

Satellite Based Fire Products: Methods, Data Access, and Applications

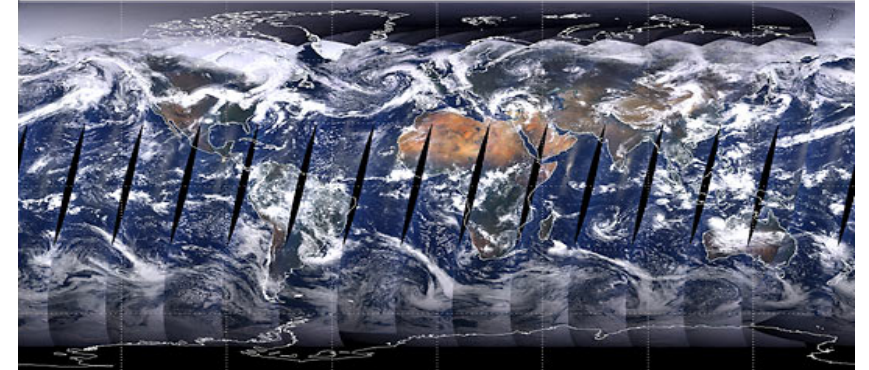
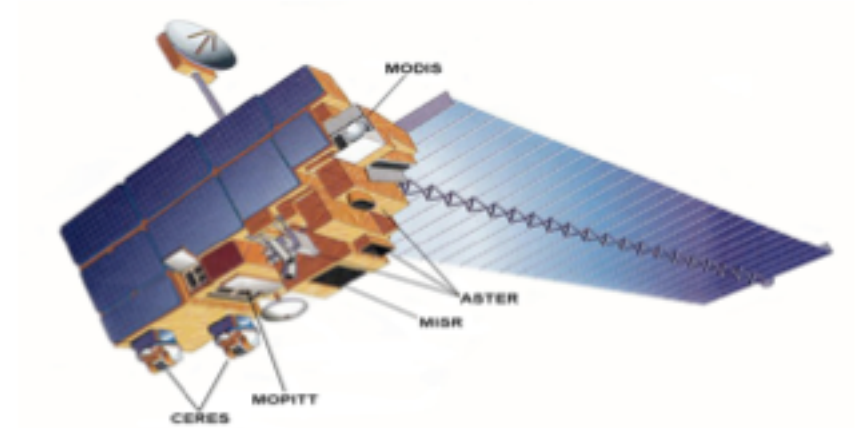
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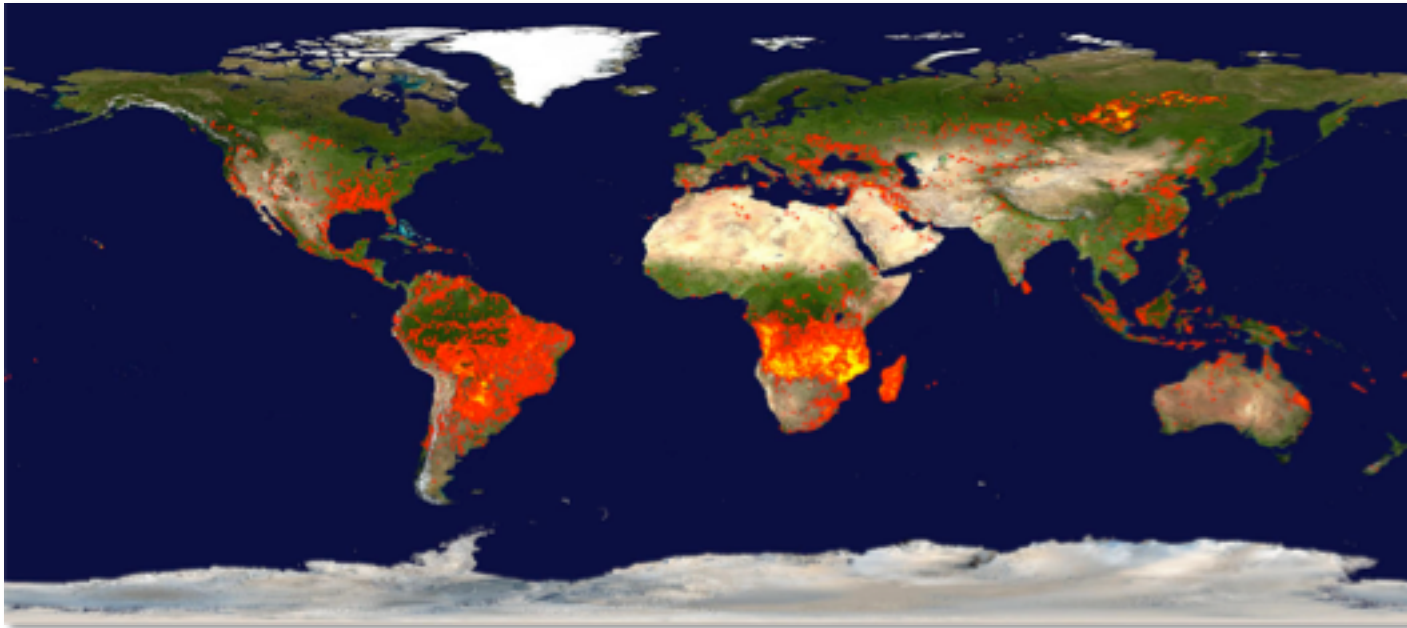
MODIS

- Spatial Resolution
 - 250 m, 500 m, 1 km
- Temporal Resolution
 - Daily, 8 day, 16 day, monthly, quarterly, yearly
 - 2000–present
- Data Format
 - Hierarchical data format – Earth Observing System Format (HDF-EO8)
- Spectral Coverage
 - 36 bands (major bands include red, blue, IR, NIR, MIR)
 - Bands 1-2: 250 m
 - Bands 3-7: 500 m
 - Bands 8-36: 1000 m



MODIS Active Fire Products (MOD04A1/MYD04A1)

- Near Real-Time (NRT) thermal anomalies and fire locations
- Provides snapshots of active burning fires and burned areas
- The Active Fire product delivers actively burning locations on a daily basis at 1 km resolution (additional 8 day and monthly products)



**Global Fire Map
(September 17 – 26, 2016)**

Colors range from red, where the fire count is low, to yellow where the number of fires is large



MODIS Thermal Anomalies Algorithm

- MODIS Fire Detection:
 - 1 km pixel flagged as containing one or more fires
 - can also detect volcanic signatures
- Significant increase in absolute radiance at $4\ \mu\text{m}$ (band 22) and $11\ \mu\text{m}$ (band 31)
 - cloud masks applied
 - VIIRS active fire detection algorithm is similar



VIIRS fire detections,
NASA Worldview



MODIS C6 Fire Detection Algorithm

<http://modis-fire.umd.edu/pages/manuals.php>

Table 2: MODIS channels used for active-fire detection and characterization.

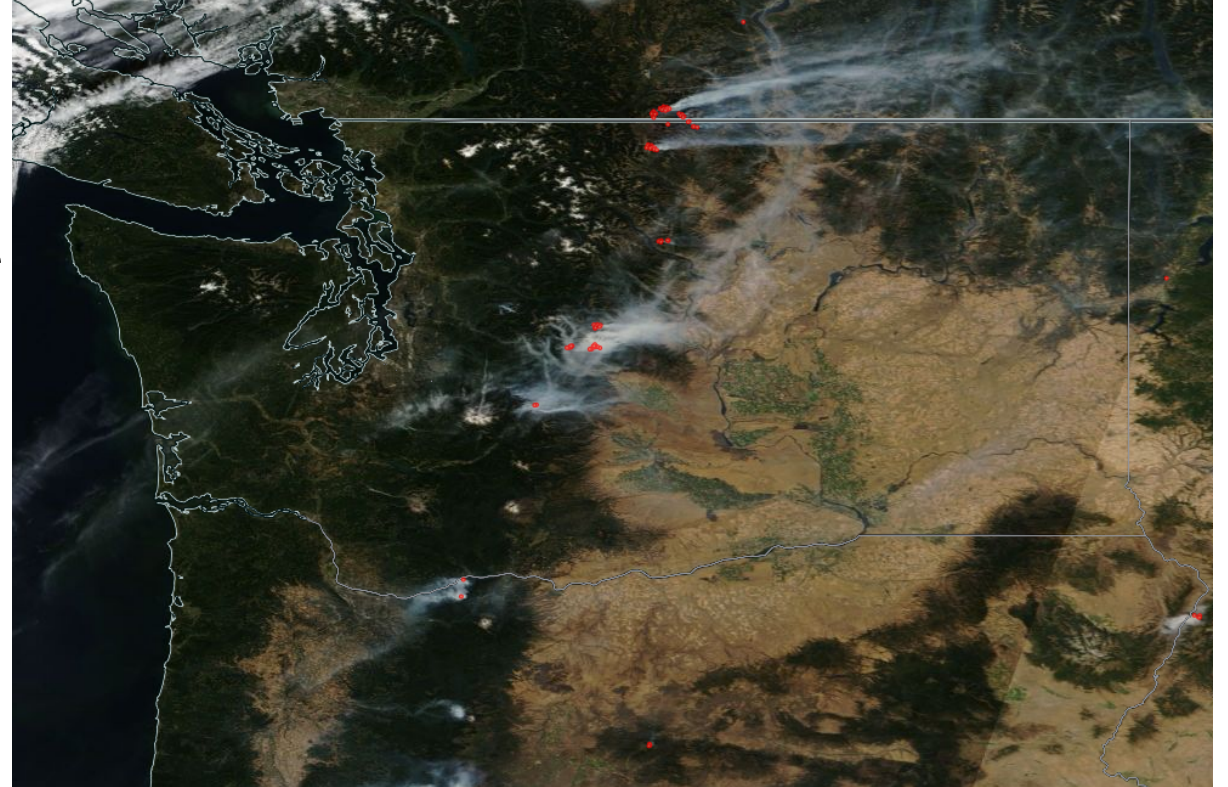
Channel	Central wavelength (μm)	Purpose
1	0.65	Sun glint and coastal false alarm rejection; cloud masking.
2	0.86	Bright surface, sun glint, and coastal false alarm rejection; cloud masking.
7	2.1	Sun glint and coastal false alarm rejection.
21	3.96	High-range channel for fire detection and characterization.
22	3.96	Low-range channel for fire detection and characterization.
31	11.0	Fire detection, cloud masking.
32	12.0	Cloud masking.

- Potential fire pixel identified
 - 0.86 reflectance < 0.35
 - $BT4 > BT4^*$ (where $300 \text{ K} \leq BT4^* \leq 330 \text{ K}$)
 - $BT4 - BT11 > \Delta BT^*$ (where $10 \text{ K} \leq \Delta BT^* \leq 35 \text{ K}$)
- Otherwise flagged as non-fire pixel



MODIS Thermal Anomalies Algorithm

- Limitations
 - False positives: small forest clearings (bare soil)
 - Large fire omissions due to thick smoke
- Collection 6 (most recent) improves upon these errors
 - Global commission error of 1.2%

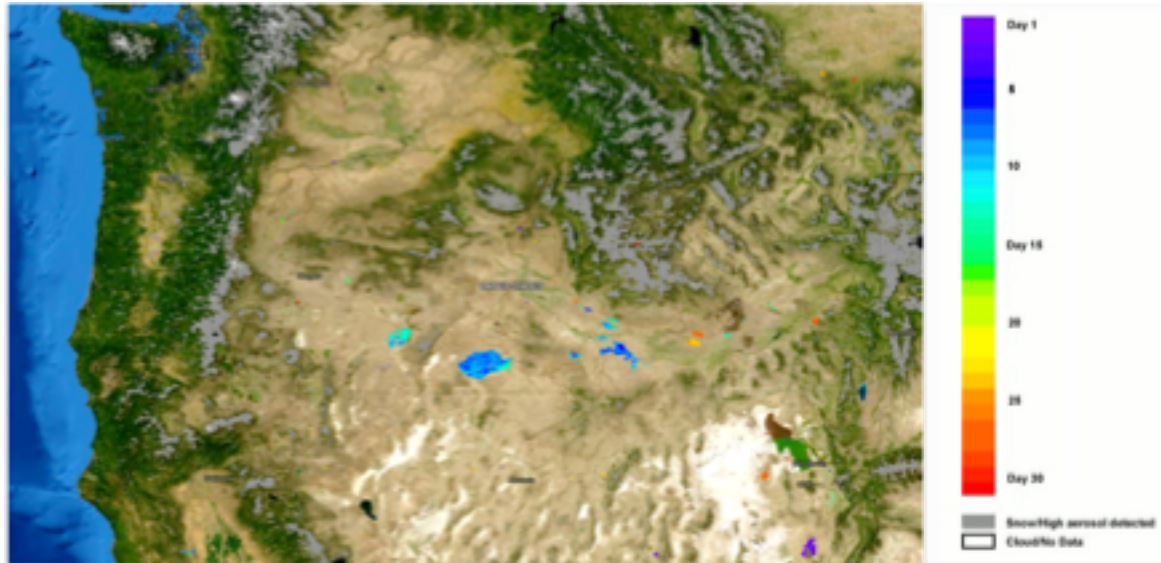


MODIS fire detections,
NASA Worldview



MODIS Land Products: Burned Area (MCD64A1)

- The combined Terra & Aqua MODIS Burned Area Product is a monthly gridded 500m product
- MODIS detects the approximate date of burning at 500m resolution
- Maps include the spatial extent of recent fires
- For more information: <http://modis-fire.umd.edu>



This image shows the extent of the Long Draw fire that occurred in southeastern Oregon

The colors represent the approximate day of the burning from July 8 (start of fire) to July 12, 2012 (end of fire)



Where to Obtain MODIS Fire Products

Archived data



Land Process Distributed Active Archive (LPDAAC):
<http://lpdaac.usgs.gov/>



NASA Earthdata: <https://earthdata.nasa.gov/>

Near Real Time (NRT)



Worldview: <http://worldview.earthdata.nasa.gov>
(archived data also accessible)

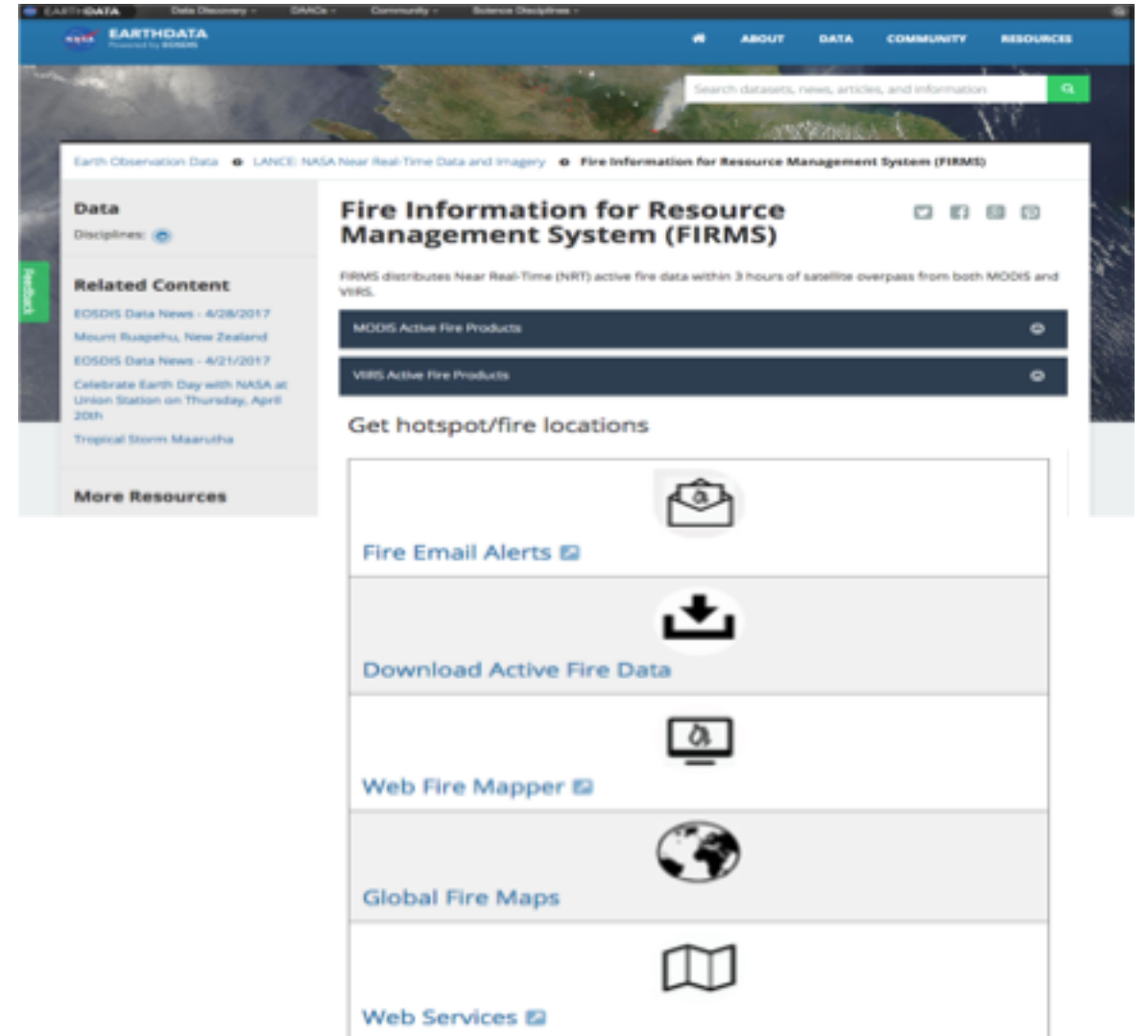


Fire Information for Resource Management System:
<http://earthdata.nasa.gov/earth-observation-data/near-real-time/firms>



Fire Information for Resource Management System (FIRMS)

- Near real-time (NRT) active fire data within 3 hours of satellite overpass
- Global MODIS and VIIRS fire locations
- Historical data available
- Available in:
 - Email alerts
 - GIS-friendly file format
 - Visualization in **Web Fire Mapper** or **Worldview**
- FIRMS Webinar
 - <https://www.youtube.com/watch?v=0fPVmnY6pBs&feature=youtu.be>

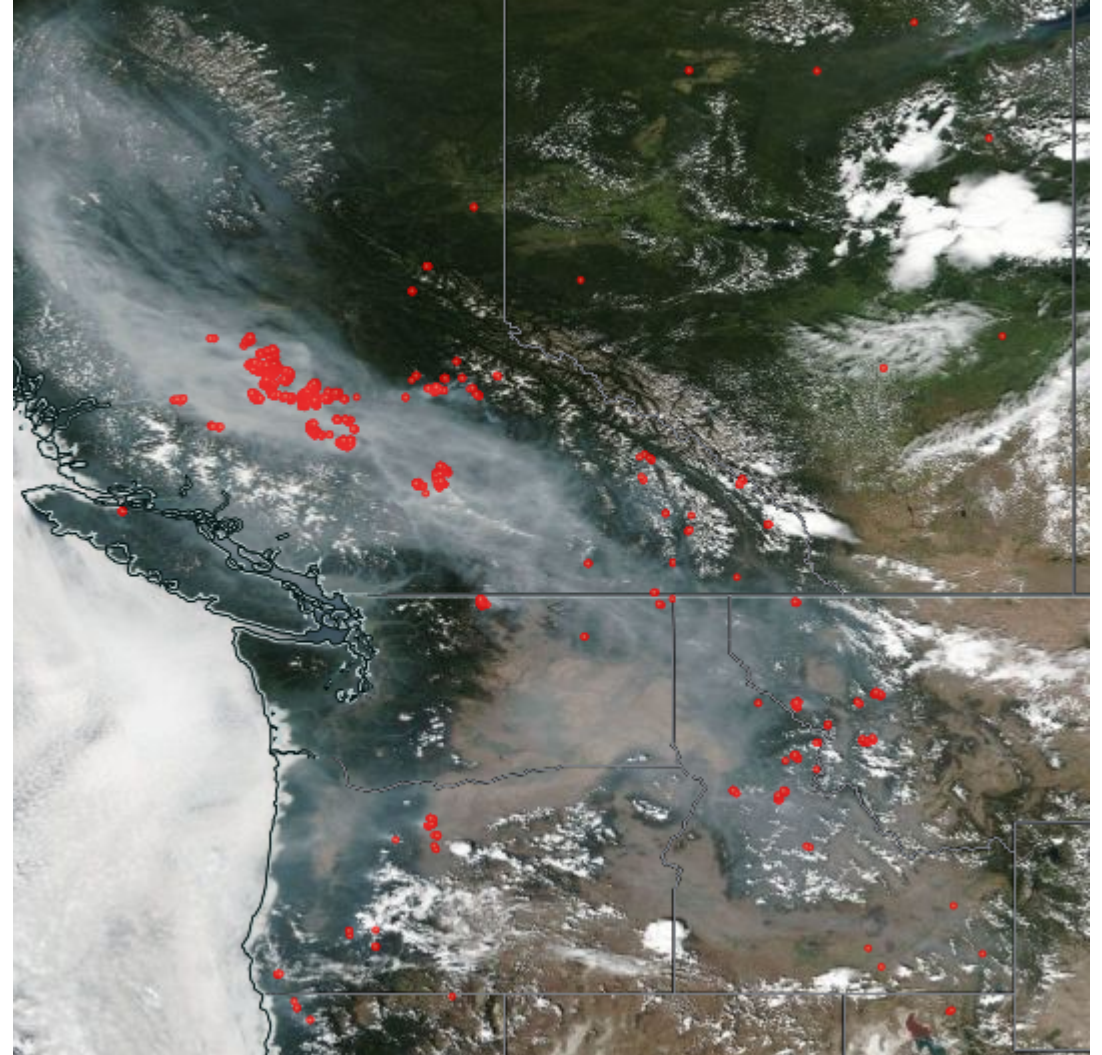


The screenshot displays the NASA EarthData website interface for the Fire Information for Resource Management System (FIRMS). The page features a blue header with the NASA logo and navigation links for 'ABOUT', 'DATA', 'COMMUNITY', and 'RESOURCES'. A search bar is positioned at the top right. The main content area is titled 'Fire Information for Resource Management System (FIRMS)' and includes a brief description: 'FIRMS distributes Near Real-Time (NRT) active fire data within 3 hours of satellite overpass from both MODIS and VIIRS.' Below this, there are two expandable sections for 'MODIS Active Fire Products' and 'VIIRS Active Fire Products'. A section titled 'Get hotspot/fire locations' contains five interactive buttons: 'Fire Email Alerts' (with an envelope icon), 'Download Active Fire Data' (with a download icon), 'Web Fire Mapper' (with a computer monitor icon), 'Global Fire Maps' (with a globe icon), and 'Web Services' (with a map icon). A left sidebar contains 'Data' and 'Related Content' sections with links to various news articles and resources.



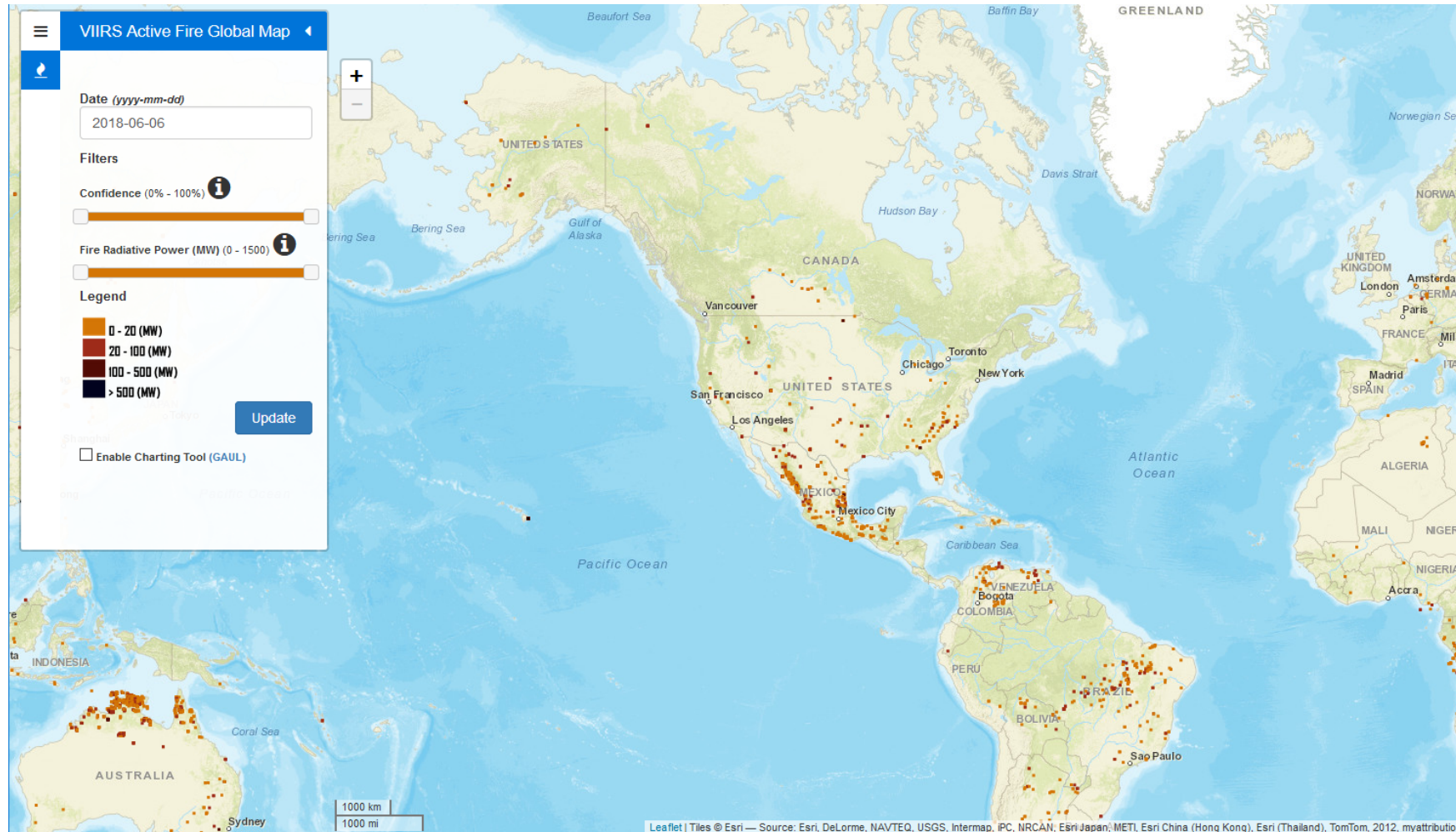
VIIRS Active Fire Product

- Released October 22, 2012
- Spatial resolution:
 - 750 m (M-band)
 - 375 m (I-band)
- Data still preliminary and continually undergo evaluation & calibration
- Data available as:
 - ASCII
 - KMZ
 - TIFF
- Exercise on this tool in upcoming session



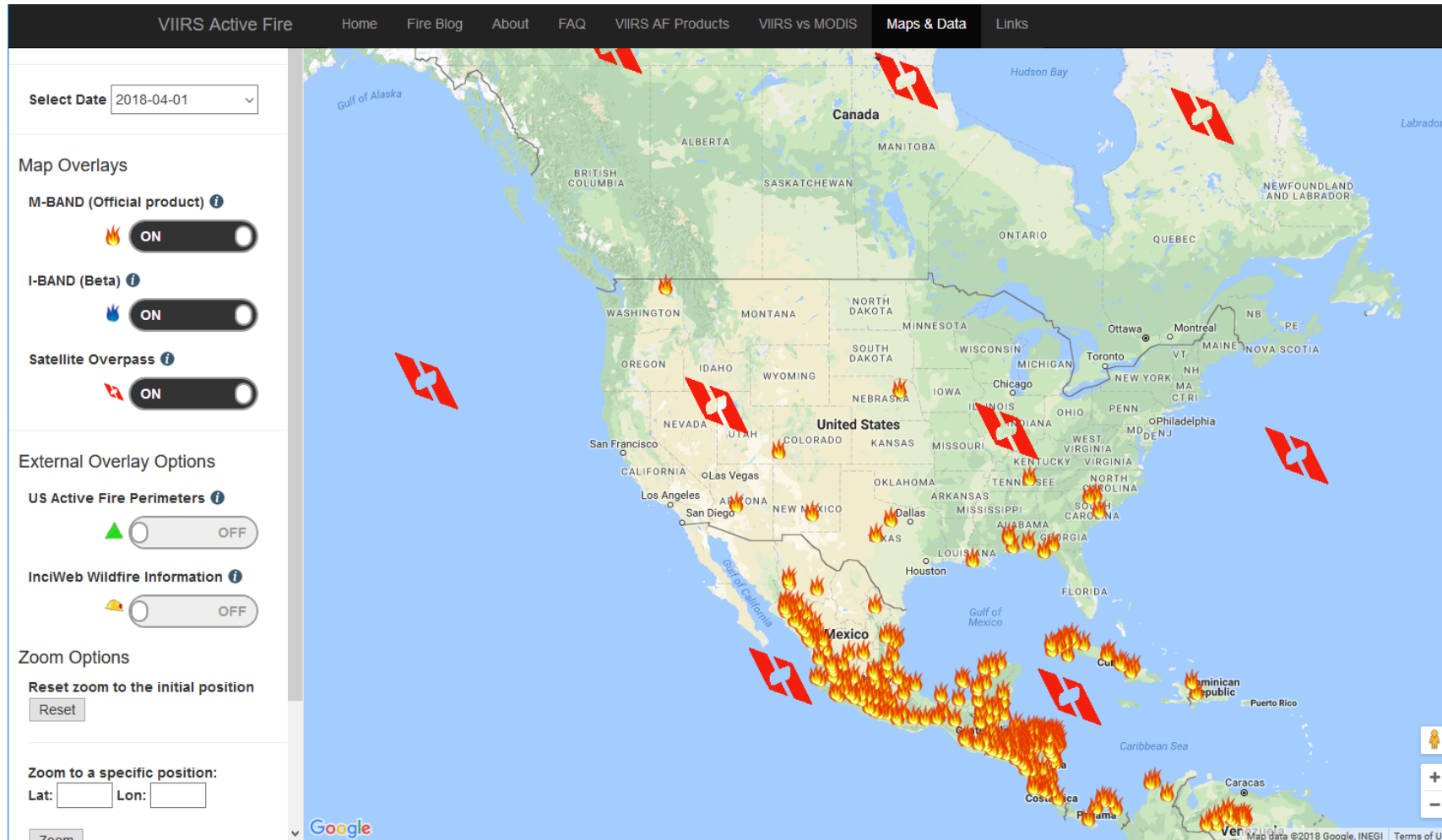
VIIRS Active Fire Map

<http://viirsfire.geog.umd.edu/map/viirsMap.php>



VIIRS Active Fire Map (CONUS)

http://viirsfire.geog.umd.edu/map/map_v2.php



US Forest Service - Tools

<https://fsapps.nwca.gov/afm/>

The screenshot displays the 'Fire Data in Google Earth' interface. At the top, it features the USDA Forest Service logo and the title 'REMOTE SENSING APPLICATIONS CENTER'. The main heading is 'Fire Data in Google Earth'. Below this, there are five satellite data source buttons: MODIS, VIIRS, LANDSAT, AVHRR, and GOES. A central map of the Continental United States shows fire detection points. A sidebar on the left contains a navigation menu with items such as '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', and 'About Active Fire Maps'. At the bottom, there is a 'KML Access' section with links for 'Fire Detections (MODIS)', 'Fire Radiative Power (MODIS)', 'Large Incidents', 'Fire Weather', and 'AFM KML Bundle'. The footer includes the RSAC logo and the address '2222 West 2300 South'.

Where to Obtain VIIRS Land Products



Worldview: <http://worldview.earthdata.nasa.gov>

VIIRS Active Fire

VIIRS Active Fire: <http://viirsfire.geog.umd.edu/pages/about.php>



NOAA Comprehensive Large Array-Data Stewardship System (CLASS):

<http://www.class.ngdc.noaa.gov/saa/products/welcome>

LAADS DAAC

Level-1 and Atmosphere Archive & Distribution System:

<http://ladsweb.nascom.nasa.gov>



References

- User guides for the MODIS active fire and burned area products
 - <http://modis-fire.umd.edu/pages/manuals.php>
- VIIRS Active Fire page:
 - <http://viirsfire.geog.umd.edu/>
- NASA VIIRS Land Products
 - <https://viirsland.gsfc.nasa.gov/Products/NASA/NASAprd.html>



Questions & Discussion Prompts

- Changes in what retrieved quantity are used to detect fires?
- What is a source of uncertainty for fire detection?

