

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

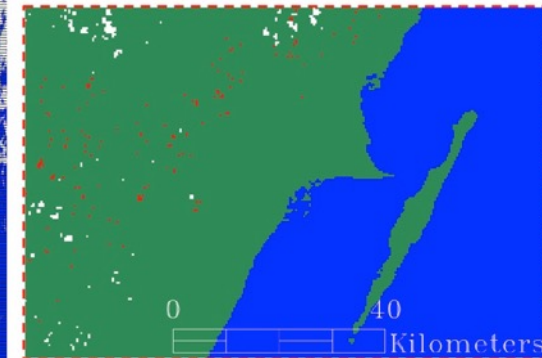
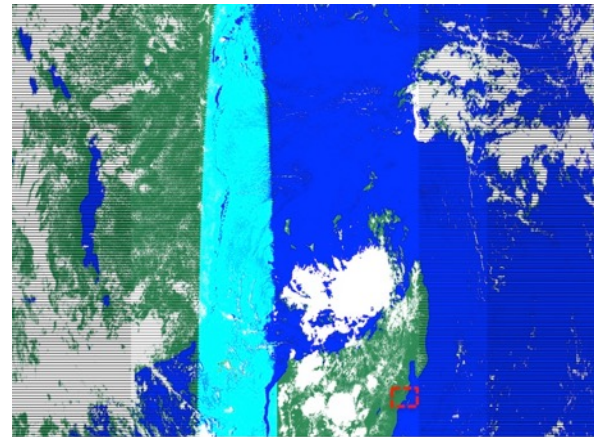
- HDF4 format
 - MOD14/MYD14 @ NASA

- 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

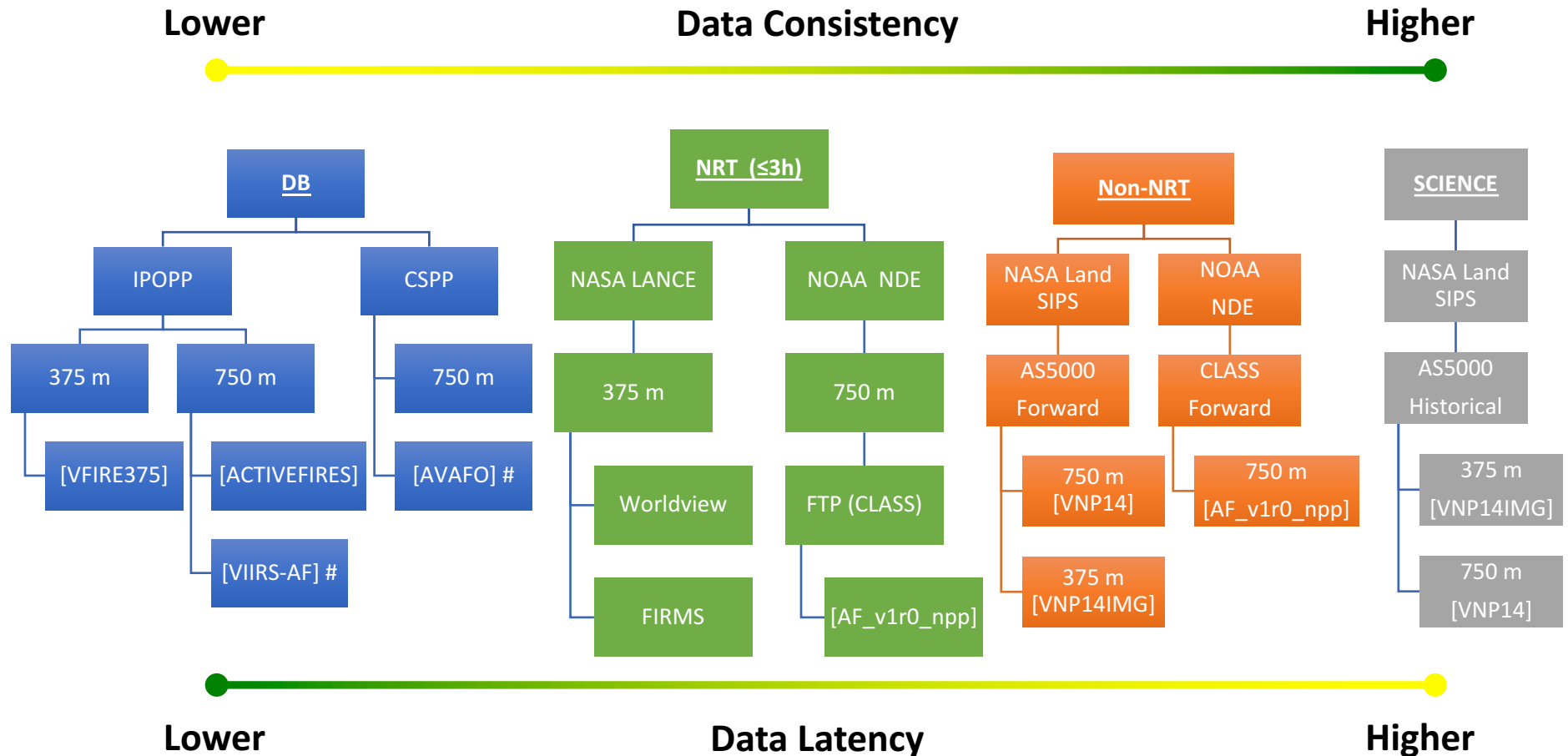
latitude	longitude	brightness	scan	track	acq_date	acq_time	satellite	confidence	version	bright_t31	frp	daynight
-24.828	149.799	317.5	1.1	1	2017-03-26	0020	T	61	6.0NRT	296.4	7.8	D
-26.5	147.385	323.5	1	1	2017-03-26	0020	T	62	6.0NRT	306.4	8.6	D
-26.937	150.22	332	1.2	1.1	2017-03-26	0020	T	82	6.0NRT	305.1	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

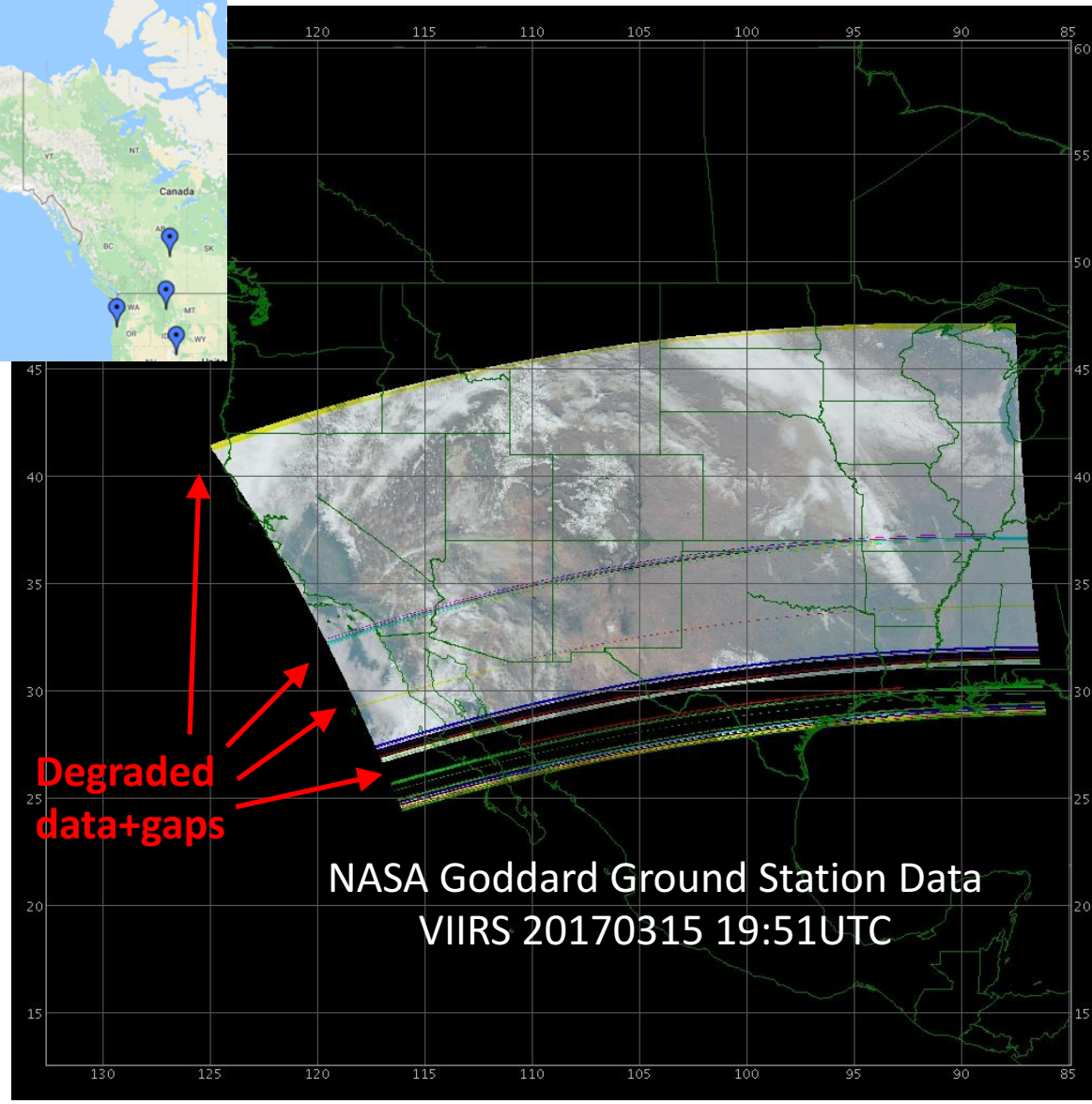
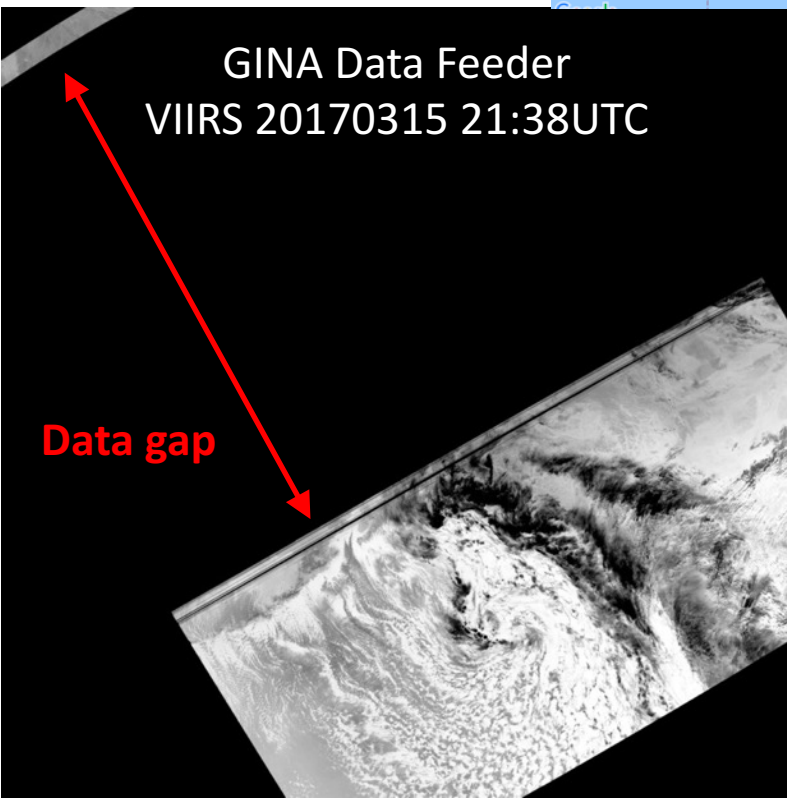
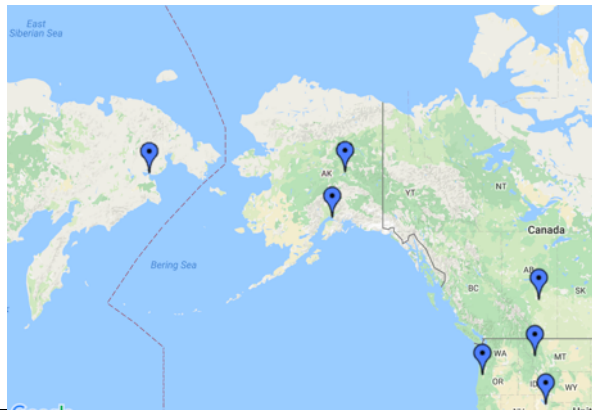
VIIRS Active Fire Product Lineage



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)

USDA FOREST SERVICE REMOTE SENSING APPLICATIONS CENTER

Fire Data in Google Earth

Current Large Incidents (Home)
New Large Incidents
Fire Detection Maps
MODIS Satellite Imagery
VIIRS Satellite Imagery
Fire Detection GIS Data
Fire Data in Google Earth
Fire Data Web Services
Latest Detected Fire Activity
Other MODIS Products
Frequently Asked Questions
About Active Fire Maps

MODIS **VIIRS** **LANDSAT** **AVHRR** **GOES**

Alaska

KML Access:
The links below provide access to several geospatial datasets relevant to fire management in Keyhole Markup Language (KML/KMZ) format for use in Google Earth and other virtual globe applications. Geospatial data are organized by specified geographic region and include location and characterization of satellite fire detections, current large incident locations and NWS fire weather forecasts.

All KMLs update automatically to ensure availability of the latest information (Current link). Animated time series KMLs are provided for the latest updates of each of the fire detection data layers (Animation link). Access to KMLs for previous dates are provided for relevant data layers (Historic link).

KML Descriptions:
Fire Detections - MODIS (1km), VIIRS (375m and 750m), Landsat 8 (30m), AVHRR (1km) and GOES (4km) fire detections by time/date of occurrence within the last 6, 12 and 24 hours, and the 6 days previous to the last 24-hour period.
Fire Radiative Power - Measured fire radiative power (fire intensity) for MODIS fire detections within the last 6, 12 and 24 hours, and the 6 days previous to the last 24-hour period. Available for MODIS and VIIRS-AF only.
Large Incidents - Location and intelligence information of large wildfire incidents currently being tracked by the National Interagency Fire Center (NIFC) and Canadian provincial and territorial fire management agencies.
Fire Weather - Current National Weather Service fire weather watch and red flag warnings by fire weather zone. Available for CONUS, Alaska and Hawaii only.
AFM KML Bundle - A single KML containing all available KMLs provided by the Active Fire Mapping Program for each geographic area.

KML
Fire Detections (MODIS): [Current](#) | [Animation](#) | [Historical](#)
Fire Radiative Power (MODIS): [Current](#) | [Animation](#) | [Historical](#)
Large Incidents: [Current](#) | [Historical](#)
Fire Weather: [Current](#)
AFM KML Bundle: [Current](#)

RSAC
Remote Sensing Applications Center
2222 West 2300 South
Salt Lake City, UT
84119 - 2020

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

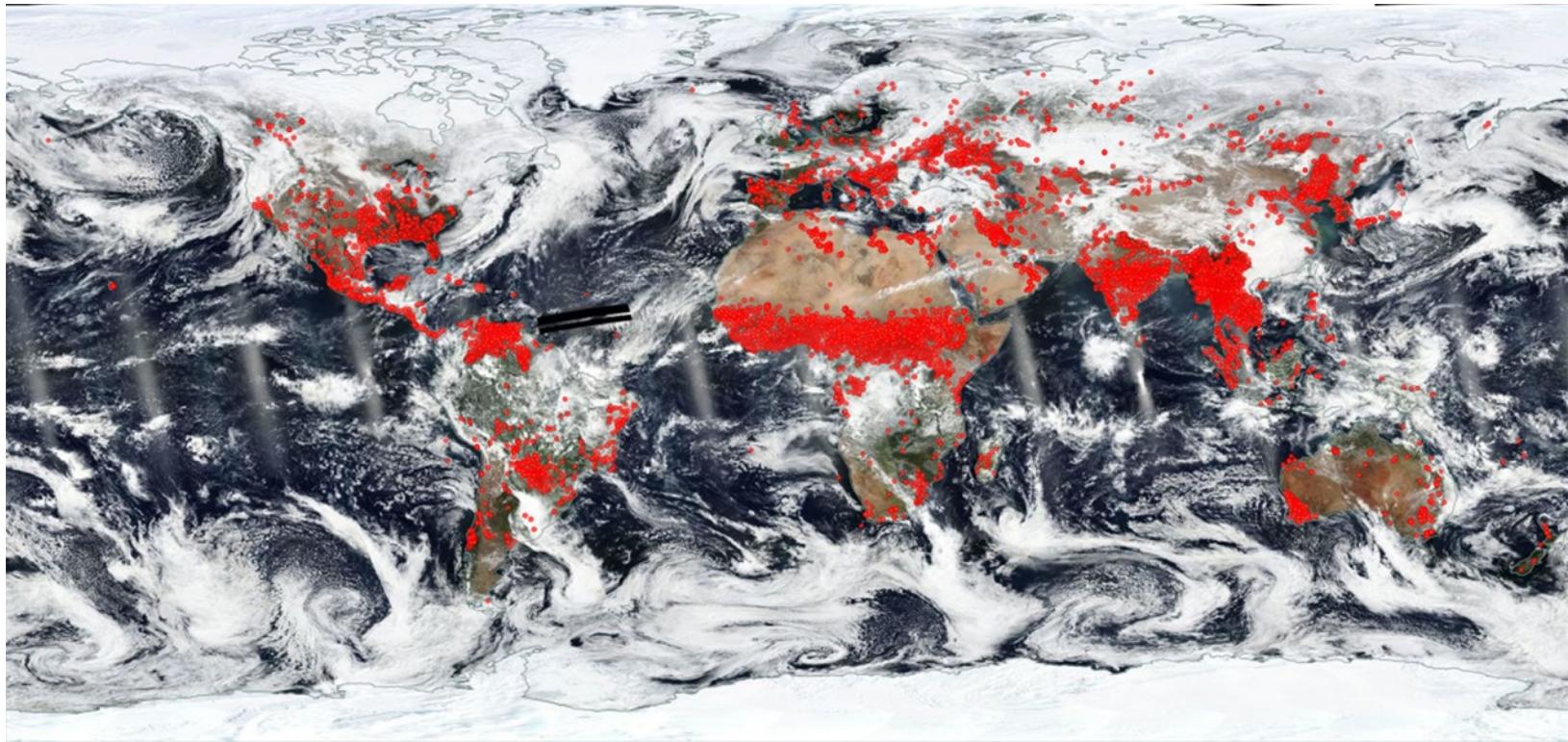
Global coverage

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

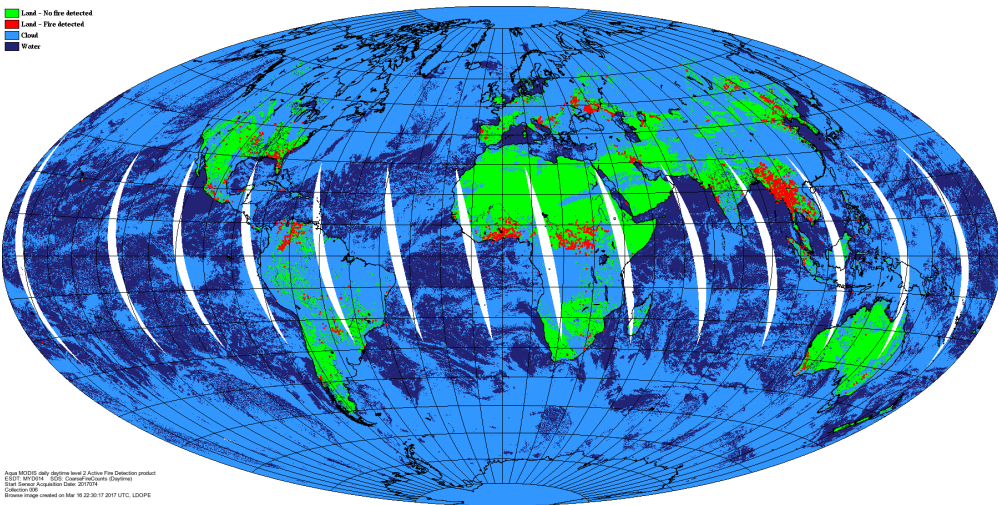
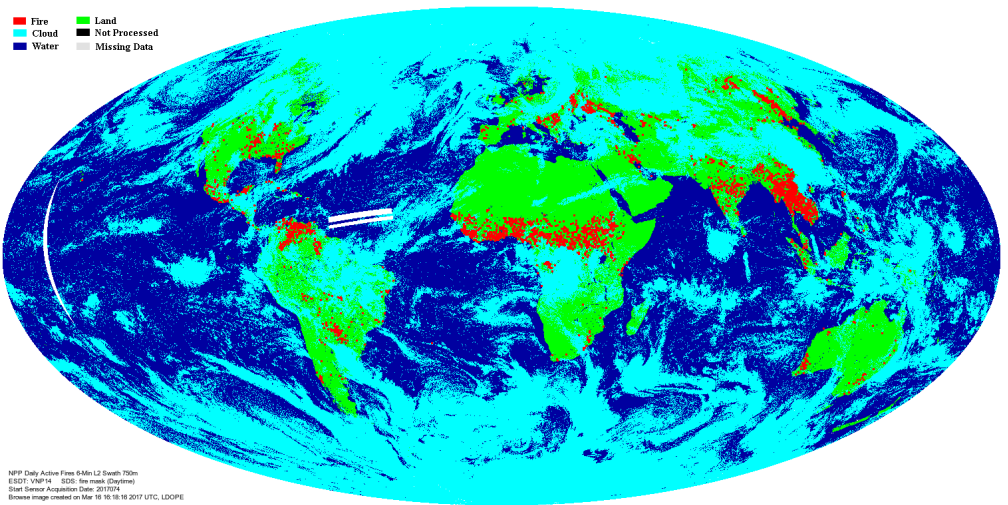
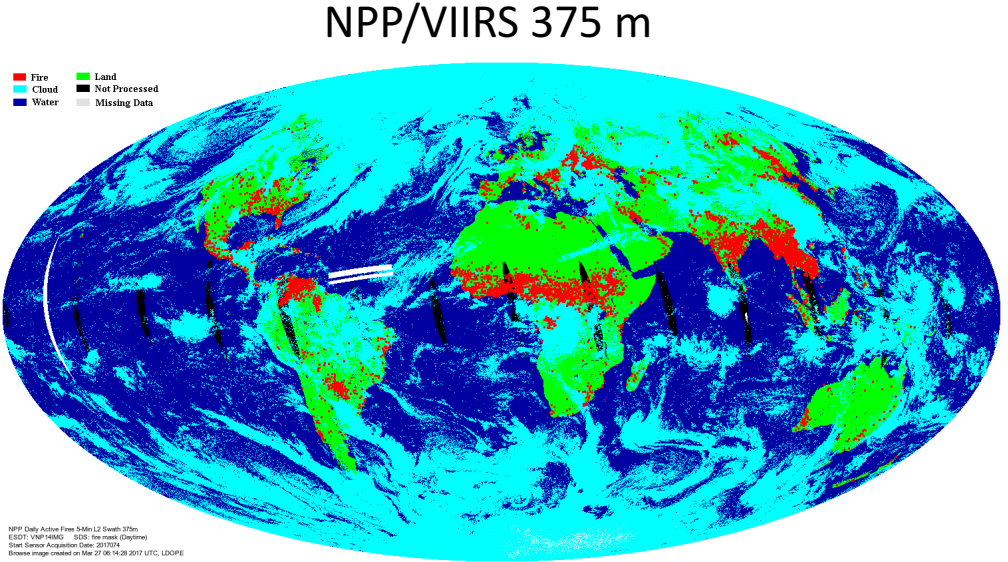
MODIS:

<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



Aqua/MODIS 1 km

NPP/VIIRS 750 m

NASA MODAPS Qualitative Data Browsers

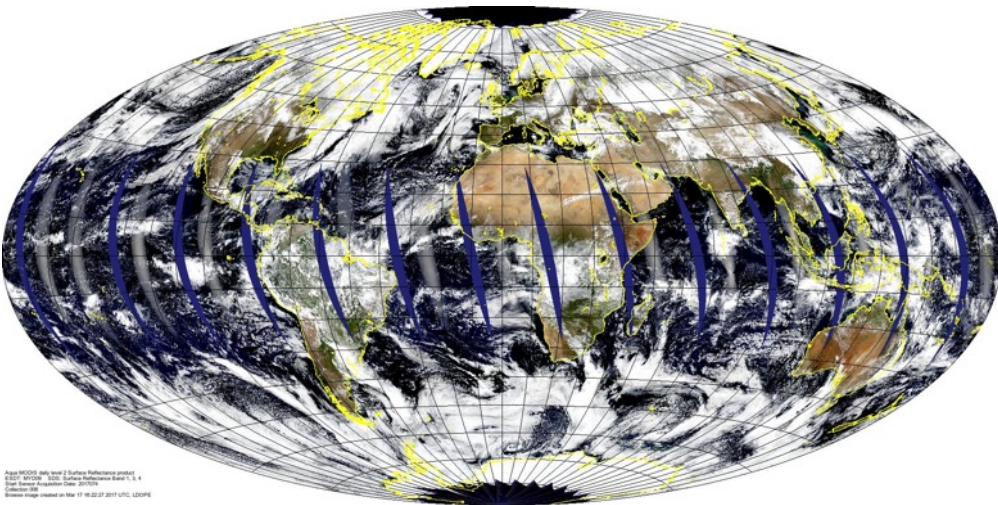
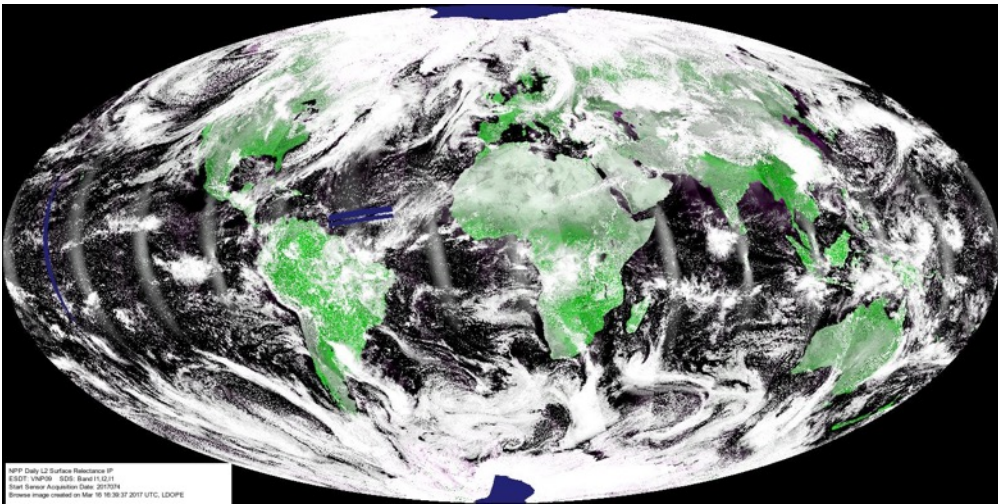
Global Browsers

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>

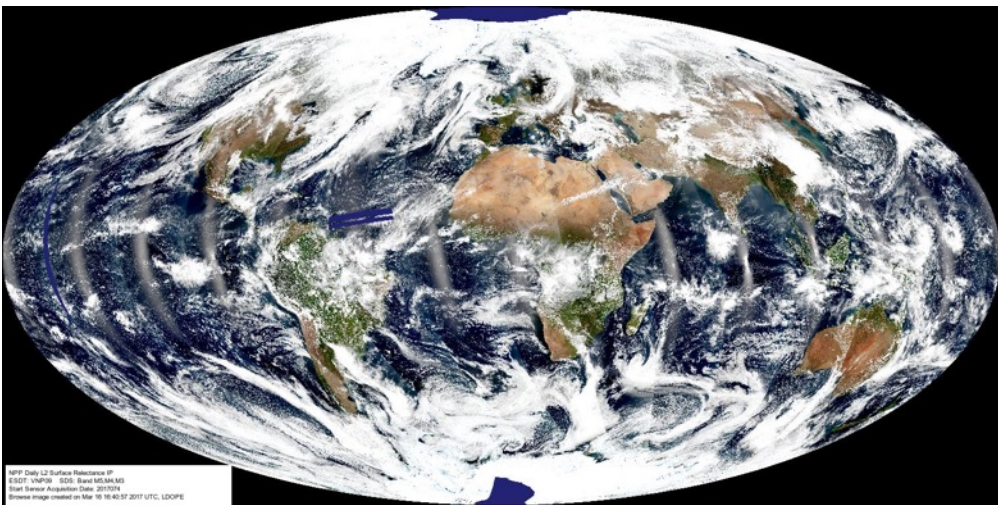
2017-03-15

NPP/VIIRS 375 m



Aqua/MODIS 1 km

NPP/VIIRS 750 m



Fire Information for Resource Management System (FIRMS)

Data
Disciplines:

Fire Information for Resource Management System (FIRMS)

FIRMS delivers global hotspots / fire locations in easy to use formats

FIRMS distributes Near Real-Time (NRT) active fire data within 3 hours of satellite overpass from both MODIS and VIIRS.

- MODIS Active Fire Products ← **Data information**
- VIIRS Active Fire Products ← **including users' guides**

Get hotspot/fire locations

- Fire Email Alerts
- Download Active Fire Data
- Web Fire Mapper
- Global Fire Maps
- Web Services

More Information

- About FIRMS
- Publications
- Links
- FIRMS Frequently Asked Questions (FAQs)
- Citation Policy and Disclaimer

Data
Disciplines:

Active Fire Data

Download active fire products from MODIS (MCD14DL) and VIIRS 375 m (VNP14IMGDL_NRT) for the last 24, 48 hours and 7 days in shapefile, KML, WMS or text file formats. The VIIRS 375 m active fire product is the latest product to be added to FIRMS. VIIRS data complement the MODIS fire detections but the improved spatial resolution of the 375 m data provides a greater response over fires of relatively small areas. [Read more about VIIRS...](#)

Data older than 7 days can be obtained from the [Archive Download Tool](#). Users intending to perform scientific analysis are advised to download the data.

Please note:

- MODIS C6 is available from November 2000 (for Terra) and from July 2002 (for Aqua) to the present.
- VIIRS 375 m NRT data is currently available from 8 January 2016 (NRT data are distinct from standard quality data).

More Resources

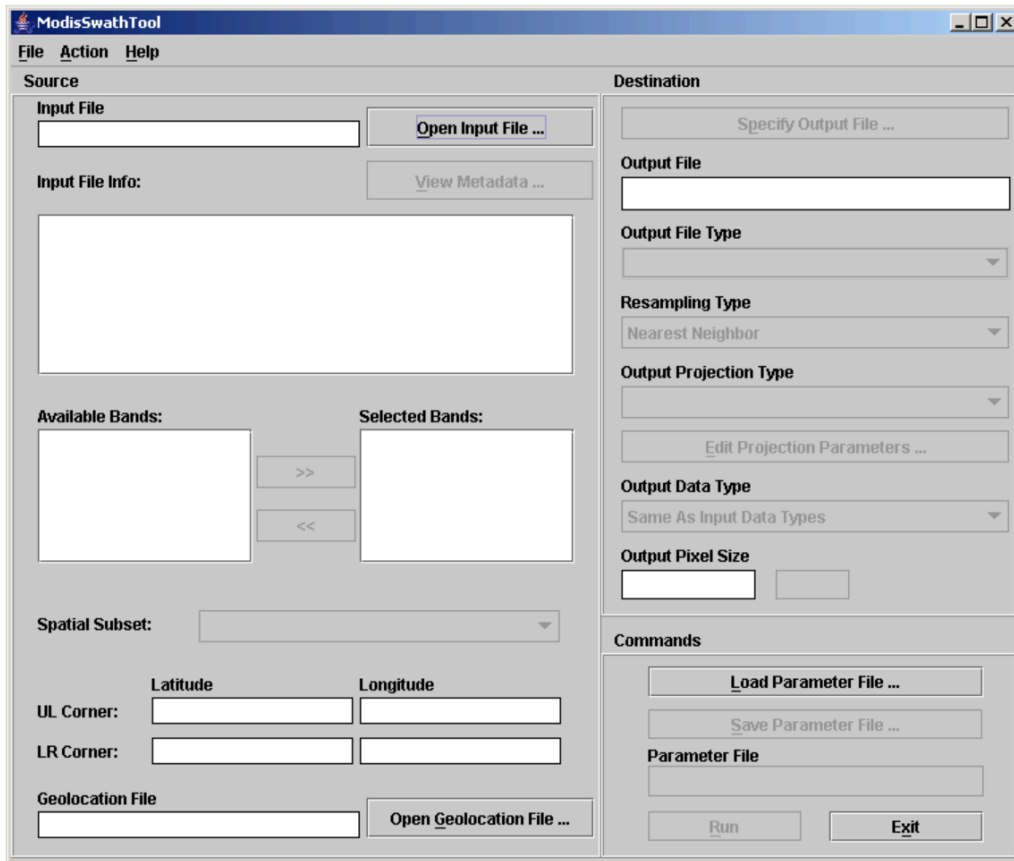
- Shapefile
- KML
- TXT
- WMS
- Archive Download Tool
- Global Fire Maps

<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:

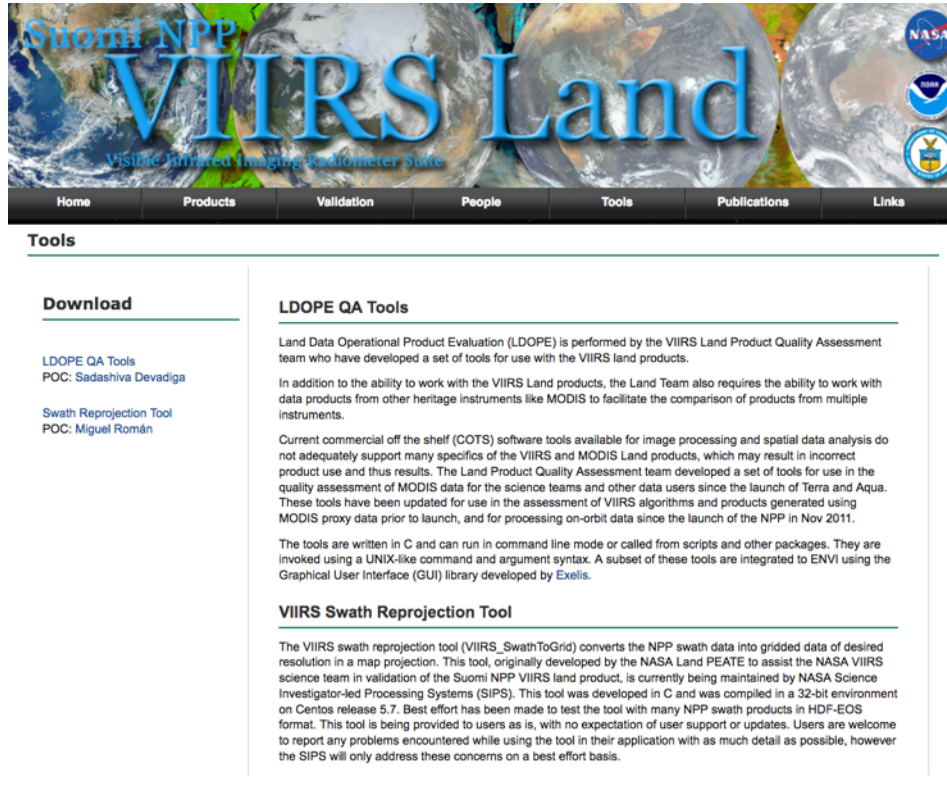
NASA MODAPS (registered users):

<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>



Download

- LDOPE QA Tools
POC: Sadashiva Devadiga
- Swath Reprojection Tool
POC: Miguel Román

LDOPE QA Tools

Land Data Operational Product Evaluation (LDOPE) is performed by the VIIRS Land Product Quality Assessment team who have developed a set of tools for use with the VIIRS land products.

In addition to the ability to work with the VIIRS Land products, the Land Team also requires the ability to work with data products from other heritage instruments like MODIS to facilitate the comparison of products from multiple instruments.

Current commercial off the shelf (COTS) software tools available for image processing and spatial data analysis do not adequately support many specifics of the VIIRS and MODIS Land products, which may result in incorrect product use and thus results. The Land Product Quality Assessment team developed a set of tools for use in the quality assessment of MODIS data for the science teams and other data users since the launch of Terra and Aqua. These tools have been updated for use in the assessment of VIIRS algorithms and products generated using MODIS proxy data prior to launch, and for processing on-orbit data since the launch of the NPP in Nov 2011.

The tools are written in C and can run in command line mode or called from scripts and other packages. They are invoked using a UNIX-like command and argument syntax. A subset of these tools are integrated to ENVI using the Graphical User Interface (GUI) library developed by Exelis.

VIIRS Swath Reprojection Tool

The VIIRS swath reprojection tool (VIIRS_SwathToGrid) converts the NPP swath data into gridded data of desired resolution in a map projection. This tool, originally developed by the NASA Land PEATE to assist the NASA VIIRS science team in validation of the Suomi NPP VIIRS land product, is currently being maintained by NASA Science Investigator-led Processing Systems (SIPS). This tool was developed in C and was compiled in a 32-bit environment on Centos release 5.7. Best effort has been made to test the tool with many NPP swath products in HDF-EOS format. This tool is being provided to users as is, with no expectation of user support or updates. Users are welcome to report any problems encountered while using the tool in their application with as much detail as possible, however the SIPS will only address these concerns on a best effort basis.

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

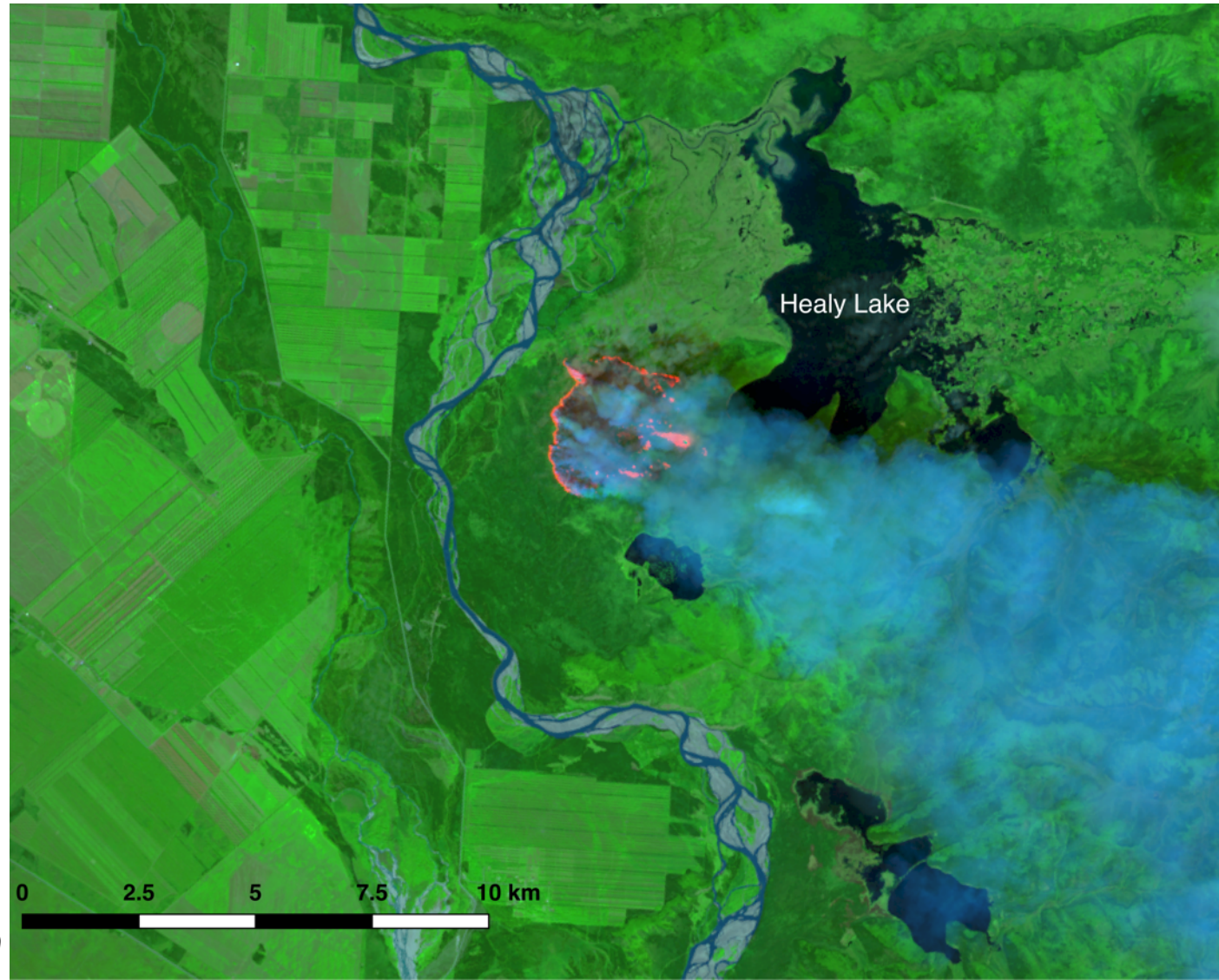
- Nominal Landsat-8 data latency (> 3h) still an issue; Gilmore Creek ground station may be able to provide quicker access for Alaska. Sentinel-2A/B expected to approximate Landsat-8 data latency

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

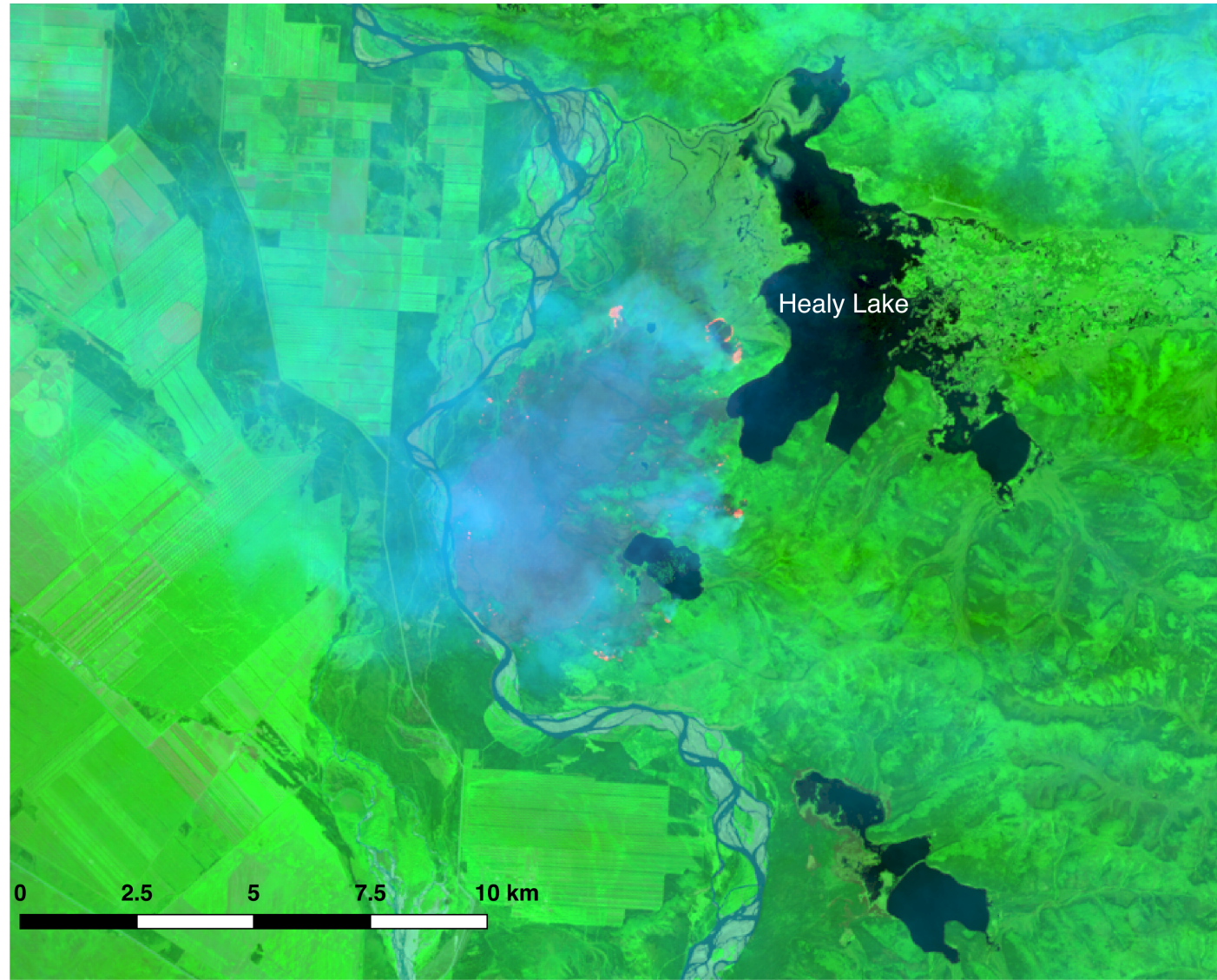
Landsat-8/OLI (30 m) Healy Lake Fire

~100 miles SE of Fairbanks

Lightning ignition:
16 June 2015

1st daytime Landsat-8 image:
17 June

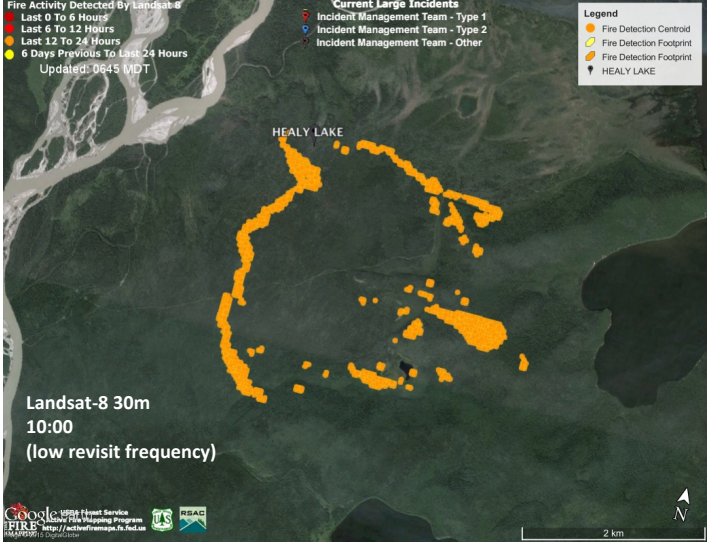
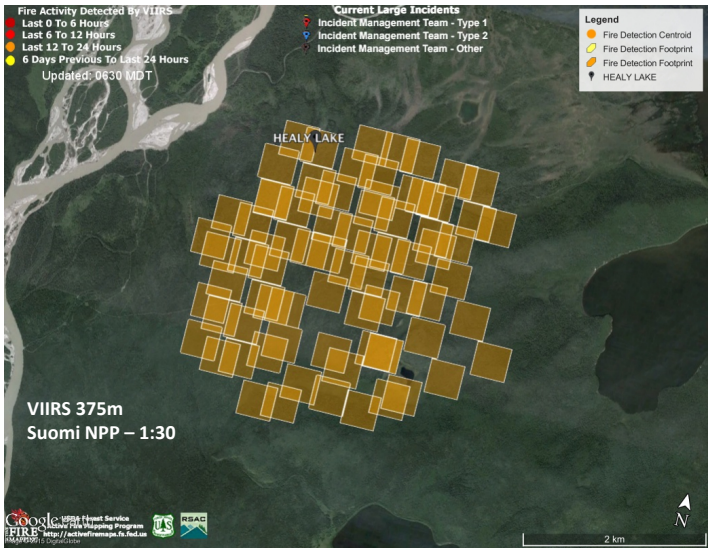
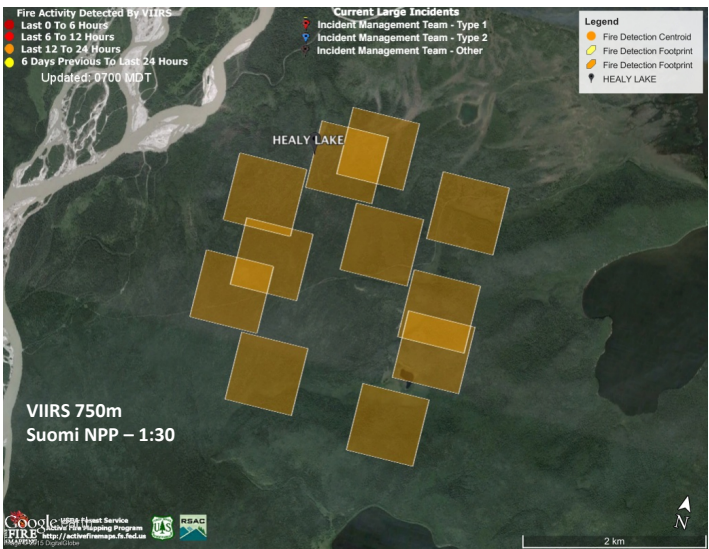
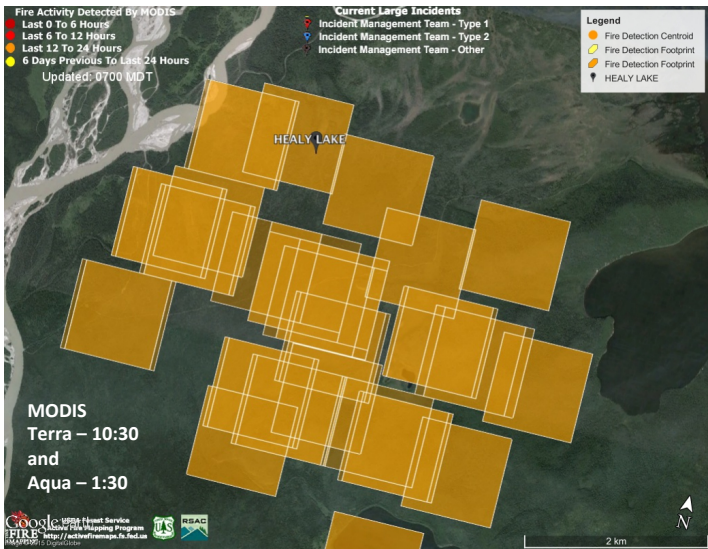
2nd daytime Landsat-8 image:
19 June



Scene: LC80660152015170LGN00

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

Healy Lake Fire (16-17 June 2015)

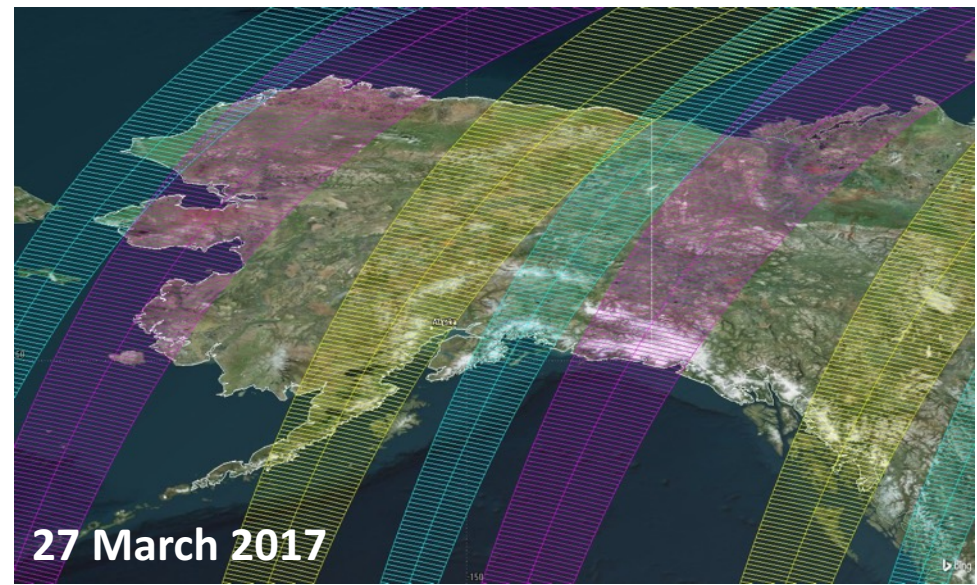
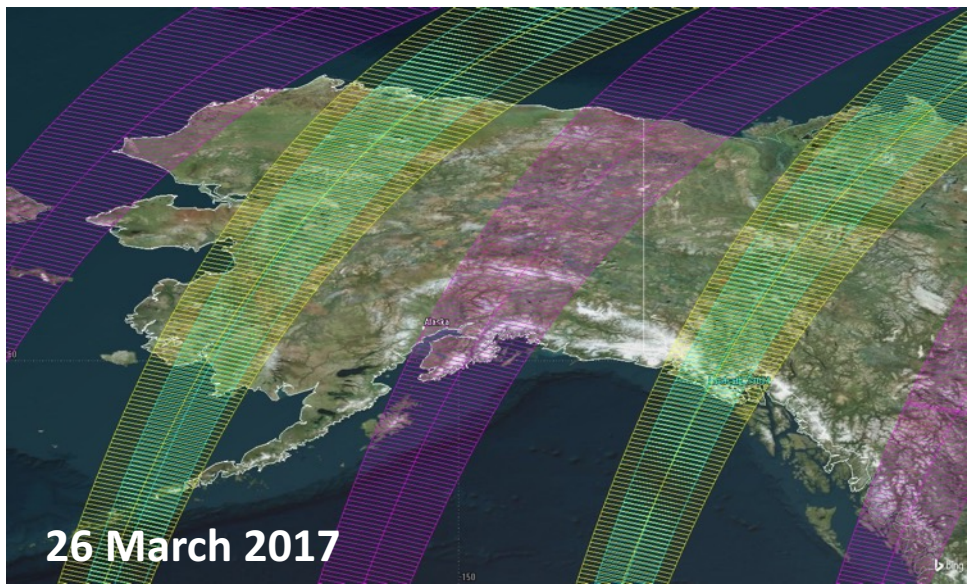
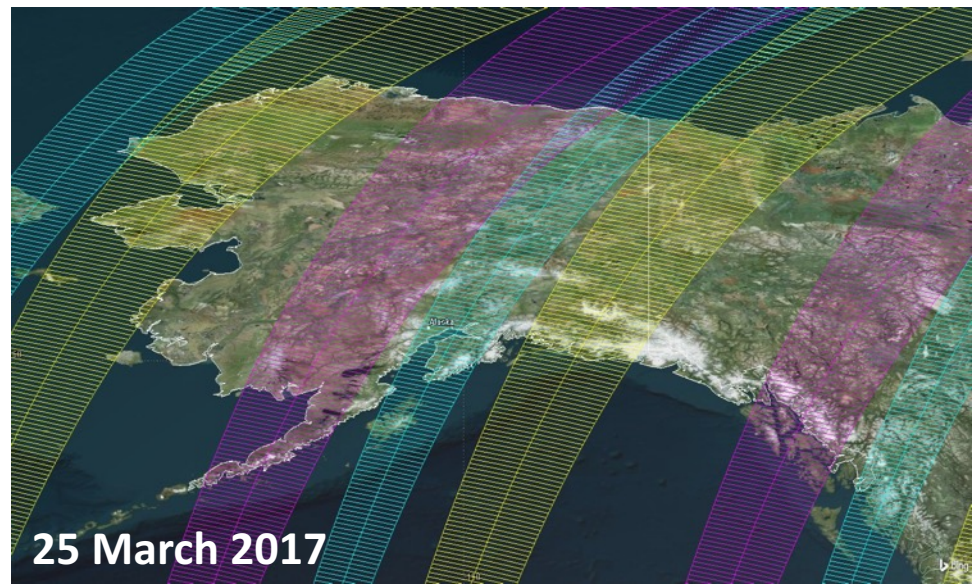


Spatial resolution

X

Temporal resolution

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



Landsat-8



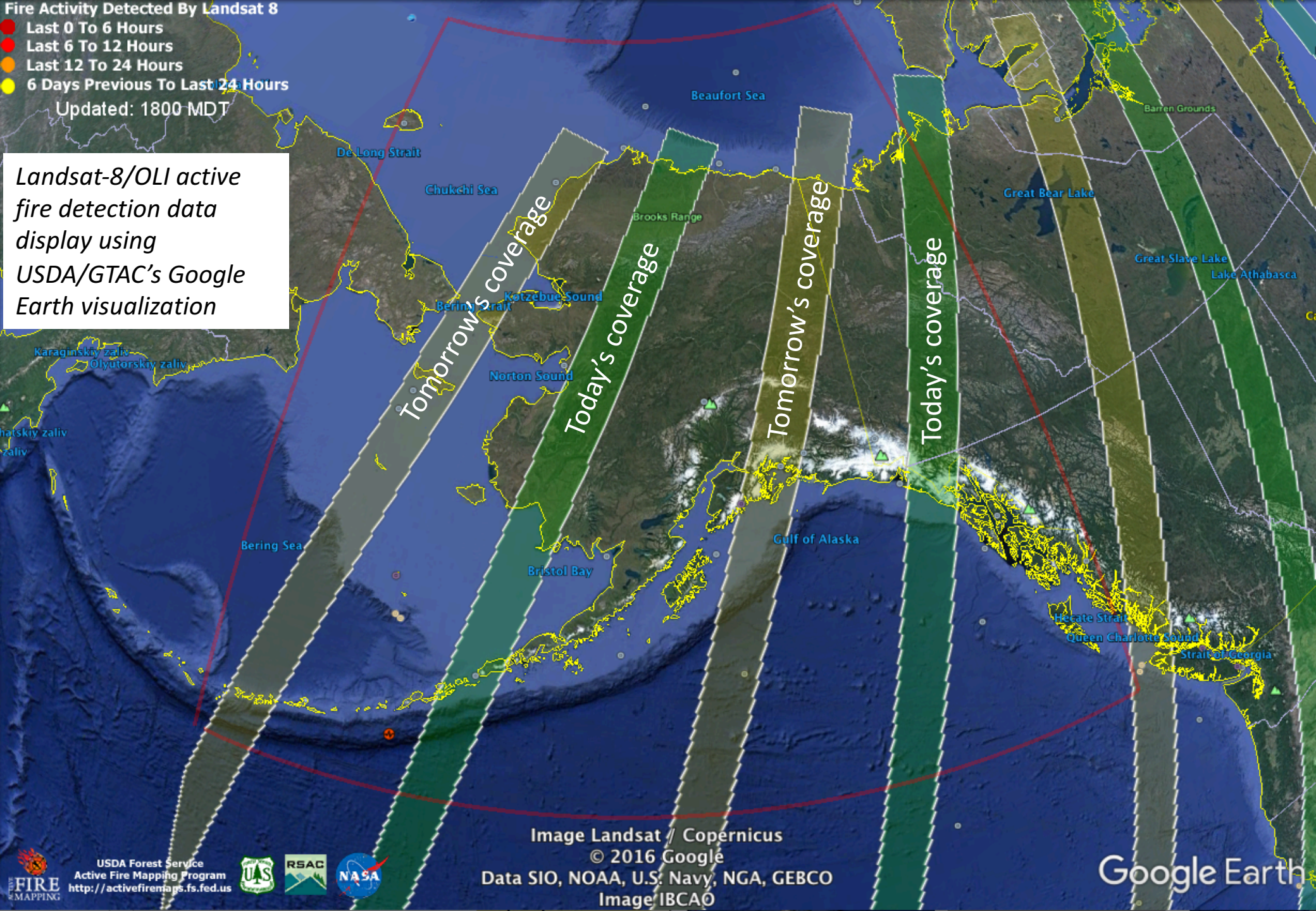
Sentinel-2A



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



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°) 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.nwccg.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/gsfcddata/npp/viirs/level2/>