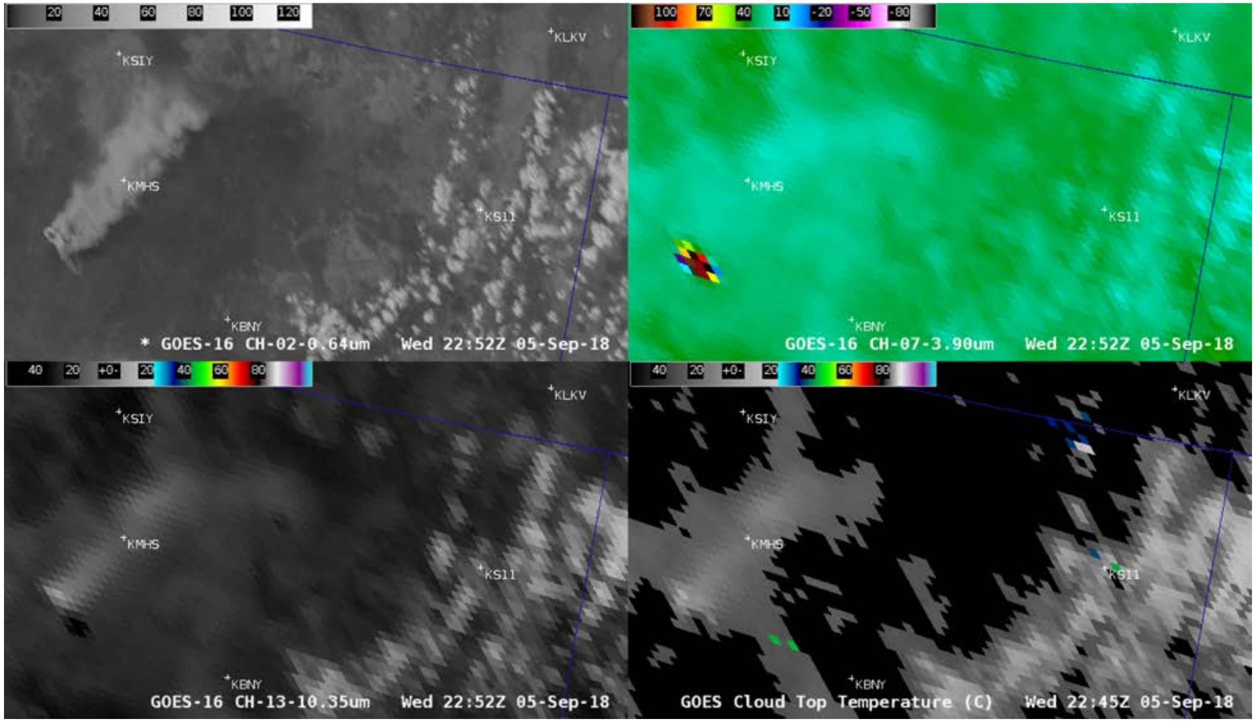
Satellite Remote Sensing of Active Fires: Capabilities, Challenges, and Opportunities

Daniel Feldman

FUEGO Meeting, October 16, 2018

EESA, Lawrence Berkeley National Laboratory



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.***

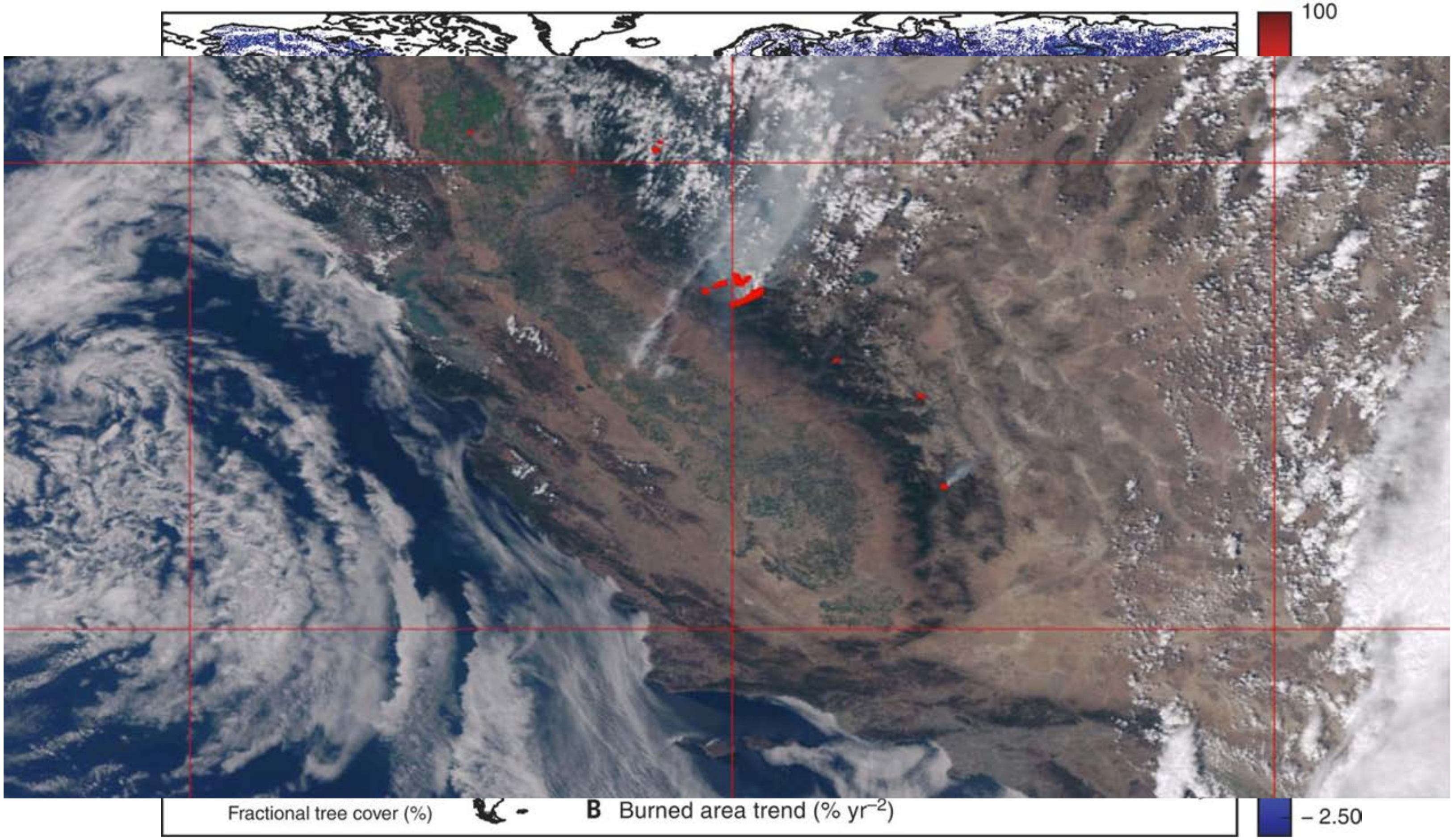
Satellite Remote Sensing Coverage

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

Sensor and additional web resources	Temporal resolution	Spatial resolution (km)	VIS-MIR bands (μm)	TIR bands (μm)
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://eo1.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	
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://eo1.gsfc.nasa.gov/technology/hyperion.html	16 days	0.03	[220 bands: 0.38–2.5 μm]	
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

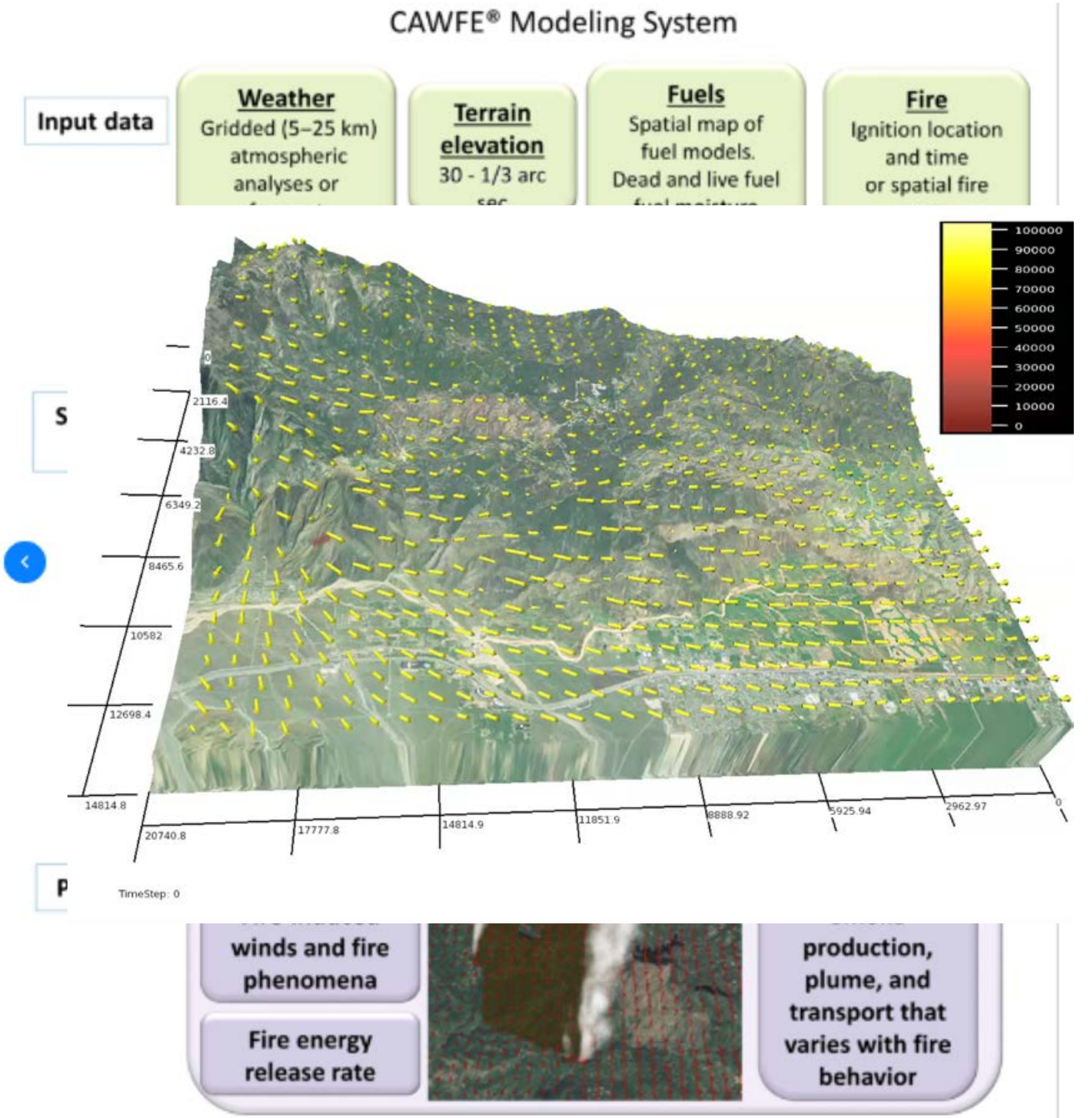
- ***With multi-spectral imagery:***
  - ***Straightforward to observe active fires, smoke as a snapshot with LEO, continuous with GEO.***
  - ***Straightforward to observe burned area.***



Andela et al, Science, 2017

Satellite Remote Sensing for Fire Forecasting

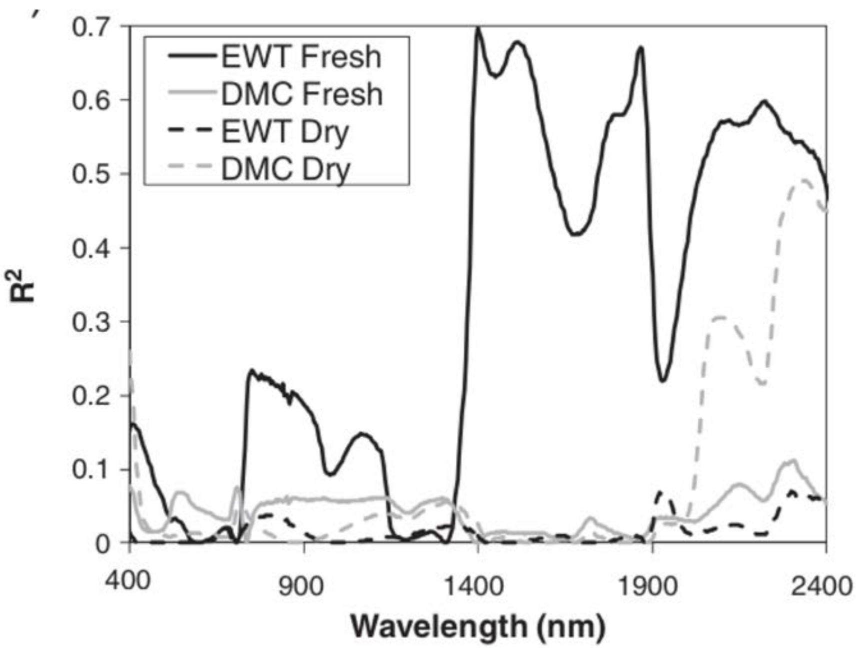
- ***Fire behavior models represent an important tool for technological fire forecasting.***
- ***WRF-SFIRE and CAWFE are built on a well-known weather-forecasting framework.***
- ***They specifically take into account the fact that fire and weather are coupled.***
- ***Model inputs are critical.***

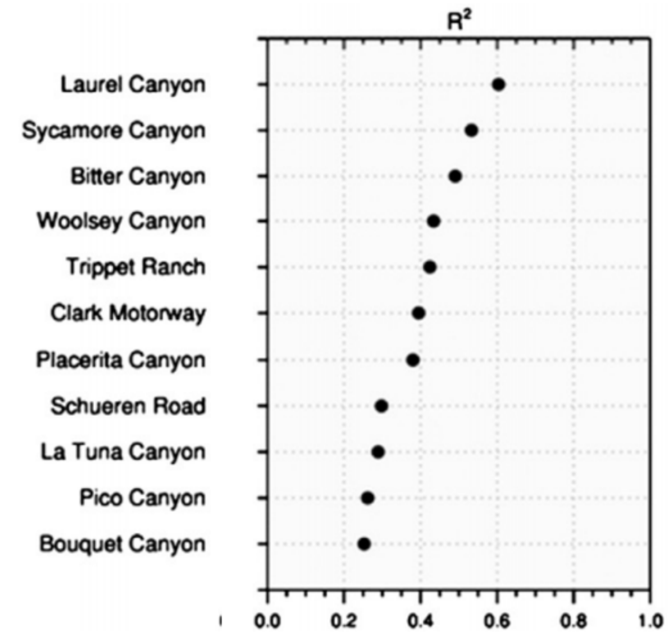


Overview of the CAWFE modeling system.

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.***

David Rumsey Map Collection