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 µm (band 22) and 11 µm (band 31)
  – cloud masks applied
  – VIIRS active fire detection algorithm is similar
MODIS C6 Fire Detection Algorithm

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

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

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

- Potential fire pixel identified
  - 0.86 reflectance < 0.35
  - BT4 > BT4* (where 300 K ≤ BT4* ≤ 330 K)
  - BT4 – BT11 > ΔBT* (where 10 K ≤ ΔBT* ≤ 35 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 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](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


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 (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
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.geoq.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.nwcg.gov/afm/
Where to Obtain VIIRS Land Products

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

VIIRS Active Fire: http://viirsfire.geoq.umd.edu/pages/about.php

NOAA Comprehensive Large Array-Data Stewardship System (CLASS):
http://www.class.nrdc.noaa.gov/saa/products/welcome

Level-1 and Atmosphere Archive & Distribution System:
http://ladsweb.nascom.nasa.gov
References

• User guides for the MODIS active fire and burned area products

• VIIRS Active Fire page:
  – http://viirsfire.aeoq.umd.edu/

• NASA VIIRS Land Products
Questions & Discussion Prompts

• Changes in what retrieved quantity are used to detect fires?

• What is a source of uncertainty for fire detection?