VIIRS, GOES-R and Landsat-class Active Fire Product Status

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VIIRS Fire Product Status

750m Data Set (S-NPP)

- Reprocessed Level 2 data (2012-present) @ NASA/LandSIPS
  - **Algorithm version**: MODIS Collection 6 equivalent
  - **Input data**: Original Science Data Record (SDR) 6-min granules
  - **Output**: NetCDF format (HDF5 compatible) 6-min granules
  - **Caveat**: corrupted SDR granules impacting output fire data (list available online)
  - **Availability**: Data archived at LPDAAC and LAADS
  - **Documentation**: ATBD and user's guide available online
- Level 2 forward data processing @ NASA/LandSIPS and NOAA/NDE
  - **Algorithm version**: MODIS Collection 6 equivalent
  - **Input data**: NASA and NOAA running unique SDR versions
  - **Output data**: NetCDF of unique filename convention/granule size. **Caveat**: Small differences between NASA and NOAA-sourced files may occur due to unique input data
  - **Availability**: NASA data -> LPDAAC and LAADS, NOAA data -> CLASS (near-real time)
- Level 3 data available @ NASA/LandSIPS
- Direct Readout
  - Available through IPOPP & CSPP

Operational NOAA-20 forward data processing at NOAA/NDE

VIIRS Fire Product Status

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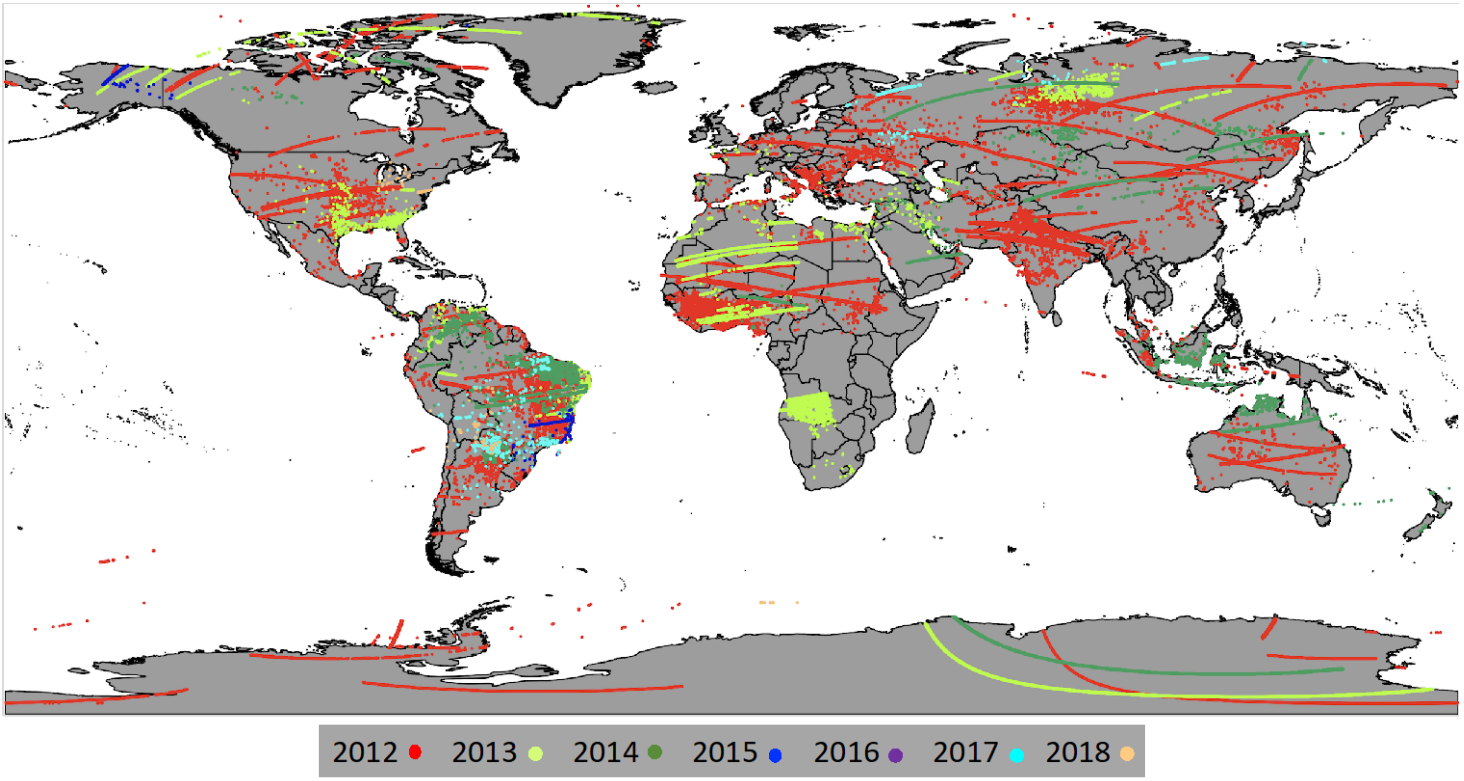
  - **Algorithm version**: Hybrid I-M band algorithm
  - **Input data**: Original Science Data Record (SDR) 6-min granules
  - **Output data**: NetCDF format (HDF5 compatible) 6-min granules
  - **Caveat**: few outstanding bad SDR data still observed
  - **Availability**: NASA LAADS ftp; near real time data at LANCE/FIRMS
- Direct Readout
  - IPOPP running slightly deprecated version of algorithm

Operational NOAA-20 forward data processing at NOAA/HMS

Data Artifacts - S-NPP/VIIRS 375m Fire Data

Data calibration errors have decreased significantly although not entirely eliminated.
Bad data propagates downstream impacting Level 2 products such as fire detection



Granules containing spurious fires:

2012: 77
2013: 15
2014: 15
2015: 2
2016: 1
2017: 6
2018: 4
Total: 120

Granules containing corrupted data:

2012: 290
2013: 65
2014: 101
2015: 7
2016: 1
Total: 464

Data Artifacts - S-NPP/VIIRS 750m Fire Data

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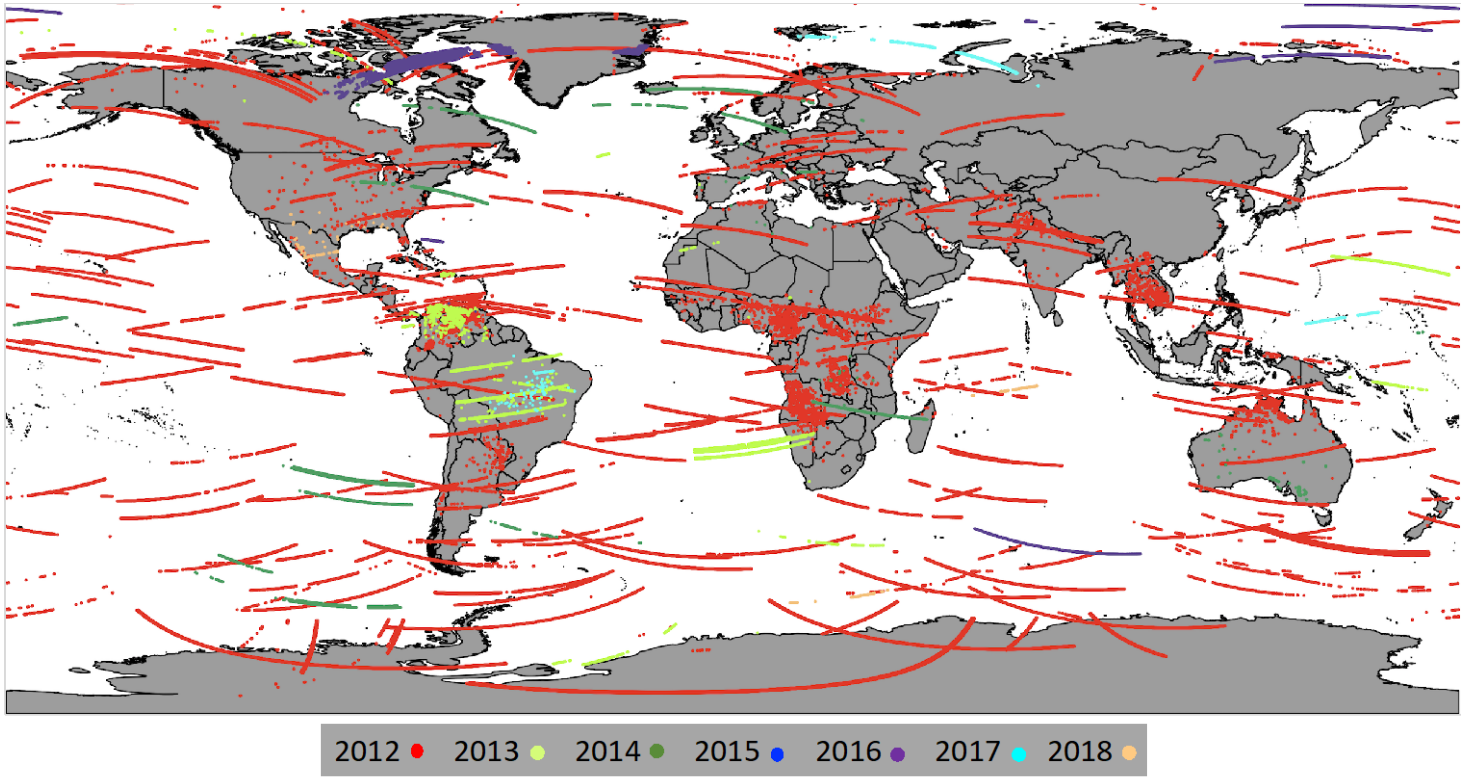
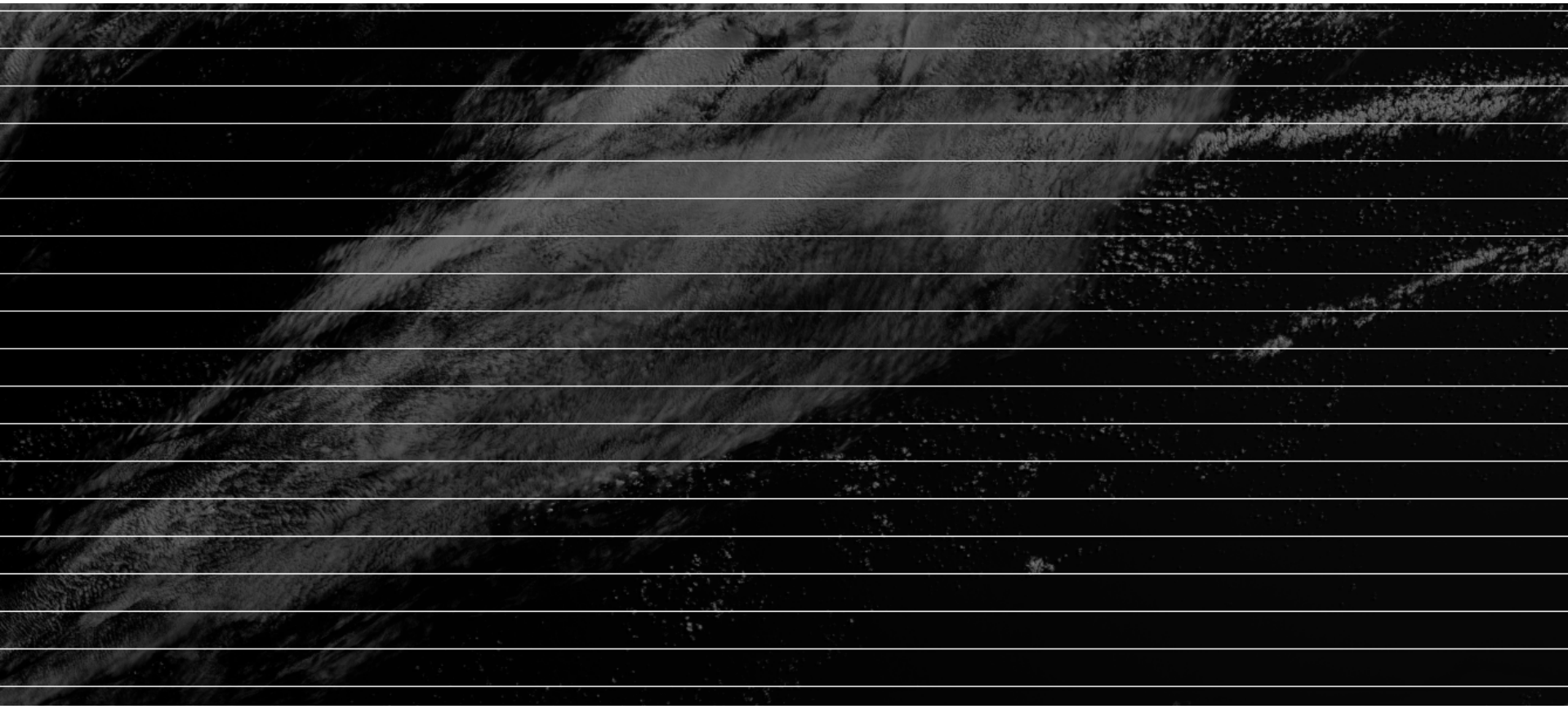


Granules containing spurious fires:

2012: 159	2016: 4
2013: 21	2017: 3
2014: 11	2018: 4
2015: 0	**Total: 202**

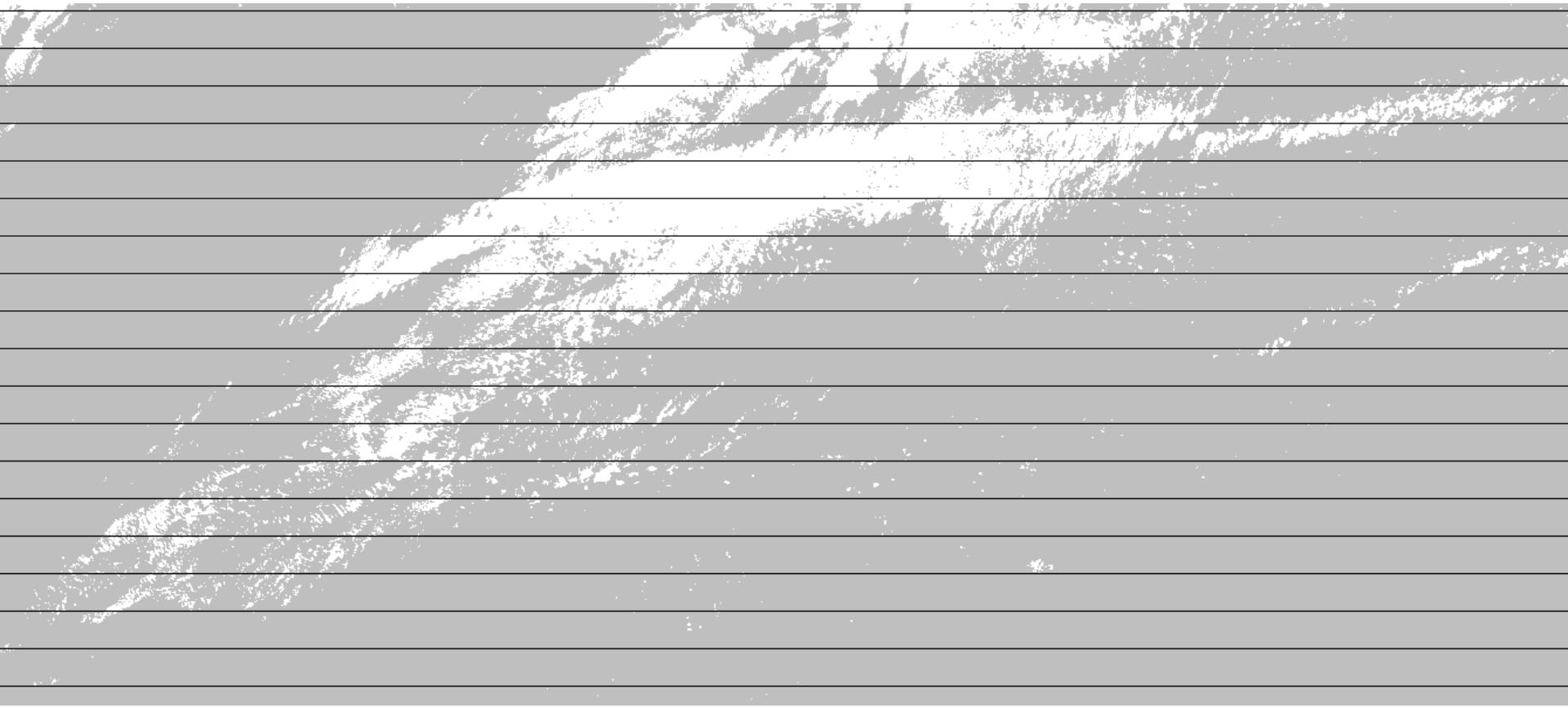
Data Artifacts - NOAA-20/VIIRS

Channel I3 (1.6um) - Dead detector #29 (out of 32)



Radiance -> 65531 = fill value

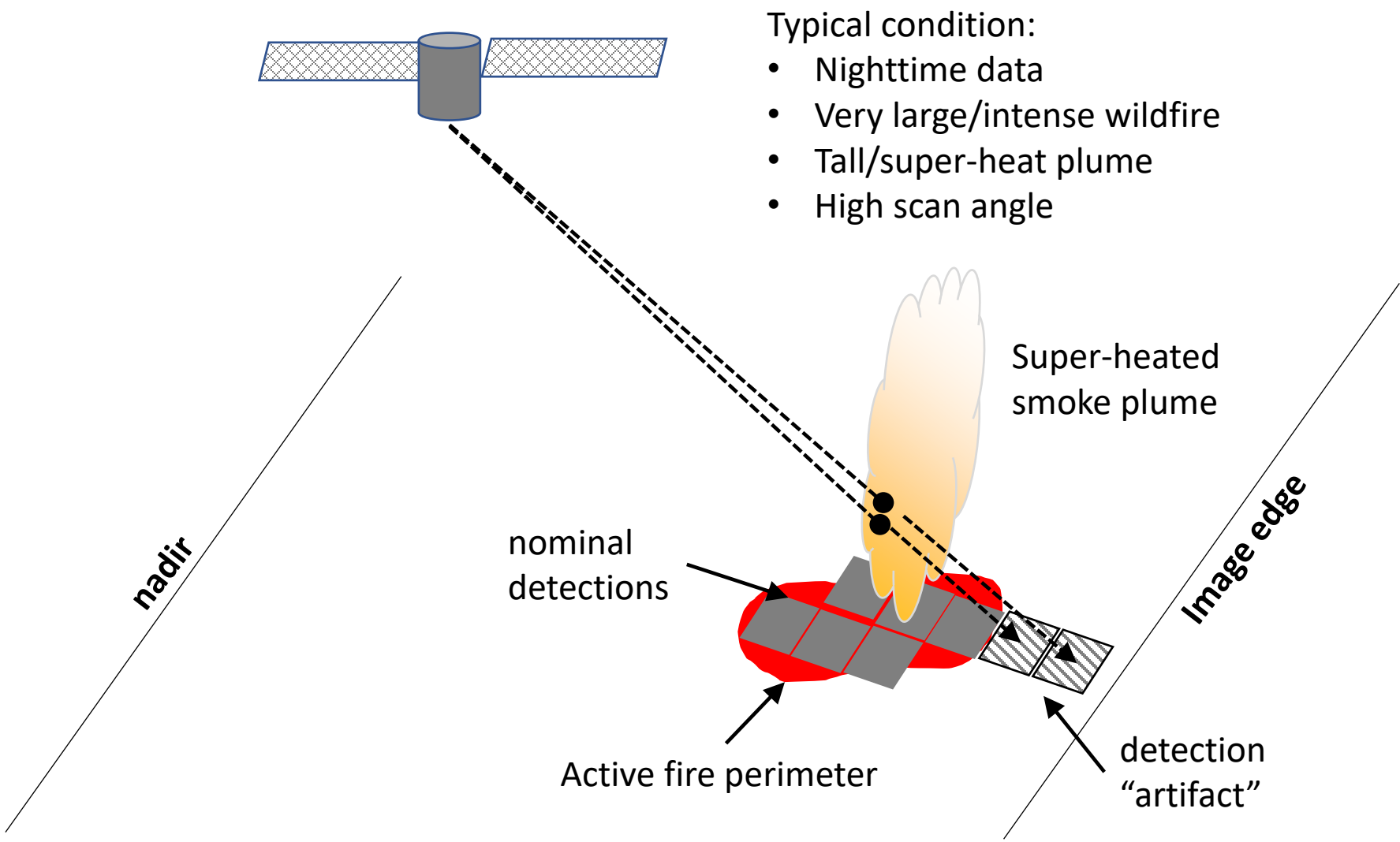
Data Artifacts - NOAA-20/VIIRS Fire Data



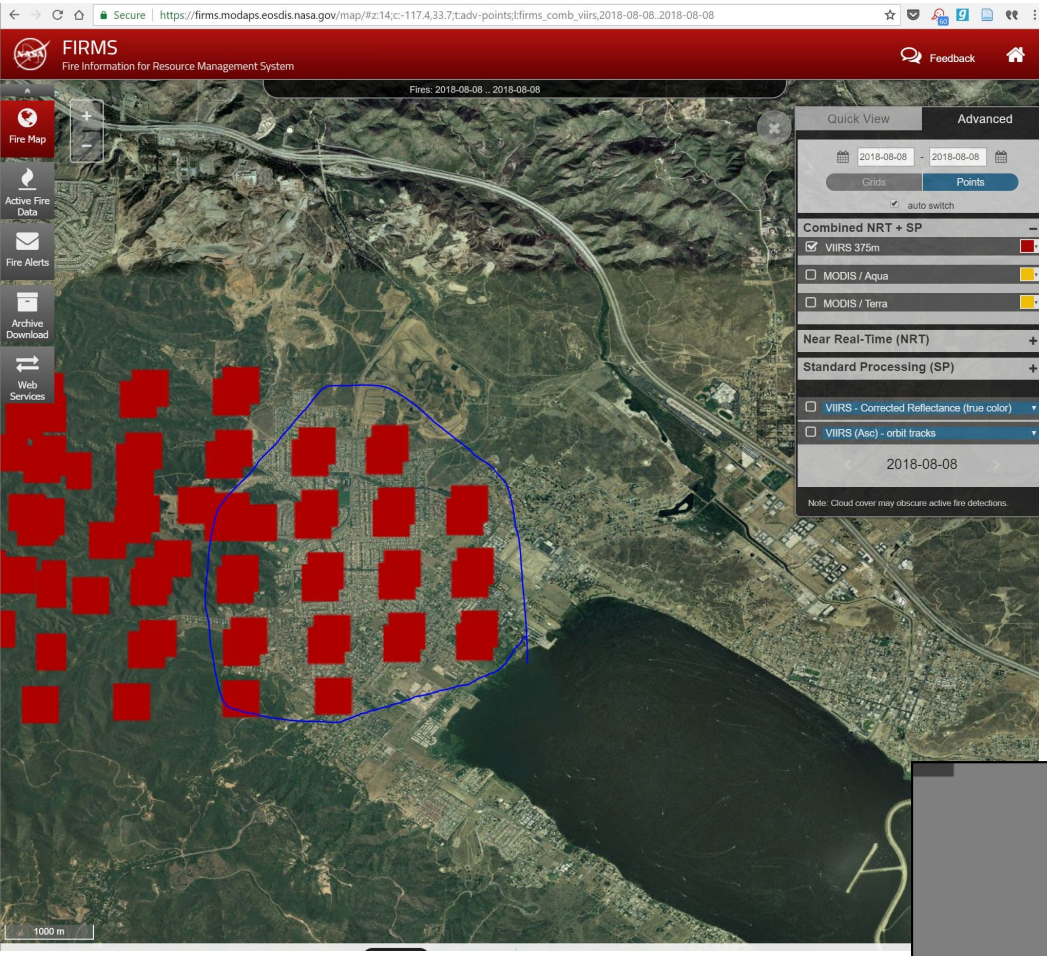
Daytime Fire Mask -> 0 = missing data

Will implement gap-filling correction to channel I3

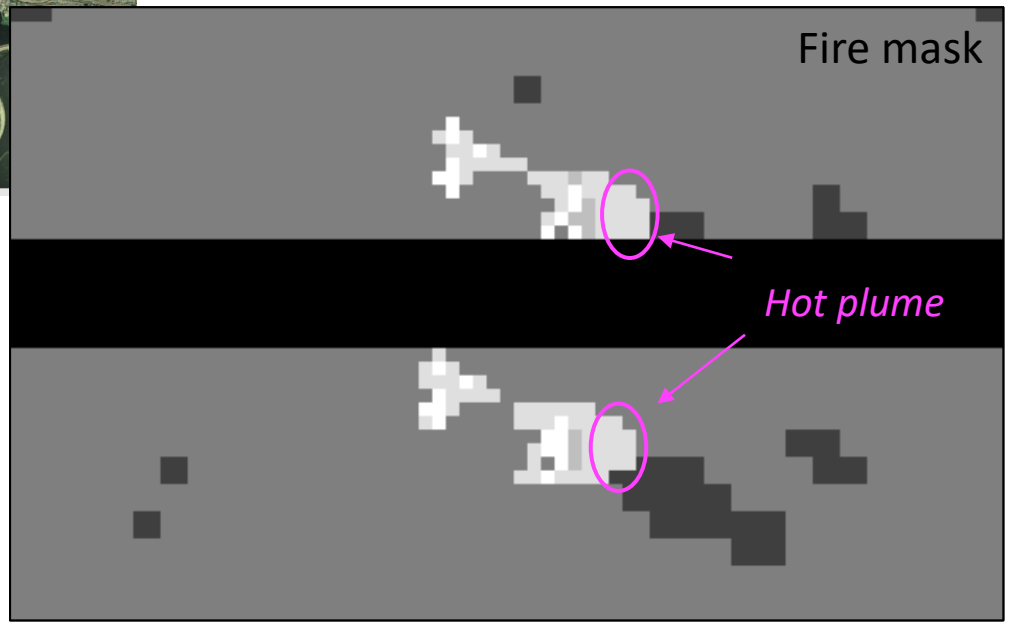
Data "Artifact" Associated with Large Wildfires



Delta Fire/CA 05 Sep 2018
Plume reaching 40,000ft
Including a "heavier" core extending to +15,000ft
Core's ground projection @55º approx. 4km

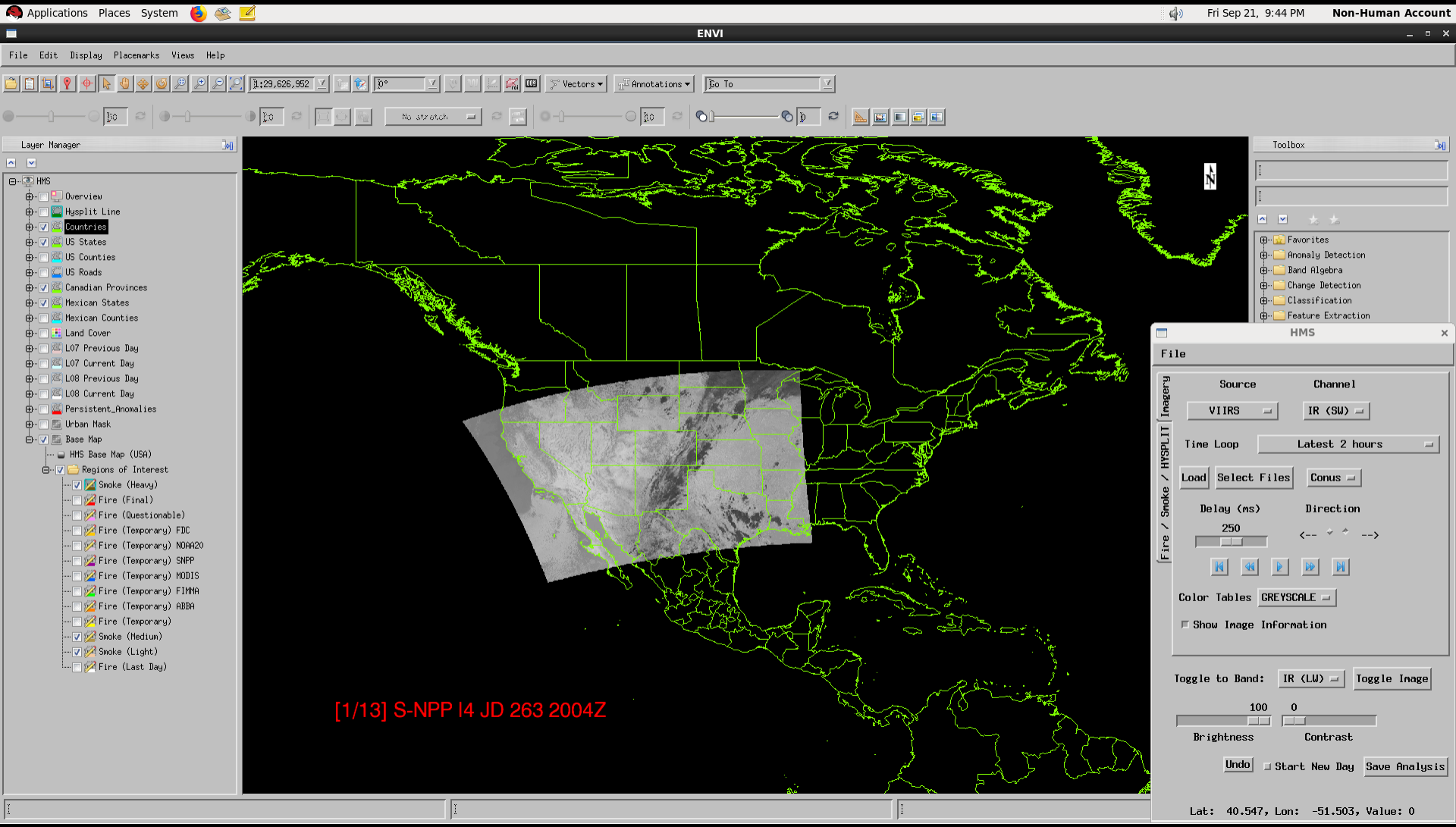


Holy Fire/CA 08 Aug 2018
Fire perimeter exacerbated due to plume detection
S-NPP/VIIRS scan angle: 55º



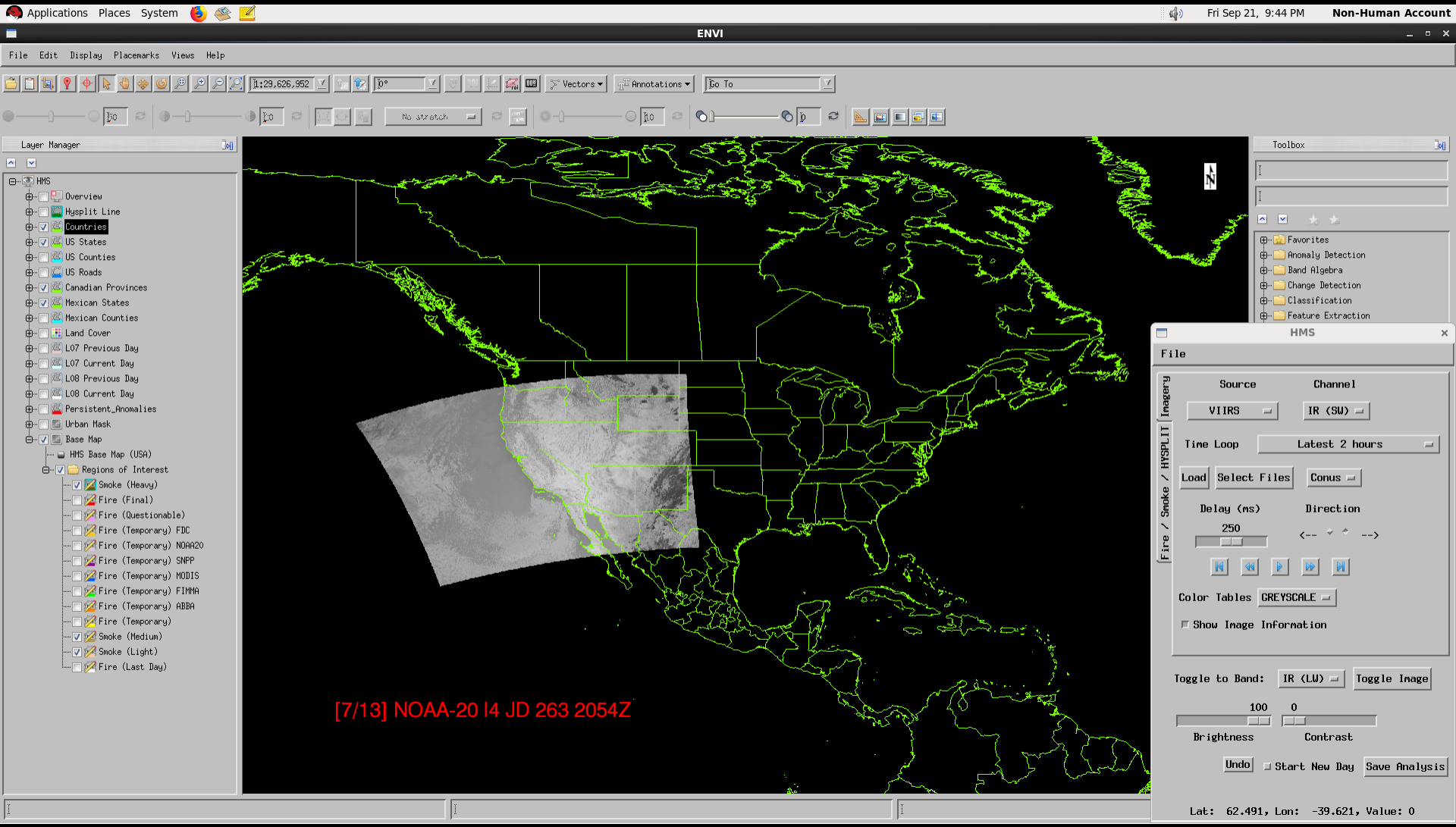
Edge of plume detection showing
$BT_{MIR} >$ ***330K***
$BT_{TIR} >$ ***287K***
$Ref_{VNIR} <$ ***25%***

Orbital Configuration



NOAA-20 trails 50min behind S-NPP
Phased by 180º

Orbital Configuration



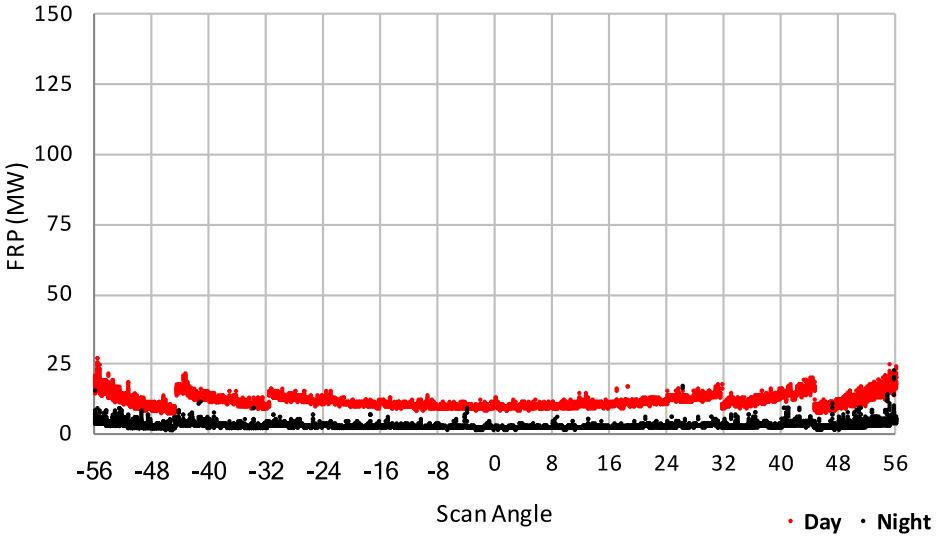
NOAA-20 trails 50min behind S-NPP
Phased by 180º

Data Continuity

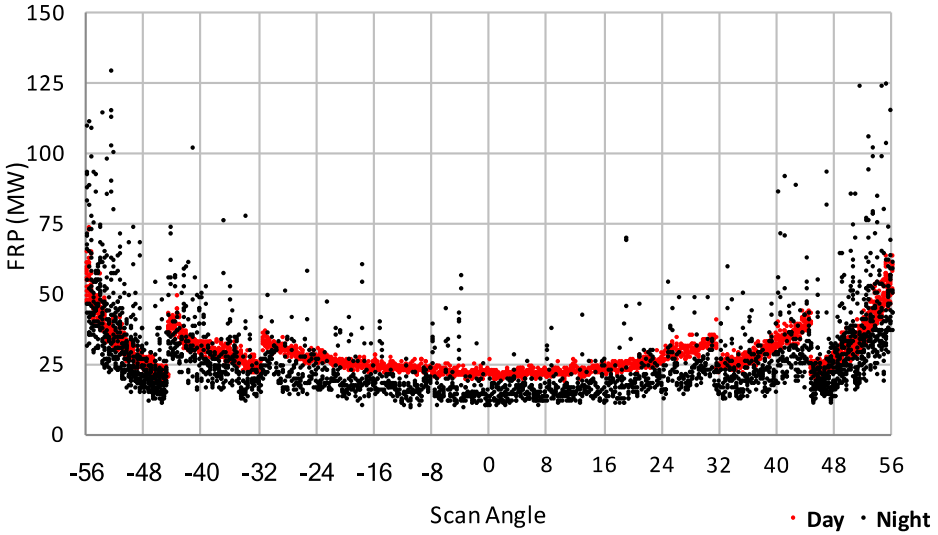
MODIS and VIIRS 750m products underperforming at night

VIIRS 375m with room for improvement using both day/night data

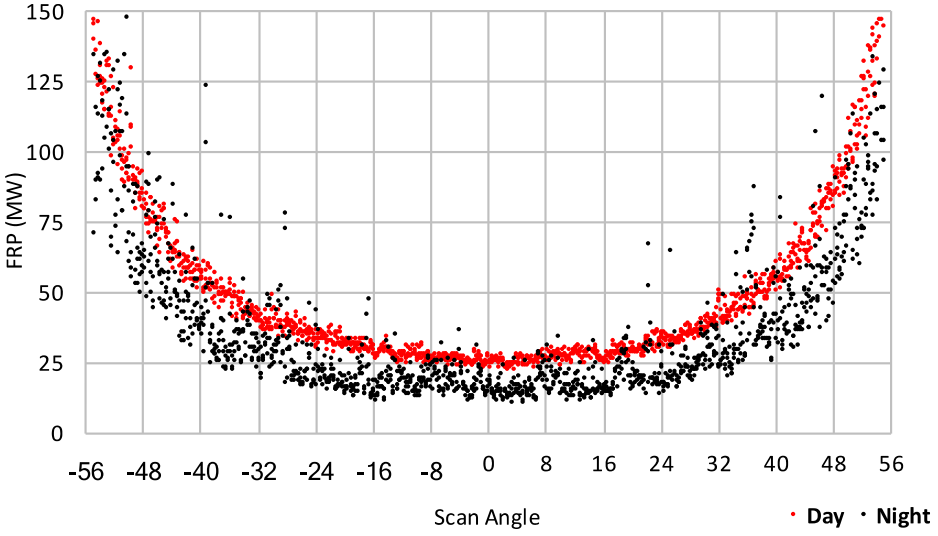
S-NPP/VIIRS 375m Mean FRP



S-NPP/VIIRS 750m Mean FRP

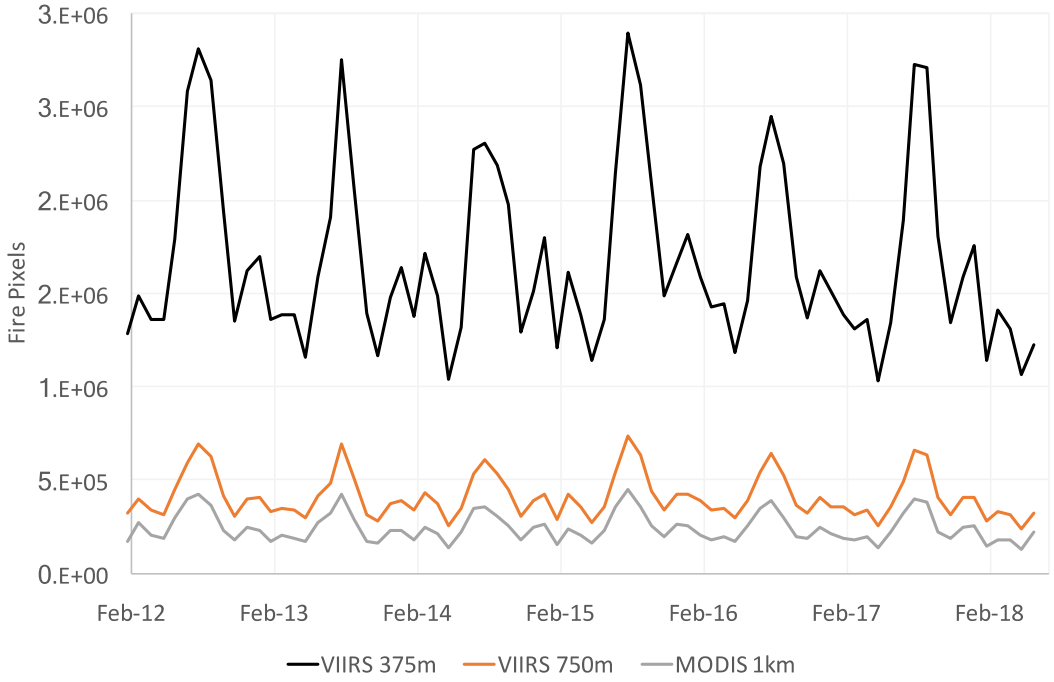


Aqua/MODIS 1km Mean FRP

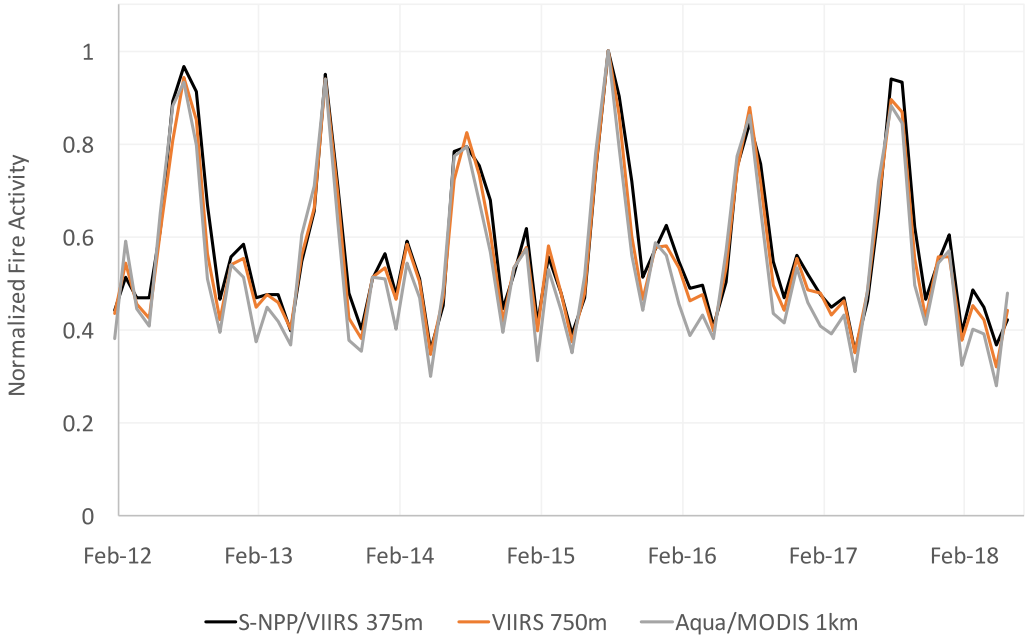


Data Continuity

5-year absolute fire pixel count



5-year normalized fire pixel count



VIIRS Algorithm Refinement Plan

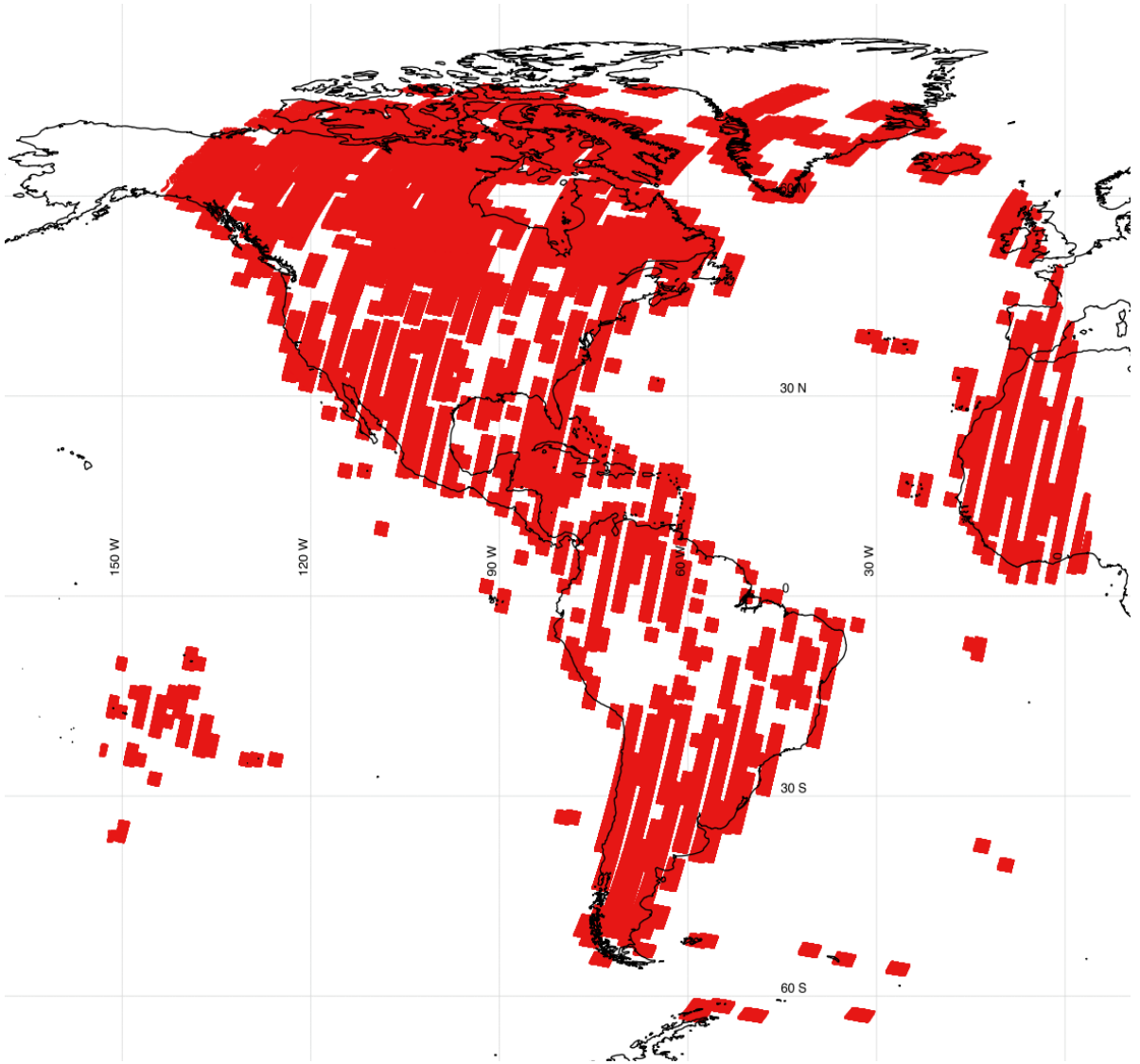
- Incorporate atmospherically corrected FRP retrievals
- Incorporate urban mask, apply more/less stringent detection tests accordingly
- Consider combined S-NPP + NOAA-20 higher level product where detection confidence is partially determined based on view angle
- Refine 375m product; maintain/phase out 750m product

GOES-16/ABI Fire Product Provisional Status

Landsat-8 Reference Data Acquired During 26th Jan – 26th Feb 2018 Matching ABI Fire Data to within 5-min

CONUS and Full Disk scan sectors

Used all (+2,000) available Landsat-8/OLI data meeting spatial/temporal matching criteria

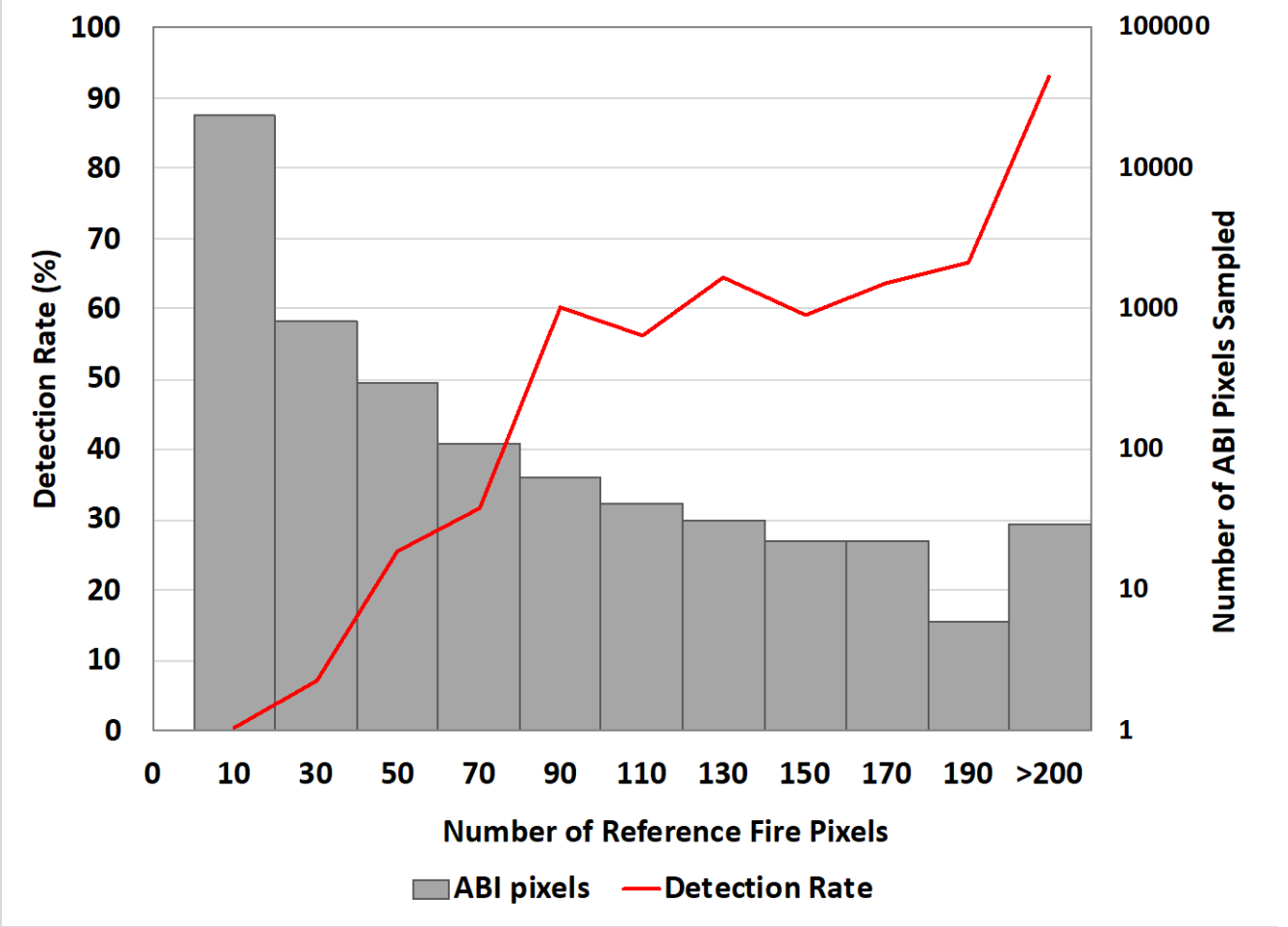


GOES-16/ABI Fire Detection Rate

1 reference fire pixel = 30x30m Landsat-8 active fire pixel

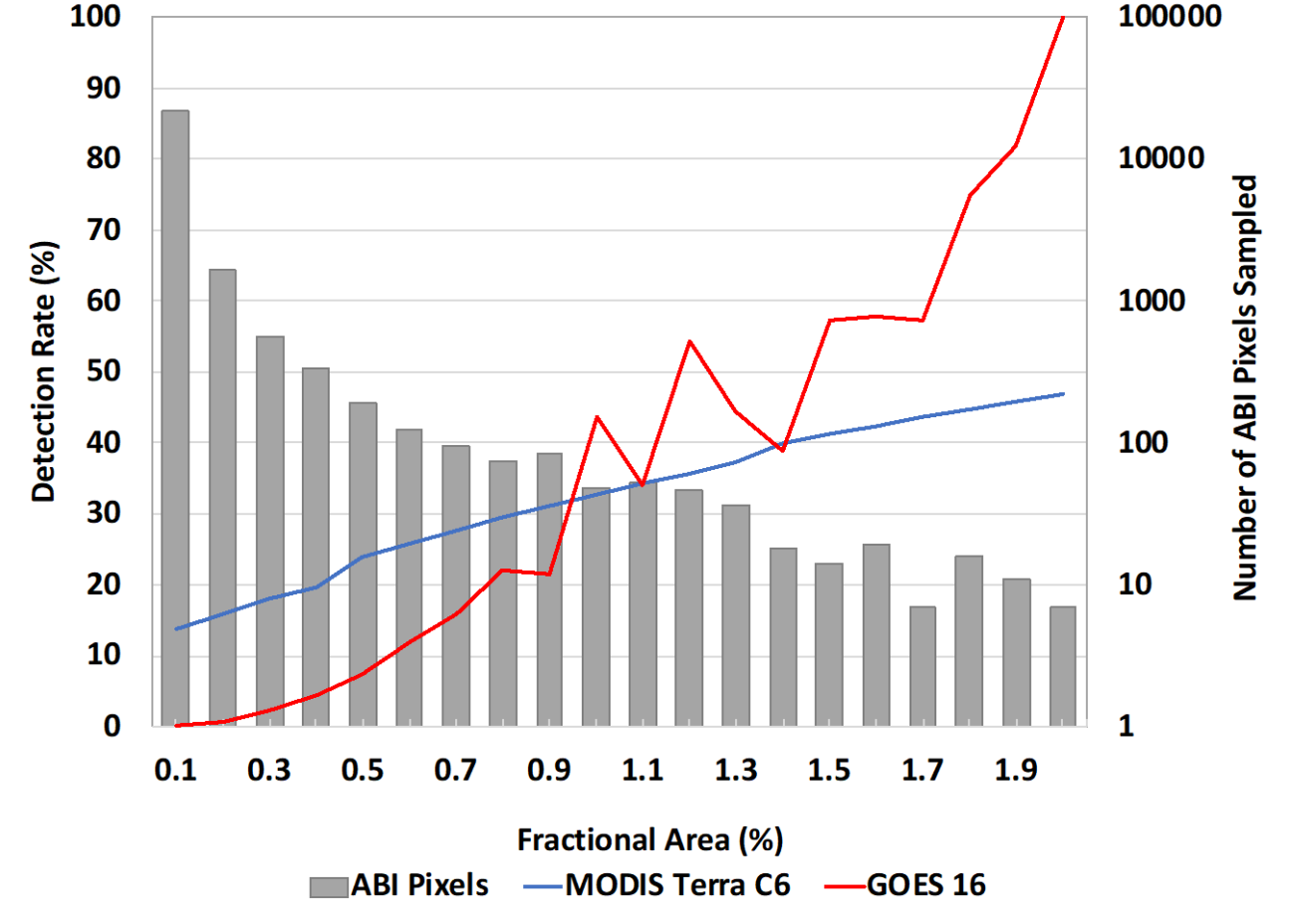
Plot combines ABI pixels of different sizes

375 true positives



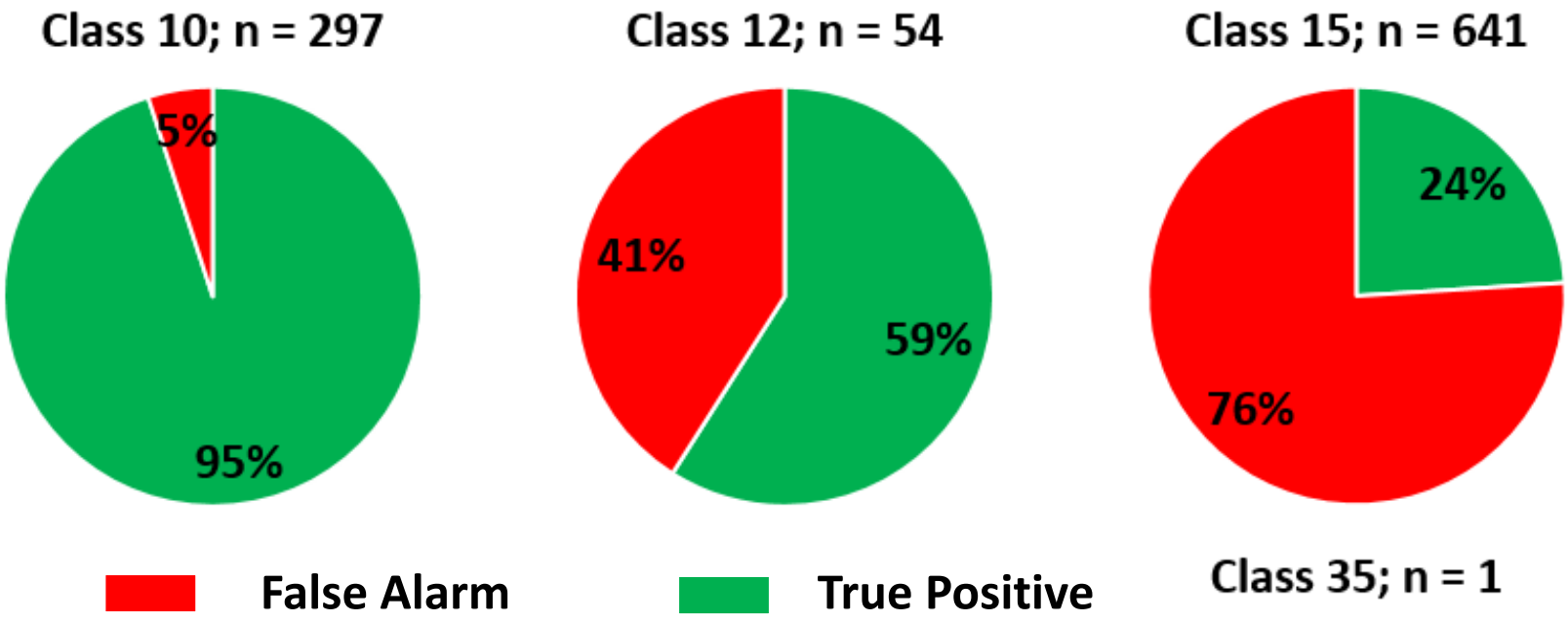
GOES-16/ABI Fire Detection Rate
Relative Fractional Area

Assumed constant 30mx30m reference fire pixel area for calculation



GOES-16/ABI Commission Error

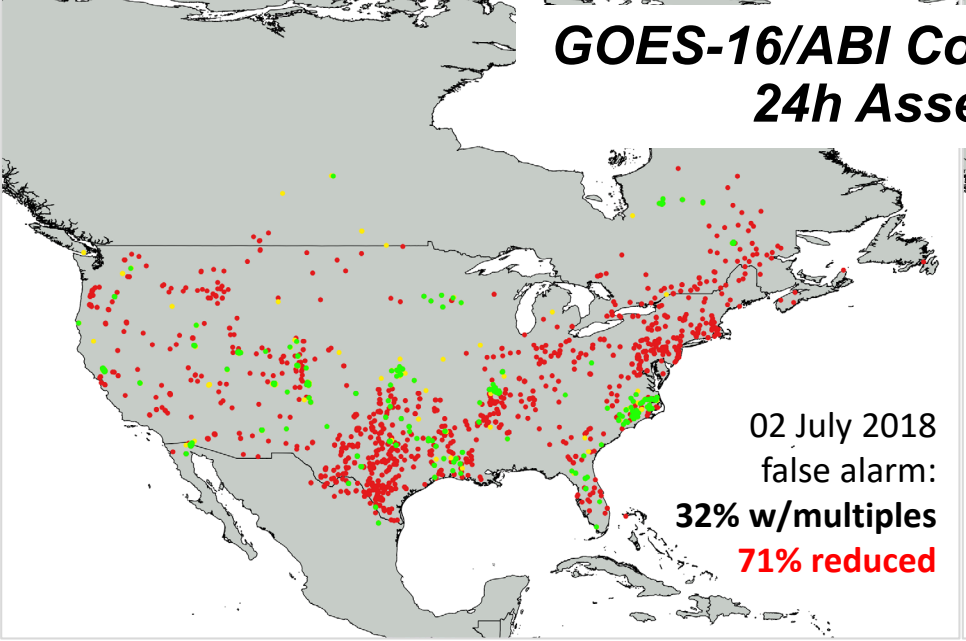
@10:30am (Landsat-overpass)

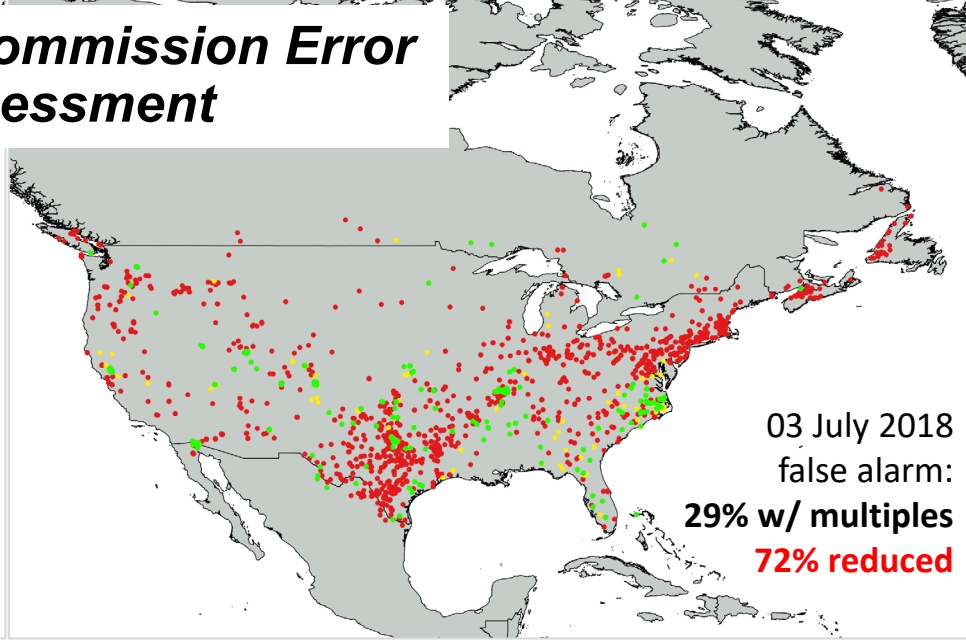


Missing 8 fire pixel classes at time of analysis:

10 (30) – processed
11 (31) – saturated
12 (32) – cloud-contaminated
13 (33) – high probability
14 (34)– medium probability
15 (35) – low probability

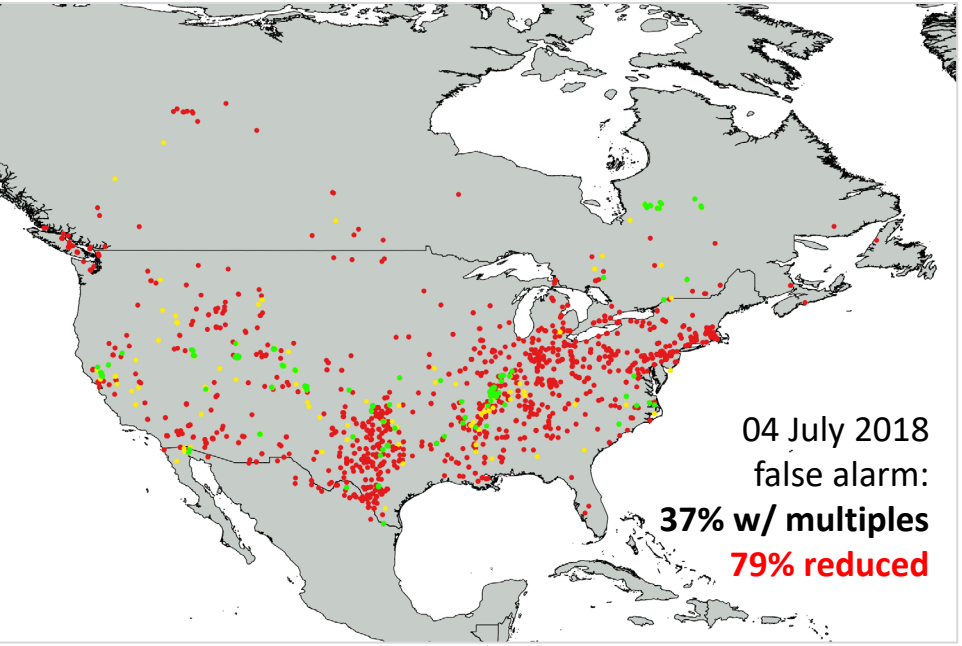
GOES-16/ABI Commission Error 24h Assessment

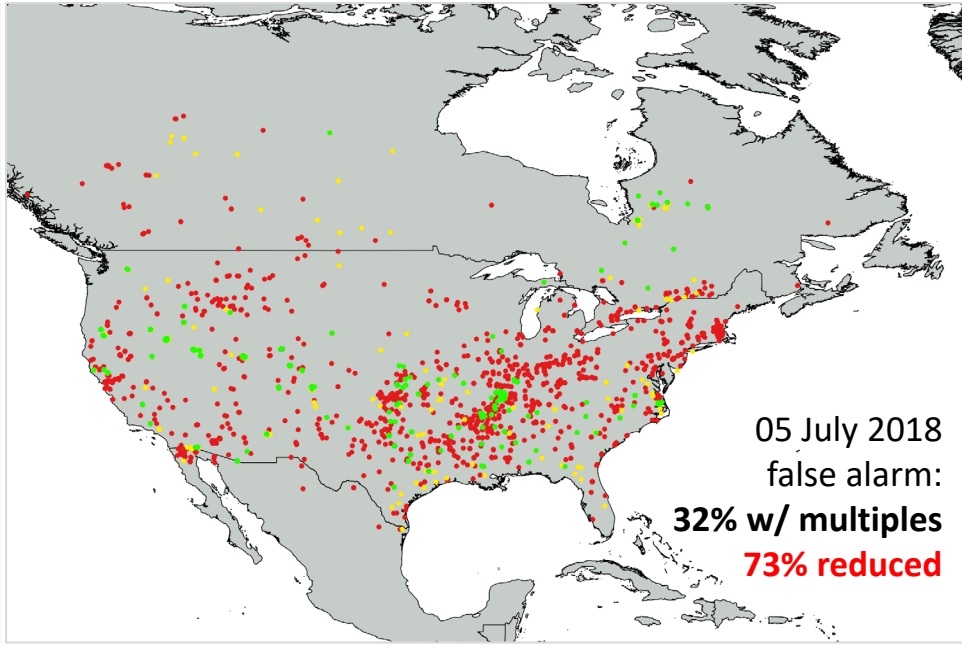




Red : FDC class 10 false alarm
Green: FDC class 10 with confirmed HMS fire
Yellow: HMS fire without FDC class 10 detection

Fire pixel **multiples** are hidden underneath reduced data shown in **red**

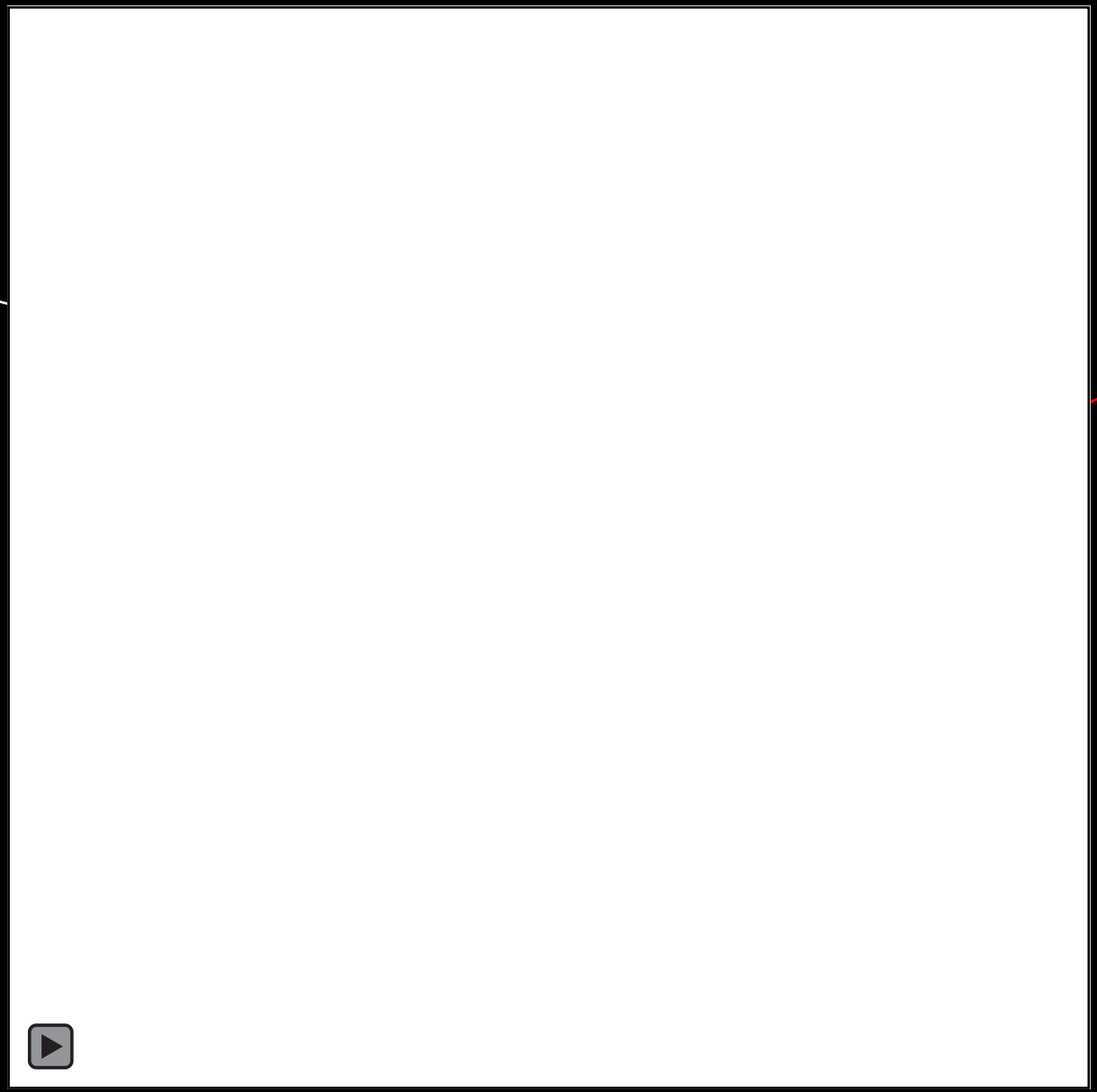




Known Issues Reflected During Provisional Data Review

- Missing fire classes
- Liberal cloud mask
- Spillage into adjacent grid cells
- High false alarm rates:
  - Croplands
  - Urban
  - Bare ground
- High viewing angle omissions

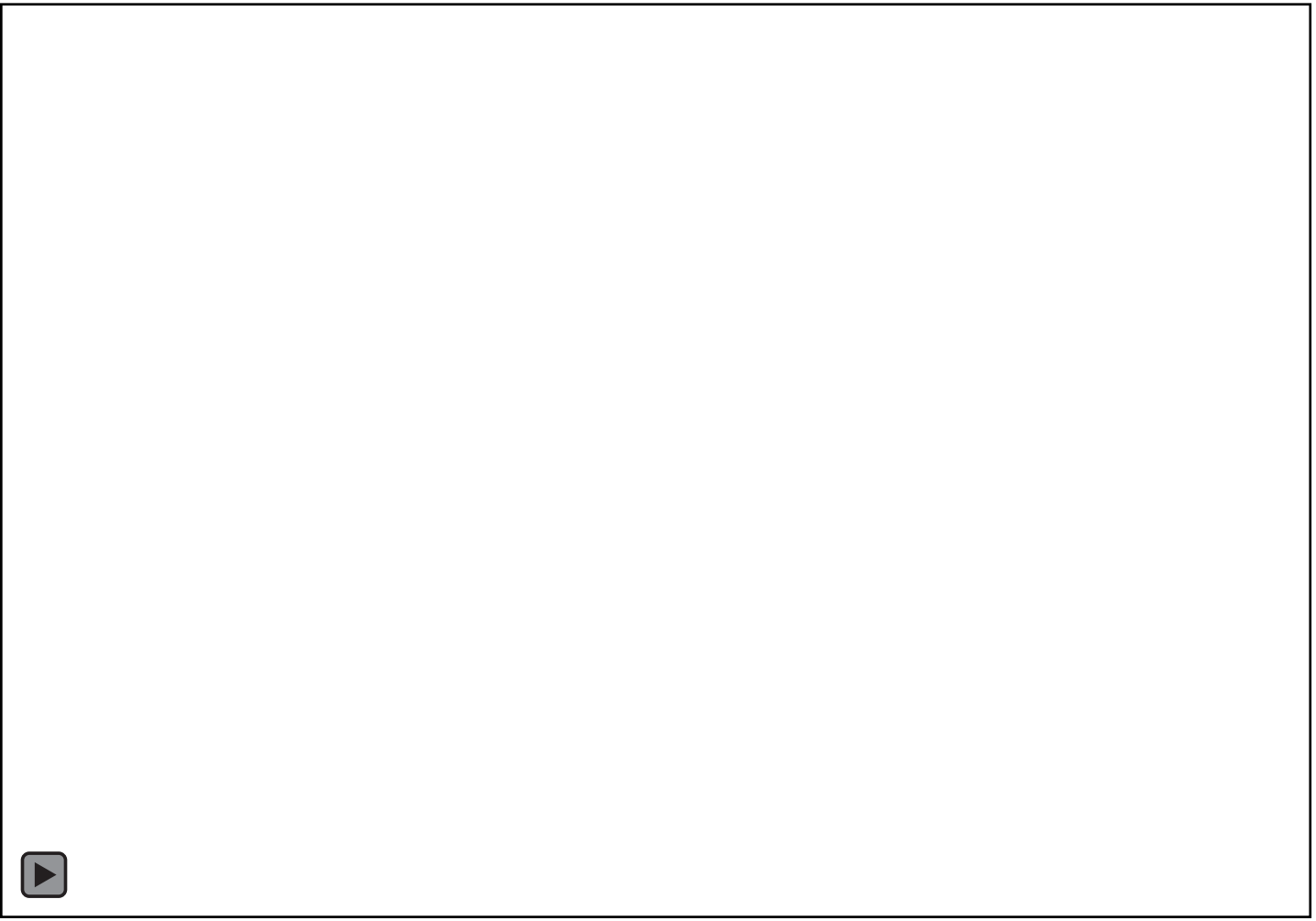
Known Issues



Full Disk FDC Mask
24h Sample

ABI Data Remapping Artifacts

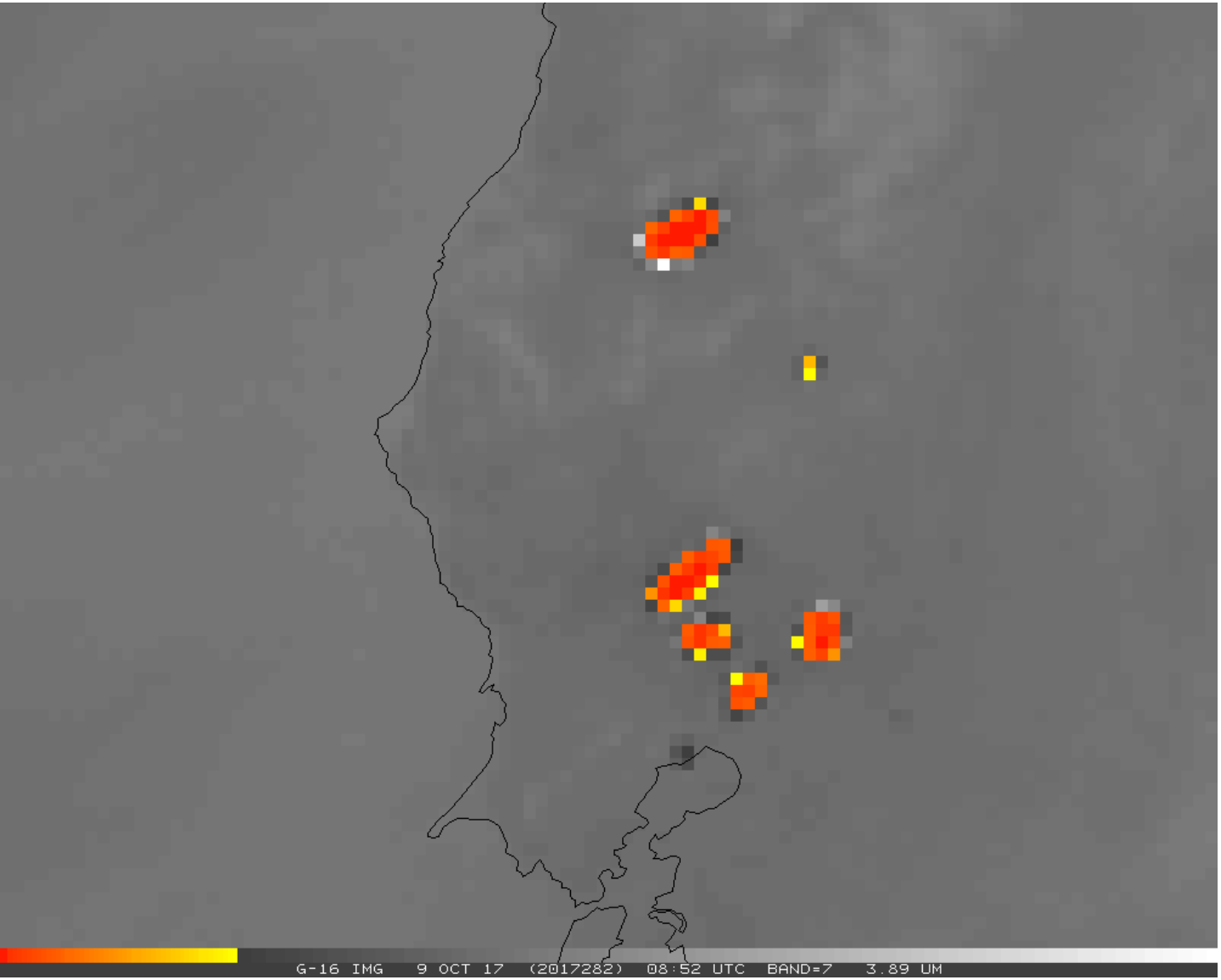
Oklahoma, 6 March 2018, 16:30-16:59 MESO1 scan



Fire signal smearing affecting 3-4 pixels

Credit: Chris Schmidt

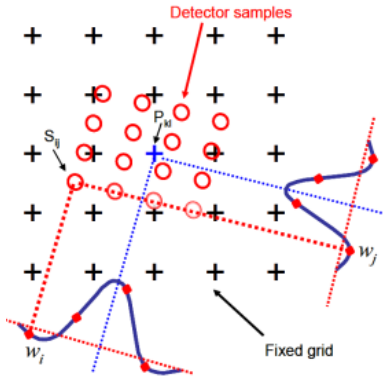
ABI Data Remapping Artifacts



Channel 7 (3.9µm) CONUS image on 09 Oct 2017, 08:52 UTC, over fires in northern California.

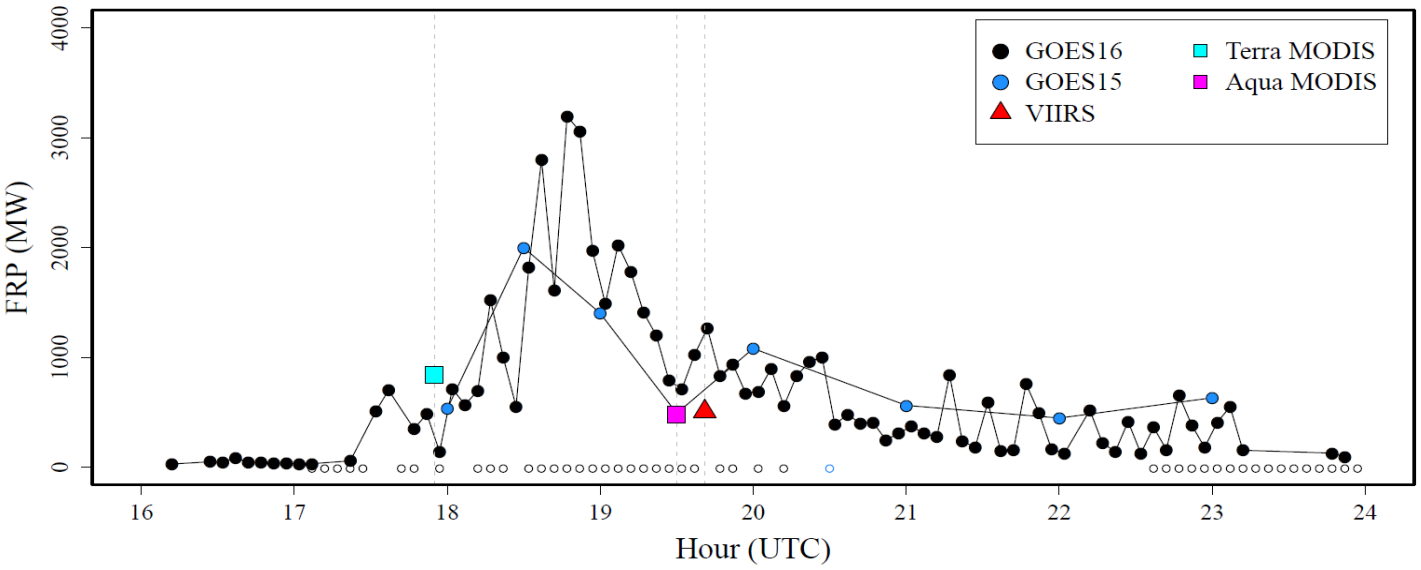
Color scale displayed between 400K (red) and 200K (white). Cold bias noticed around fire pixels

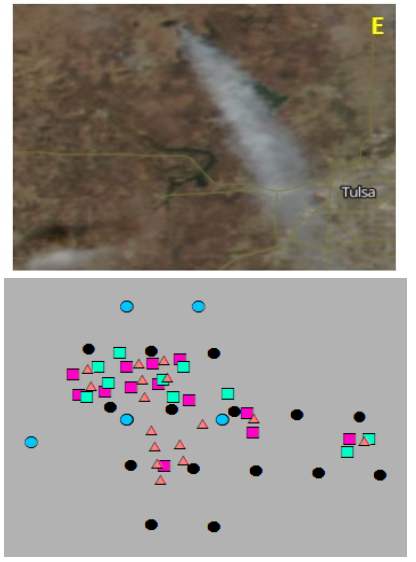
Data saturation/folding also present

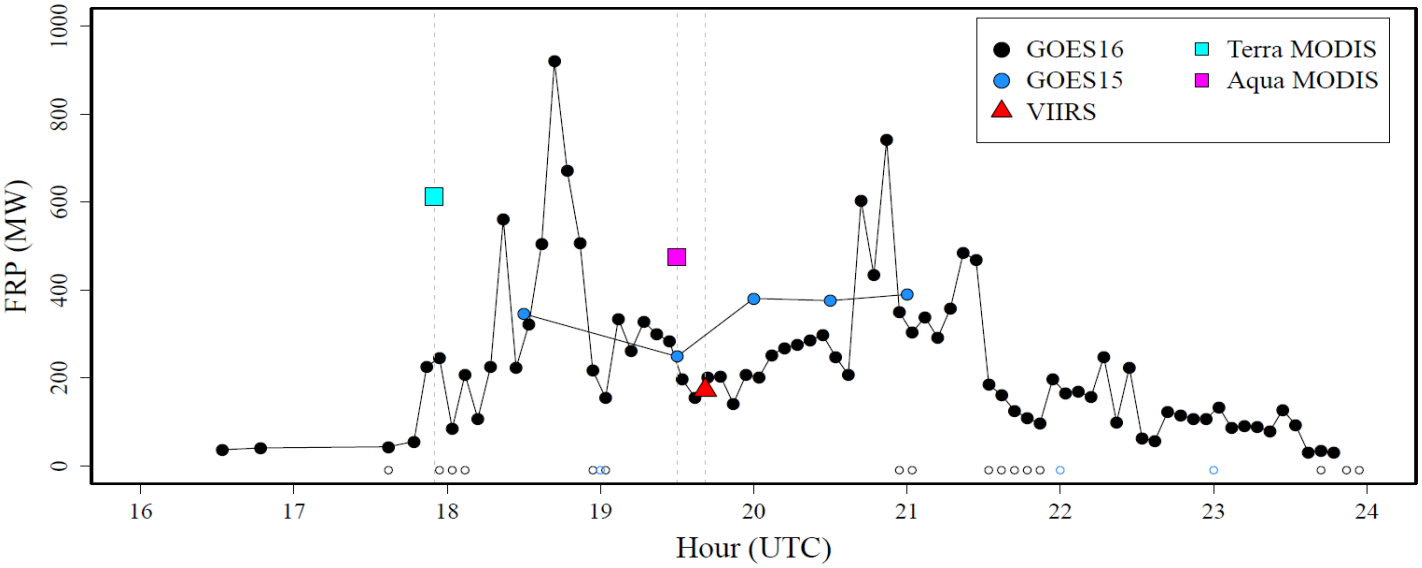


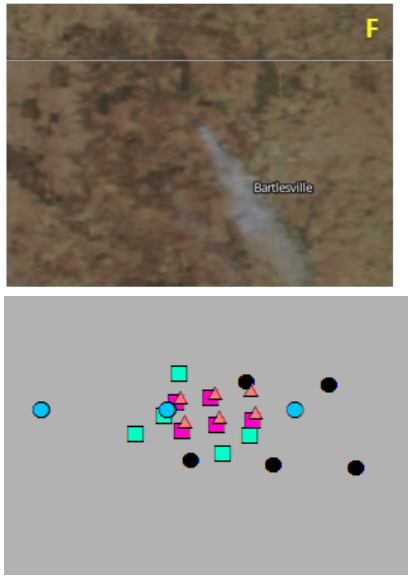
Credit: Tim Schmidt

GOES-16/ABI FRP



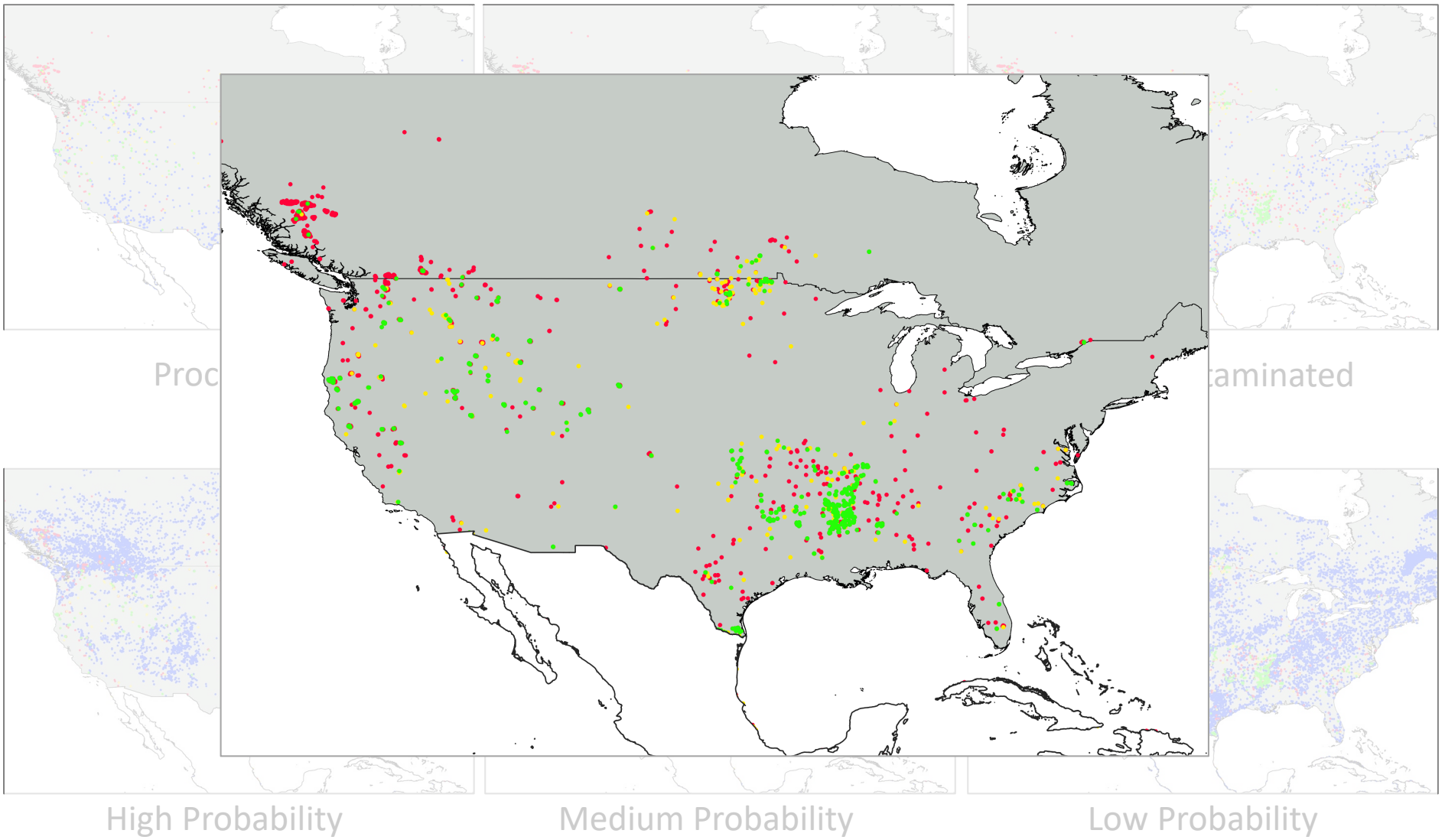






Credit: Shobha Kondragunta

GOES-16/ABI Fire Detection 01-05 Sep 2018



Landsat-Class Active Fire Data

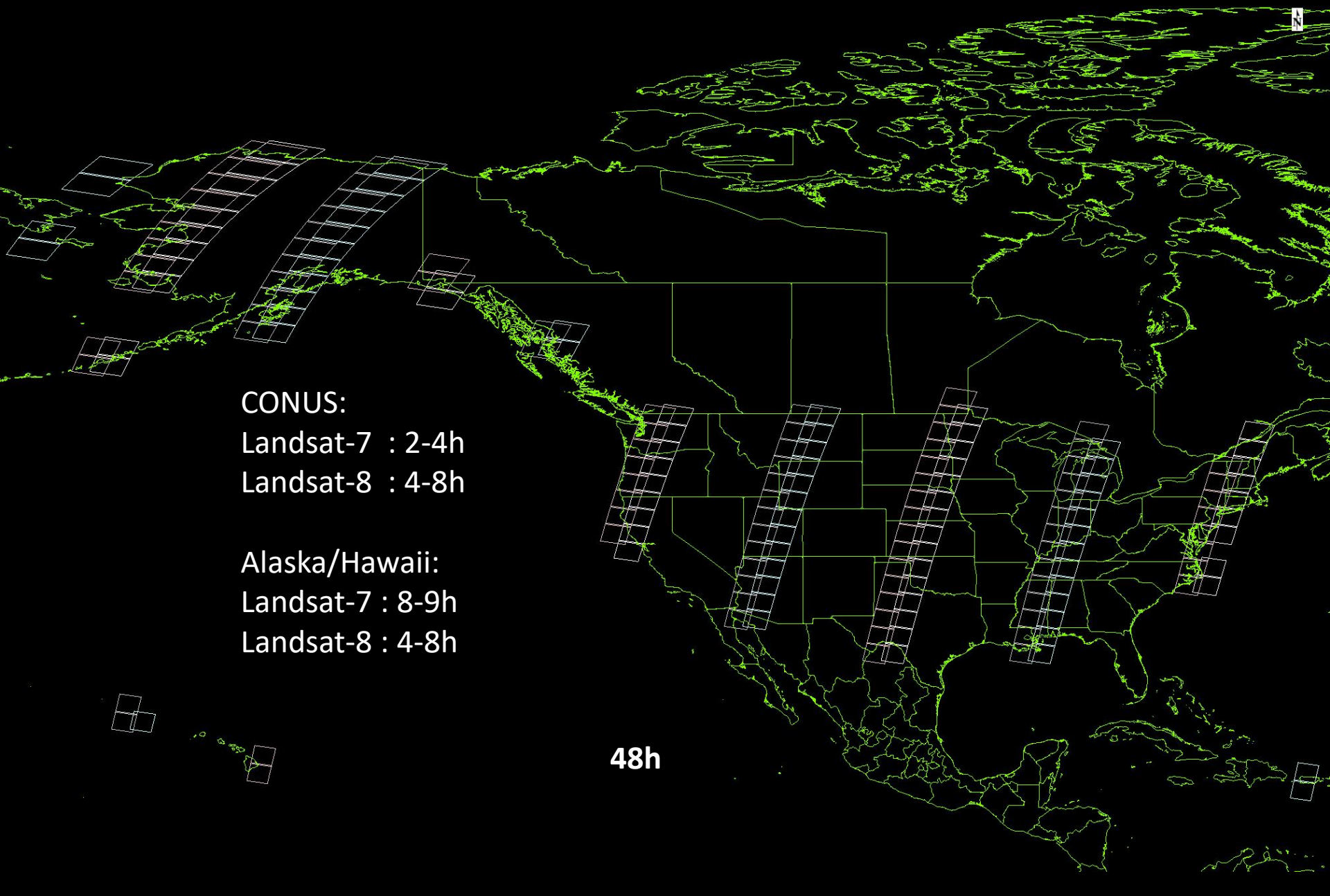
- Landsat-8/OLI near real-time active fire algorithm implemented operationally
  - NOAA/NESDIS: Conterminous U.S., Alaska, Hawaii. Image composites (fire RGB) used in support of fire data analyses
  - USDA/Forest Service: U.S. and Canada
  - Quasi-systematic nighttime acquisitions over western US during peak fire season
  - Sub-optimal data latency Landsat-8/OLI

- Historical Landsat-8/OLI fire data processed using NASA/NEX facility
  - 31,000 scenes processed in ~3 days; primarily U.S. data

- Landsat-7/ETM+ near real-time imagery (fire RGB) used in support of fire data analyses at NOAA/NESDIS covering Conterminous U.S., Alaska, Hawaii
  - Quasi-optimal data latency

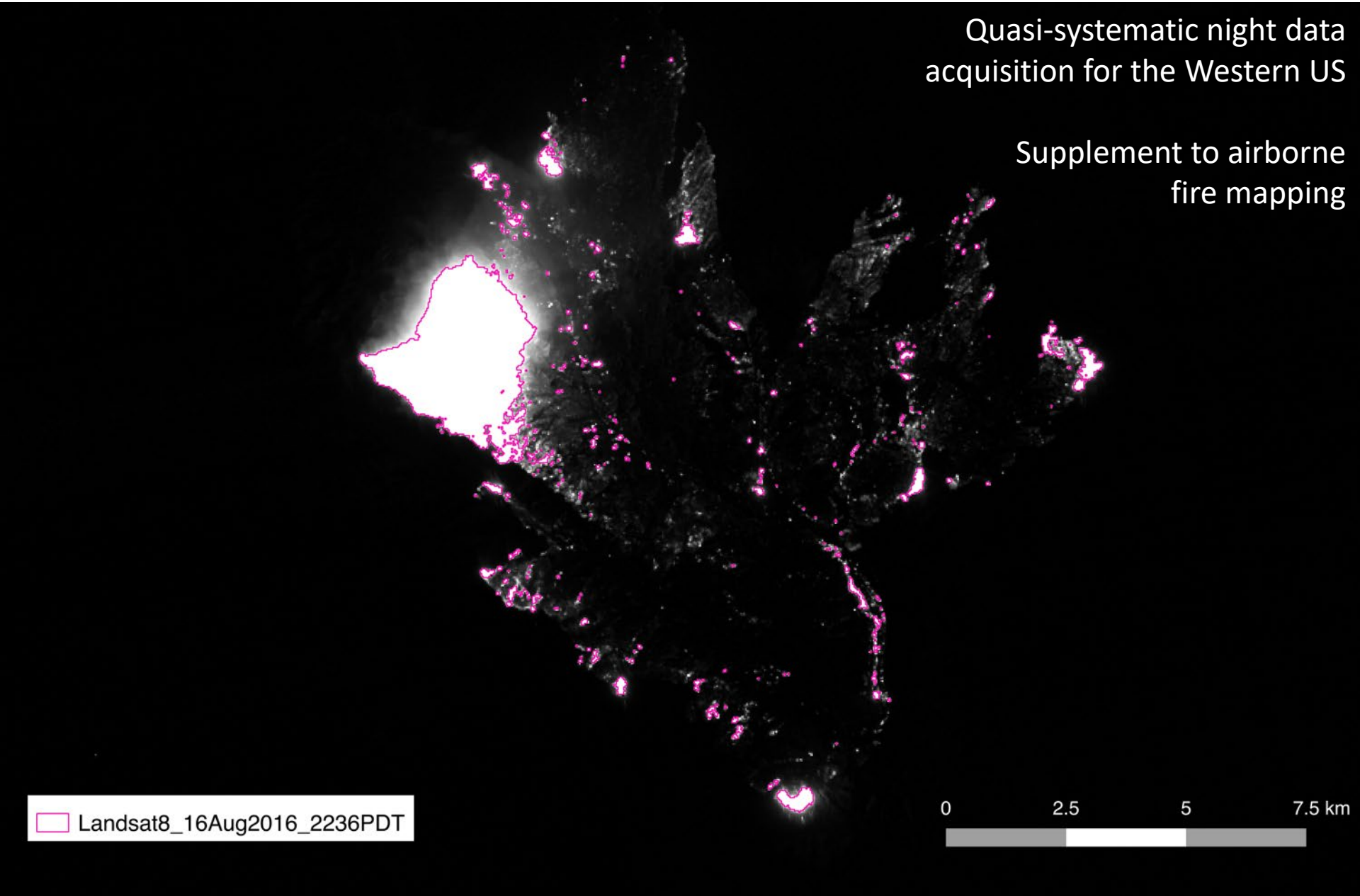
- Sentinel-2 active fire product building on Landsat-8/OLI algorithm
  - Operational data processing attempted at NOAA/NESDIS for the U.S.
  - Prohibitive data volumes (250GB/day); inadequate transfer rates
  - Sub-optimal data latency (several hours)

Landsat-7&8 Daily Coverage & Latency over U.S.



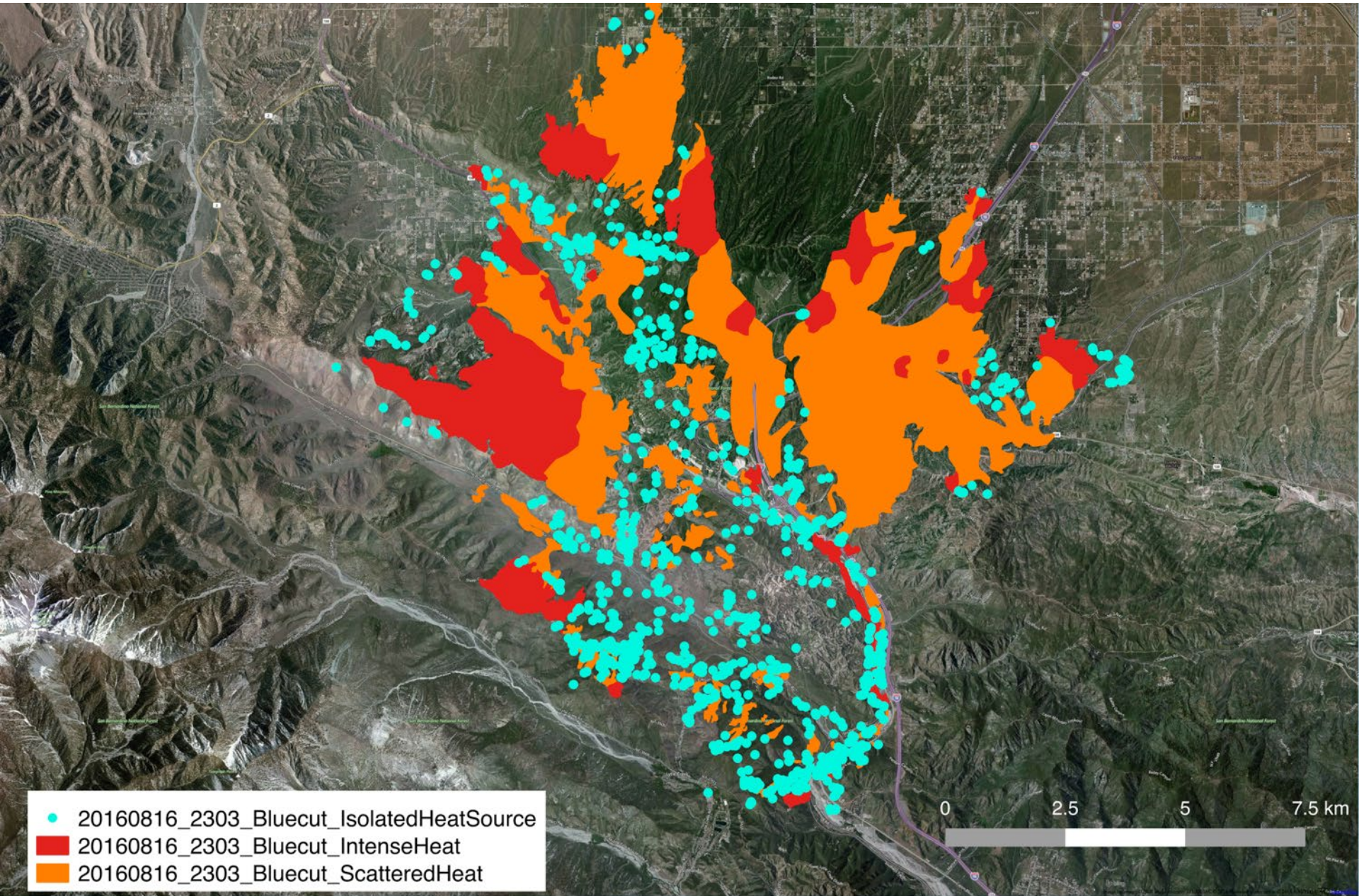
On-demand nighttime Landsat-8 acquisition

Blue Cut Fire 16 Aug 2016 22:36 PDT



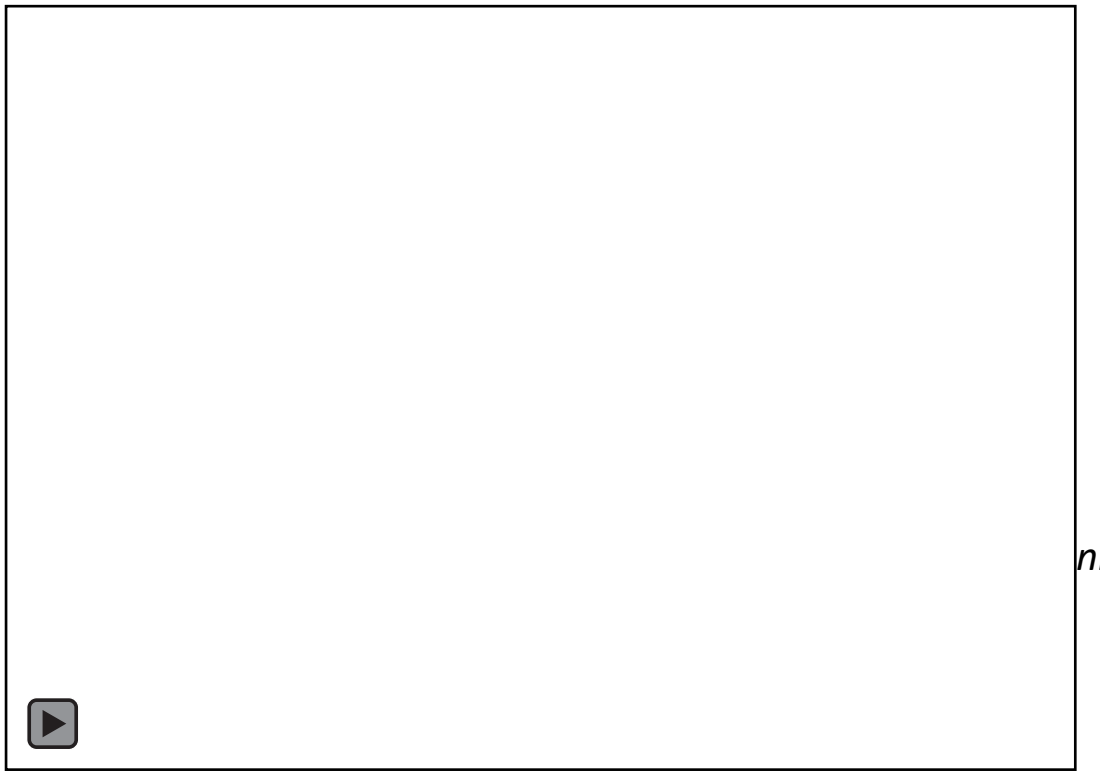
On-demand nighttime NIROPs acquisition

Blue Cut Fire 16 Aug 23:03 PDT



Near Real-Time Fire Management Application

- Coupled Atmosphere-Wildland Fire Environment (CAWFE) using VIIRS/Landsat active fire data to initialize high-resolution (~300m) fire behavior simulations
- Framework being implemented for the State of Colorado, supporting forest management/wildfire risk remediation in California
- Ongoing discussion to have it implemented in support of NOAA/NESDIS and National Weather Service fire programs



nice Coen/NCAR

Final Remarks

- S-NPP & NOAA-20 VIIRS fire data available to the community
  - Algorithm/product refinement due soon
  - Seek higher level product combining S-NPP & NOAA-20 fire data
- GOES-16/17 ABI fire algorithm requiring major adjustments/overhaul
  - Spatial/temporal resolution improvement noticeable although majority of events still too small to allow unambiguous detection, data remapping scheme complicates matter
- Landsat-class data providing good support to routine fire mapping
  - Higher latency limiting full realization of data potential
  - Large data volumes demanding upstream data processing
    - Add active fires to land product suite??
    - Cloud computing solutions?