The Rim fire in Yosemite, CA: Opportunities for the HyspIRI Prepatory Airborne Campaign

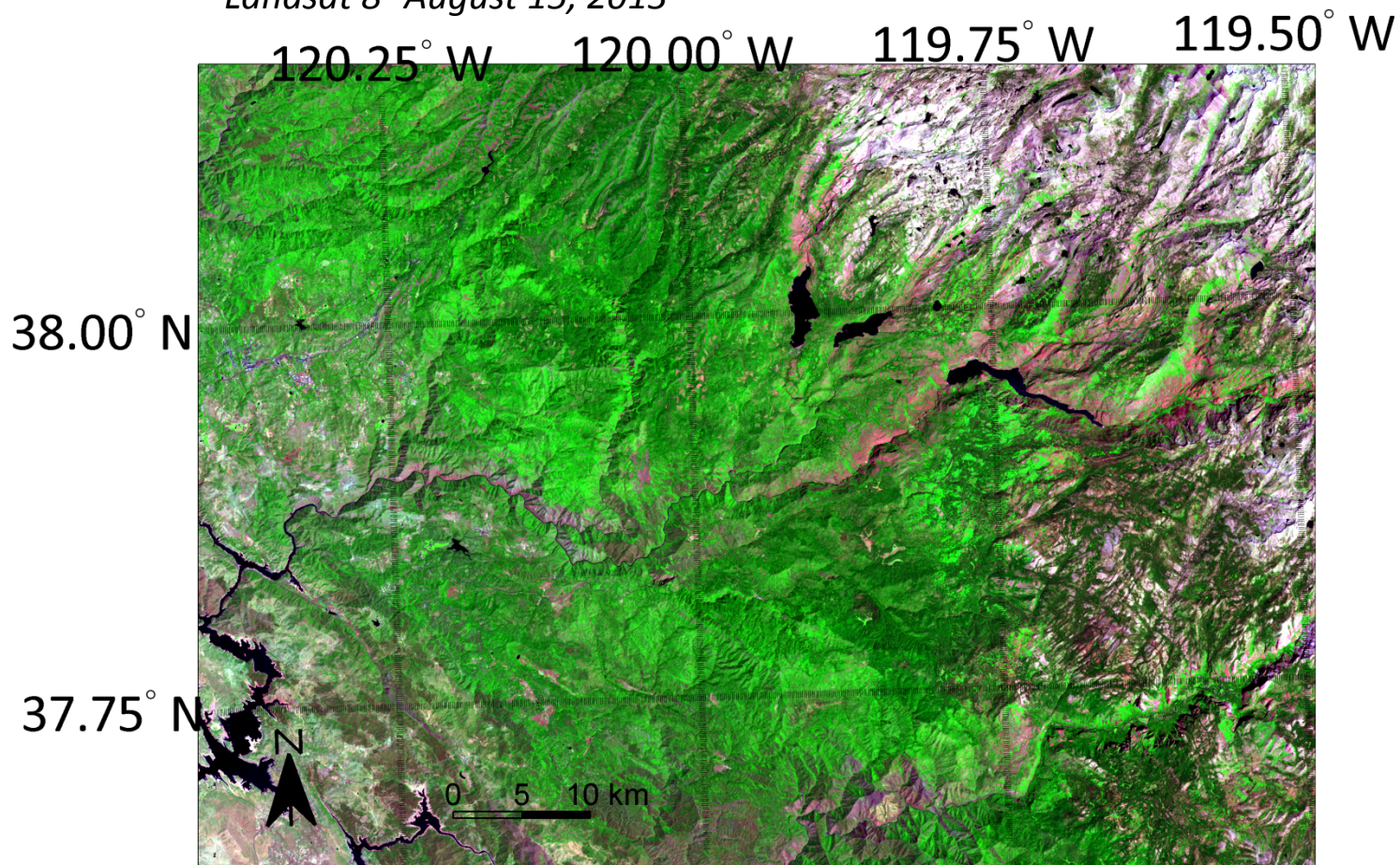Sander Veraverbeke, Simon Hook and Rob Green
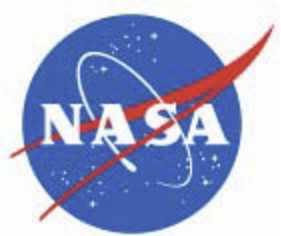*Jet Propulsion Laboratory (NASA), California Institute of Technology*

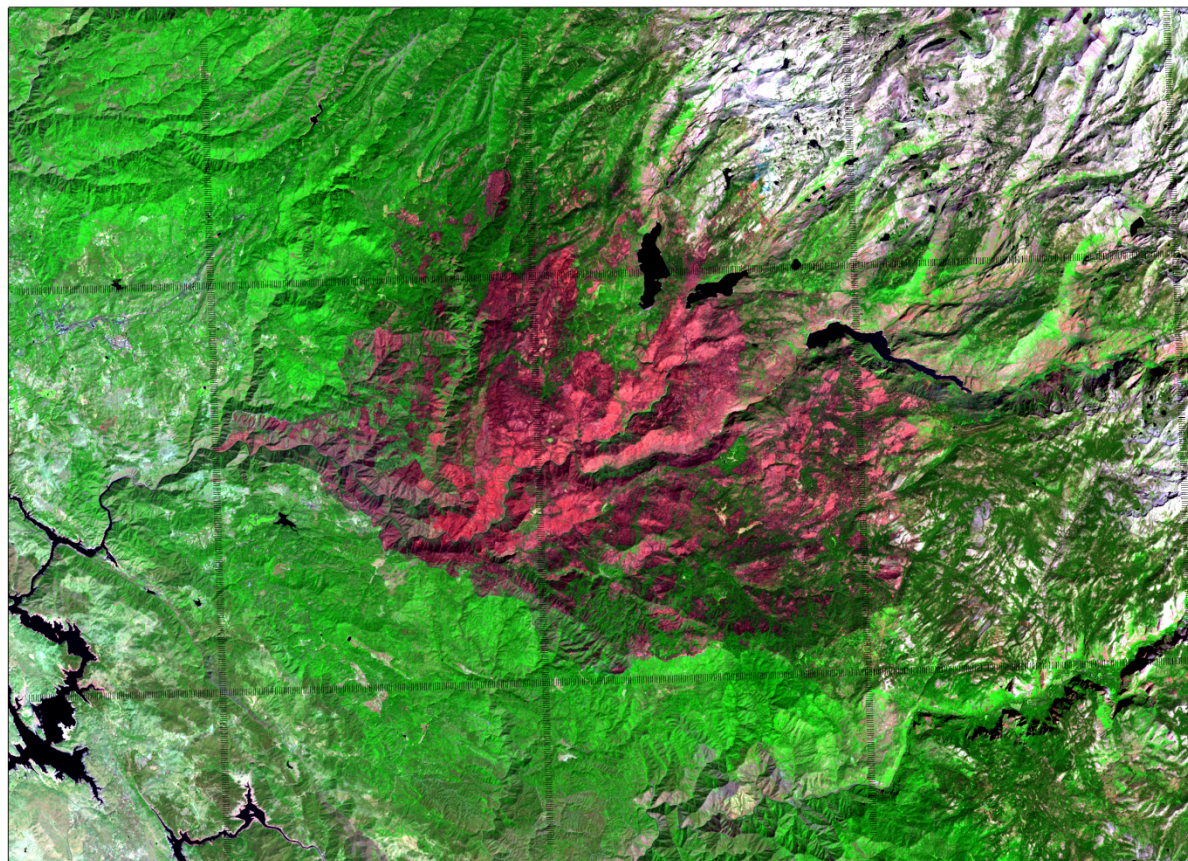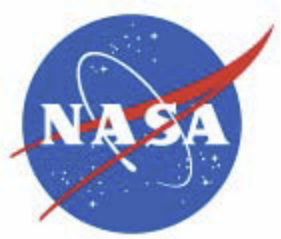# Overview

Landsat 8   August 15, 2013

Overview

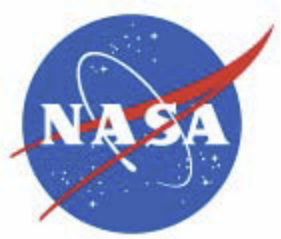*Landsat 8   September 16, 2013*

Overview

One of the largest fires in the recorded CA fire history (104 000 ha)

Burned in a *heterogeneous landscape* of mixed conifer forest, chaparral, meadows

Main tree species: sugar, Jeffrey and Ponderosa pine, red and white fir

Data coverage

Pre-fire
MASTER covers 95%
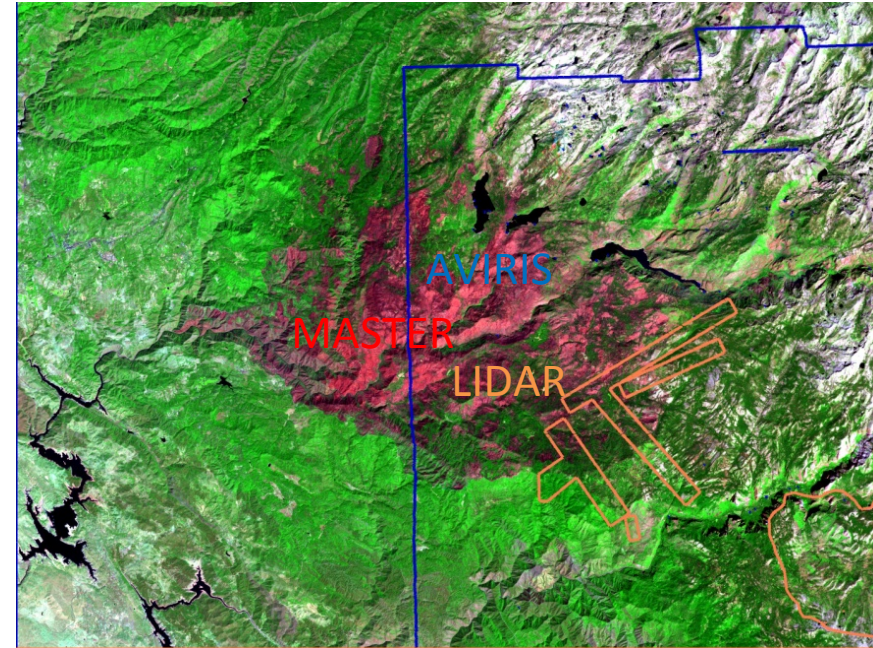AVIRIS more than 50%
LIDAR less than 5%

Active fire
MASTER and AVIRIS collected data on September 13

Post-fire
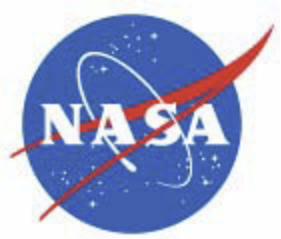All sensors will cover entire fire perimeter
MASTER and AVIRIS → JPL
LIDAR → NCALM and UC Davis

Fire is a key science and application area for HyspIRI (pre-fire, active fire and post-fire)

→ The availability of **pre**- and **post**-fire **MASTER**, **AVIRIS** and **LIDAR** presents an unprecedented opportunity

Highlights the need for HyspIRI-like routine global coverage

Planned field work

Composite Burn Index

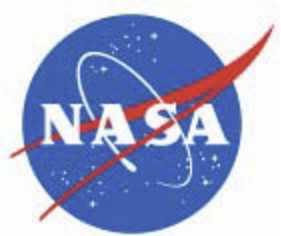A. GeoCBI = 3   B. GeoCBI = 1.95   C. GeoCBI = 0.85

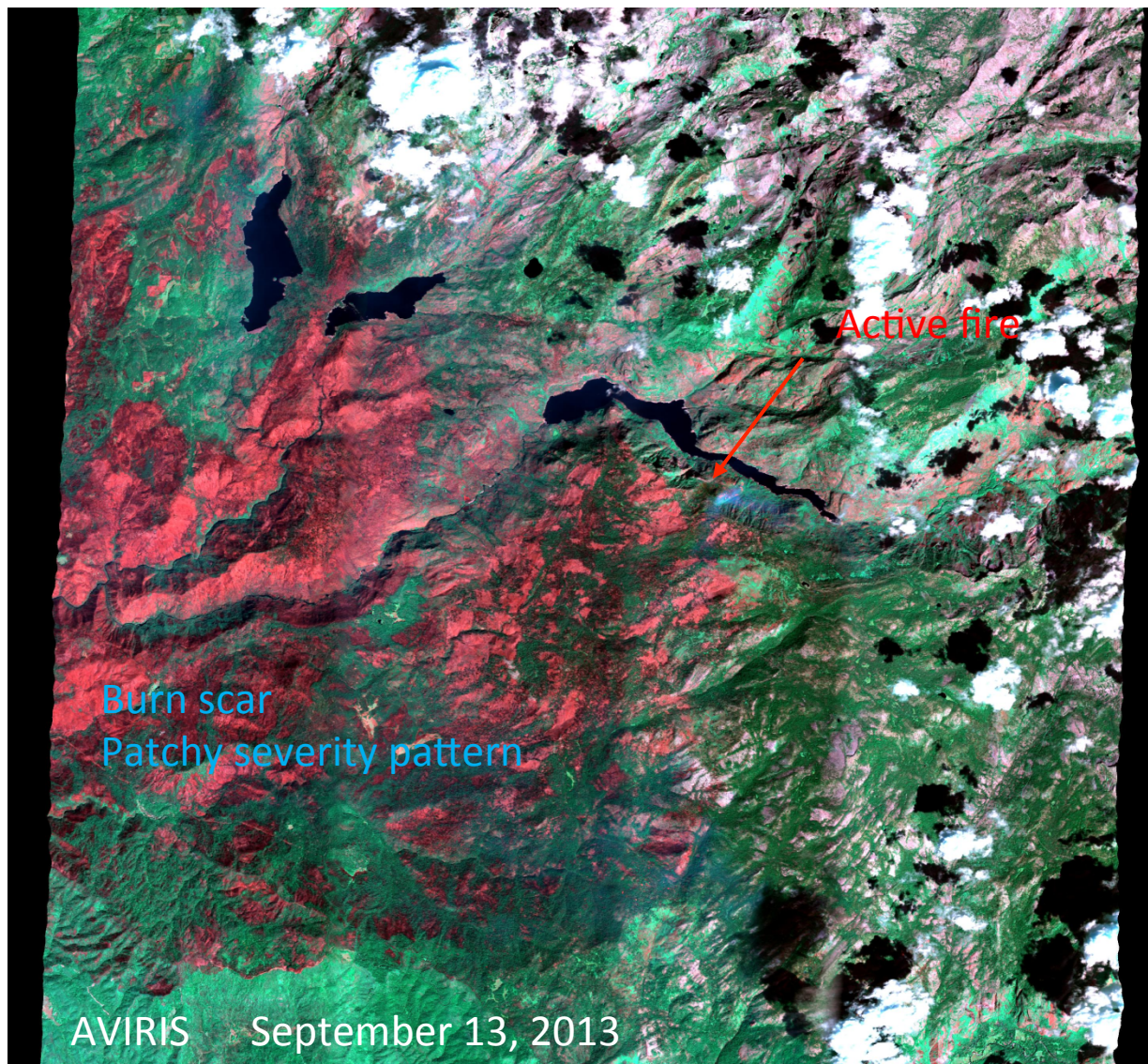Tree mortality, % 'black-brown-green'

Tree species

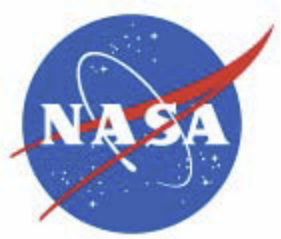Bark, branch and canopy combustion completeness

Tree DBH

Biomass and carbon loss
(through allometry)
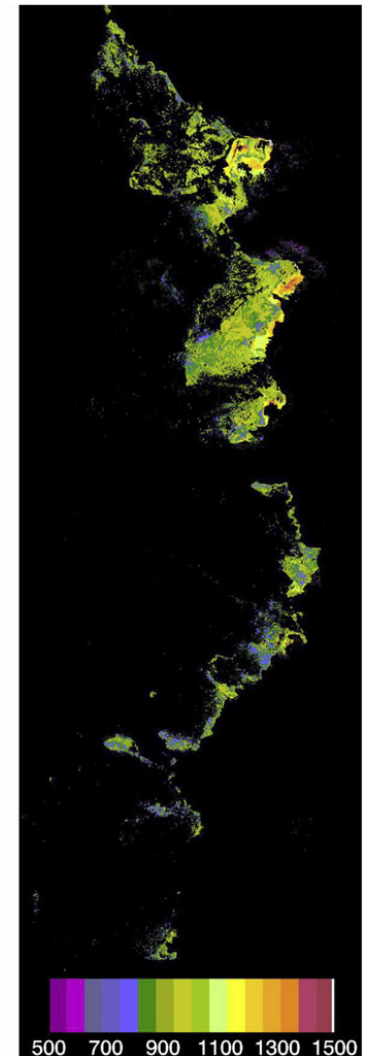
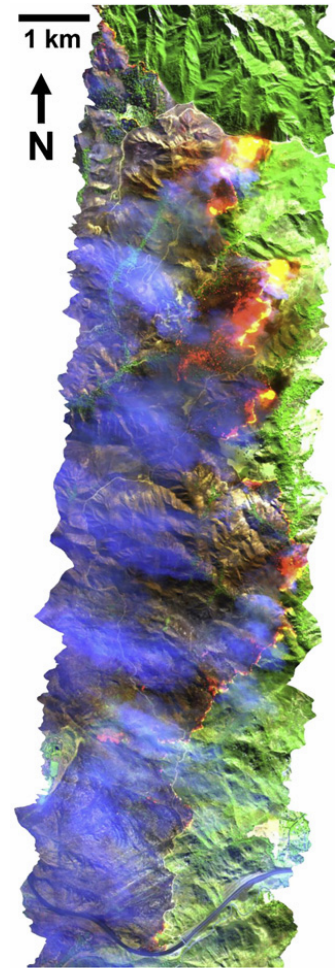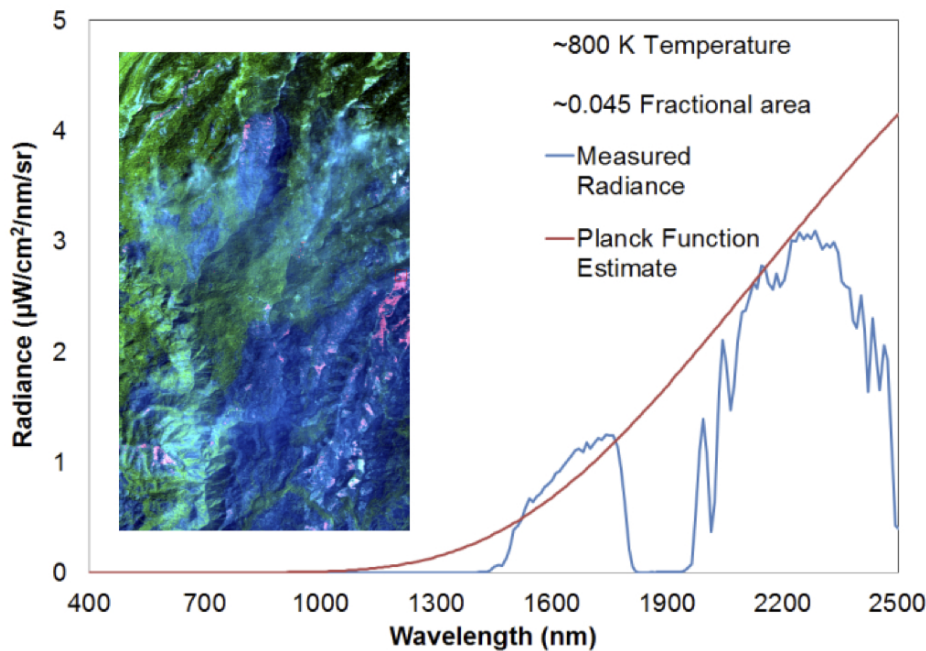# Opportunities for active fire and post-fire research

Active fire

Burn scar
Patchy severity pattern

AVIRIS   September 13, 2013

Opportunities for active fire research
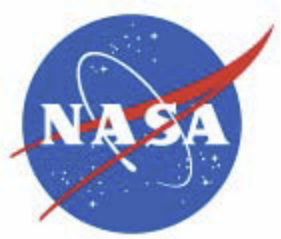
VSWIR

Retrieval of fire temperature and fractional area

(Dennison et al. 2006)
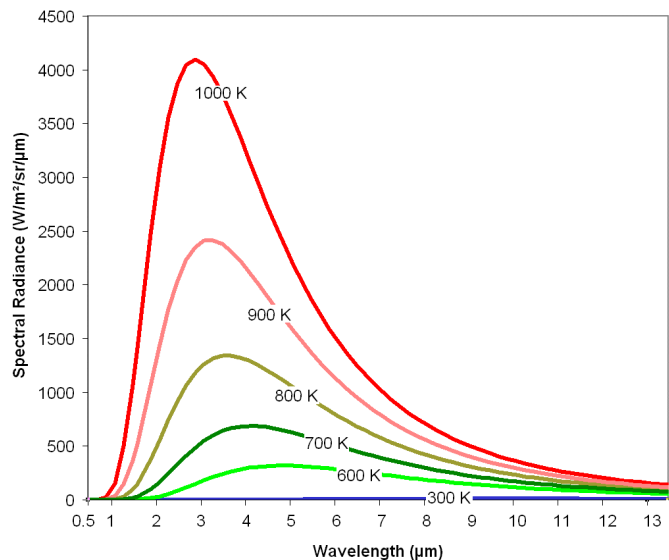
Opportunities for active fire research

MTIR

Retrieval of fire radiative power (FRP), directly related to instantaneous emissions:

$$FRP = \frac{A_{sampl}.\sigma.\varepsilon}{a.\varepsilon_{MIR}}(L_{MIR,fire} - L_{MIR,bg})$$
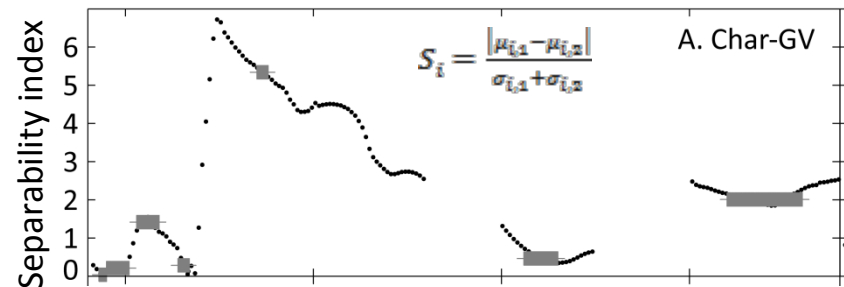
Needs mid (4 µm) and thermal (7.5-12 µm) to capture Planck curve and maximize detection
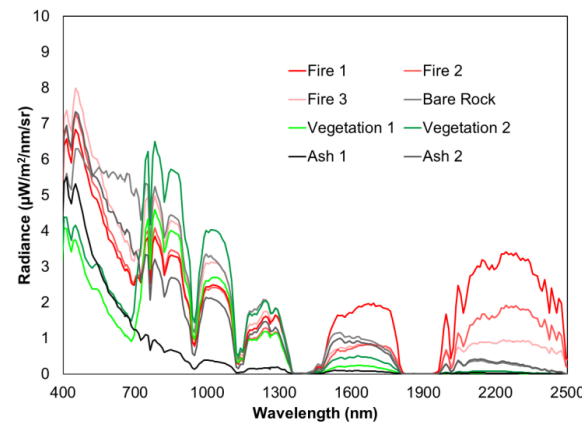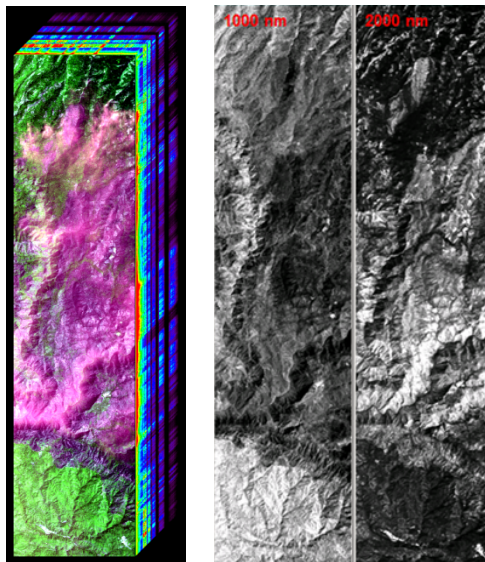
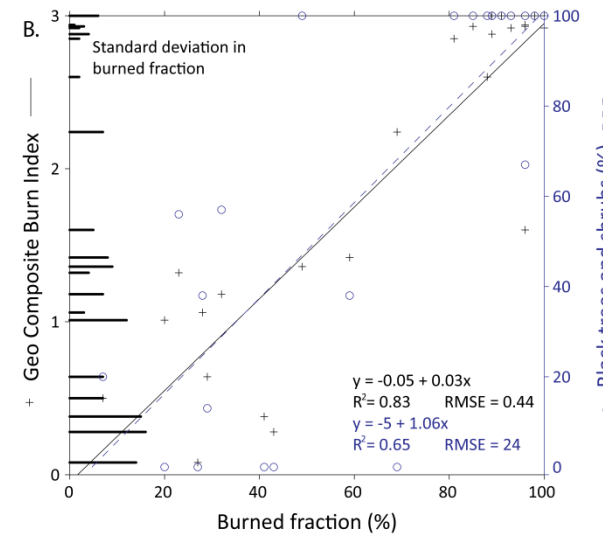# Opportunities for post-fire research

Narrowband spectral indices

Characterization of post-fire fractional cover and relation with fire severity

$$S_i = \frac{|\mu_{i,1} - \mu_{i,2}|}{\sigma_{i,1} + \sigma_{i,2}}$$

A. Char-GV

A.

118.45° W 118.40° W 118.35° W

B. Standard deviation in burned fraction

y = -0.05 + 0.03x
R^2=0.83   RMSE = 0.44
y = -5 + 1.06x
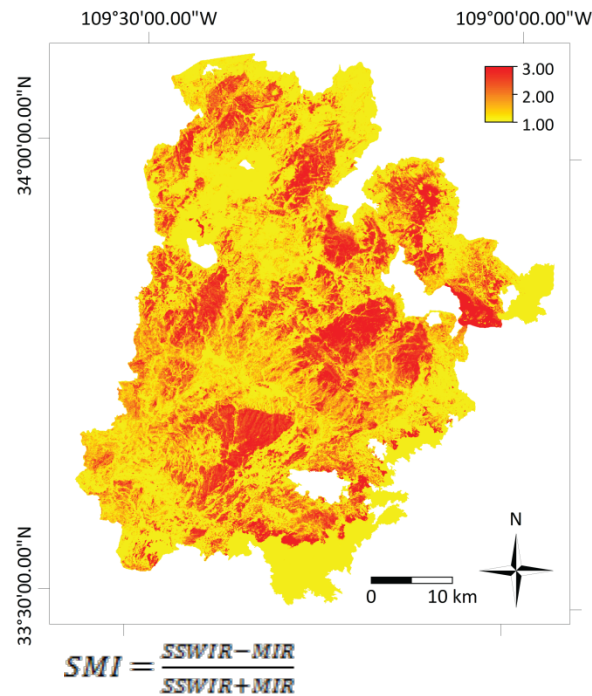R^2=0.65   RMSE = 24

(Veraverbeke and Hook 2013)

Opportunities for post-fire research
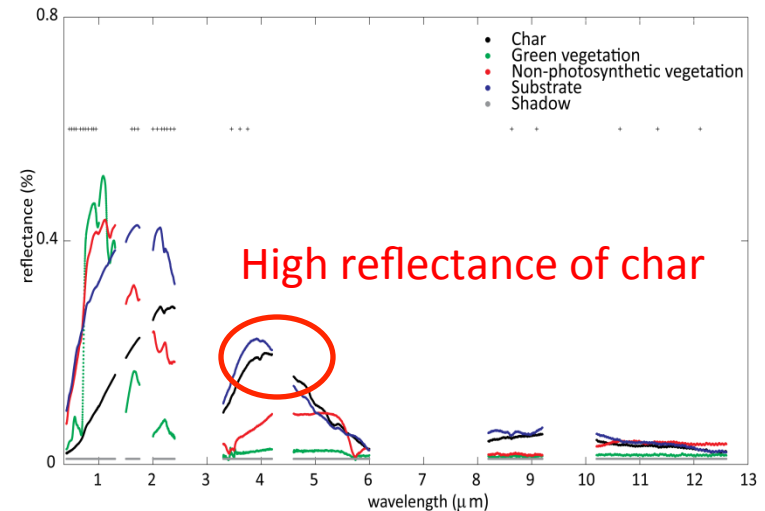
MTIR
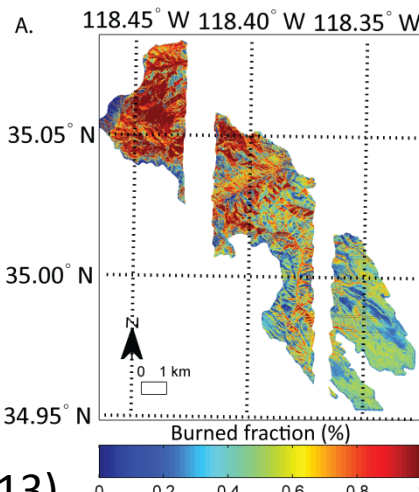
High reflectance of charcoal in MIR is extremely useful for burned area and fire severity mapping
Post-fire changes in land surface temperature
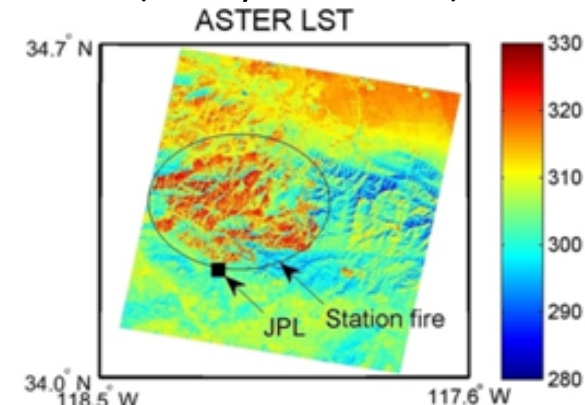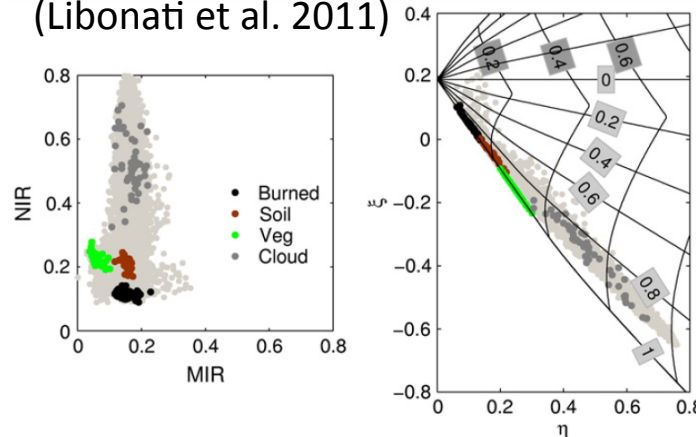
A. GeoCBI estimated from MASTER SMI

$$SMI = \frac{SSWIR - MIR}{SSWIR + MIR}$$

(Veraverbeke et al. 2011)
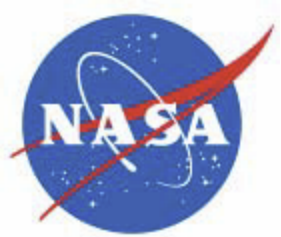

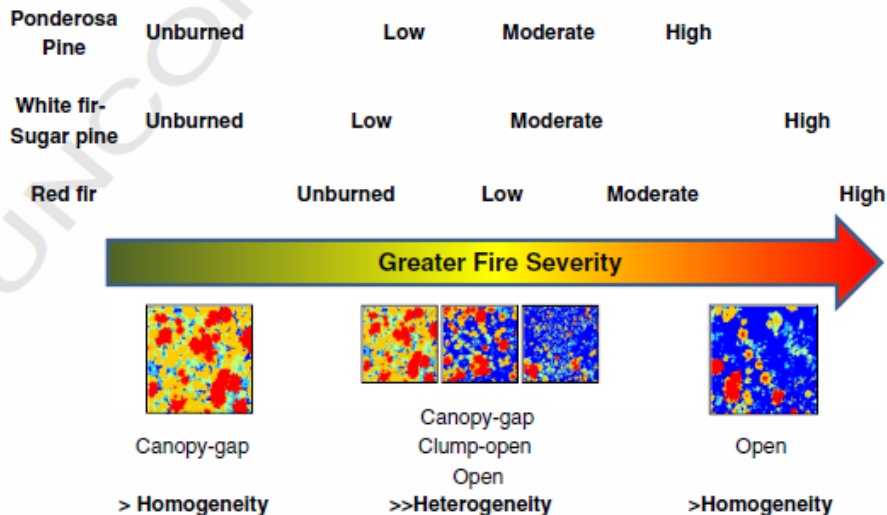High reflectance of char

(Veraverbeke et al. 2012)
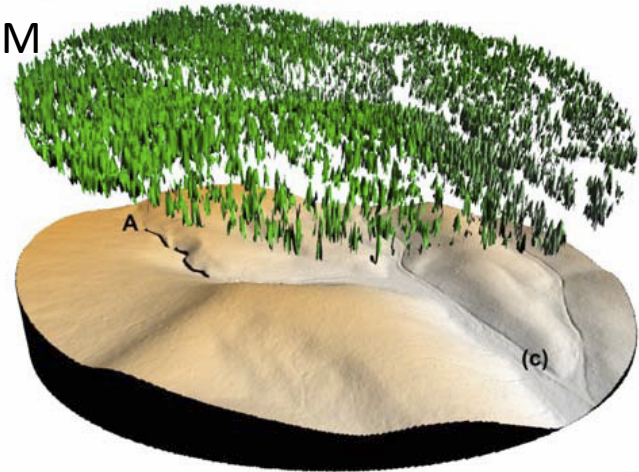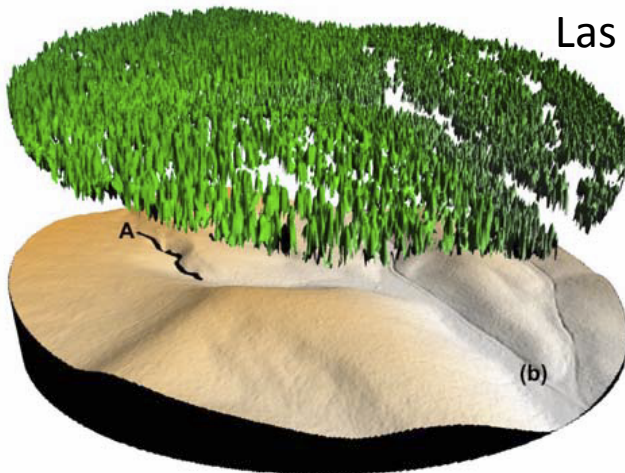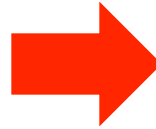(Hulley et al. 2013)

(Libonati et al. 2011)
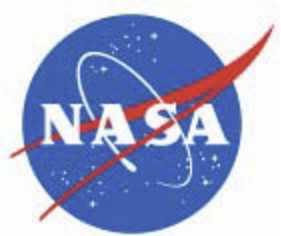

ASTER LST

Opportunities for post-fire research

Changes in vegetation structure (horizontal and vertical) and relation to fire severity

Las Conchas fire, NM
(NCALM)

(Kane et al. 2013)

Conclusions

The large Rim fire provides **unprecedented** opportunities for fire research:
 - Partial and overlapping **pre-fire** coverage with **AVIRIS**, **MASTER** and **LIDAR**
 - Full **post-fire** coverage with **AVIRIS**, **MASTER** and **LIDAR**

HyspIRI would routinely acquire VSWIR spectroscopy and multispectral MTIR pre- and post-fire

Each type of data has its own opportunities for active fire and post-fire research

Potential synergies between multispectral TIR, hyperspectral VSWIR and LIDAR may open new perspectives in fire research, for example with regards to biomass consumption and emission estimates