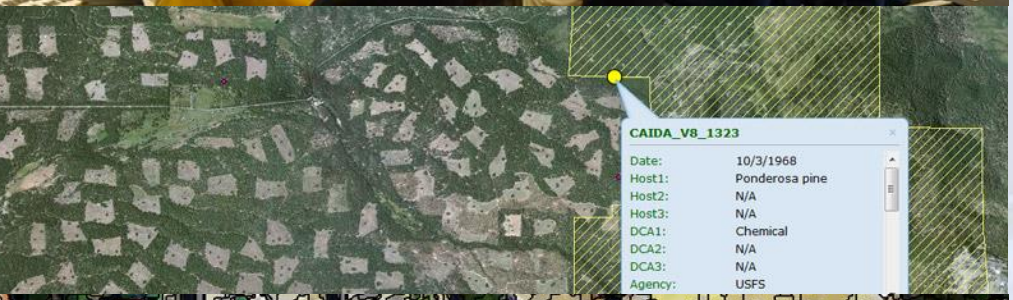
Campus Resources and FUEGO – Maggi Kelly

- GIF & Kelly Lab
  - Spatial Data Science focus
  - Research Projects
- FUEGO preliminary work
  - The FUEGO concept
  - Image differencing results
  - Ongoing needs



Geospatial Innovation Facility (GIF) gif.berkeley.edu

UC Support

- 30+ departments
- Training & Advising
- Hardware & Software
- Events

Application Development

- Web Mapping
- Data Visualization
- Remote Sensing
- Spatial Analysis

GIF workshops

Run every semester, focus in Introduction across spatial data science: Remote sensing, GIS, web mapping

Date	Time	Workshop
Thursday 9/5	9am-1 pm	Intro to Geographic Information Systems (GIS): *Environmental Science Focus*
Thursday 9/12	9am-1 pm	Intro to Geographic Information Systems (GIS): *Social Science Focus*
Thursday 9/19	9am-1 pm	Intro to Global Positioning Systems (GPS): Working with Garmin receivers
Thursday 10/3	9am-1 pm	Intro to Remote Sensing: Understanding digital imagery
Thursday 10/10	9am-1 pm	Intro to Remote Sensing: Pixel-based analysis
Thursday 10/17	9am-1 pm	Intro to Remote Sensing: Land cover change analysis
Thursday 10/24	9am-1 pm	Intro to Remote Sensing: Object-based image analysis (OBIA)
Tuesday 11/5	9am-1 pm	Intro to Open Source GIS: Working with Quantum GIS (QGIS)
Tuesday 11/12	9am-1 pm	Intro to species distribution modeling
Thursday 12/5	9am-1 pm	Creating your own web maps

Our Research and Projects

Building sophisticated geospatial applications that target the needs of unique audiences.

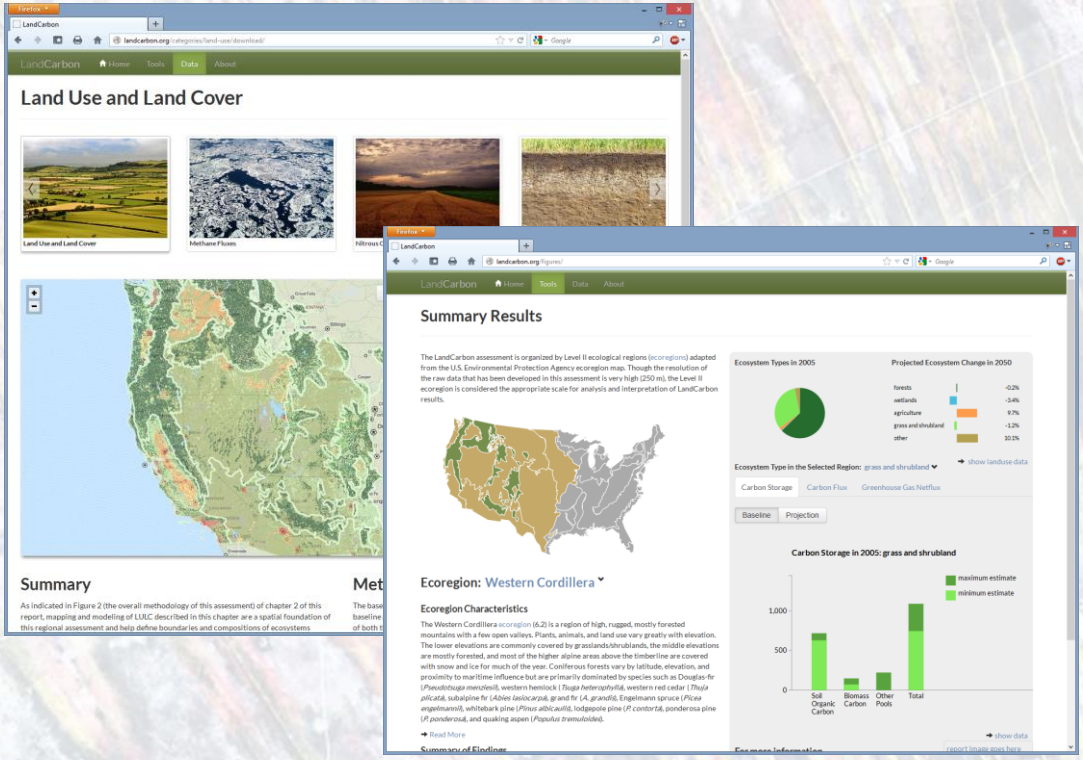
- Scientists
- General Public
- Planners and Decision Makers
- Experts

LandCarbon

Data visualization and access tool for the National Carbon Sequestration Assessment.

Partner

US Geological Survey



Audience

- Experts
- Planners & Decision Makers

Technology

- PostGIS
- Python
- Django

http://landcarbon.org/

Delta Wetlands

Can remotely sensed estimates of aboveground plant productivity be linked to belowground biomass and productivity of emergent marsh vegetation?

Partner

US Geological Survey

Audience

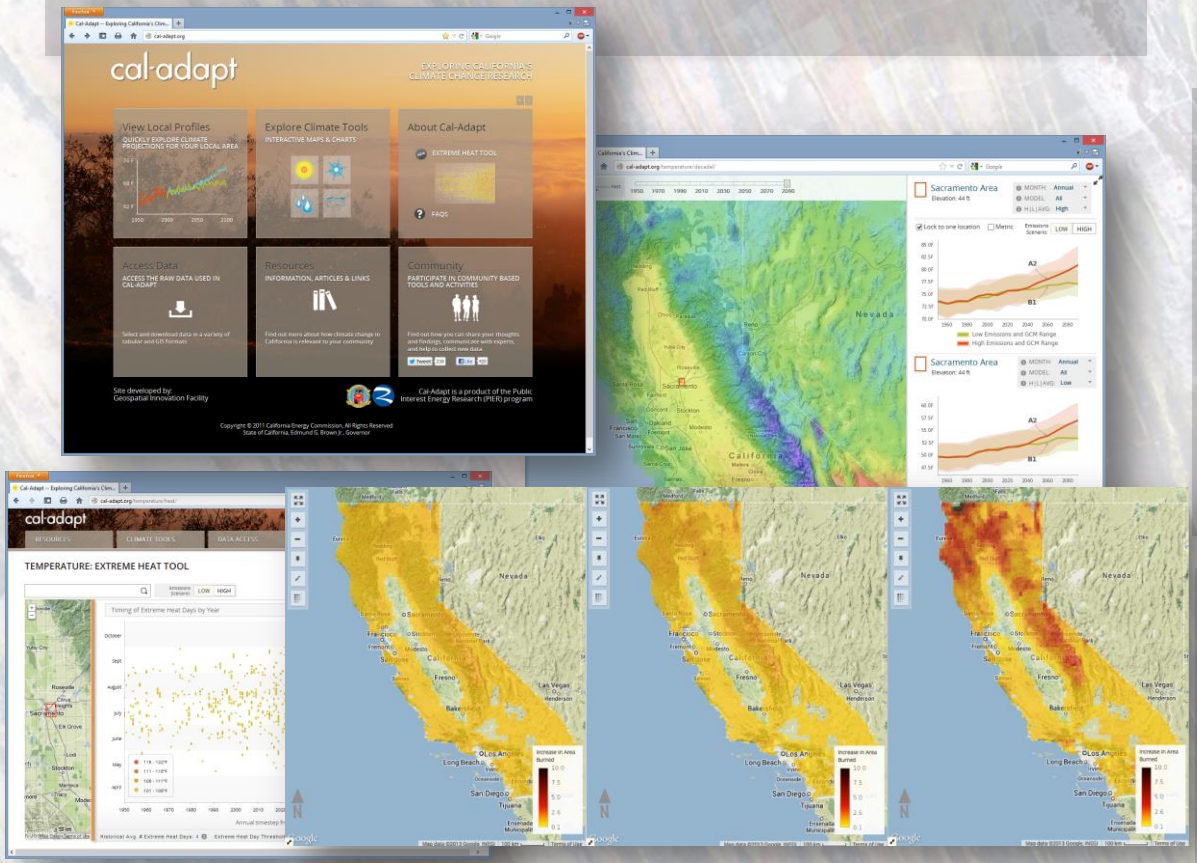
- Scientists
- Managers
- Public

Technology

- Hyper and multi-spectral remote sensing

Cal-Adapt

Data visualization and access tool for California's Public Interest Energy Research (PIER) program



Partner

California Energy Commission

Audience

- Experts
- Planners & Decision Makers
- General Public

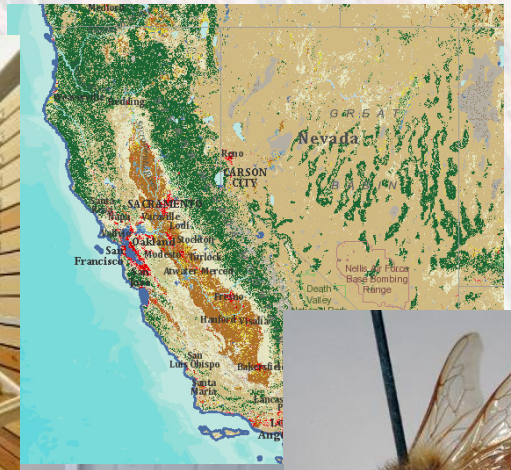
Technology

Open Source stack including PostGIS, Python, Django

http://cal-adapt.org

HOLOS Engine

Data discovery, visualization and analysis platform for Berkeley Natural History Museums



Partner

Berkeley Initiative in Global Change Biology (BiGCB)

Audience

- Experts
- Managers

Technology

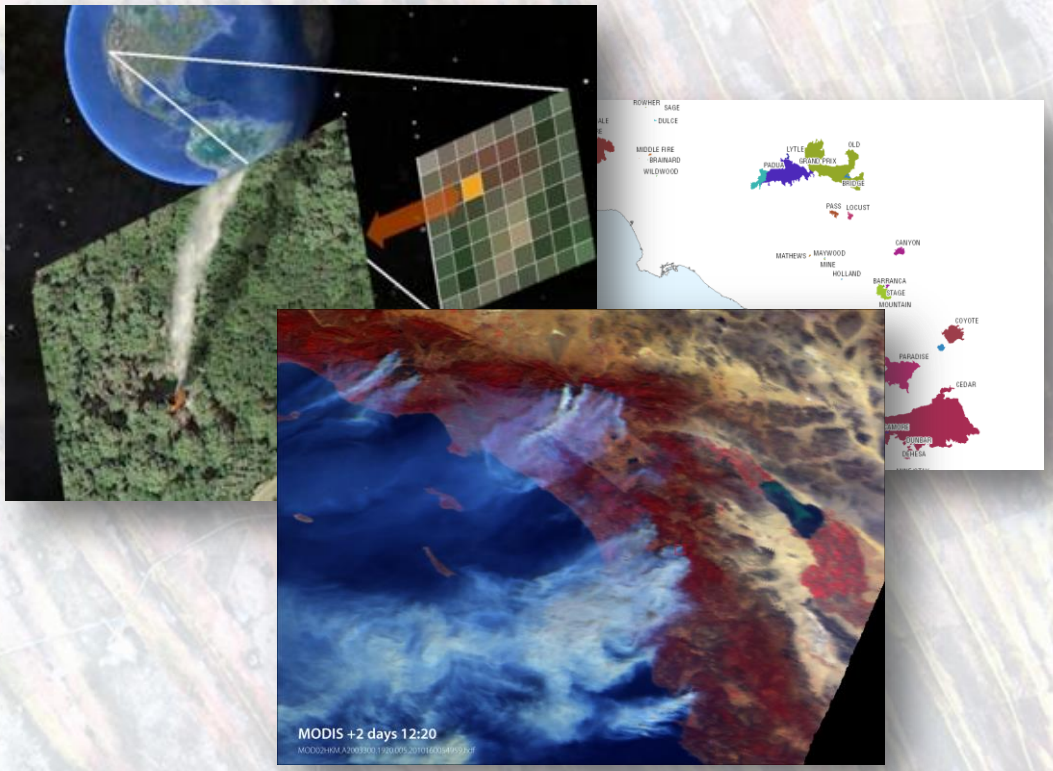
Open Source stack including PostGIS, Python, Django

http://holos.berkeley.edu

FUEGO

A framework for a geosynchronous satellite to detect heat from

early and small fires, and yield minute-scale detection times.



Partner

Berkeley Vice Chancellor for Research

Audience

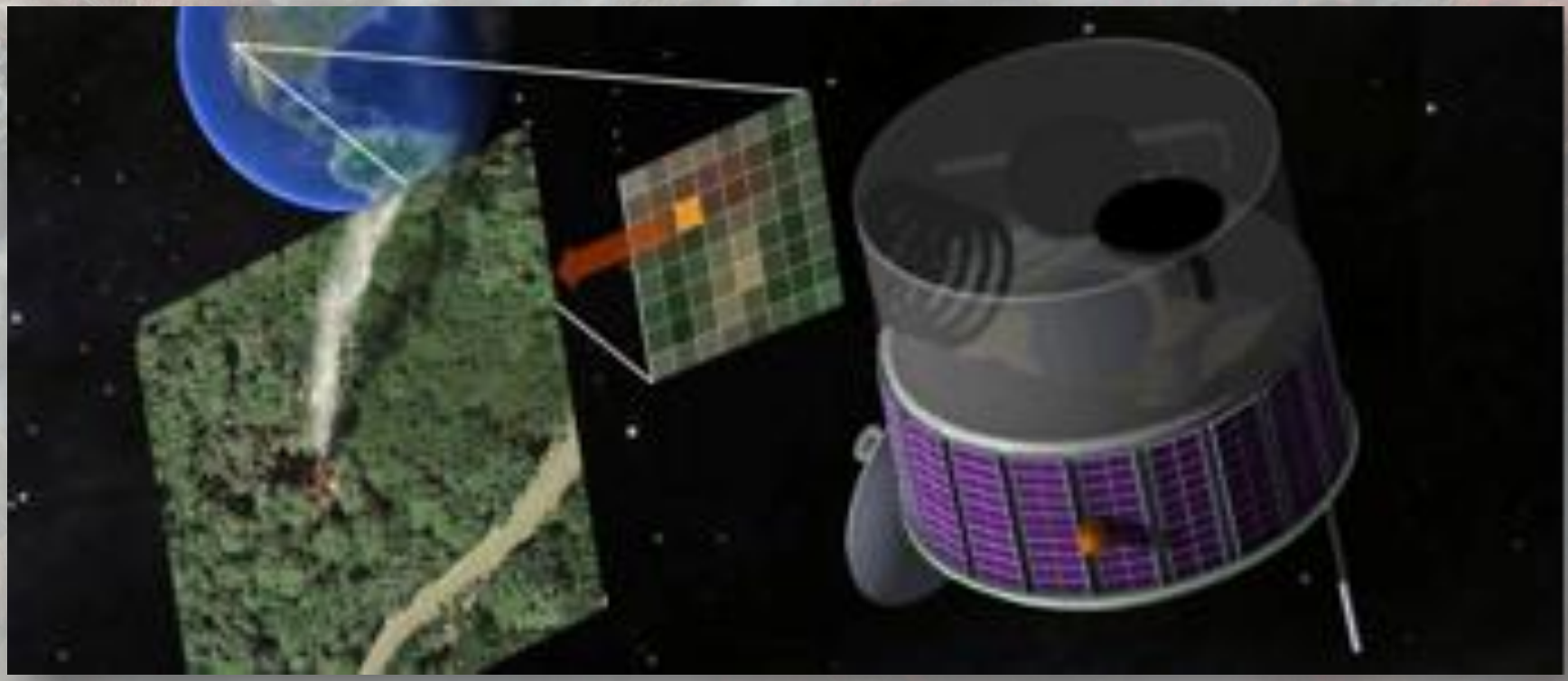
- Scientists
- Managers

Technology

Remote sensing, space science

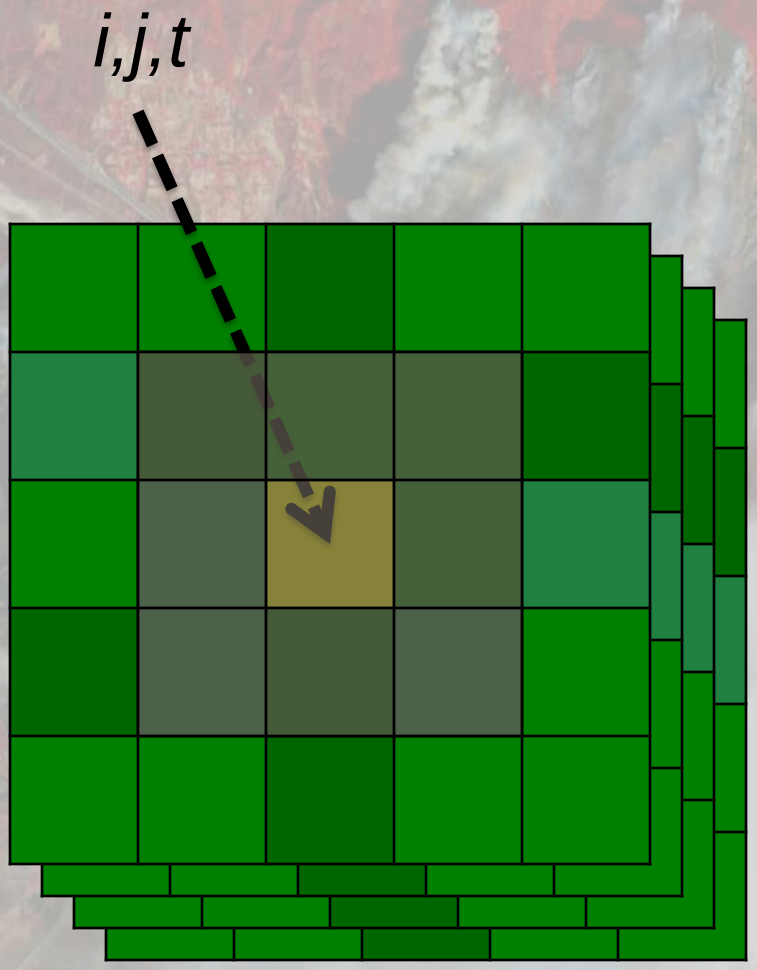
Pennypacker, et al. 2013. FUEGO—Fire Urgency Estimator in Geosynchronous Orbit—A proposed early-warning fire detection system. *Remote Sensing* 5(10): 5173-5192

FUEGO Goal: to develop one or more on-orbit continuous sensors keeping the Continental United States or the Southern California Fire Critical Region under nearly continuous study.



Pennypacker, et al. 2013. FUEGO—Fire Urgency Estimator in Geosynchronous Orbit—A proposed early-warning fire detection system. *Remote Sensing* 5(10): 5173-5192

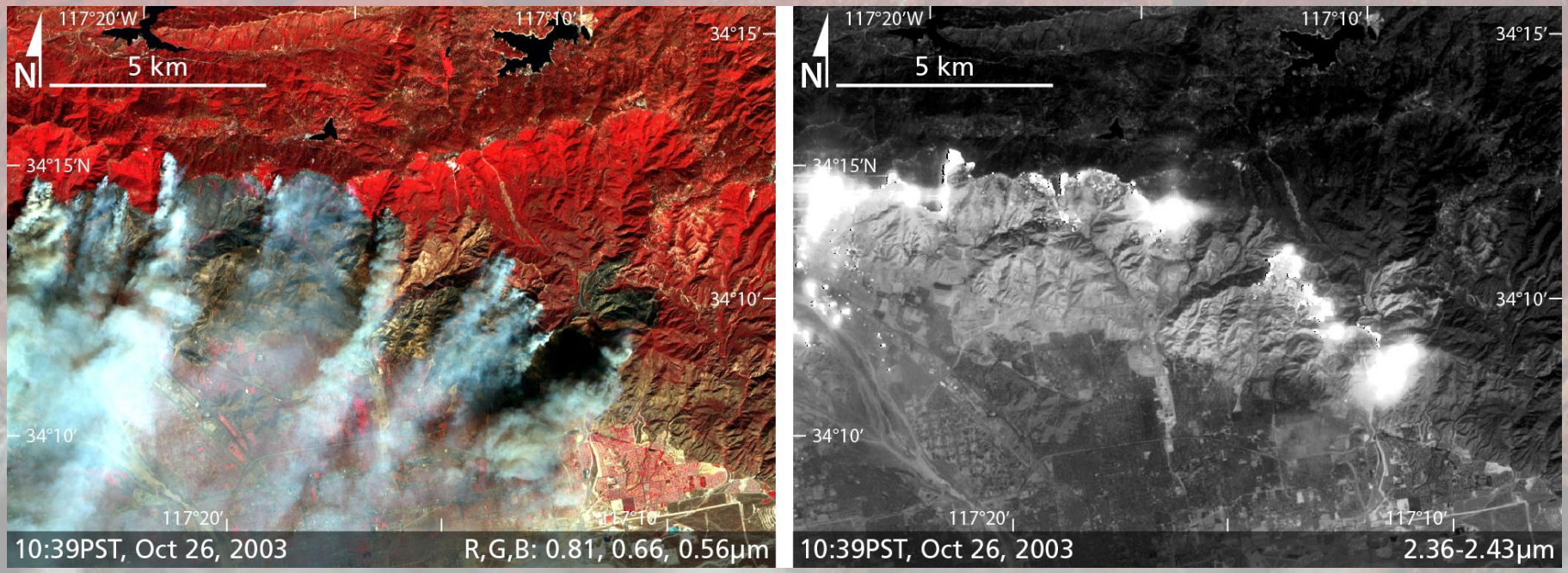
FUEGO Concept



The proposed FUEGO system involves three necessary components:

1. signal to noise calculations,
2. rejection of false alarms,
   - difference from the temporal trend
   - difference from neighbors
   - constrained changes
3. real-time treatment and follow-up of candidates.

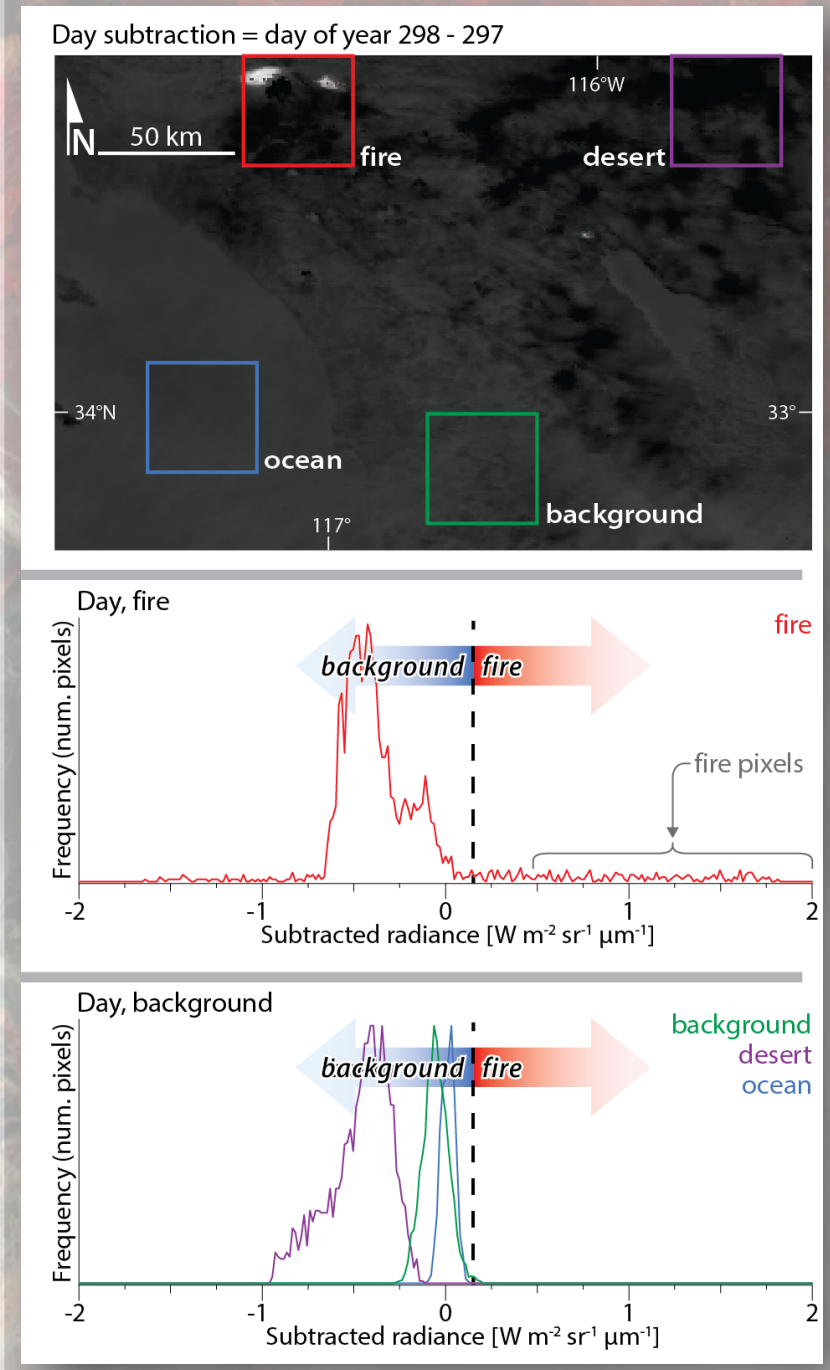
Spectral Sensitivity



- Atmospheric transmission windows in the near and mid-infrared are adequate for detecting fires.
- Fires cannot be seen under heavy cloud cover, and can be detected with reduced sensitivity under smoke and thin clouds, depending on the wavelength of the detectors, smoke particulate size, and moisture content of the atmospheric column.

A preliminary test

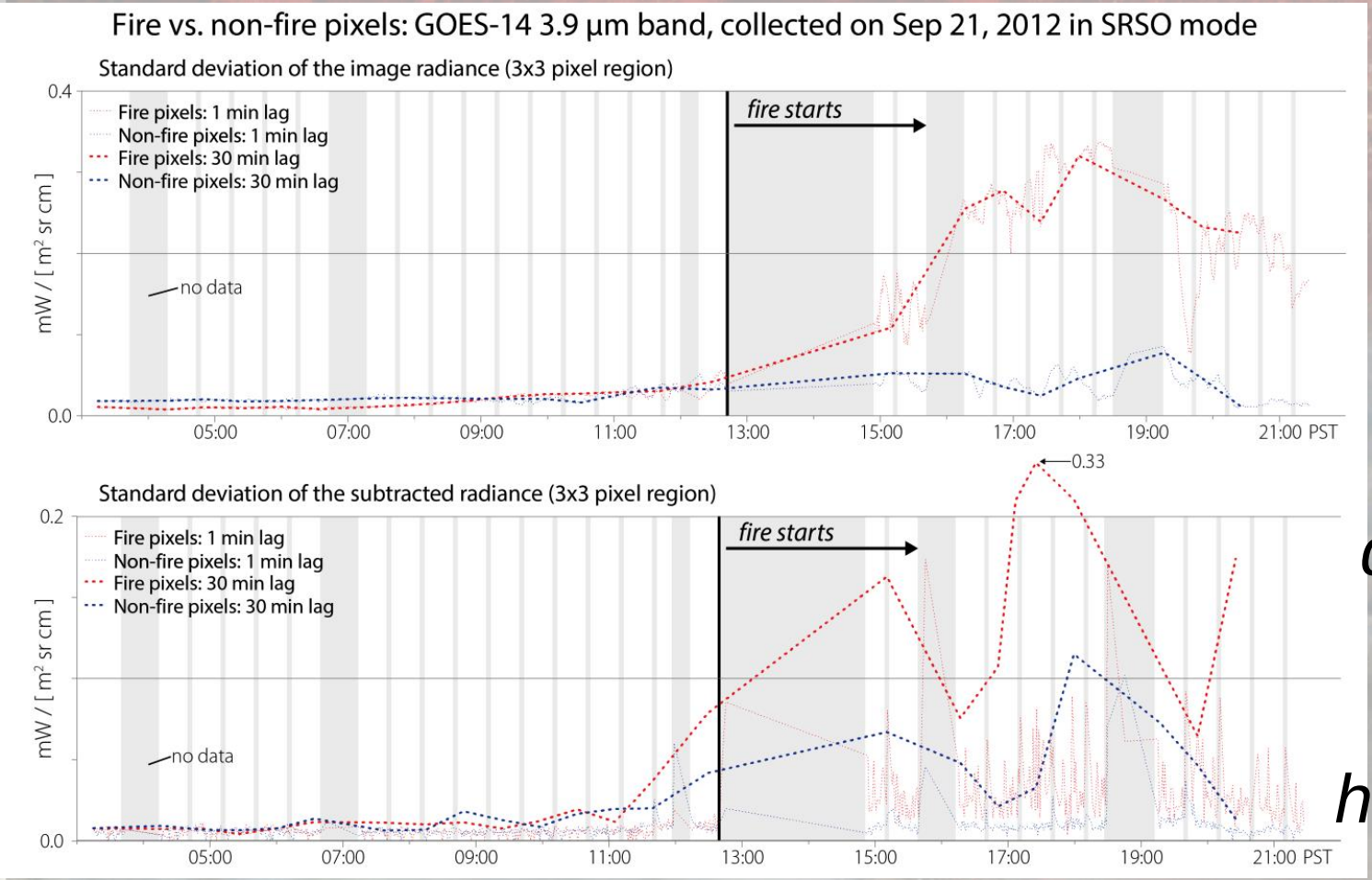
We used mid-wave infrared (4.05 μm) images from the MODIS instrument over the Cedar and Grand Prix fires to test our system. These were part of a complex of human-caused wildfire that burned through a large area of San Diego County, CA, in October 2003.



Test with MODIS (4.05-micron) images acquired on consecutive days: *Daily Image differencing highlights fire*

Histograms are calculated over the square areas indicated on the images. The histograms were calculated from subtraction of image pairs. Top histogram shows residual radiance of fire pixels (red squares and graph lines). Bottom histogram shows residual radiance of the background areas: background (green), desert (purple) and the ocean (blue).

The background histograms are nearly Gaussian with narrow range of residual radiance indicating nearly identical before and after images. The fire histograms contain fire pixels far outside of the normal background pixel distribution.



Test with band 2 of GOES-14: *Rapid scanning image differencing at 3.9 microns highlights fire*

Standard deviation of the radiance (**top**) and radiance of sequentially subtracted images (**bottom**). The standard deviations were calculated for two small (3 × 3 pixels) regions: one directly over a fire (red) and another immediately adjacent with no fire (blue). The subtracted and raw radiance of both regions is nearly identical until the fire start between 12:45 and 14:53 PST, at which time the subtracted radiance standard deviation of the fire pixels is over 10 times higher than that of the non-fire pixels.

What is still needed

- Our calculations indicate that a 12 m^2 fire at a temperature of 1,100° K is about 100 standard deviations larger than fluctuations against Poisson noise from subtractions of images immediately preceding outbreak, against the solar background light in a few second exposure.
- Work is needed over the next two years to quantify and understand false alarm sources and their time dependence whose signal is 100 standard deviations above background fluctuations.
- The feasibility of a prototype sensor over a prescribed burn is essential.