



*The Rim fire in Yosemite, CA:
Opportunities for the HypIRI Preparatory
Airborne Campaign*

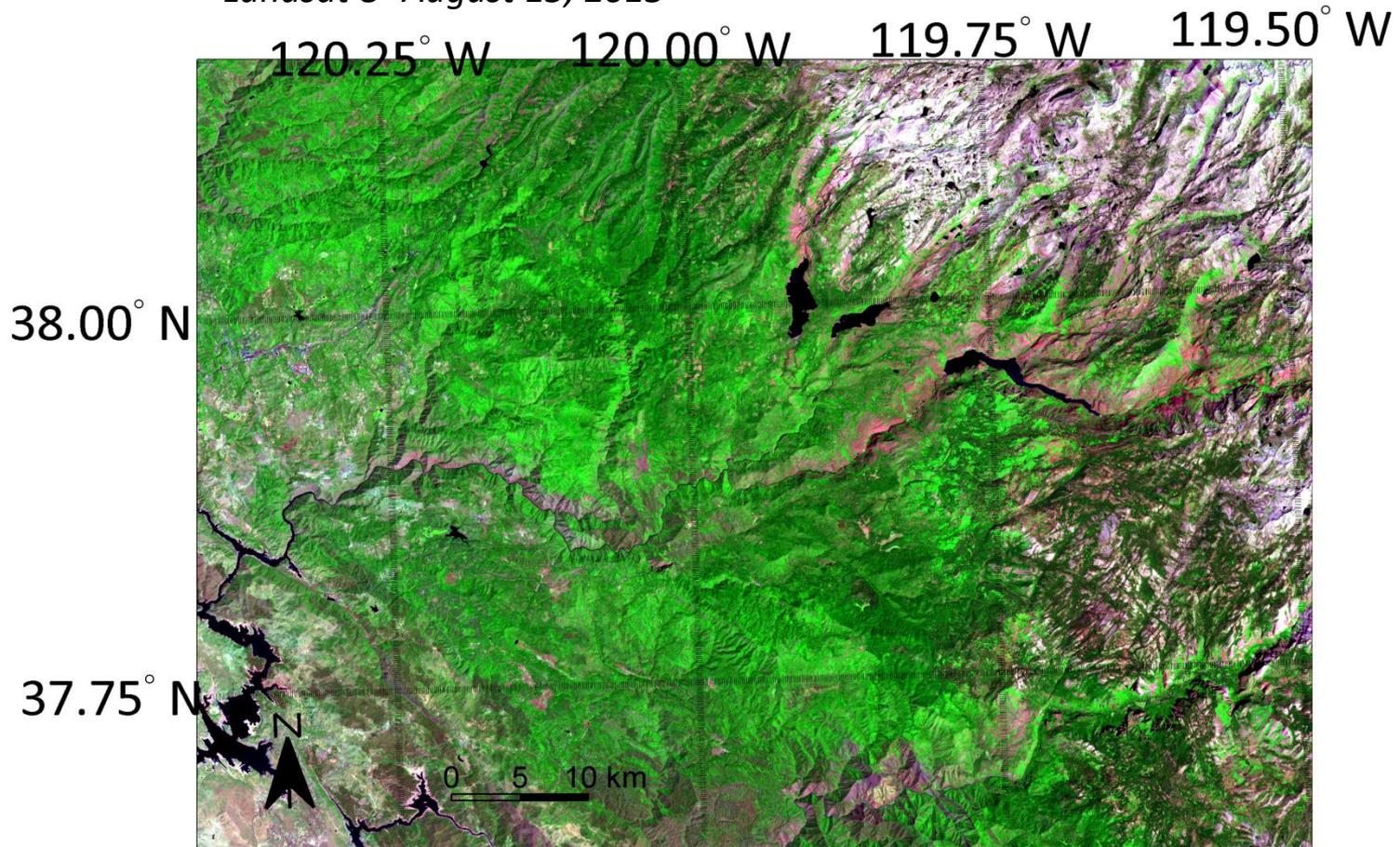
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Overview



Landsat 8 August 15, 2013

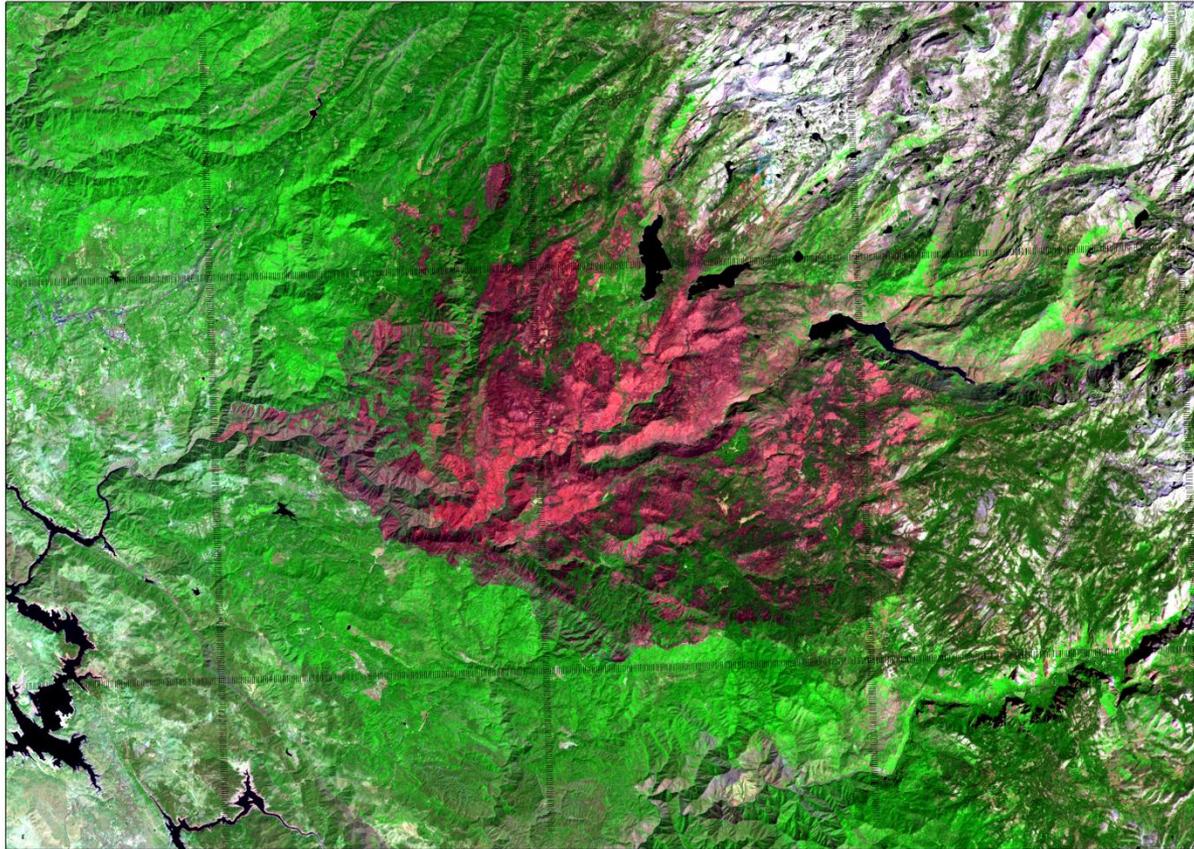




Overview



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

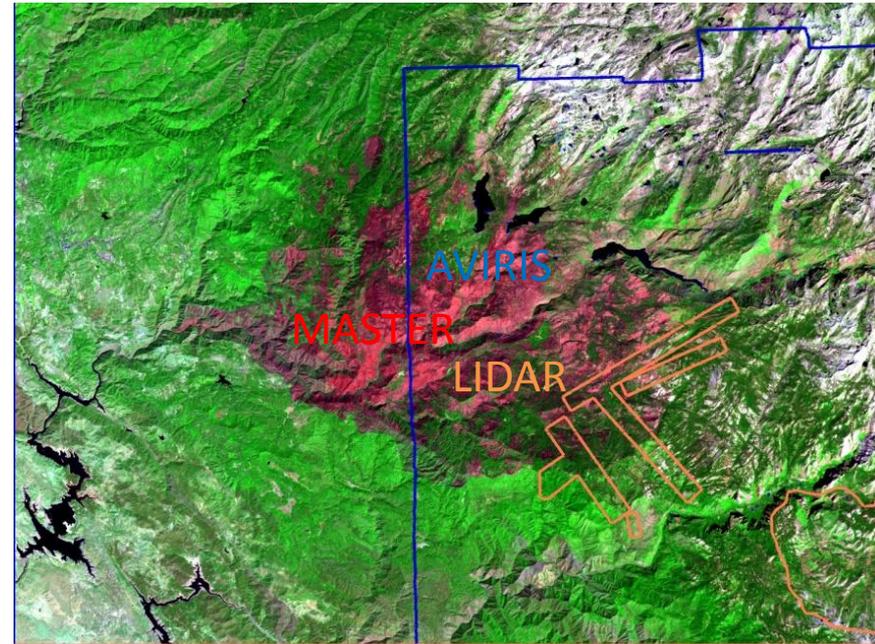
MASTER and AVIRIS collected data on September 13

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 HypSIIRI (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 HypSIIRI-like routine global coverage



Planned field work



Composite Burn Index

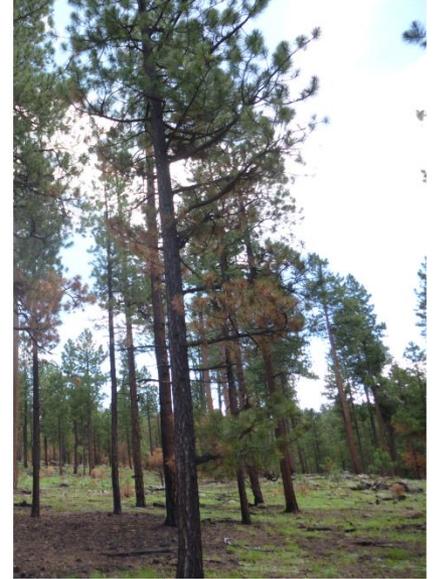
A. GeoCBI = 3



B. GeoCBI = 1.95



C. GeoCBI = 0.85



Tree mortality, % 'black-brown-green'

Tree species

Bark, branch and canopy combustion completeness

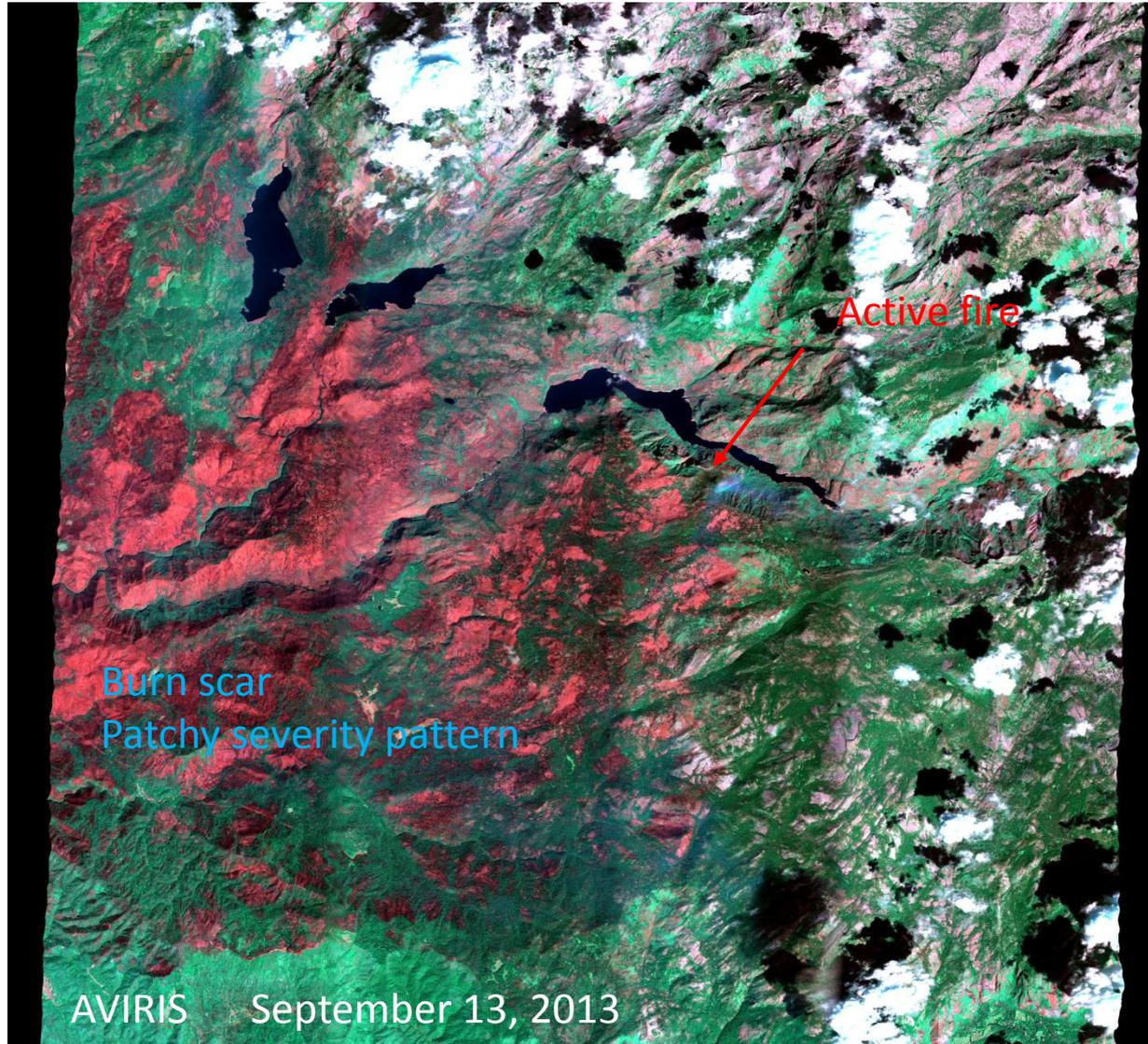
Tree DBH



Biomass and carbon loss
(through allometry)



Opportunities for active fire and post-fire research



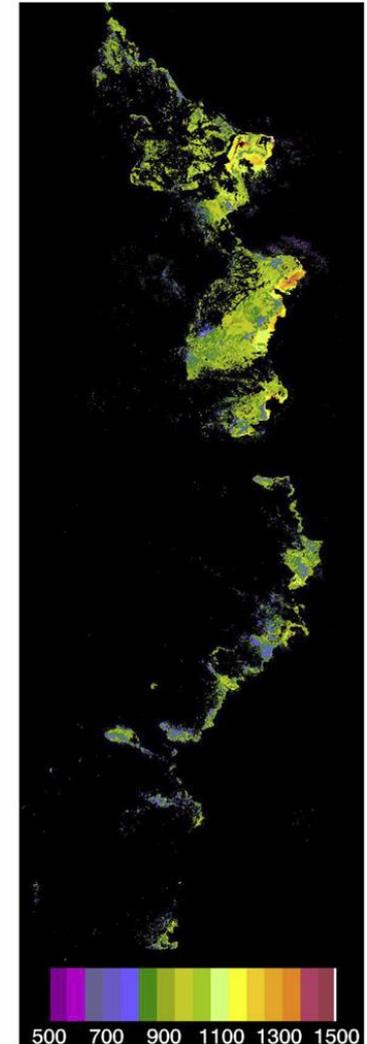
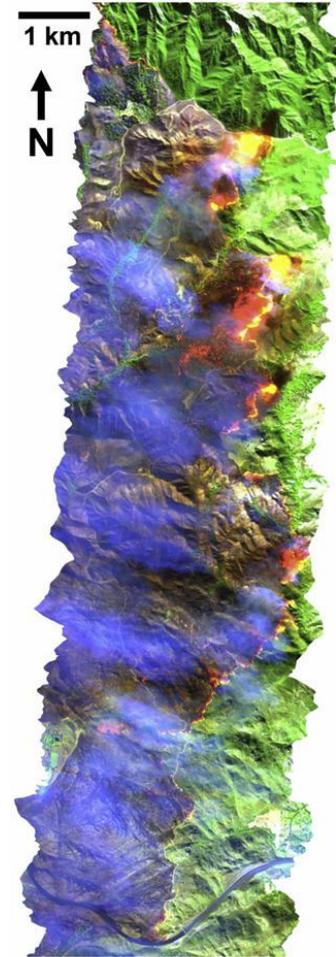
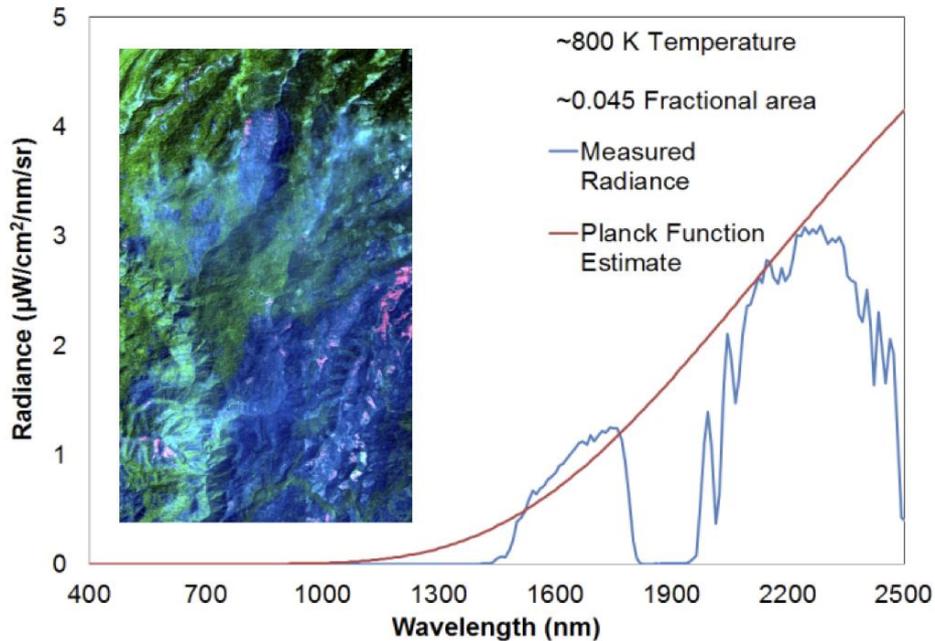


Opportunities for active fire research



VSWIR

Retrieval of fire temperature and fractional area



(Dennison et al. 2006)



Opportunities for active fire research

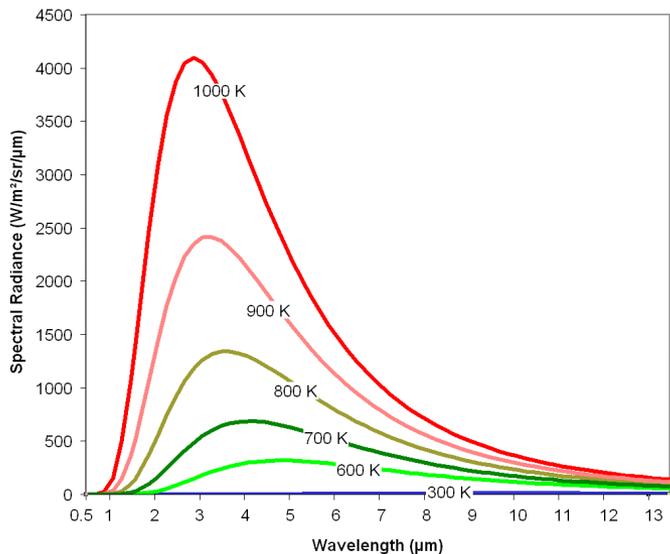


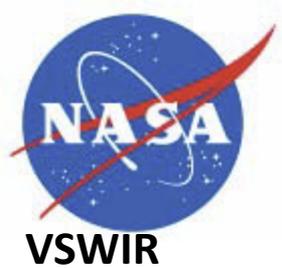
MTIR

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

$$FRP = \frac{A_{\text{sampl}} \cdot \sigma \cdot \epsilon}{\alpha \cdot \epsilon_{MIR}} (L_{MIR, \text{fire}} - L_{MIR, \text{bg}})$$

Needs mid (4 μm) and thermal (7.5-12 μm) to capture Planck curve and maximize detection



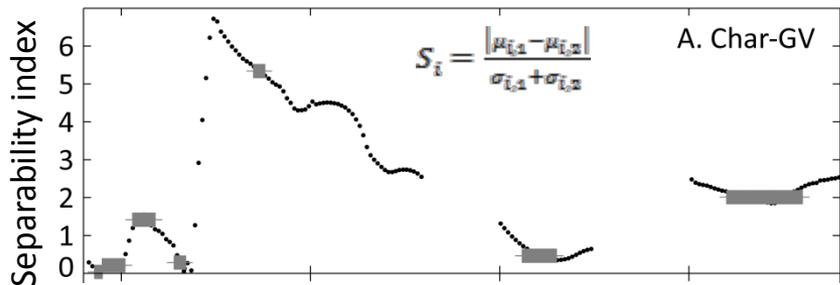
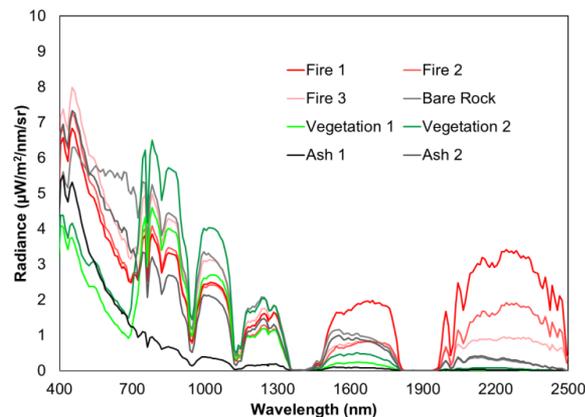
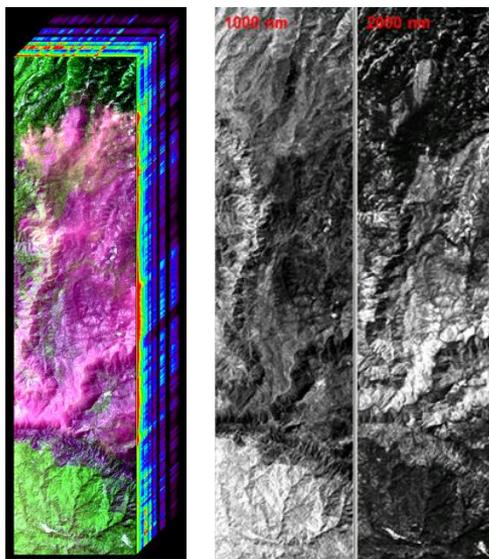


Opportunities for post-fire research

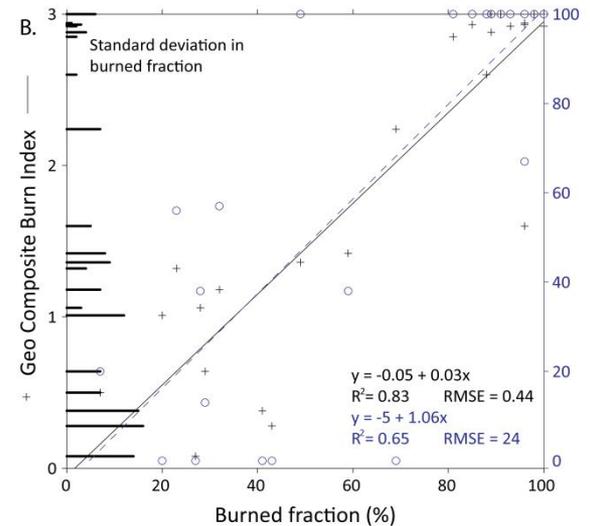
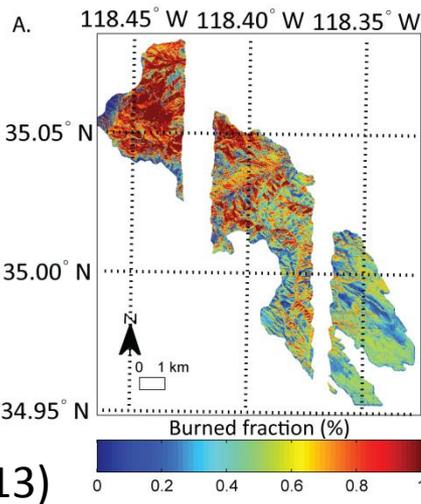


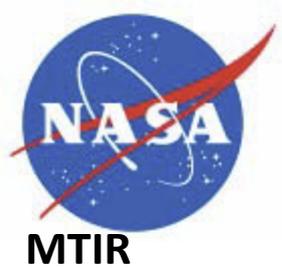
Narrowband spectral indices

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



(Veraverbeke and Hook 2013)



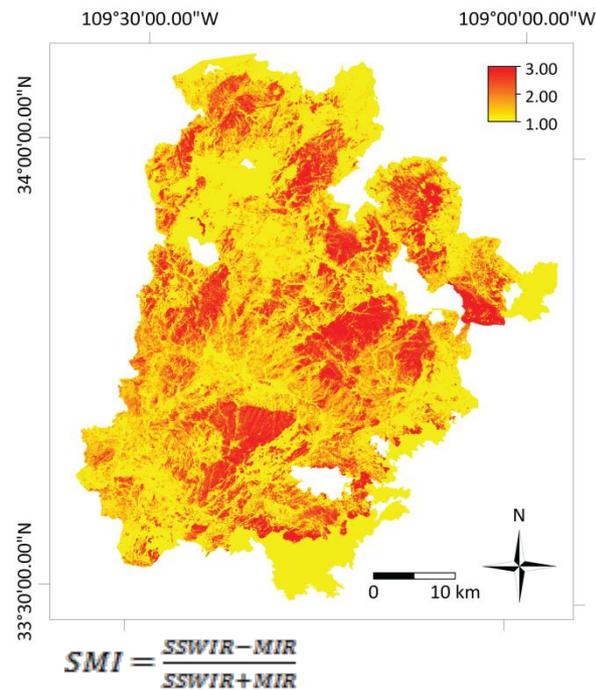


Opportunities for post-fire research



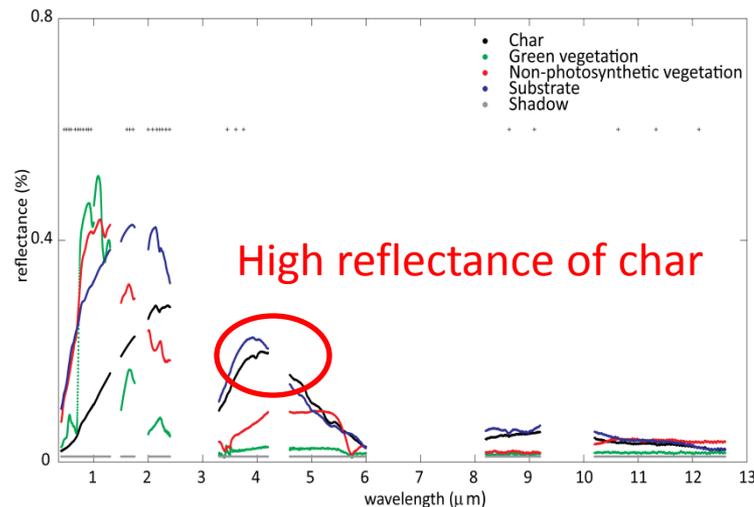
High reflectance of charcoal in MIR is extremely useful for burned area and fire severity mapping
 Post-fire changes in land surface temperature

A. GeoCBI estimated from MASTER SMI



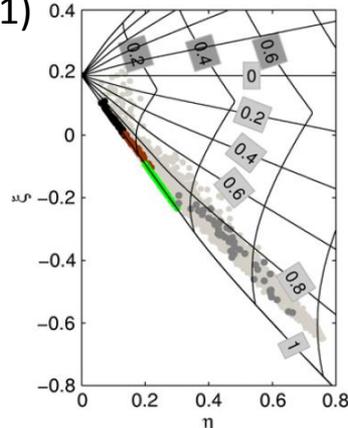
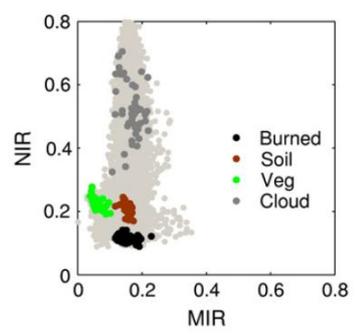
$$SMI = \frac{SSWIR - MIR}{SSWIR + MIR}$$

(Veraverbeke et al. 2011)

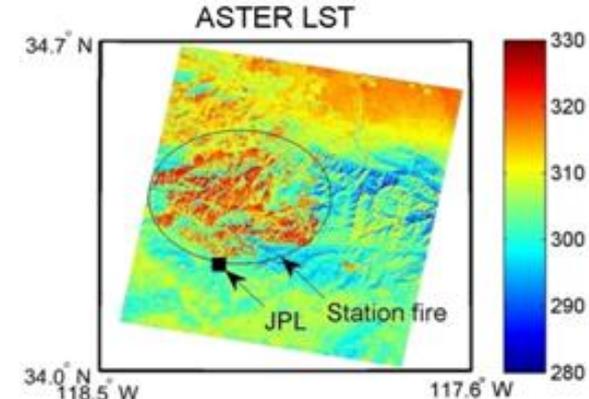


(Veraverbeke et al. 2012)

(Libonati et al. 2011)



(Hulley et al. 2013)





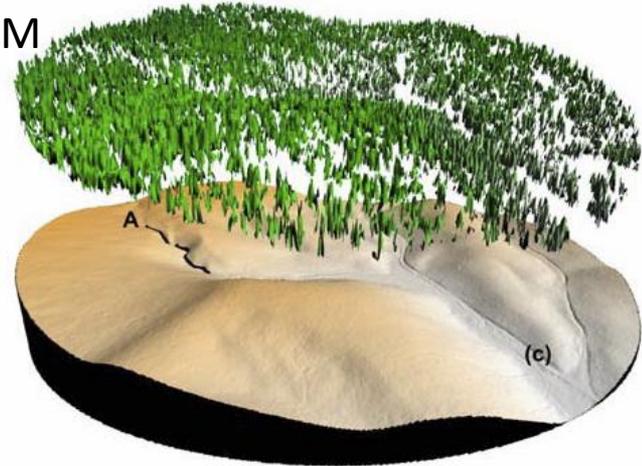
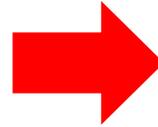
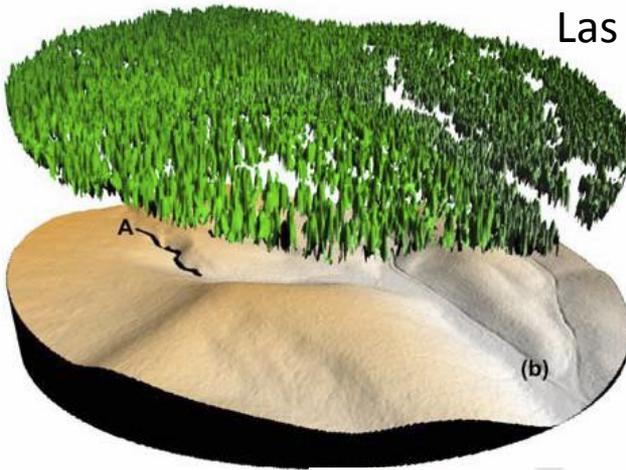
Opportunities for post-fire research



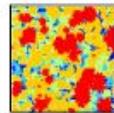
LIDAR

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

Las Conchas fire, NM
(NCALM)

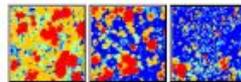


Ponderosa Pine	Unburned	Low	Moderate	High
White fir-Sugar pine	Unburned	Low	Moderate	High
Red fir	Unburned	Low	Moderate	High



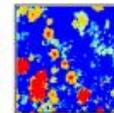
Canopy-gap

> Homogeneity



Canopy-gap
Clump-open
Open

>> Heterogeneity



Open

> Homogeneity

(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