Validated Maturity Science Review
For VIIRS 750m and 375m Active Fire algorithms

Presented by Ivan Csiszar

Date: 2020/02/06

JPSS Data Products Maturity Definition

1. **Beta**
   - Product is minimally validated, and may still contain significant identified and unidentified errors.
   - Information/data from validation efforts can be used to make initial qualitative or very limited quantitative assessments regarding product fitness-for-purpose.
   - Documentation of product performance and identified product performance anomalies, including recommended remediation strategies, exists.

2. **Provisional**
   - Product performance has been demonstrated through analysis of a large, but still limited (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from selected locations, time periods, or field campaign efforts.
   - Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose.
   - Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists.
   - Product is recommended for potential operational use (user decision) and in scientific publications after consulting product status documents.

3. **Validated**
   - Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).
   - Comprehensive documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies for a full range of retrieval conditions and severity level.
   - Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.
   - Product is ready for operational use based on documented validation findings and user feedback.
   - Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument.

Validated Maturity Review - Entry Criteria

- Product Requirements
- Pre-launch Performance Matrix/Waivers
- Validated Maturity Performance Validation
  - On-orbit instrument performance assessment
    - Identify all of the instrument and product characteristics you have verified/validated as individual bullets
    - Identify pre-launch concerns/waivers, mitigation and evaluation attempts with on-orbit data
- Users/EDRs feedback
- Risks, Actions, Mitigations
  - Potential issues, concerns
- Path forward
- Summary

Validated Maturity Review - Exit Criteria

- Validated Maturity Performance is well characterized and meets/exceeds the requirements:
  - On-orbit instrument performance assessment
    - Provide summary for each identified instrument and product characteristic you have validated/verified as part of the entry criteria
    - Provide summary of pre-launch concerns/waivers mitigations/evaluation and address whether any of them are still a concern that raises any risk.
- Updated Validated Maturity Slide Package addressing review committee's comments for:
  - Cal/Val Plan and Schedules
  - Product Requirements
  - Validated Maturity Performance
  - Risks, Actions, Mitigations
  - Path forward

VALIDATED MATURITY REVIEW MATERIAL

Outline

- Algorithm Cal/Val Team Members
- Product Overview/Requirements
- Evaluation of algorithm performance to specification requirements
  - Algorithm version, processing environment
  - Evaluation of the effect of required algorithm inputs
  - Quality flag analysis/validation
  - Error Budget
- User Feedback
- Downstream Product Feedback
- Risks, Actions, and Mitigations
- Documentation (Science Maturity Check List)
- Conclusion
- Path Forward

Active Fire Cal/Val Team and key stakeholders

Name	Organization	Major Task
Ivan Csiszar	STAR	Active Fire product government lead
Marina Tsidulko	IMSG	STAR code development, data analysis
Wei Guo	IMSG	Persistent anomalies, enterprise algorithm, validation
Yingxin Gu	IMSG	Enterprise algorithm development
Wilfrid Schroeder	OSPO	I-band algorithm development, validation; HMS
Mike Wilson	IMSG	STAR ASSIST integration
Louis Giglio	UMD	M-band Algorithm developer
Zhaohui Cheng	OSPO	Product Area Lead
Evan Ellicott	UMD	User outreach
Shobha Kondragunta	STAR	Smoke/aerosol user outreach and analysis, GBBEPx
Ravan Ahmadov	ESRL	HRRR-smoke POC
Bill Sjoberg	NJO	Fire and Smoke Initiative coordinator

Product Overview/Requirements

Data Product Objective Capabilities Document (DPOCD) JPSS-REF-5110 – Section 2.7.1 (*From L1RDS-273, L1RD-S section 5.5.1)*

SENSOR
Current Sensor: VIIRS
Current refresh: At least 90% coverage of the globe every 12 hours (monthly average)
Objective refresh: NS

ALGORITHM
Applicable Conditions: Delivered in daytime and night-time regimes under clear-sky conditions and within the clear areas between scattered and broken clouds.
Current horizontal cell size: 0.80 km nadir 1.6 km worst case
Objective horizontal cell size: 0.25 km nadir NS worst case
Current horizontal reporting interval: HCS
Objective horizontal reporting interval: NS
Current horizontal coverage: Global
Objective horizontal coverage: Global
Current 3σ mapping uncertainty at nadir: 1.5 km
Objective 3σ mapping uncertainty at nadir: 0.75 km
Current measurement range: 1.0 MW to 5.0 $(10)^3$ MW Fire radiative power (FRP)
Objective measurement range: 1.0 MW to 1.0 $(10)^4$ MW Fire radiative power (FRP)
Current measurement uncertainty: 50% Fire radiative power (FRP)
Objective measurement uncertainty: 20% Fire radiative power (FRP)

Processing Environment and Algorithms

Algorithm	Suomi NPP	NOAA-20
750m M-band: NDE v1r2*	Operational since March 15, 2016	Operational since August 13, 2018
375m/750m I/M-band: STAR v2r1	Systematic production since January 30, 2018	Systematic production since February 5, 2018

- **Global NRT data**
  - 750m product from NDE ->PDA
  - 375m product through STAR ftp
  - All included in JSTAR Mapper
  - *750m product upgraded to v1r2 with a post-processor to add persistent anomaly flag
- **CSPP / CIMSS (DB)**
  - 750m and 375m product included
  - CIMSS processes and distributes DB data
  - Now included in RealEarth™
- **HRRR-smoke**
  - Non-operational products provided through STAR ftp
  - Operational products through PDA
- **GBBEPx**
  - Uses operational M-band data

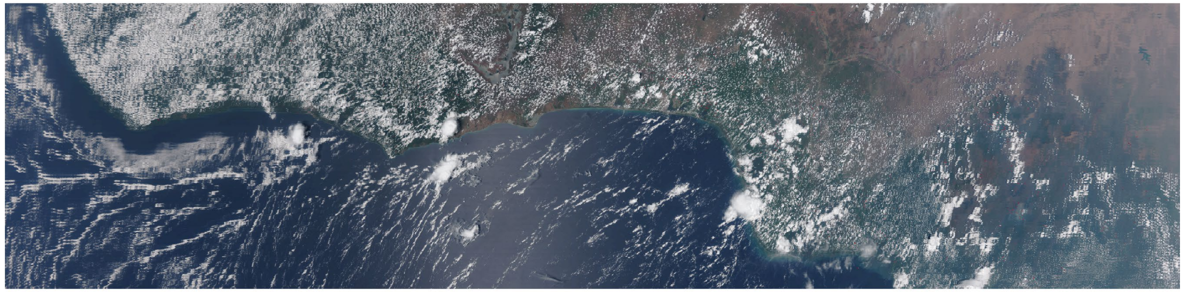
Evaluation of the effect of required algorithm inputs

- Required Algorithm Inputs
  - Primary Sensor Data
    - VIIRS bands M5, M7, M11, M13, M15, M16, geolocation (M-band)
    - VIIRS bands I1, I2, I3, I4, I5, M13, M13 unaggregated, geolocation (I-band)
  - Ancillary Data
    - Granulated land/water mask
    - Persistent anomaly database
  - Upstream algorithms
    - None within the standard suite of JPSS products
    - GBBEPx uses 750m product as one of the input products
  - LUTs / PCTs
    - none
- Evaluation of the effect of required algorithm inputs
  - VIIRS SDR performance monitoring through ICVS and maturity reviews
  - No effect of LWIR degradation observed in global analysis
  - I3 bad detector impacts 1/32 of scanlines

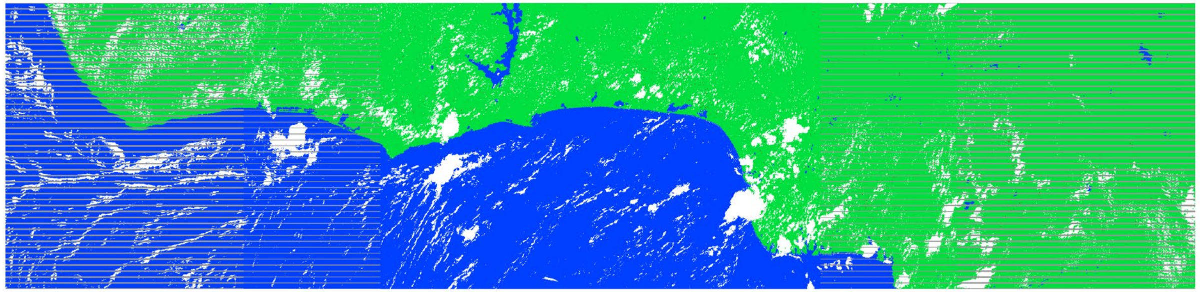
Quality flag analysis/validation

- Fire Mask: three levels of detection confidence
  - No change since Provisional Review
- QA Mask: 32 bits of information on quality and algorithm
  - No change in bit masks except persistent anomaly flag

RGB image



Fire Mask



Surface Type (water: grey, coastal: red, land: yellow)

Surface Type (water: grey, coastal: red, land: yellow)

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	unitless	**0 - 9**
algorithm QA	32 bit Integer	Fire algorithm QA mask	3200 x 768	unitless	**0 - 31**
FP_line	16 bit Integer	Fire pixel line	Sparse data array 1 – N	unitless	**0 - 768**
FP_sample	16 bit Integer	Fire pixel sample	Sparse data array 1 – N	unitless	**0 – 3200**
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 (M-band only)	8 bit Integer	Fire detection confidence	Sparse data array 1 – N	%	**0 – 100**
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

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 (obsolete) (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 confidence strictly less than 20% fire
		Fire Medium – 8	Fire pixel with confidence between 20% and 80%
		Fire High – 9	Fire pixel with confidence greater than or equal to 80%
Fire Algorithm QA Mask	32-bit unsigned integer	See next slide for details	

M-band and I-band Active Fire Product content

Bit s	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

See ATBDs for details of deriving the various QA flags

Format of output text files

old

```
year,month,day,hh,mm,lon,lat,mask,confidence,bright_t13,frp,line,sample,bowtie;    nfire = 16
2018, 11, 18, 20, 50, -120.051445,   35.373226,   8,  75,  454.137024,  523.866943,   184,  1851,   0
2018, 11, 18, 20, 50, -120.053154,   35.379963,   7,   0,  458.887634,  568.377380,   185,  1851,   0
2018, 11, 18, 20, 50, -120.062065,   35.378429,   9,  87,  446.435364,  456.827118,   185,  1852,   0
2018, 11, 18, 20, 50, -120.083344,   35.388844,   8,  75,  488.237793,  911.507202,   187,  1854,   0
2018, 11, 18, 20, 50, -120.101158,   35.385788,   8,  39,  310.548340,    3.728809,   187,  1856,   0
2018, 11, 18, 20, 50, -118.601891,   36.226536,   7,  29,  300.670258,    3.968884,   274,  1661,   0
2018, 11, 18, 20, 50, -118.646439,   36.226280,   8,  35,  305.535767,    5.064438,   275,  1666,   0
2018, 11, 18, 20, 50, -118.622269,   36.236893,   9,  99,  357.488892,   53.261333,   276,  1663,   0
2018, 11, 18, 20, 50, -118.647957,   36.232841,   8,  45,  309.880249,    6.892451,   276,  1666,   0
2018, 11, 18, 20, 50, -118.640907,   36.240753,   9, 100,  398.086121,  155.975922,   277,  1665,   0
2018, 11, 18, 20, 50, -118.657928,   36.238068,   9,  84,  334.233887,   23.713444,   277,  1667,   0
2018, 11, 18, 20, 50, -118.739067,   36.395573,   7,  24,  300.086029,    4.420272,   302,  1671,   0
2018, 11, 18, 20, 50, -118.724632,   36.411800,   9,  96,  349.282104,   42.508846,   304,  1668,   0
2018, 11, 18, 20, 50, -118.726379,   36.418312,   9,  84,  326.054657,   18.055126,   305,  1668,   0
2018, 11, 18, 20, 50, -119.584526,   37.810020,   8,  74,  313.540253,   10.418139,   529,  1713,   0
2018, 11, 18, 20, 50, -119.593361,   37.808594,   8,  79,  319.367859,   13.668173,   529,  1714,   0
```

new

```
year,month,day,hh, mm,lon,lat,mask,confidence,bright_t13,frp,line,sample,bowtie,persist_anomaly;  nfire =
16
2018, 11, 18, 20, 50, -120.051445,   35.373226,   8,  75,  454.137024,  523.866943,   184,  1851,   0,    3
2018, 11, 18, 20, 50, -120.053154,   35.379963,   7,   0,  458.887634,  568.377380,   185,  1851,   0,    3
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2018, 11, 18, 20, 50, -118.601891,   36.226536,   7,  29,  300.670258,    3.968884,   274,  1661,   0,    0
2018, 11, 18, 20, 50, -118.646439,   36.226280,   8,  35,  305.535767,    5.064438,   275,  1666,   0,    0
2018, 11, 18, 20, 50, -118.622269,   36.236893,   9,  99,  357.488892,   53.261333,   276,  1663,   0,    0
2018, 11, 18, 20, 50, -118.647957,   36.232841,   8,  45,  309.880249,    6.892451,   276,  1666,   0,    0
2018, 11, 18, 20, 50, -118.640907,   36.240753,   9, 100,  398.086121,  155.975922,   277,  1665,   0,    0
2018, 11, 18, 20, 50, -118.657928,   36.238068,   9,  84,  334.233887,   23.713444,   277,  1667,   0,    0
2018, 11, 18, 20, 50, -118.739067,   36.395573,   7,  24,  300.086029,    4.420272,   302,  1671,   0,    0
2018, 11, 18, 20, 50, -118.724632,   36.411800,   9,  96,  349.282104,   42.508846,   304,  1668,   0,    0
2018, 11, 18, 20, 50, -118.726379,   36.418312,   9,  84,  326.054657,   18.055126,   305,  1668,   0,    0
2018, 11, 18, 20, 50, -119.584526,   37.810020,   8,  74,  313.540253,   10.418139,   529,  1713,   0,    0
2018, 11, 18, 20, 50, -119.593361,   37.808594,   8,  79,  319.367859,   13.668173,   529,  1714,   0,    0
```
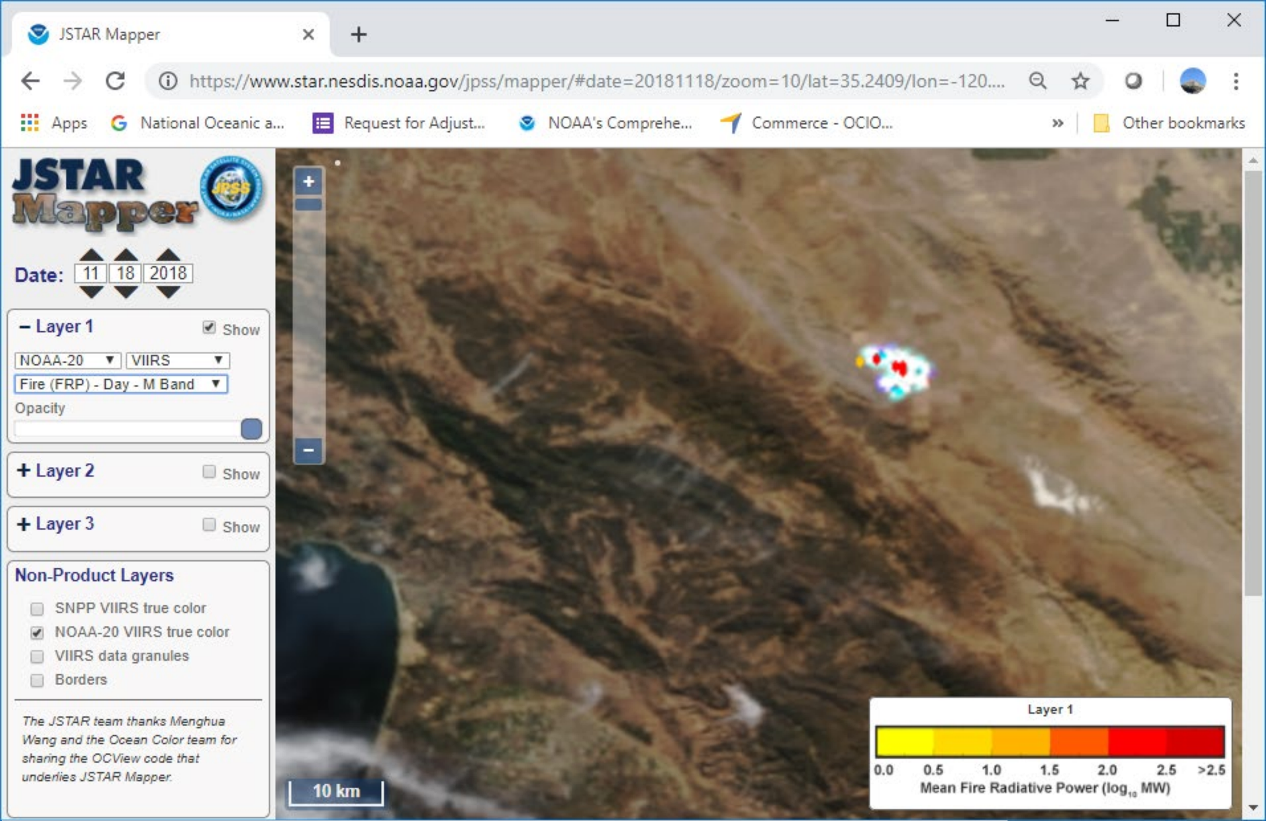
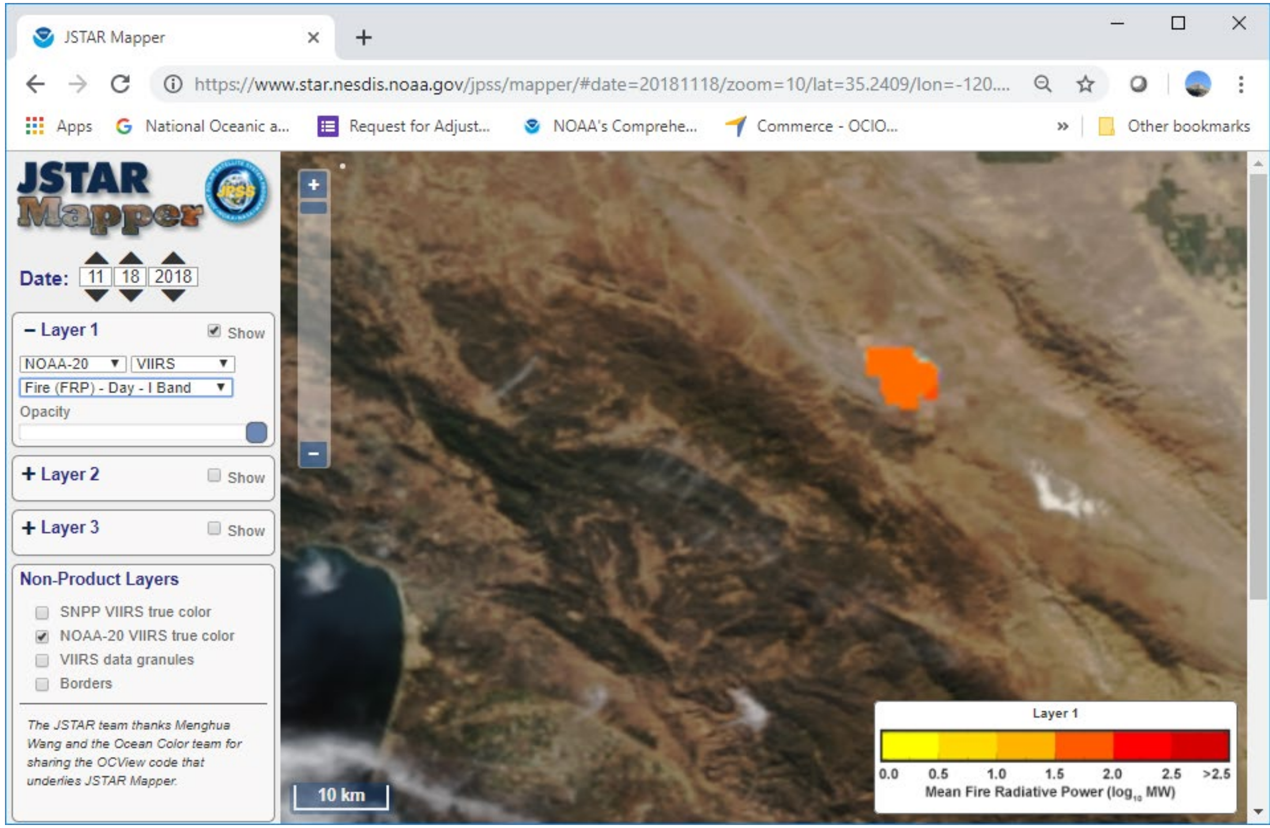
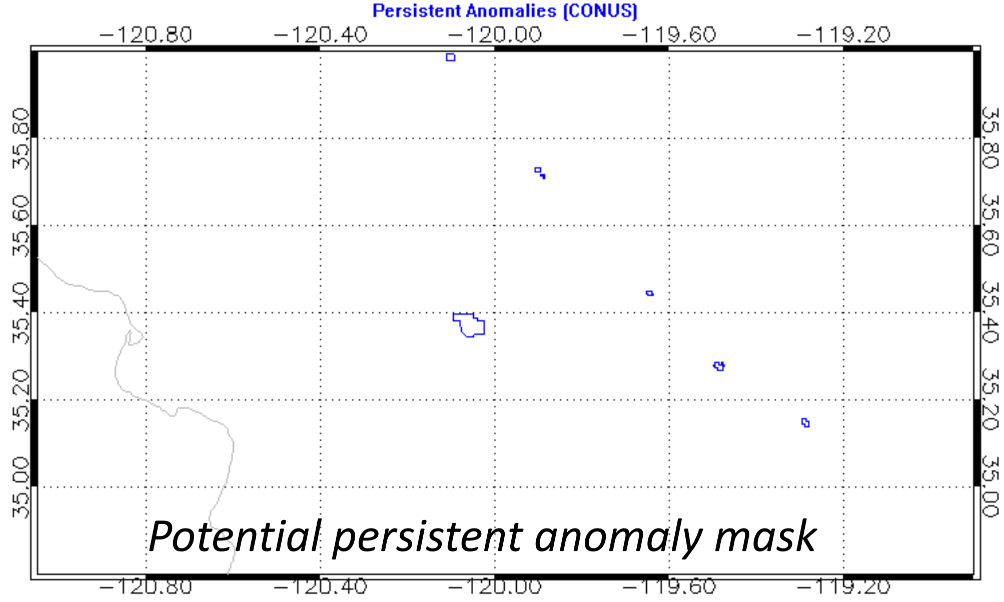

Persistent anomalies and false alarms



An example of a false alarm caused by reflection from the Topaz Solar Farm in California. NOAA-20, 11/18/2018



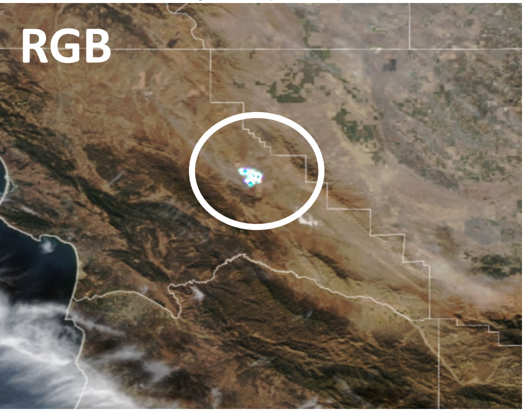


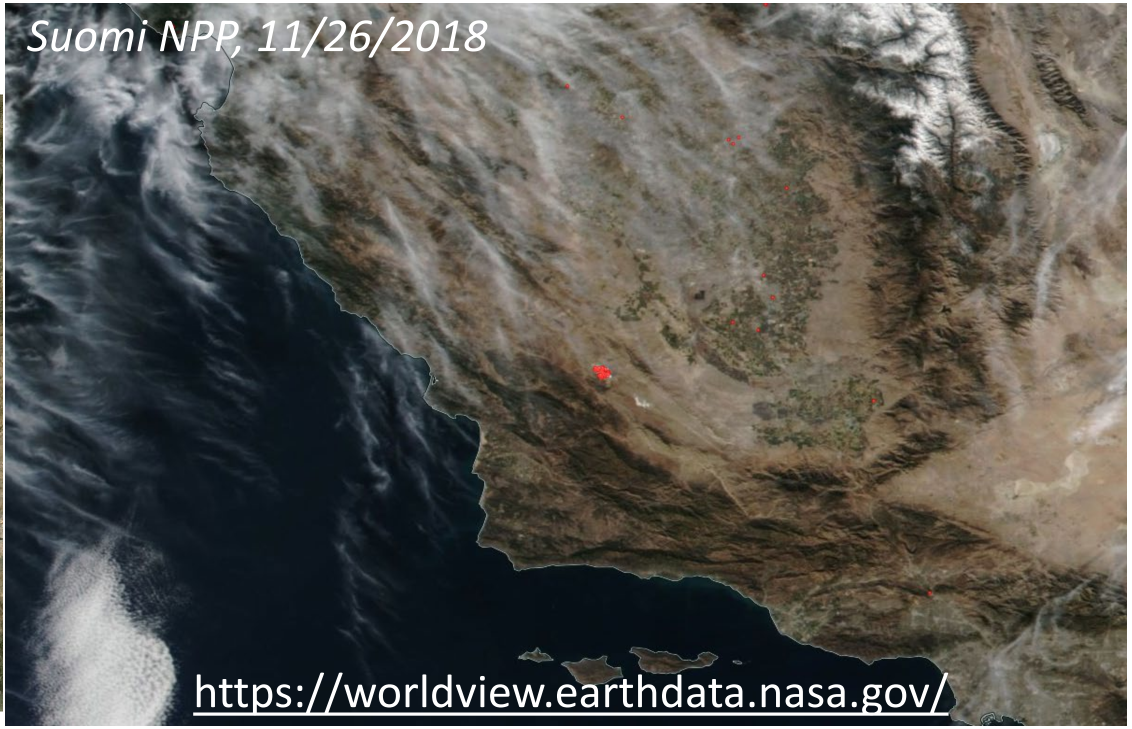
Potential persistent anomaly mask

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.)*

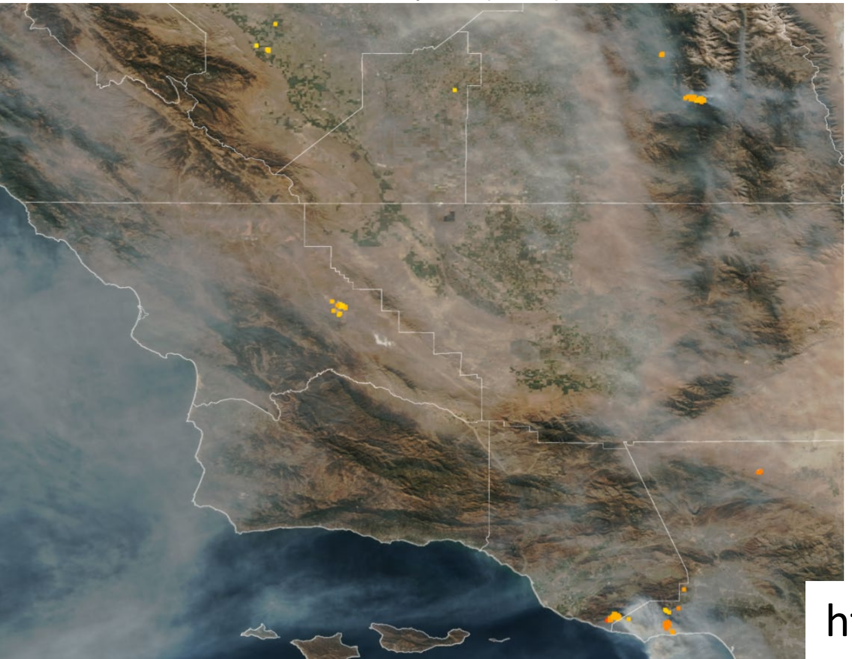
False fire detections from solar farms

NOAA-20, 11/18/2018

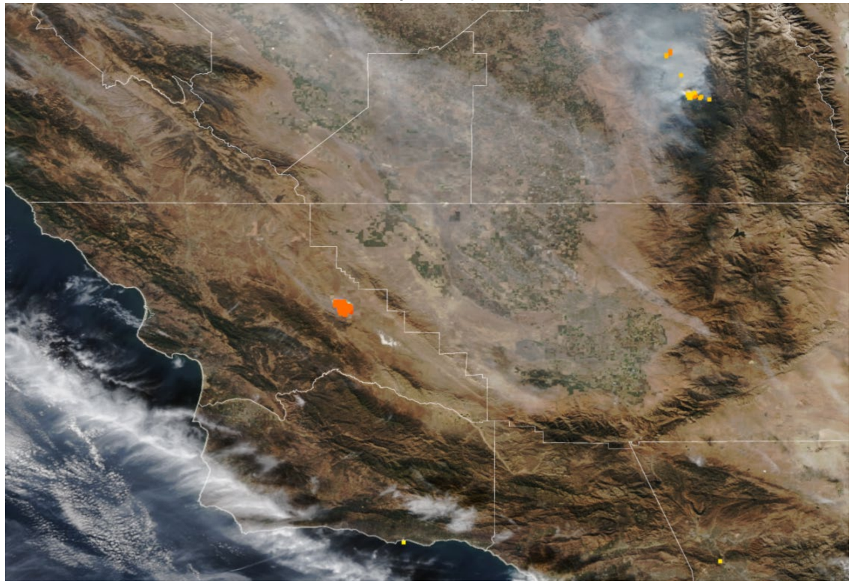




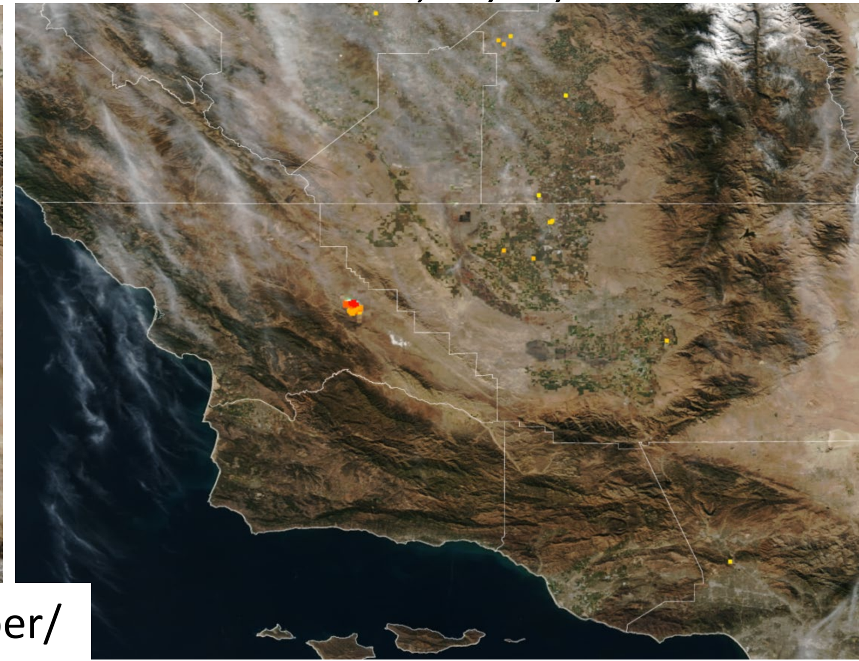
Suomi NPP, 11/10/2018



NOAA-20, 11/18/2018



Suomi NPP, 11/26/2018



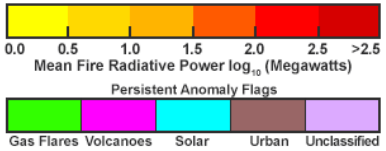
https://www.star.nesdis.noaa.gov/jpss/mapper/

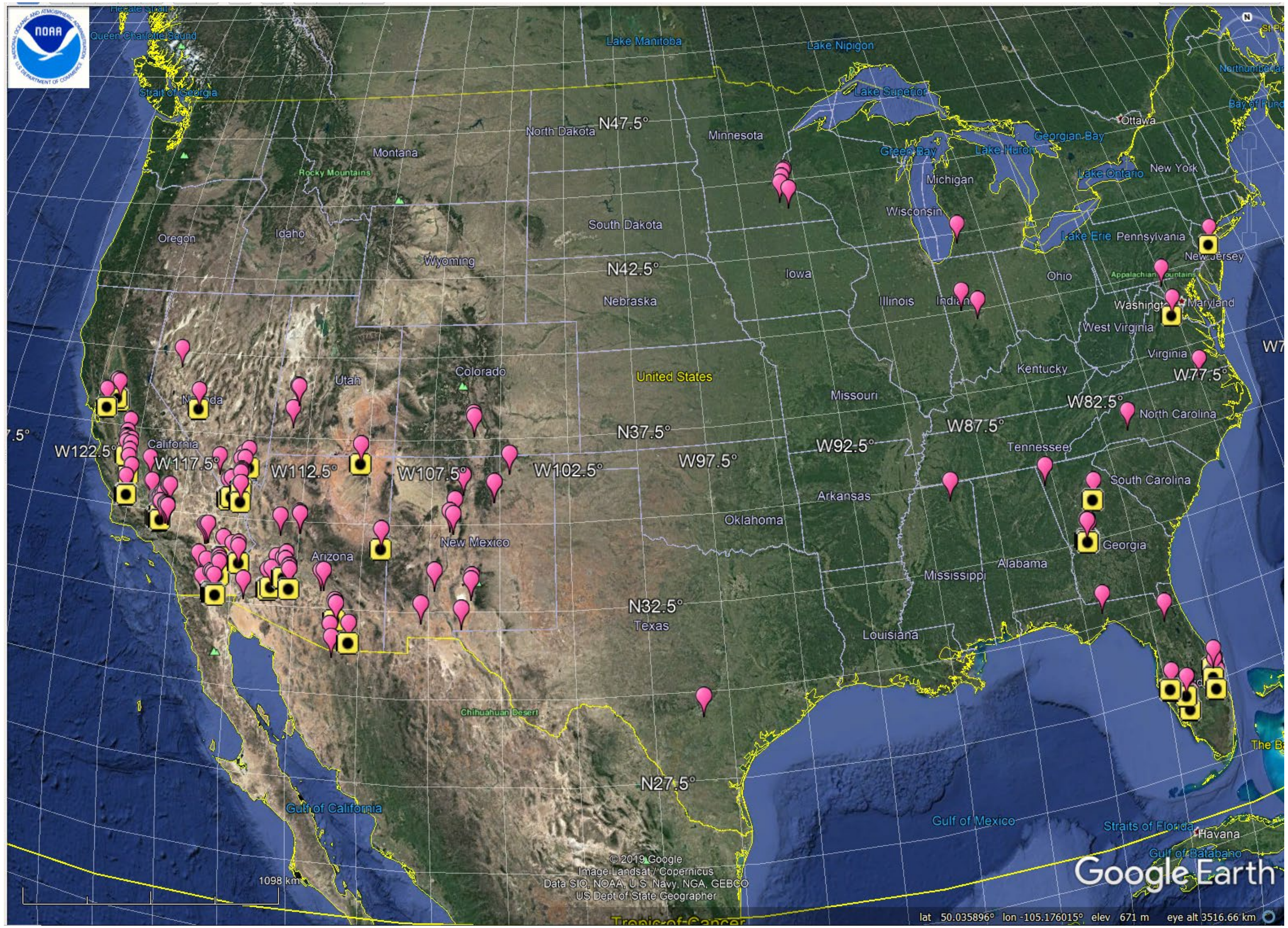
Examples of the solar farm flag in the NDE 750m product

NOAA-20, 1/15/2020

Suomi NPP, 1/24/2020

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



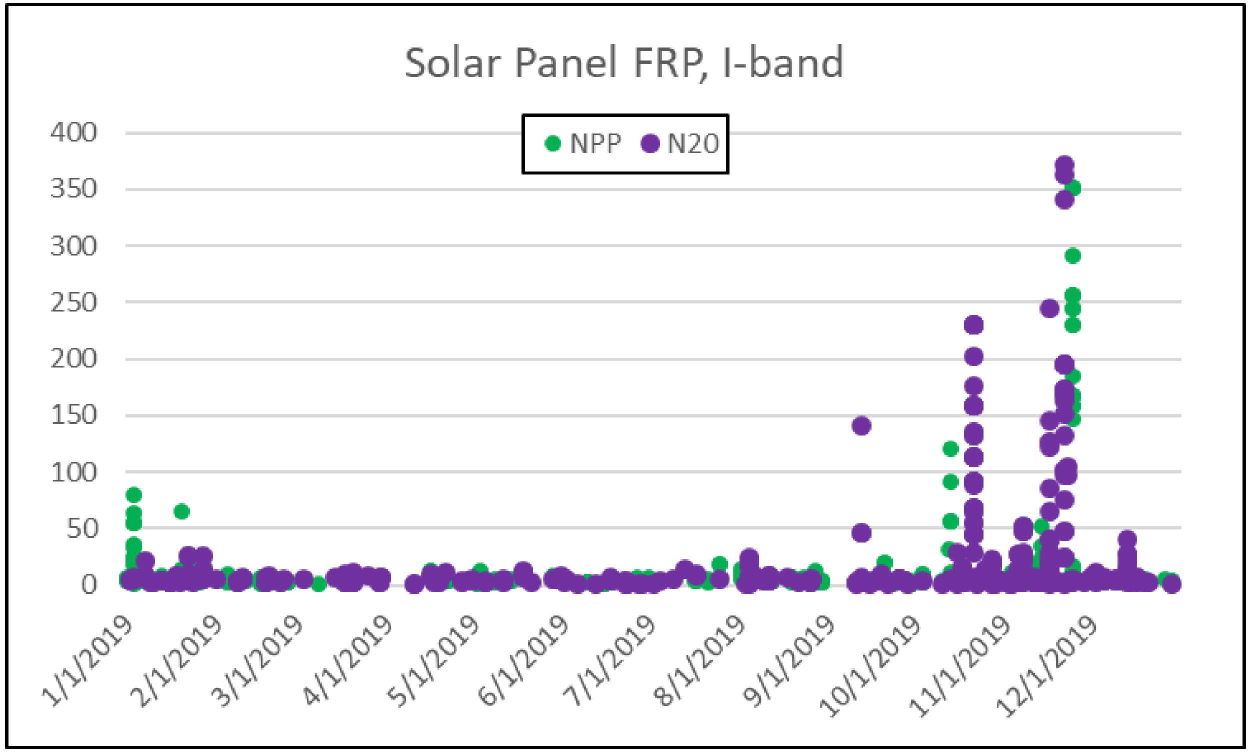


Solar panels in database

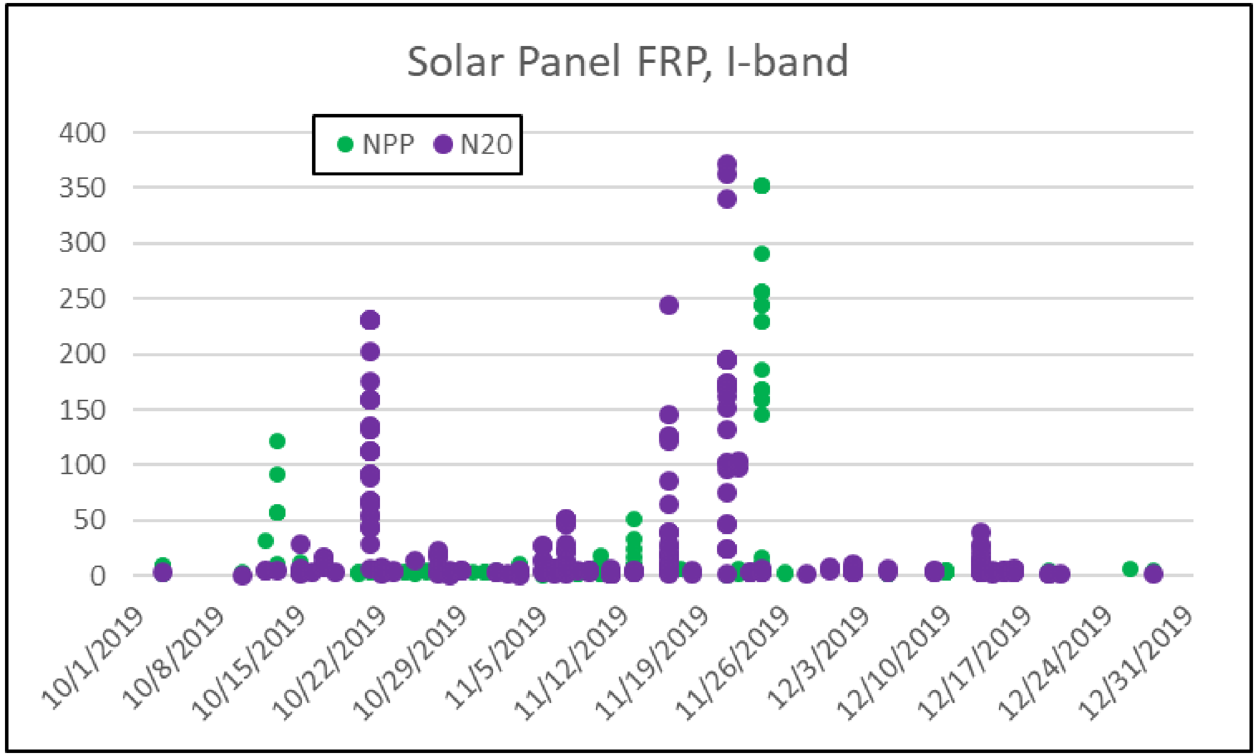
Solar panels detected by I-band algorithm Oct-Dec 2019

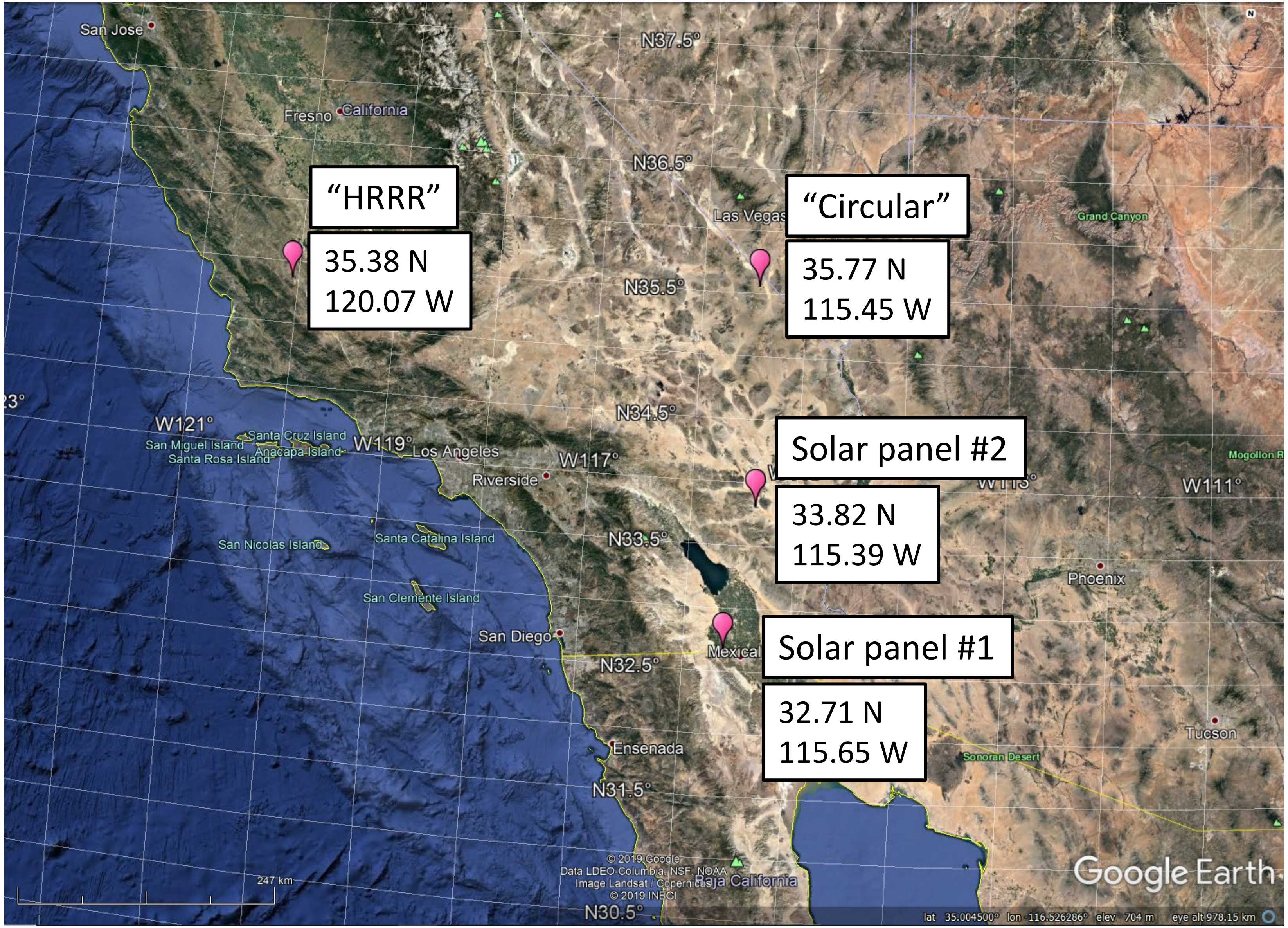
False detections and FRP from solar panels

2019



Q4 2019





Locations for solar panels timeseries plots

"Circular"

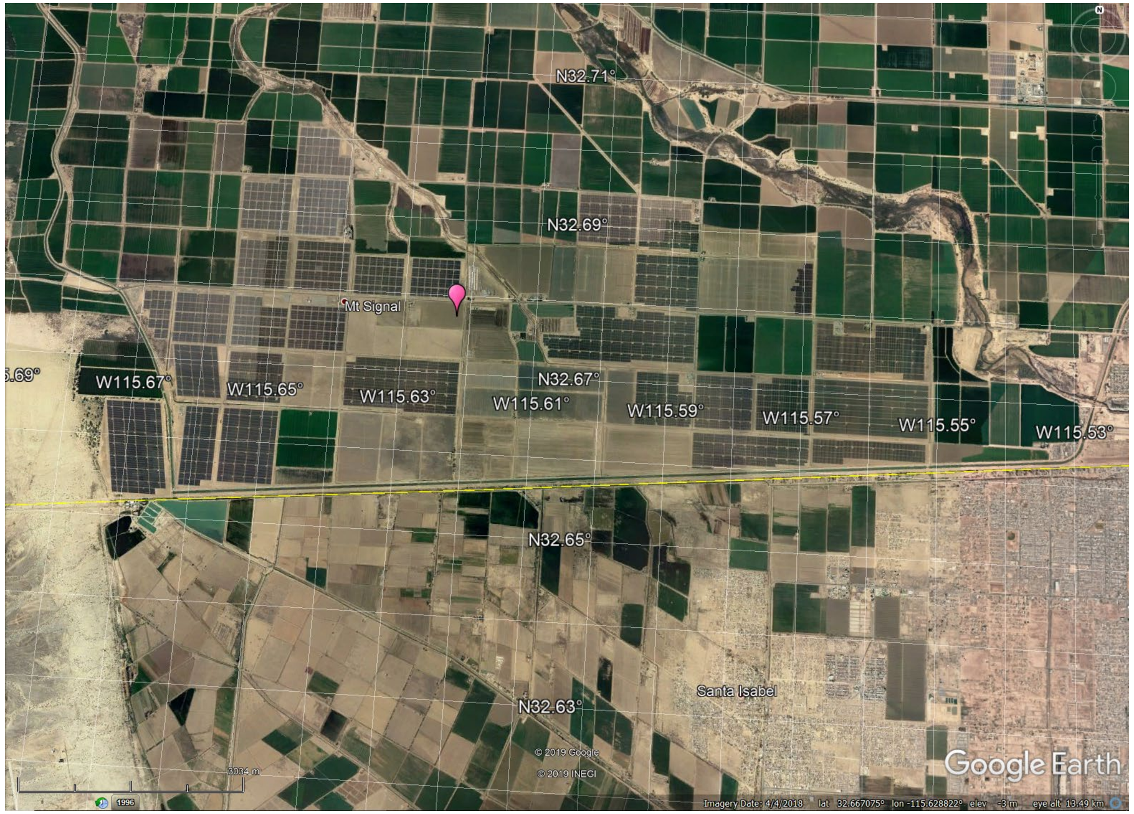
35.77 N
115.45 W

"HRRR"

35.38 N
120.07 W

Solar panel #1

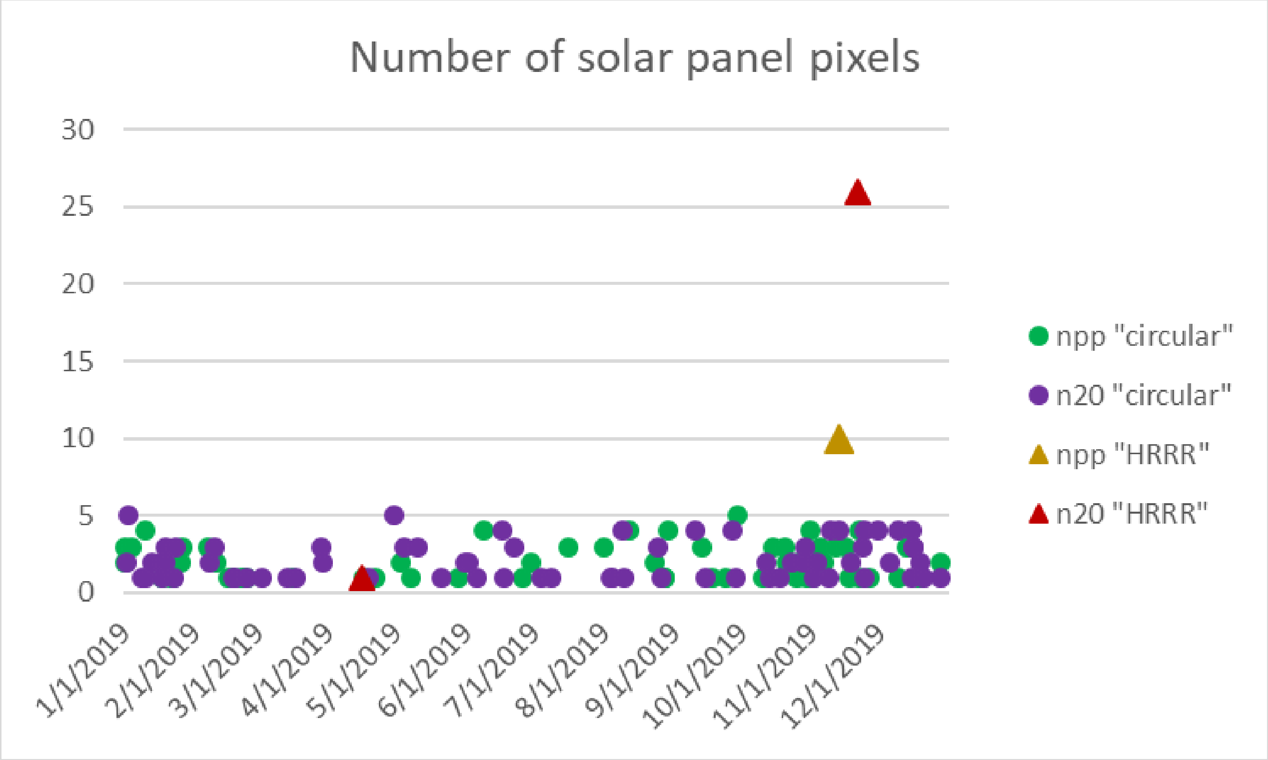
32.71 N
115.65 W

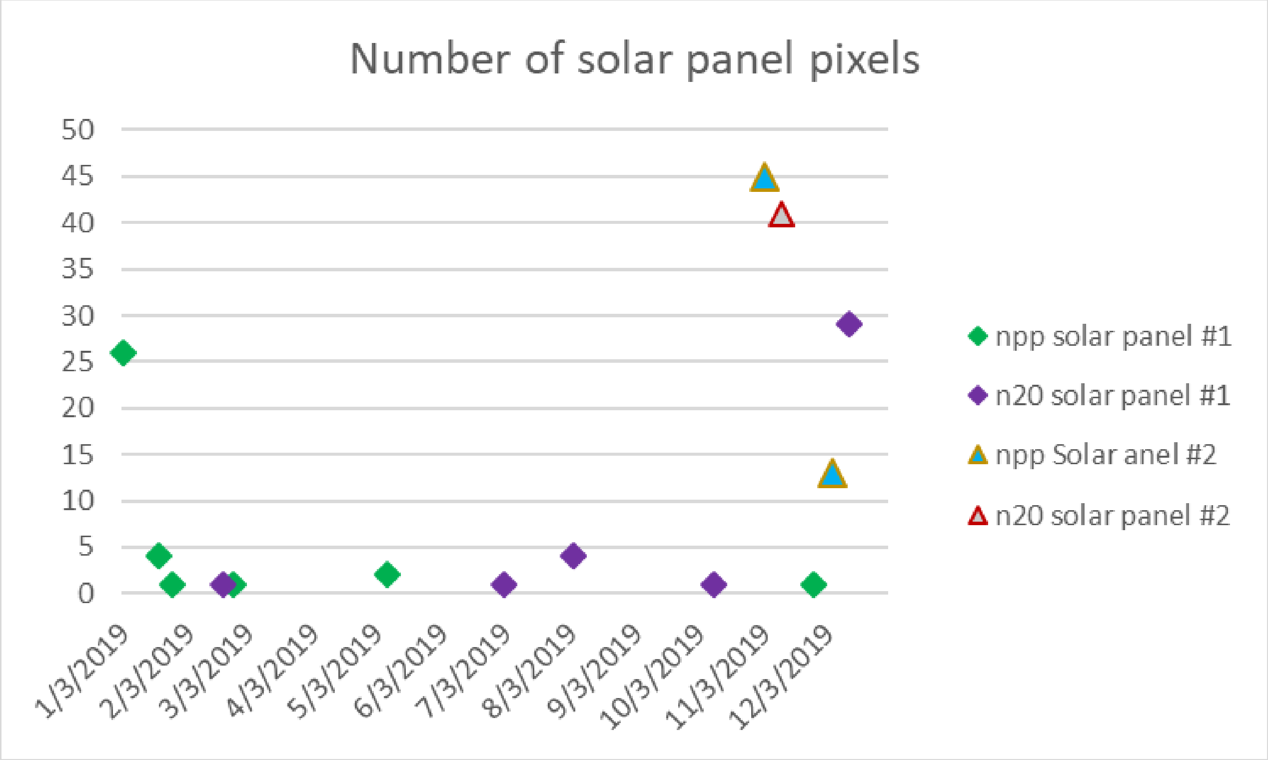


Solar panel #2

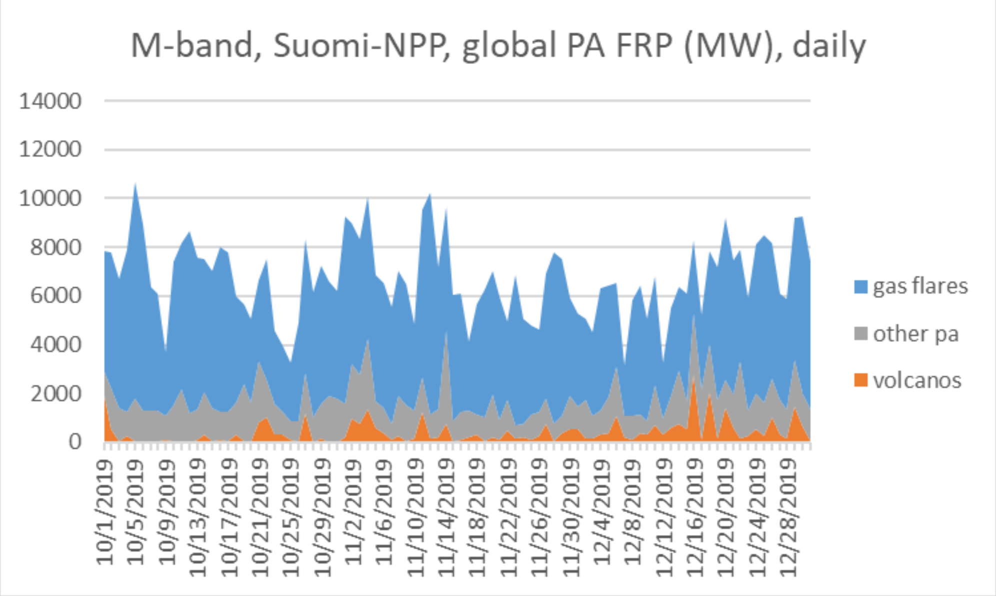
33.82 N
115.39 W

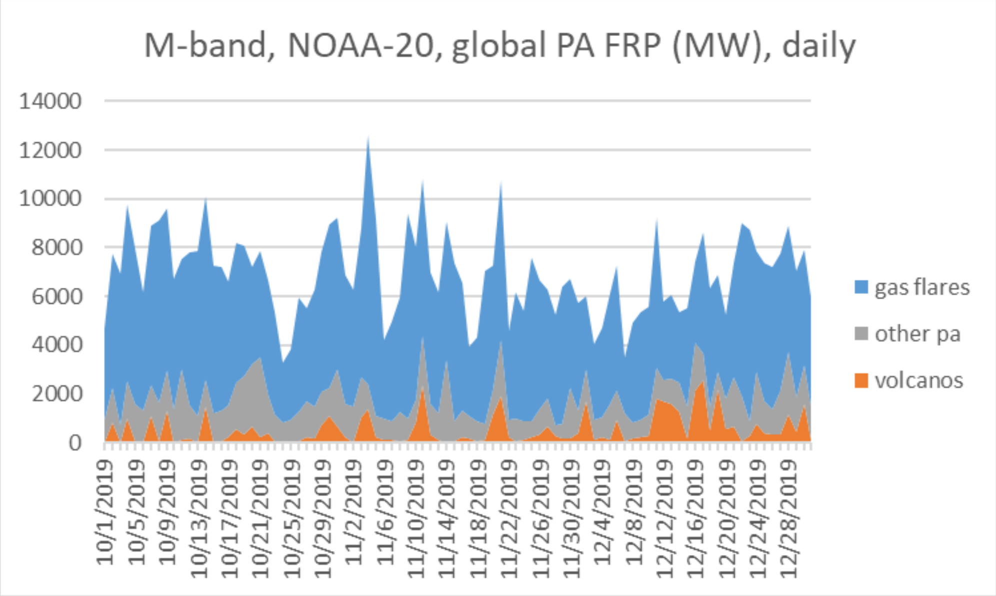
False detections and FRP from solar panels

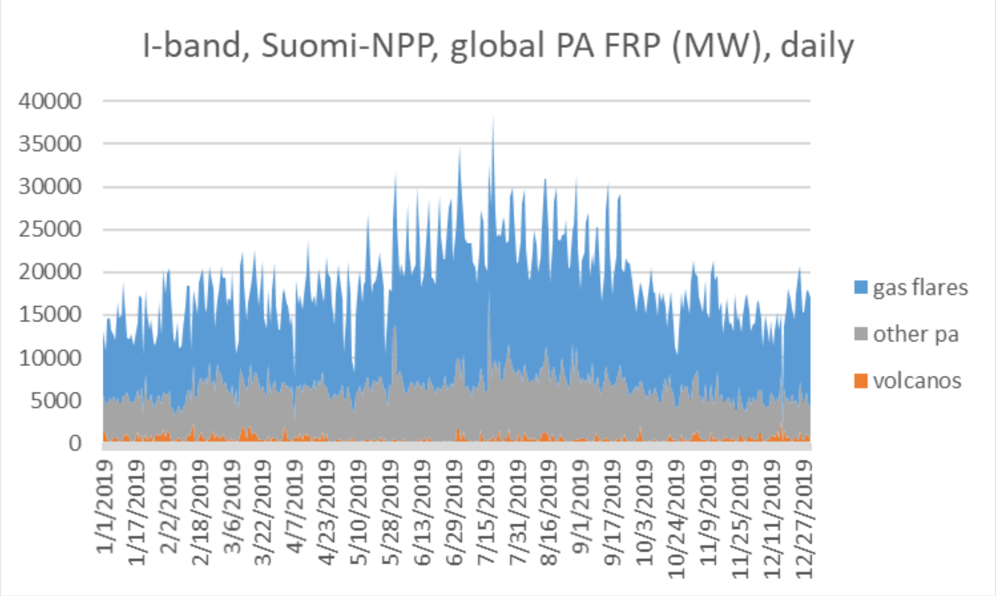


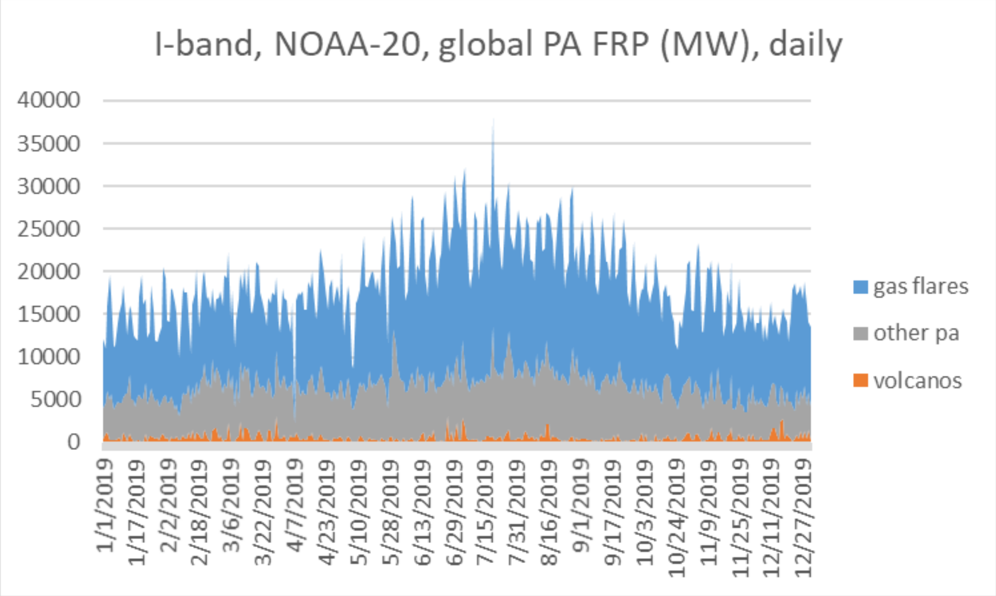


False detections and FRP from persistent anomaly sources



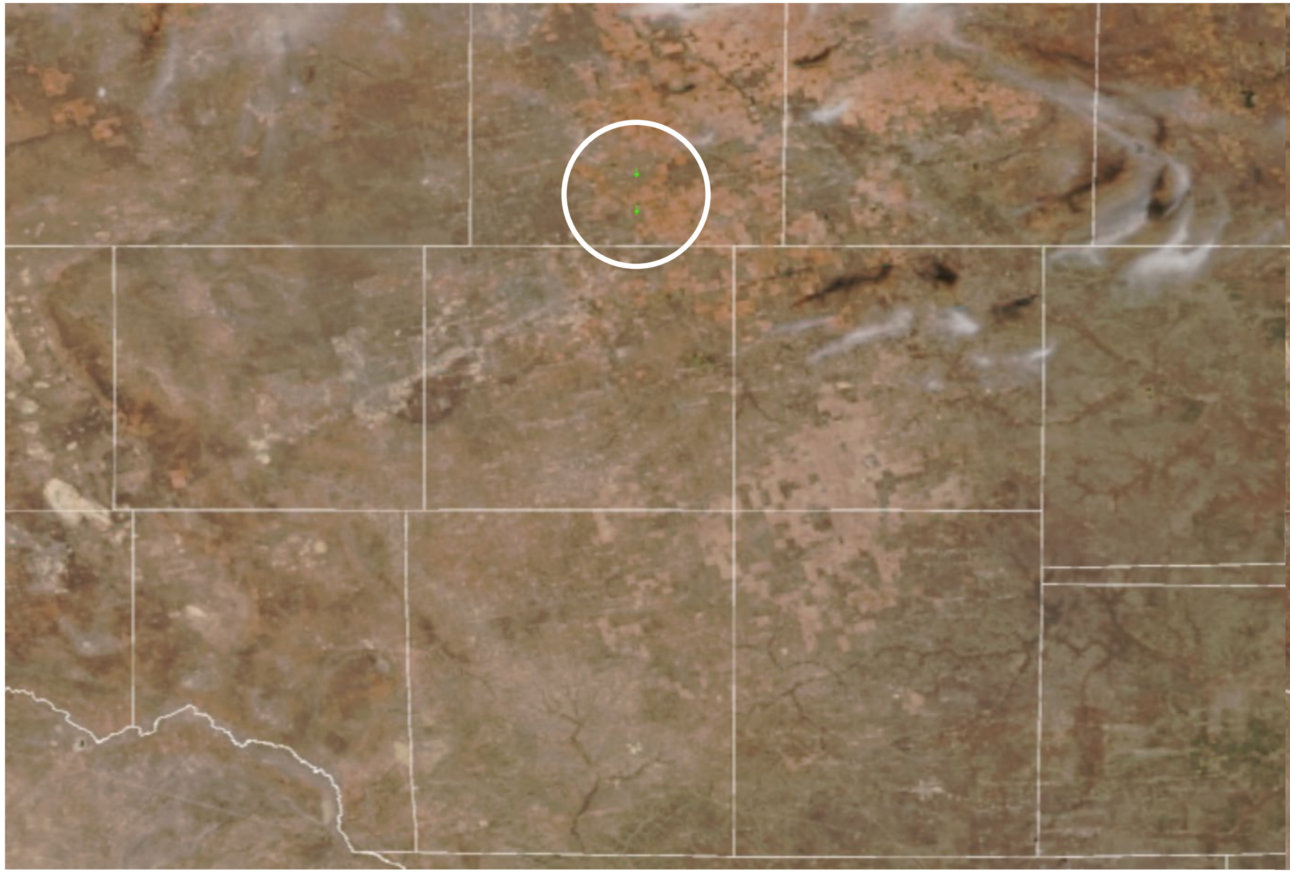






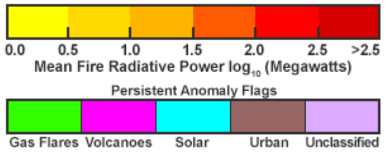
Examples of the gas flare flag in the NDE 750m product

Suomi NPP, 1/23/2020

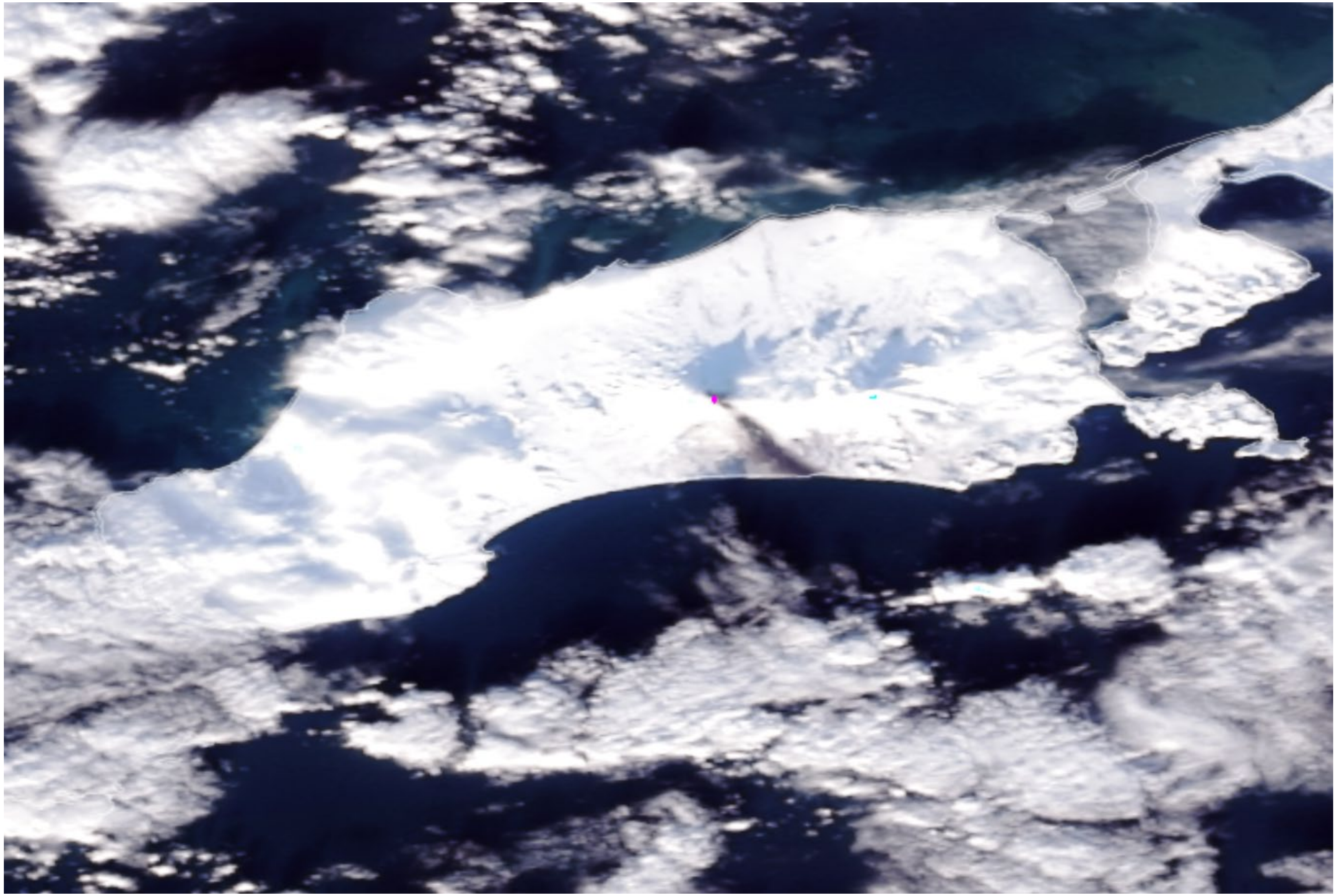


Suomi NPP, 1/24/2020

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



An example of the volcano flag in the NDE 750m product

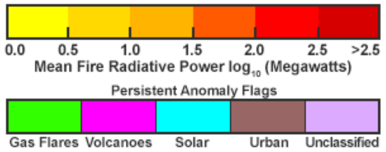


NOAA-20, 1/4/2020

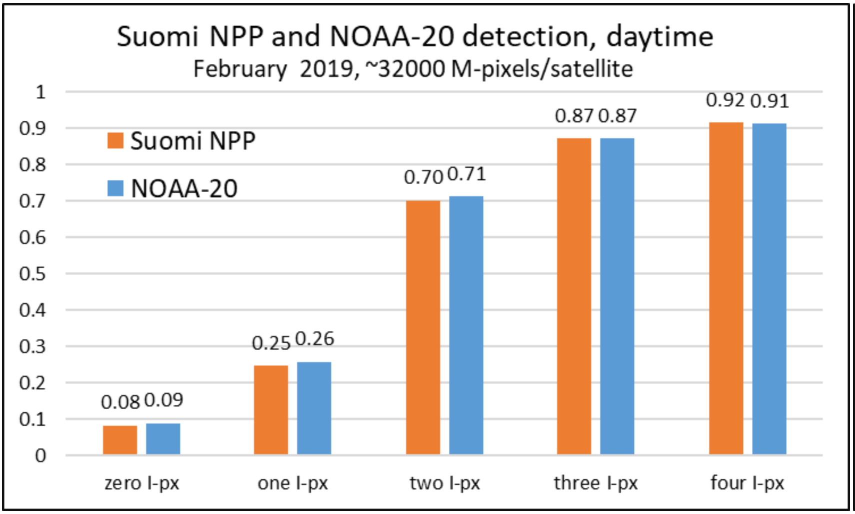
Shishaldin, Unimak Island, USA

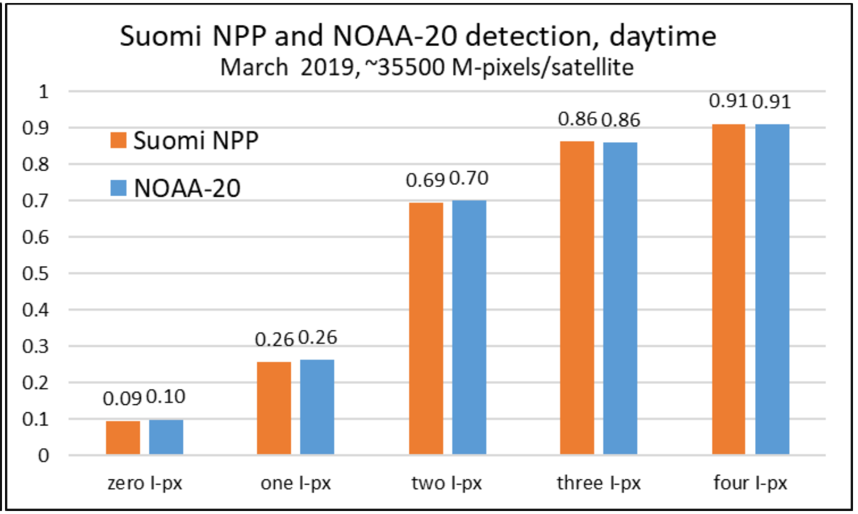
Holocene Volcano Database obtained from

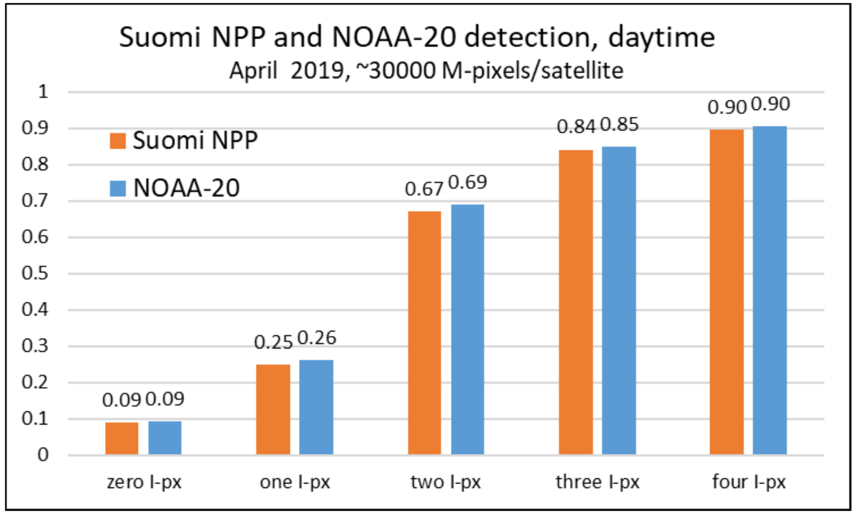
Global Volcanism Program, 2013. Volcanoes of the World, v. 4.8.5. Venzke, E (ed.). Smithsonian Institution. Downloaded 13 Nov 2019. https://doi.org/10.5479/si.GVP.VOTW4-2013

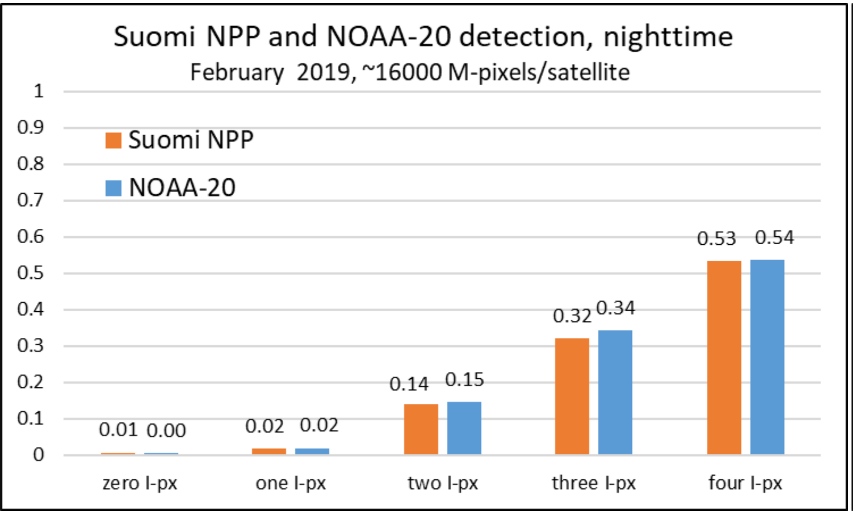


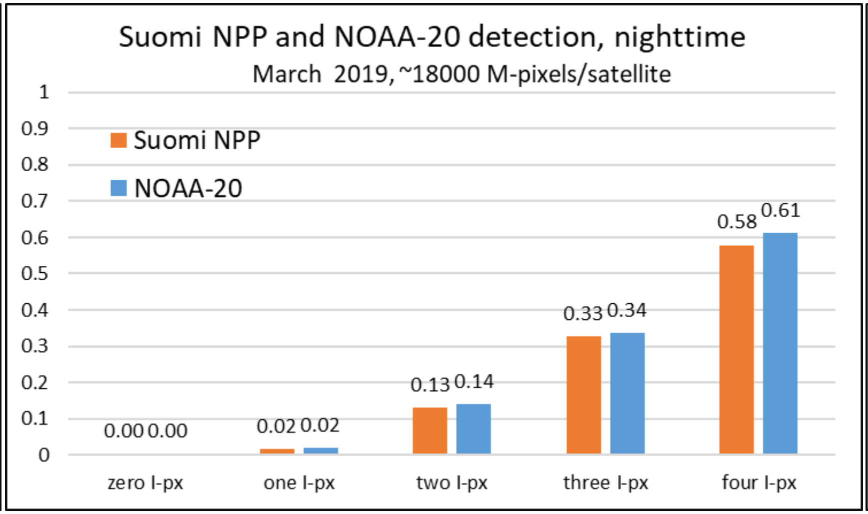
M-band to I-band traceability: relative detection rates

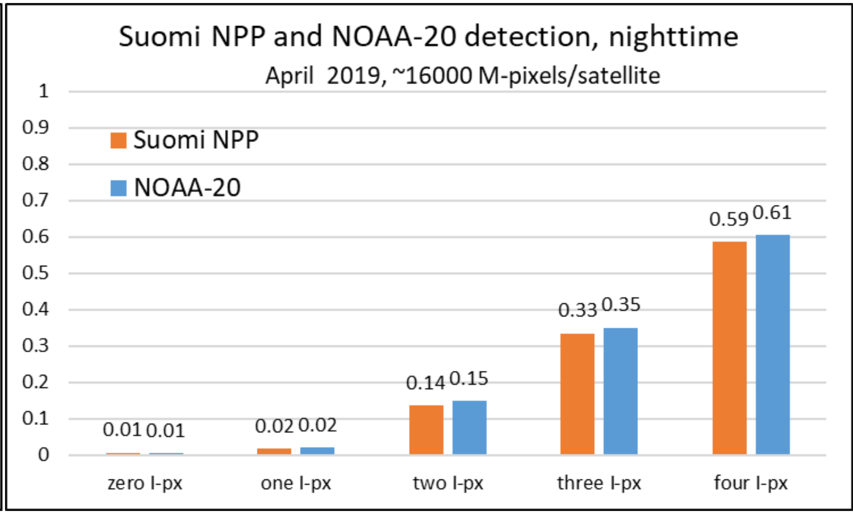




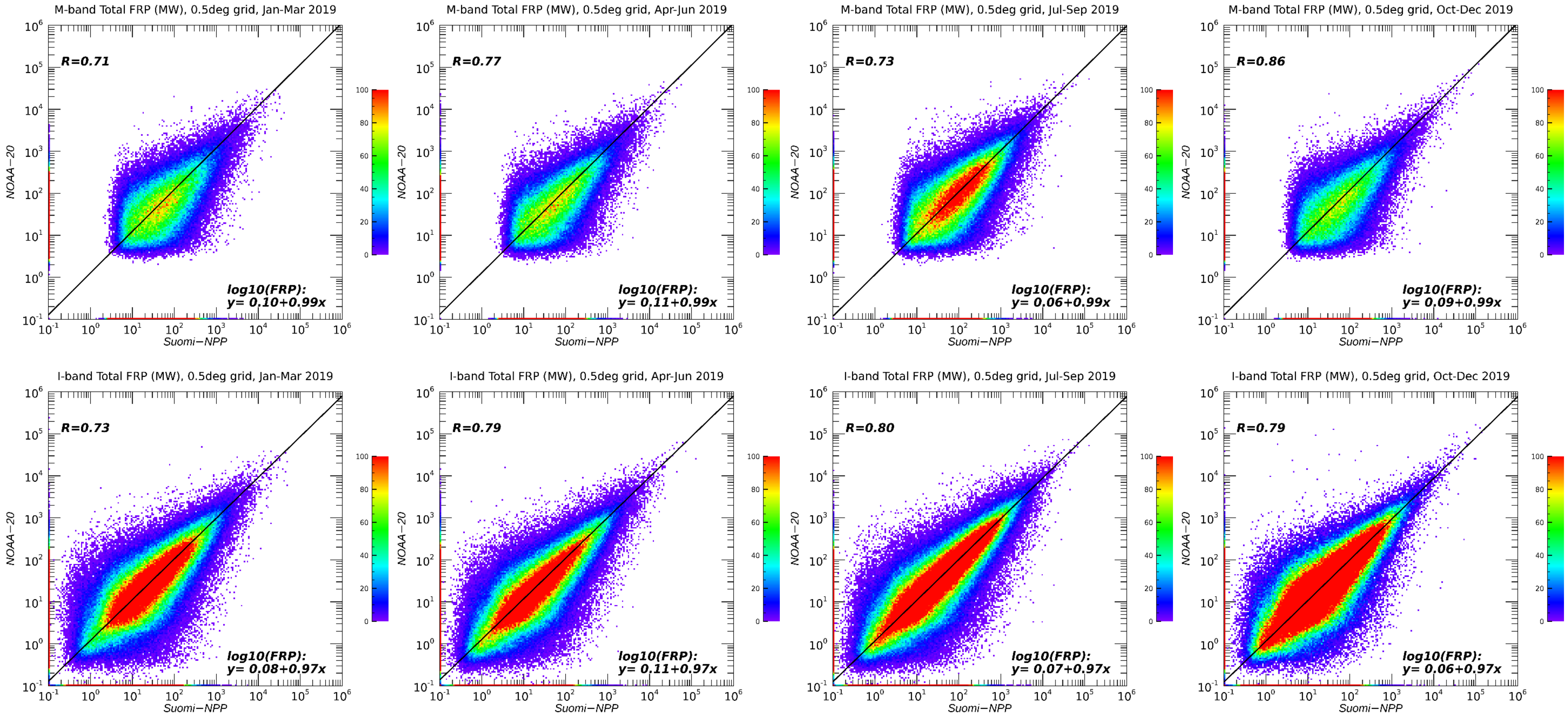




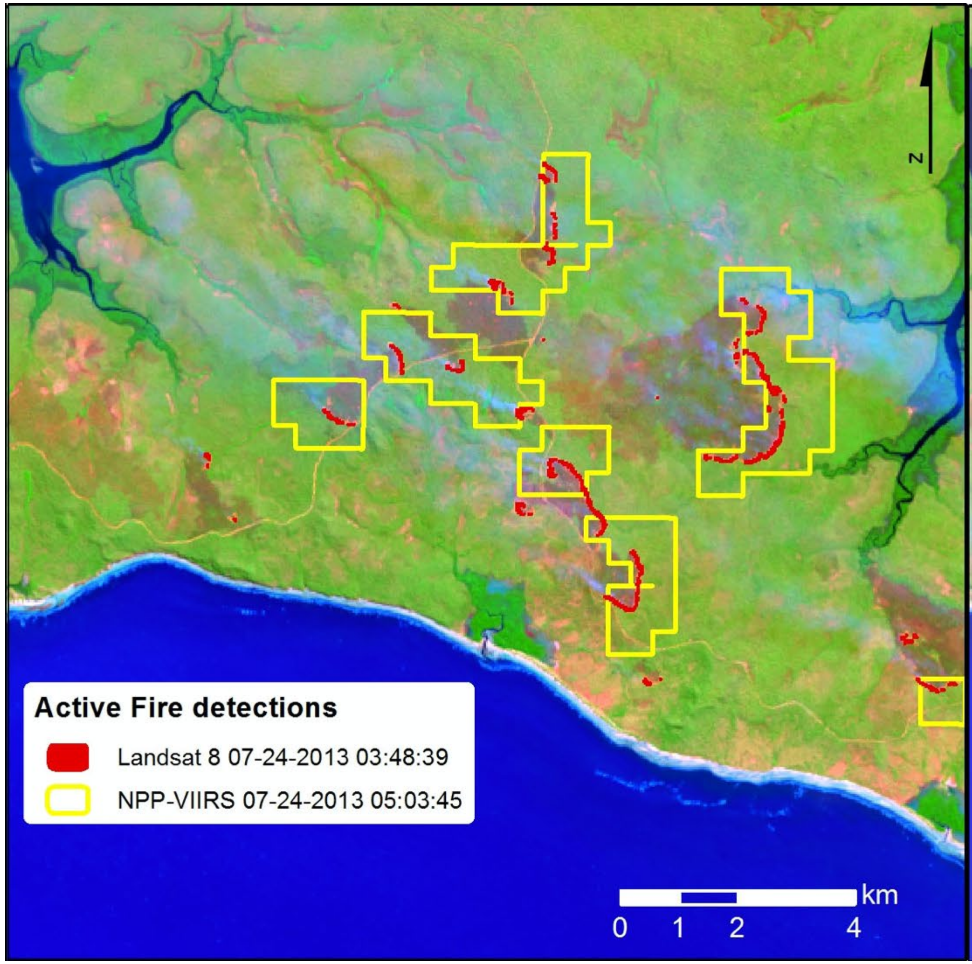


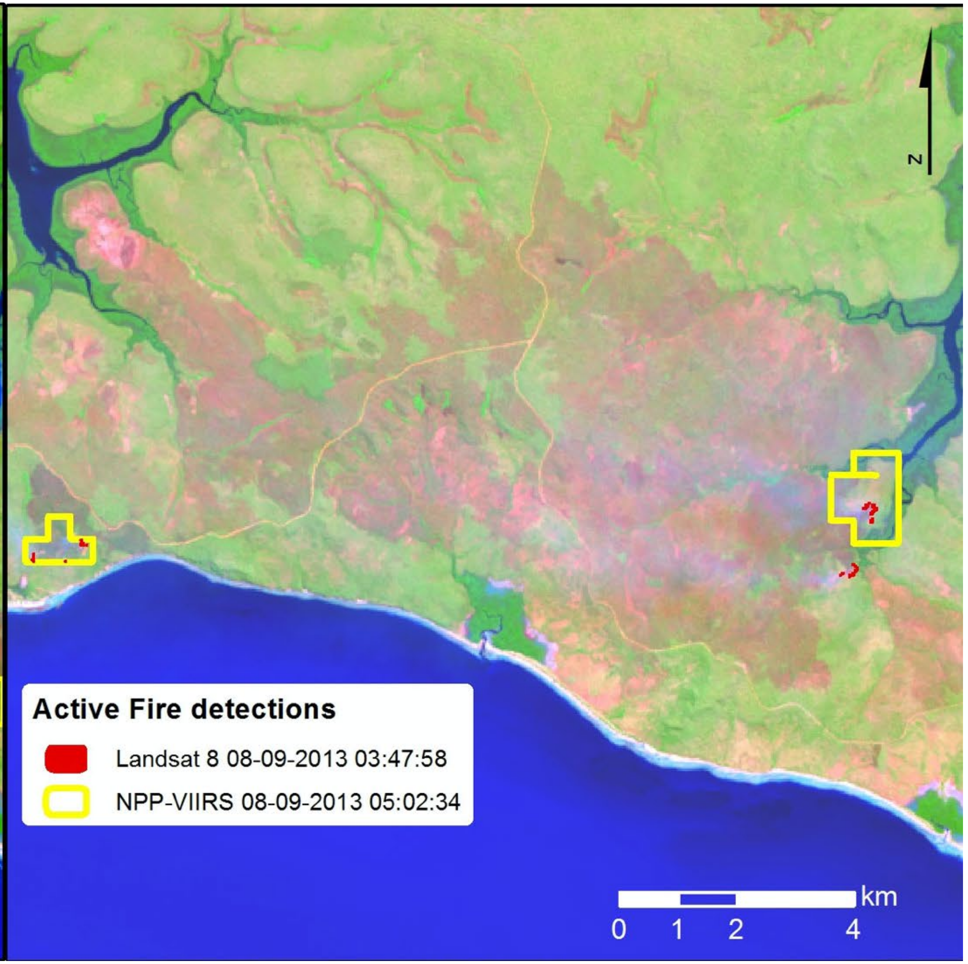


Suomi NPP vs. NOAA-20 Fire Radiative Power in 2019



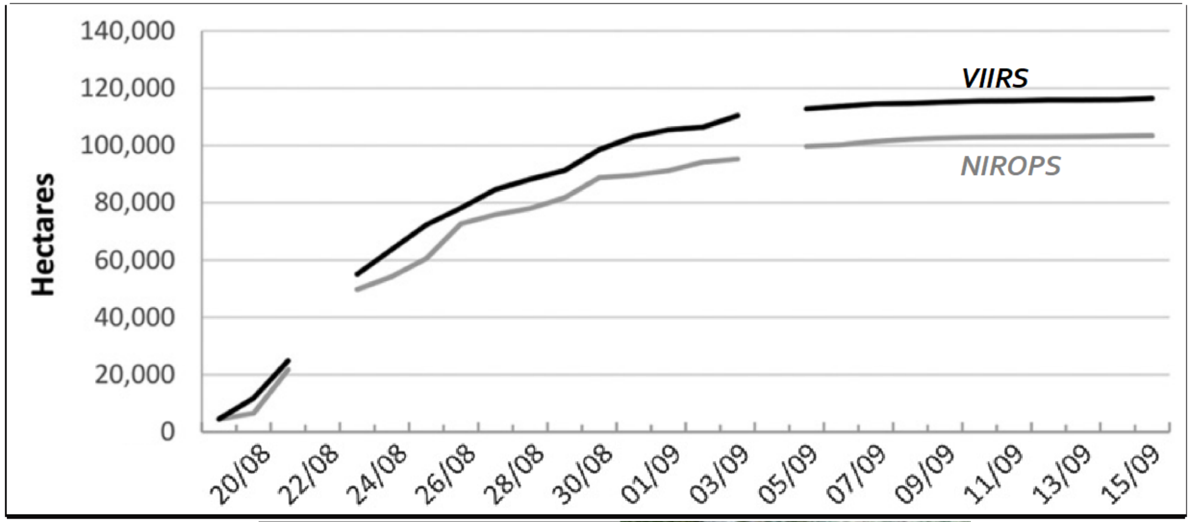
Landsat-8/OLI 30m × VIIRS 375 m Fire Data Intercomparison



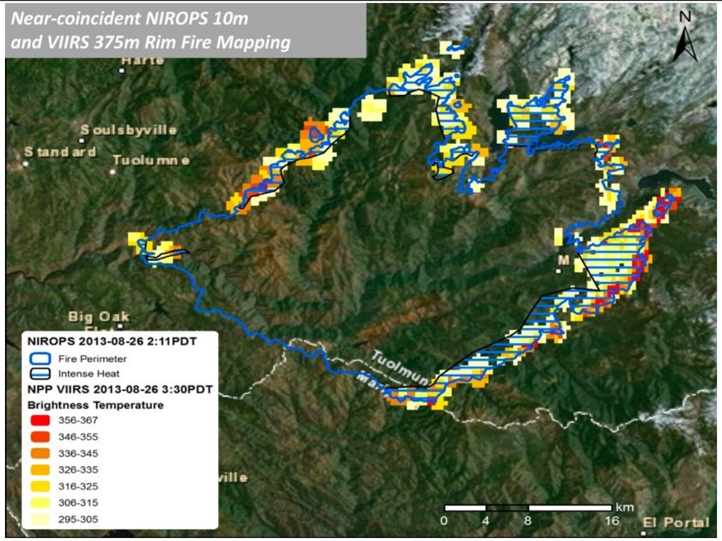


Active fires in Australia

NIROPS 10m x VIIRS 375 m Fire Data Intercomparison (Rim Fire/CA 2013)

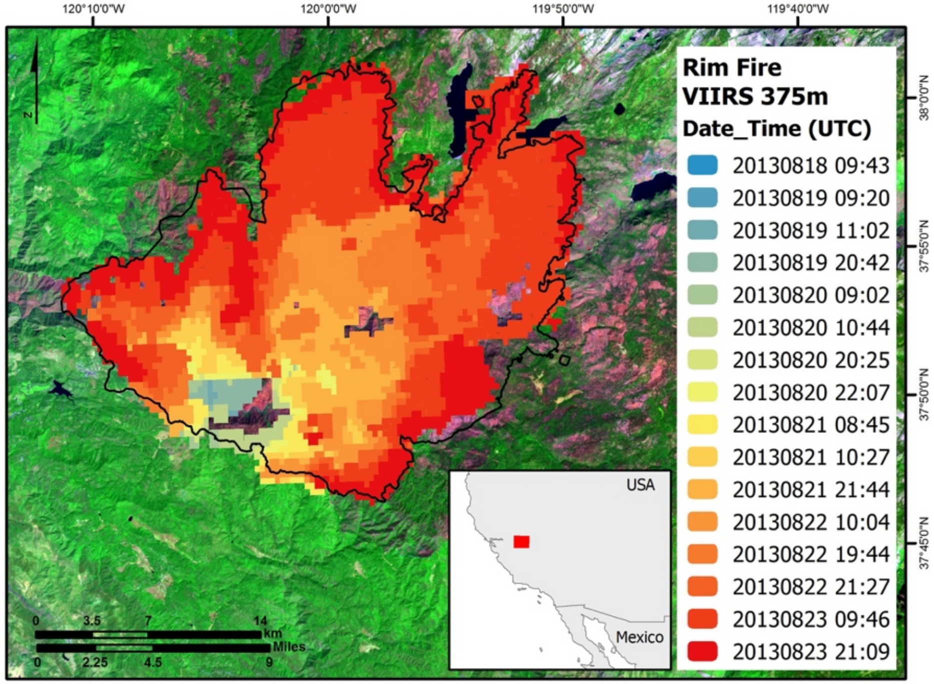


Daily mapping of fire-affected area using airborne and S-NPP/VIIRS data



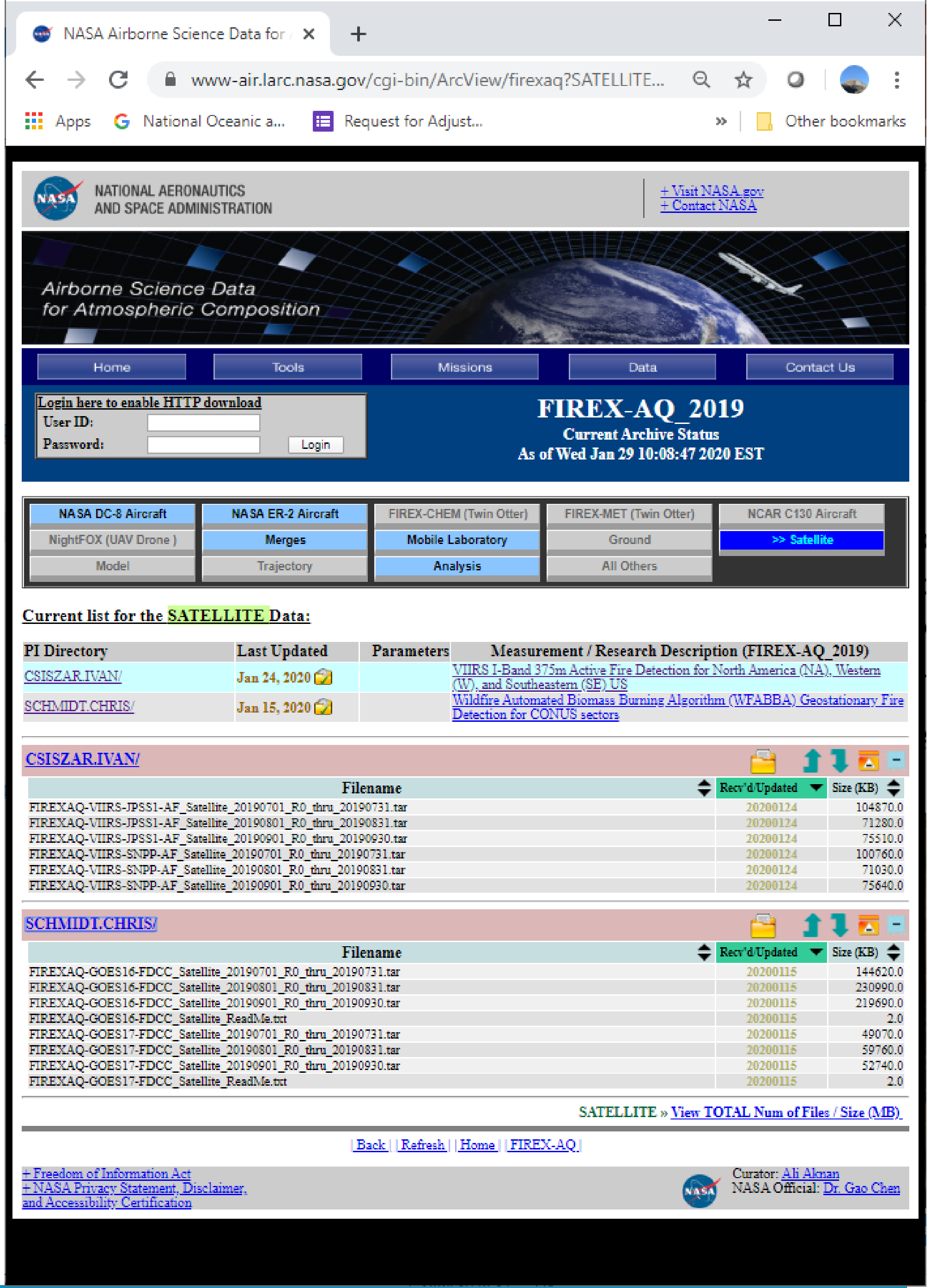
Instantaneous mapping of active fire line using near-coincident airborne and S-NPP/VIIRS data

Cumulative map of S-NPP/VIIRS fire pixels + Landsat fire perimeter



VIIRS Active Fire data support of the 2019 FIREX-AQ campaign

- VIIRS 375 active fire data in KML/KMZ format were provided for July – September 2019 for
  - Western US/Canada (32N – 57N, 129W – 104W)
  - Southeast US (25-42.5 N, 102.5-75 W)
  - North America (15N – 65N, 140W – 70W)
- Coincident high resolution fire data from airborne missions can be used for product evaluation



Williams Flats VIIRS/MASTER comparison during FIREX-AQ

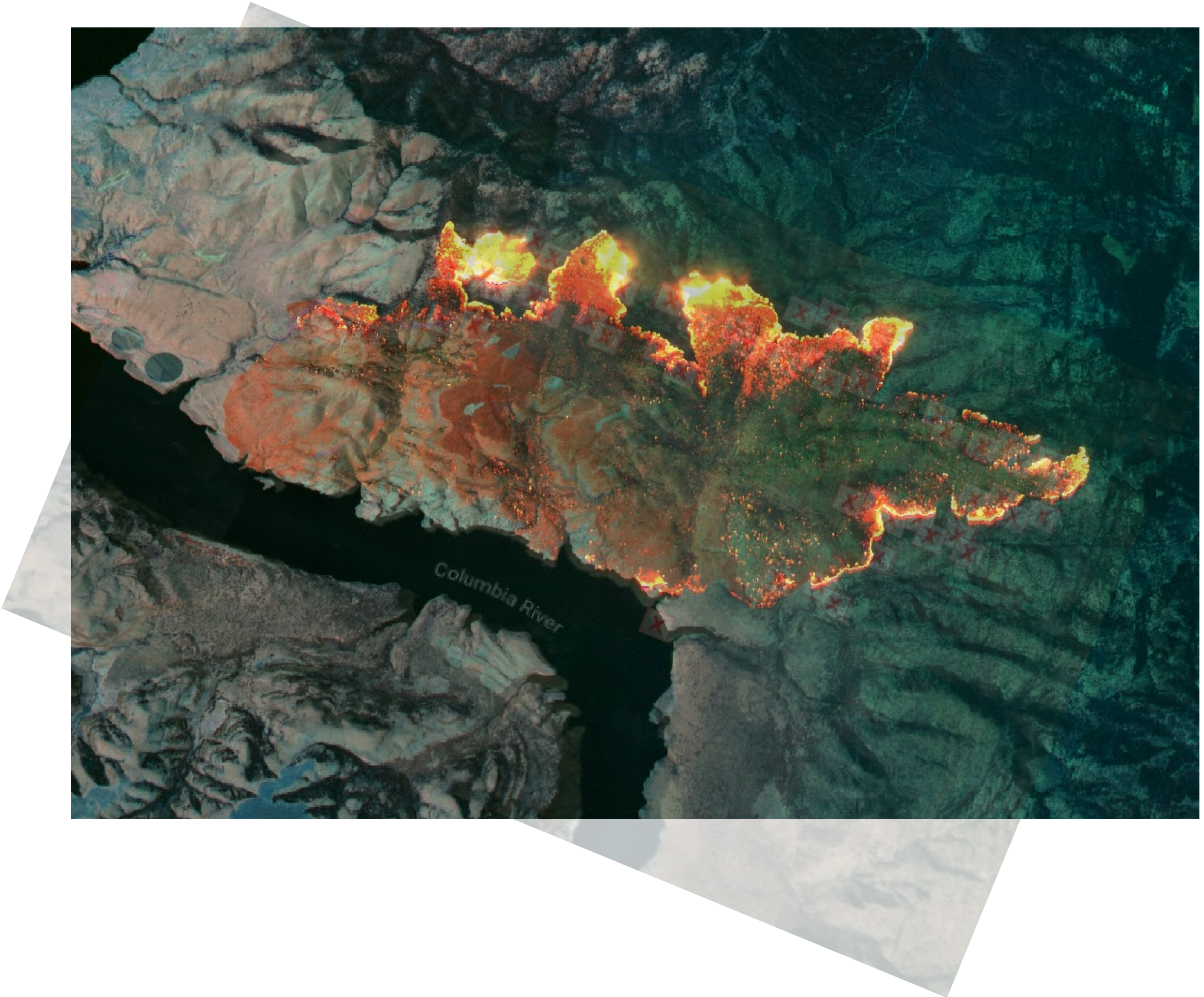
MASTER IR detection with 20m pixels from the DC8 at 21:57Z and ~8000 m AMSL altitude.

Fade in:
VIIRS fire detections: 20190803 at 21:57:30 Z

MASTER: MODIS/ASTER Airborne Simulator
https://master.jpl.nasa.gov/

Slide courtesy of Joshua Schwarz, NOAA ESRL

Williams Flats VIIRS/MASTER comparison during FIREX-AQ



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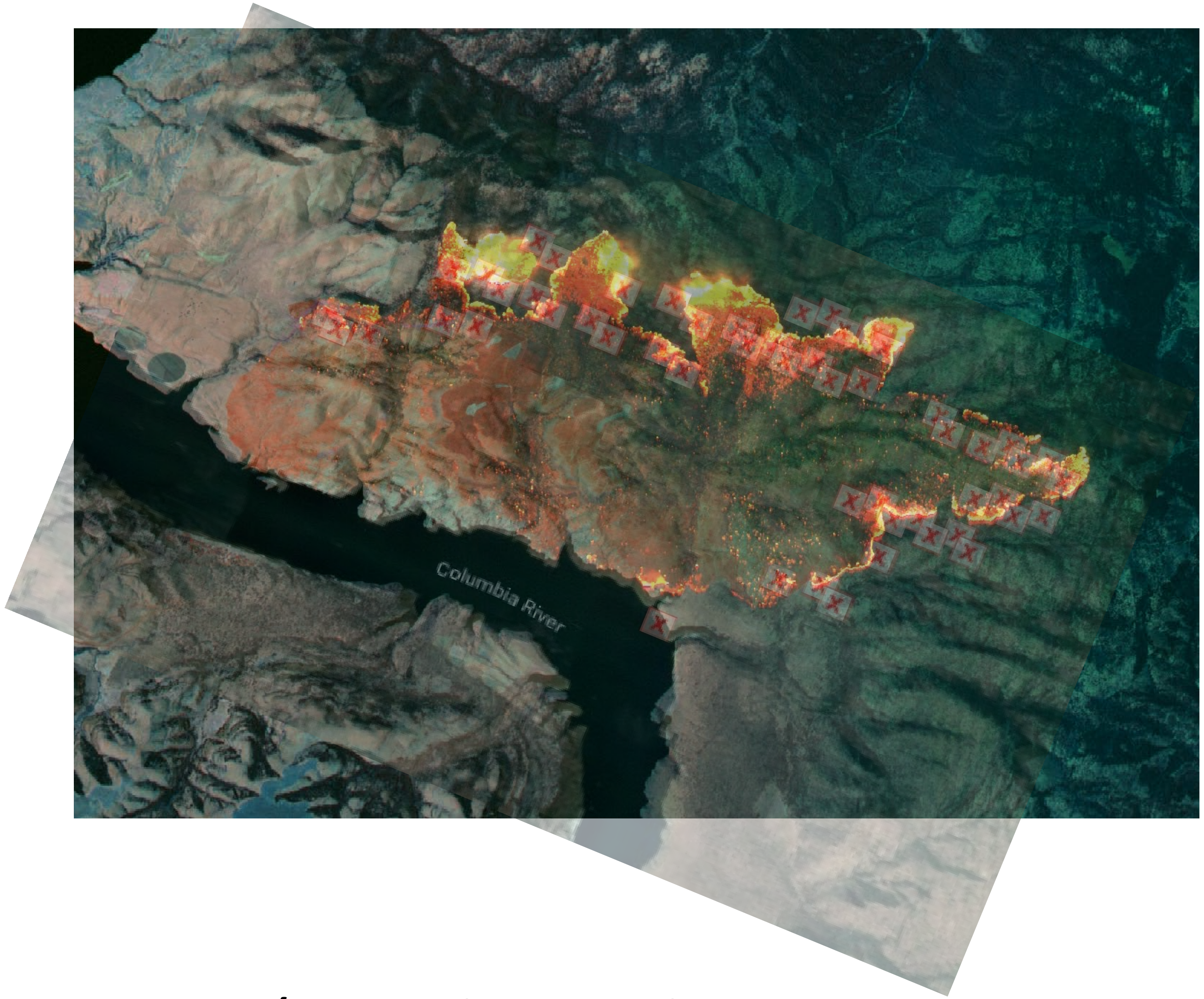

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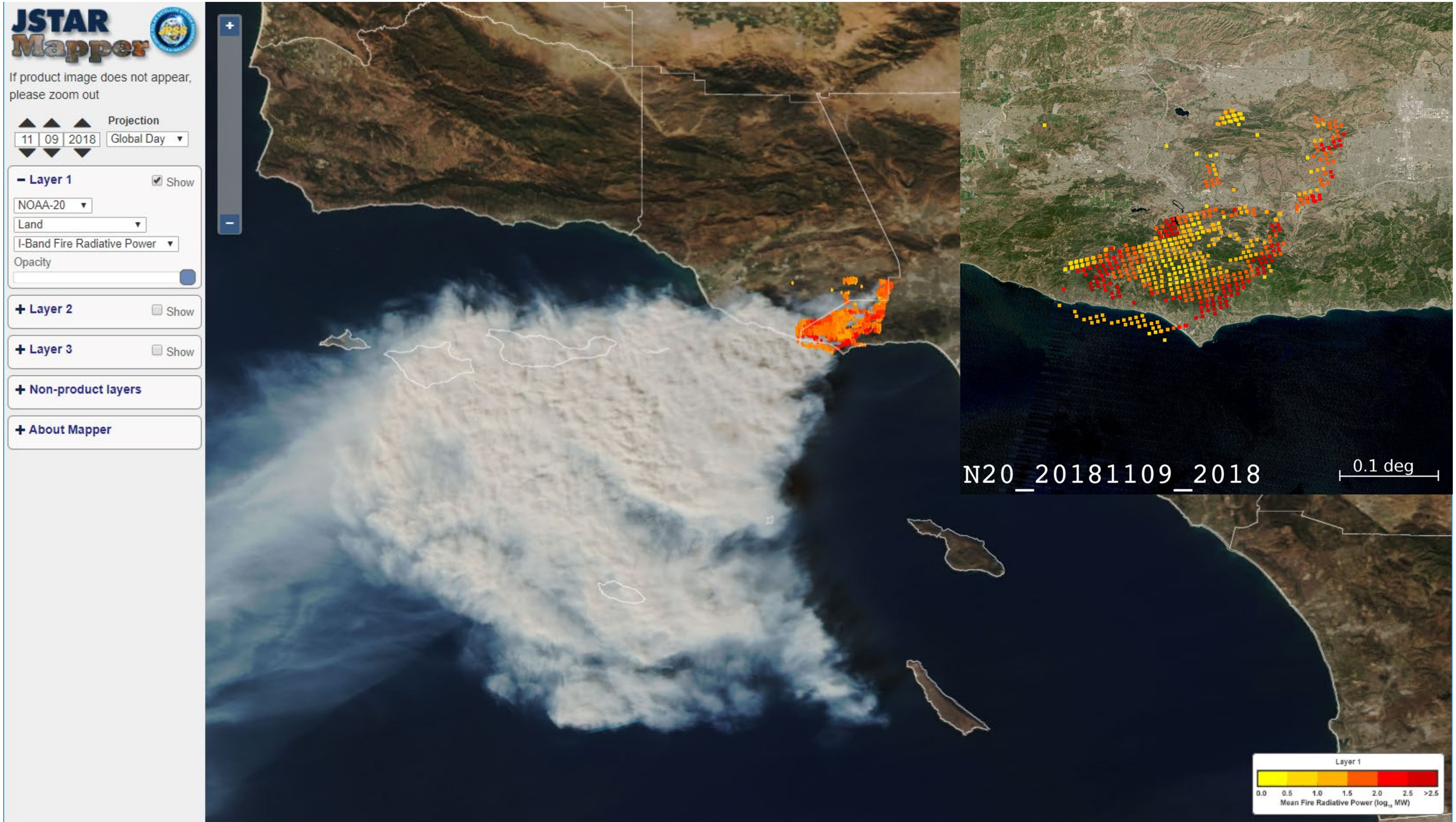
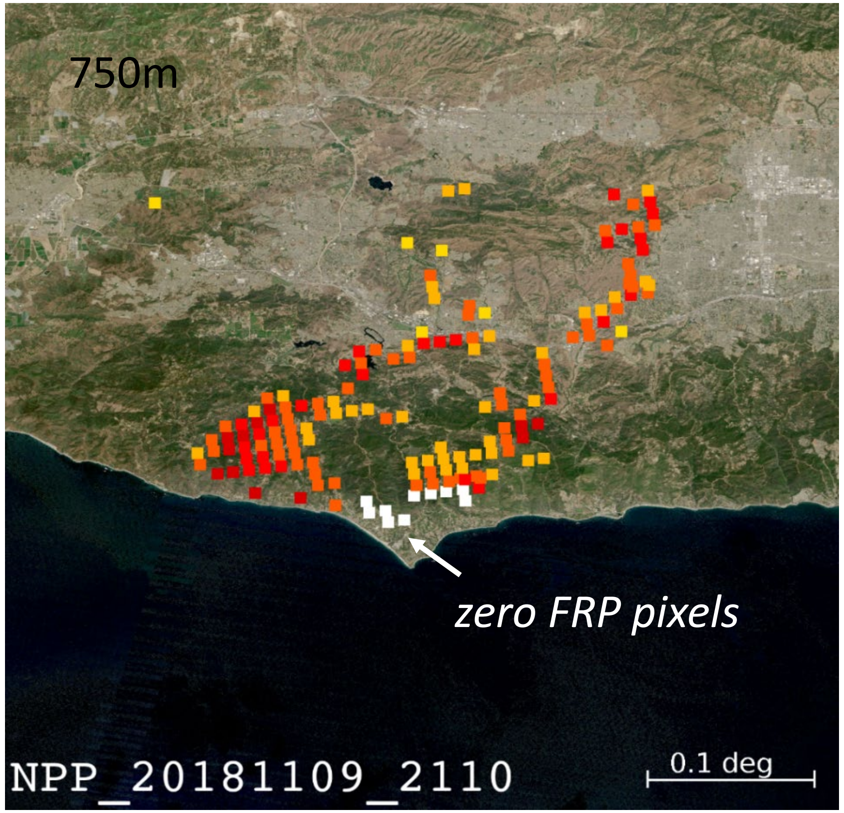
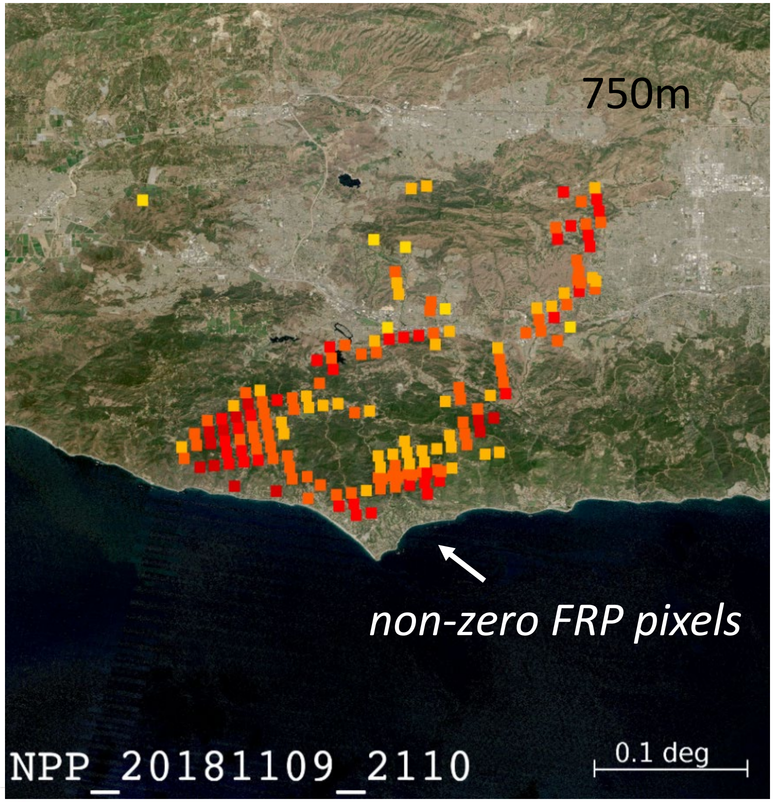
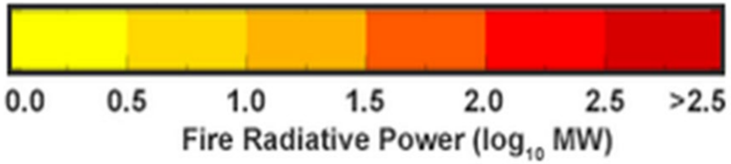
False detections from hot smoke plumes



Missing FRP retrievals from large fires







Some pixels have zero FRP due to lack of valid background pixels in FRP calculation

Increased background search window results in proper FRP in high confidence fire pixels

Evaluation of algorithm performance to specification requirements

- Findings/Issues from provisional review
  - No spurious scanlines – no evidence of spurious detections due to I4 calibration issues
  - Small percentage of missed detections due to I3 bad detector
  - Compatible detections counts and FRP retrievals between Suomi NPP and NOAA-20
  - False alarms from persistent anomalies
- Improvements
  - Persistent anomaly information included
  - I3 bad detector fix algorithm available, will be included in delivered I-band code
- Algorithm performance evaluation
  - Test data
    - Operational NDE product for M-band
    - STAR processing environment for I-band
  - Validation strategies / methods
    - Cross-comparison with Suomi NPP and M-band products
    - Relative performance against the experimental I/M band “hybrid product
      - Performance assessment using semi-independent, higher quality data
  - Limited validation results using in-situ data

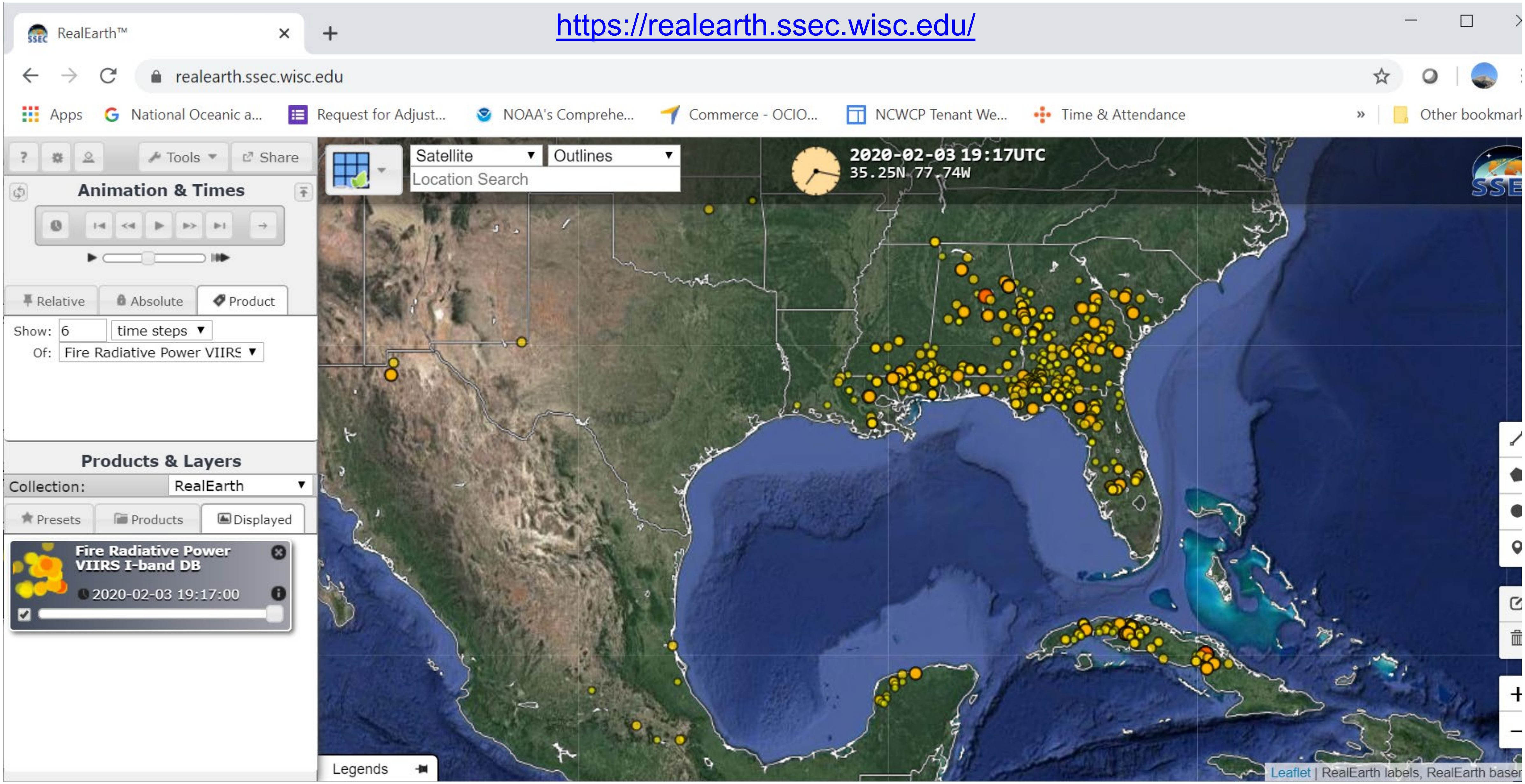
User Feedback

Name	Organization	Application	User Feedback - User readiness dates for ingest of data and bringing data to operations
Ravan Ahmadov	NOAA ESRL	High Resolution Rapid Refresh-Smoke	Prepared code to ingest persistent anomaly information in the operational M-band product. Also working on testing I-band input.
John Simko	OSPO SAB	Hazard Mapping System	375m I/M product is used in production and analysis.
Shobha Kondragunta	STAR	eIDEA, GBBEPx	Working on incorporating persistent anomaly information into operational GBBEPx. Analyzing product in pact on NCEP air quality monitoring and modeling systems.
Andy Edman	NWS	Fire weather	Increasing need for data with the onset of the fire season
HRRR group	NCEP	High Resolution Rapid Refresh-Smoke operational implementation	Working with ESRL, STAR and OSPO on operational implementation of HRRR-smoke in NCEP operations.

Feedback on the contribution of VIIRS fire data to FIREX-AQ

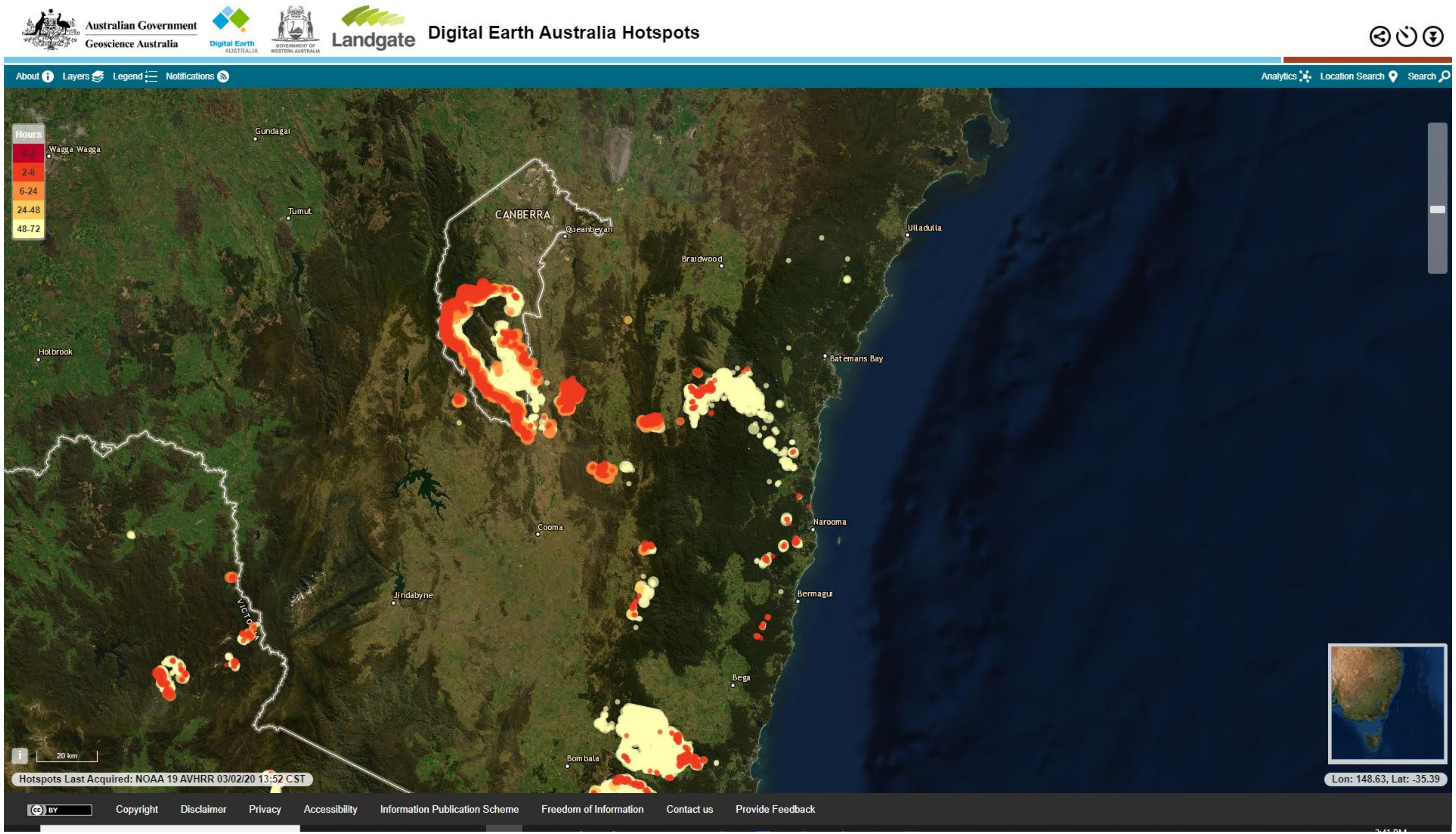
- Feedback provided by **Brad Pierce (SSEC)**
- “The **VIIRS I band fire product** was provided to the NASA/NOAA FIREX-AQ (https://www.esrl.noaa.gov/csd/projects/firex-aq/, https://espo.nasa.gov/firex-aq/content/FIREX-AQ) in real-time and incorporated into the NASA Airborne Science Mission Tools Suite (MTS, https://mts.nasa.gov/) where it **was used on a daily basis for flight planning operations during both the Western (Boise, ID) and Southeastern (Salina, KS) phases of the FIREX-AQ campaign.** The high resolution VIIRS I band fire product was used in conjunction with coarser spatial resolution, but higher temporal resolution fire detection from the ABI instruments on GOES-16 and GOES-17 and provided validated fire detection that was used to confirm the ABI detection, which would occasionally report false detection or miss fires that were detected by VIIRS. **The ability to utilize the VIIRS I Band active fire product in real-time was particularly critical during the SouthEastern phase of the campaign where the objectives focused on sampling agricultural fires.** Due to the short duration and small scale of these fires, model guidance was not available for flight planning activities and the **FIREX-AQ mission management had to rely on the real-time ABI and VIIRS fire detection to vector the NASA DC8 aircraft towards fire activity as the aircraft was deployed.**
- The **VIIRS JPSS and SNPP Active Fire products** provided during FIREX-AQ are now archived at NASA Langley Research Center as part of mission data record (https://www-air.larc.nasa.gov/cgi-bin/ArcView/firexaq) and **are available for use by the FIREX-AQ Science Team for post mission analysis**. This data will be made publicly available in the near future.(…)”
- Feedback from **Amber Soja (NASA Langley Research Center, National Institute of Aerospace)**
- Both during the Boise (western wildfire) and Salina (central/southeastern) portions of the campaign, the **science team relied heavily on VIIRS I-band active fire data**. When viewed at ~ the same time, the 375-m data captured a substantially larger number of fire and detections (*than GOES-R ABI*) (…) While in Boise, **VIIRS data were critical to both fight planning a to guiding the flights to the most active fires.**

VIIRS I-band data from Direct Broadcast in RealEarth™



VIIRS Active Fire Data to monitor fires in Australia

- we supported Charter Activation 613 in November by providing I-band data from our experimental STAR production.
- coordinated by William Straka (SSEC) and the JPSS Fire and Smoke Proving Ground Initiative.
- it was confirmed that Geoscience Australia had direct broadcast capabilities and thus our data feed was no longer needed.
- CSPP includes our NOAA versions of the VIIRS algorithms (750m M-band and 375m I-band).



https://hotspots.dea.ga.gov.au/

Downstream Product Feedback

Algorithm	Product	Downstream Product Feedback - Reports from downstream product teams on the dependencies and impacts
GBBEPx	Blended Global Biomass Burning Emissions Product	VIIRS M-band product is an input. GBBPEx has been recently modified to read persistent anomaly flag. Working with NCEP and ARL on product evaluation.

Risks, Actions, and Mitigations

Identified Risk	Description	Impact	Action/Mitigation and Schedule
Dependence on Risk Reduction package for granulated land-water mask (LWM)	The operational code currently reads LWM from Framework.	Dependence of Framework output in operations; CSPP LWM in CSPP.	Implement stand-alone pre-processor in operational package.
VIIRS I-band implementation in NDE is preferred to occur by the start of the 2020 North America fire season	It is desirable to implement the I-band product in operations to better support resource management. Transition also needs coordination with downstream users.	Key operational users may not have access to best information for situational awareness	Provide I-band data through STAR internal production to select users

Documentation

Science Maturity Check List	Yes ? (M/I)
ReadMe for Data Product Users	Yes / In preparation
Algorithm Theoretical Basis Document (ATBD)	Yes / In preparation
Algorithm Calibration/Validation Plan	Yes
(External/Internal) Users Manual	Yes / In preparation
System Maintenance Manual (for ESPC products)	Yes / In preparation
Peer Reviewed Publications (Demonstrates algorithm is independently reviewed)	Yes (Suomi NPP) / Yes (Suomi NPP)
Regular Validation Reports (at least annually) (Demonstrates long-term performance of the algorithm)	JPSS Annual Meeting presentations

Check List - Validated Maturity

Validated Maturity End State	Assessment
Product performance has been demonstrated over a large and wide range of representative conditions (i.e., global, seasonal).	Yes. A full calendar year of data (2019) were processed and analyzed. Seasonal Suomi NPP vs. NOAA-20 comparisons were presented.
Comprehensive documentation of product performance exists that includes all known product anomalies and their recommended remediation strategies for a full range of retrieval conditions and severity level.	The 750m algorithm is based on the MODIS heritage algorithm, which has extensively been validated and documented. The performance of the I-band algorithm has been documented in a peer-reviewed paper.
Product analyses are sufficient for full qualitative and quantitative determination of product fitness-for-purpose.	Validation is compatible with well-established MODIS products.
Product is ready for operational use based on documented validation findings and user feedback.	M-band is operational. I-band is ready for operations. The same I-band algorithm has been produced and distributed systematically by NASA.
Product validation, quality assurance, and algorithm stewardship continue through the lifetime of the instrument	Product LTM, OSPO quality monitoring and science team maintenance and sustainment activities continue.

Requirement Check List – Active Fires

JERD	Requirement	L1RDS-273 Objective	Performance
JERD-2406	The algorithm shall produce an Active Fires product with a horizontal cell size of 0.80 km at nadir.	Horizontal Cell Size: 0.25 km at nadir	M-band: 750m at nadir I-band: 375m at nadir
JERD-2407	The algorithm shall produce an Active Fires product with a horizontal reporting interval of 0.80 km at nadir.		M-band: 750m at nadir I-band: 375m at nadir
JERD-2408	The algorithm shall produce an Active Fires product globally (Note 2).	Horizontal Coverage: Global	Global coverage for both M-band and I-band
JERD-2409	The algorithm shall produce an Active Fires product with a mapping uncertainty, 3 sigma, of 1.5 km.	Mapping Uncertainty: 0.75 km	Driven by VIIRS SDR performance
JERD-2410	The algorithm shall produce an Active Fires Radiative Power product with a measurement range of 1.0 MW to 5.0 $(10)^3$ MW (Note 3).	Measurement Range: 1.0 MW to $1.0(10)^4$ MW	Exceed performance due to higher true M13 saturation level
JERD-2411	The algorithm shall produce an Active Fires Radiative Power product with a measurement uncertainty of 50%.	Measurement Uncertainty (FRP): 20%	Insufficient independent reference data to establish exact measurement uncertainty. Suomi NPP vs. NOAA-20 comparison suggests good consistency

Notes:

2. The requirement of global coverage is based on user community stated intentions to extend Active Fires product capabilities to non-land based targets (e.g., offshore gas flares).
3. The high end of the FRP Measurement Range threshold requirement (5000 MW) is based on current design capabilities (i.e., the present 634 K saturation specification for the M13 Band on VIIRS) and the recommendation of the NOAA-NASA Land Science Team.

Conclusion

- Cal/Val results summary
  - Team recommends algorithm validated maturity
  - Proposed effectivity date for M-band: December 5, 2019
    - Date of implementation of r1v2 (persistent anomaly flags)
  - Proposed effectivity date for I-band: TBD
- Address pre-launch concerns/waivers
  - No impacts to report
- Caveats
  - validation against independent reference data remains problematic
  - spatial heterogeneity window size for large fires
    - no FRP if not enough valid background pixels are found
  - false detections from hot smoke plumes
  - I3 missing detector fix to be incorporated into delivered I-band product

Path Forward

- Lessons learned for NOAA-20 Cal Val
  - a critical component of cal/val is explicit user feedback that may lead to product and algorithm improvements
    - user feedback was critical to implement persistent anomaly flag
    - Other issues (e.g. FRP in Canada) are being investigated
- Planned improvements
  - stand-alone land-water mask
    - expected impact on product performance is marginal, but is important for code portability
  - relax thresholds for spatial heterogeneity test
    - will improve per fire FRP estimates
  - reduce false alarms from hot smoke plumes
  - improve FRP retrieval through atmospheric correction
- Future Cal/Val activities / milestones
  - Operational transition of I-band product during 2020
  - Need to coordinate with NOAA and external users