Satellite Remote Sensing of Active Fires: Capabilities, Challenges, and Opportunities

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Satellite Remote Sensing Capabilities

- Numerous satellite assets that map the Earth from low-earth and geostationary orbit at wavelengths that provide information about active fires.
- Visible provides info on smoke, near-IR on fire power, mid-IR on hot spots.
Satellite Remote Sensing Coverage

- **Often a mismatch between satellite coverage and active fire needs.**

<table>
<thead>
<tr>
<th>Sensor and additional web resources</th>
<th>Temporal resolution</th>
<th>Spatial resolution (km)</th>
<th>VIS-MIR bands (μ.m)</th>
<th>TIR bands (μ.m)</th>
</tr>
</thead>
</table>
| Advanced Along Track Scanning Radiometer  
http://www.le.ac.uk/ph/research/eos/aatsr/ | 2 days              | 1.00                    | 0.56, 0.66, 0.86, 1.6 | 3.7, 11, 12     |
| Advanced Land Imager  
http://eol.gsfc.nasa.gov/Technology/ALIhome1.htm | 16 days             | 0.010–0.09              | 0.44, 0.48, 0.56, 0.64, 0.79, 0.87, 1.25, 1.65, 2.23 | 8.3, 8.65, 9.1, 10.6, 11.3 |
| Advanced Spaceborne Thermal Emission and Reflection Radiometer  
http://asterweb.jpl.nasa.gov/ | 16 days             | 0.015–0.09              | 0.56, 0.66, 0.82, 1.65, 2.17, 2.21, 2.26, 2.33, 2.34 | 8.3, 8.65, 9.1, 10.6, 11.3 |
| Along Track Scanning Radiometer  
http://www.atsr.rl.ac.uk/ | 3 days              | 1.00                    | 0.55, 0.67, 0.87, 1.6 | 3.7, 10.8, 12   |
| Advanced Very High Resolution Radiometer  
http://www.nesdis.noaa.gov/ | 4 daily             | 1.10                    | 0.63, 0.91, 1.61     | 3.74, 11, 12    |
| Hot Spot Recognition Sensor System  
http://www.itc.nl/research/products/sensordb/getsen.aspx?name=HSRS |                  | 0.37                    |                      | 3.8, 8.9        |
| Hyperion  
http://eol.gsfc.nasa.gov/technology/hyperion.html | 16 days             | 0.03                    | [220 bands: 0.38–2.5 μ.m] |                  |
| IKONOS  
http://www.spaceimaging.com/ | 3 days              | 0.001–0.004             | 0.48, 0.55, 0.67, 0.81 |                  |
| Indian Remote Sensing-1A,B  
http://www.isro.org/ | 22 days             | 0.036–0.072             | 0.55, 0.65, 0.83     |                  |
| Indian Remote Sensing-1B,C  
http://www.isro.org/ | 24 days             | 0.023–0.188             |                      |                  |
| Landsat 5, 7  
http://landsat.gsfc.nasa.gov/ | 16 days             | 0.015–0.09              | 0.48, 0.56, 0.66, 0.85, 1.65, 2.17 | 11.5 |
| Moderate Resolution Imaging Spectroradiometer  
http://modis.gsfc.nasa.gov/ | 4 daily             | 0.25–1.0                | 19 bands            | 16 bands        |
| Quickbird  
http://directory.eoportal.org/pres_QUICKBIRD2.html | 1–5 days            | 0.001–0.004             | 0.48, 0.56, 0.66, 0.83 |                  |
| VEGETATION  
http://www.spot-vegetation.com/ | 1 daily             | 1.15                    | 0.55, 0.65, 0.84, 1.62 |                  |
Satellite Remote Sensing Products

- **With multi-spectral imagery:**
  - Straightforward to observe active fires, smoke as a snapshot with LEO, continuous with GEO.
  - Straightforward to observe burned area.

Andela et al, Science, 2017
Satellite Remote Sensing for Fire Forecasting

- **Fire behavior models** represent an important tool for technological fire forecasting.

- **WRF-SFIRE and CAWFE** are built on a well-known weather-forecasting framework.

- They specifically take into account the fact that fire and weather are coupled.

- Model inputs are critical.
The Fuel Moisture Frontier

- Reflectance spectra are readily observed but represent a convolution of canopy traits and fuel moisture content.
- Understory information is needed but unavailable from spectra.
- Vegetation indices are loosely related to fuel moisture.
- Microwave measurements are also hard to interpret.
- The challenge of fuel moisture remains.

Yebra et al, Rem. Sens. Env., 2013
Opportunities Abound

• **The silo-ed traditional approach to forecasting fire behavior is insufficient.**
  – This meeting would not be taking place if it were.

• **Do we have enough pieces to solve this puzzle?**
  – Weather forecasts are continuously improving.
  – Satellite data products are ever-expanding.

• **Is it just a question of integrated existing datasets through assimilation and forecasting?**

• **Clearly, more information is needed to provide actionable data for addressing fires and fire risk.**

• **EESA has stood-up a capability for advanced vegetation modeling that can complement remote sensing with information that is not currently available.**