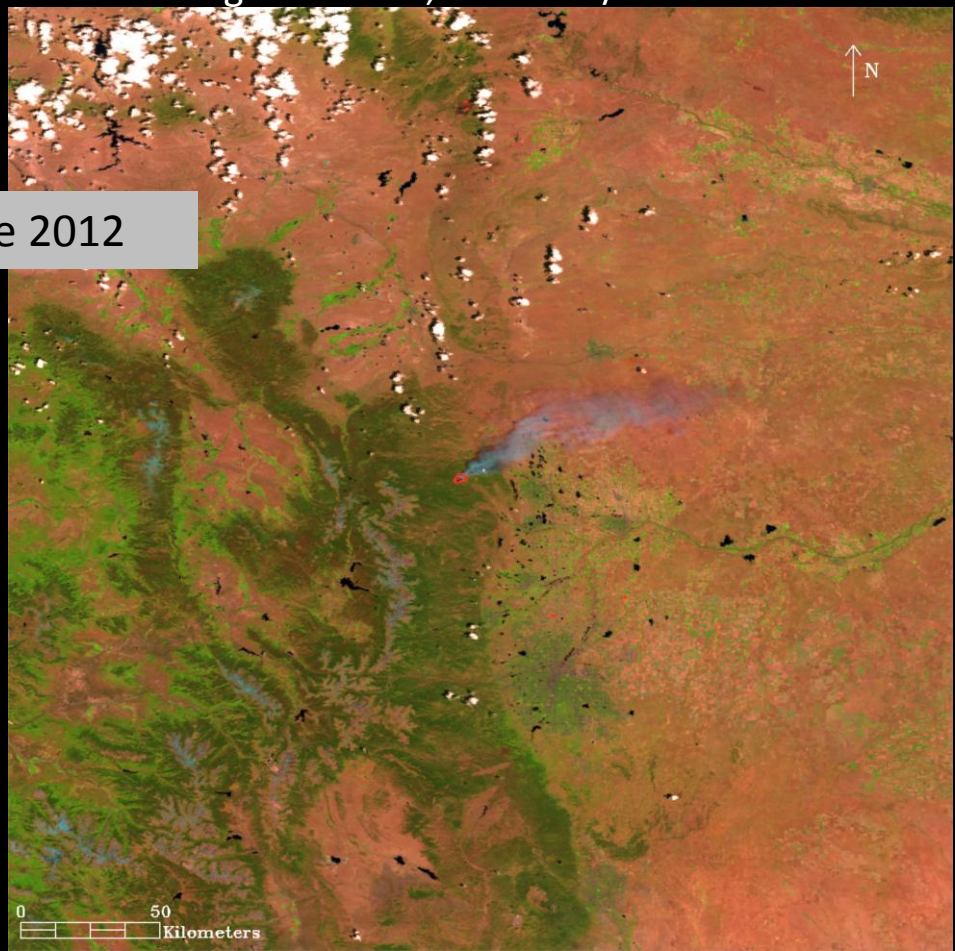
New satellite active fire detection data sets will provide refined spatial information

- "Hot spots" may be replaced by "fire polygons" describing individual burns
- Imagery should be made available and used – when possible – along with "fire polygons"

Little Bear Fire, New Mexico/USA



High Park Fire, Colorado/USA



09 June 2012

Fire Detection Applications

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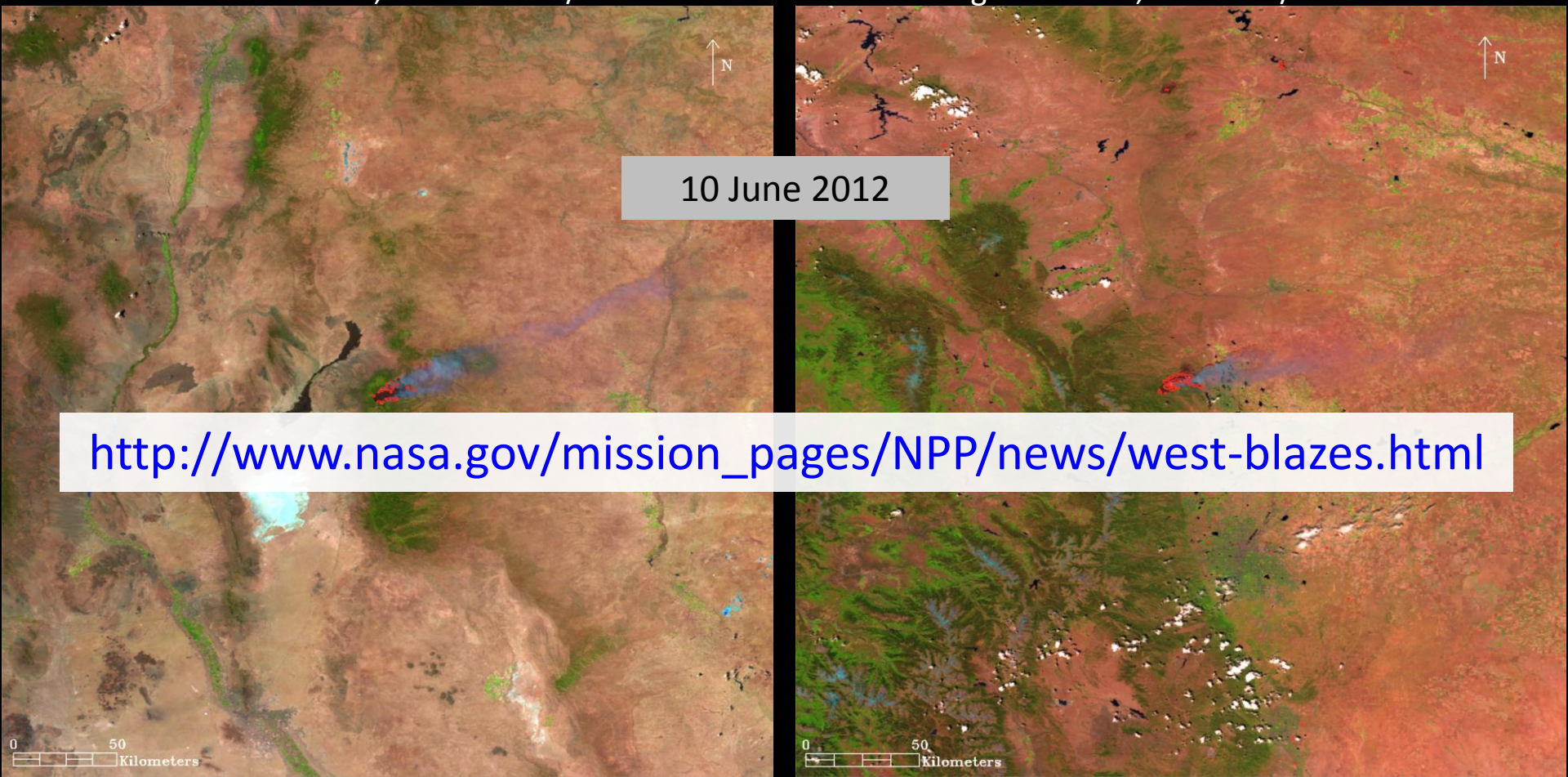
Little Bear Fire, New Mexico/USA

High Park Fire, Colorado/USA



http://www.nasa.gov/mission_pages/NPP/news/west-blazes.html

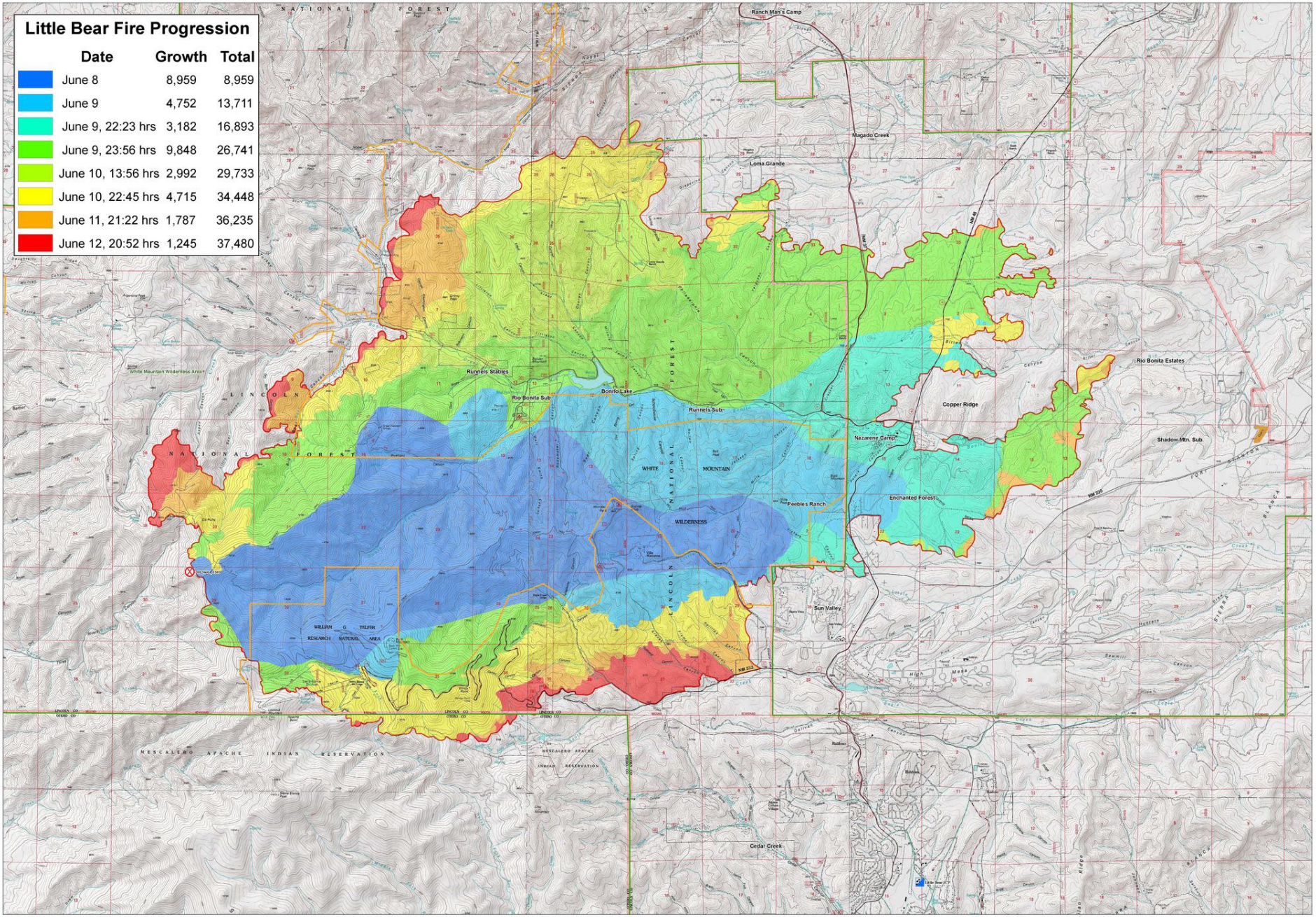
Example 1:
Little Bear Fire, June 2012

Location: 200km SE of Albuquerque, NM
Center Coords (approx.): 33.4^{o}N 105.8^{o}W

Active Fire Detection Polygons Derived from USDA Forest Service fire survey, NPP/VIIRS 375m, EO1-ALI, and MODIS 500m data

Fire behavior modeling using CAWFE

First detection made by VIIRS on 08 June ~20:31UTC
four days after lightning strike (ignition source)



Little Bear Progression Map

Day Operational Period: 6/13/2012

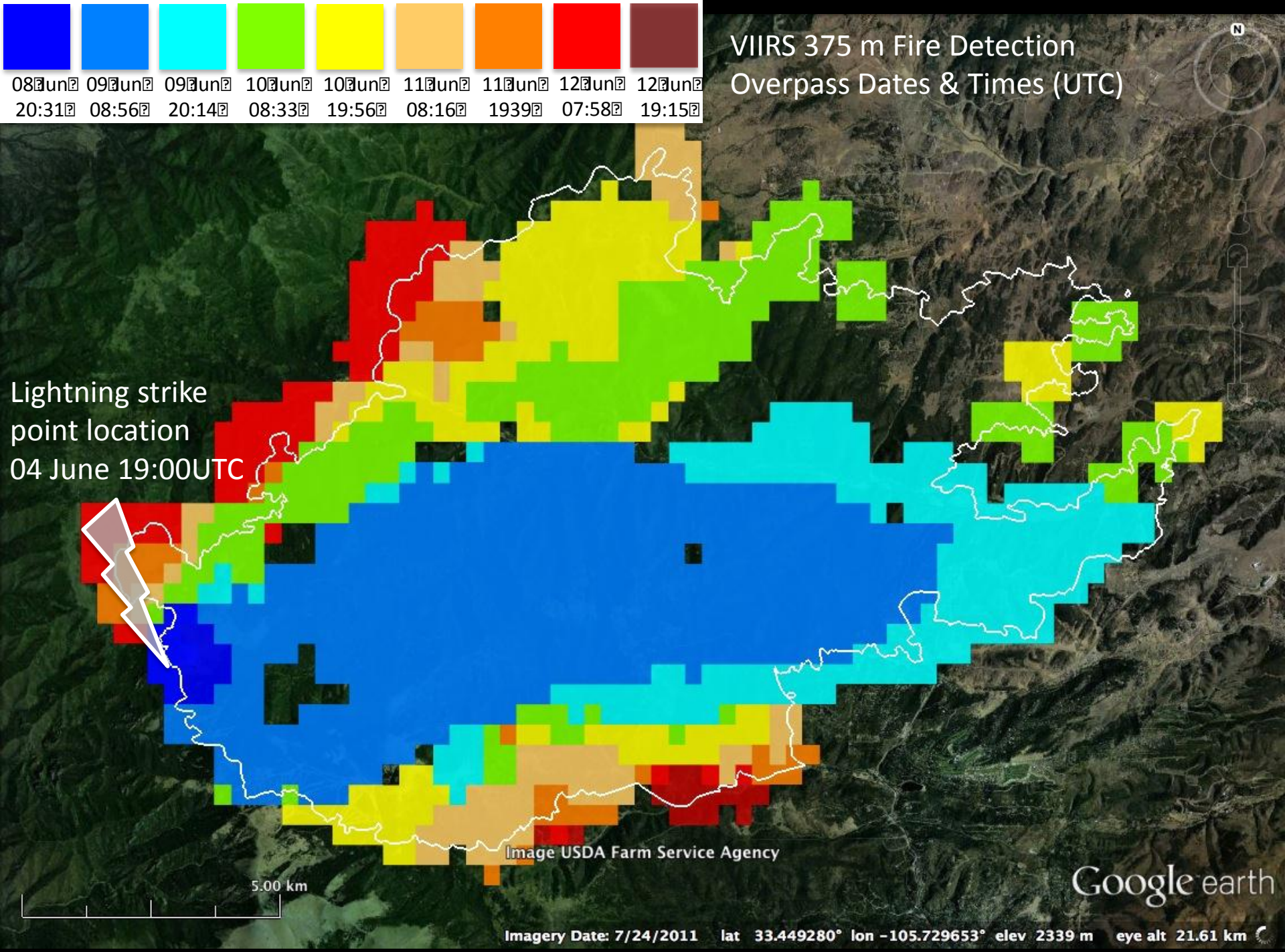
Map Created 6/13/2012 RDC/CIMM

0 0.5 1 2 Miles

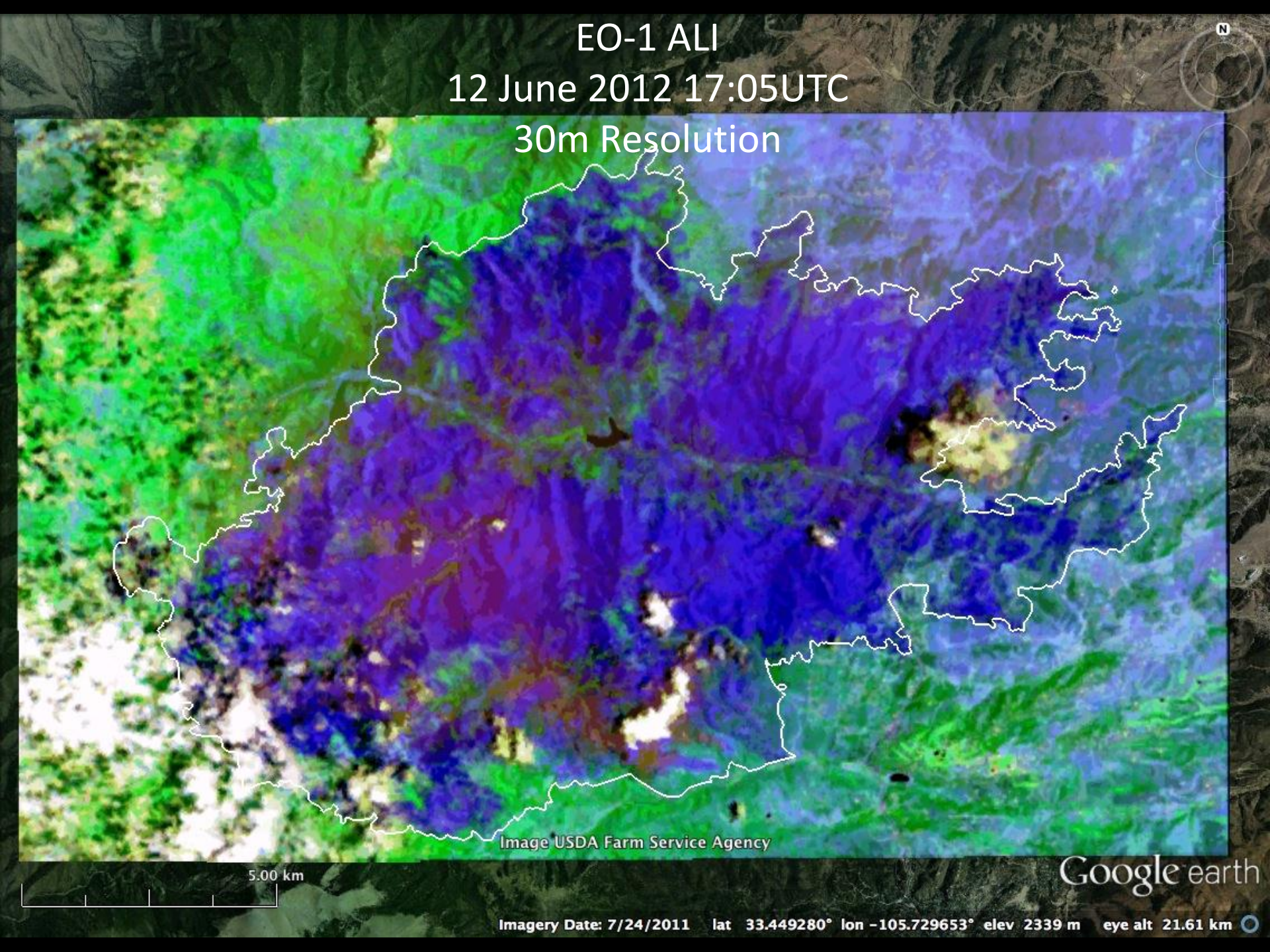
0 0.5 1 2 Kilometers

1:24,000

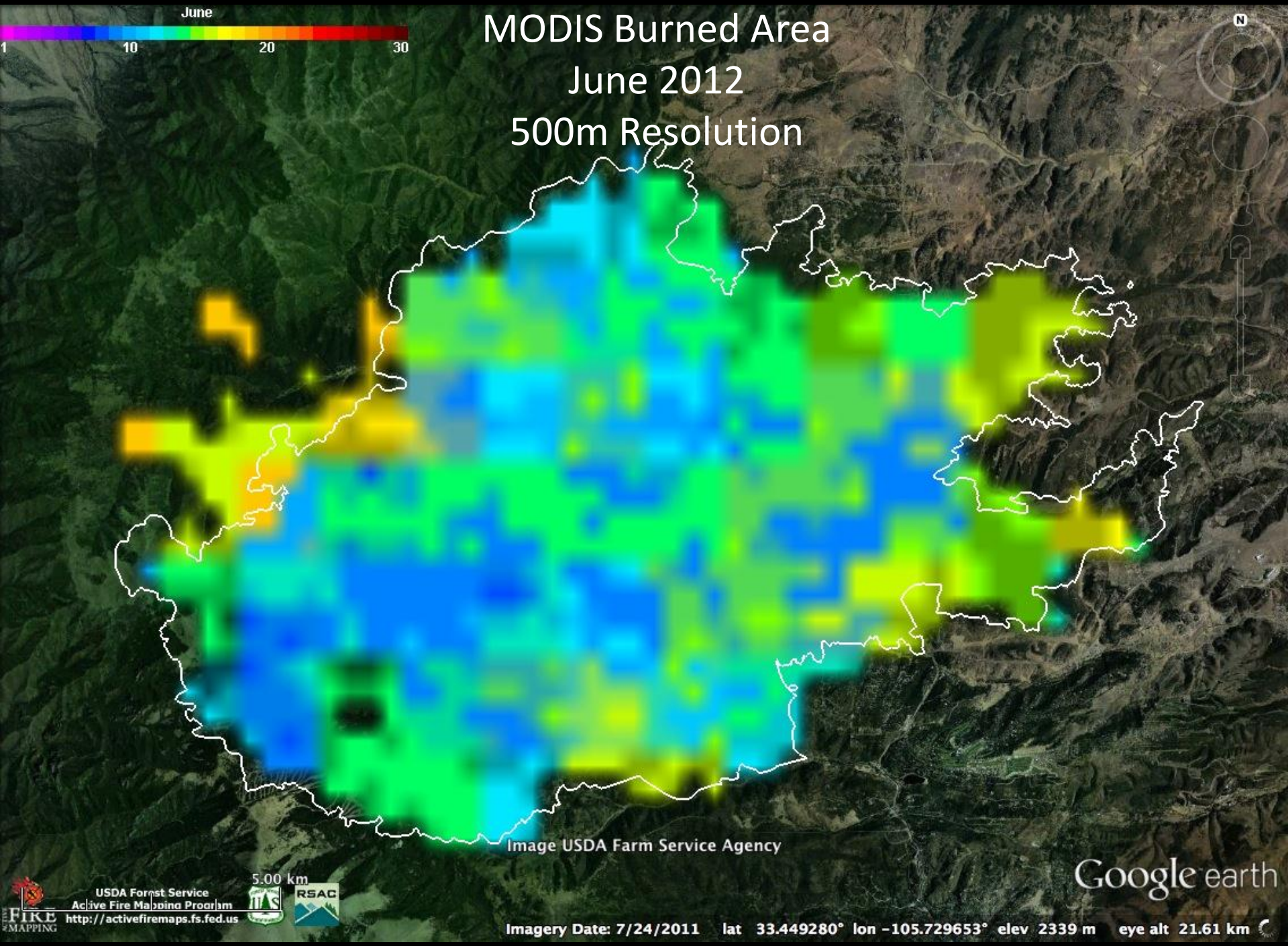
Fire Origin | Incident Command Post | Lincoln NF | Wilderness


08 Jun 20:31
09 Jun 08:56
09 Jun 20:14
10 Jun 08:33
10 Jun 19:56
11 Jun 08:16
11 Jun 1939
12 Jun 07:58
12 Jun 19:15
VIIRS 375 m Fire Detection
Overpass Dates & Times (UTC)
Lightning strike
point location
04 June 19:00UTC
Image USDA Farm Service Agency
5.00 km
Google earth
Imagery Date: 7/24/2011 lat 33.449280° lon -105.729653° elev 2339 m eye alt 21.61 km

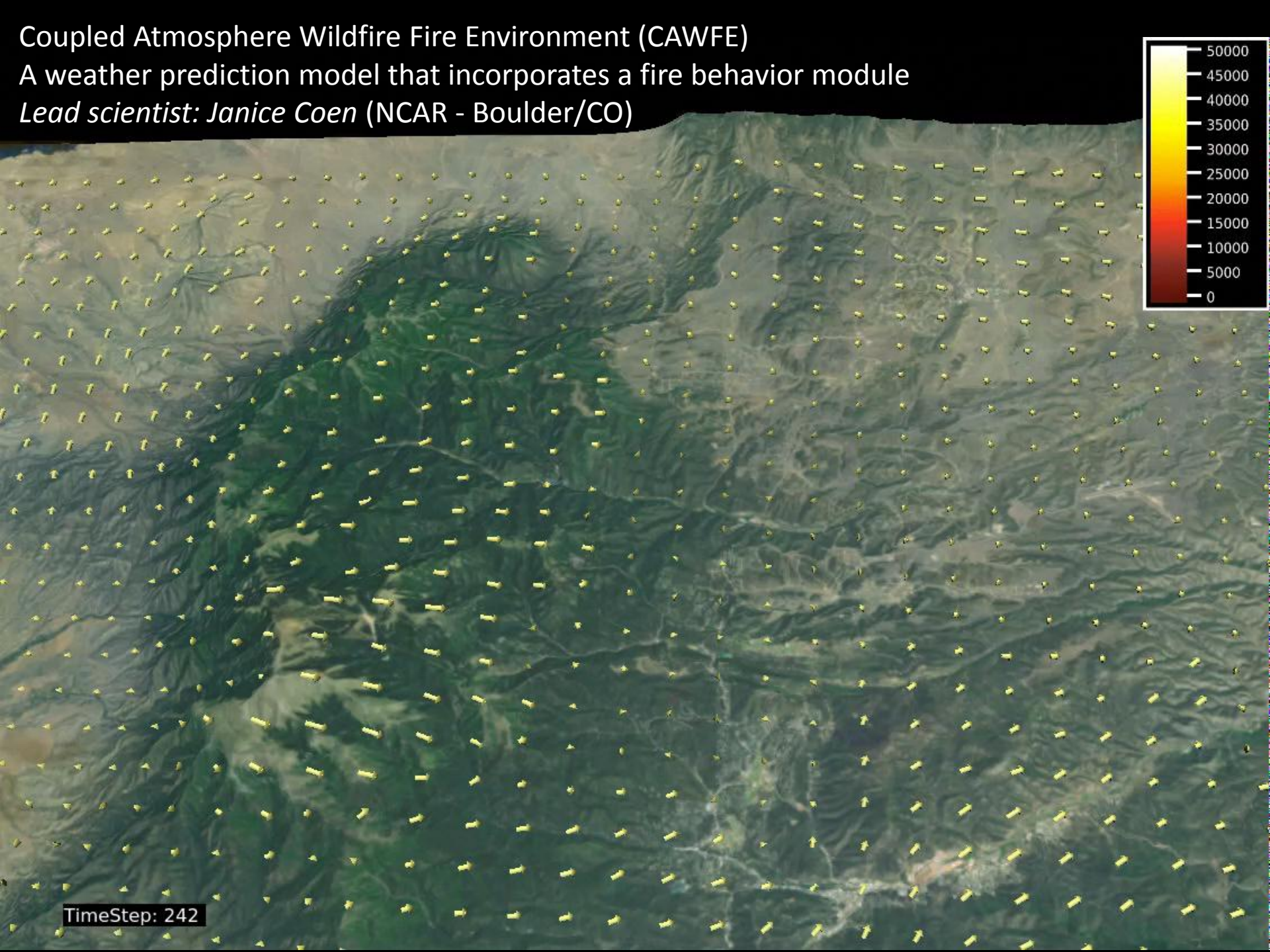
EO-1 ALI
12 June 2012 17:05UTC
30m Resolution



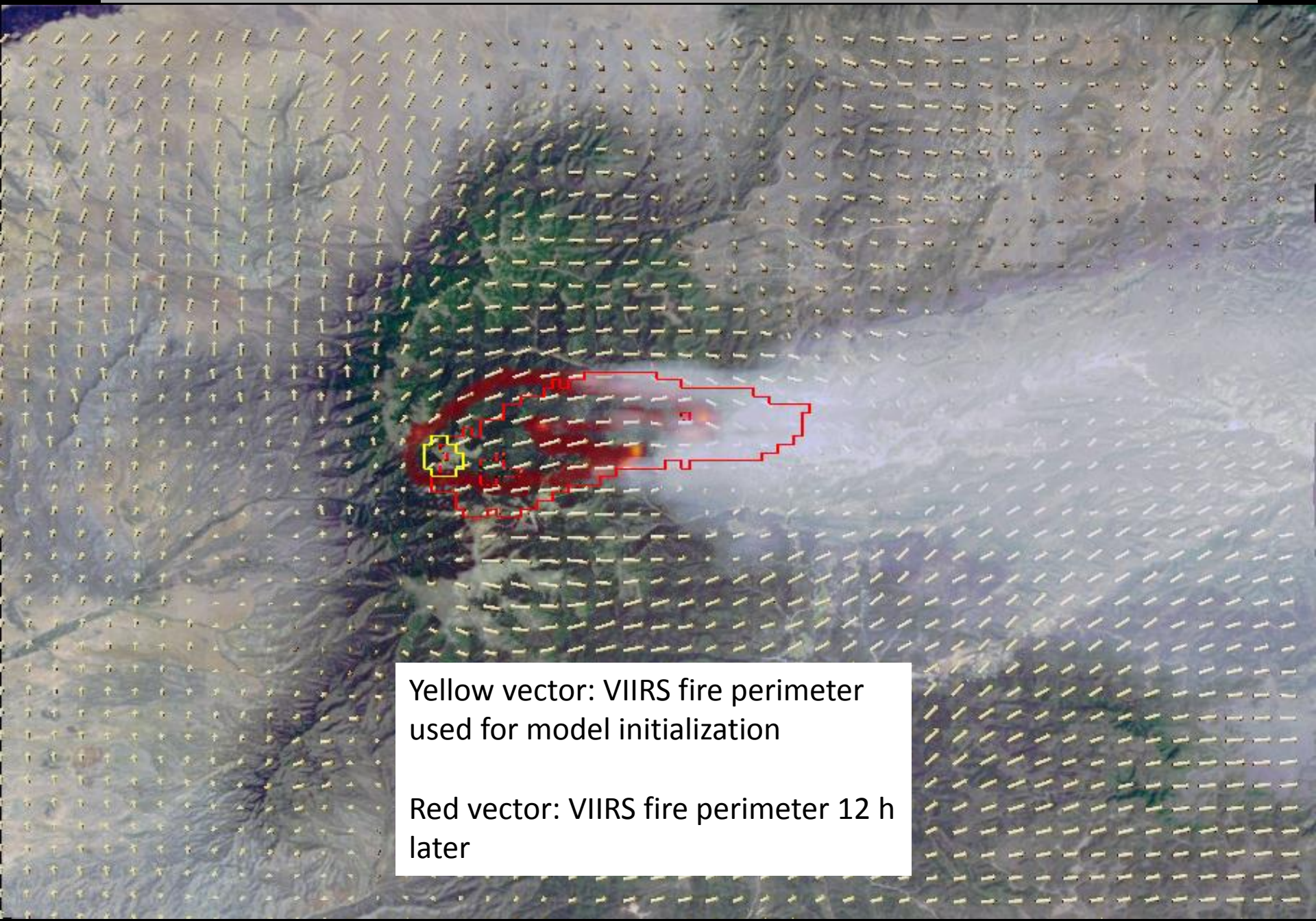
MODIS Burned Area
June 2012
500m Resolution



Coupled Atmosphere Wildfire Fire Environment (CAWFE)
A weather prediction model that incorporates a fire behavior module
Lead scientist: Janice Coen (NCAR - Boulder/CO)



12h CAWFE model prediction + coincident (actual) VIIRS data



Yellow vector: VIIRS fire perimeter used for model initialization

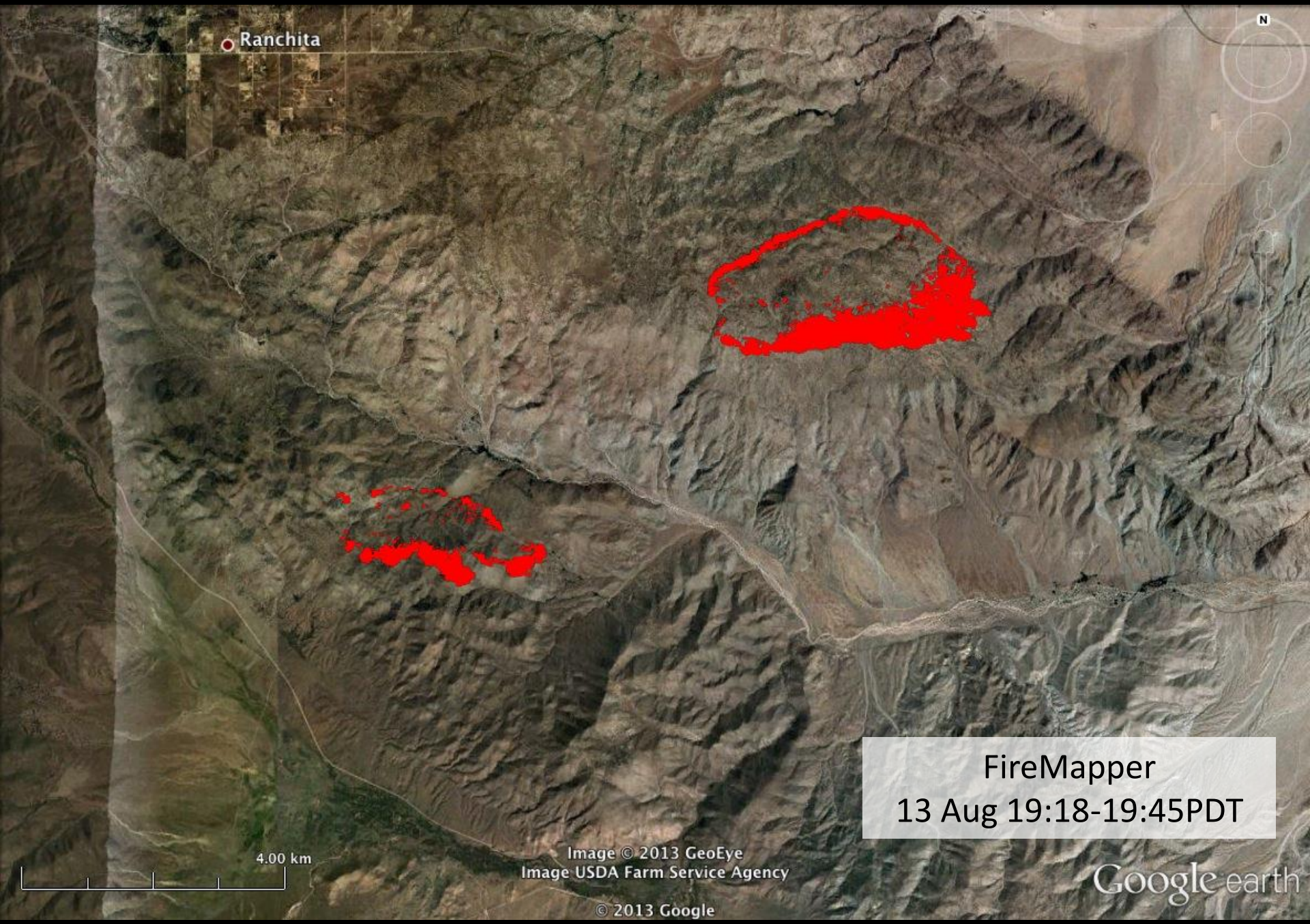
Red vector: VIIRS fire perimeter 12 h later

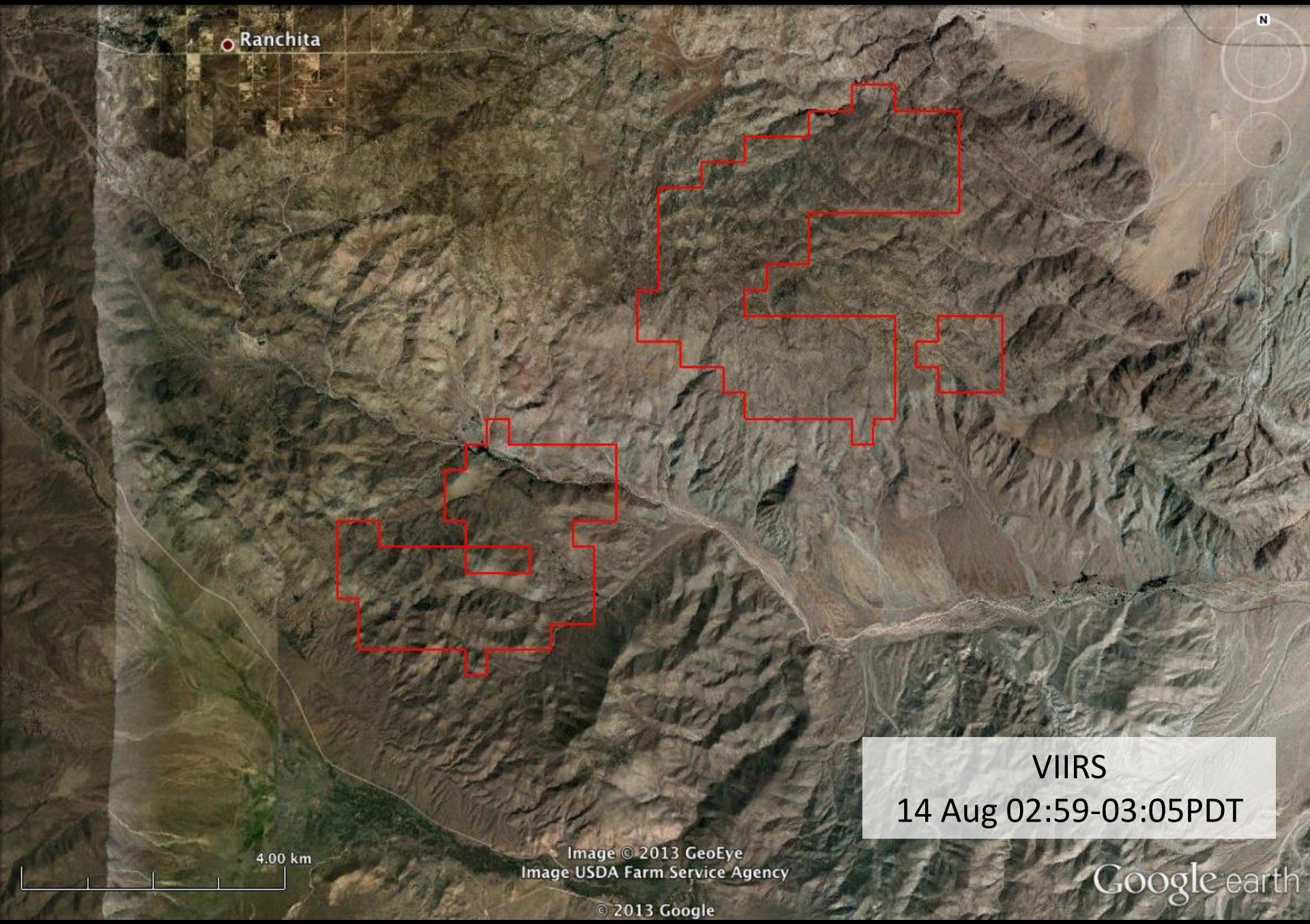
Example 2:
Vallecitos Fire, Aug 2012

Location: 80km NE of San Diego, CA
Center Coords (approx.): 33.1ºN 116.4ºW

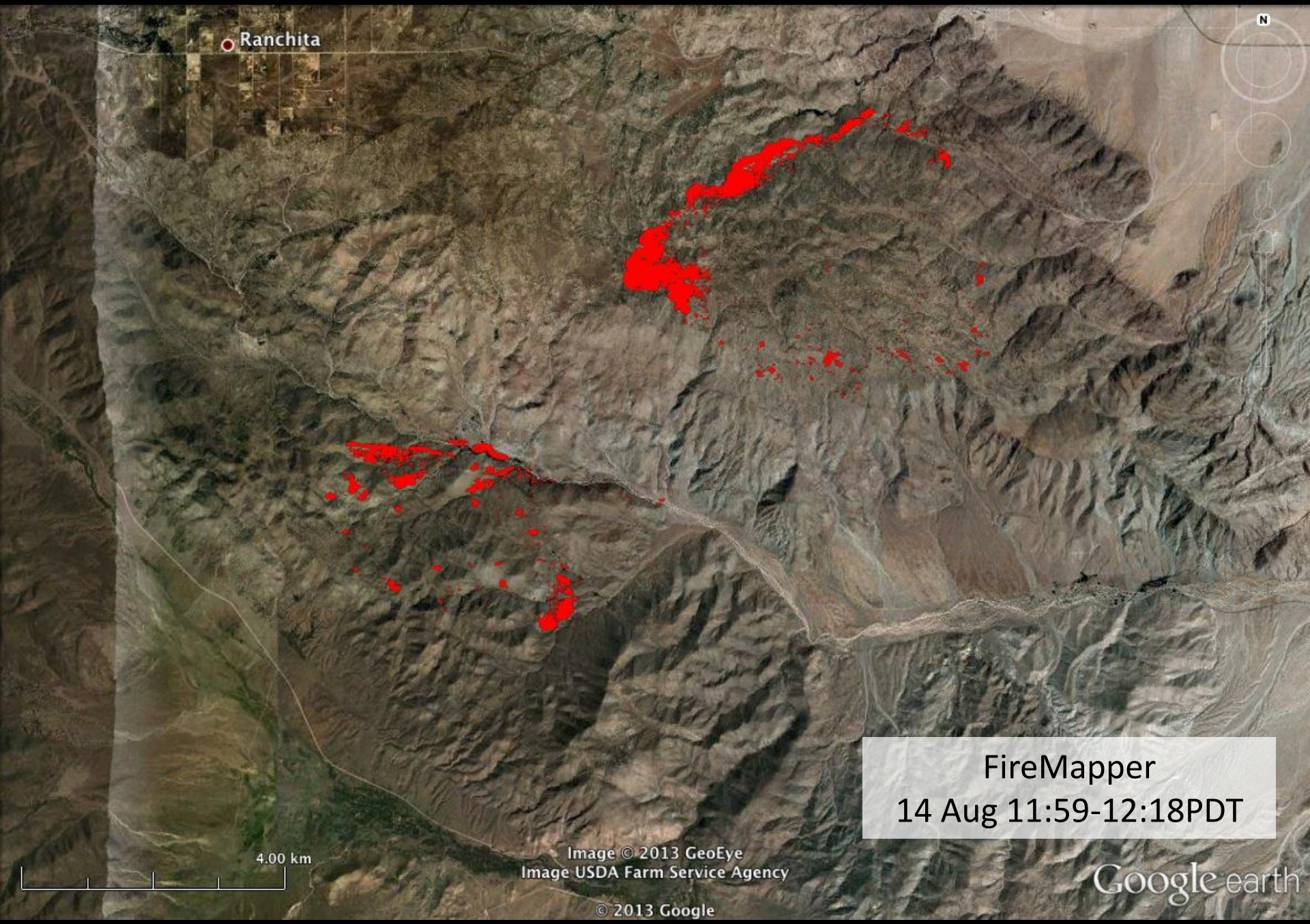
Active Fire Detection Polygons Derived from USDA FireMapper 10m airborne data and NPP/VIIRS 375m spaceborne data

First detection made by FireMapper on 13 Aug ~19:00PDT
followed by alternating imaging of fire by both VIIRS and FireMapper
VIIRS overpasses prior to 13 Aug 19:00PDT showing no distinguishable fire signature

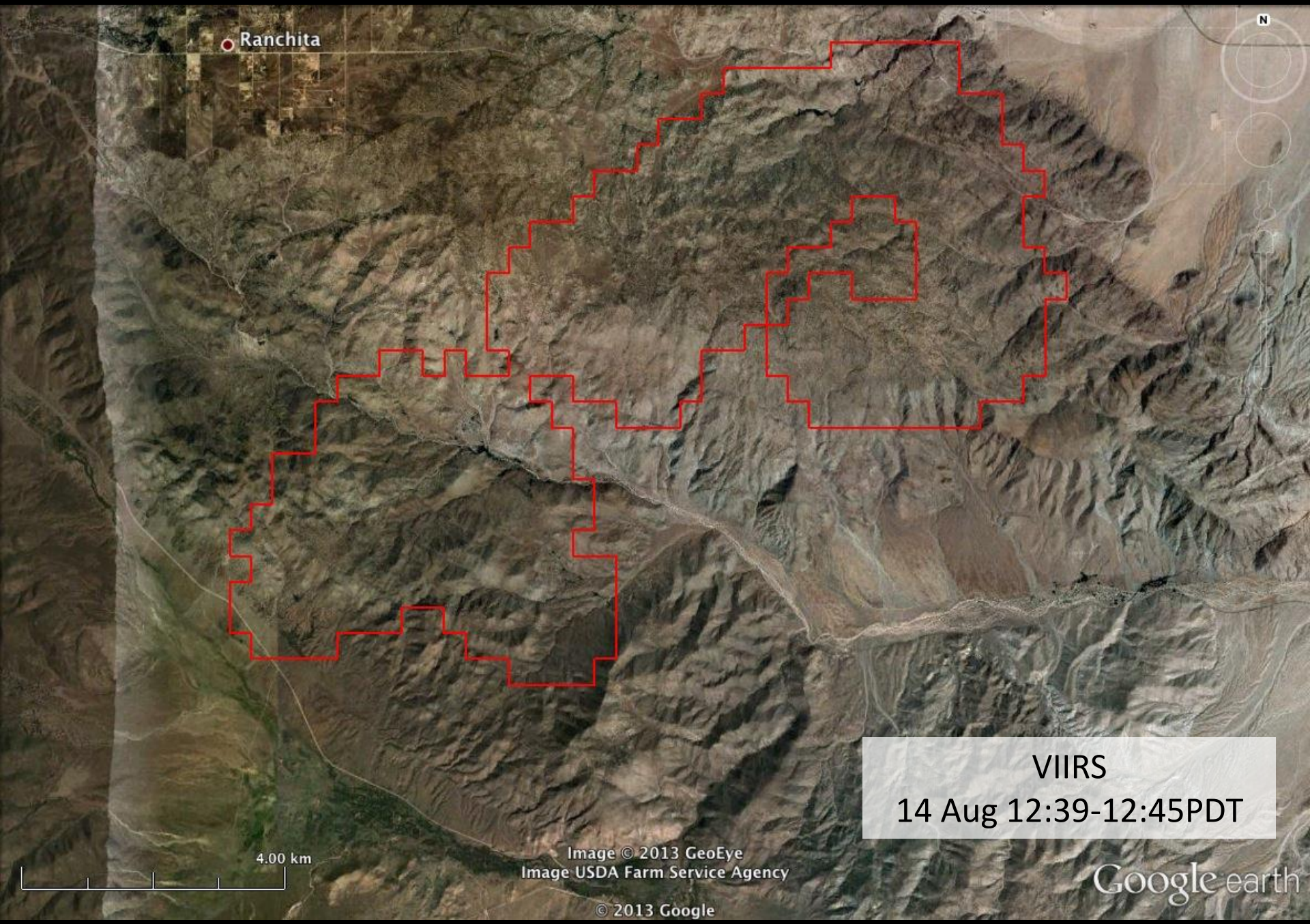

Ranchita
N
4.00 km
Image © 2013 GeoEye
Image USDA Farm Service Agency
© 2013 Google
Google earth
FireMapper
13 Aug 19:18-19:45PDT

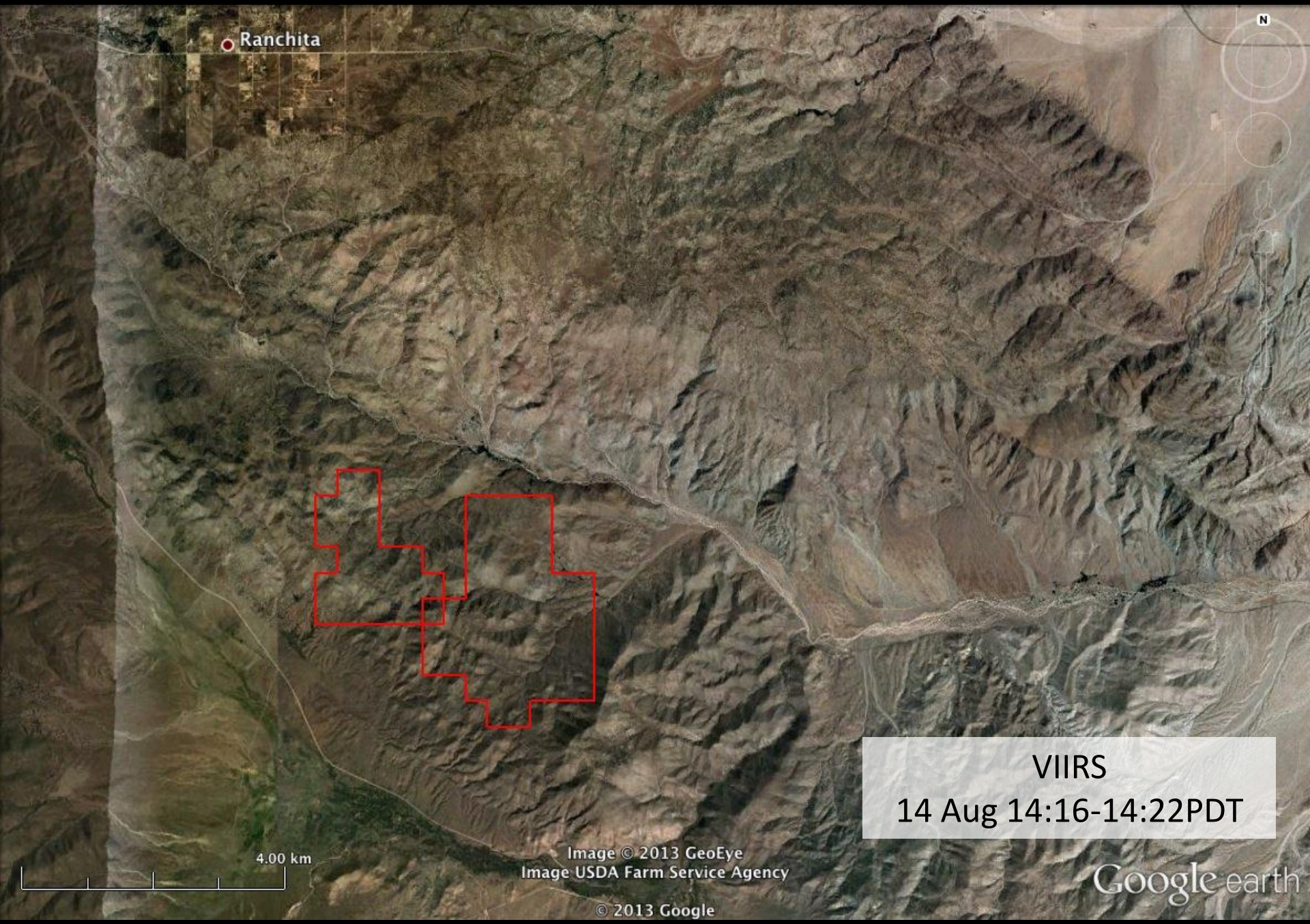


VIIRS
14 Aug 02:59-03:05PDT

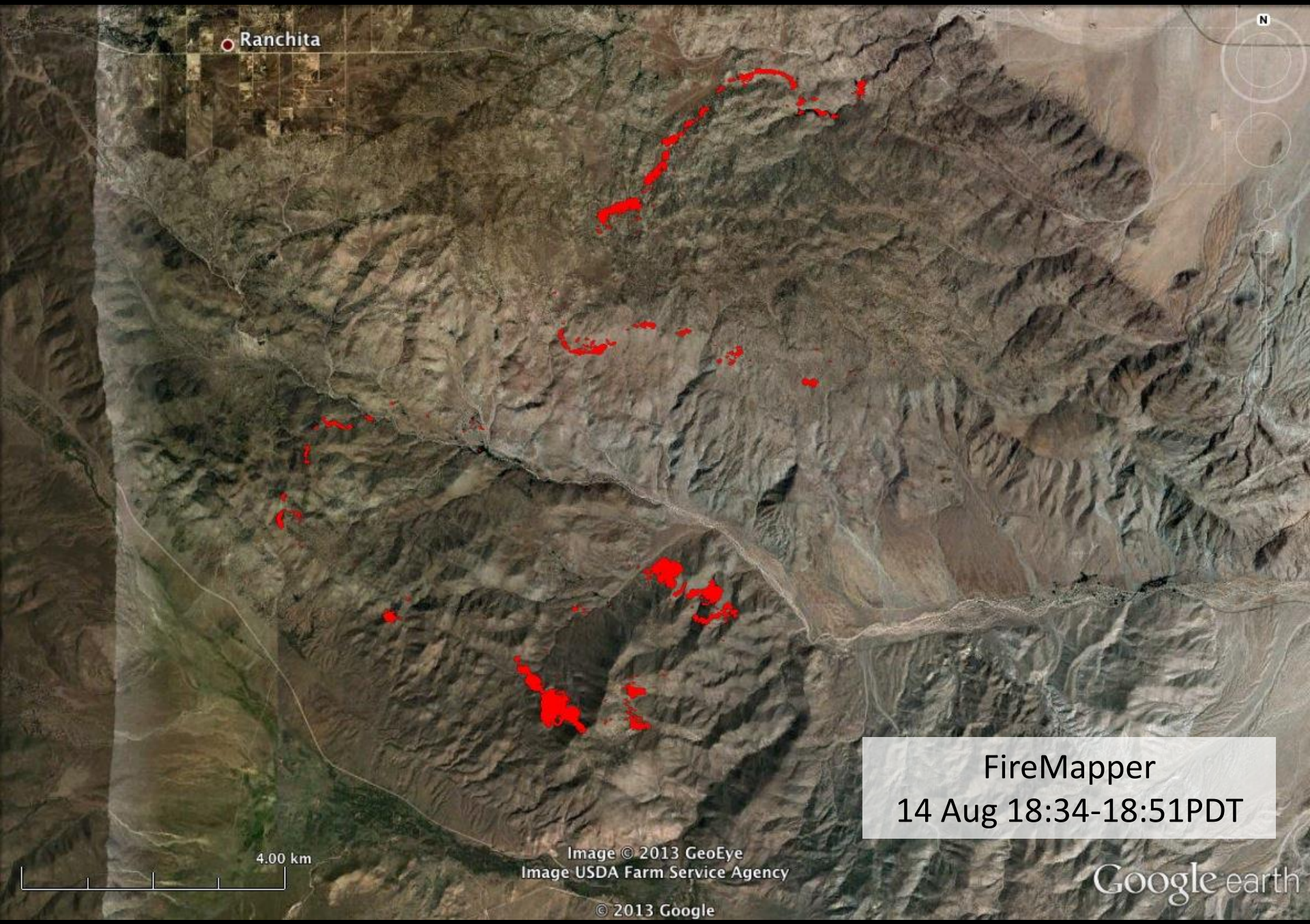


FireMapper
14 Aug 11:59-12:18PDT

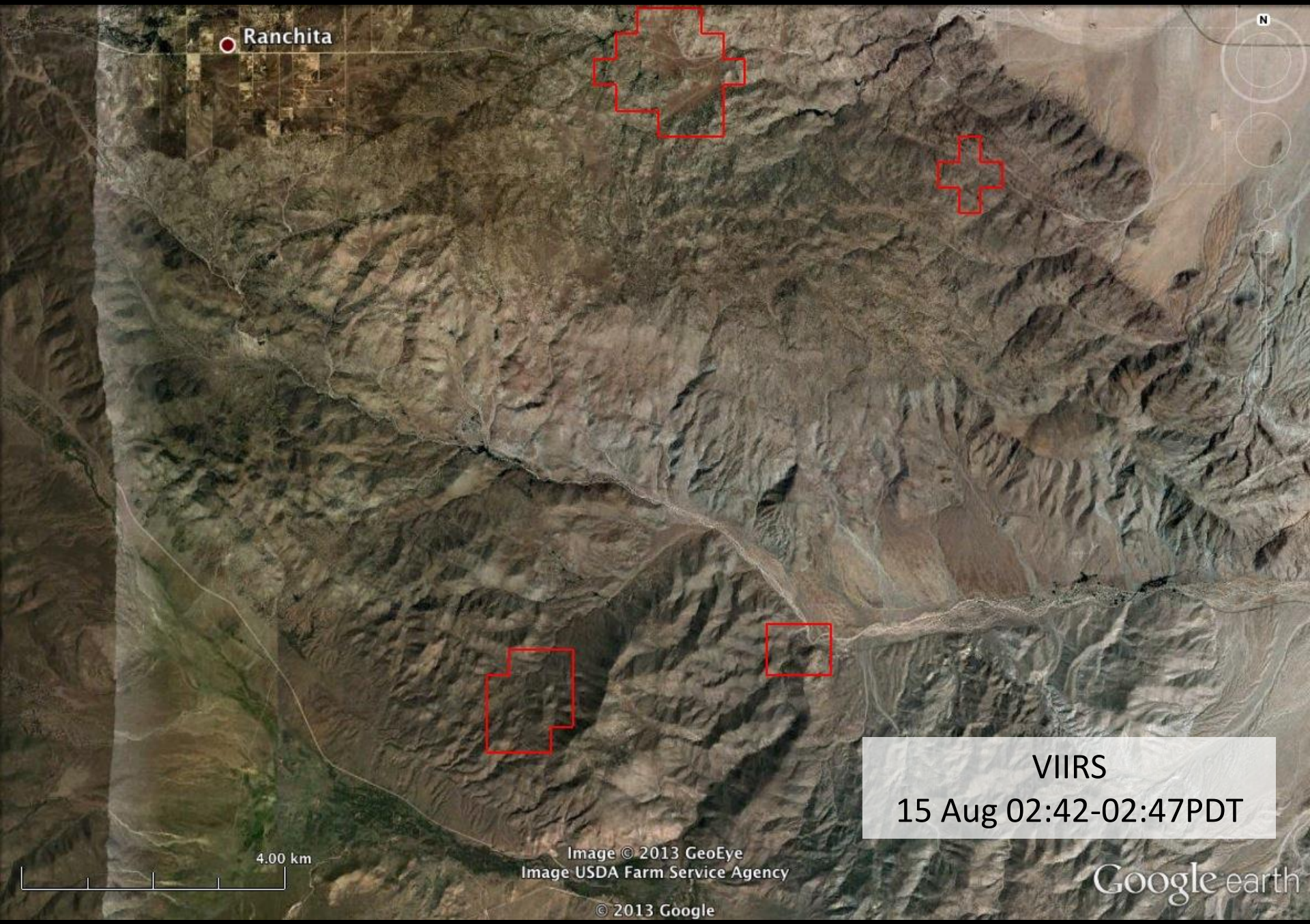

Ranchita
N
VIIRS
14 Aug 12:39-12:45PDT
4.00 km
Image © 2013 GeoEye
Image USDA Farm Service Agency
© 2013 Google
Google earth

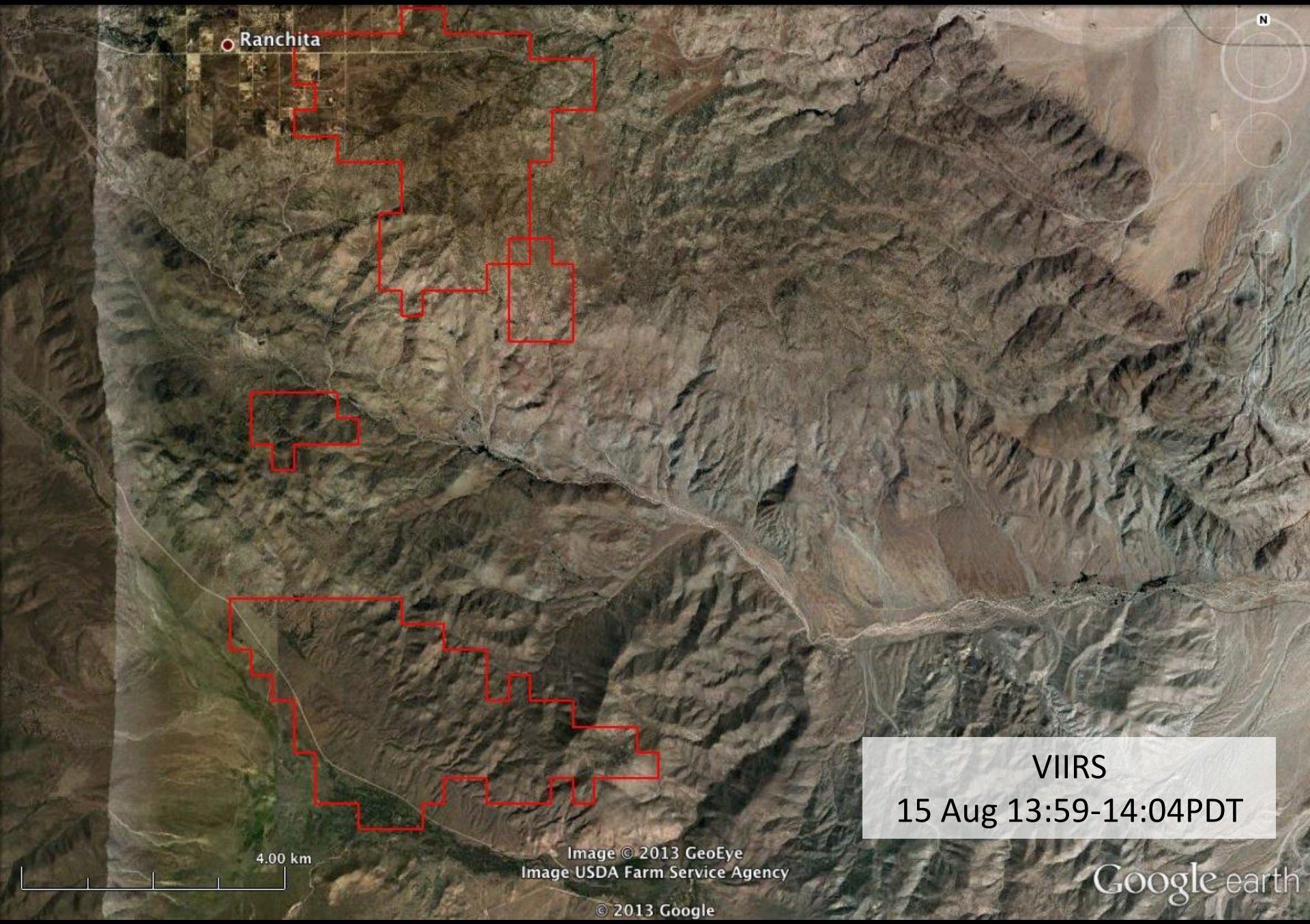


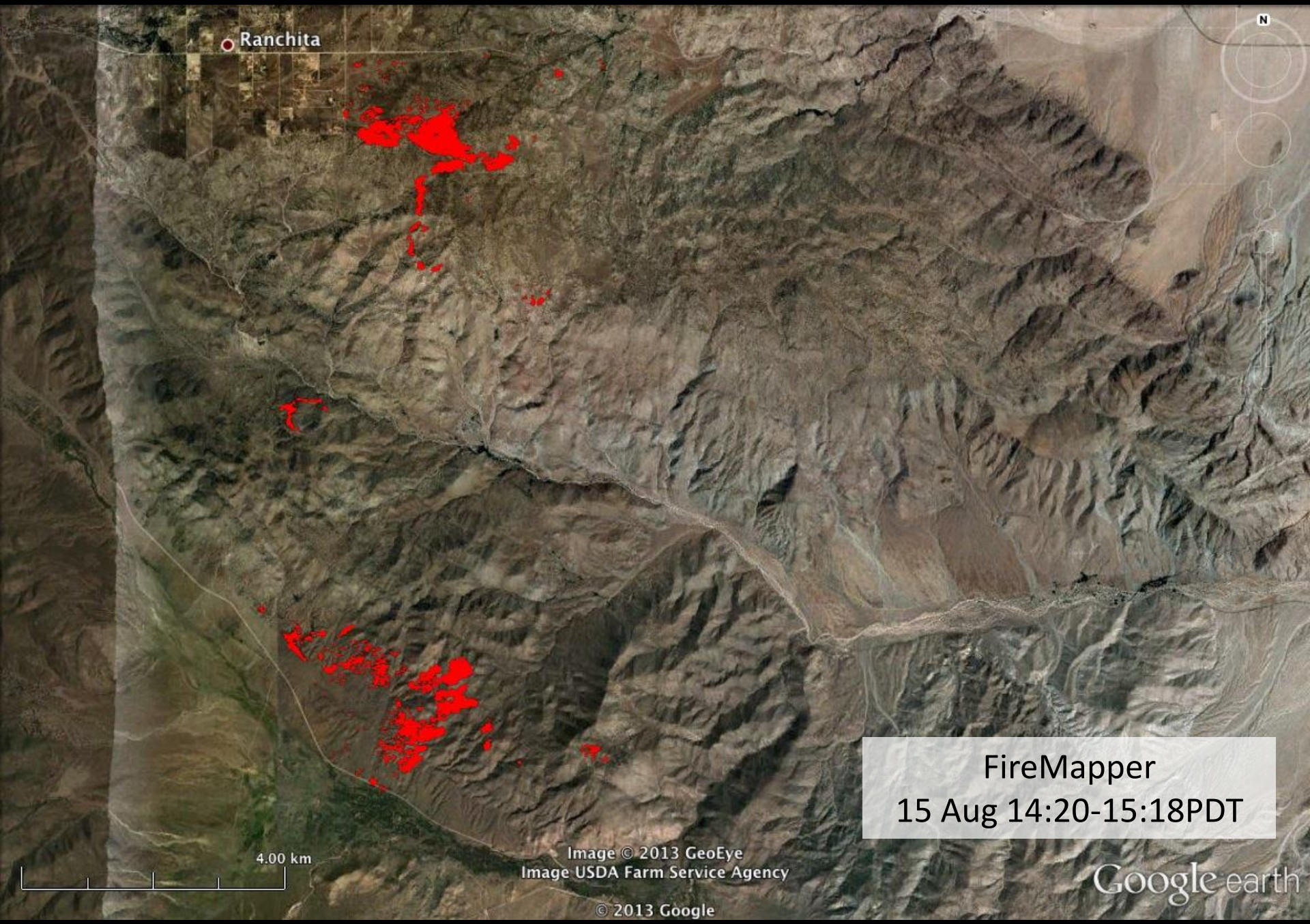
VIIRS
14 Aug 14:16-14:22PDT



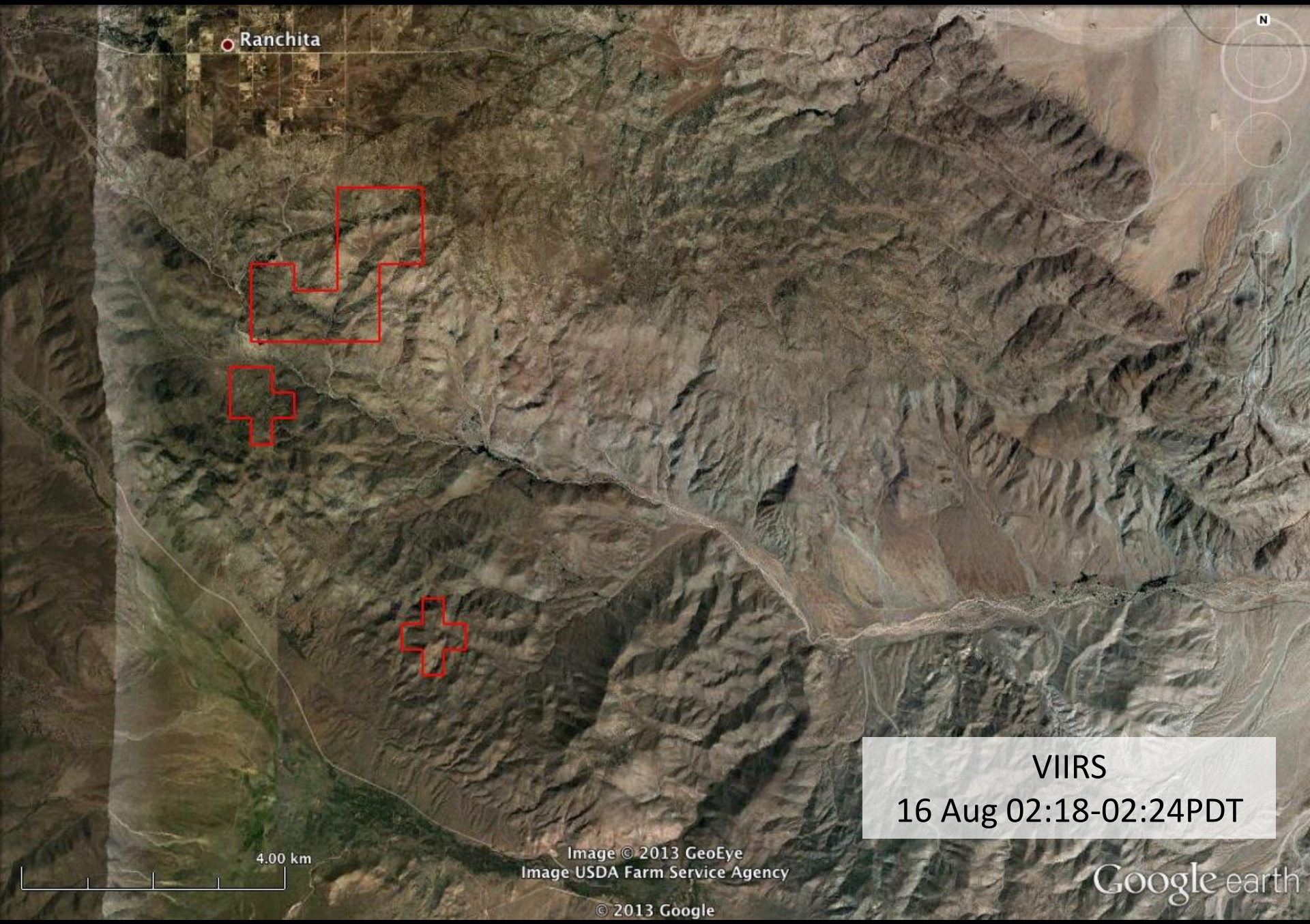
FireMapper
14 Aug 18:34-18:51PDT

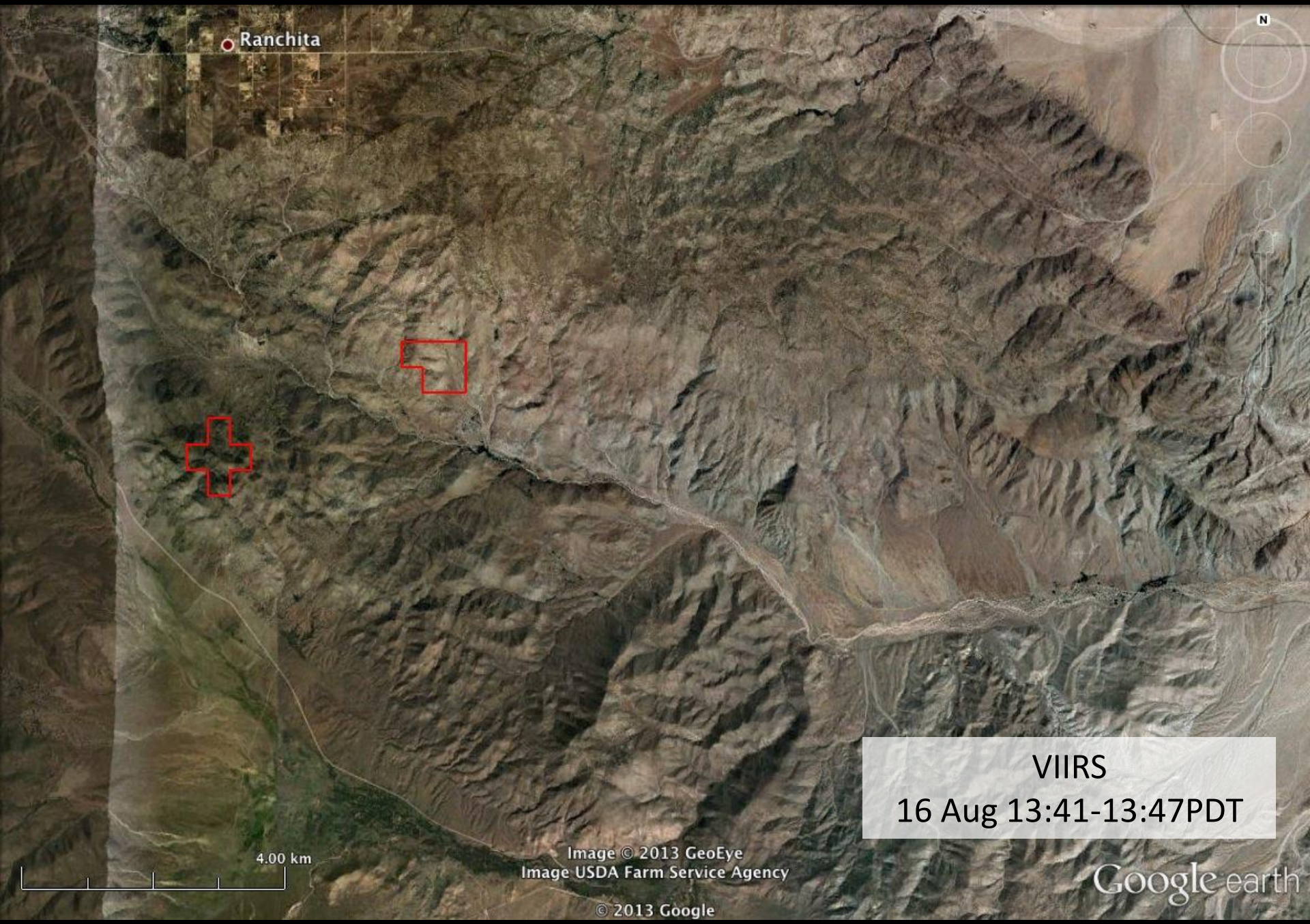

Ranchita
N
4.00 km
Image © 2013 GeoEye
Image USDA Farm Service Agency
© 2013 Google
Google earth
VIIRS
15 Aug 02:42-02:47PDT


Ranchita
N
4.00 km
Image © 2013 GeoEye
Image USDA Farm Service Agency
© 2013 Google
Google earth
VIIRS
15 Aug 13:59-14:04PDT



FireMapper
15 Aug 14:20-15:18PDT


Ranchita
N
4.00 km
Image © 2013 GeoEye
Image USDA Farm Service Agency
© 2013 Google
Google earth
VIIRS
16 Aug 02:18-02:24PDT



VIIRS
16 Aug 13:41-13:47PDT

FireMapper
16 Aug 14:21-15:48PDT

Ranchita
N
4.00 km
Image © 2013 GeoEye
Image USDA Farm Service Agency
© 2013 Google
Google earth
VIIRS
17 Aug 02:01-02:07PDT

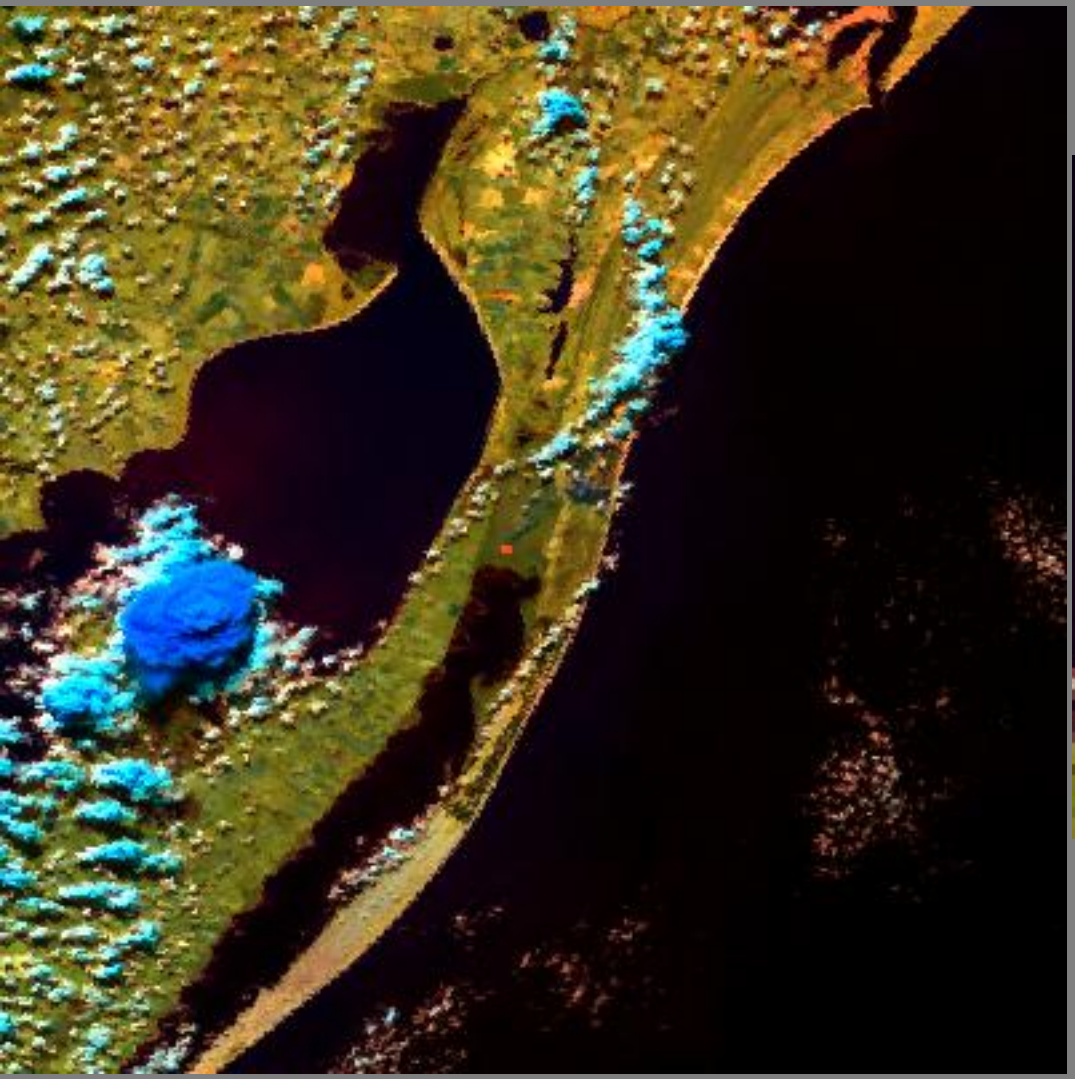
VIIRS
17 Aug 13:18-13:24PDT

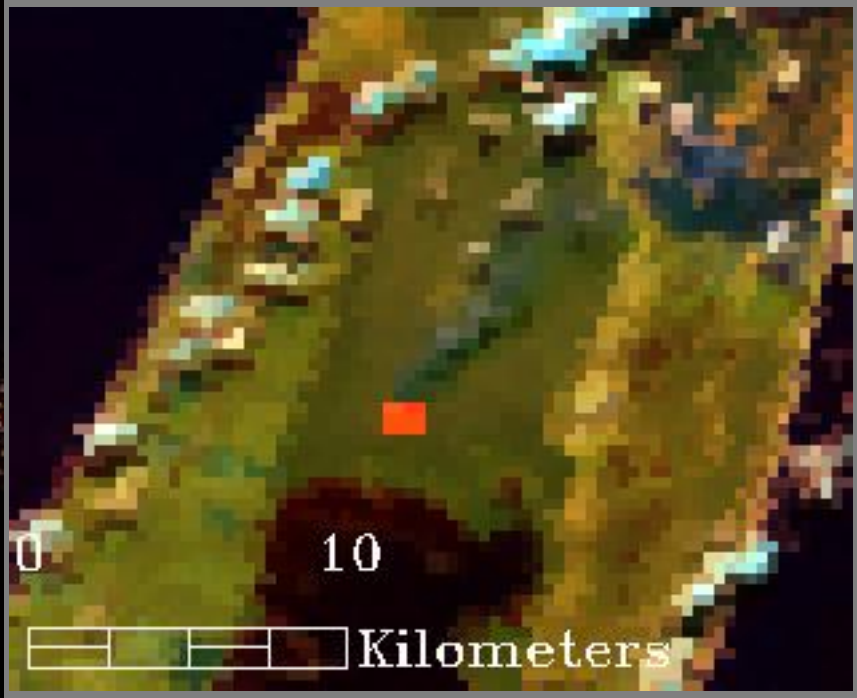
Example 3:
Taim Ecological Reserve, Southern Brazil

Center Coords (approx.): 32.7^{o}S 52.55^{o}W

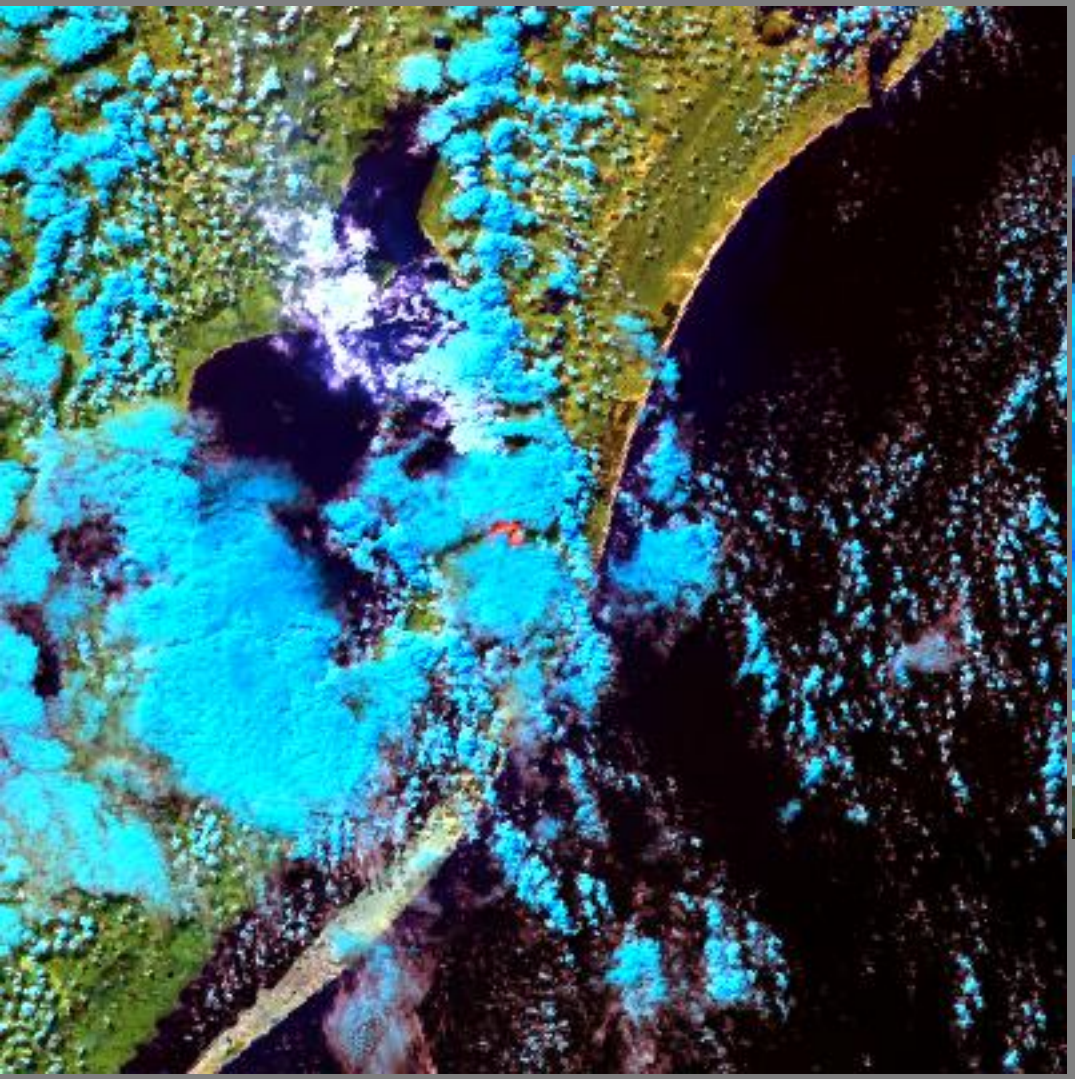
Active Fire Detection Polygons Derived from NPP/VIIRS 375 m data and fire pixel point locations from MODIS 1 km data

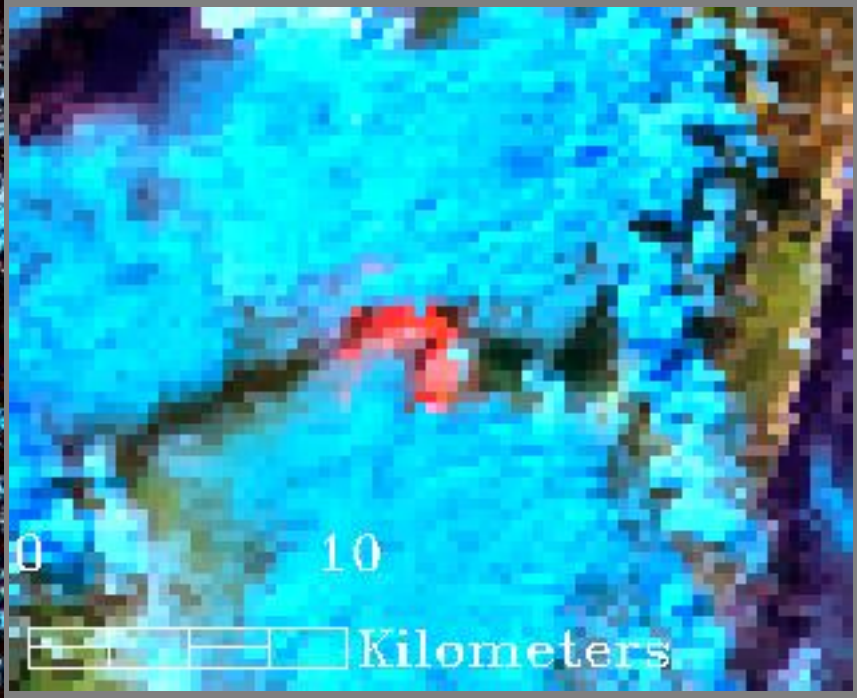
ESEC Taim – VIIRS 375 m
26 March 14:35 h (local)



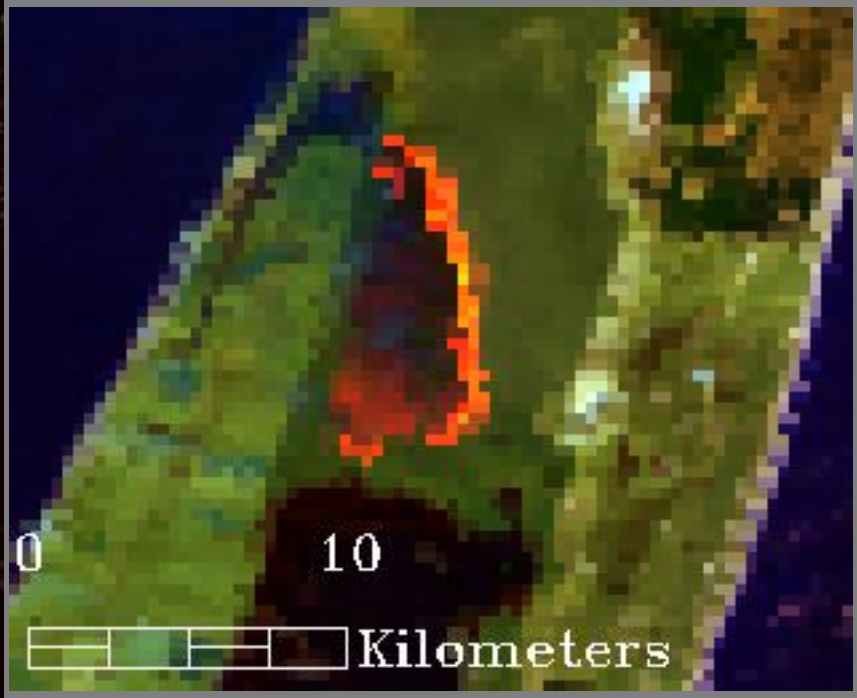


ESEC Taim – VIIRS 375 m
27 March 14:17 h (local)

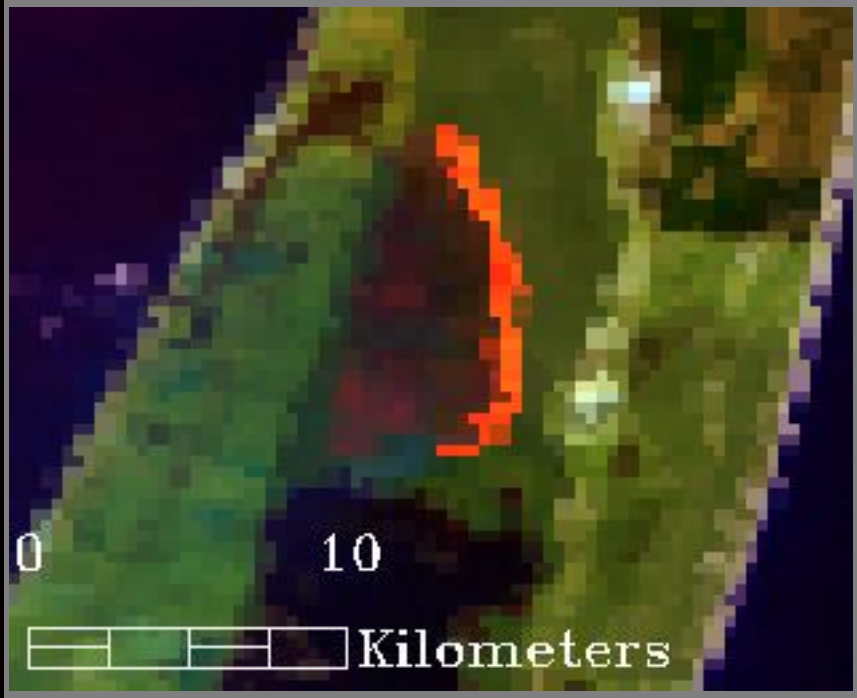


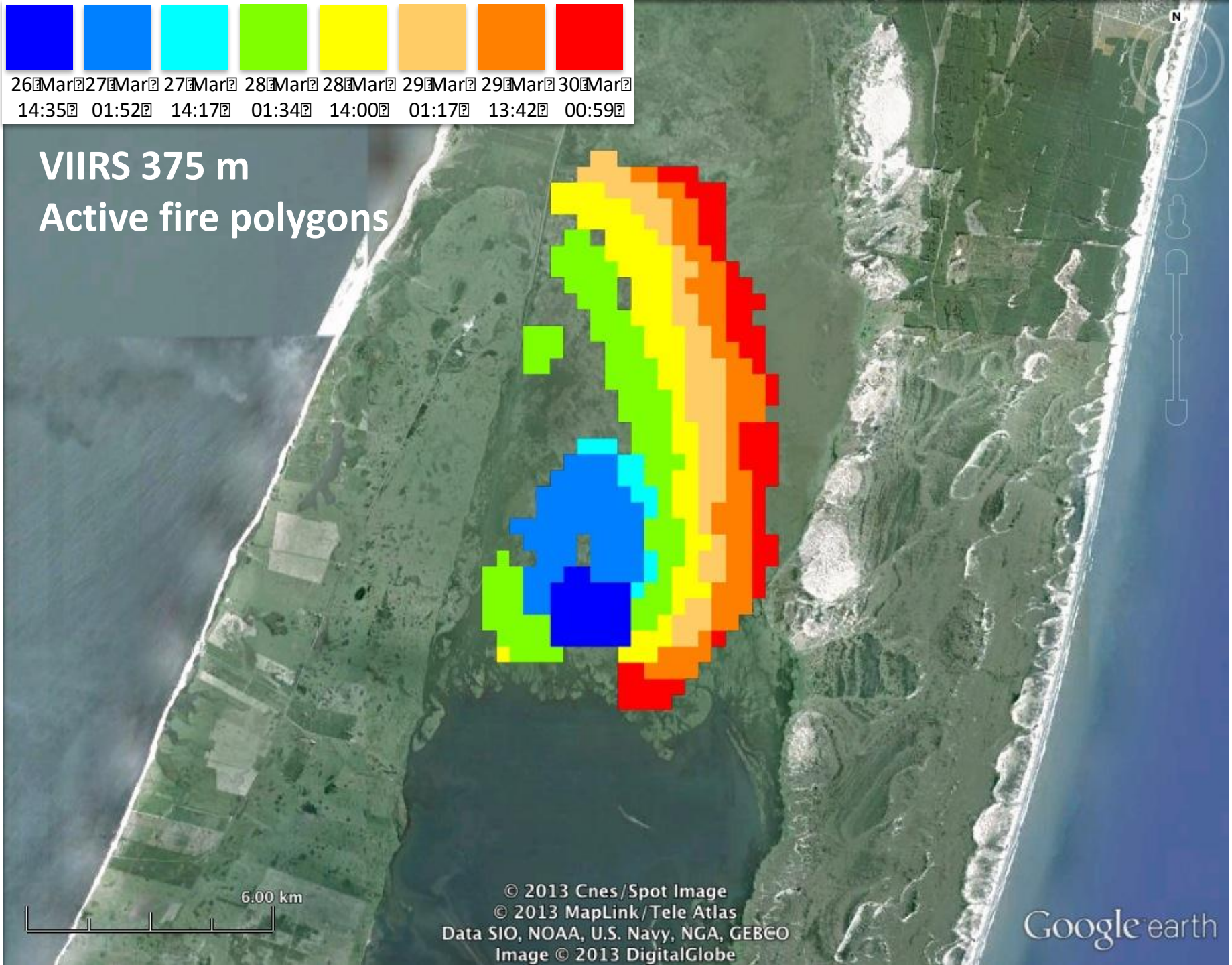


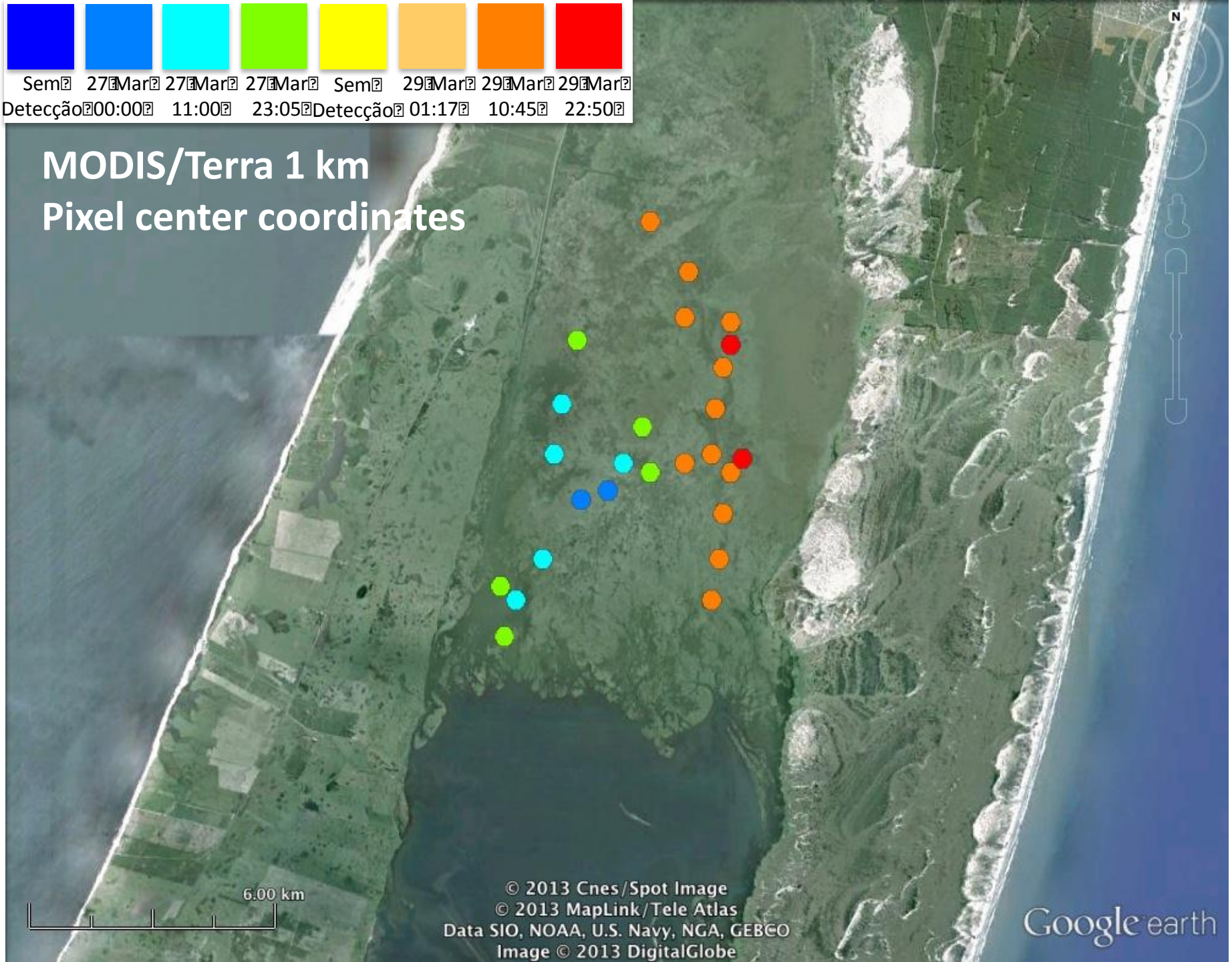
ESEC Taim – VIIRS 375 m
28 March 14:00 h (local)

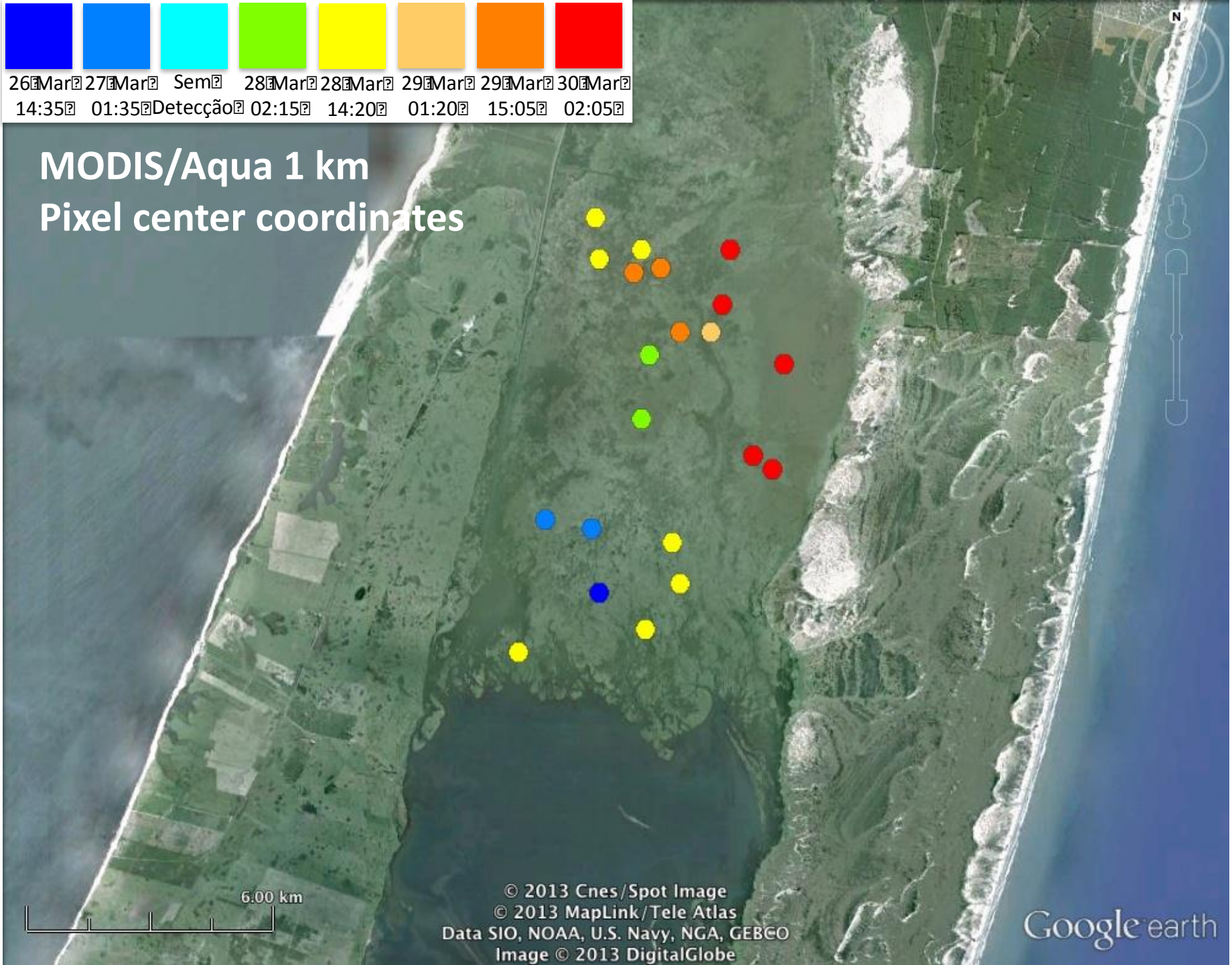


ESEC Taim – VIIRS 375 m
29 March 13:42 h (local)




26 Mar 14:35
27 Mar 01:52
27 Mar 14:17
28 Mar 01:34
28 Mar 14:00
29 Mar 01:17
29 Mar 13:42
30 Mar 00:59
VIIRS 375 m
Active fire polygons
6.00 km
© 2013 Cnes/Spot Image
© 2013 MapLink/Tele Atlas
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2013 DigitalGlobe
Google earth


Sem Detecção
27 Mar 00:00
27 Mar 11:00
27 Mar 23:05
Sem Detecção
29 Mar 01:17
29 Mar 10:45
29 Mar 22:50
MODIS/Terra 1 km
Pixel center coordinates
6.00 km
© 2013 Cnes/Spot Image
© 2013 MapLink/Tele Atlas
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2013 DigitalGlobe
Google earth


26 Mar 14:35
27 Mar 01:35
Sem Detecção
28 Mar 02:15
28 Mar 14:20
29 Mar 01:20
29 Mar 15:05
30 Mar 02:05
MODIS/Aqua 1 km
Pixel center coordinates
6.00 km
© 2013 Cnes/Spot Image
© 2013 MapLink/Tele Atlas
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image © 2013 DigitalGlobe
Google earth

New Landsat-8 Active Fire Data

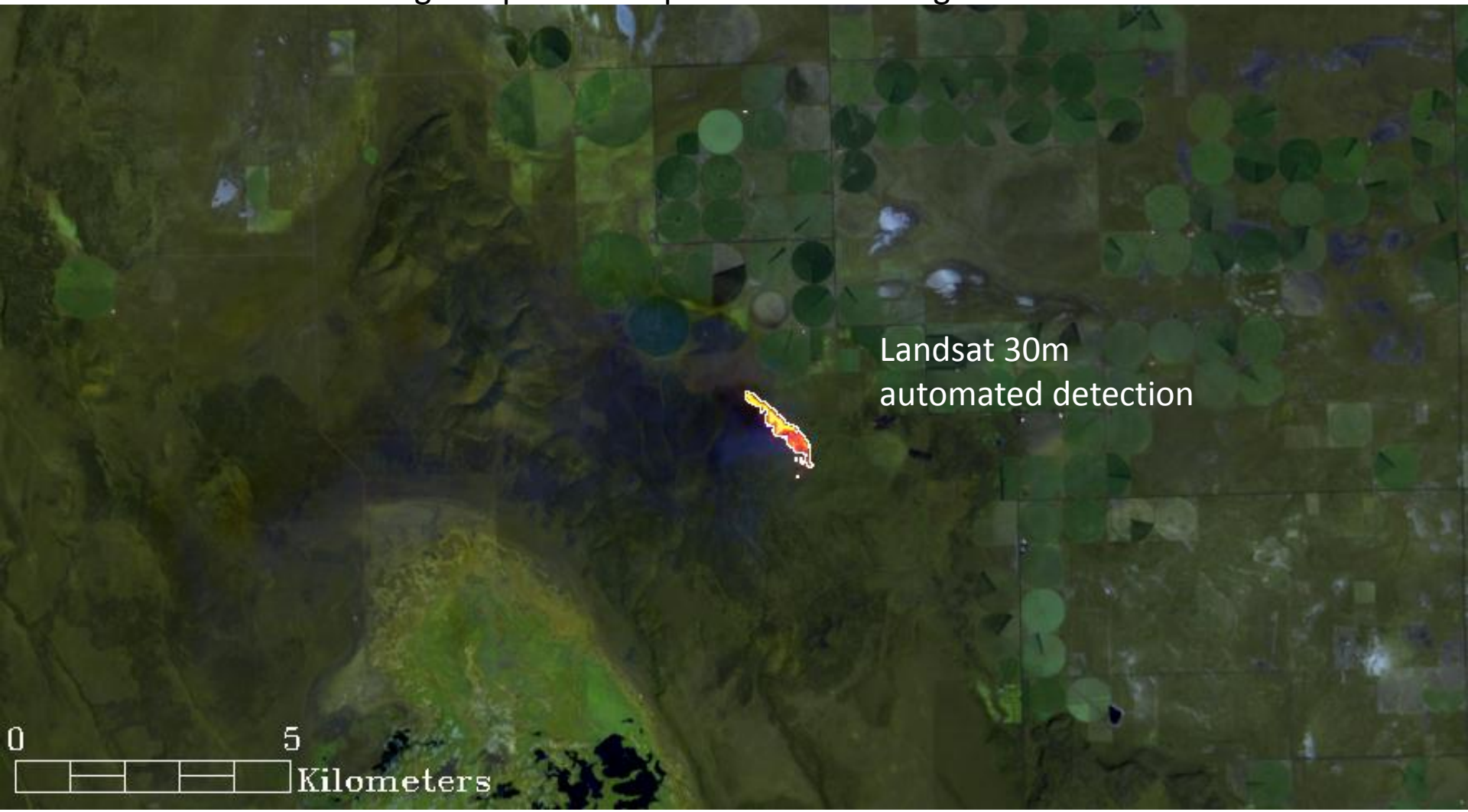
Image acquired 23 April 2013 over Oregon state

16 day revisit on one sensor (daytime only)

Potential for significantly improved revisit time by incorporating other Landsat-class sensors

New Landsat-8 Active Fire Data

Image acquired 23 April 2013 over Oregon state



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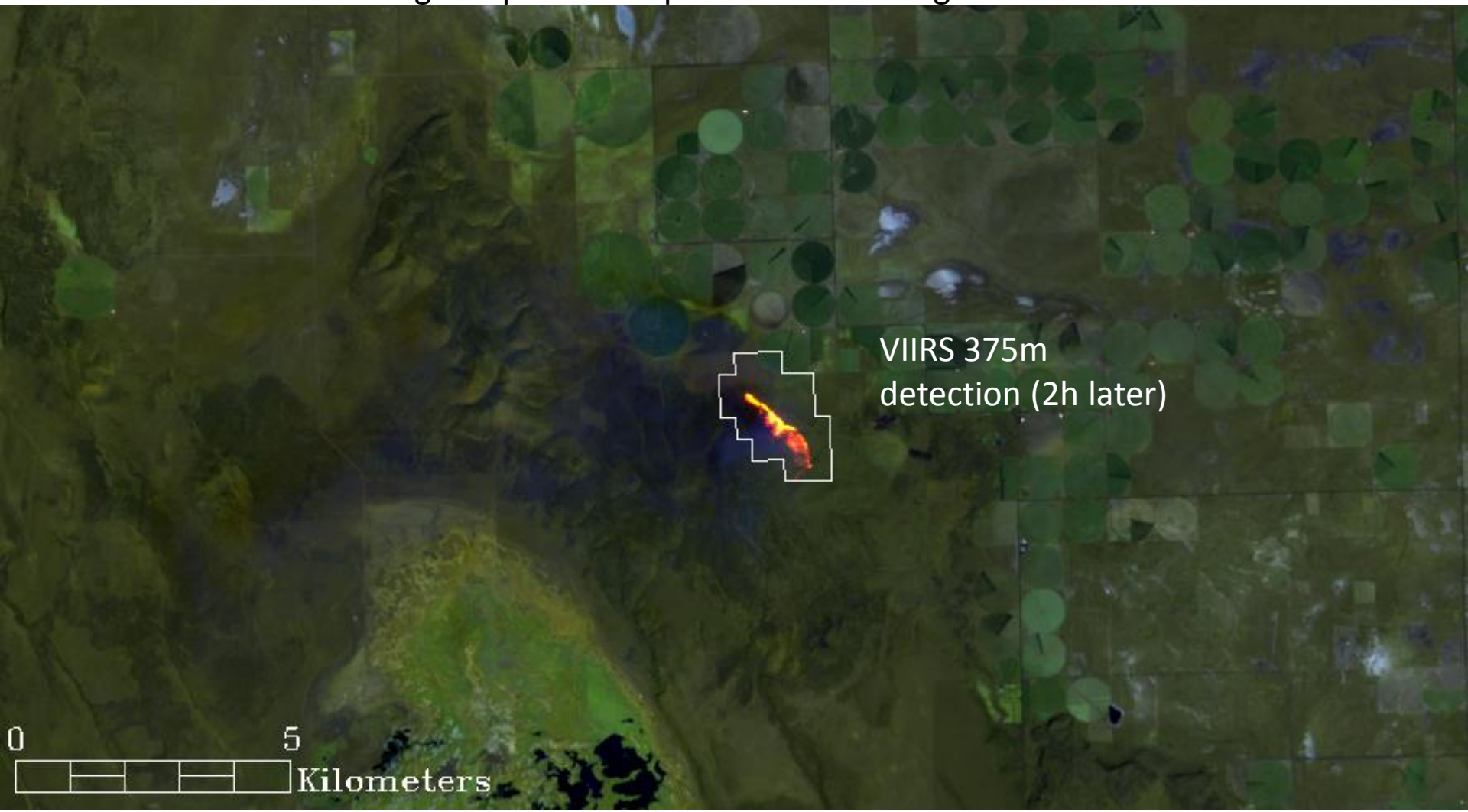

16 day revisit on one sensor (daytime only)
Potential for significantly improved revisit time by incorporating other Landsat-class sensors

Conclusions

- VIIRS baseline 750 m fire product looking good
  - Data publicly available as of 03 May 2012
  - Upgrading to MODIS C6-equivalent algorithm
  - Incorporating fire mask plus FRP retrievals
  - Working with direct readout community to expedite implementation of revised product

- Alternative VIIRS 375 m fire detection product showing promising results
  - Science code being refined and prepared for operational use

- Fire detection algorithm being implemented to new Landsat-8 data
  - RSAC working with USGS to facilitate data access

- MOU being established between UMD/NOAA and DLR Germany to support FireBIRD fire-dedicated small satellite science & data exchange
  - TET-1 launched in summer 2012, fire data acquisition to begin summer 2013
  - Second satellite (BIROS) to be launched in 2014-2015 (looking for a piggy back launch opportunity)

- Airborne fire retrieval algorithms have been developed
  - Supporting satellite product development and validation

- Finer spatial resolution remote sensing fire data sets successfully assimilated into coupled atmosphere-fire model
  - Fire behavior model showing great potential
  - Expanding the number of model runs including complex real-life fire scenarios

VIIRS Active Fire Product Website

http://viirsfire.geog.umd.edu