The NOAA VIIRS Active Fire Product

Presented by Ivan Csiszar

NOAA/NESDIS Center for Satellite Applications and Research (STAR)

with signification contribution by

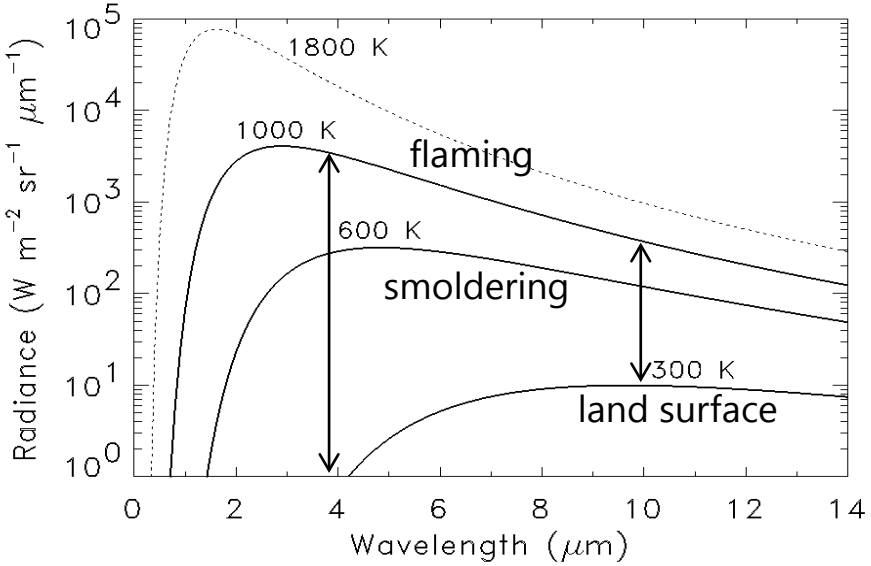
Wilfrid Schroeder (OSPO), Marina Tsidulko, Wei Guo, Amy Huff (IMSG@STAR), William Straka, Chris Schmidt (CIMSS)

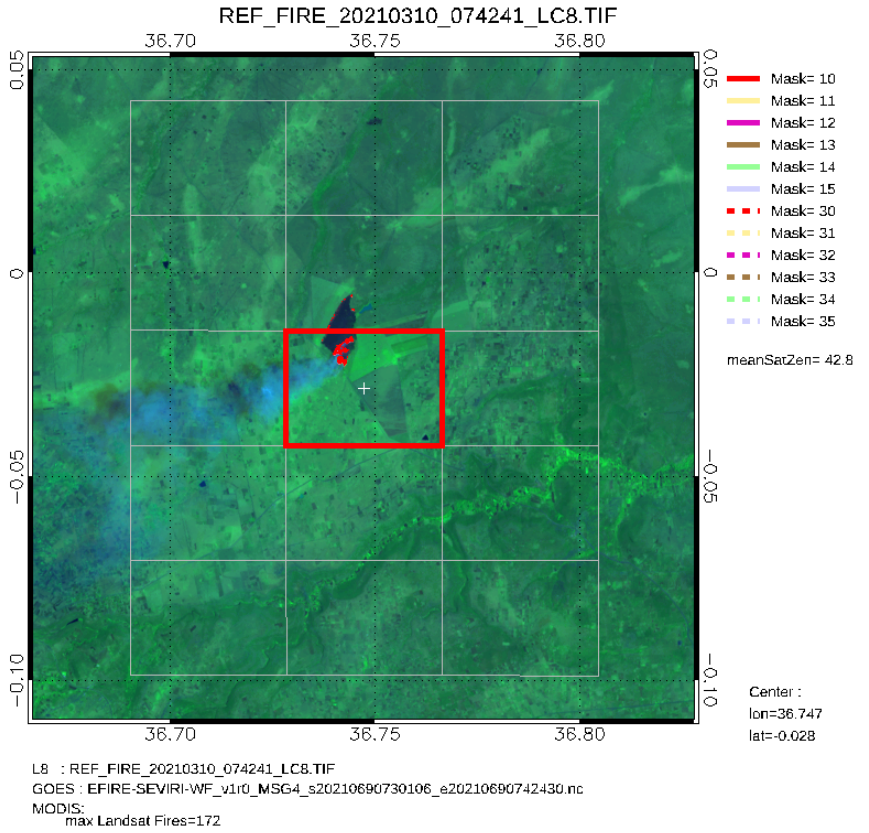
additional individual credits are listed on specific slides

Primary signals from actively burning fires

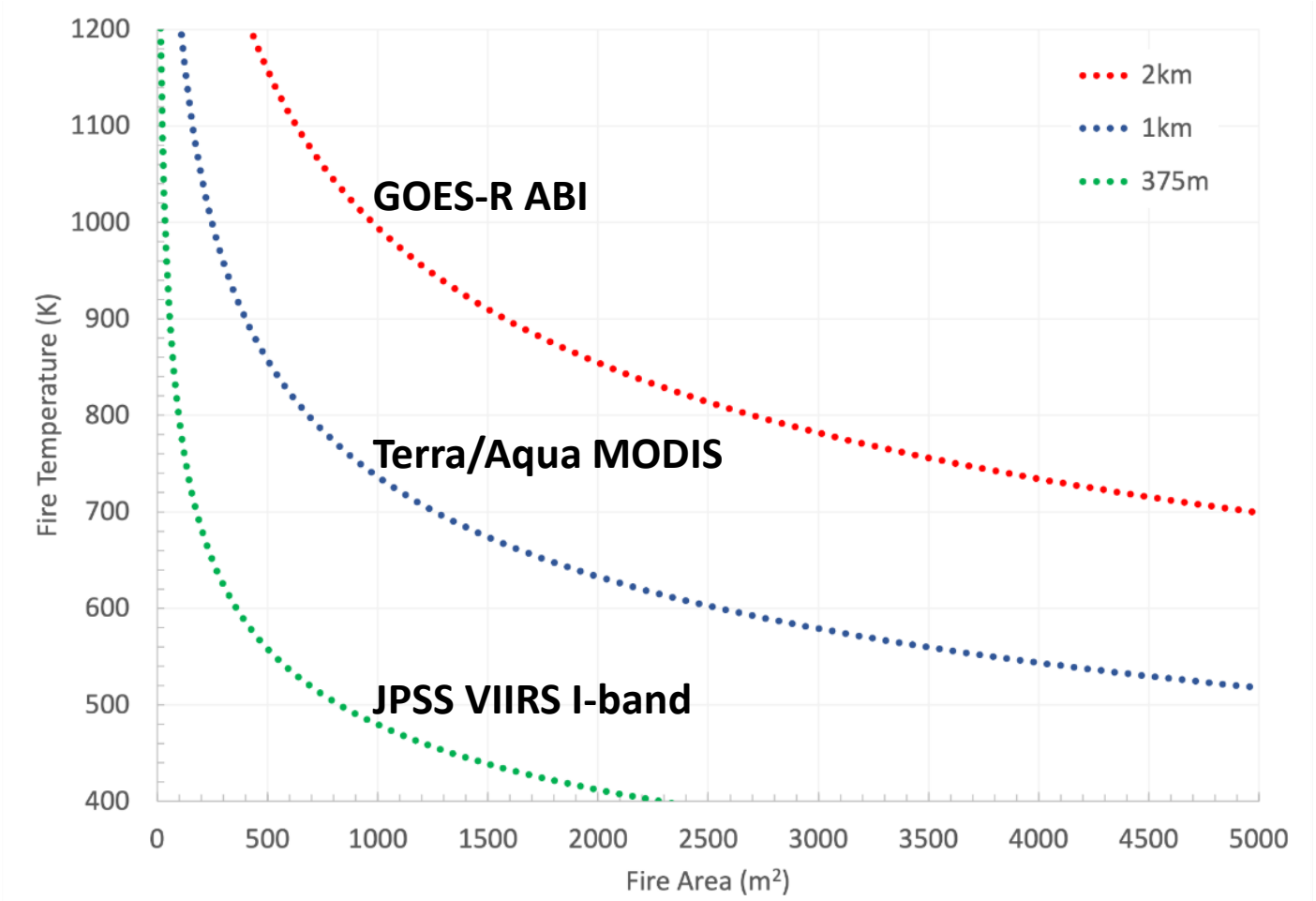
- **Radiometric signal:** distinct emitted signal from pixels that contain fires (Planck function)
  - Spectral position of the maximum signal is a function of temperature (Wien's displacement law)
  - contrast between bands with strong an weak (or no) signal from fires (most baseline algorithms: 4 µm vs. 11 µm)
  - **Issues:**
    - reflected solar radiation during daytime weakens or overwhelms the shortwave signal
    - potential false alarm from reflected solar radiation, hot surfaces, cloud edges etc.
    - sensor response at high radiance levels
- **Spatial signal:** contrast between fire signal and non-burning background
  - **Issues:** insufficient number of background pixels
    - clouds, hot surface, large fires
- **Temporal signal:** persistence over a given time period

For VIIRS I-band algorithm details, see the Quick Brief "VIIRS Active Fires Algorithm Basics and Anomalous Detections" by Carl Dierking, Jen Delamere and Jay Cable (U. Alaska-Fairbanks, GINA)
https://gina.alaska.edu/wp-content/uploads/2022/03/VIIRSFireDetectionAlgorithm.mp4



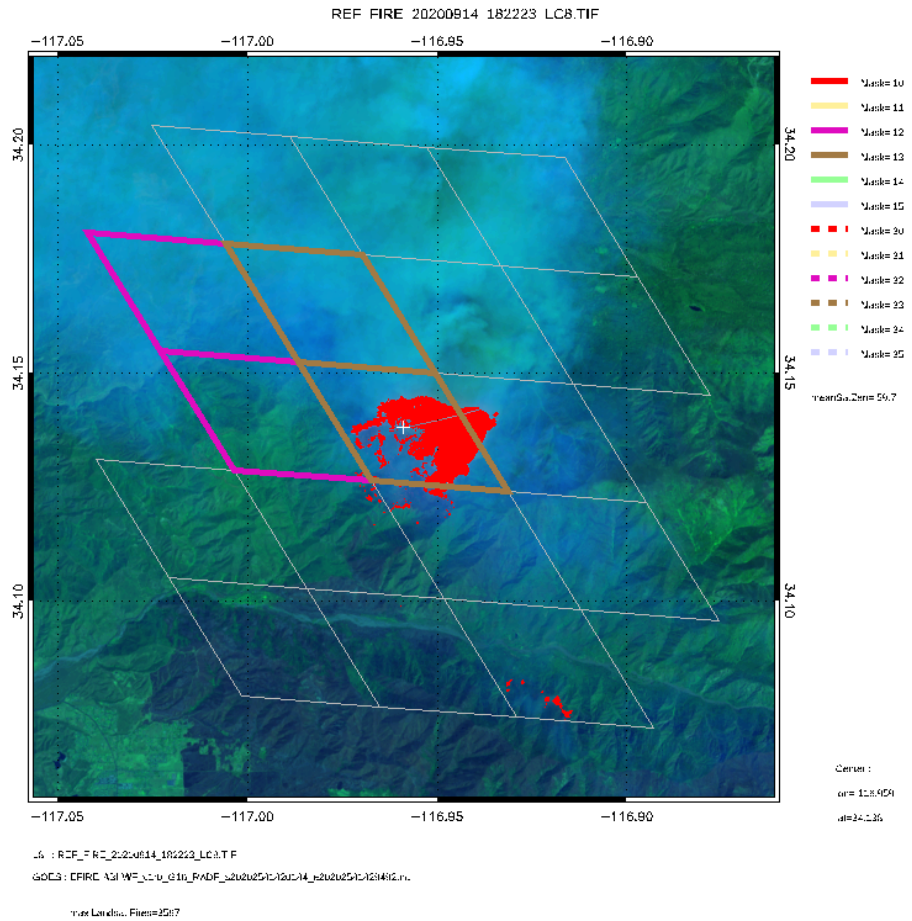


Spatial resolution and detection envelopes



50% probability of detection <u>at nadir</u> as a function of fire size/area combinations by the current operational detection algorithm approach

Detection limits are driven by the fractional area of the fire within the satellite footprint



Fire radiative power (FRP)

FRP is the rate of emitted radiative energy by the fire at the time of the observation.

Definition for a mixed pixel:

$$FRP_{def} = A_{sample}\varepsilon\sigma\sum_{k=1}^{n} p_k T_k^4$$

A commonly used retrieval approach (*Wooster et al., 2005*):

$$FRP_{MIR} = \frac{A_{sample}\sigma}{a}\left(L_{MIR} - L_{B,MIR}\right)$$

L_{MIR}	4 μm observed radiance
$L_{B,MIR}$	4 μm calculated background radiance
A_{sample}	Area of pixel
a	A constant (function of instrument SRF)

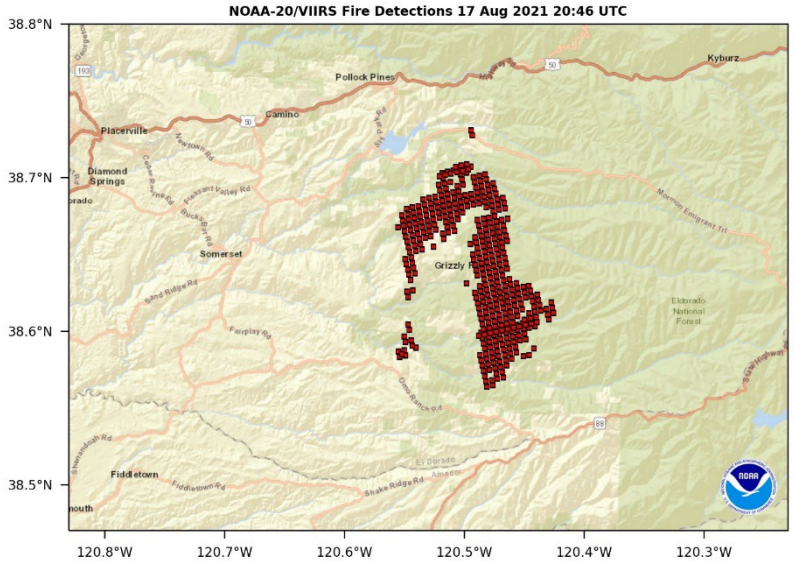
p_k	Instantaneous proportion of pixel on fire
T_k	Instantaneous target temperature of sub-pixel fire
ε	Emissivity of fire (typ. assumed to be 1)
σ	Stefan-Boltzmann constant

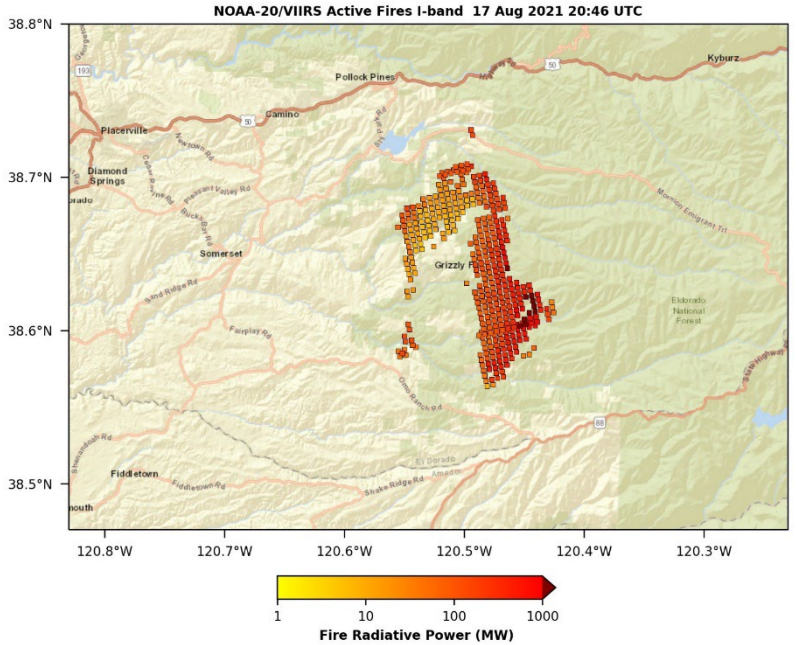
Chris Schmidt, UW-Madison

Wooster, M.J., Roberts, G., Perry, G.L.W., Kaufman, Y.J., 2005. Retrieval of biomass combustion rates and totals from fire radiative power observations: FRP derivation and calibration relationships between biomass consumption and fire radiative energy release. J. Geophys. Res. 110, D24311 https://doi.org/10.1029/

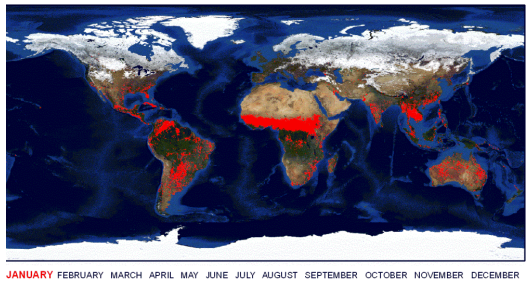
FRP is a key variable to characterize the active burning process e.g.

- **Locate the area of the most intense burning**
- **Determine the amount of emissions into the atmosphere**
- **Determine the height of injecting smoke into the atmosphere**

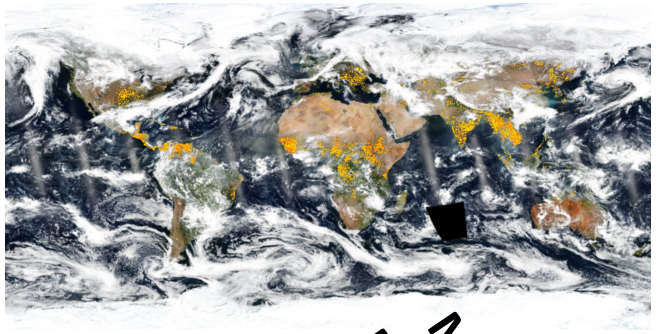




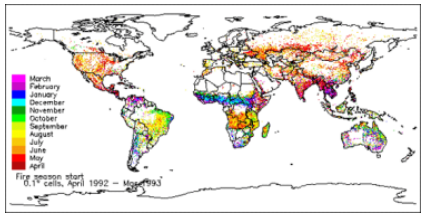
MODIS (MOD14/MYD14)



VIIRS



GLOBAL (AVHRR) FIRE PRODUCT (1992-93)



bioval.jrc.ec.europa.eu/

1980s

1990s

2000s

2010s

PRESENT

AVHRR production

AVHRR global analyses

MODIS production

MODIS validation

MODIS CMG

Suomi NPP VIIRS

JPSS VIIRS

GOFC-GOLD Fire

GCOS Fire ECV

GOES reprocessing

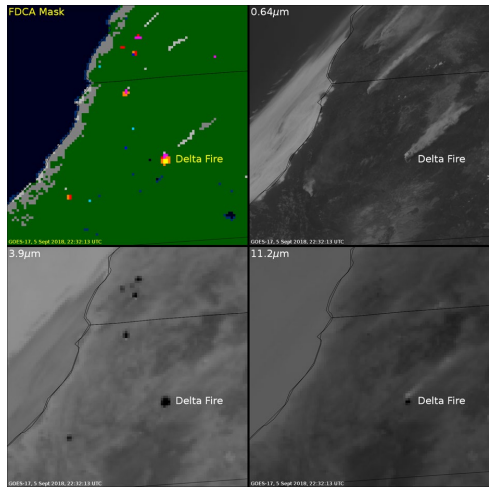
GOES-R ABI

GOES production

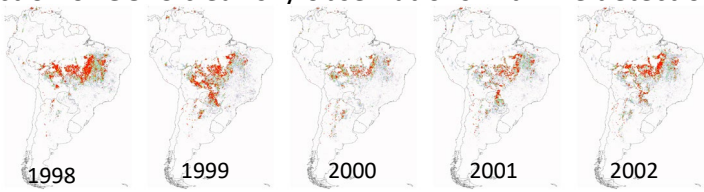
polar

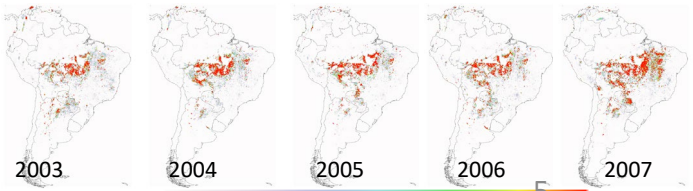
geostationary

GOES-16 fire



Fraction of GOES clear-sky observations with fire detections





Operational NOAA satellites and imagers

Joint Polar Satellite System (JPSS)

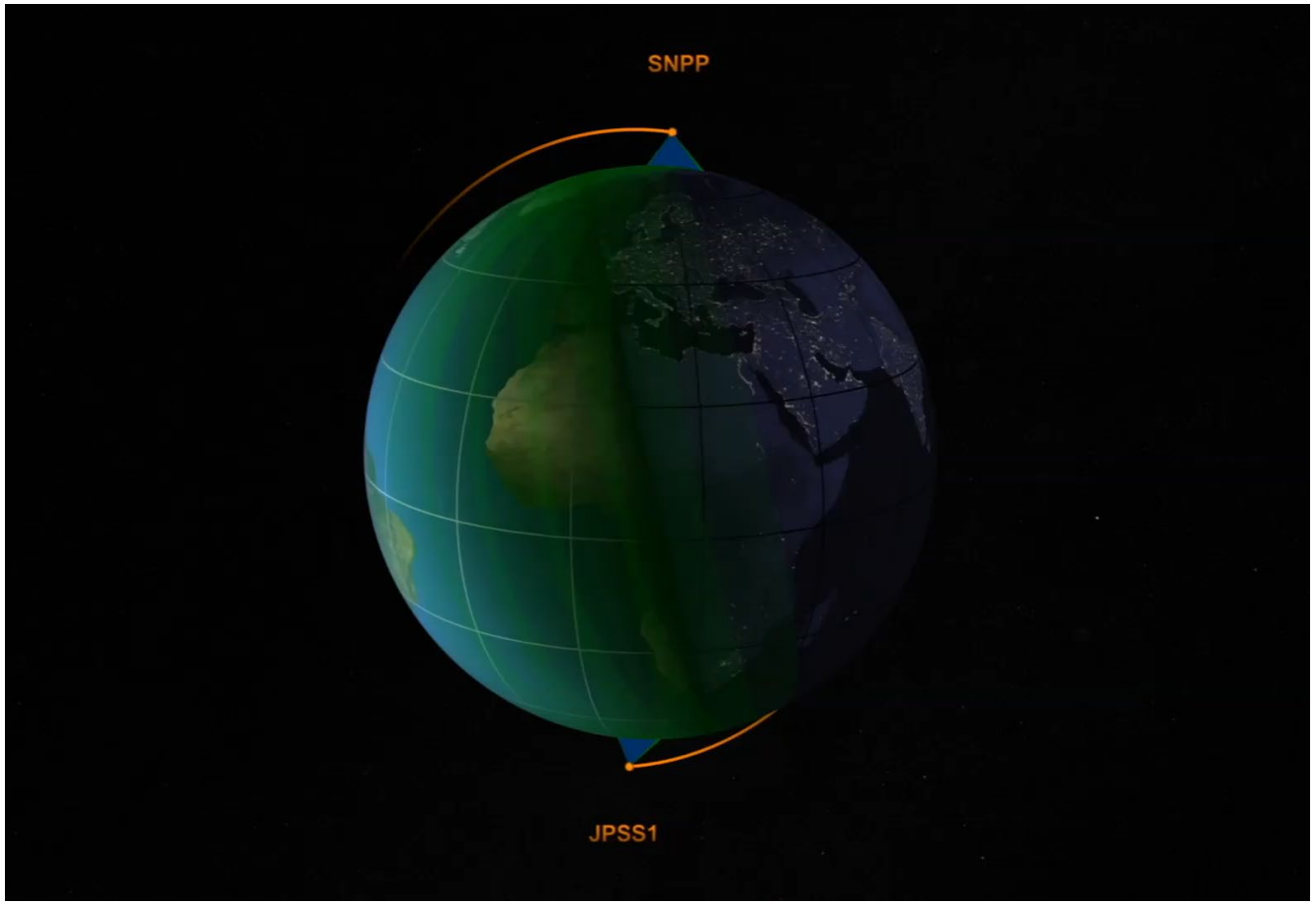
- Suomi NPP (November 2011)
- NOAA-20 (November 2017)
- JPSS-2 launch in late 2022

Geostationary Operational Environmental Satellite – R (GOES-R)

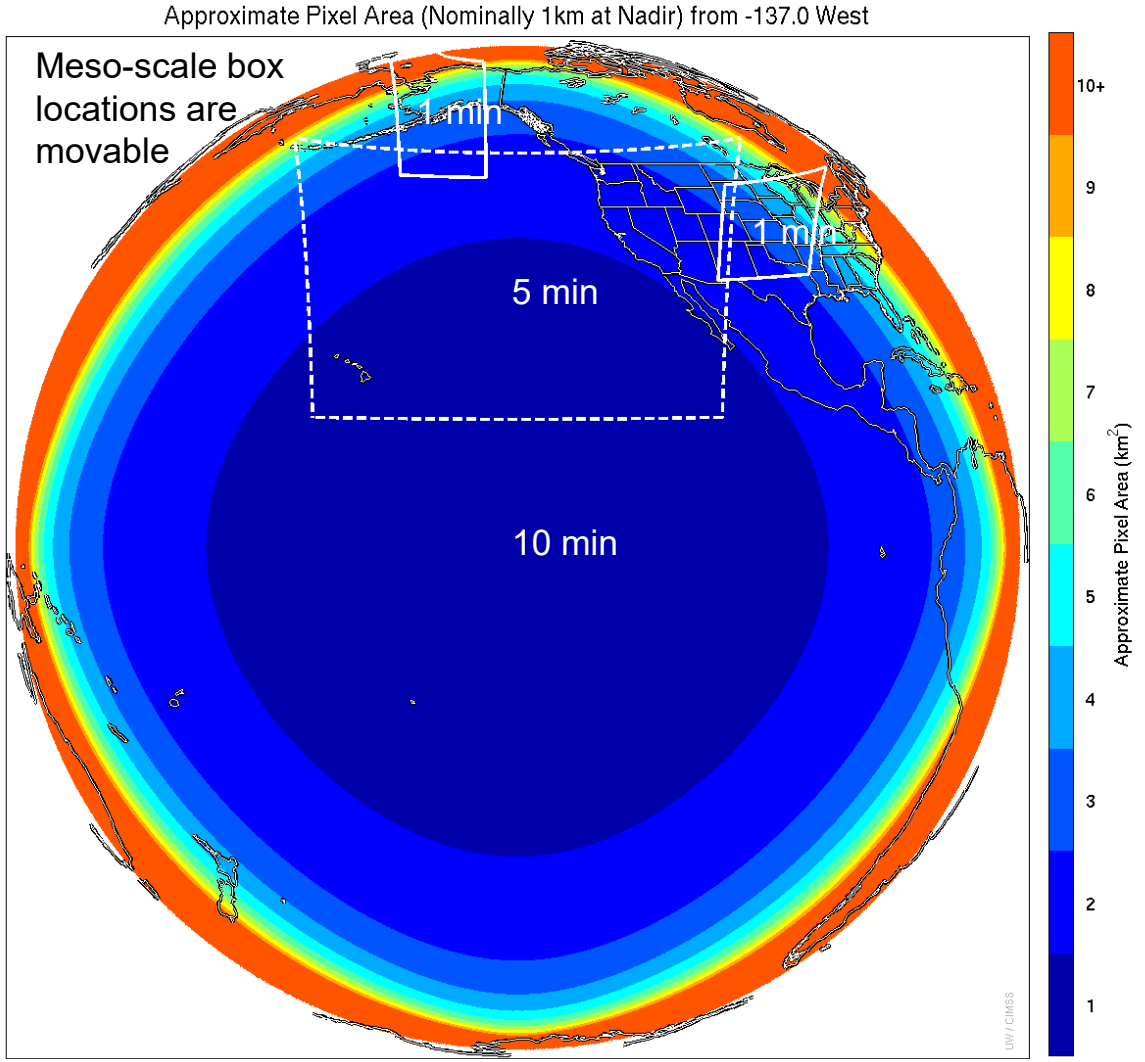
- GOES-16 (East; November 2016)
- GOES-17 (West; March 2018)
- GOES-T March 1 2022

Sensor	Visible Infrared Imaging Radiometer Suite (VIIRS)	Advanced Baseline Imager (ABI)
Spectral Coverage	22 bands 0.41 ~ 12.01 μm	16 bands 0.47 ~ 13.3 μm
Spatial Resolution at nadir	M-band: 750 m at nadir I-band: 375 m at nadir	0.64 μm Visible: 0.5 km Other visible/near-IR: 1.0 km Bands (>2 μm): 2 km
Spatial Coverage	at least every 12 hours	Full Disk: 10 min Conterminous / Pacific US (CONUS / PACUS): 5 min Mesoscale: 30 or 60 sec

JPSS VIIRS



GOES-R (West) ABI



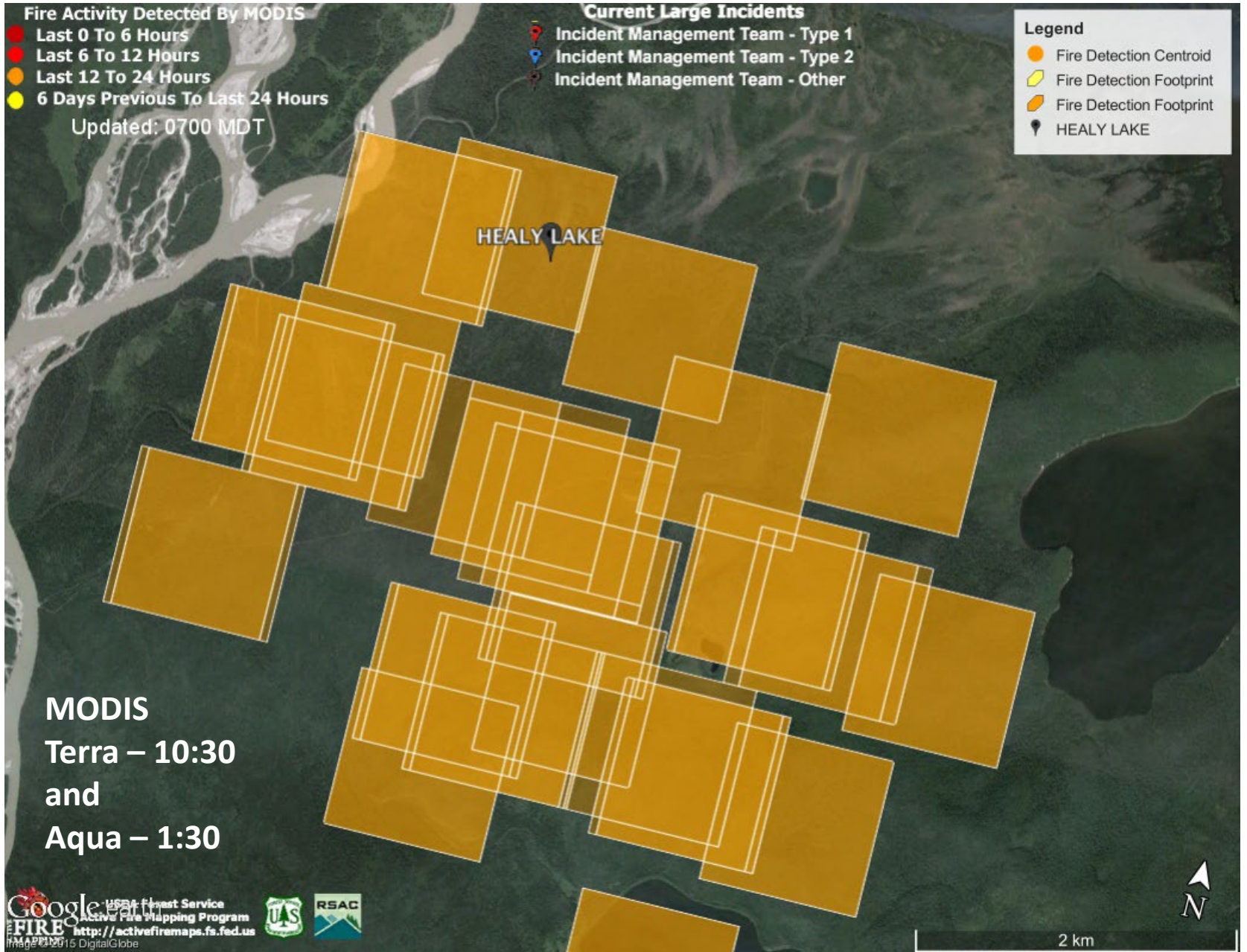
JPSS animation from NOAA JPSS Program Office

GOES-R ABI figure and information from Mat Gunshor, CIMSS and Tim Schmit, NOAA

Scan mode (6) or 'flex mode' for the ABI:

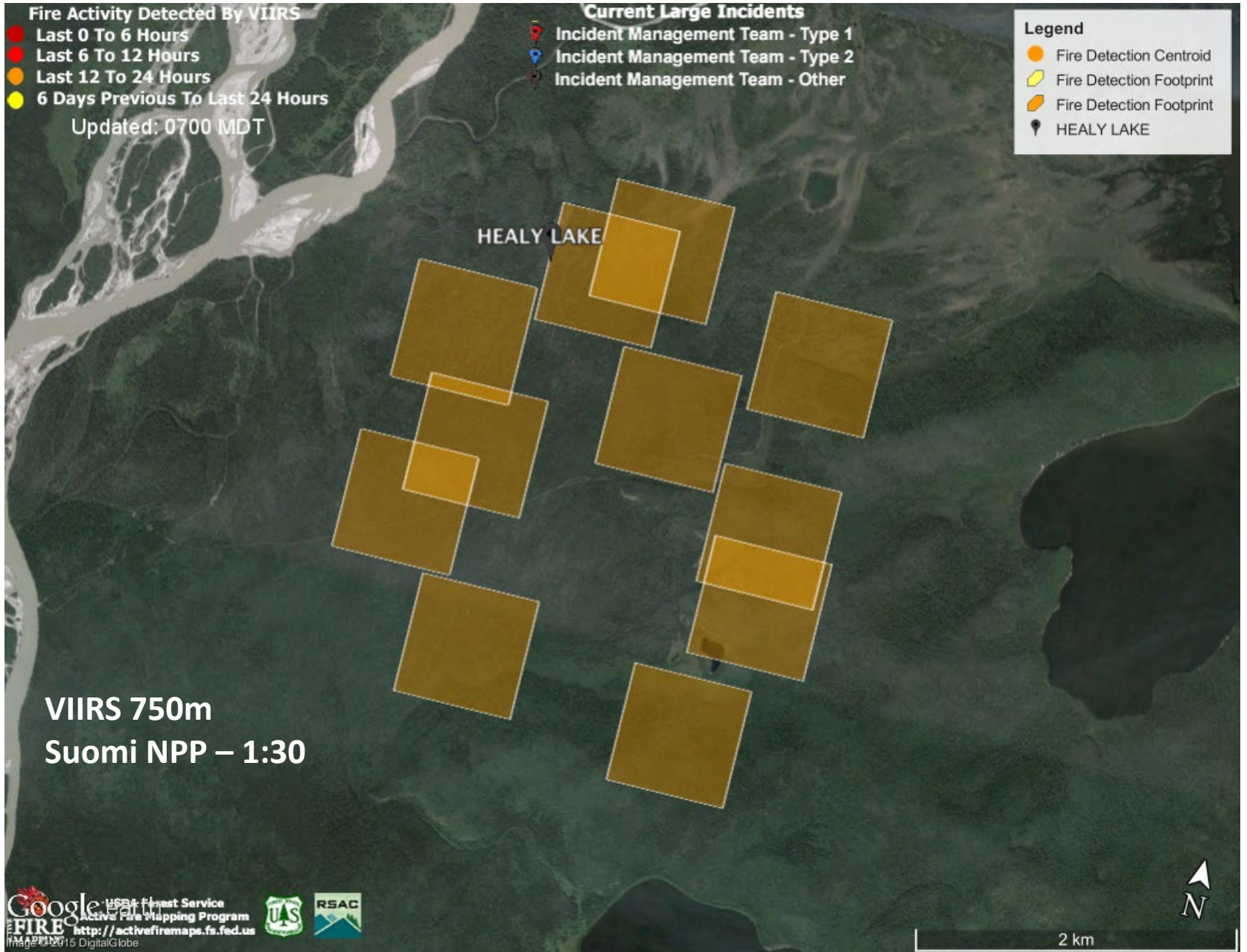
- **Full disk every 10 min (15 min during "cooling" times – 4 periods over the year for GOES-17 only)**
- **+ 5 min CONUS**
- **+ 1-min mesoscale (2 locations).**

Healy Lake Fire (Alaska)



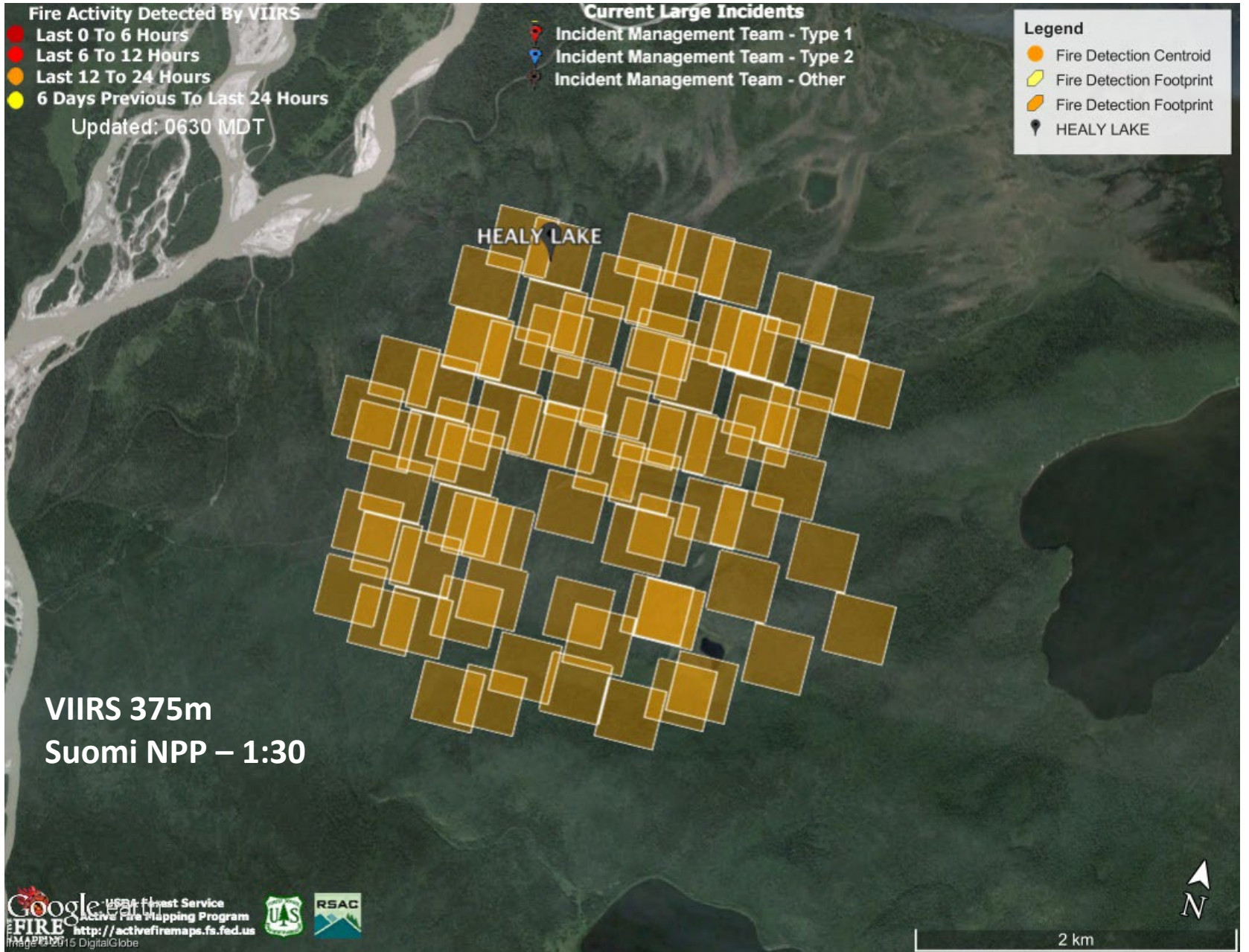
Wilfrid Schroeder, NOAA

Healy Lake Fire (Alaska)



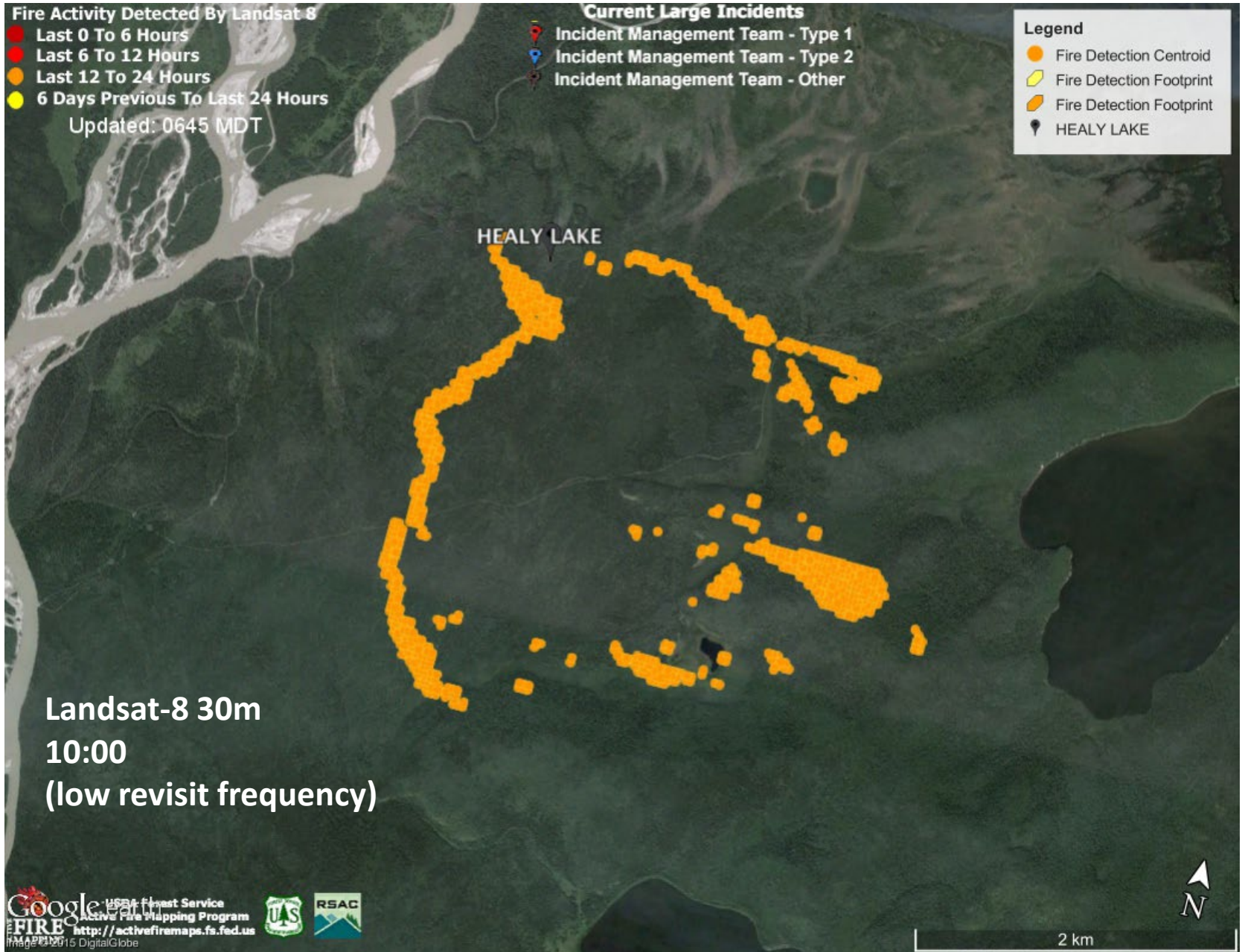
Wilfrid Schroeder, NOAA

Healy Lake Fire (Alaska)



Wilfrid Schroeder, NOAA

Healy Lake Fire (Alaska)



Wilfrid Schroeder, NOAA

Primary VIIRS bands used for heritage MODIS / AVHRR – like active fire algorithms

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					
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					
M7	0.846 - 0.885	750	16	0.862 - 0.877	1000	2					
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					
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			

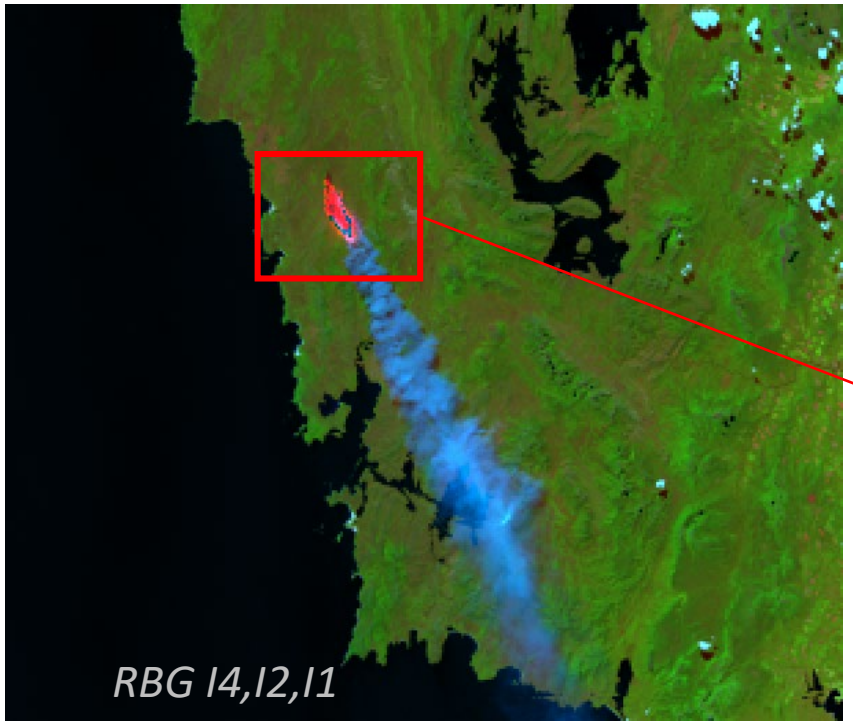
M-band: 750m resolution
high 4 µm (M13) saturation
good signal for FRP

Hybrid: I-band for detection
M-band for FRP

I-band: 375m resolution
low 4 µm (I4) saturation
poor signal for FRP

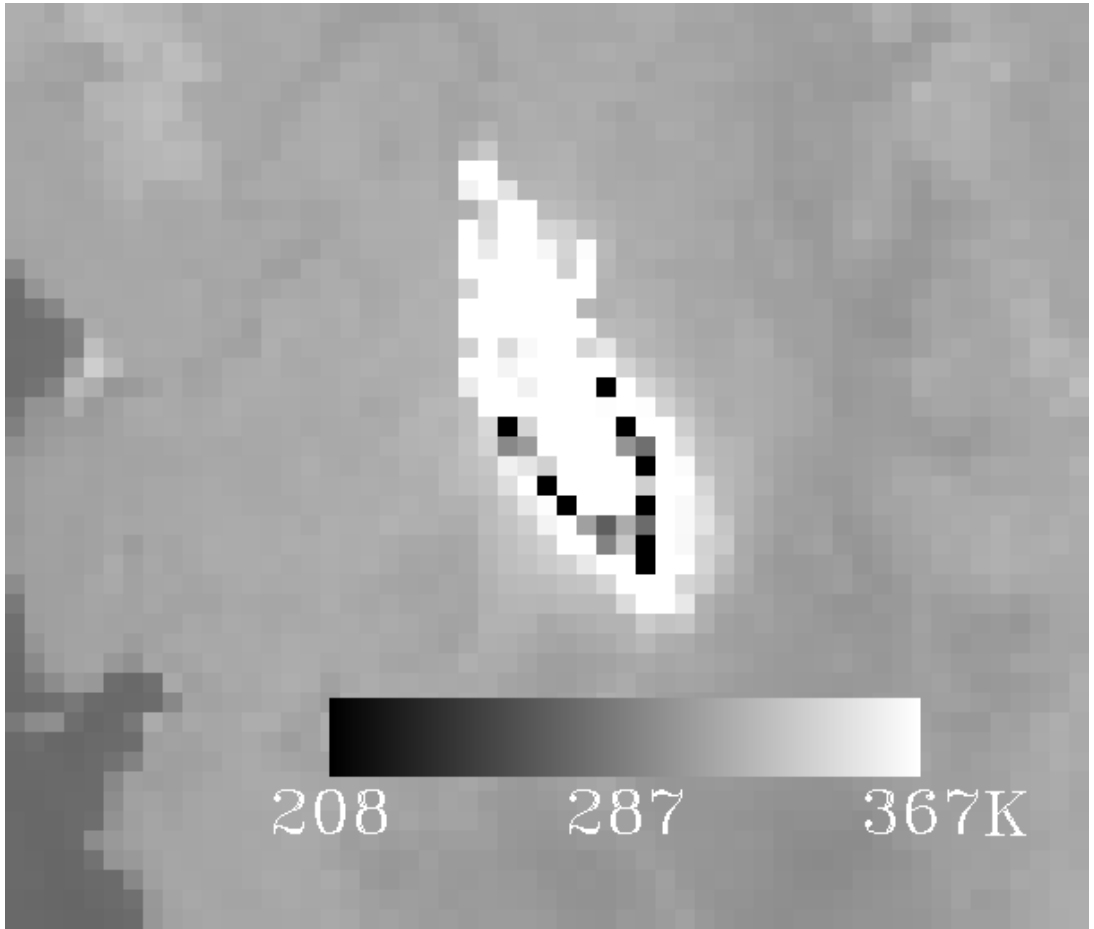
There are many approaches for fire detection and visualization from VIIRS

I-band fire signal: effects of the low saturation level



An example of the folding of I04 BT values over pixels exceeding saturation temperature

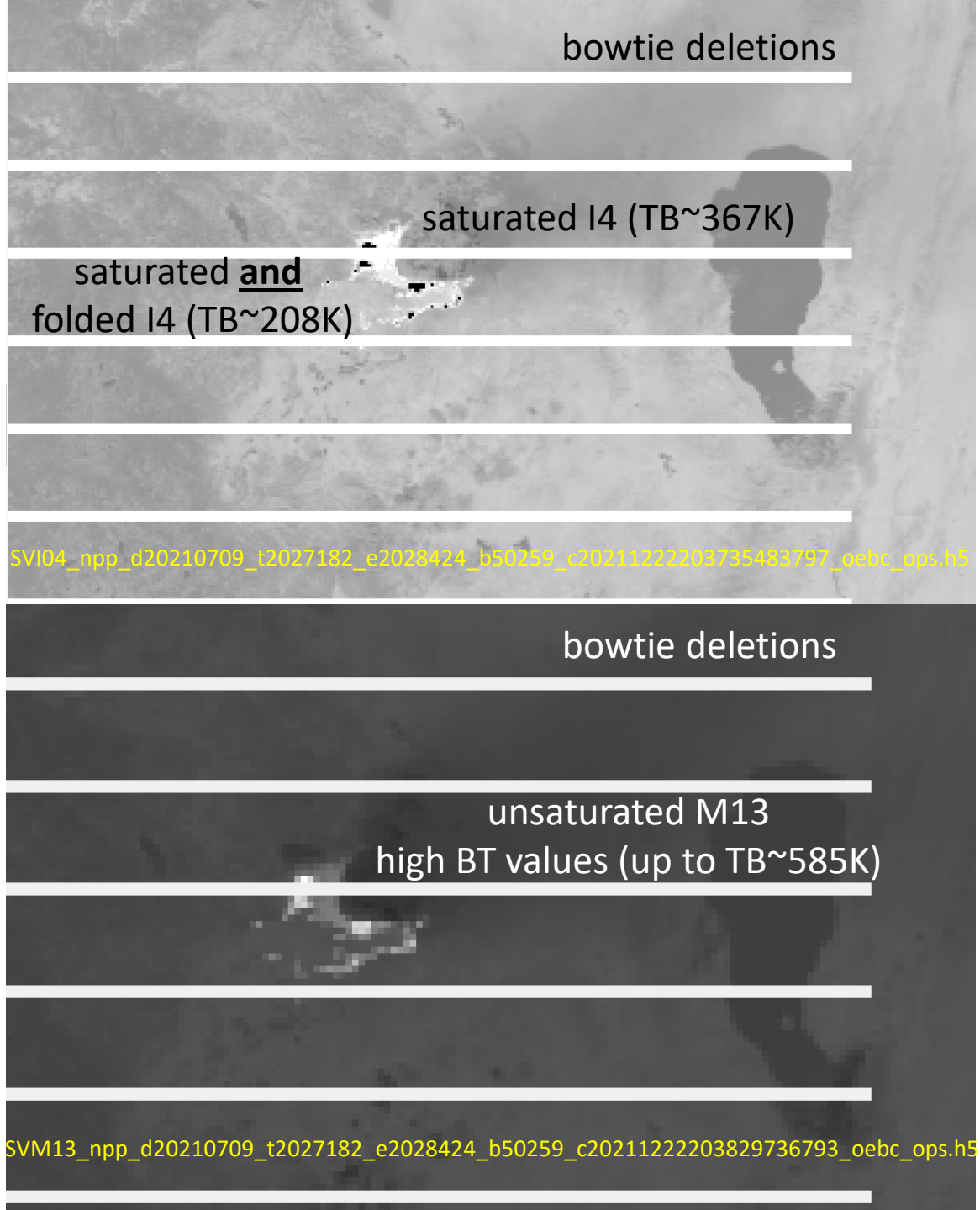
Zoom I04 – Brightness Temp



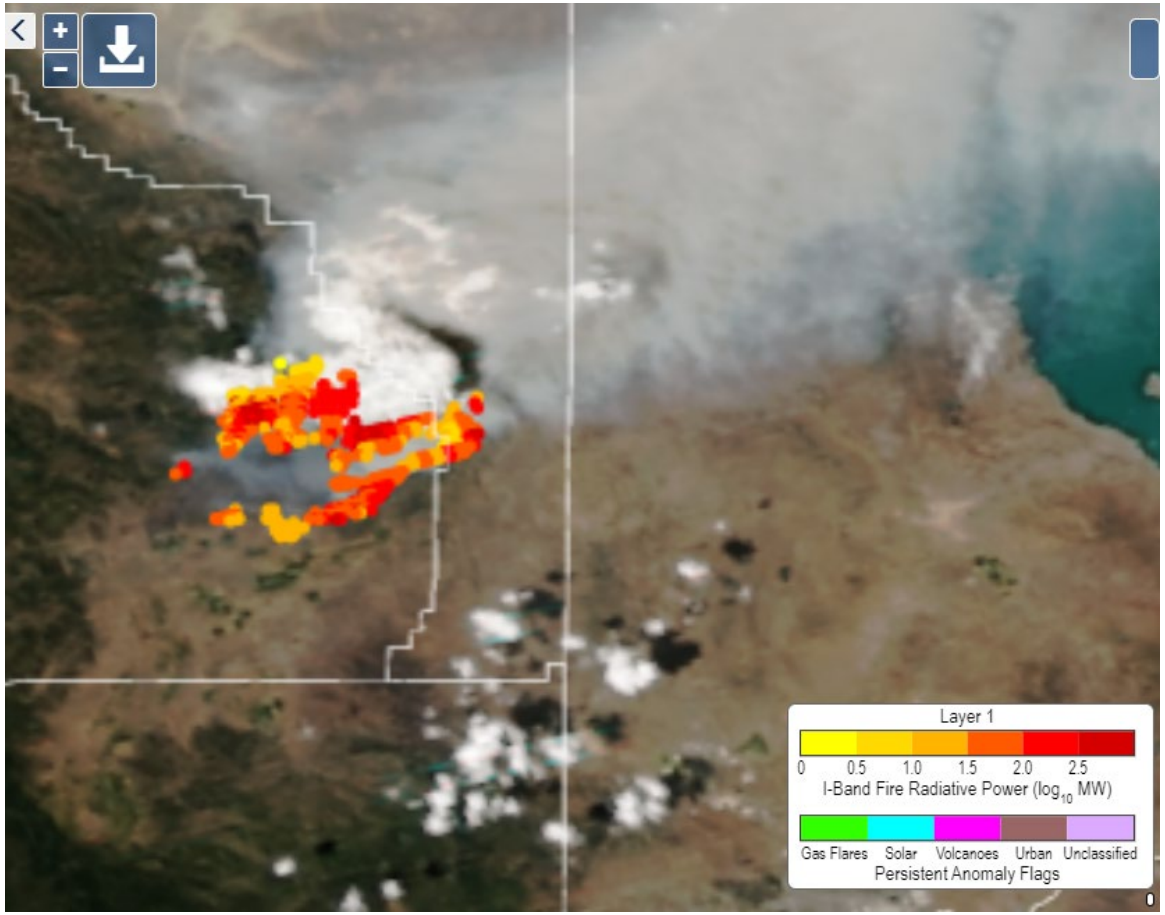
Abnormally low BT (208<>300K) within active fire perimeter and coinciding with outline of head fire where highest temperatures typically occur

208K prevailing among those pixels although higher/intermediate values are also found

Wilfrid Schroeder, NOAA



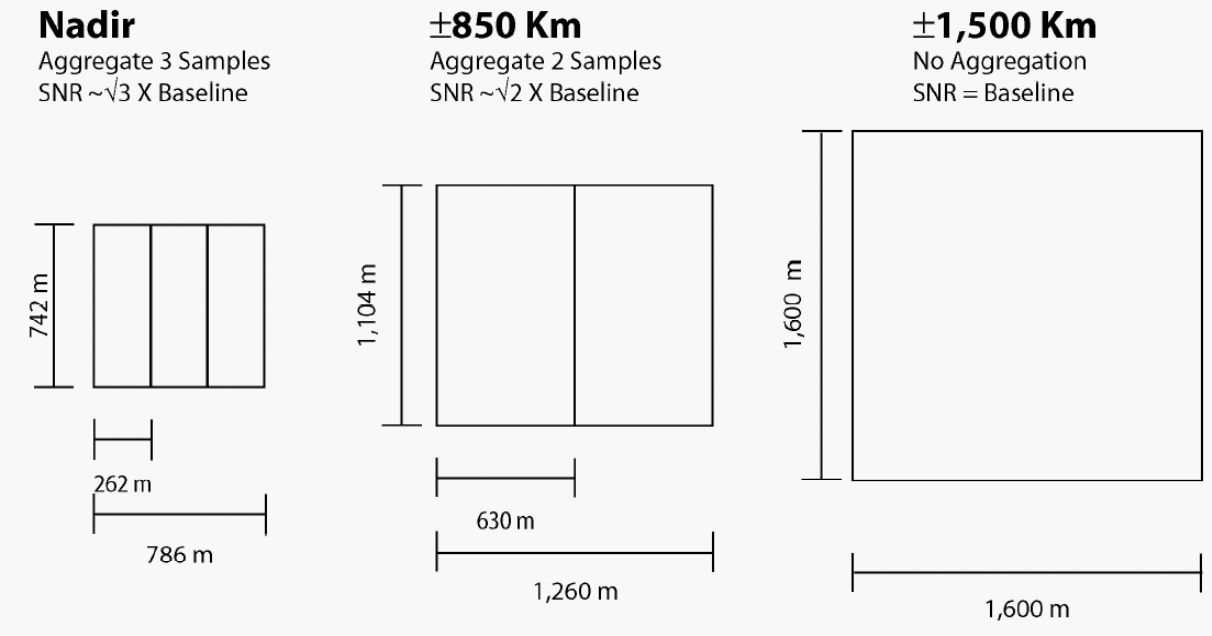
From Level 1 measurements to data products



https://www.star.nesdis.noaa.gov/jpss/mapper/

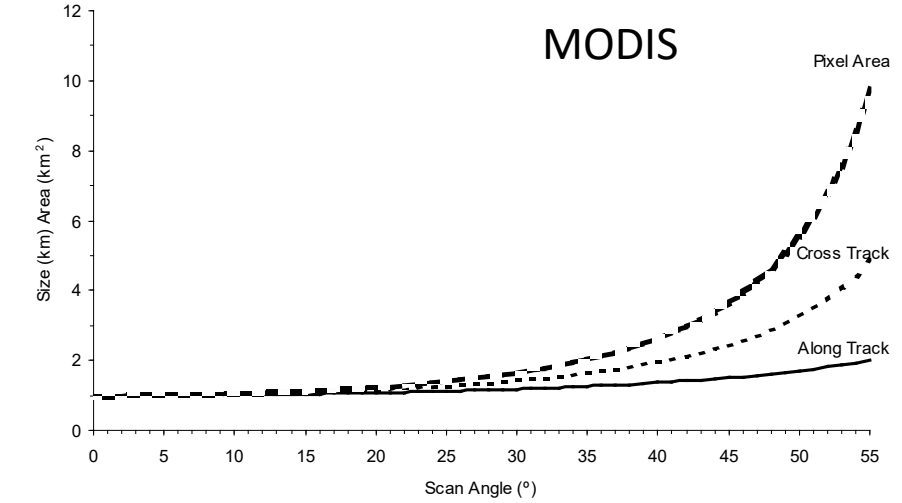
Suomi NPP, July 9, 2021

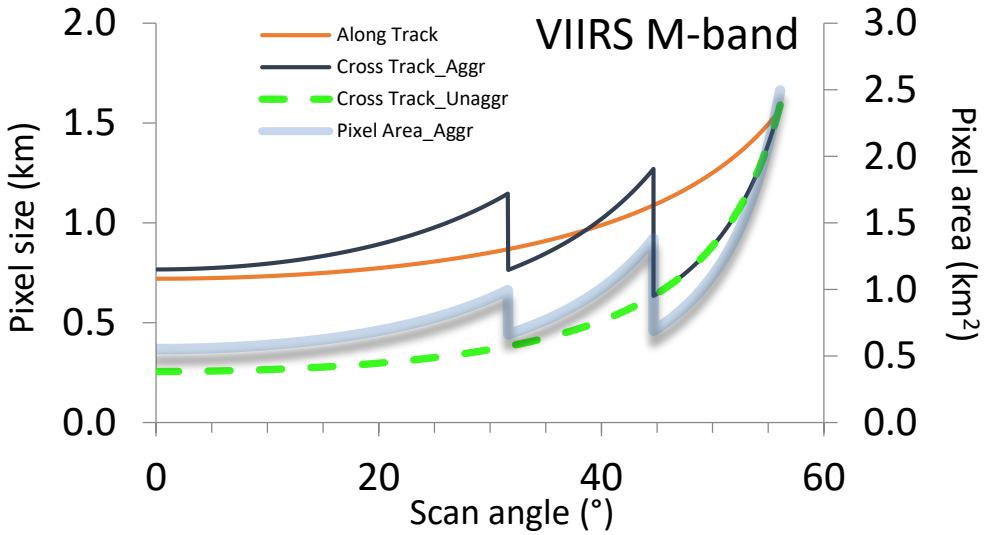
VIIRS Detector Aggregation Scheme: making spatial resolution more uniform along the scan line



JPSS program

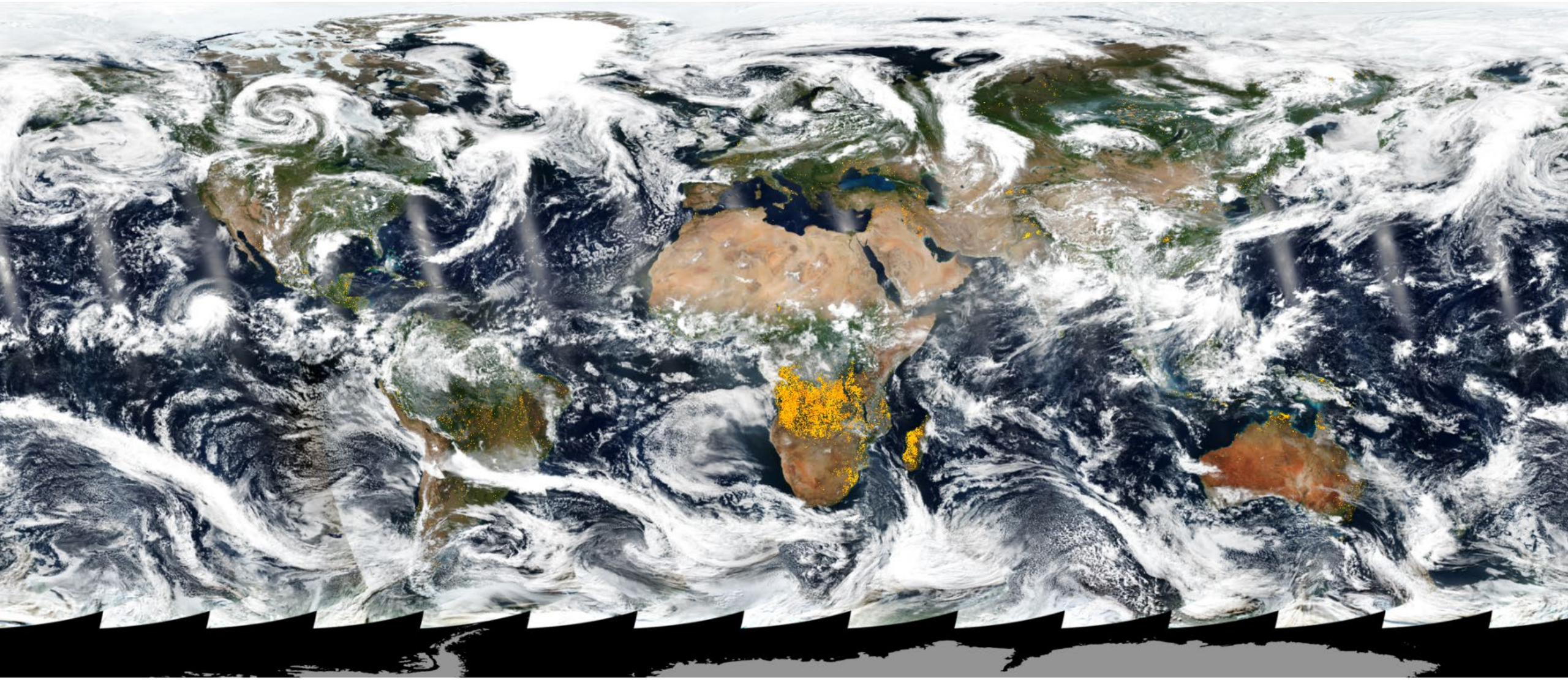
Example show here is for 750m M-band pixels. The same scheme applies to 357m I-band pixels.





Csiszar, I., W. Schroeder, L. Giglio, E. Ellicott, K. P. Vadrevu, C. O. Justice, and 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.

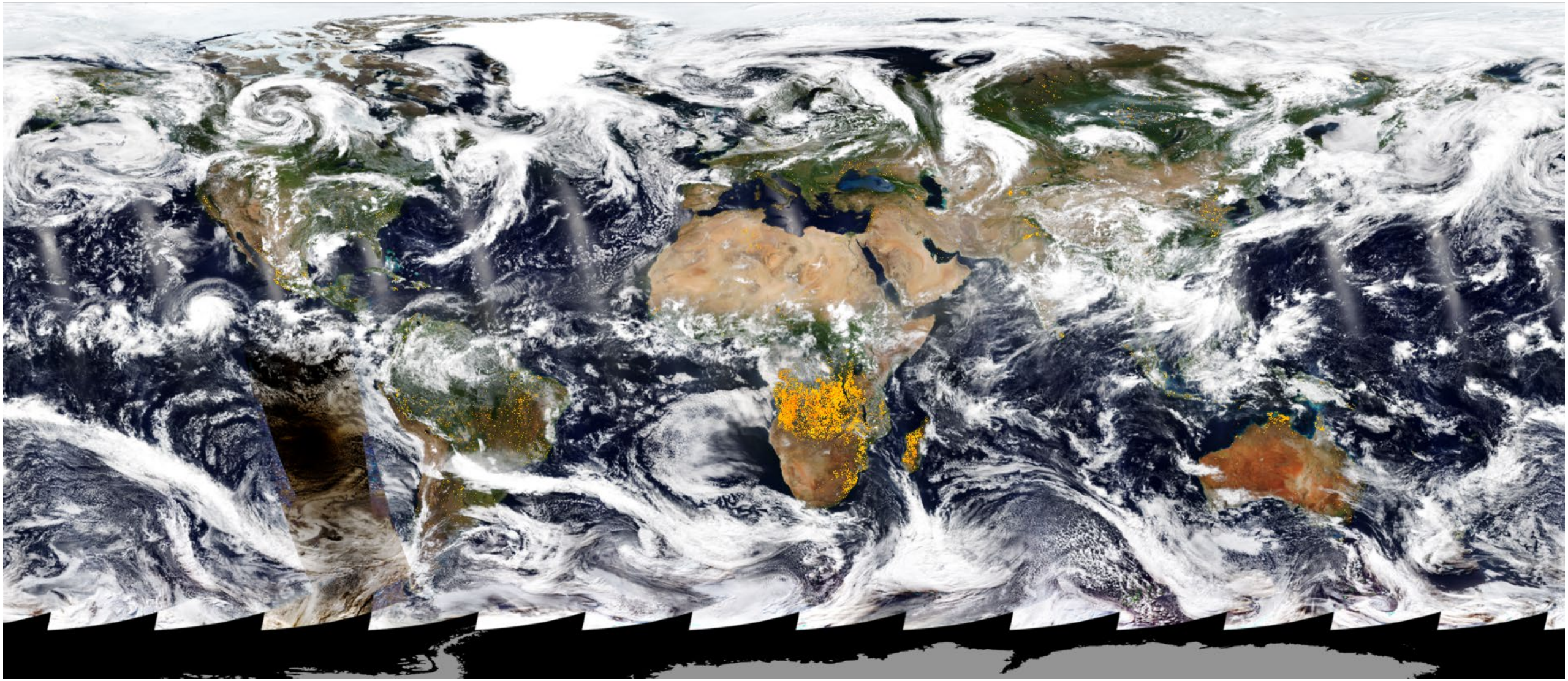
Suomi NPP VIIRS



July 2, 2019

https://www.star.nesdis.noaa.gov/jpss/mapper/

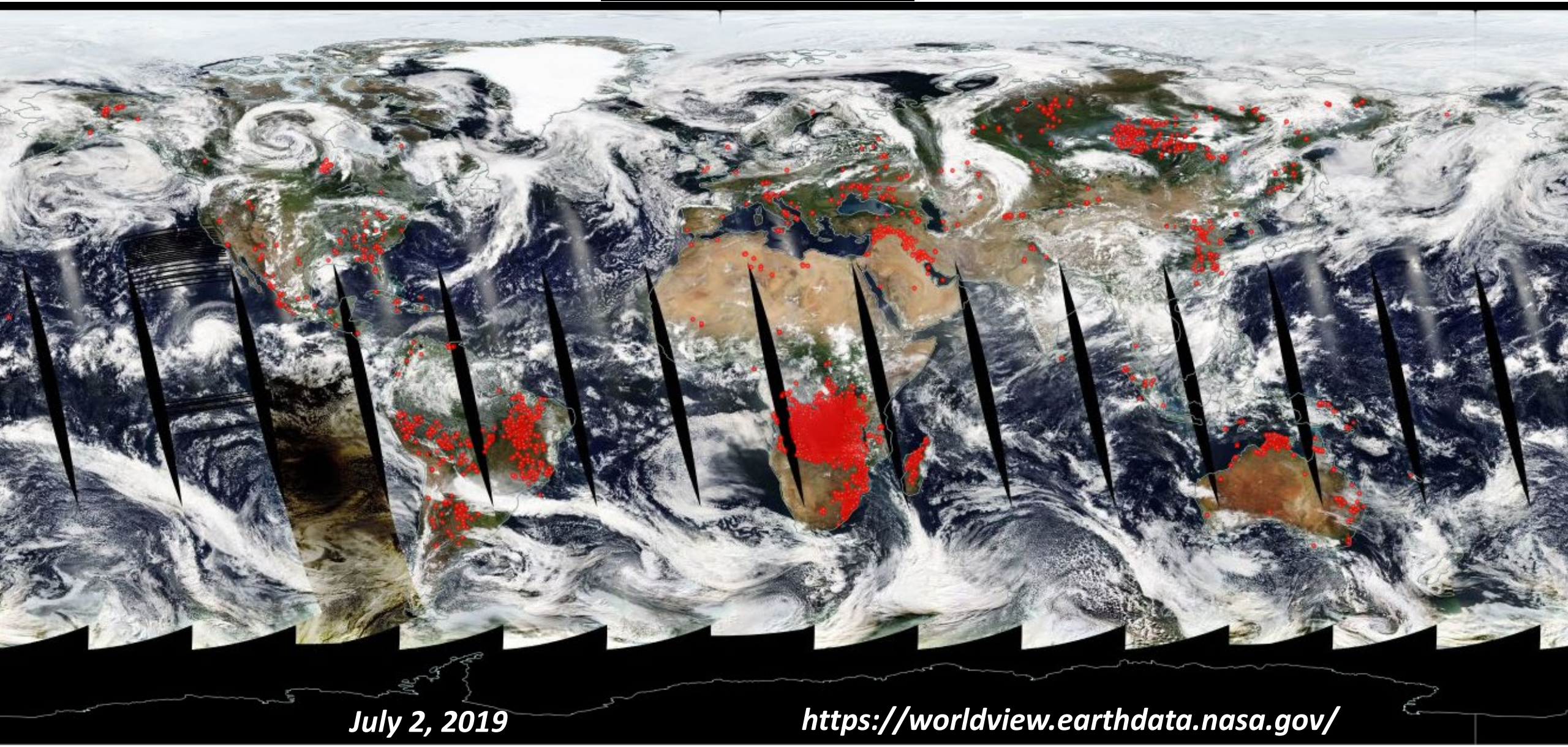
NOAA-20 VIIRS



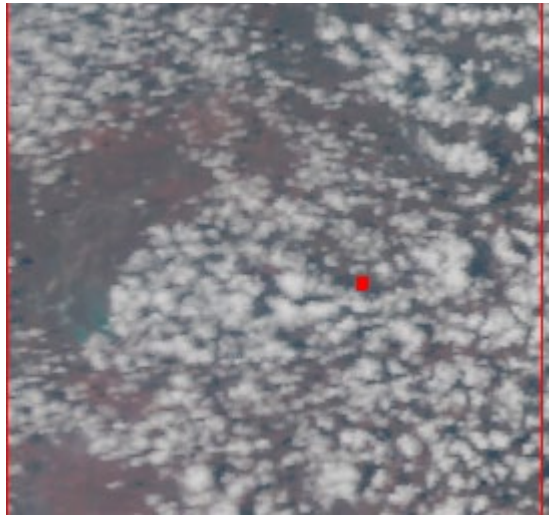
July 2, 2019

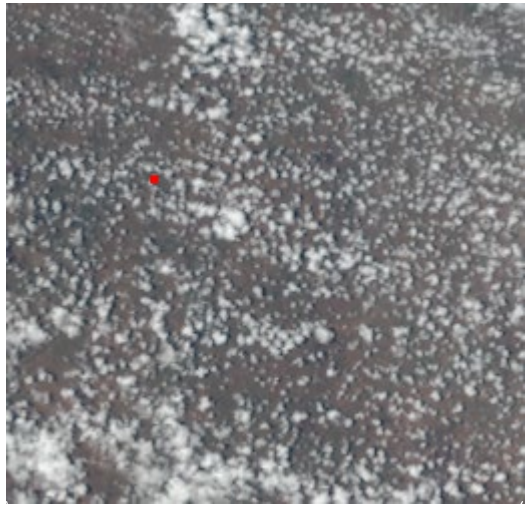
https://www.star.nesdis.noaa.gov/jpss/mapper/

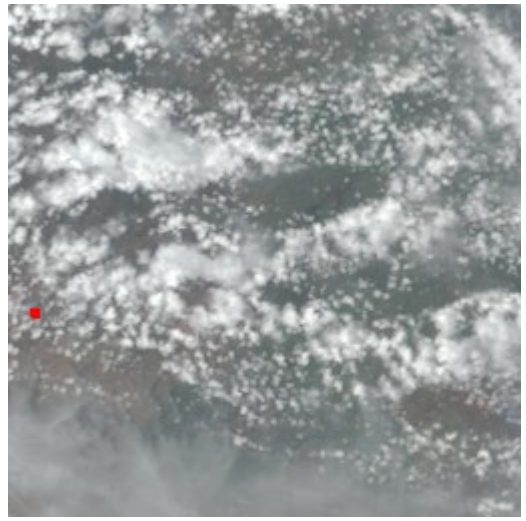
Aqua MODIS

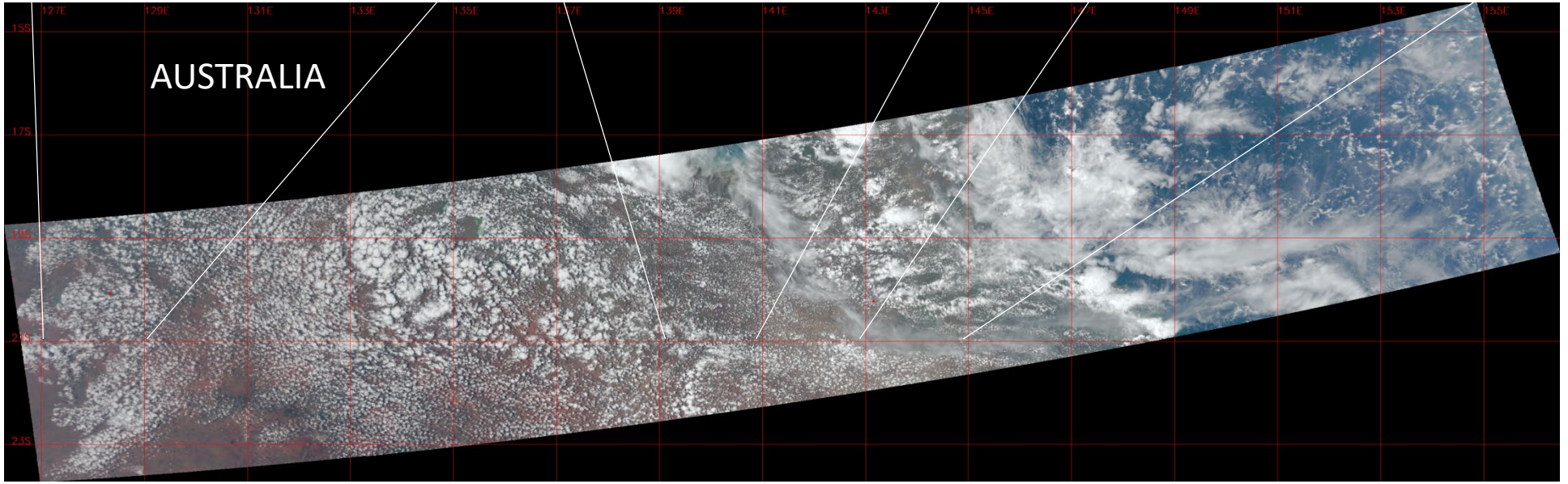


Day one Suomi NPP VIIRS fire detections: January 19, 2012



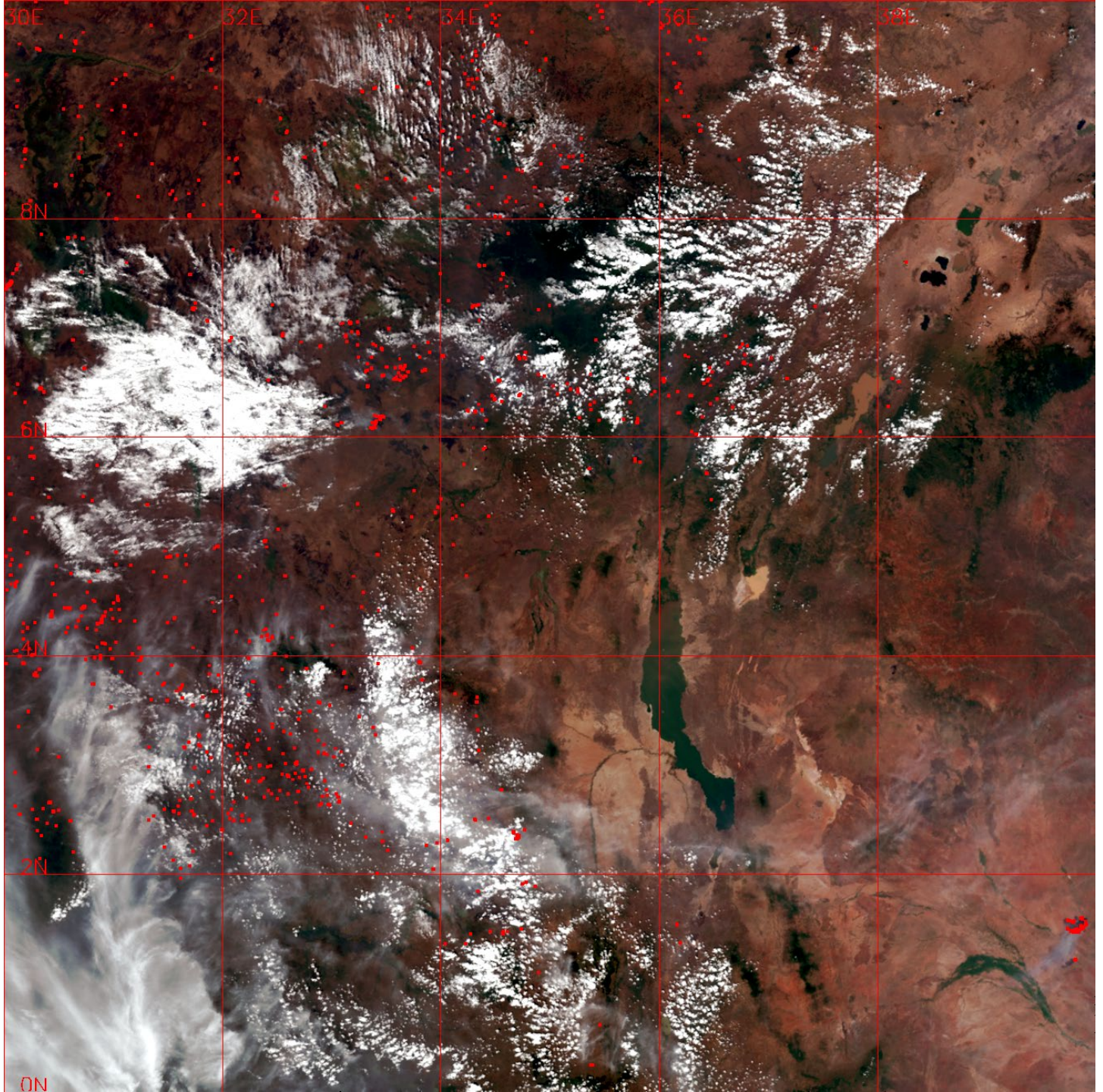






Day one Suomi NPP VIIRS fire data

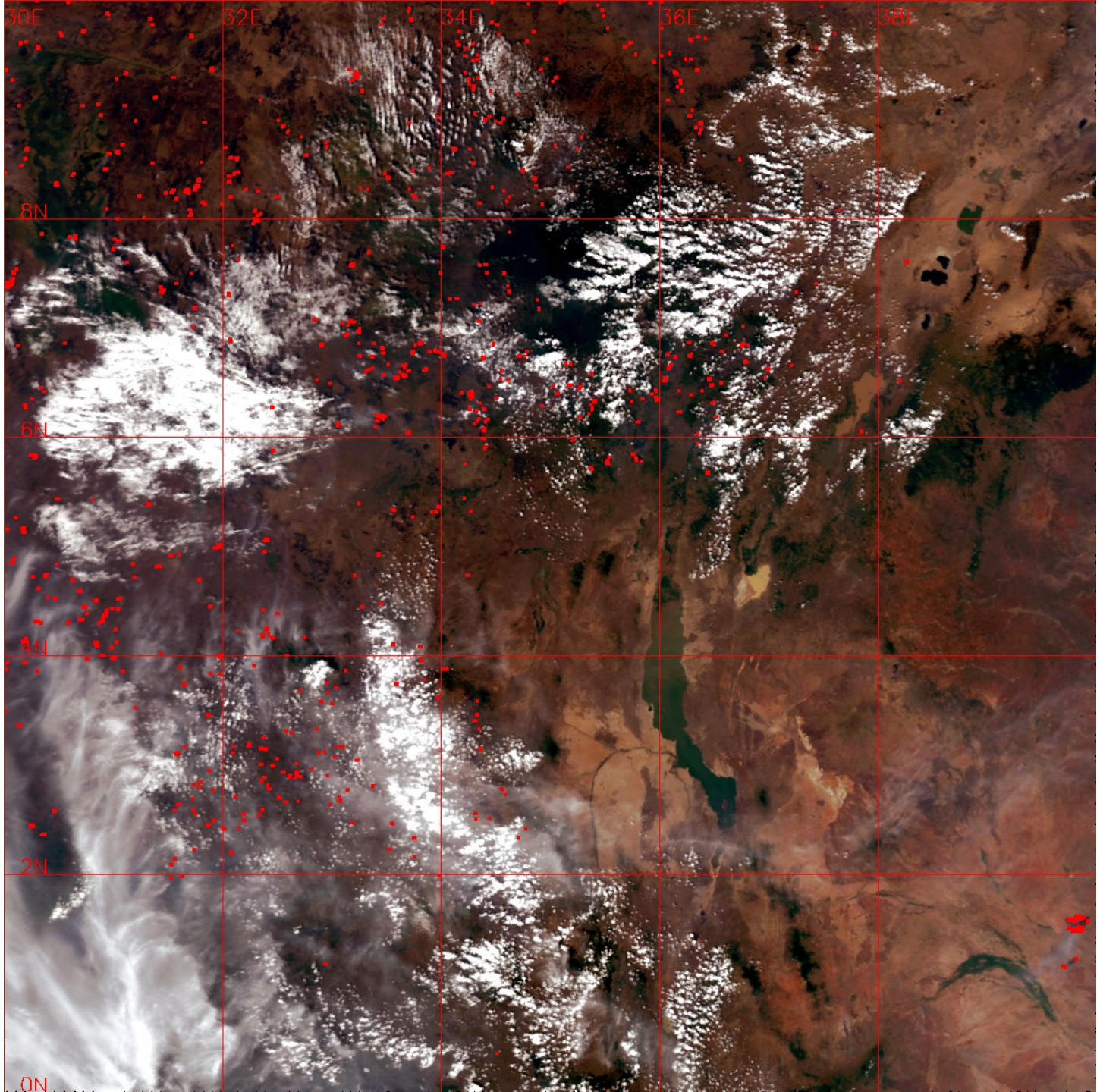
M5-M4-M3 RGB
+
IDPS Active Fire ARP



January 19, 2012
~11:05 UTC

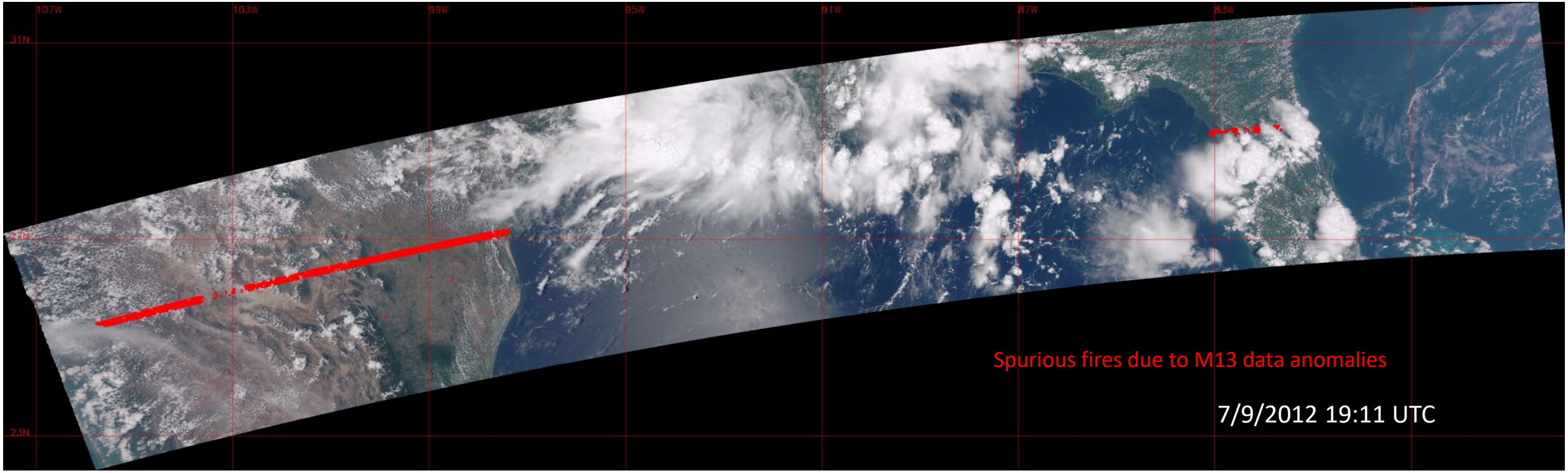
…followed by Aqua MODIS five minutes later

Band 1-4-3 RGB
+
MYD14



January 19, 2012
~11:10 UTC

Spurious Fire Detections in the Early Suomi NPP VIIRS product



Intensive calibration and validation following satellite launch was performed to identify issues and take corrective actions.

Reprocessing of the data record is critical to ensure high-quality time series suitable for scientific analysis.

Reprocessing: missing or incorrectly calibrated scanlines

GMODO-SVM13_npp_d20120515_t1808155_e1813559_b02843_c20161008070834377460_noaa_ops



[220-352K]

Original IDPS; current CLASS archive

GMODO-SVM13_npp_d20120515_t1808155_e1813559_b02843_c20161008070834377460_noaa_ops



[400-562K]

SVM13_npp_d20120515_t1808155_e1809397_b02843_c20160923170107206350_devl_dev



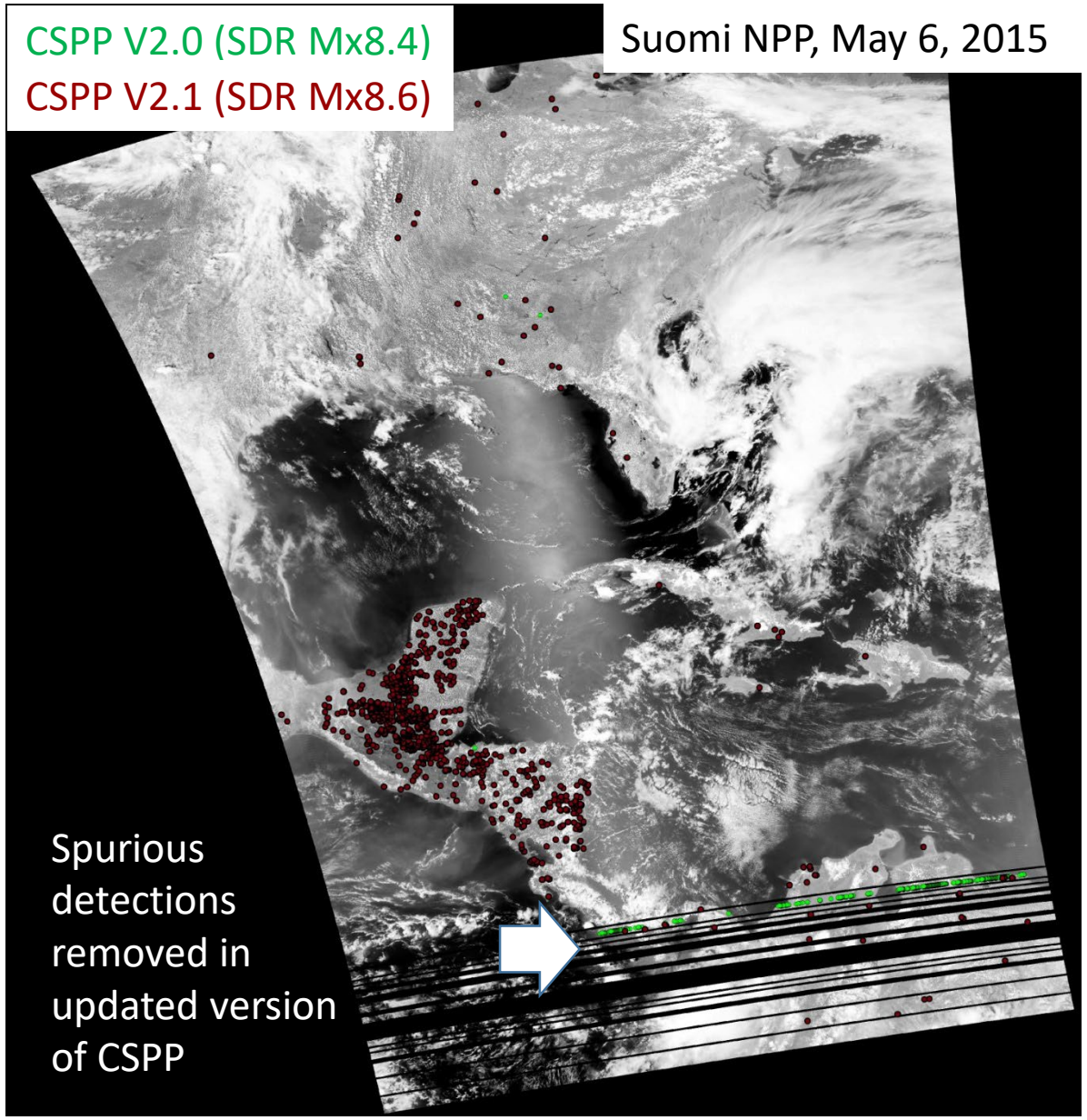
[220-352K]

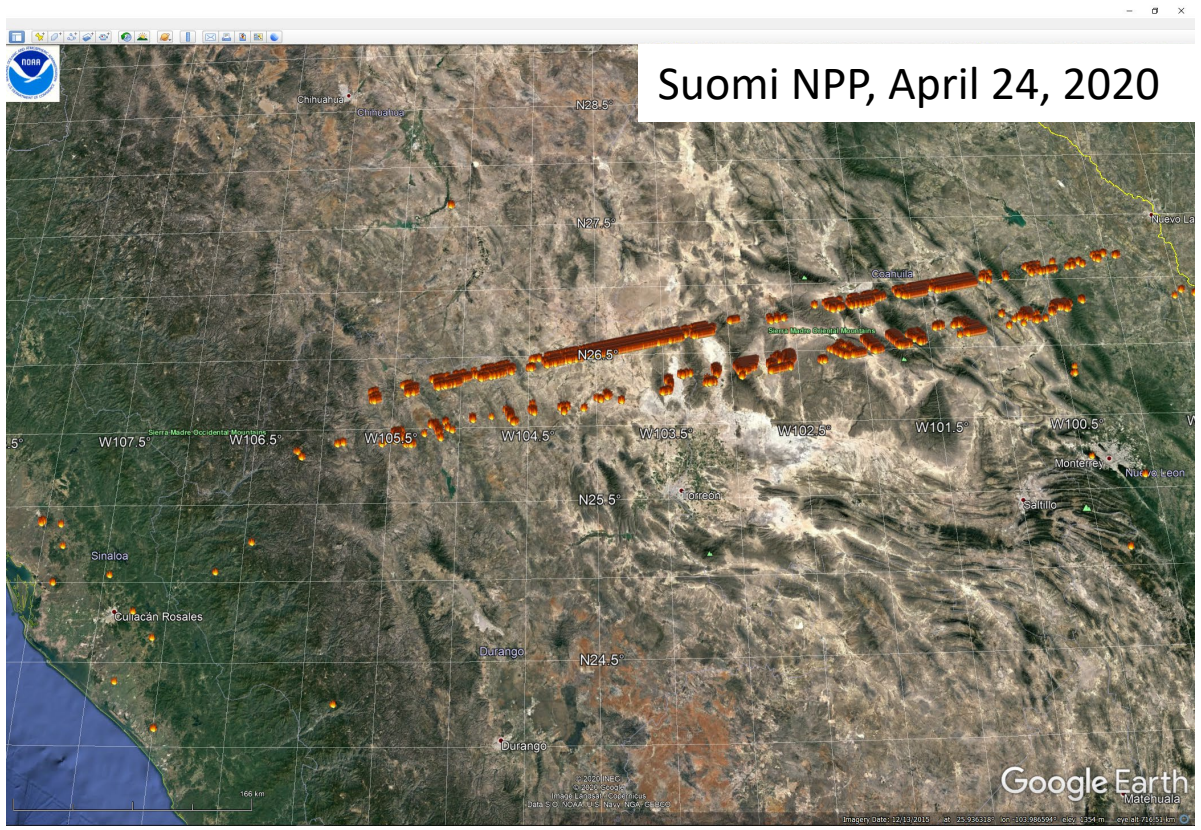
Reprocessed; repaired granule and latest SDR algorithm

Direct broadcast support and product improvements

CSPP V2.0 (SDR Mx8.4)
CSPP V2.1 (SDR Mx8.6)

Suomi NPP, May 6, 2015





Recent relevant CSPP updates:

Suomi National Polar-orbiting Partnership (S-NPP) and NOAA-20 Sensor Data Record (SDR) Software Version 3.2.1

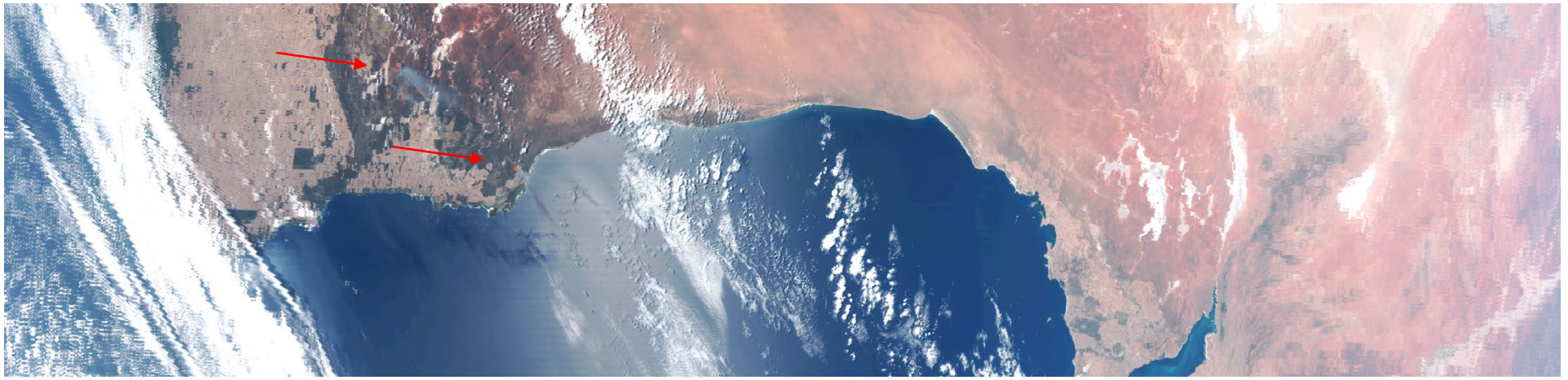
CSPP NOAA JPSS VIIRS Active Fire Software Version 1.1.1 Release

CSPP: Community Satellite Processing Package; https://cimss.ssec.wisc.edu/cspp/

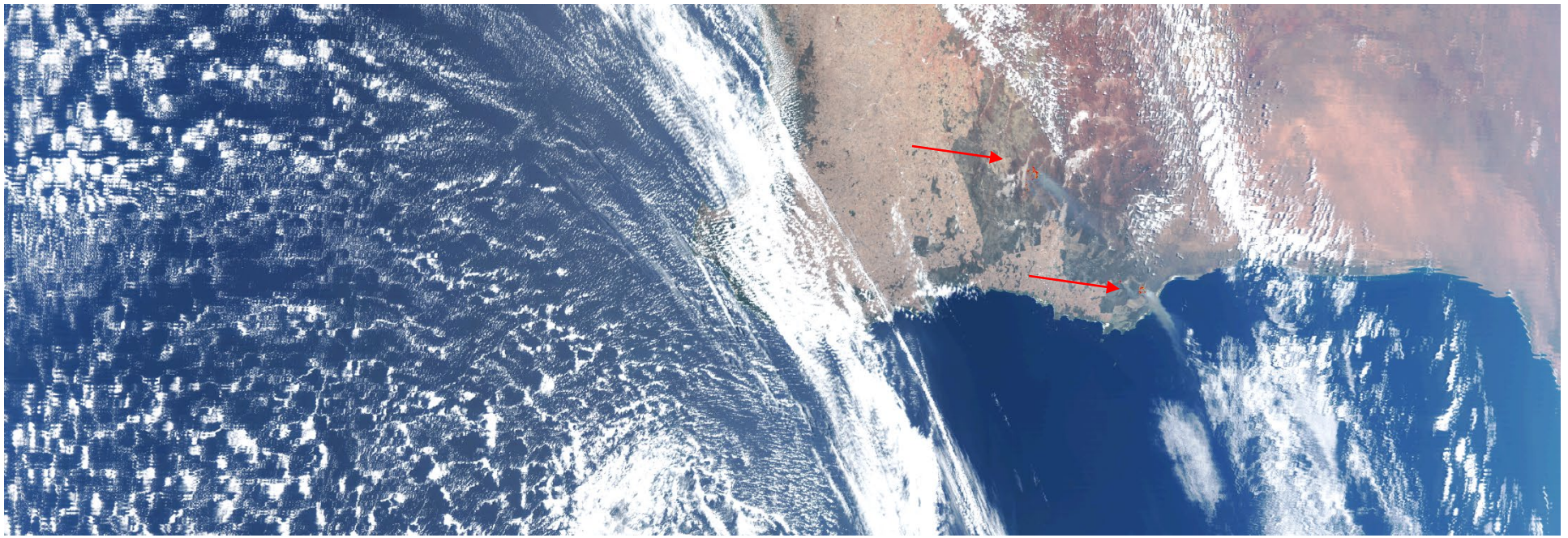
Courtesy Isabel Cruz, CONABIO, Mexico; CSPP Development Team, U. Wisconsin, CIMSS

Day one NOAA-20 VIIRS fire data

Suomi NPP 5:11 UTC



NOAA-20 6:01 UTC

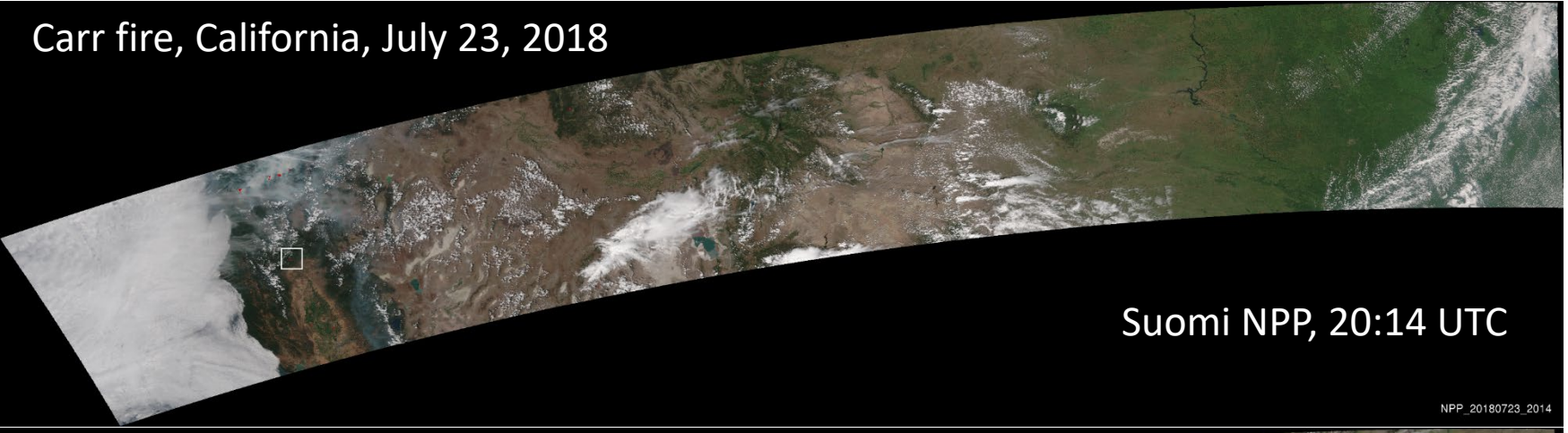


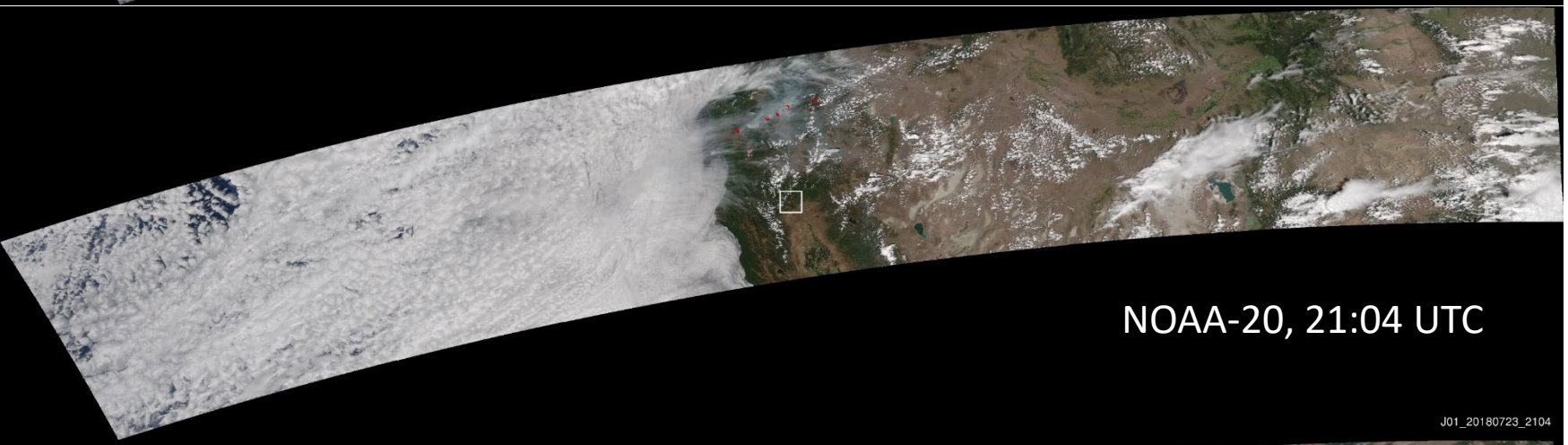
VIIRS 750m
Active fires on
January 5, 2018

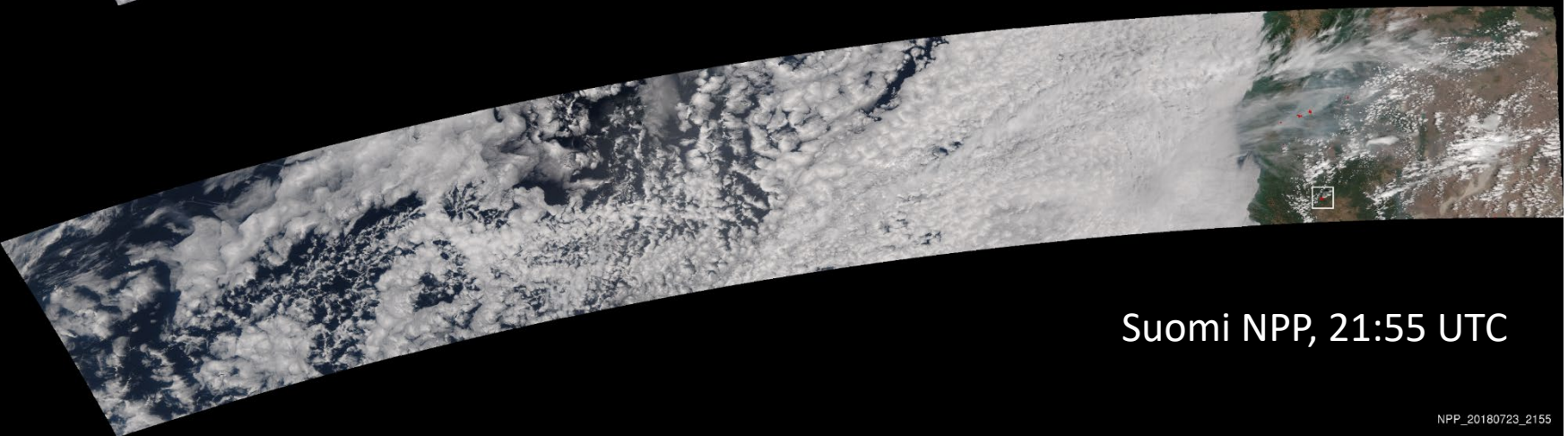
"first light" NOAA-20 fire image by the Science Team

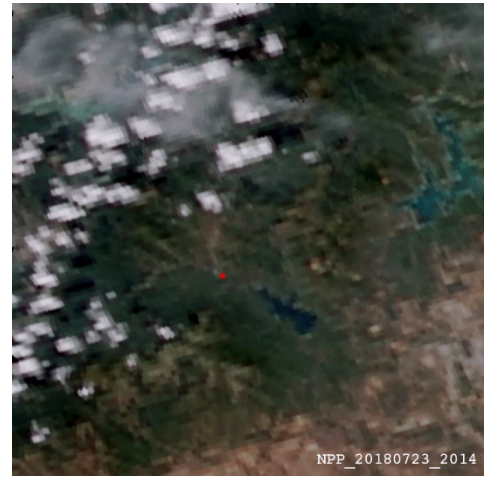
Level 2 product

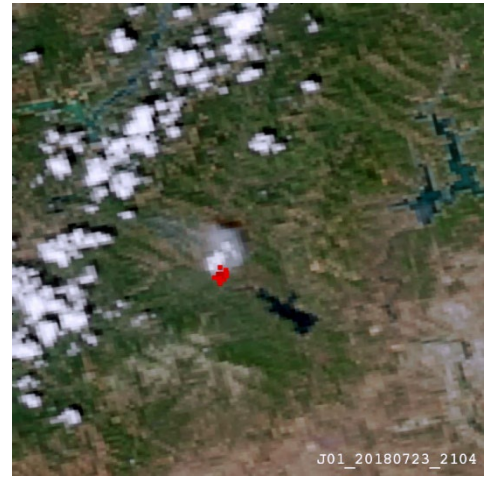
Carr fire, California, July 23, 2018













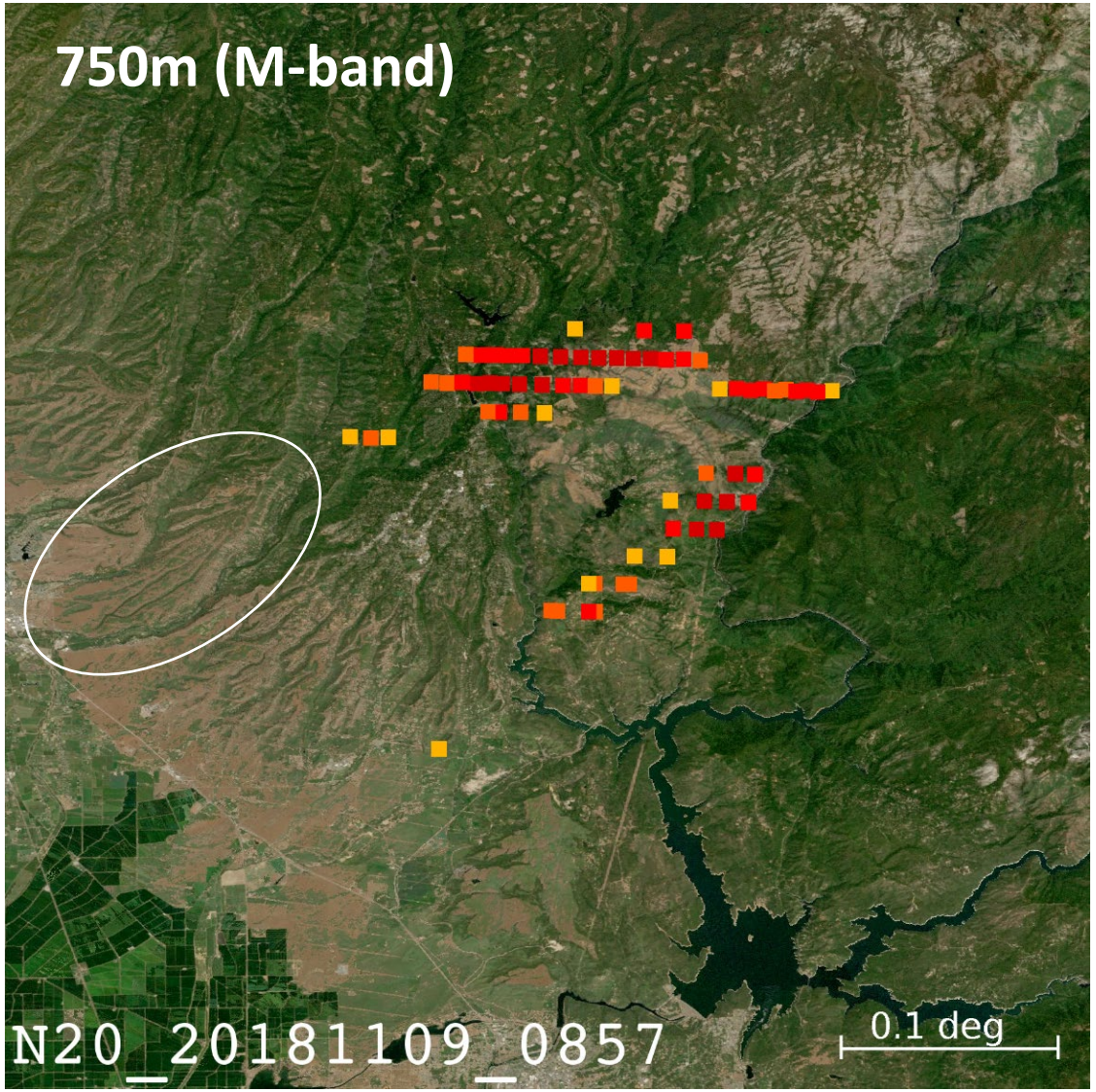
JPSS VIIRS product status

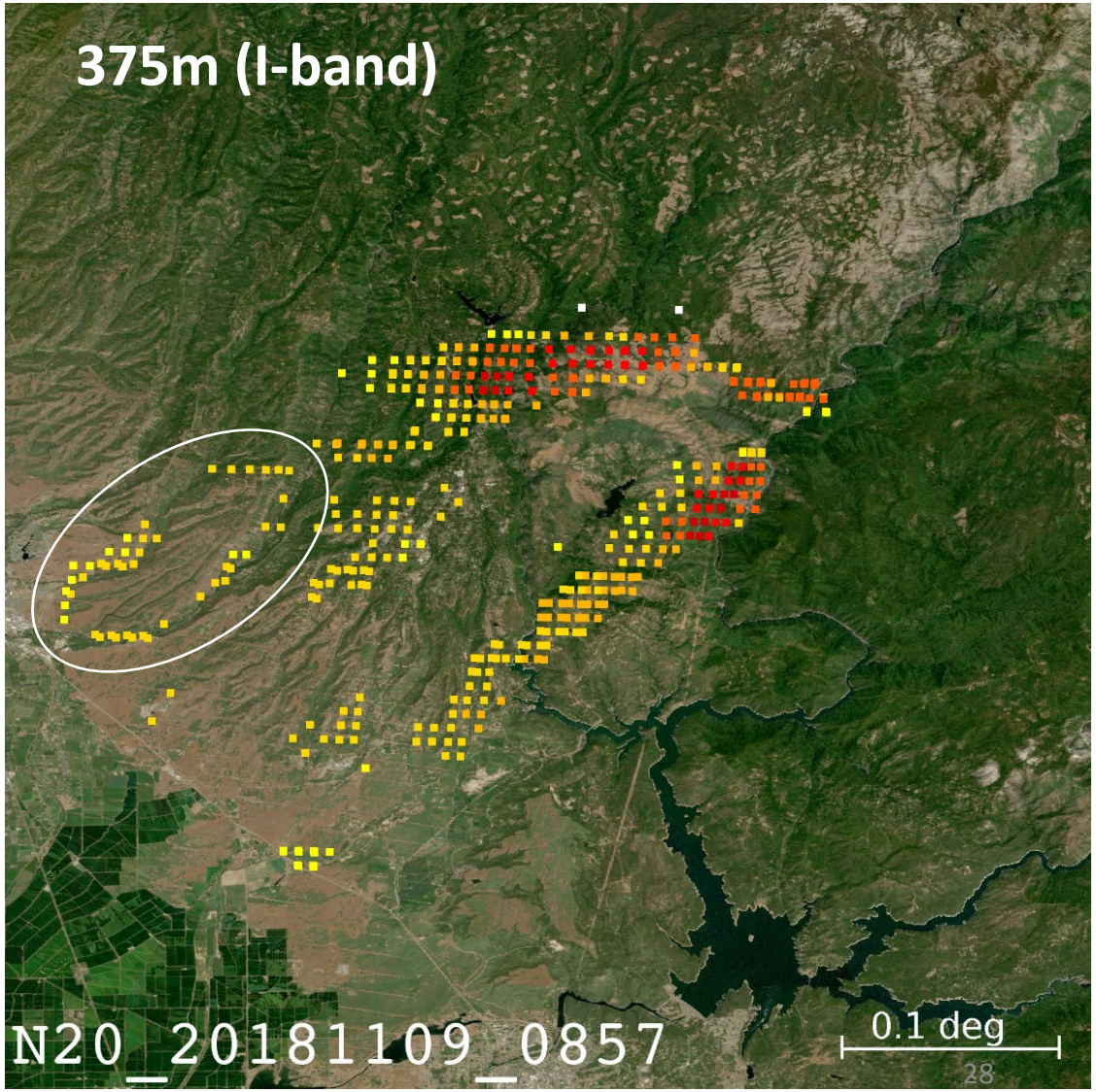
- **375m "I-band" product**
  - New NOAA Operational Product
  - Primary band is I4 for detection; M13 is used for characterization due to low I4 saturation
  - Much higher sensitivity than the 750m product
- **750m "M-band" product**
  - Heritage NOAA operational product
  - MODIS heritage
  - Primary band is VIIRS dedicated fire band (M13)
  - To be phased out after the transition of the downstream applications to the 375m "I-band" product
- **Both algorithms**
  - Work at daytime and nighttime
  - Process Suomi NPP and NOAA-20 (50 minutes apart on the 1:30 orbit)
  - Provide fire radiative power (FRP)
  - Provide full fire mask (fire detections, clear land, water, cloud, etc.)
  - Contain persistent anomaly flag (i.e. likely detection due to non-biomass burning related sources of signal)

Algorithm	Suomi NPP	NOAA-20
750m (M-band)	IDPS: 1/2012 NDE: 3/15/2016	NDE: 8/13/2018
375m (I-band)	STAR: 1/30/2018 NDE: 9/30/2020	STAR: 2/5/2018 NDE: 9/30/2020

- **Global Near-real-time data**
  - 750m and 375m products from NDE ->PDA, CLASS
  - All included in JSTAR Mapper
  - Latest versions include persistent anomalies
- **Direct Broadcast: CSPP / CIMSS**
  - 750m and 375m product included
  - CIMSS processes and distributes DB data
  - Now included in RealEarth™
- **Used in emission modeling and smoke forecasting**
  - HRRR-smoke, GBBEPx etc.

Camp Fire, CA M-band vs. I-band

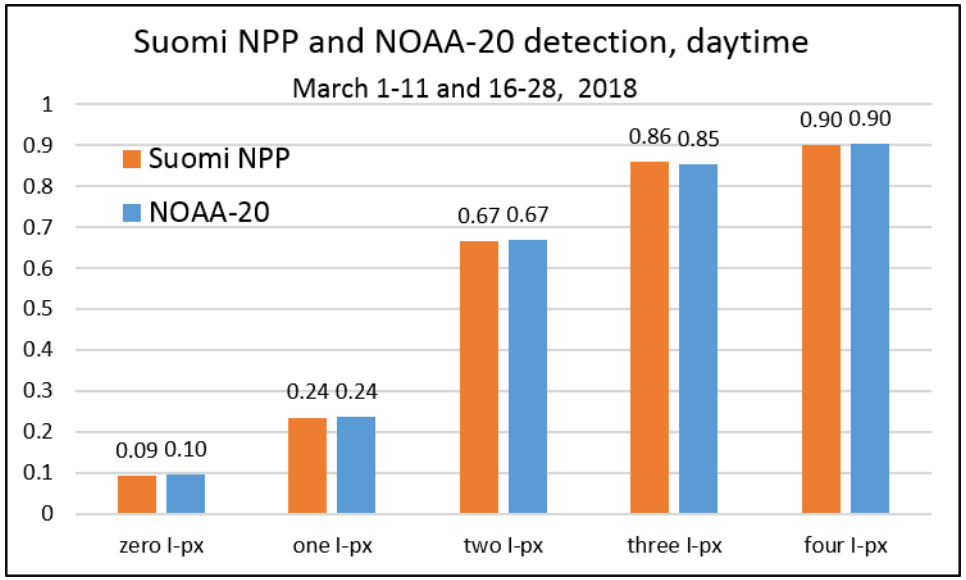


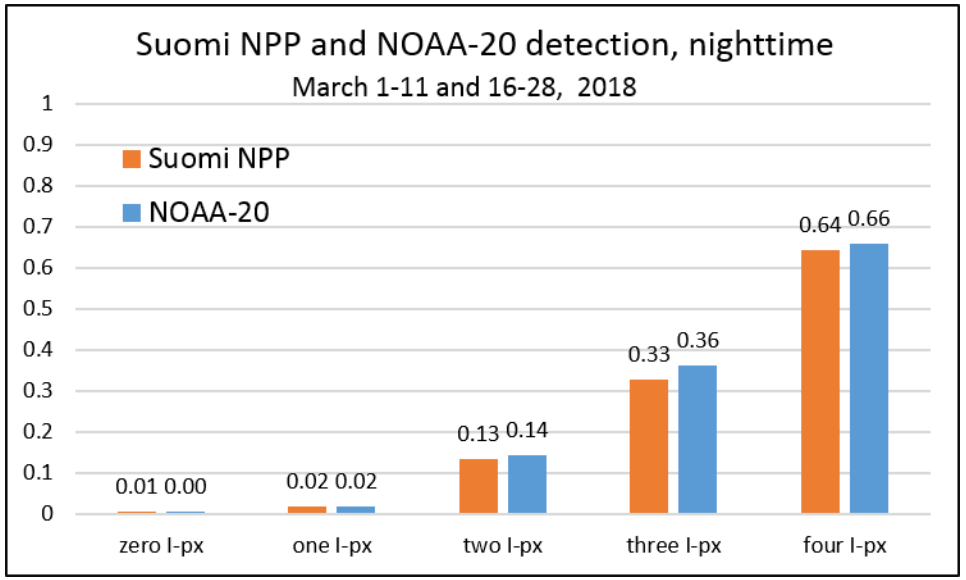


M-band vs. I-band detection rates

- Detection rates relative to the 375m I/M "hybrid" product as a function of the number of I-band resolution detections within the M-band pixel footprint
- Frequency of M-band detections without a single I-band detection were used as a proxy for commission errors
- Increase of detection rates with increasing number of I-band detections
- Good consistency of detection rates between Suomi NPP and NOAA-20
- Significant differences between daytime and nighttime detection rates, indicating a more conservative performance of the nighttime M-band algorithm

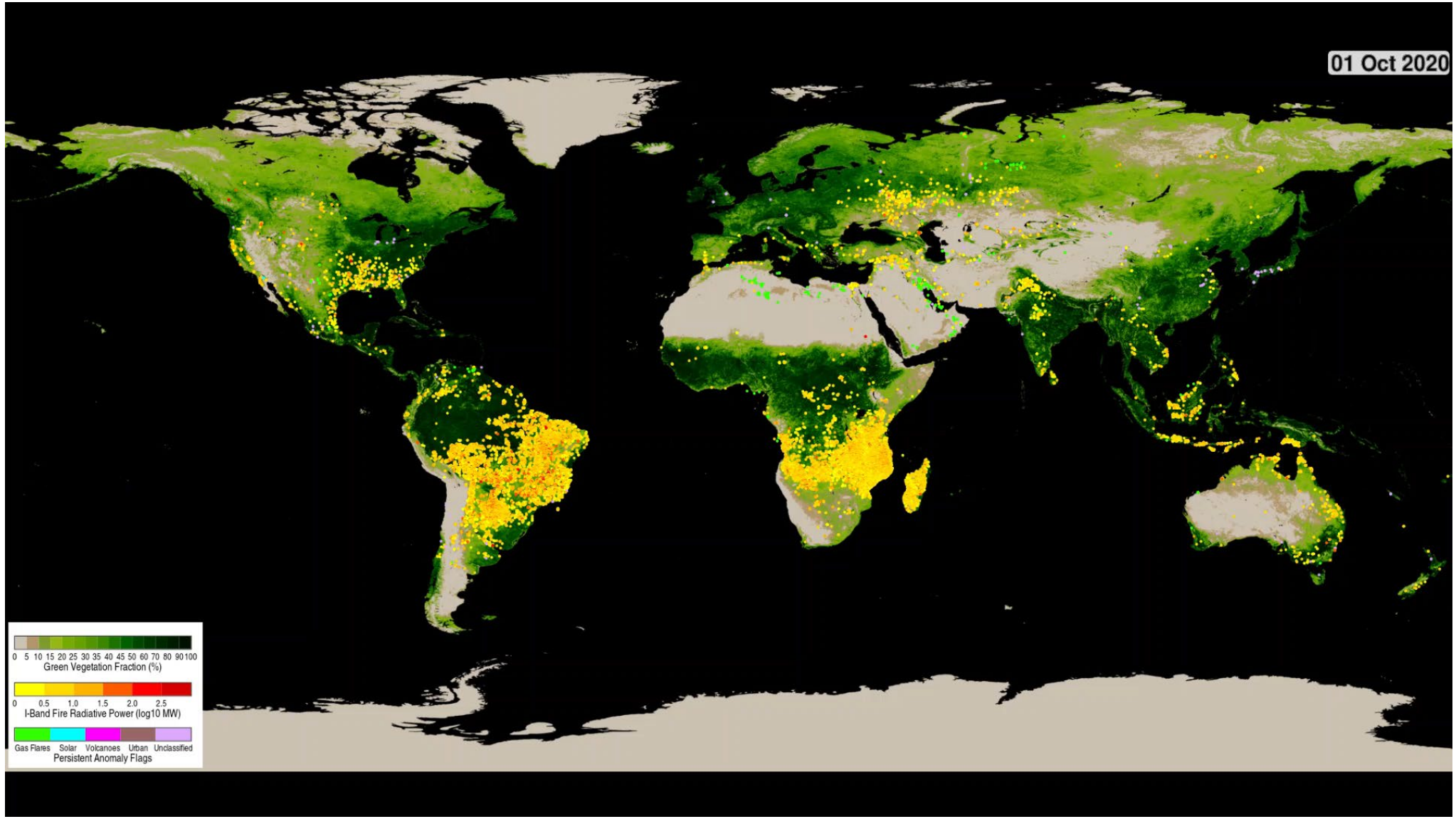
Daytime (left) and nighttime (right) relative detection performance between the operational 750m M-band and 375m I/M-band VIIRS active fire products





One year* of Suomi NPP VIIRS I-band FRP

Global Suomi NPP VIIRS I-band fire radiative power data over a Green Vegetation Fraction (GVF) background



A total of seven days with missing/incomplete data were excluded for better visualization (12/25, 12/26, 12/28, 6/22, 8/3, 8/4, 8/5)

M-band and I-band Active Fire File content

Name	Type	Description	Dimension	Units	Range
fire mask	8 bit integer	Fire mask	3200 x 768 (M-band) 6400 x 1536 (I-band)	unitless	**0 - 9**
algorithm QA	32 bit Integer	Fire algorithm QA mask	3200 x 768 (M-band) 6400 x 1536 (I-band)	unitless	**0 - 31**
FP_line	16 bit Integer	Fire pixel line	Sparse data array 1 – N	unitless	**0 – 767 / 0-1535**
FP_sample	16 bit Integer	Fire pixel sample	Sparse data array 1 – N	unitless	**0 – 3199 / 0-6399**
FP_latitude	32 bit Float	Fire pixel latitude	Sparse data array 1 – N	degrees	**-90 - 90**
FP_longitude	32 bit Float	Fire pixel longitude	Sparse data array 1 – N	degrees	**-180 - 180**
FP_power	32 bit Float	Fire radiative power	Sparse data array 1 – N	MW	**0 - 5000**
FP_confidence	8 bit Integer	Fire detection confidence	Sparse data array 1 – N	%	**0 – 100 / 7-9**
FP_land	8 bit Integer	Land pixel flag	Sparse data array 1 – N	unitless	**1 – land** **0 – water**
FP_PersistentAnomalyCategory	8 bit Integer	Persistent industrial or natural source	Sparse data array 1 – N	unitless	**0: no persistent anomaly** **1: oil or gas flare** **2: volcano** **3: solar panel** **4: urban (currently not used)** **5: unclassified**
18 FP diagnostic variables	See netCDF4 metadata	Variables to describe observing and environmental conditions, and results of algorithm tests	Sparse data array 1 – N	See netCDF4 metadata	**See netCDF4 metadata**

*** N is a dimension of sparse data array; defined in "nfire" variable**

M-band and I-band Active Fire Product content: Fire Mask

Output	Type	Description	
Fire Mask	8-bit unsigned integer	Missing – 0	Missing input data
		Scan – 1	On-board bowtie deletion
		Other – 2 (M-band) Sun glint – 2 (I-band)	Not processed (M-band) Pixel classified as sun glint (I-band)
		Water – 3	Pixel classified as non-fire water
		Cloud – 4	Pixel classified as cloudy
		No Fire – 5	Pixel classified as non-fire land
		Unknown – 6	Pixel with no valid background pixels
		Fire Low – 7	Fire pixel with low confidence
		Fire Medium – 8	Fire pixel with medium confidence
		Fire High – 9	Fire pixel with high confidence
Fire Algorithm QA Mask	32-bit unsigned integer	See backup slide for details	

M-band and I-band Active Fire Product content: QA Mask

Bits	Description
0-1	Surface Type (water=0, coastal=1, land=2)
2	EDR ground bowtie deletion zone (0=false, 1=true)
3	Atmospheric correction performed (0=false, 1=true)
4	Day/Night (daytime = 1, nighttime = 0)
5	Potential fire (0=false, 1=true)
6	spare
7-10	Background window size parameter
11	Fire Test 1 valid (0 - No, 1 - Yes)
12	Fire Test 2 valid (0 - No, 1 - Yes)
13	Fire Test 3 valid (0 - No, 1 - Yes)
14	Fire Test 4 valid (0 - No, 1 - Yes)
15	Fire Test 5 valid (0 - No, 1 - Yes)
16	Fire Test 6 valid (0 - No, 1 - Yes)
17-19	spare
20	Adjacent clouds (0/1)
21	Adjacent water (0/1)
22-23	Sun Glint Level (0-3)
24	Sun Glint rejection
25	False Alarm (excessive rejection of legitimate background pixels)
26	False Alarm (rejection of land pixel due to water background)
27	Amazon forest-clearing rejection test
28	False alarm (rejection of water pixel due to land or coastal background)
29-31	Persistent anomaly category (same as in sparse array)

Bits	Description
0	Channel I1 quality (0 = nominal (or nighttime), 1 = non-nominal)
1	Channel I2 quality (0 = nominal (or nighttime), 1 = non-nominal)
2	Channel I3 quality (0 = nominal (or nighttime), 1 = non-nominal)
3	Channel I4 quality (0 = nominal, 1 = non-nominal)
4	Channel I5 quality (0 = nominal, 1 = non-nominal)
5	Geolocation data quality (0 = nominal, 1 = non-nominal)
6	Channel M13 quality (0 = nominal, 1 = non-nominal)
7	Unambiguous fire (0 = false, 1 = true [night only])
8	Background pixel (0 = false, 1 = true)
9	Bright pixel rejection (0 = false, 1 = true)
10	Candidate pixel (0 = false, 1 = true)
11	Scene background (0 = false, 1 = true)
12	Test 1 (0 = false, 1 = true)
13	Test 2 (0 = false, 1 = true)
14	Test 3 (0 = false, 1 = true)
15	Test 4 (0 = false, 1 = true) (day)
16	Pixel saturation condition (0 = false, 1 = true) (day)
17	Glint condition (0 = false, 1 = true) (day)
18	Potential South Atlantic magnetic anomaly pixel (0 = false, 1 = true)
19	Fire pixel over water (0 = false, 1 = true)
20	Persistence test 1 (0 = false, 1 = true)
21	Persistence test 2 (0 = false, 1 = true)
22	Residual *bowtie* pixel (0 = false, 1 = true)
23-25	Persistent anomaly category
26-31	Reserved for future use

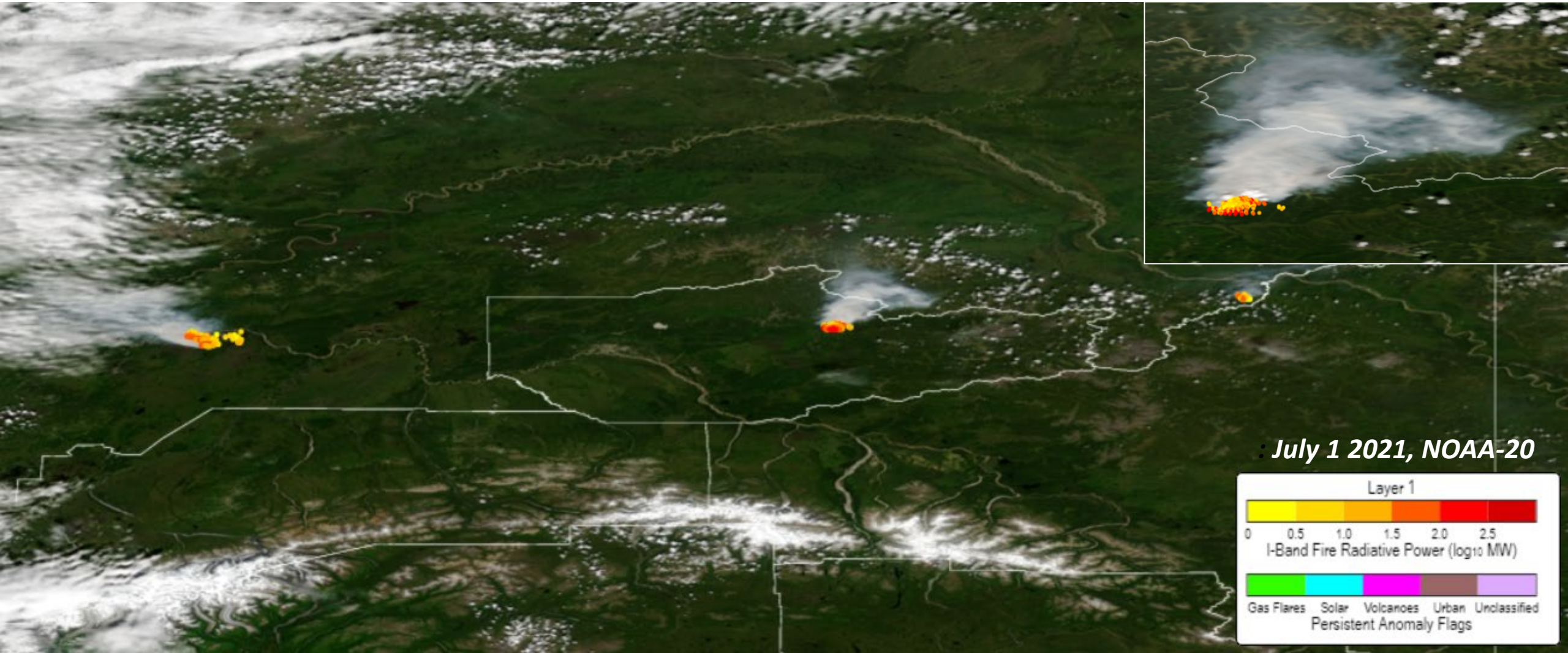
Giglio, L., Schroeder, W., Csiszar, I., Tsidulko, M., Algorithm Theoretical Basis Document For NOAA NDE VIIRS Active Fire Version 2.6 June, 2016

Schroeder, W., Giglio, L., Csiszar, I., Tsidulko, M., Algorithm Theoretical Basis Document For NOAA NDE VIIRS I-band (375m) Active Fire Version 1.0 June, 2020

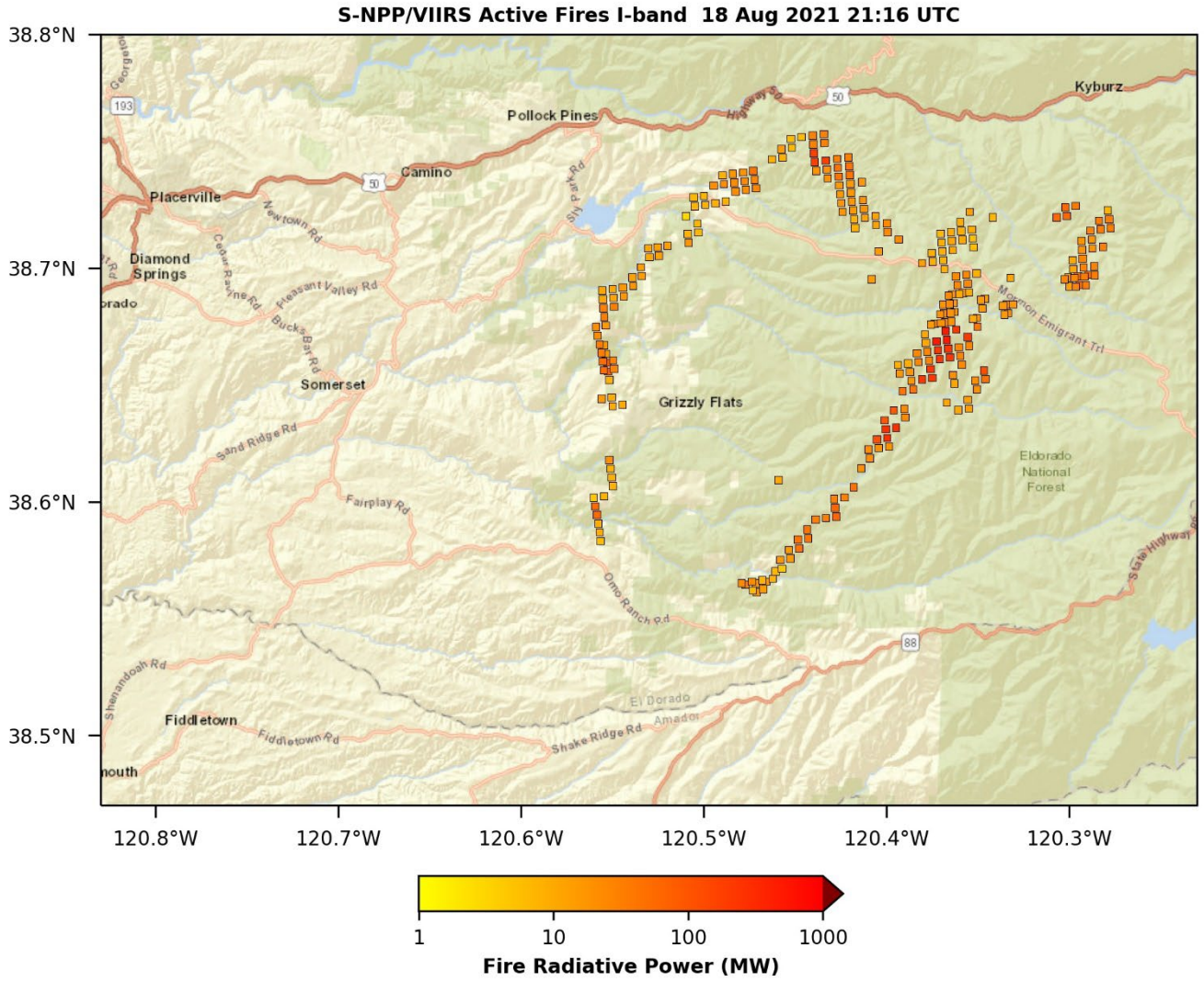
NOAA/NESDIS/STAR JSTAR Mapper

https://www.star.nesdis.noaa.gov/jpss/mapper/

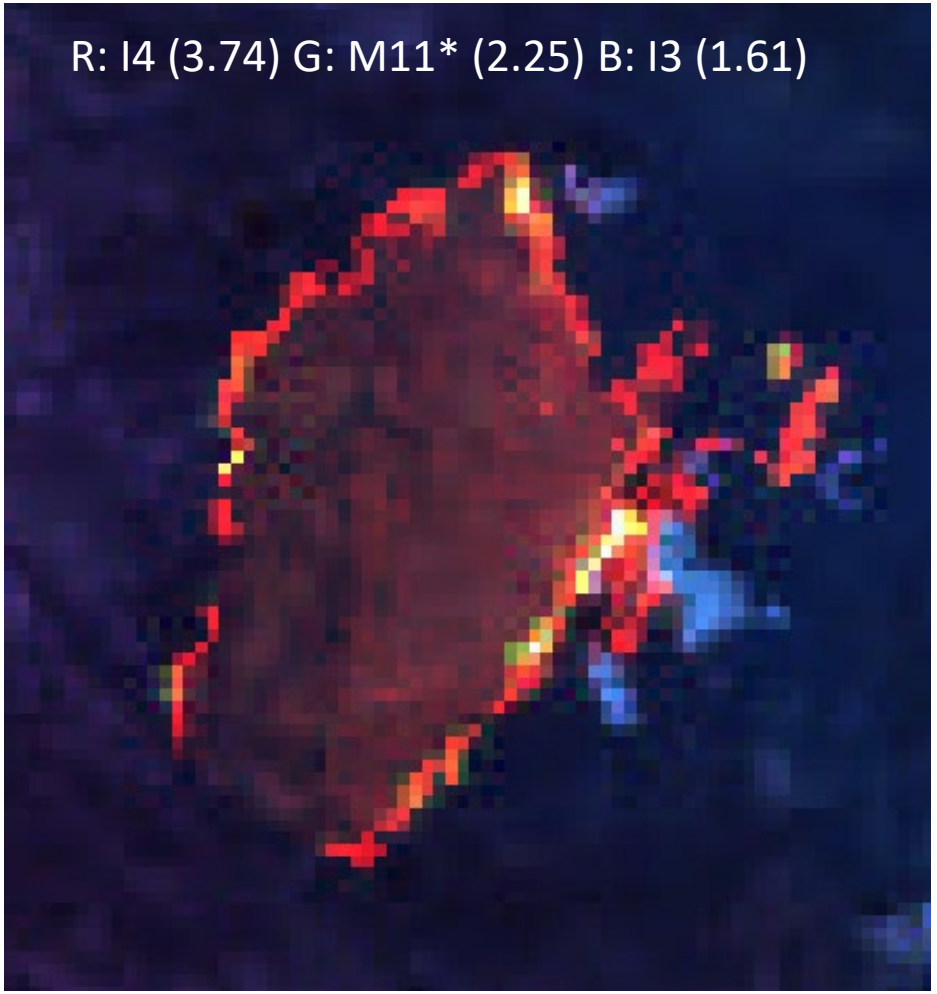
- *Integrated monitoring and visualization system for a number of JPSS products (e.g. fire, aerosol and air quality information)*
- *Data from Suomi NPP and NOAA-20 with moderate latency*
- *VIIRS I-band and M-band FRP for daytime and nighttime*
- *STAR is working on a further improved visualization and data access system*



Caldor fire: VIIRS Fire Radiative Power

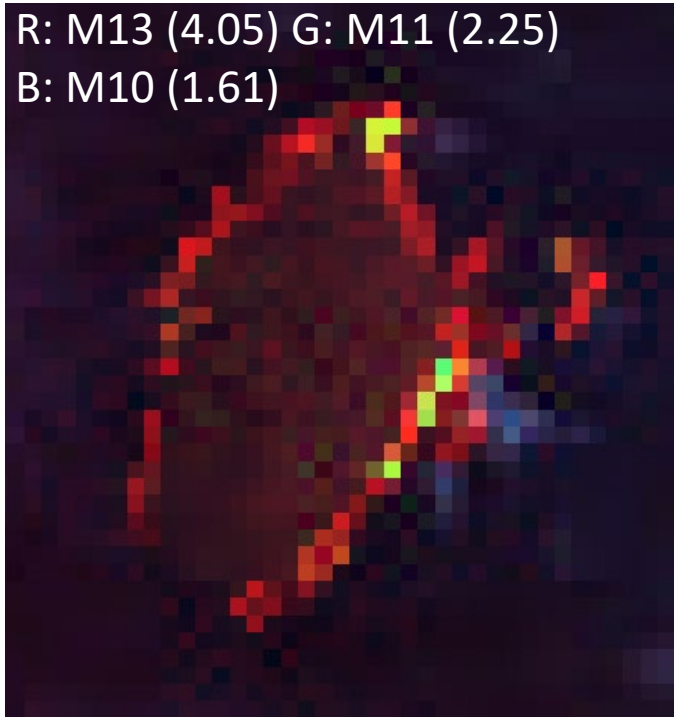


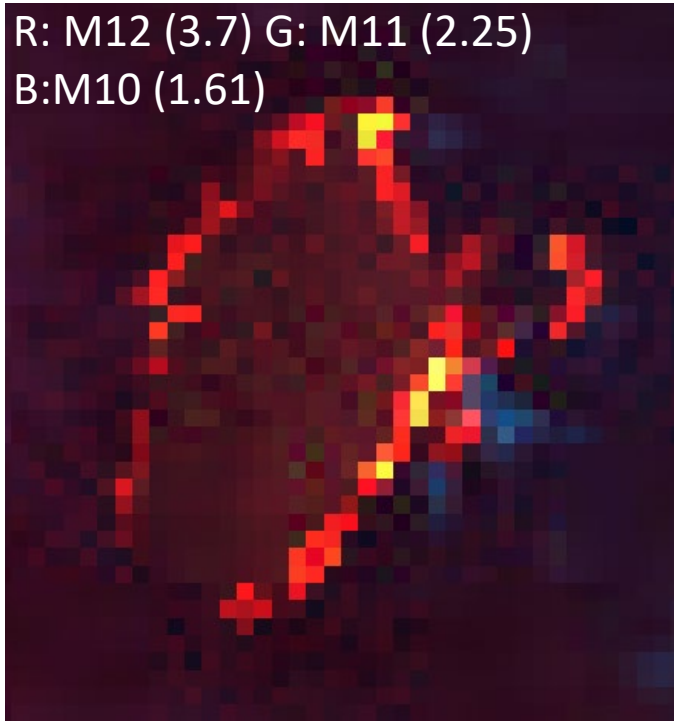
VIIRS Fire Temperature RGBs



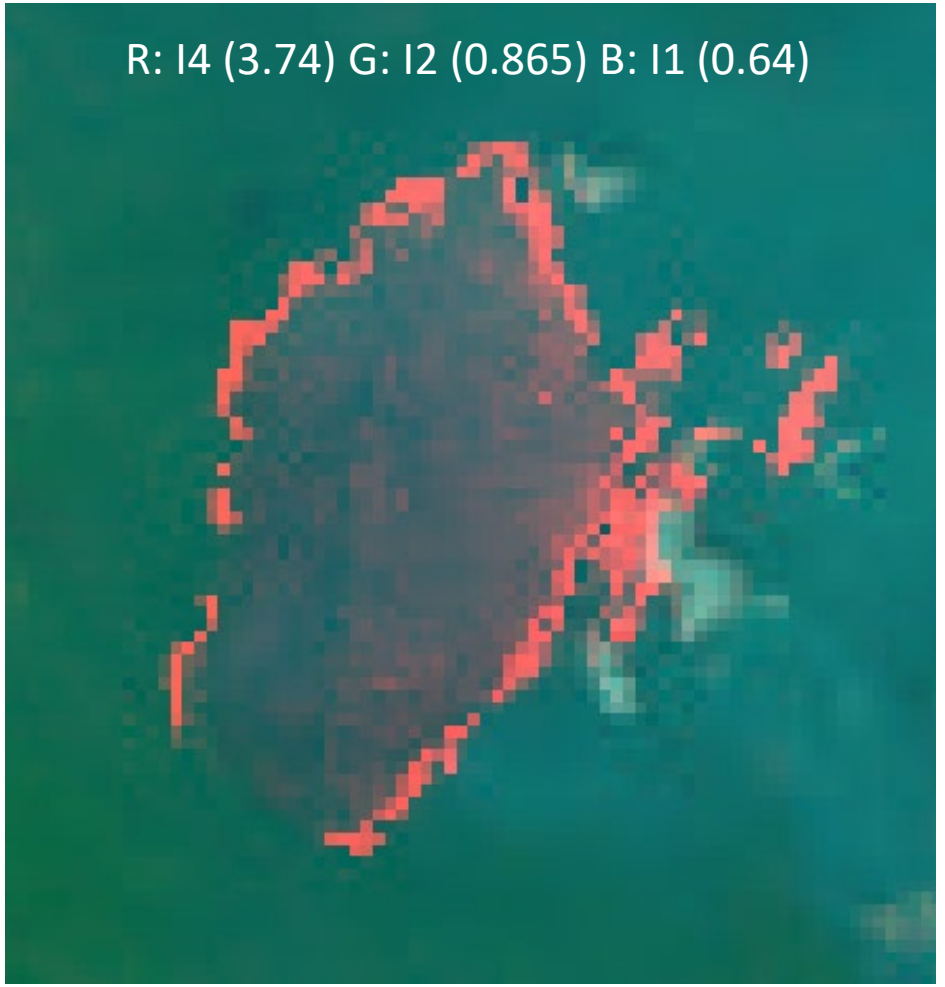
**M11 rescaled to I-band resolution*

Curtis Seaman, CIRA ***20210818_210950_npp***





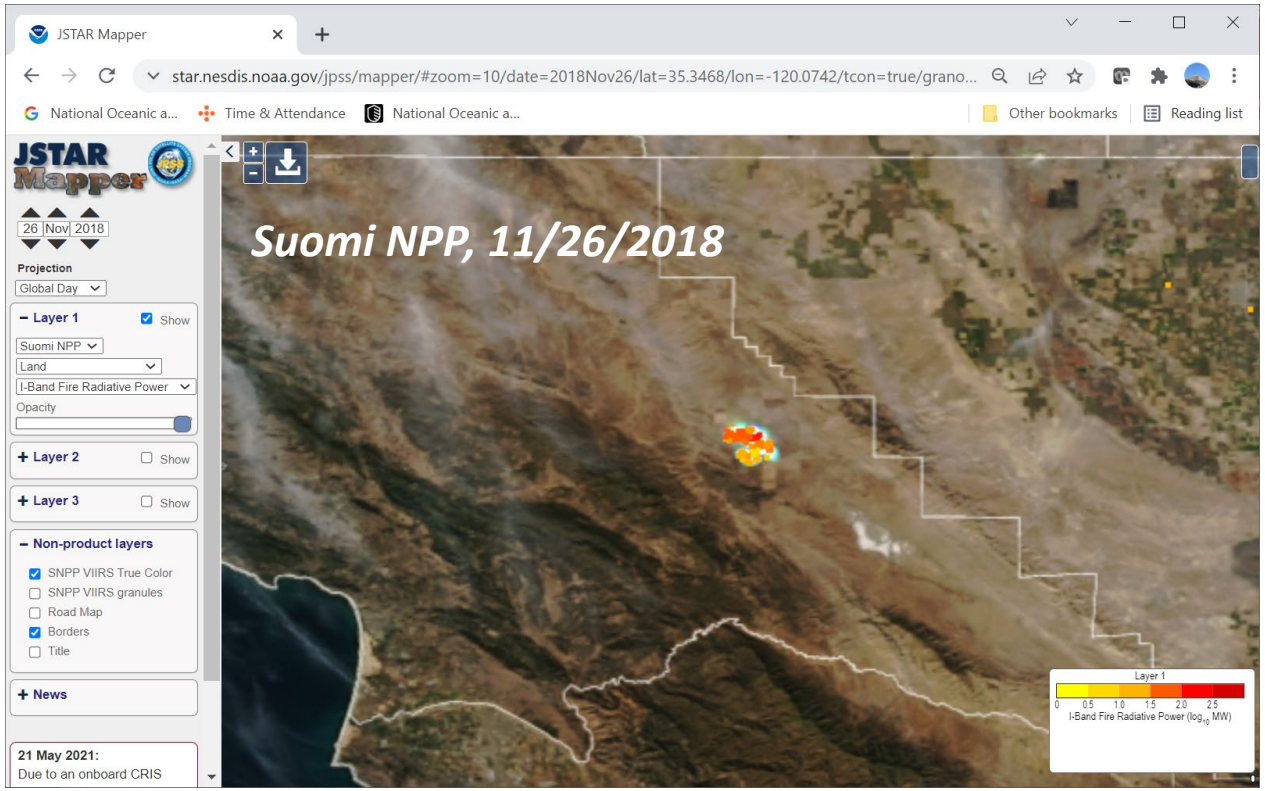
VIIRS Fire RGB

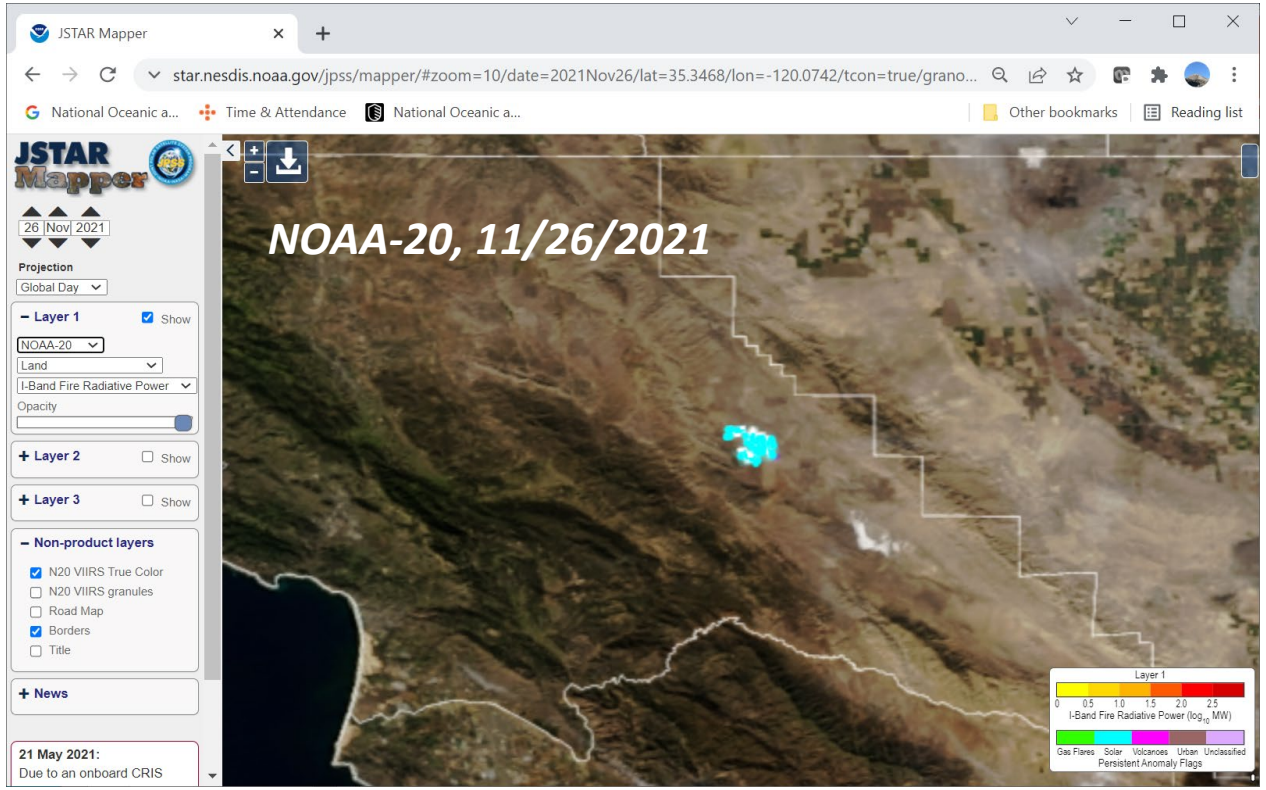


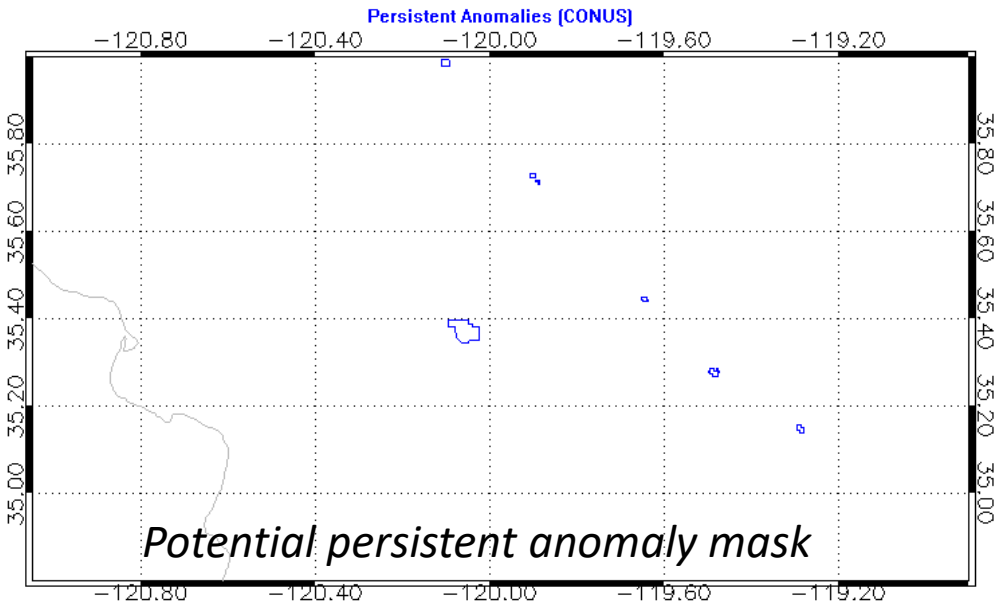
VIIRS band central wavelengths in micrometers (µm)

Persistent anomaly flags to identify potential false alarms

An example of a false alarm caused by reflection from the Topaz Solar Farm in California.



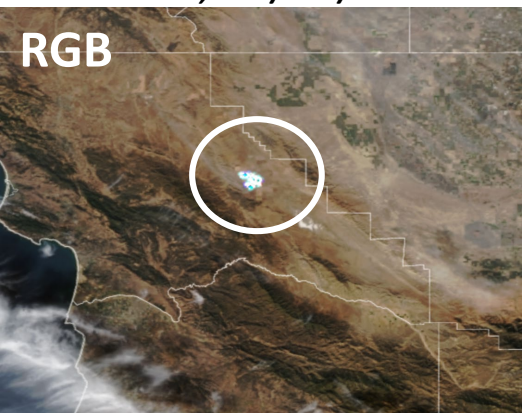


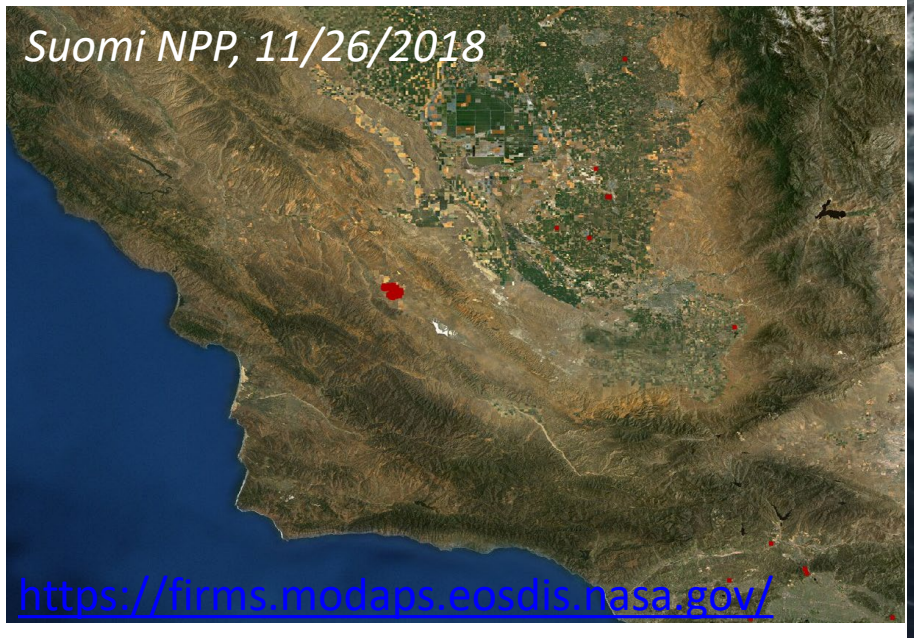


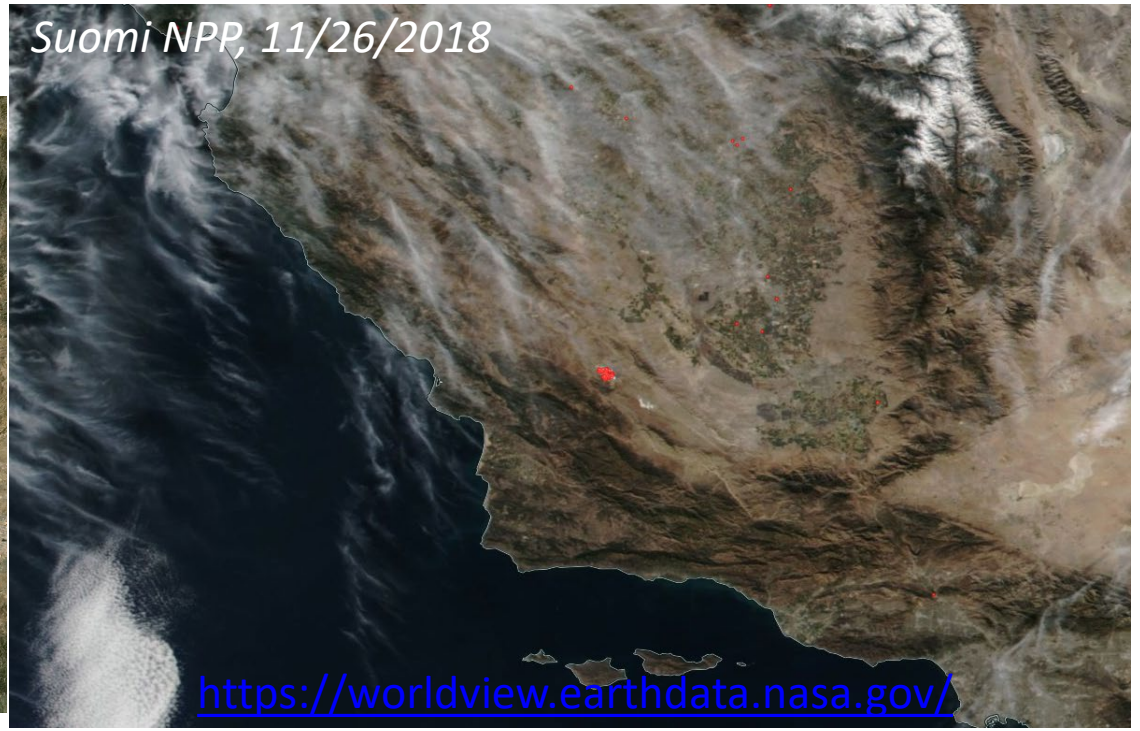
1. *Oil/gas*
2. *Volcanos*
3. *Solar farms (currently only for the HMS domain – extended North America)*
4. *Urban (currently a placeholder)*
5. *Everything else (industrial buildings, power plants, unknown etc.)*

False fire detections from solar farms

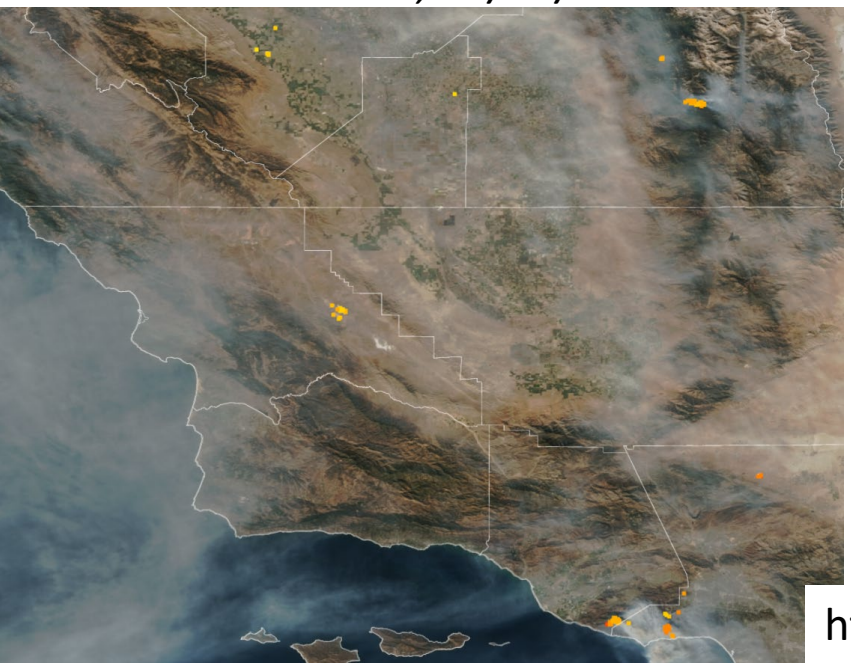
NOAA-20, 11/18/2018



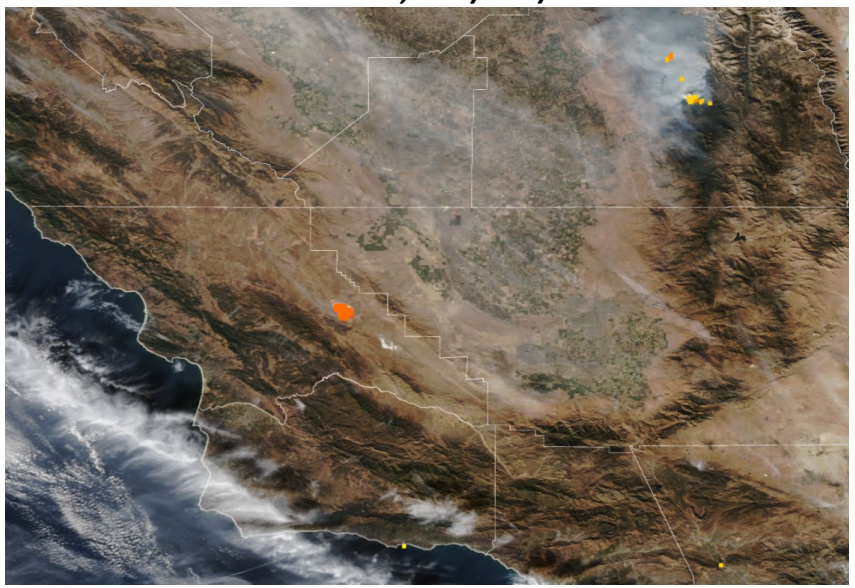




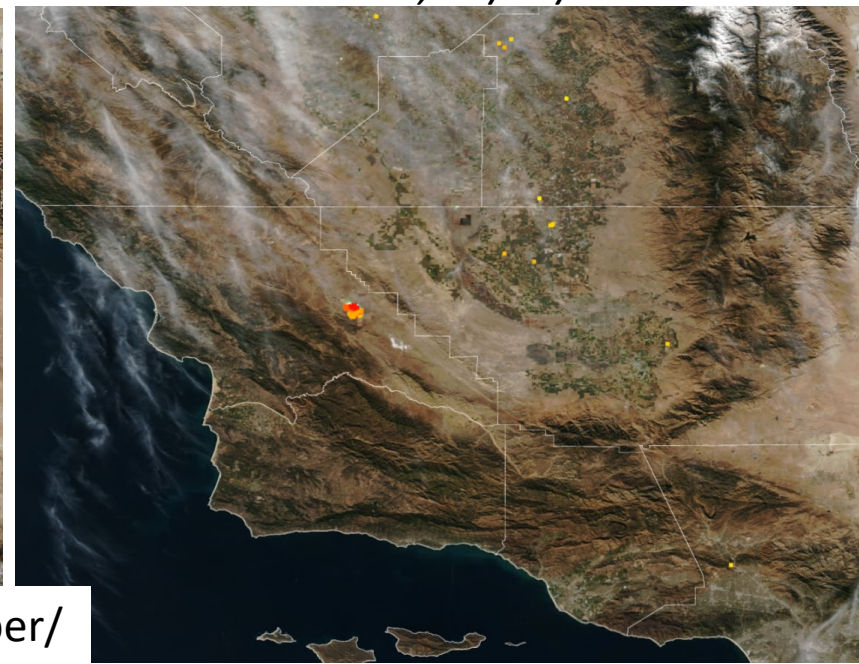
Suomi NPP, 11/10/2018



NOAA-20, 11/18/2018

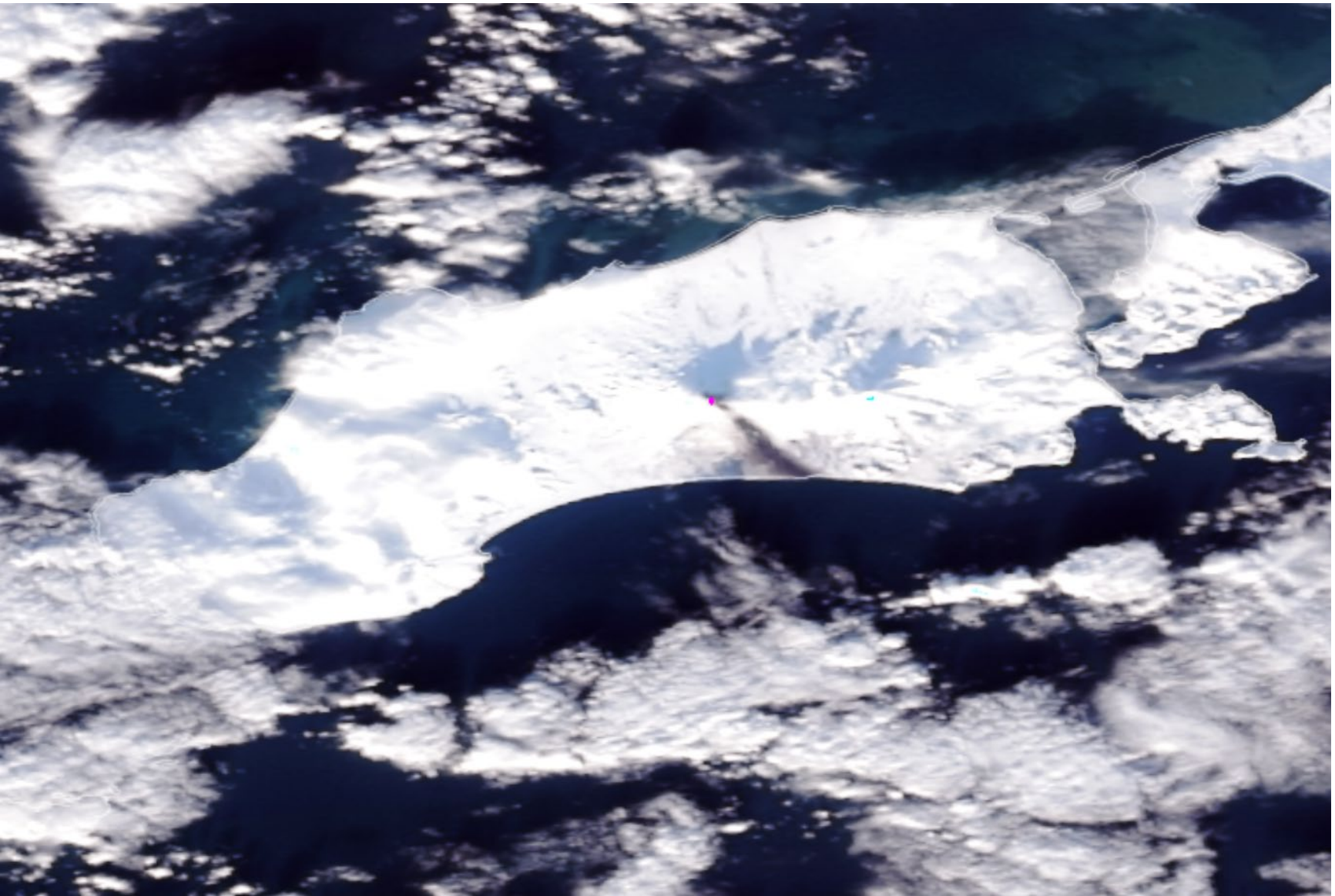


Suomi NPP, 11/26/2018



https://www.star.nesdis.noaa.gov/jpss/mapper/

Examples of the volcano flag



I-band, Suomi NPP, 11/13/2021

Great Sitkin, USA

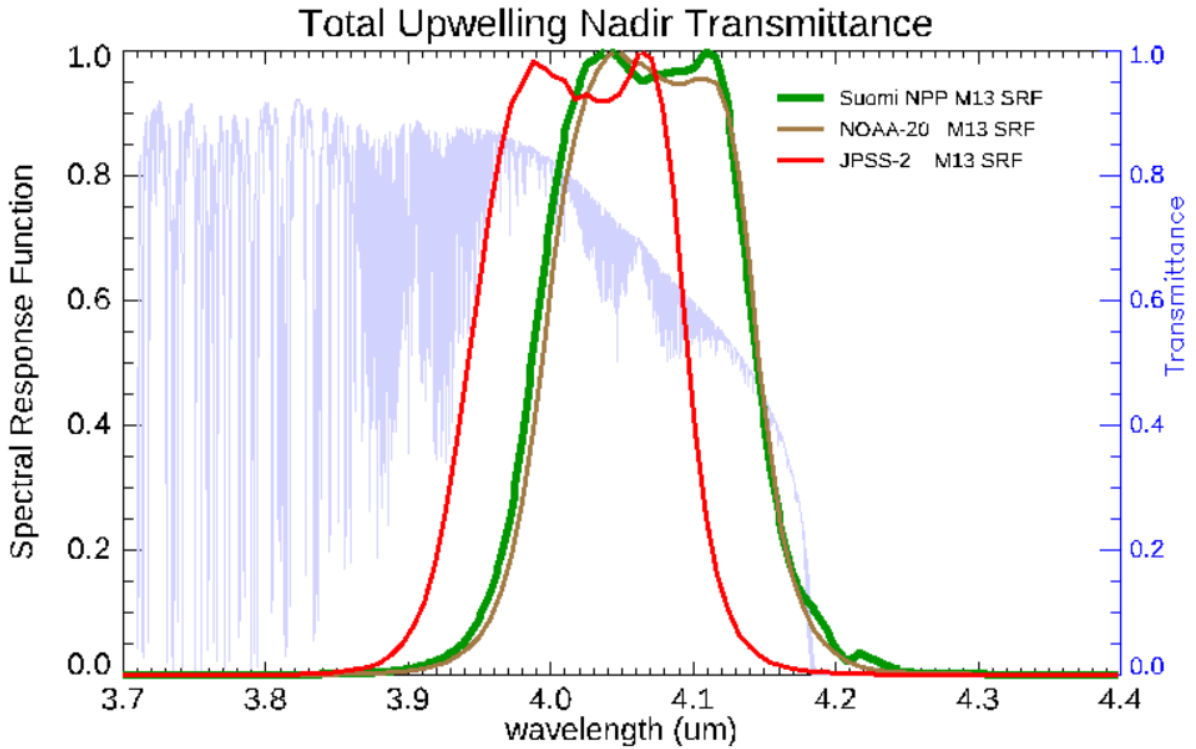


M-band, NOAA-20, 1/4/2020

Shishaldin, Unimak Island, USA

Holocene Volcano Database obtained from Global Volcanism Program, 2013. Volcanoes of the World, v. 4.8.5. Venzke, E (ed.). Smithsonian Institution. Downloaded 13 Nov 2019. https://doi.org/10.5479/si.GVP.VOTW4-2013

JPSS-2 readiness and atmospheric correction



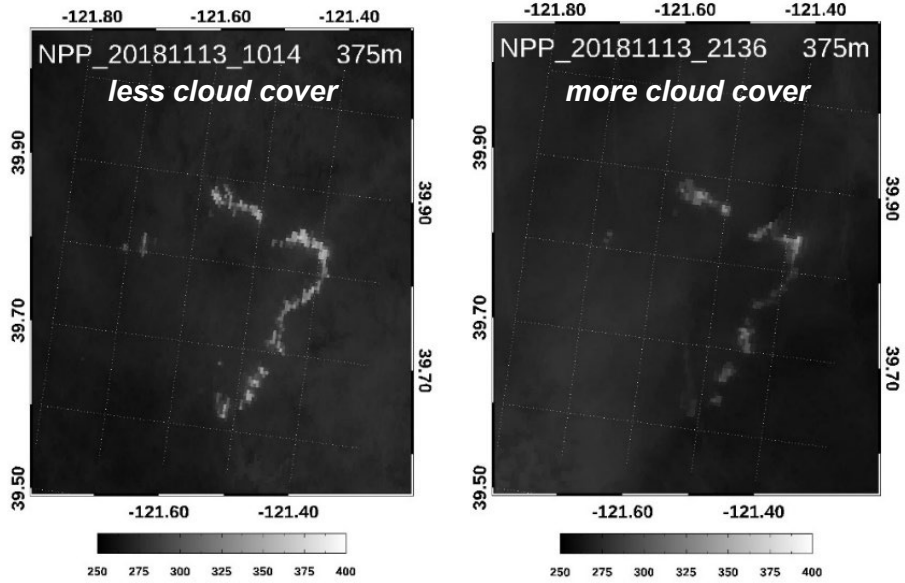
VIIRS band M13 spectral response functions https://ncc.nesdis.noaa.gov/. Data courtesy JPSS Program and VIIRS Sensor Team, NOAA/NESDIS/STAR

Also shown is an example of total atmospheric transmittance spectrum (H_2O, CO_2, O_3, N_2O, CO, CH_4, water continuum absorption) derived using the Community Radiative Transfer Model (CRTM) for a ECMWF training profile. Data courtesy Yong Chen, NOAA/NESDIS/STAR

The radiative signal from fires is impacted by atmospheric attenuation.

- **Atmospheric gases**
- **Atmospheric particles**

Camp Fire, November 13, 2018



Suomi NPP VIIRS I4 (~3.74 µm) brightness temperature

Detection and characterization under clouds and smoke

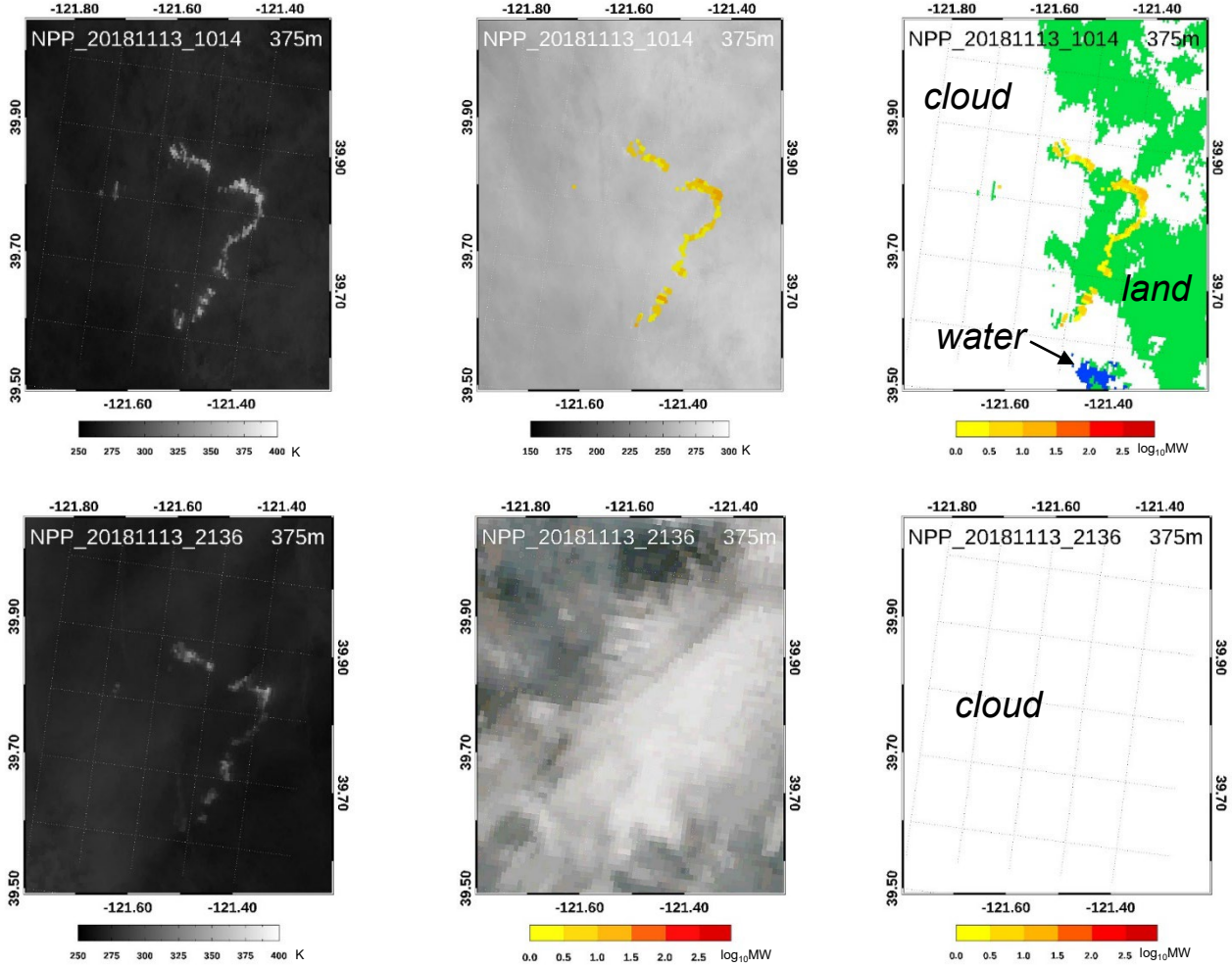
nighttime

daytime

VIIRS I4 TB

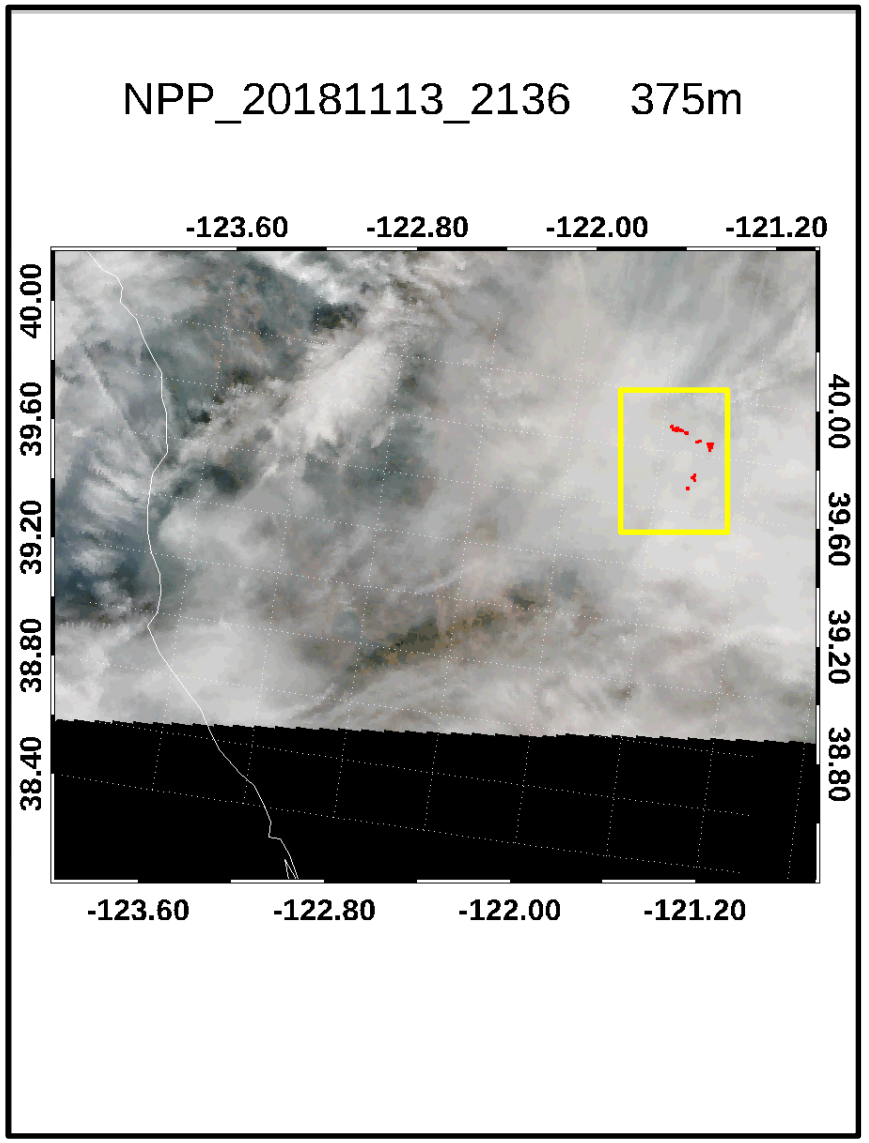
FRP over background image

VIIRS I-band fire mask



improved initial screening

relaxed internal cloud mask



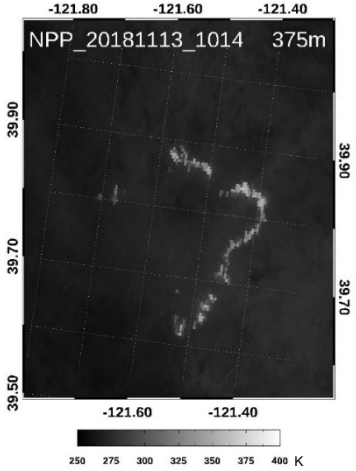
Detection and characterization under clouds and smoke

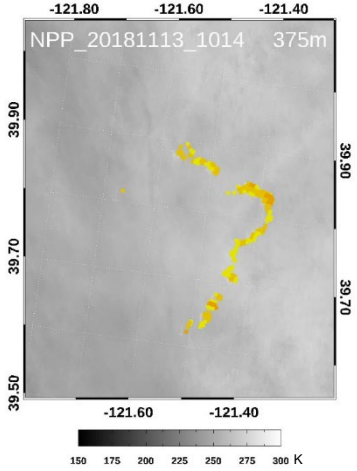
VIIRS I4 TB

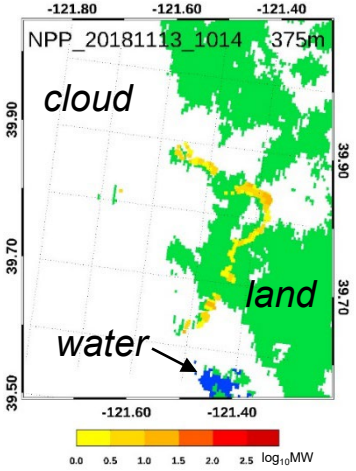
FRP over background image

VIIRS I-band fire mask

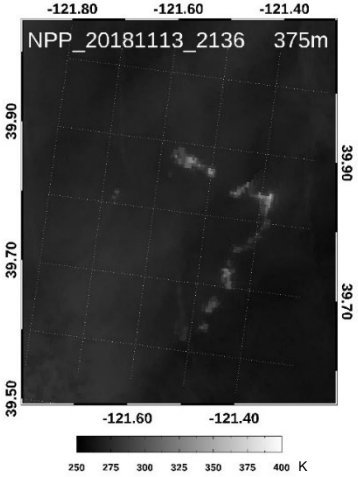
nighttime

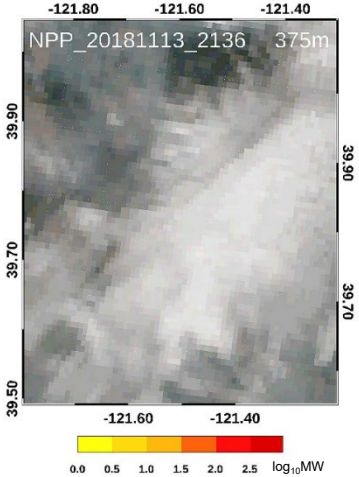


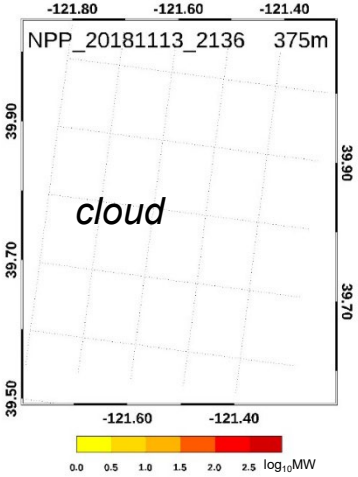




daytime



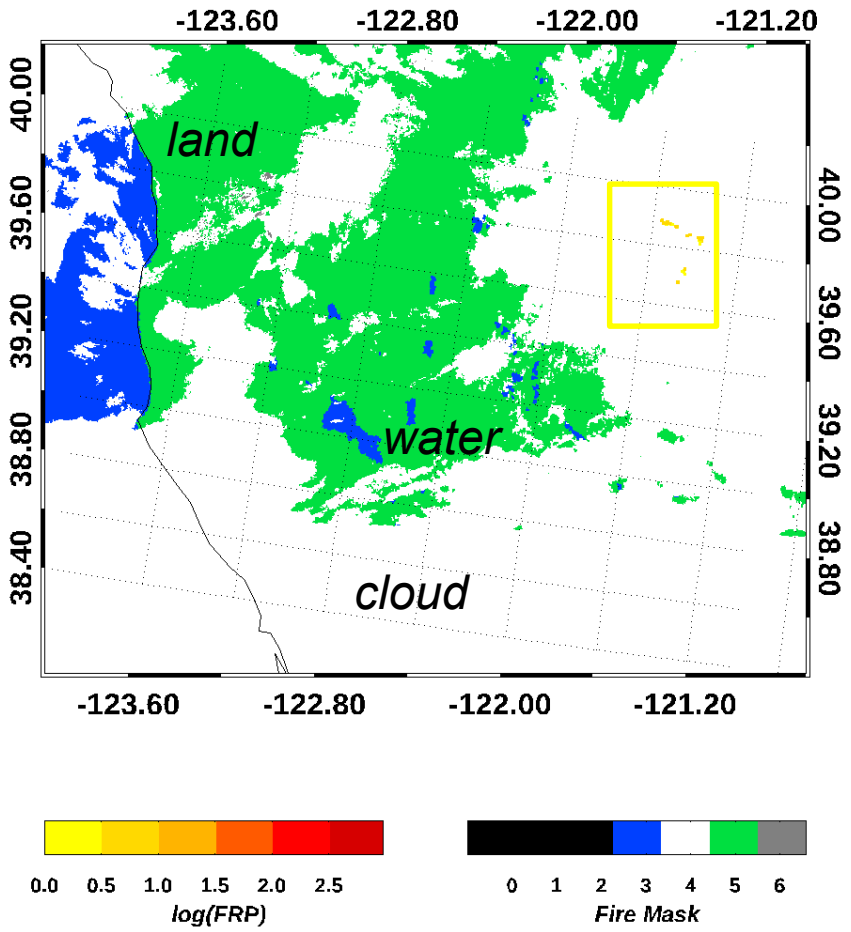




improved initial screening

relaxed internal cloud mask

NPP_20181113_2136 375m

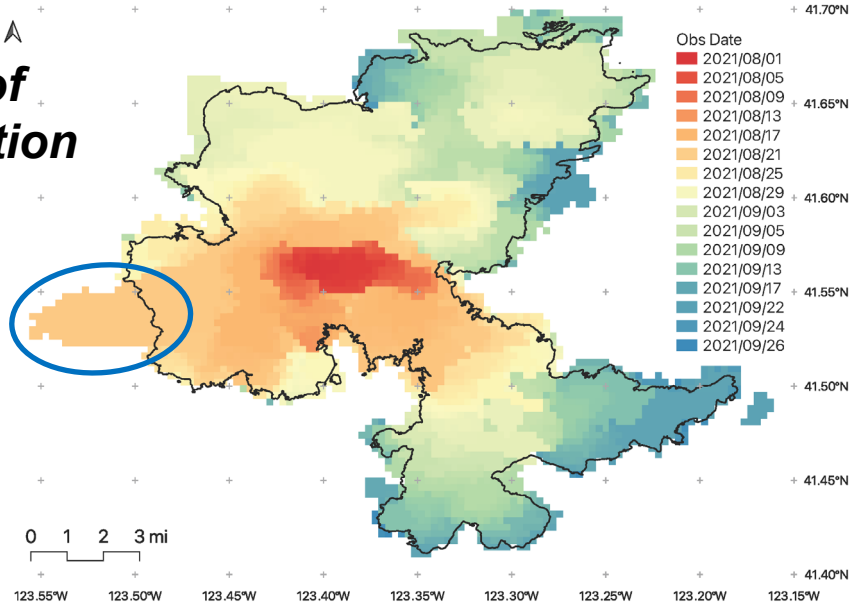


McCash Fire, CA August - September 2021

VIIRS FRP and NIFC fire perimeter

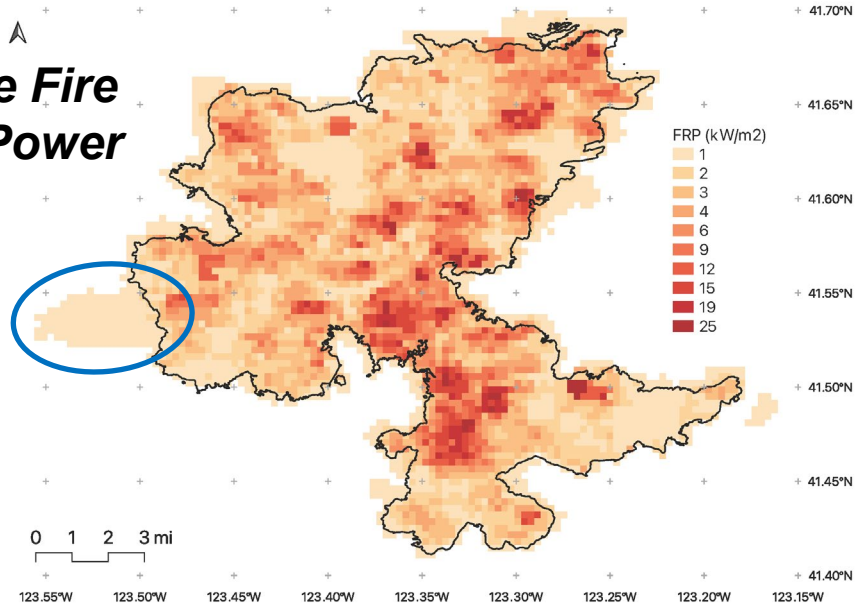
Date of observation

False signal from hot smoke plume

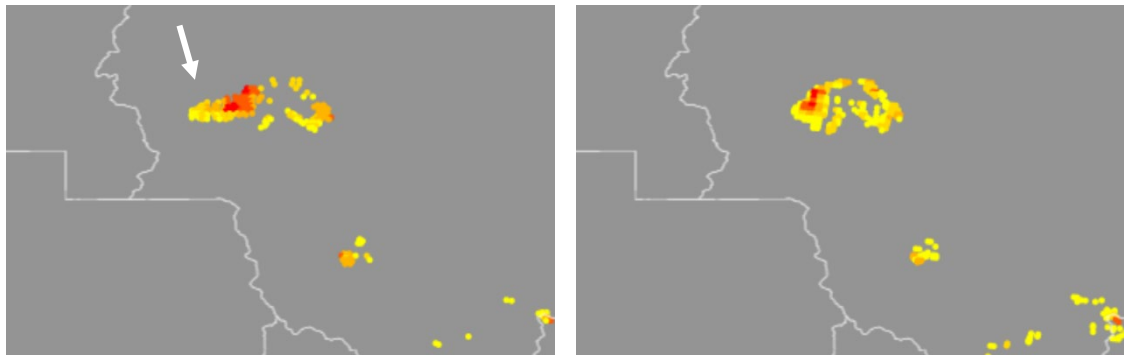


Cumulative Fire Radiative Power

False signal from hot smoke plume

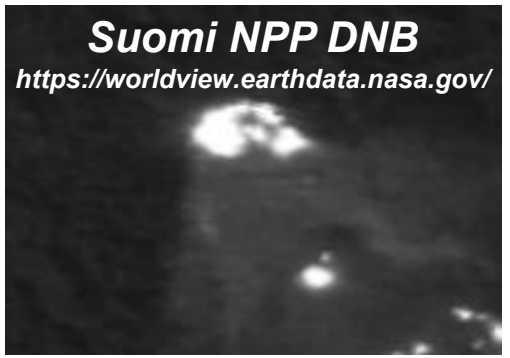


Suomi NPP
8/21/2021
8:58 UTC
Scan angle ~55º



https://www.star.nesdis.noaa.gov/jpss/mapper/

NOAA-20
8/21/2021
9:49 UTC
Scan angle ~26º



https://worldview.earthdata.nasa.gov/

Key application areas

Fire emission / air quality modeling and forecasting

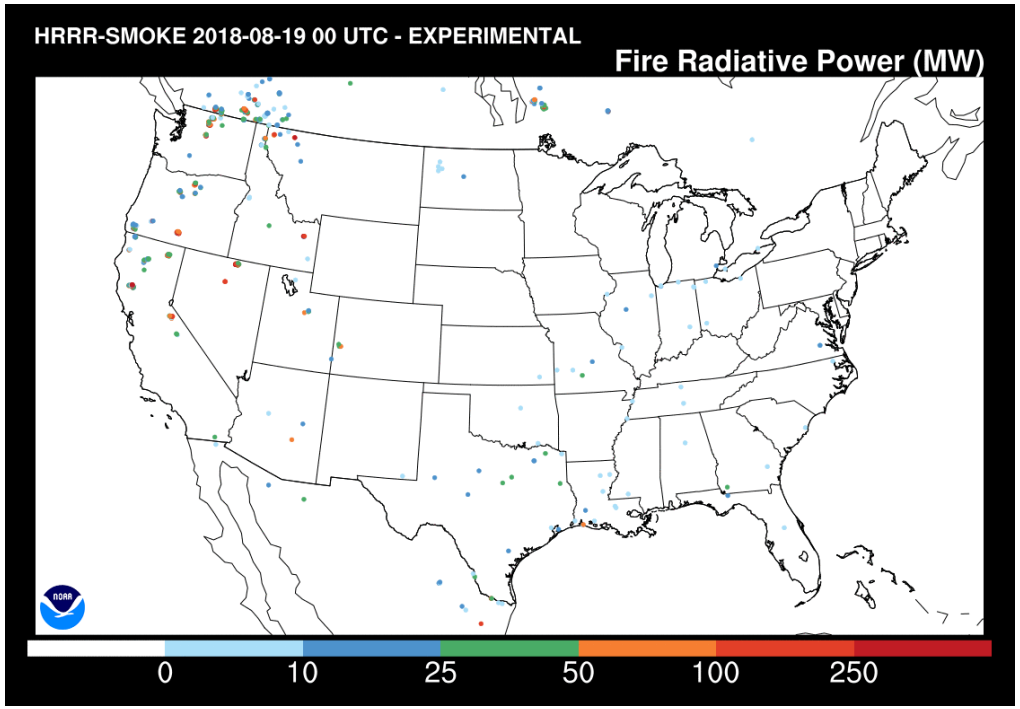
- Operational and experimental systems (see examples)

Fire behavior prediction models

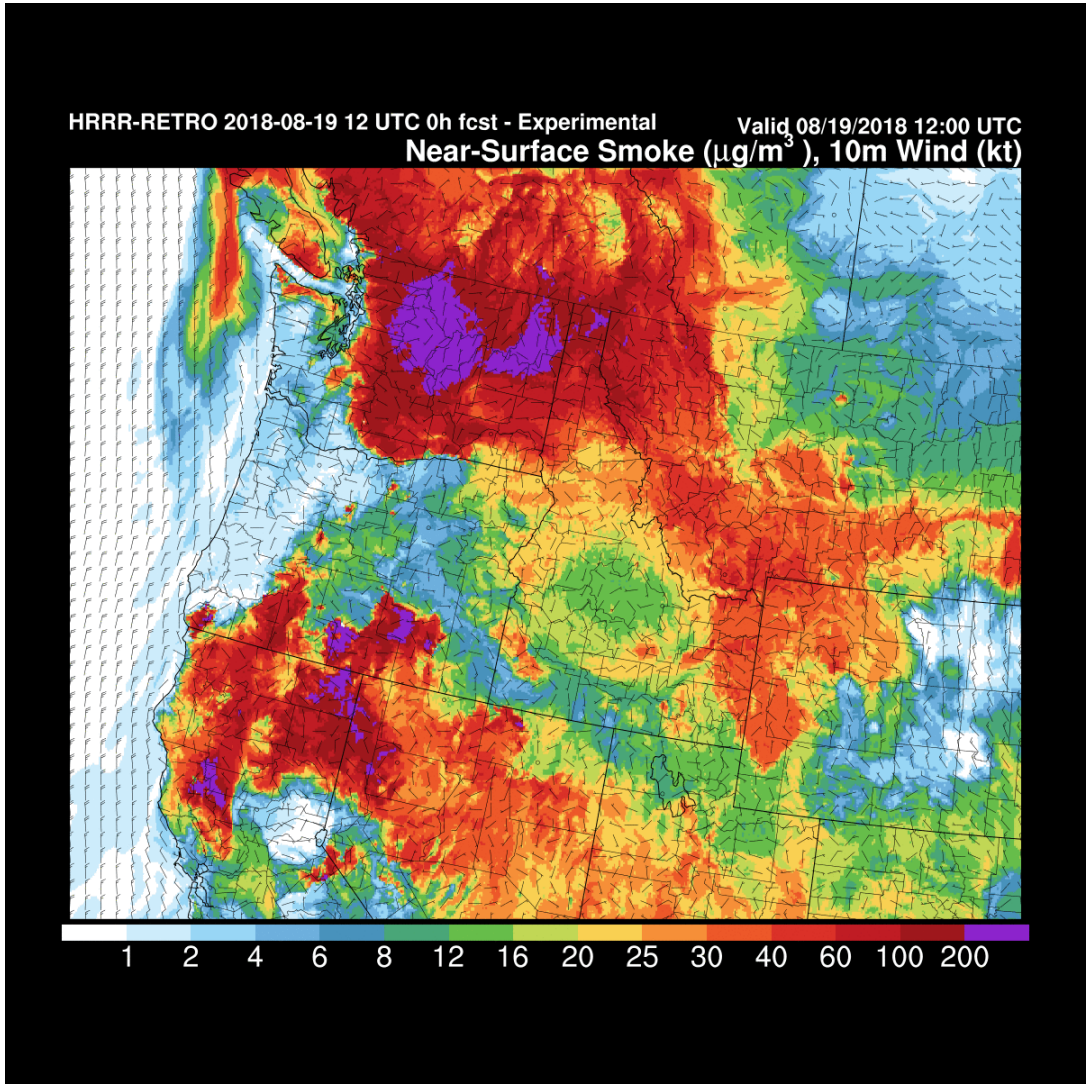
- Routine utilization is needed

Incident management

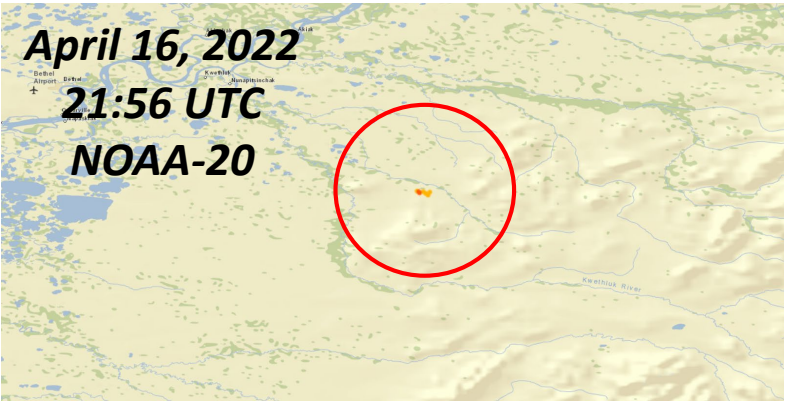
- incident-based customized products (reduce bandwidth, latency and increase information content)



24hr average FRP data mapped over 3x3km HRRR CONUS grid pixels for August 19, 2018



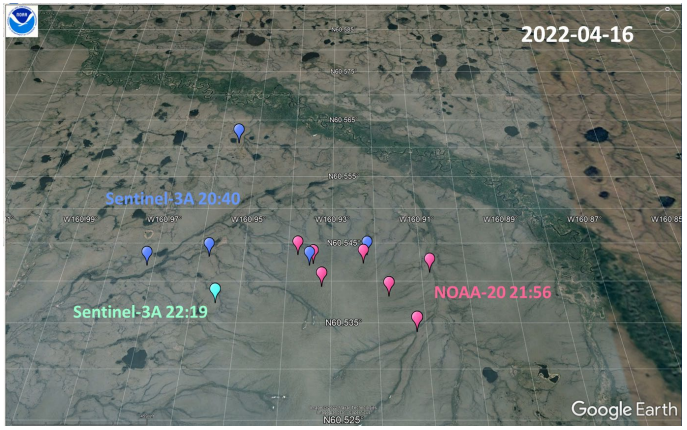
Experimental HRRR-smoke model run
https://rapidrefresh.noaa.gov/hrrr/HRRRsmoke/



HRRR-smoke Alaska

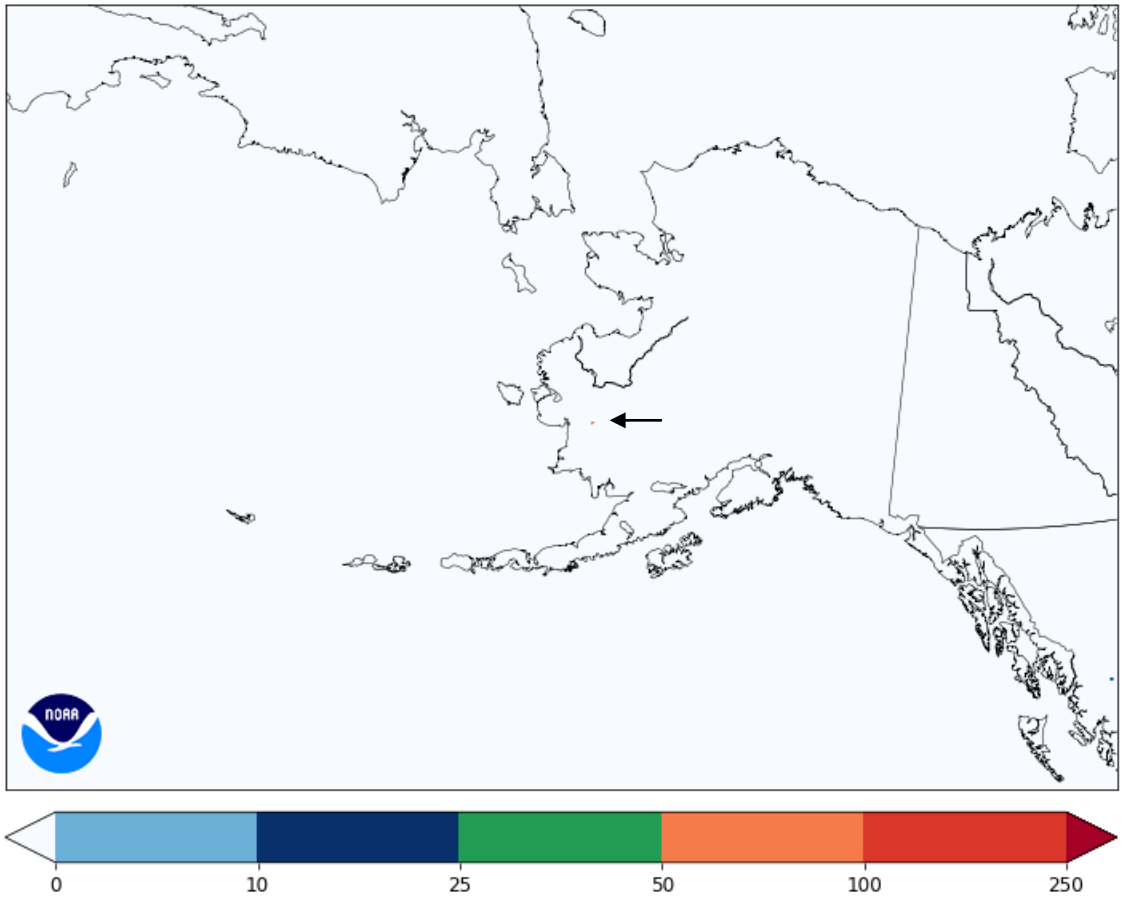
https://rapidrefresh.noaa.gov/hrrr/HRRR-AKsmoke/

Current input from VIIRS and MODIS; evaluation of Sentinel-3 SLSTR and future MetOp-SG METImage is ongoing



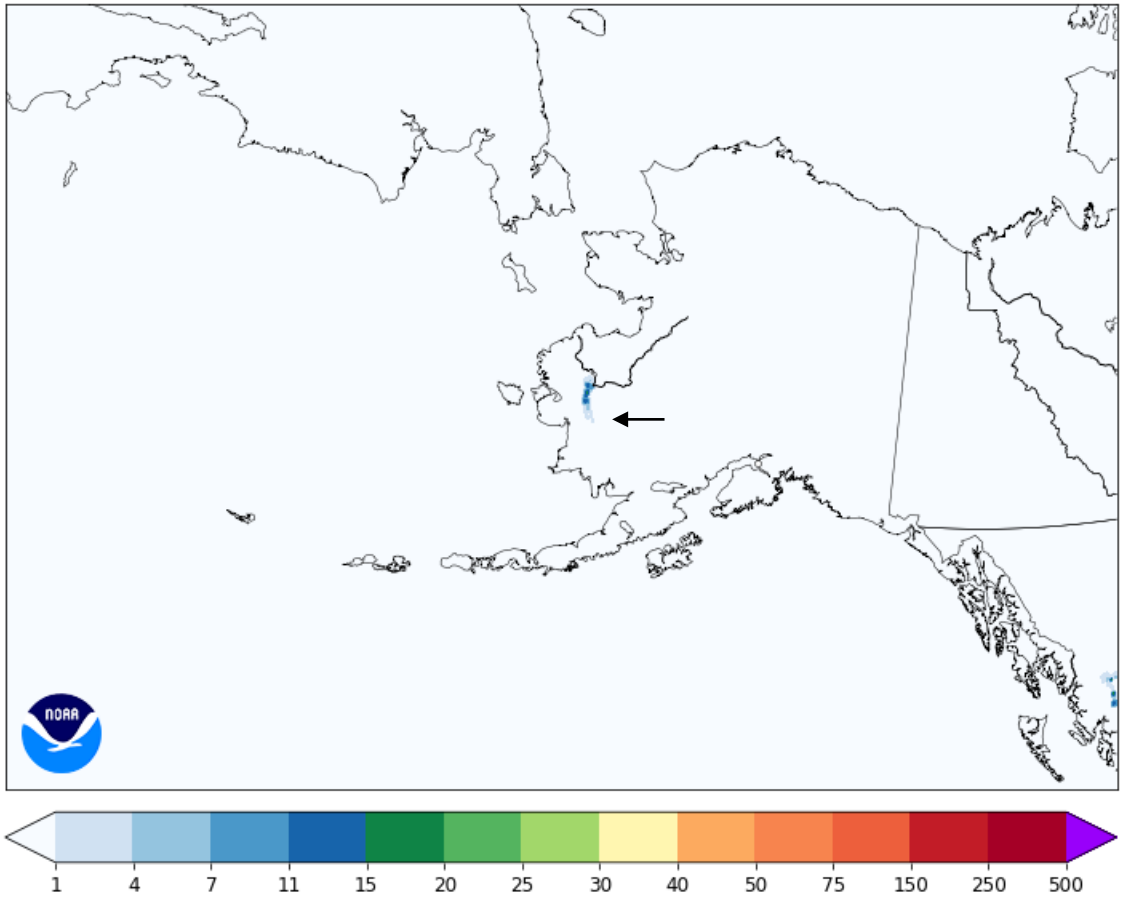
Fire Radiative Power (MW, shaded)

HRRR-AK-NCEP: 20220417 00 UTC
Fcst Hr: 6, Valid Time 20220417 06 UTC

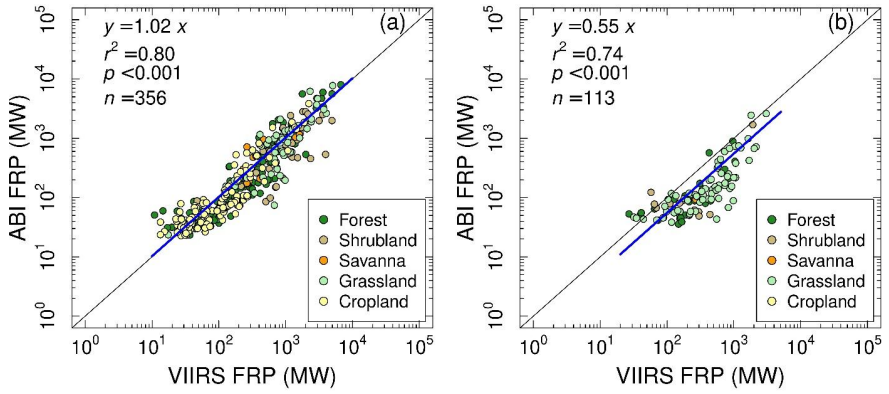


Vertically Integrated Smoke (mg/m^2, shaded)

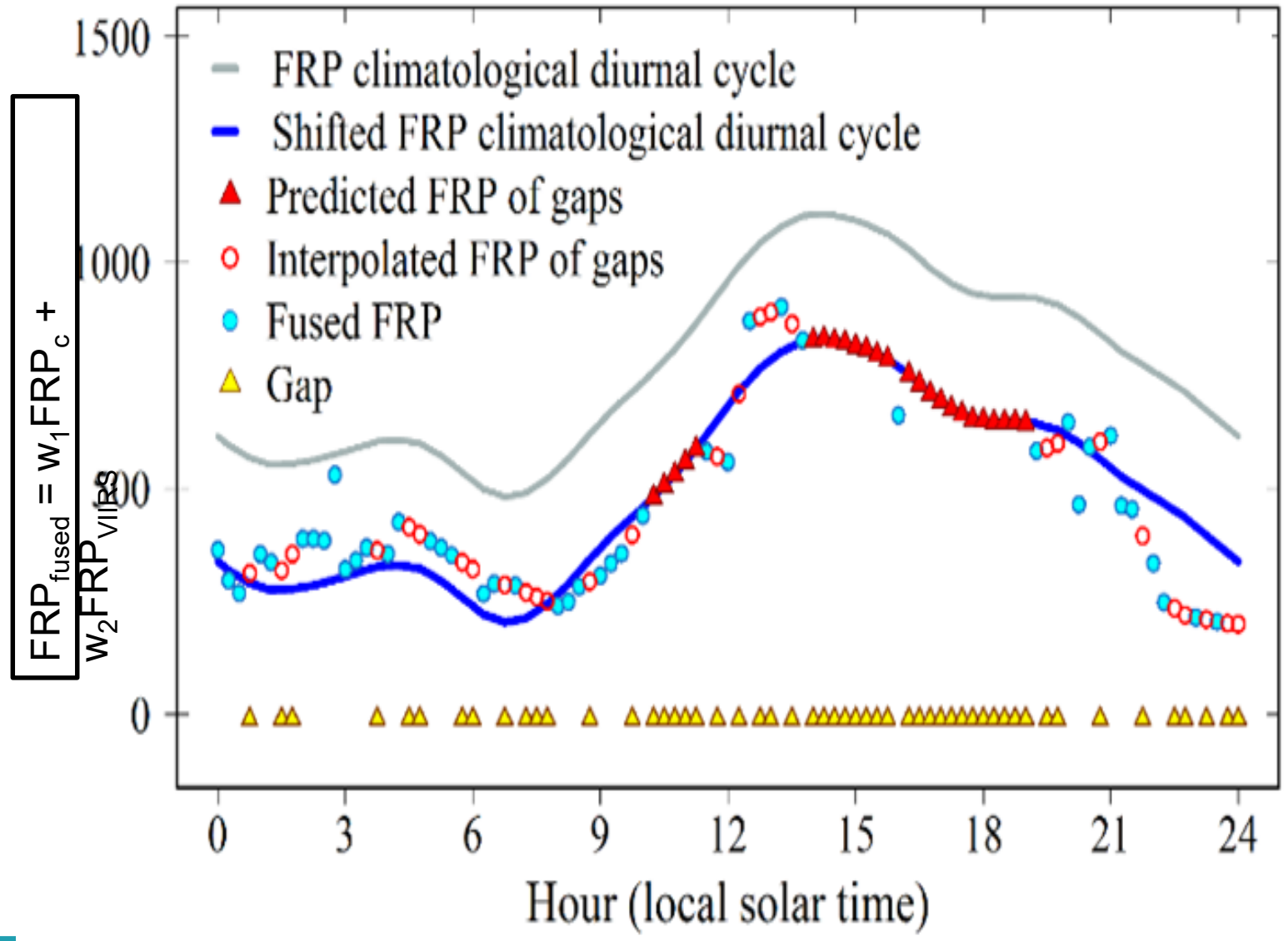
HRRR-AK-NCEP: 20220417 00 UTC
Fcst Hr: 6, Valid Time 20220417 06 UTC



Regional Hourly ABI and VIIRS Emissions (RAVE) for NWS Air Quality Forecasting

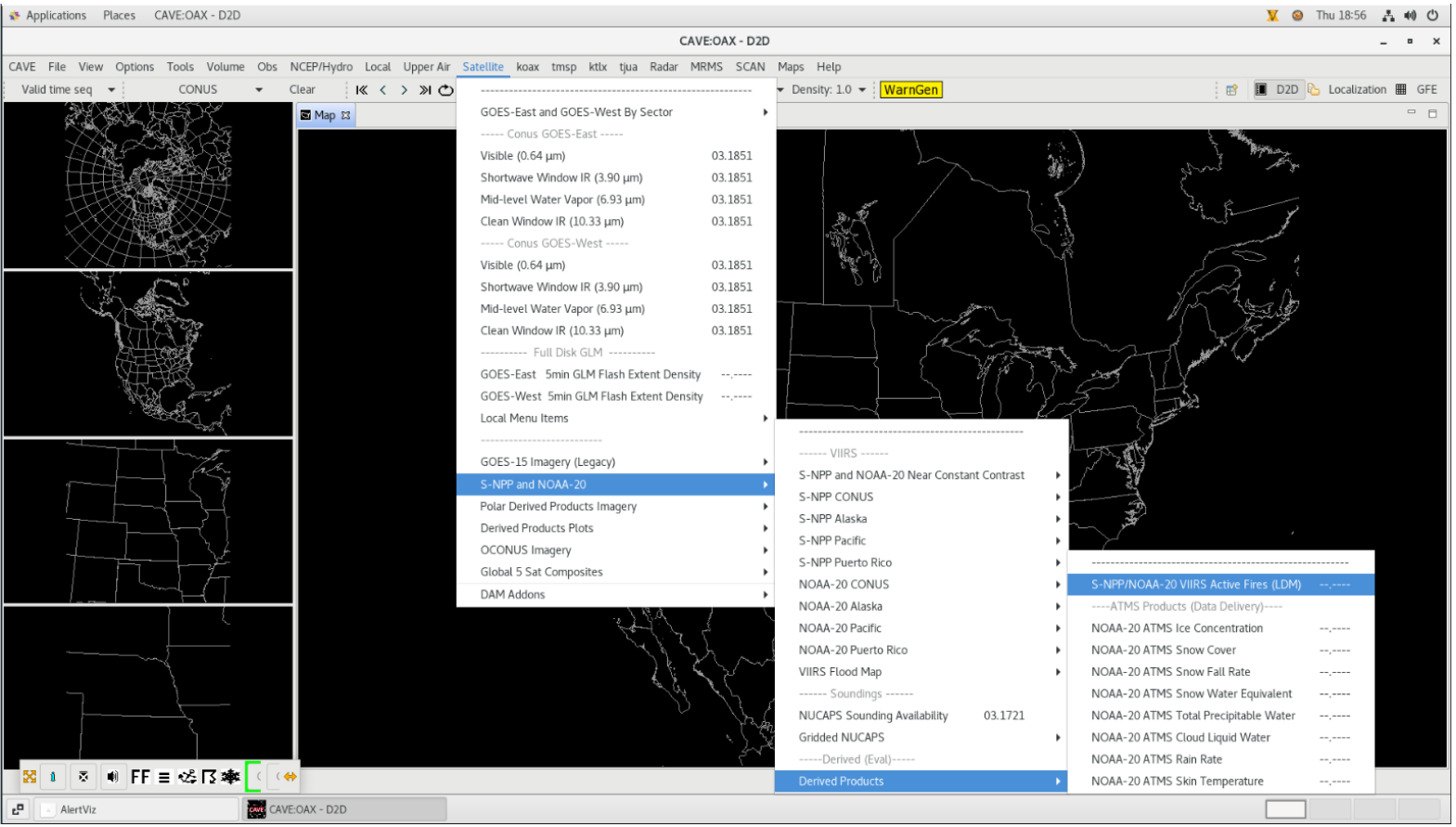


GOES ABI FRP is adjusted for view angle bias and calibrated with VIIRS I-band FRP. Shown on y-axis is blended ABI and VIIRS FRPs (FRP_{fused})

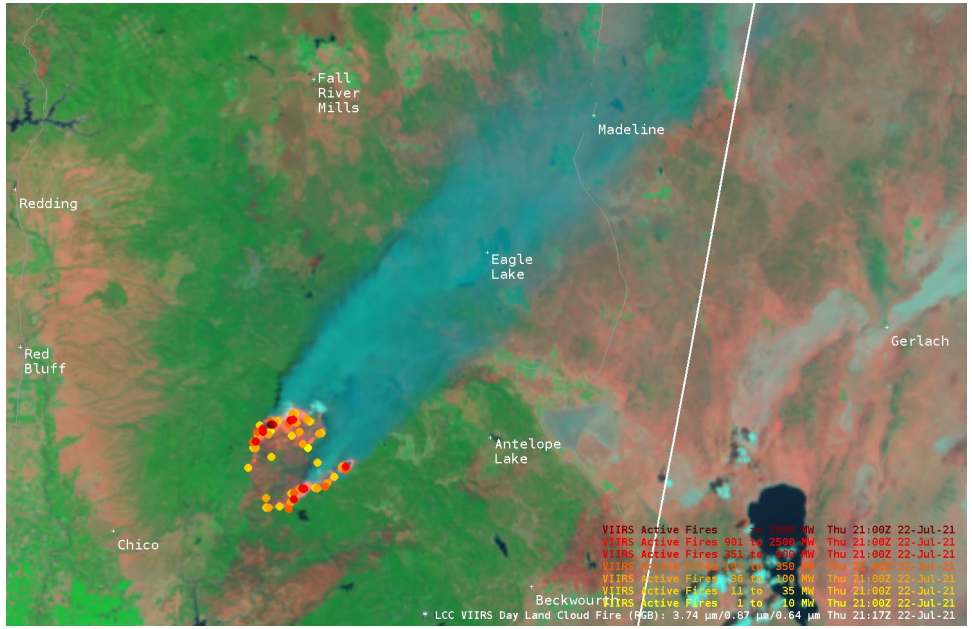


Li et al., in preparation, 2022

VIIRS Active Fire in AWIPS-II



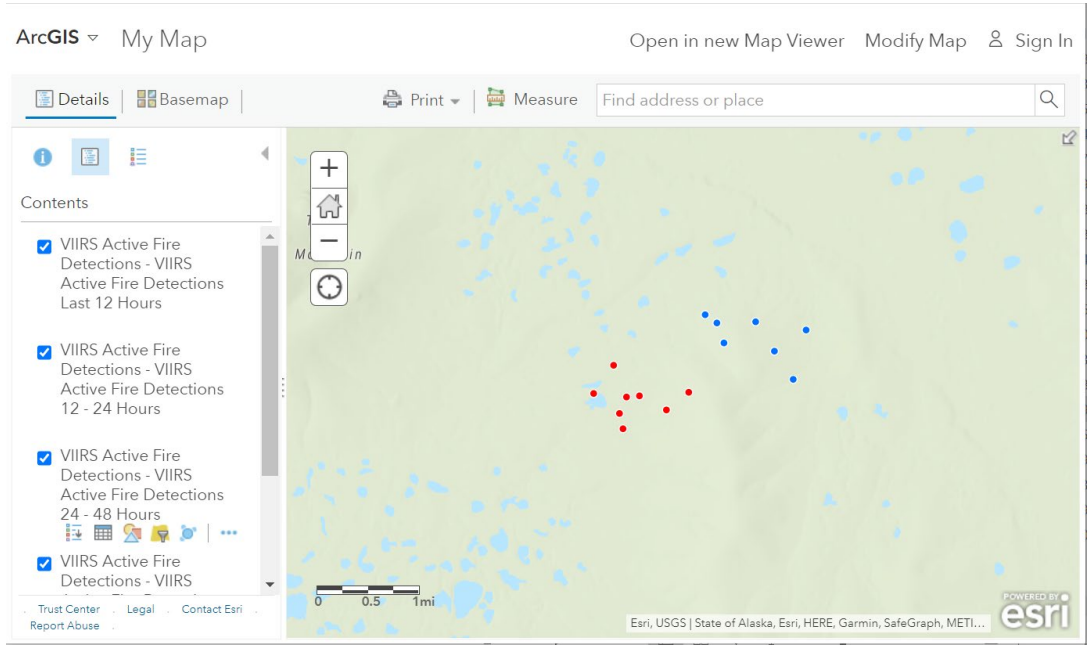
Dixie Fire, CA: VIIRS Active Fire points overlaid onto VIIRS Day Land Cloud Fire RGB

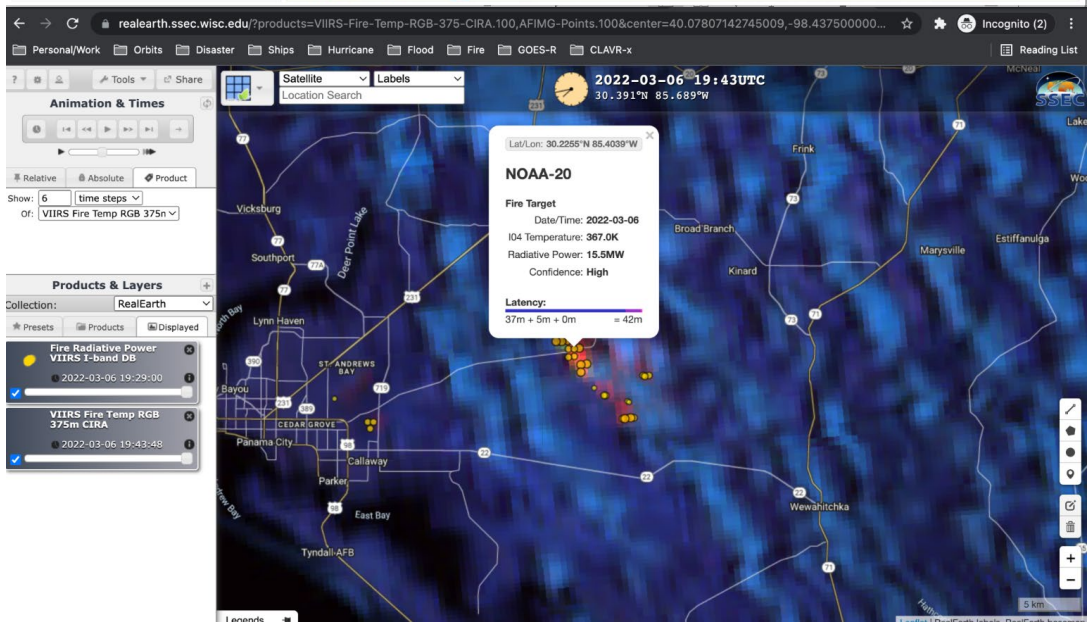


Figures provided by Lee Byerle, TOWR-S Team

VIIRS Fire Products and Information

- CIMSS Fire and Smoke website
  - https://www.ssec.wisc.edu/noaa-fire-smoke/
- GINA Webpage
  - http://hippy.gina.alaska.edu/distro/nrt/
- GINA ArcGIS
  - https://fire-dev.gina.alaska.edu/arcgis/rest/services/afs/VIIRS_Active_Fire_Detections/FeatureServer
- Alaska Interagency Coordination Center
  - https://fire.ak.blm.gov/incinfo/aklgfire.php
- GINA Quick Guides and Briefs
  - https://gina.alaska.edu/training-resources/quick-quides-briefs/
- CIRA RAMMB training and data access:
  - https://rammb2.cira.colostate.edu/training/
- RealEarth™ one can overlay the VIIRS Active Fire
  - https://realearth.ssec.wisc.edu
- JSTAR Mapper
  - https://www.star.nesdis.noaa.gov/jpss/mapper/
- CIRA RAMSDIS (Fire Temperature, Day Land Cloud Fire RGB):
  - http://rammb.cira.colostate.edu/ramsdis/online/
- NOAA Hazard Mapping System:
  - https://www.ospo.noaa.gov/Products/land/hms.html
- NOAA AerosolWatch:
  - https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/
- NASA WorldView:
  - https://worldview.earthdata.nasa.gov/
- NASA LANCE:
  - https://earthdata.nasa.gov/earth-observation-data/near-real-time
- NASA/USFS FIRMS US/Canada
  - https://firms.modaps.eosdis.nasa.gov/usfs/





Thank you!

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