NRT Tools Overview

MODIS, VIIRS and Landsat-class Active Fire Detection Data

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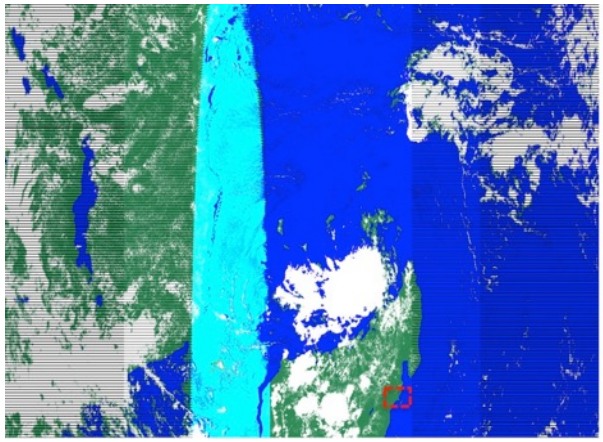
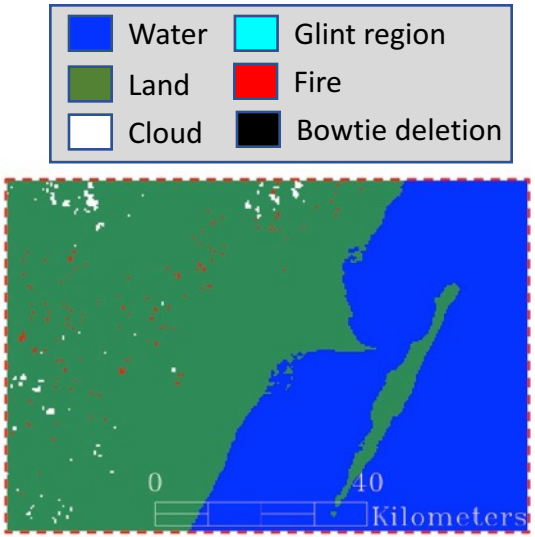
MODIS & VIIRS Active Fire Data Commonalities

- **Level 2 (swath) product**
  - 2D image classification product (fire mask) identifying fire (+confidence), land, cloud, water pixels. Need companion geolocation file in order to reproject fire mask
  - Sparse arrays carrying fire radiative power (FRP), and numerous other fire pixel attributes – a subset of which is used in the ASCII distribution format
- MODIS 1 km *Fire and Thermal Anomalies* Product
  - HDF4 format
    - MOD14/MYD14 @ NASA
- VIIRS 750 m Active Fire Product
  - NetCDF format
    - VNP14 @ NASA
    - AF_v1r0_npp @ NOAA NDE
- VIIRS 375 m Active Fire Product
  - NetCDF format
    - VNP14IMG @ NASA





VNP14IMG fire mask

MODIS & VIIRS Active Fire Data Commonalities

- **GIS-Friendly (ASCII)**
  - Lists fire pixel locations along with basic attributes
  - Usually in comma-separated format
  - MOD14, MYD14, VNP14IMG data available

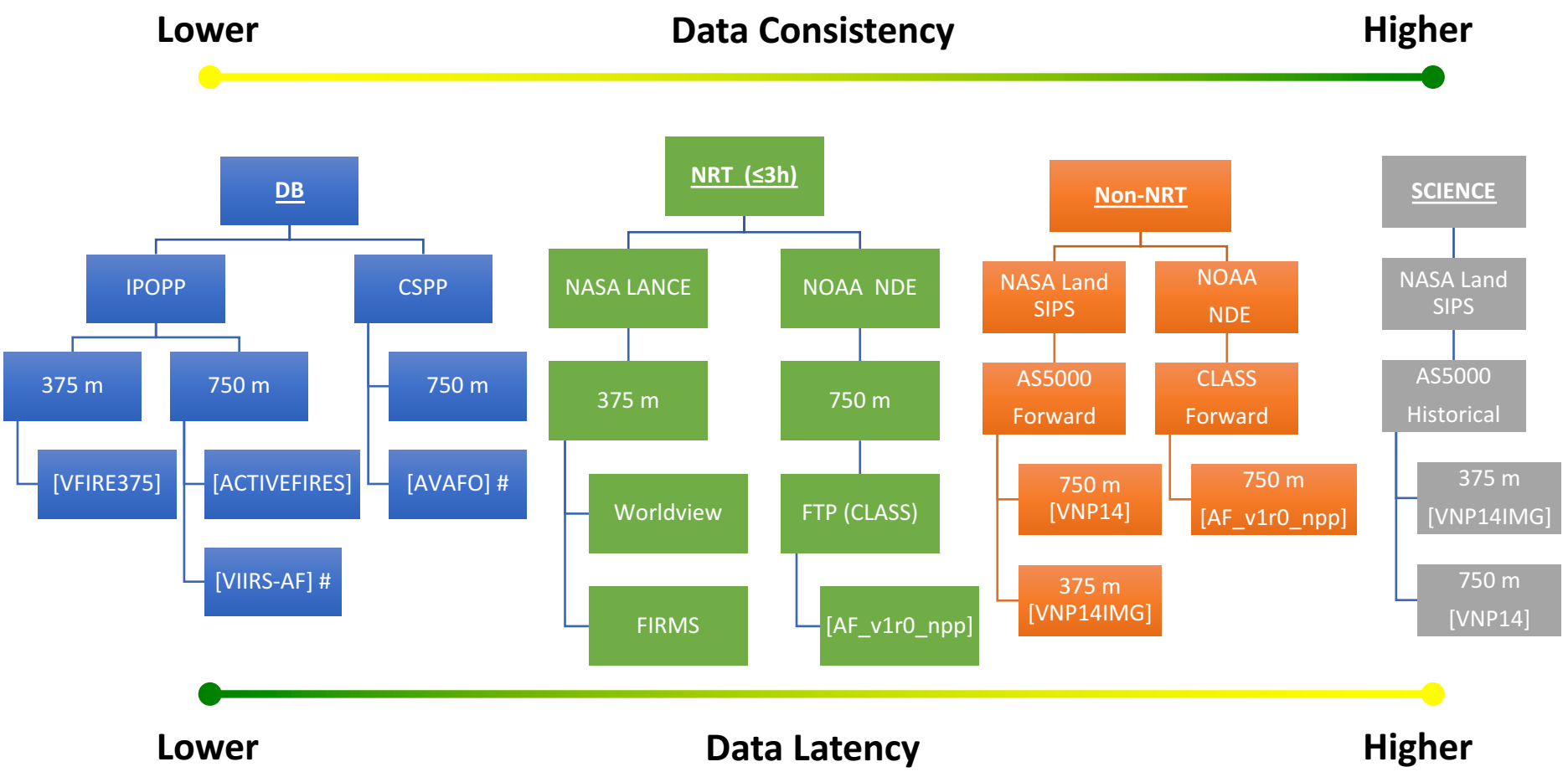
Center pixel latitude	Center pixel longitude	mid-IR temp of fire pixel (K)	Pixel size along scan (km)	Pixel size along track (km)	Acquisition date (YYYY-MM-DD)	Acquisition time (hhmm UTC)	Satellite identifier (T=Terra, A=Aqua, N=NPP)	Detection confidence (% or categorical)	Algorithm version	Long-IR temp of fire pixel (K)	Fire Radiative Power (MW)	Day/Night flag
latitude	longitude	brightness	scan	track	acq_date	acq_time	satellite	confidence	version	bright_t31	frp	daynight
-24.828	149.799	317.5	1.1	1	2017-03-26	0020	T	61	6.0NRT	296.4	7.8	D
-26.5	147.385	323.5	1	1	2017-03-26	0020	T	62	6.0NRT	306.4	8.6	D
-26.937	150.22	332	1.2	1.1	2017-03-26	0020	T	82	6.0NRT	305.1	26.5	D
-28.356	149.707	332	1.2	1.1	2017-03-26	0020	T	81	6.0NRT	303	25.5	D
-28.366	149.705	326.9	1.2	1.1	2017-03-26	0020	T	59	6.0NRT	302.5	17.3	D

latitude	longitude	bright_ti4	scan	track	acq_date	acq_time	satellite	confidence	version	bright_ti5	frp	daynight
-25.17904	16.4096	312	0.6	0.5	2017-03-26	0036	N	nominal	1.0NRT	288.1	0	N
-26.92053	13.08236	307.7	0.4	0.4	2017-03-26	0036	N	nominal	1.0NRT	288.3	0	N
-28.51069	15.78038	334.2	0.6	0.5	2017-03-26	0036	N	nominal	1.0NRT	286.9	0	N
-32.93756	18.76052	310.5	0.5	0.7	2017-03-26	0036	N	nominal	1.0NRT	287.1	0	N
-32.93747	18.76043	311.2	0.5	0.7	2017-03-26	0036	N	nominal	1.0NRT	287.4	0	N

Higher VIIRS resolution requires higher precision

Soon to be populated

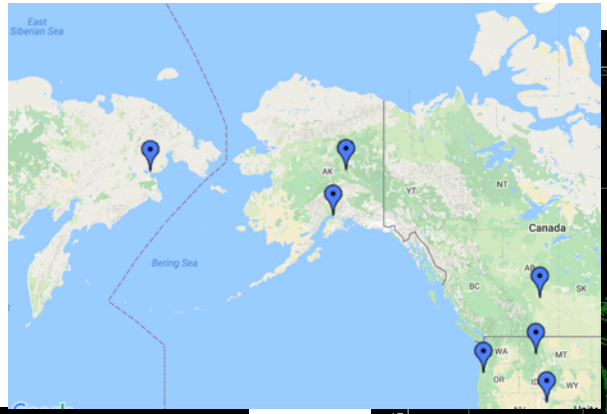
VIIRS Active Fire Product Lineage

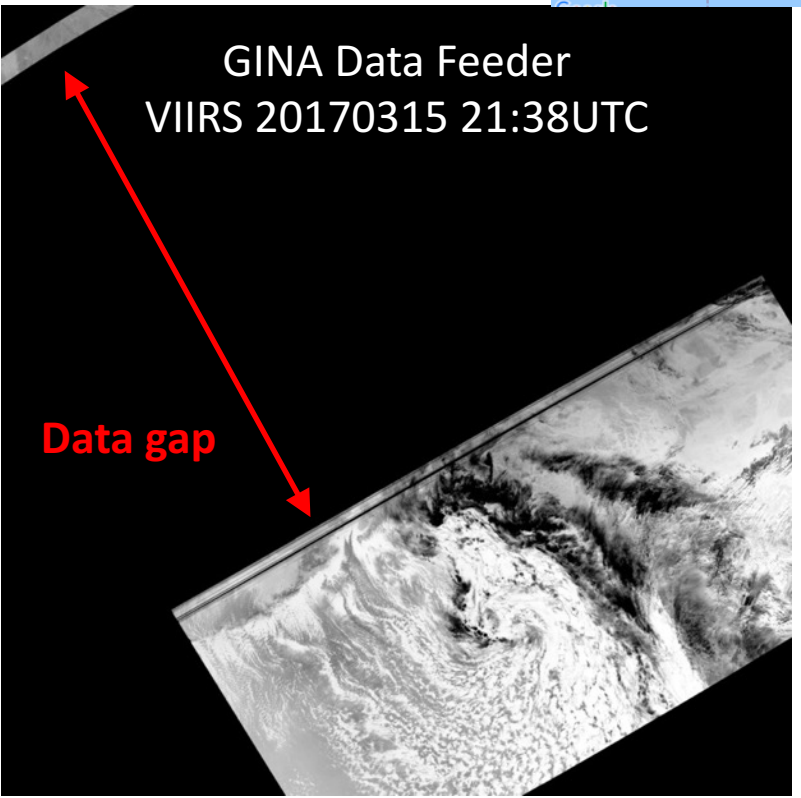


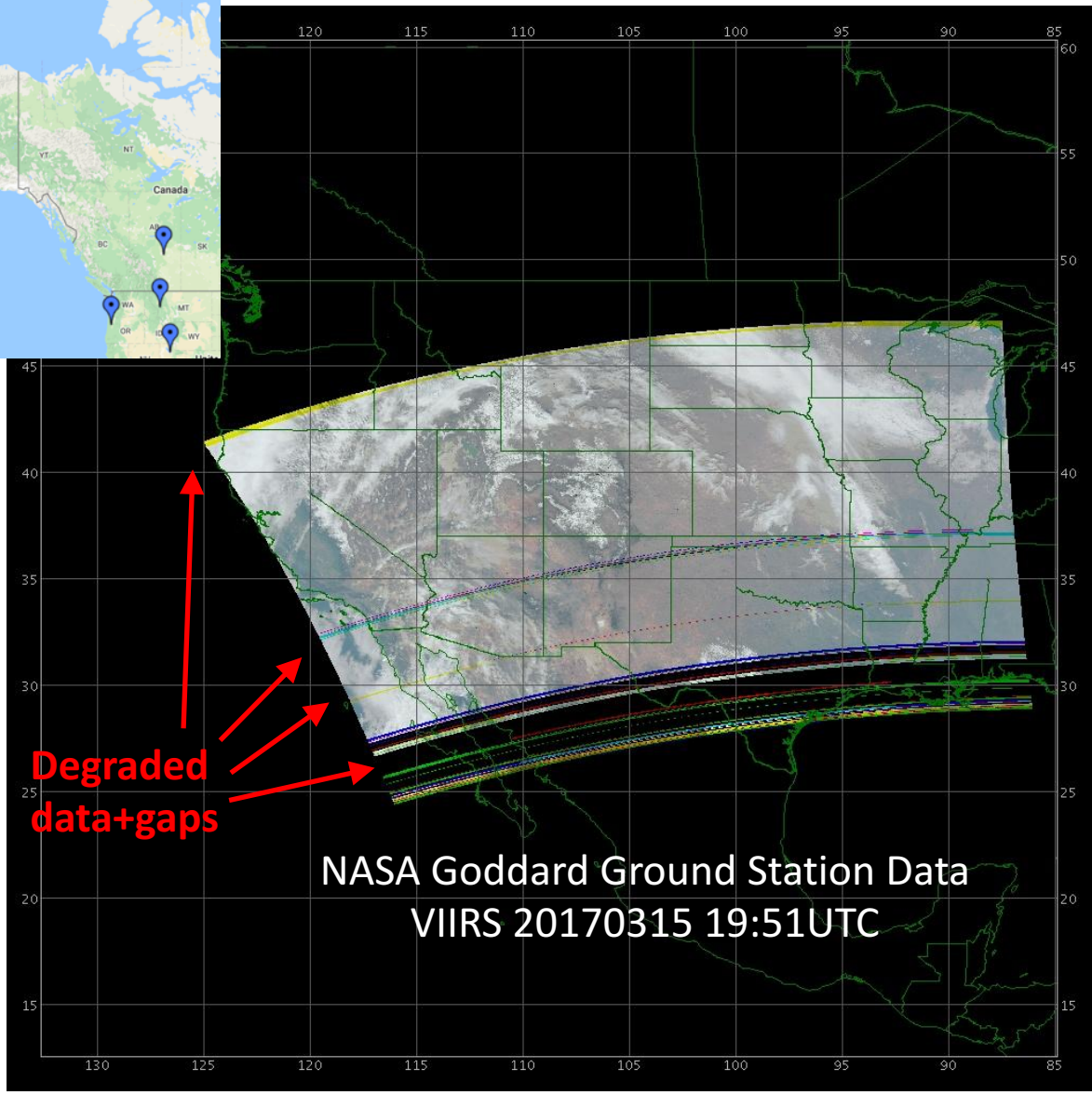
marked products describe discontinued algorithm
[ ] indicates official product name

Direct Readout Station Data

- Network of ground receiving stations
- Coverage dependent on antenna's location
- Supporting regional NRT applications







Direct Readout Station Data

USDA Geospatial Technology and Applications Center (GTAC) integrated direct readout satellite fire data portal

https://fsapps.nwcg.gov/afm/

GTAC collaborates with the fire algorithm teams

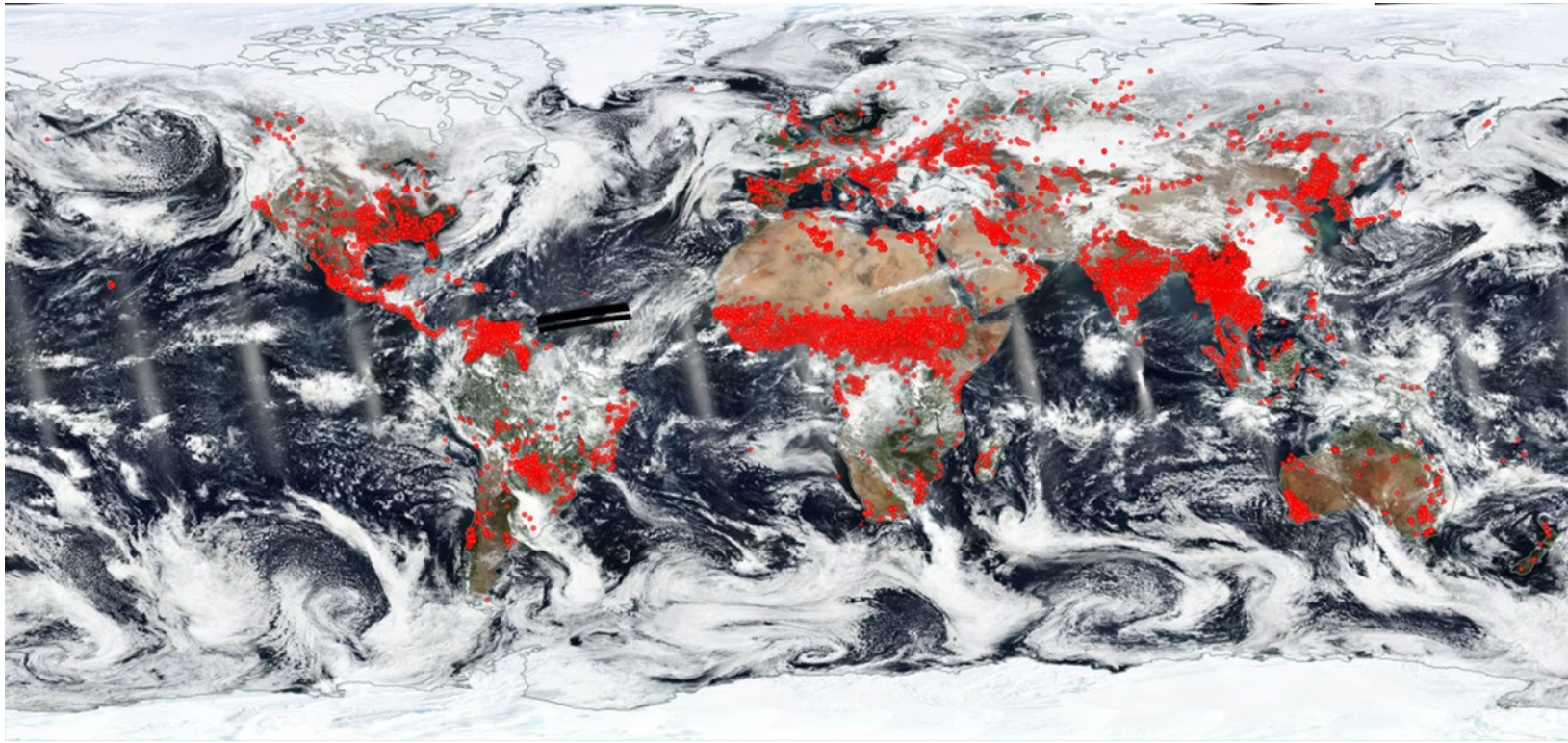
Maintains the latest MODIS and VIIRS fire algorithms

Data feeds serving a large numbers of users in the US (e.g., GAACs)

NASA Land, Atmosphere Near real-time Capability for EOS (LANCE)

Global coverage
Approx. 3 h data latency
Complements direct readout data
VIIRS and MODIS active fire data distributed via FIRMS & MODAPS FTP

VIIRS 20170315



https://worldview.earthdata.nasa.gov

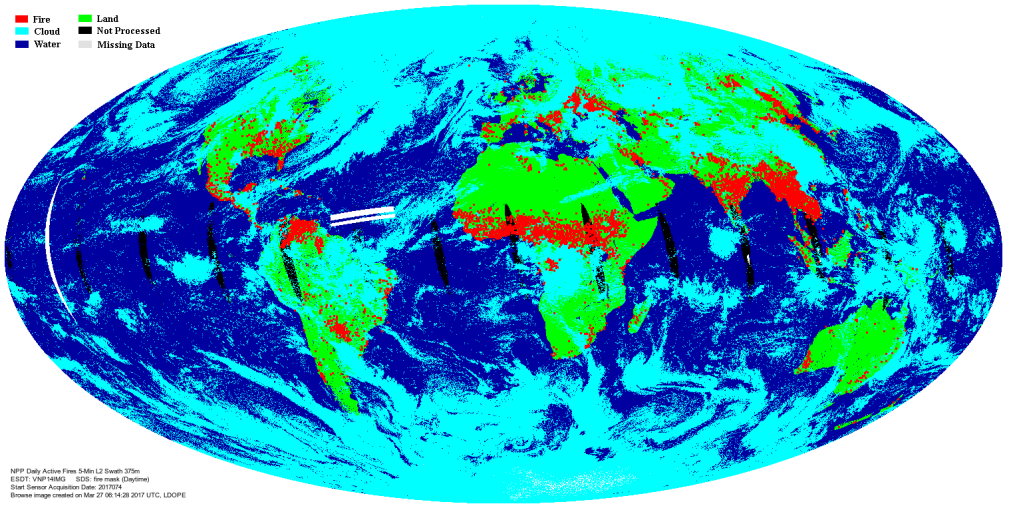
NASA MODAPS Qualitative Data Browsers

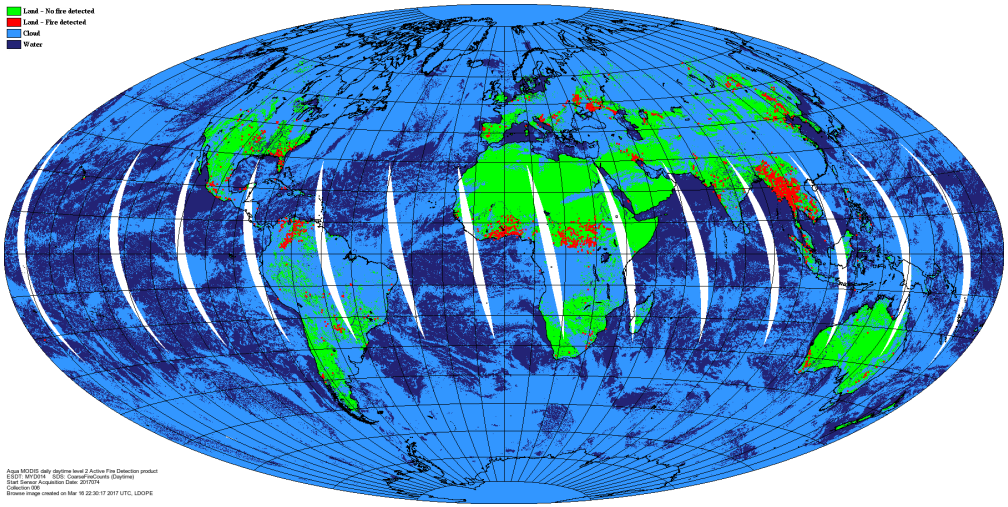
Global Browsers
MODIS:
https://landweb.modaps.eosdis.nasa.gov/cgi-bin/browse/browseMODIS.cgi

VIIRS:
https://landweb.modaps.eosdis.nasa.gov/cgi-bin/NPP/browse/NPPbrowse.cgi

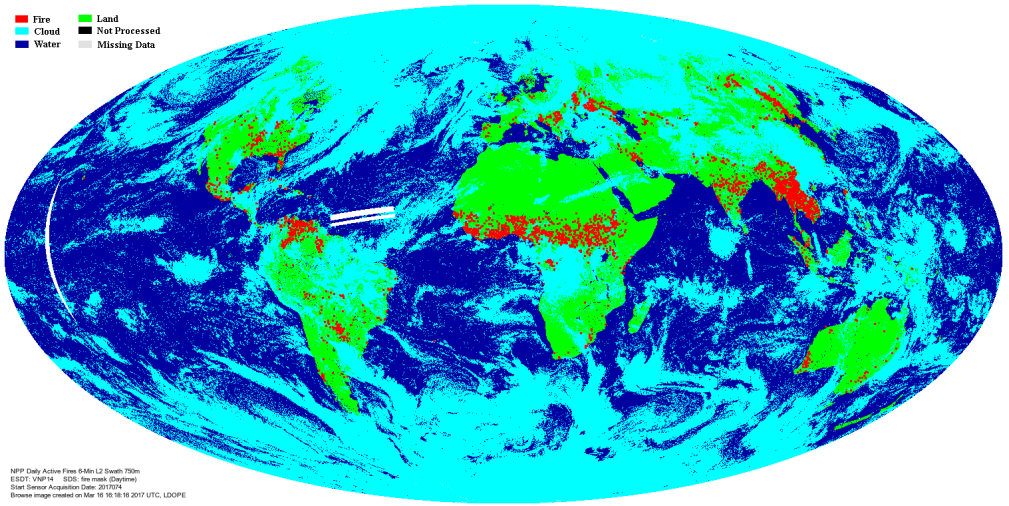
2017-03-15

NPP/VIIRS 375 m





Aqua/MODIS 1 km



NPP/VIIRS 750 m

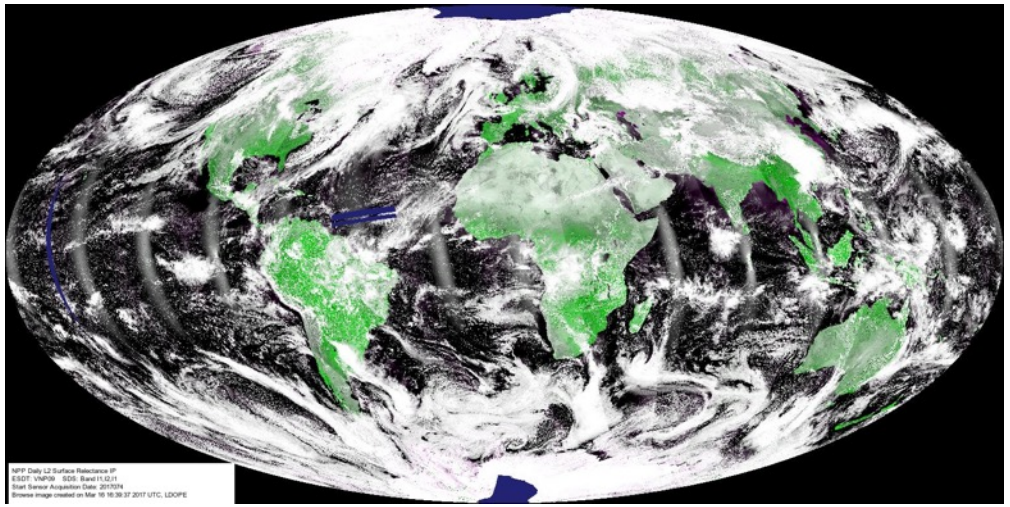
NASA MODAPS Qualitative Data Browsers

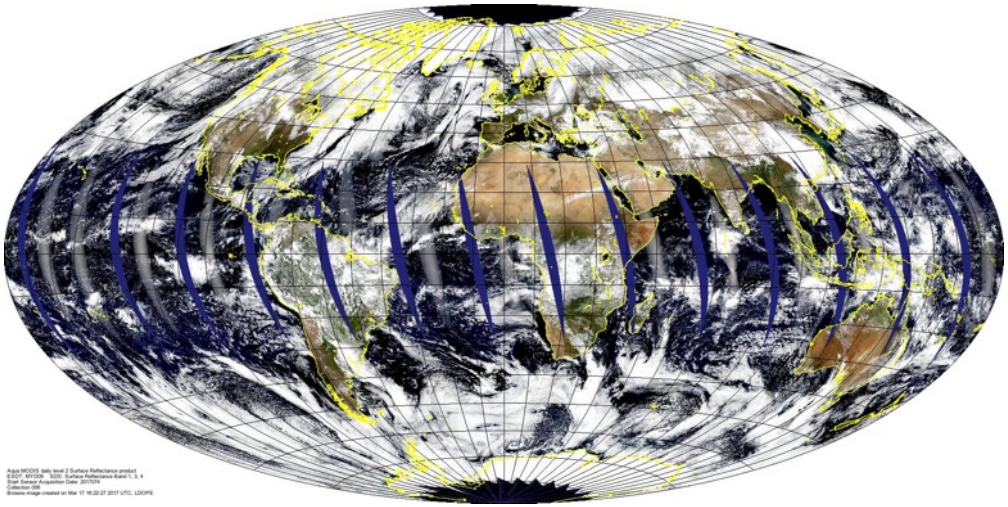
Global Browsers
MODIS:
https://landweb.modaps.eosdis.nasa.gov/cgi-bin/browse/browseMODIS.cgi

VIIRS:
https://landweb.modaps.eosdis.nasa.gov/cgi-bin/NPP/browse/NPPbrowse.cgi

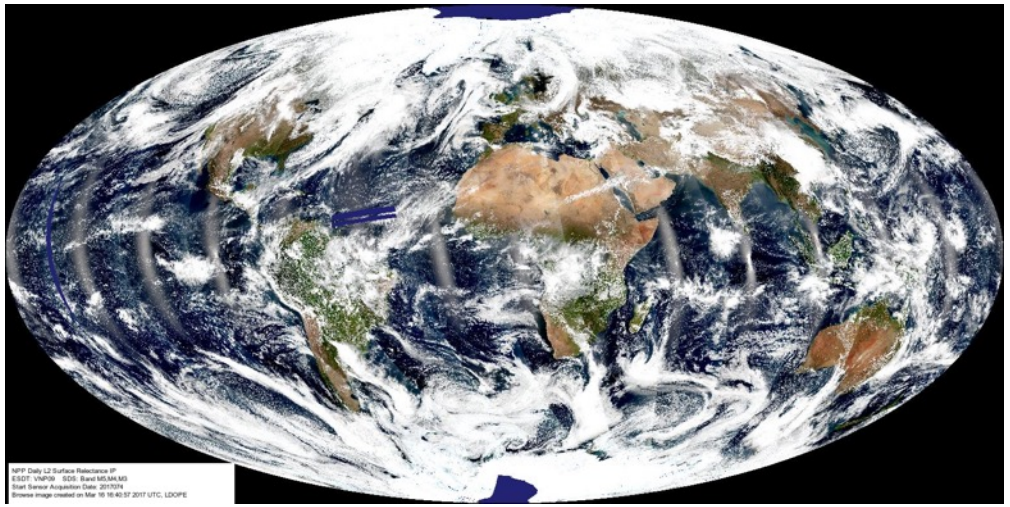
2017-03-15

NPP/VIIRS 375 m



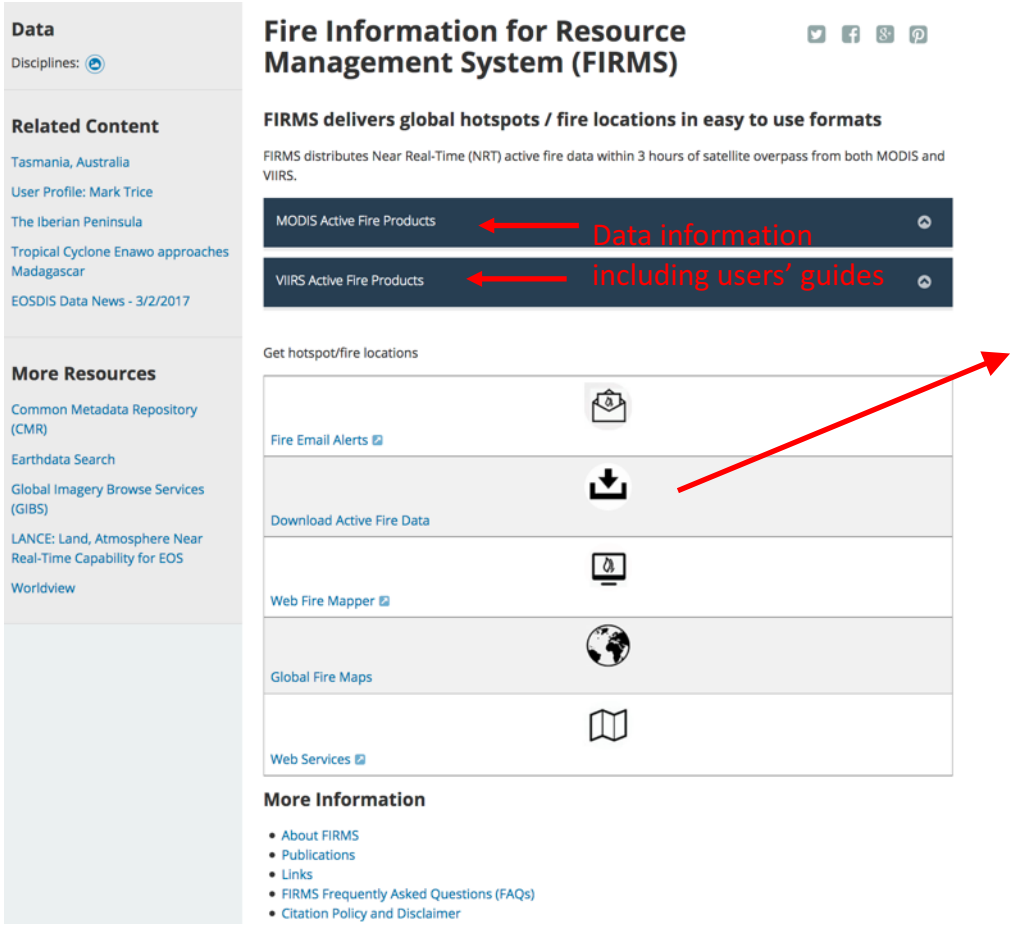


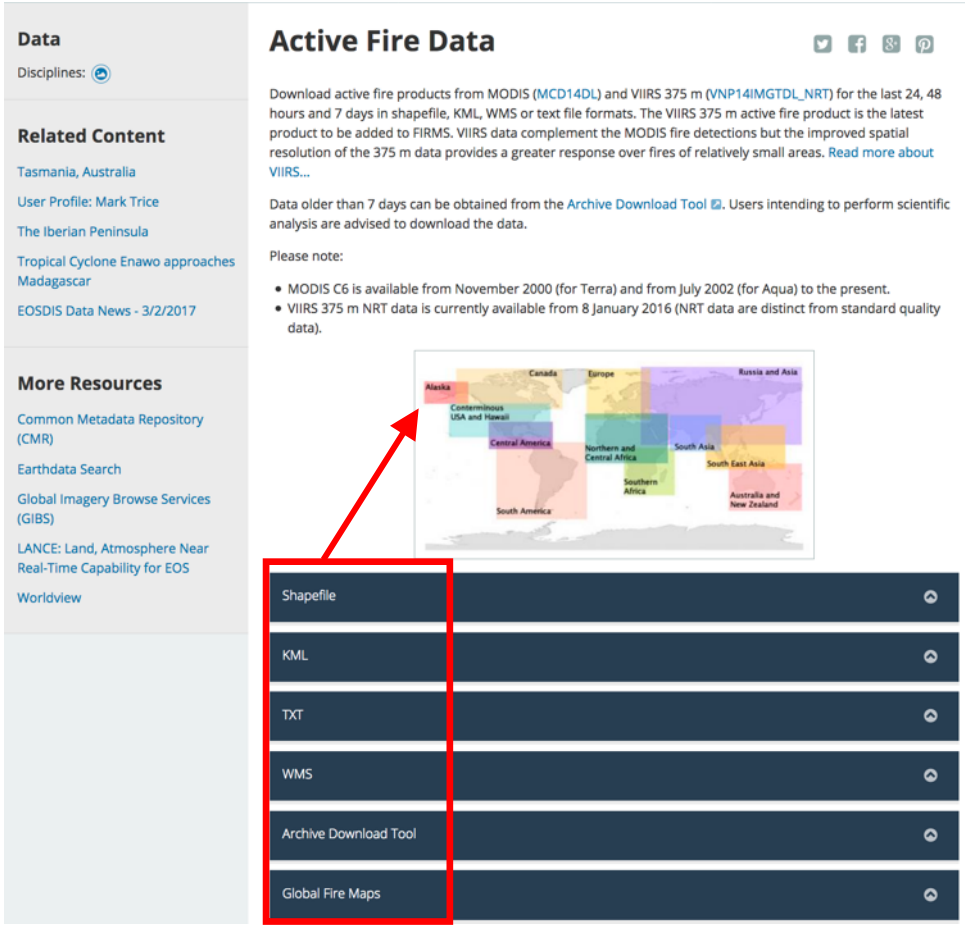
Aqua/MODIS 1 km



NPP/VIIRS 750 m

Fire Information for Resource Management System (FIRMS)



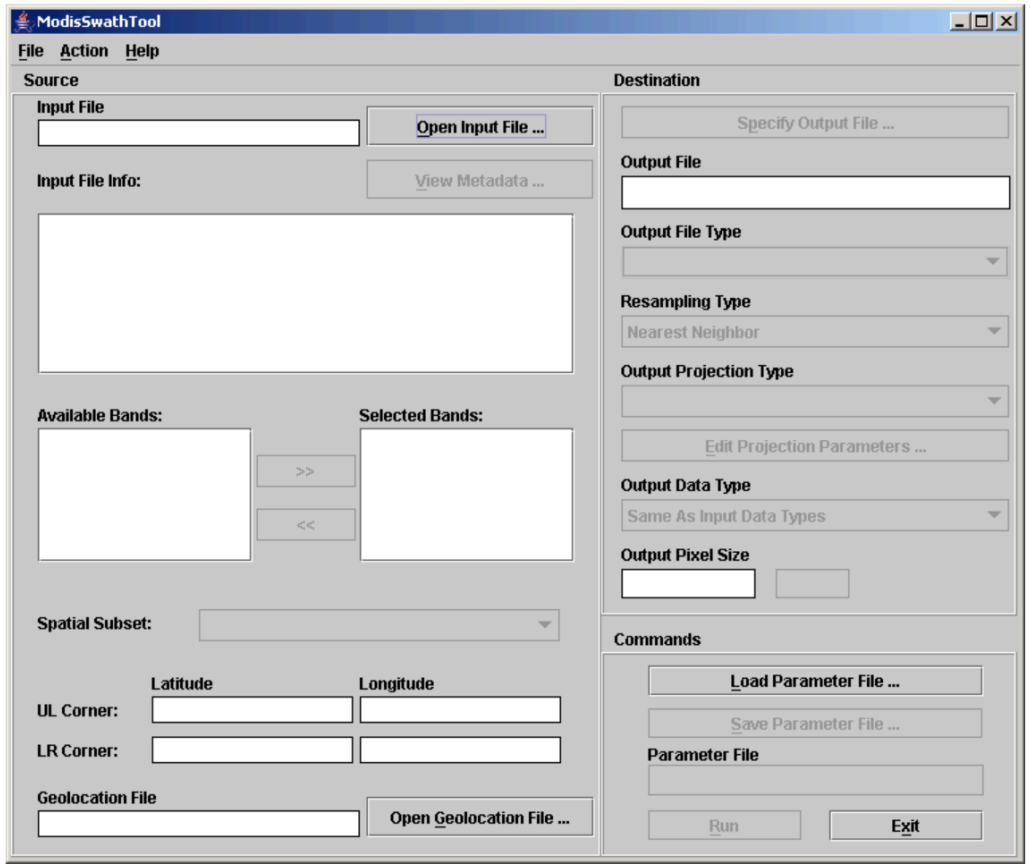


https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms

MODIS Data Resources

MODIS Swath Reprojection Tool

https://lpdaac.usgs.gov/tools/modis_reprojection_tool_swath



Reprojection Tool Input Requirements:
MOD14*.hdf or MYD14*.hdf fire data files
MOD03*.hdf or MYD03*.hdf geolocation files

MODIS Fire University of Maryland website
http://modis-fire.umd.edu/index.php

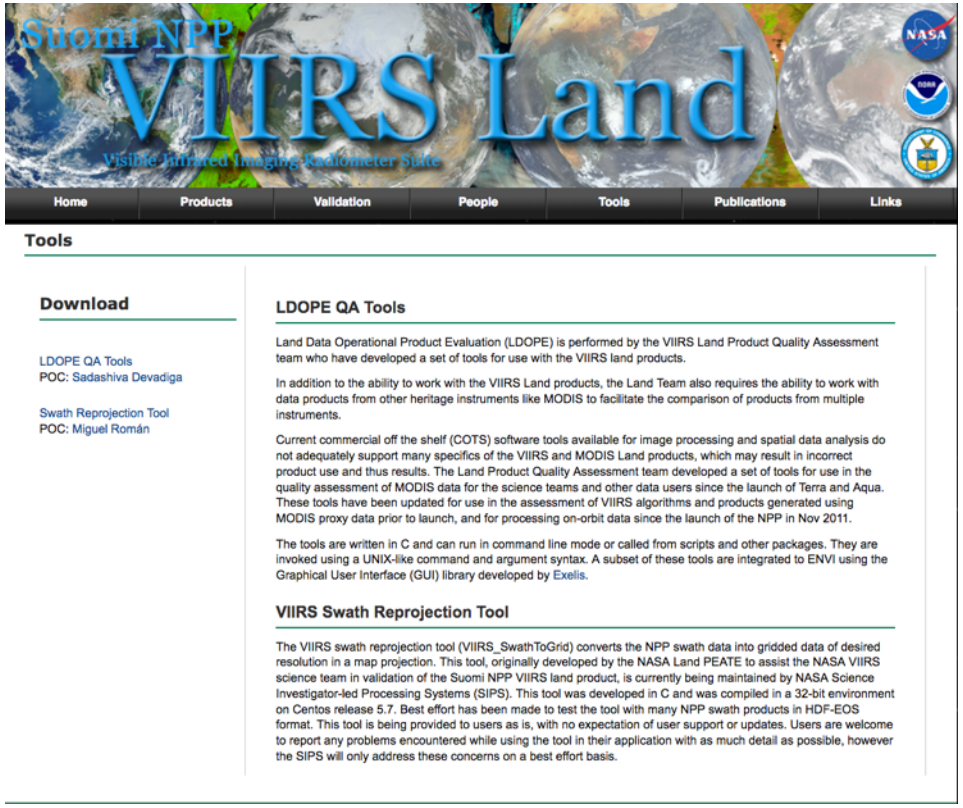
MODIS Fire Data Users' Guide:
http://modis-fire.umd.edu/pages/manuals.php

NRT data download:

NASA MODAPS (registered users):
https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data/modis-nrt

VIIRS Data Resources

VIIRS Swath Reprojection Tool
(command line – Linux)
https://viirsland.gsfc.nasa.gov/Tools.html



Reprojection Tool Input Requirements:
VNP14IMG*.nc or VNP14*.nc fire data files
VNP02IMG*.nc or VNP02*.nc geolocation files
Data converter to HDF/EOS

VIIRS Fire University of Maryland website:
http://viirsfire.geog.umd.edu/

VIIRS Fire Data Users' Guide:
https://viirsland.gsfc.nasa.gov/Products/FireESDR.html

NRT data download options:

NASA MODAPS (registered users):
https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data/viirs-nrt

NOAA NDE (anonymous FTP):
ftp://ftp-npp.class.ngdc.noaa.gov/
Select:
Date ->
NDE-L2 ->
VIIRS-Active-Fire-EDR-NOAA-Enterprise-Algorithm

Landsat-8 & Sentinel-2 Active Fire Data Sets

- **Level 2 product**
  - 2D image classification product (fire mask) identifying fire (+confidence), land, cloud, water pixels; multi-temporal filter separating low confidence detection pixels associated with urban sources (e.g., flares, power plants)
  - Frequent data saturation prevents FRP retrieval
  - Distinct approach based on NIR/SWIR bands captures mostly flaming combustion during daytime

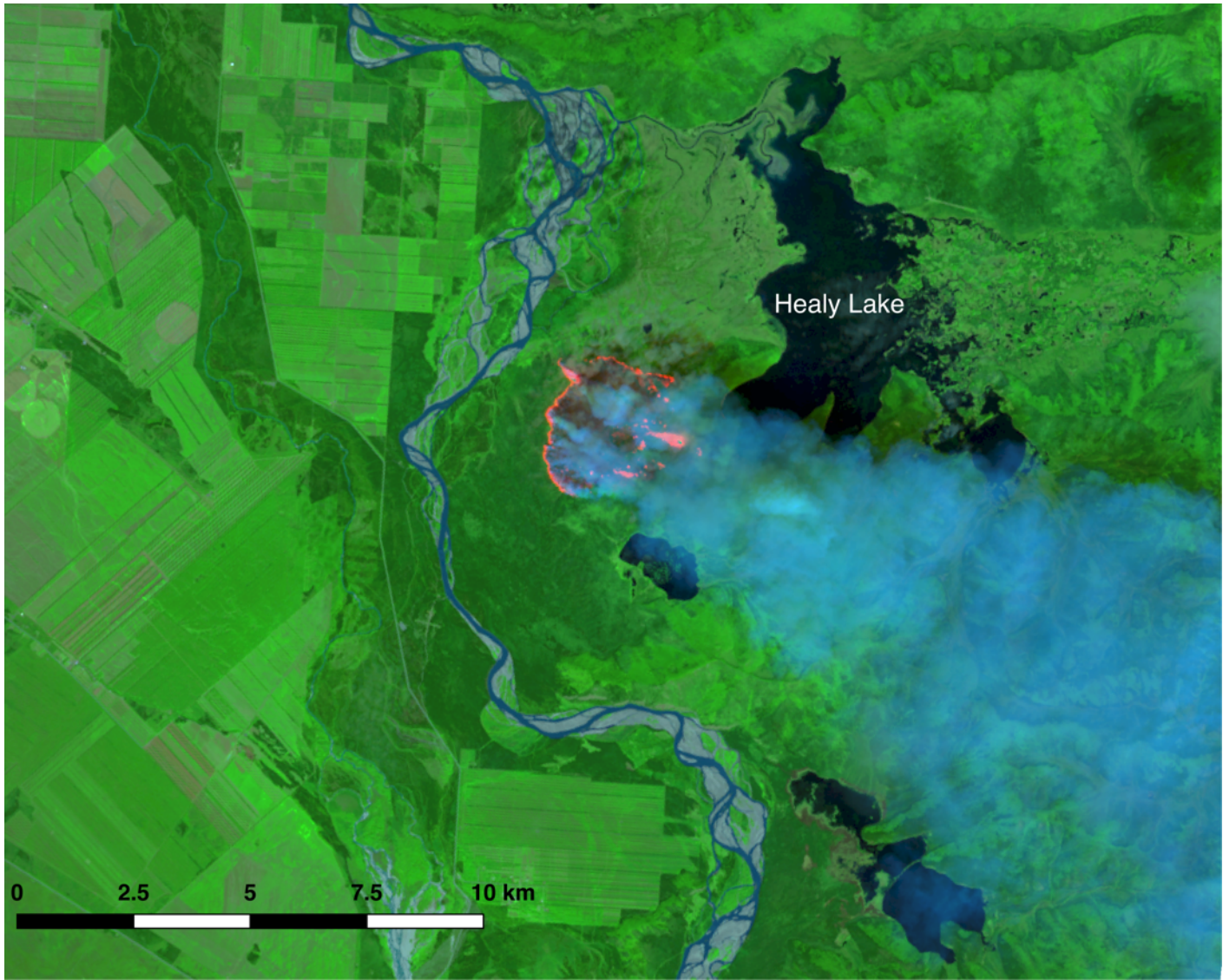
- Landsat-8/OLI 30 m active fire product
  - Routinely processed and distributed by USDA/GTAC
- Sentinel-2A/B 20 m active fire product
  - In development at UMD
- Data format facilitates display of active fire pixels with proper ground footprints
- Nominal Landsat-8 data latency (> 3h) still an issue; Gilmore Creek ground station may be able to provide quicker access for Alaska. Sentinel-2A/B expected to approximate Landsat-8 data latency

Landsat-8/OLI (30 m) Healy Lake Fire

~100 miles SE of Fairbanks

Lightning ignition:
16 June 2015

1st daytime Landsat-8 image:
17 June



Scene: LC80680152015168LGN00

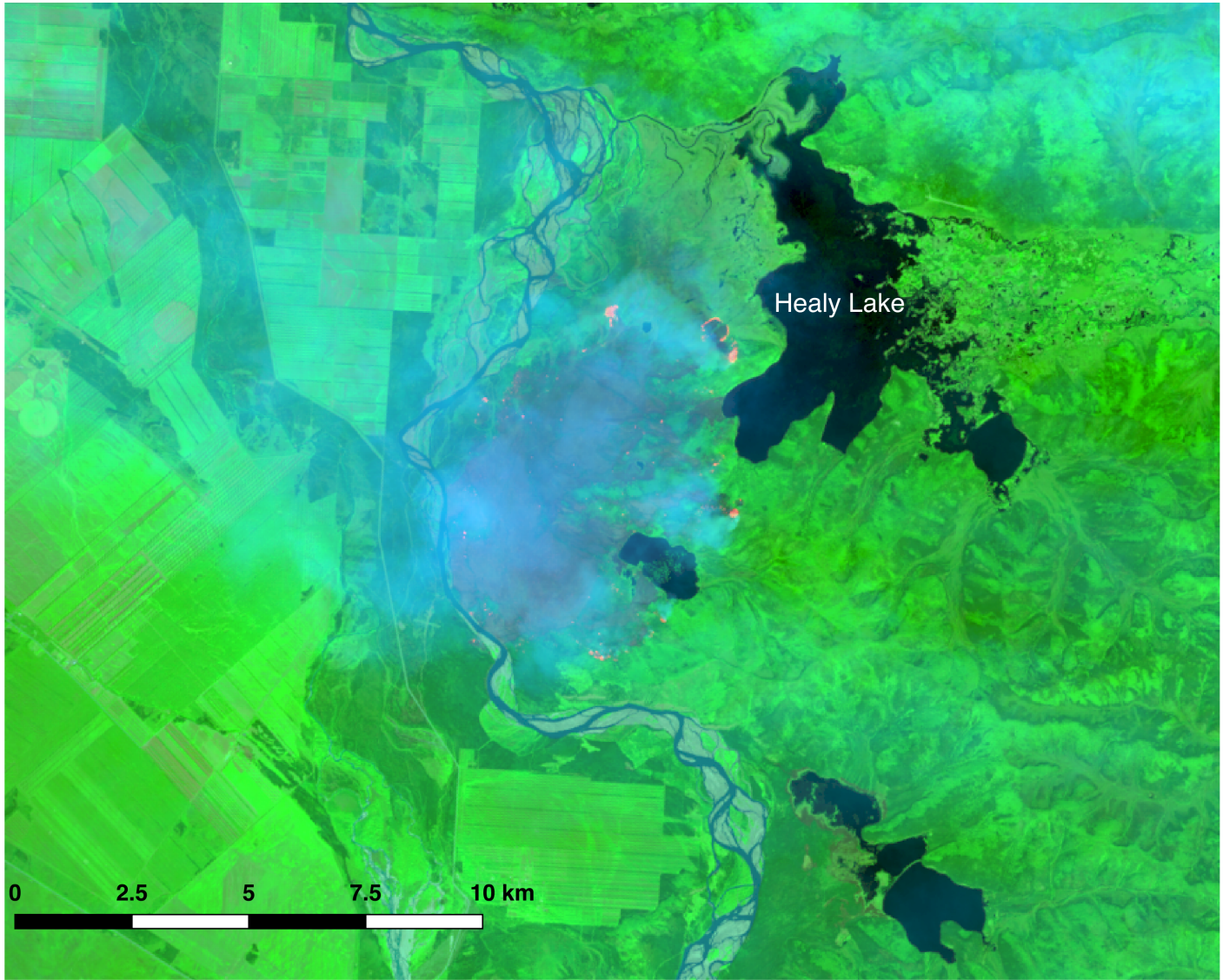
Landsat-8/OLI (30 m) Healy Lake Fire

~100 miles SE of Fairbanks

Lightning ignition:
16 June 2015

1st daytime Landsat-8 image:
17 June

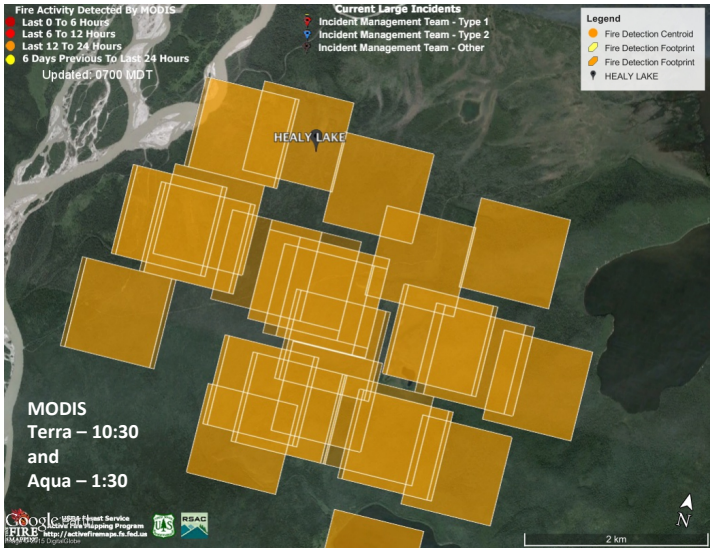
2nd daytime Landsat-8 image:
19 June

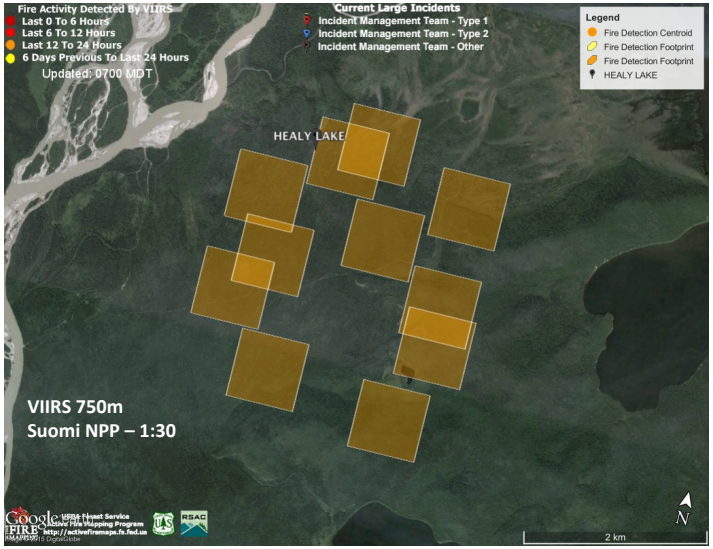


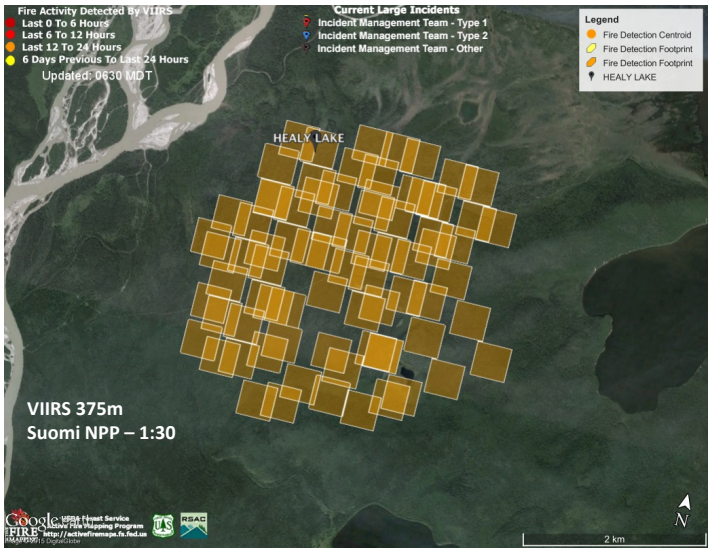
Scene: LC80660152015170LGN00

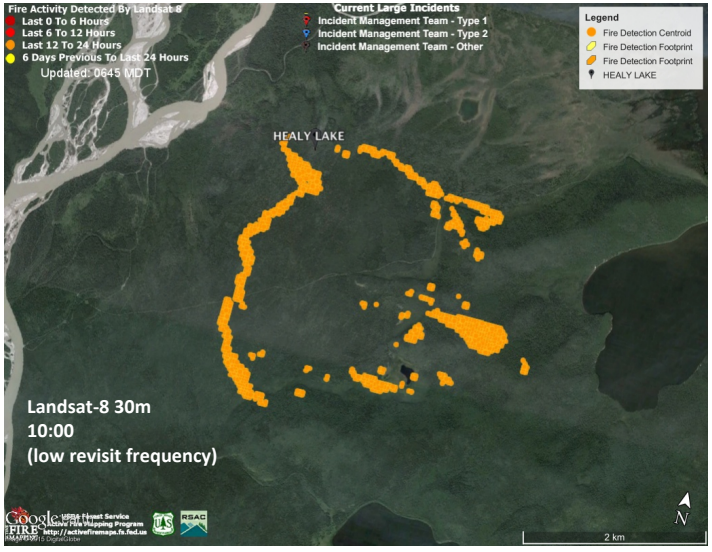
Comparing Landsat-8 (30 m), VIIRS (375, 750 m) & MODIS (1km)

Healy Lake Fire (16-17 June 2015)







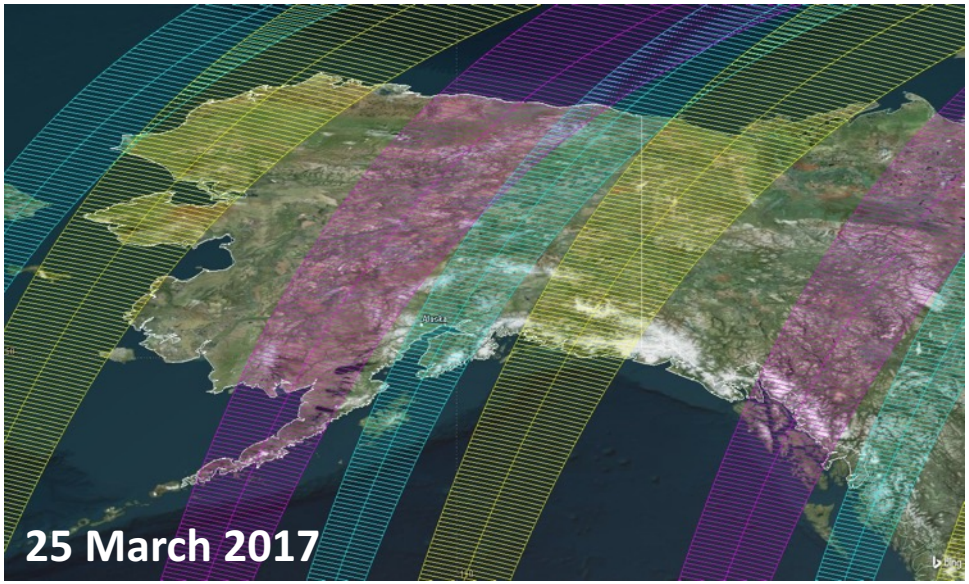


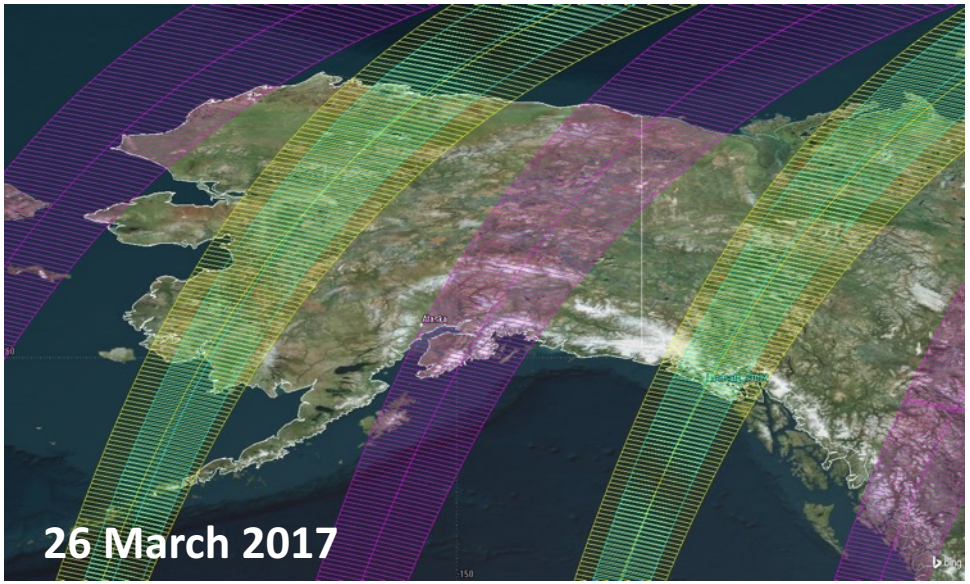
Spatial resolution

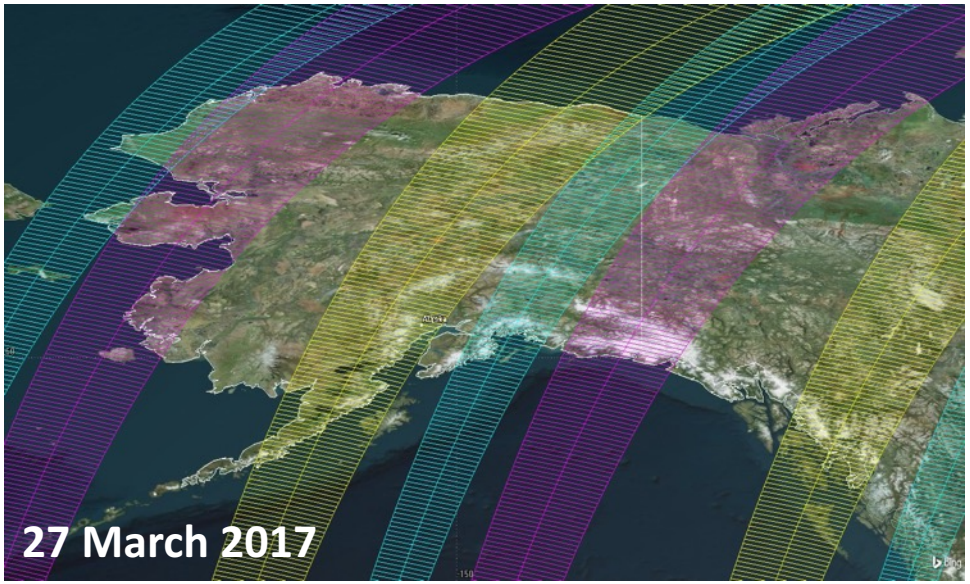
X

Temporal resolution

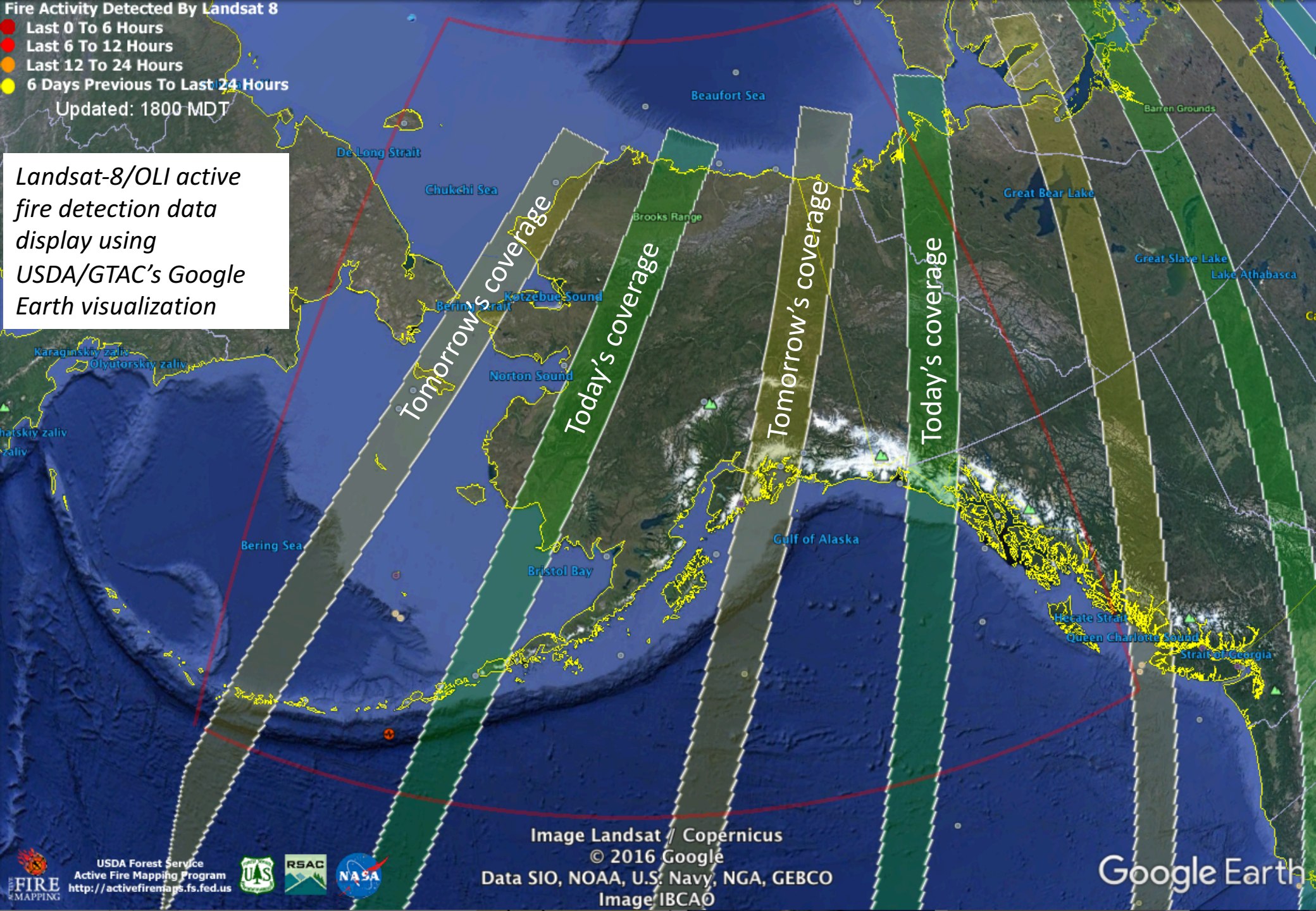
Achievable Coverage Using Landsat-8+Sentinel-2A/B







Landsat-8 Sentinel-2A Sentinel-2B


Fire Activity Detected By Landsat 8
Last 0 To 6 Hours
Last 6 To 12 Hours
Last 12 To 24 Hours
6 Days Previous To Last 24 Hours
Updated: 1800 MDT
Landsat-8/OLI active fire detection data display using USDA/GTAC's Google Earth visualization
Tomorrow's coverage
Today's coverage
Tomorrow's coverage
Today's coverage
Beaufort Sea
Barren Grounds
De Long Strait
Chukchi Sea
Brooks Range
Great Bear Lake
Great Slave Lake
Lake Athabasca
Kotzebue Sound
Bering Strait
Karaginskiy zaliv
Olyutorskiy zaliv
Norton Sound
Bering Sea
Bristol Bay
Gulf of Alaska
Hecate Strait
Queen Charlotte Sound
Strait of Georgia
Image Landsat / Copernicus
© 2016 Google
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO
USDA Forest Service
Active Fire Mapping Program
http://activefiremaps.fs.fed.us
RSAC
NASA
Google Earth

Conclusions

- Higher spatial resolution data sets available in NRT/quasi-NRT
  - VIIRS 375 m (VNP14IMG):
    - Improved response over small/low-intensity fires helping with early detection (as well as capturing smoldering heat)
    - Improved sub-daily mapping of large fires
    - Second VIIRS instrument expected for late 2017: similar overpass time (30min apart) , phased (180^{o}) orbit
  - Landsat-8 and Sentinel-2A/B:
    - Growing data availability. Orbit convergence over Alaska significantly increases the data application potential (24-36h sampling possible)
    - Data latency still needs to improve to fully support NRT use

NRT Active Fire Data Visualization Exercise - I

- Using NASA's Worldview let's display VIIRS and MODIS (Terra/Aqua) active fire data

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

  - Add fire, AOD, satellite tracks

  - Switch projection to improve data visualization over Alaska

  - Simulate a data download (note that not all layers are currently available)
    - MOD14/MYD14 available, MOD03/MYD03 must be obtained separately if data reprojection is desired

NRT Active Fire Data Visualization Exercise - II

- Download VIIRS fire data (e.g., *.csv, *.shp, *kml) for a selected area/acquisition date using available sources and display it on Google Earth

  - USDA/GTAC active fire mapping data portal (select fire data bundle):
    https://fsapps.nwcg.gov/afm/googleearth.php

  - FIRMS active fire download page:
    https://earthdata.nasa.gov/earth-observation-data/near-real-time/firms/active-fire-data

  - NASA MODAPS ftp:

    ftp://nrt3.modaps.eosdis.nasa.gov/FIRMS/viirs/ or

    ftp://nrt4.modaps.eosdis.nasa.gov/FIRMS/viirs/

    For MODIS data replace /viirs/ in the FTP link above with /c6/

    If you don't have an account, you may register at:

    https://urs.earthdata.nasa.gov/users/new

NRT Active Fire Data Visualization Exercise – II (cont'd)

- Now let's add the geotiff image background corresponding to the same area/date

  - GINA Puffin Feeder website:

  http://feeder.gina.alaska.edu/

  - Note: USDA/GTAC VIIRS satellite imagery being developed, MODIS imagery available at:

  https://fsapps.nwcg.gov/afm/imagery.php

  - NASA Direct Readout FTP (VIIRS true color and/or fire mask NPP_VF375_L2*.tif):

  ftp://is.sci.gsfc.nasa.gov/gsfcdata/npp/viirs/level2/