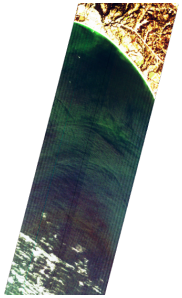
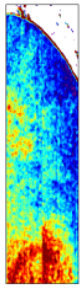
Ocean and Coastal Applications

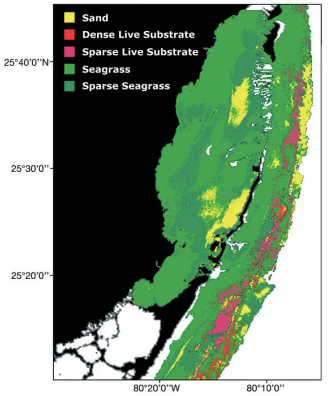
- Products
  - Sea color (e.g. Chlorophyll-A, Fluorescent line height, Maximum Chlorophyll Index,…) (VSWIR)
  - Sea Surface Temperature (SST) (TIR)
- Heritage: MODIS, AVHRR, MERIS, SeaWifs, ASTER, Landsat ETM, VIIRS, Hyperion, CZCS, OCTS
- Applications
  - River plumes, reef studies, HAB, Oil spills, TSS, Chlorophyll, Carbon



False Color Level 1G Hyperion



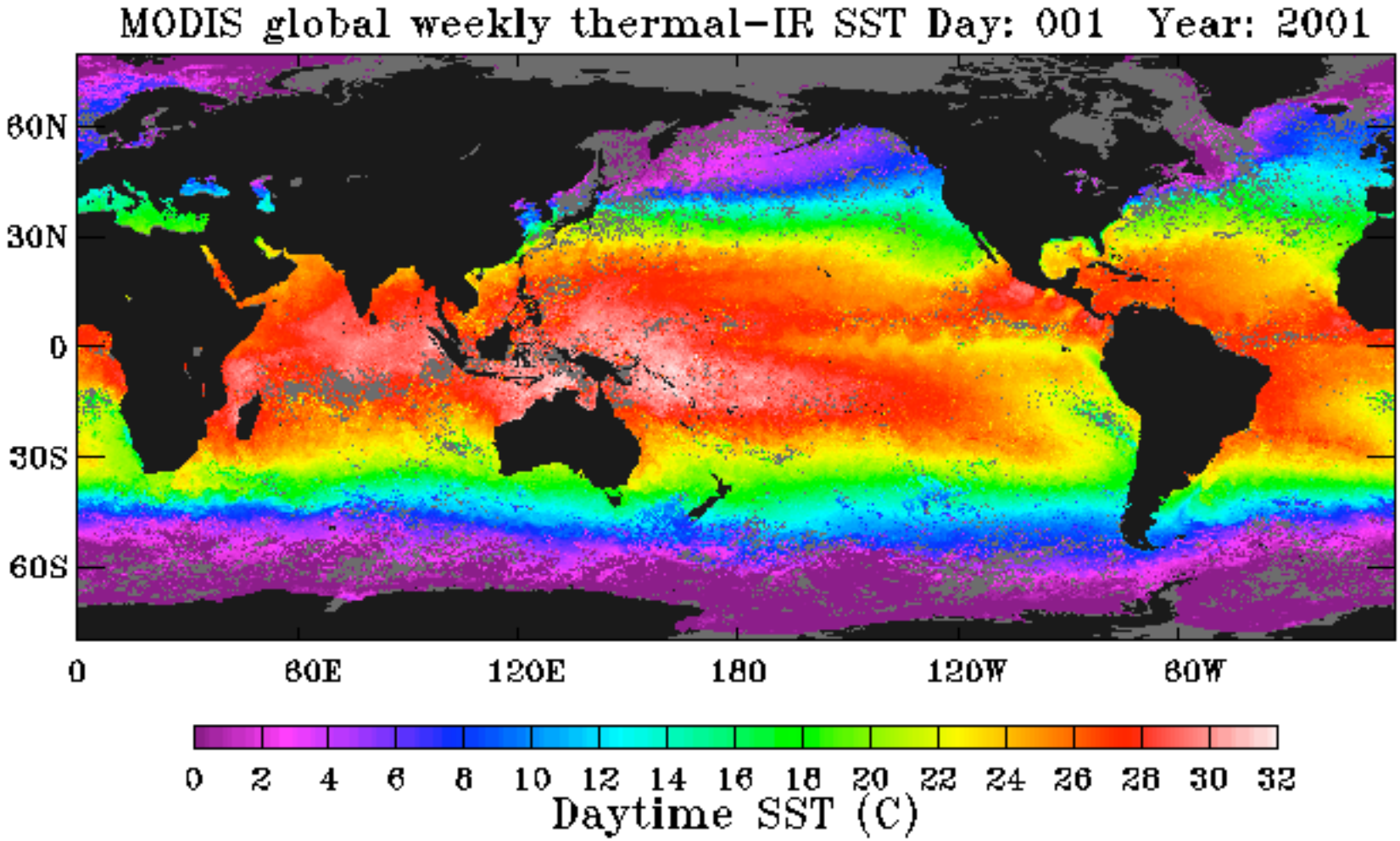
FLH From Level 0.5R Hyperion [Chien et al 2009]



Reef classification map derived from Landsat ETM [Moses et al. 2008]

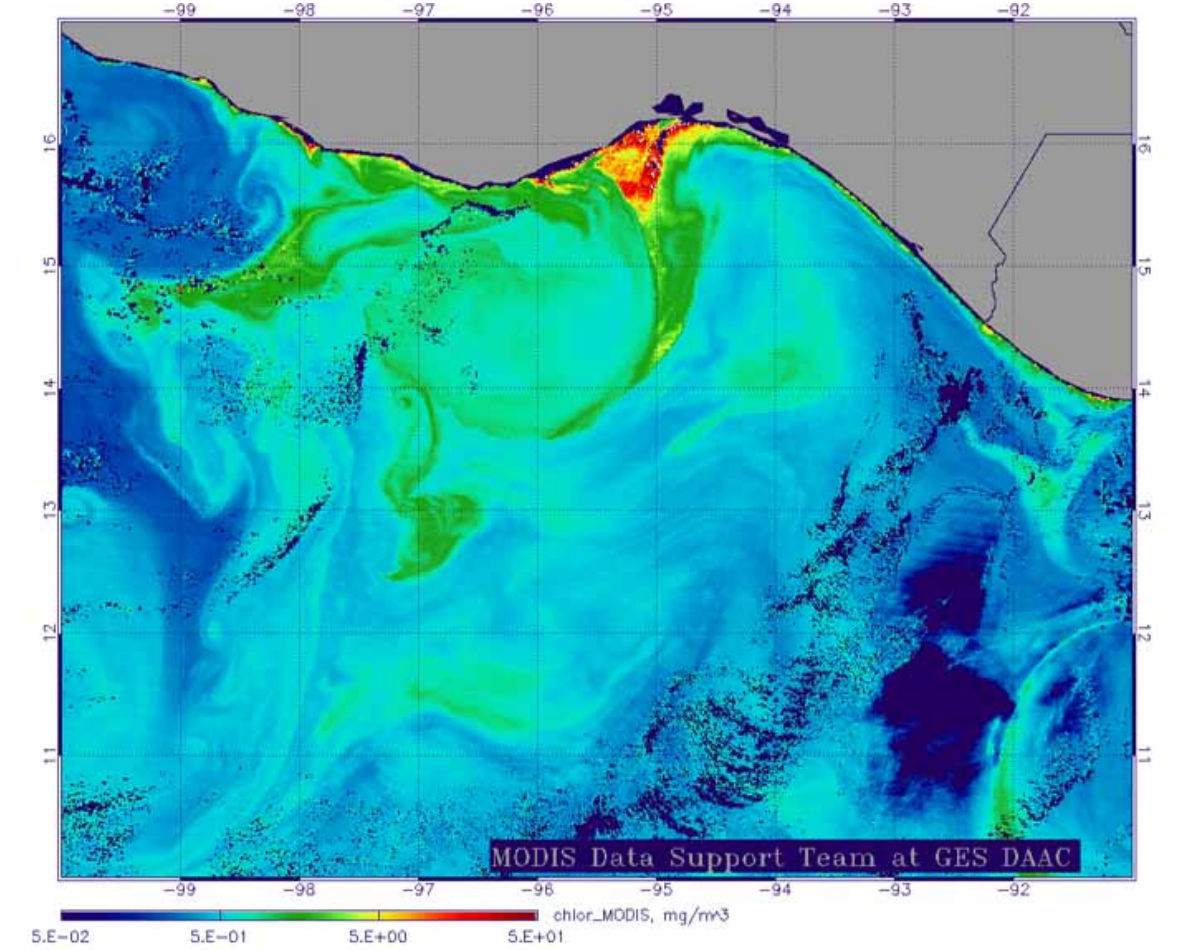
- Challenges
  - Atmospheric correction, cloud rejection (SST)
  - Case 2 waters (CDOM, TSS)

Heritage (ground) - MODIS SST



Uses 11-12 μm, 3.8-4.1 μm Courtesy PO DAAC

Heritage (ground) - MODIS CHl

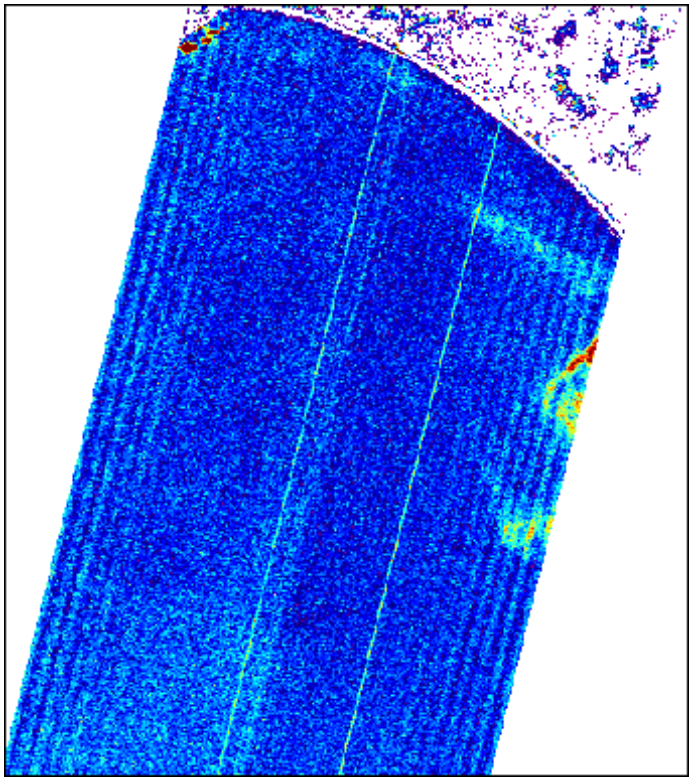


Uses 490nm/555nm or 490nm/565 nm reflectance data

Courtesy GSFC DAAC

Heritage (ground) -

- EO-1 sensorweb has developed workflows to automatically deliver FLH, MCI for ROI images



Maximum Chlorophyll Index derived from Hyperion imagery acquired 21 October 2008 of Monterey Bay [Chien et al. 2009] using 660, 681, 711, 752, nm.

Volcanic Applications

- Thermal: Detection of thermal signature in TIR triggers downlink of VSWIR and TIR spectra for selected pixels
- Plume: detection of ash, SO_2 spectral signature triggers downlink of selected spectra for region
- Products – alerts, thermal summaries, ash products (extent, spectra)
- Heritage -
  - Thermal: MODIS, GOES, ASTER, AVHRR, Hyperion
  - Plume: MODIS, ASTER
- Applications – volcano monitoring, aviation hazard
- Challenges – low effort, site specific thermal characterization for triggers, rapid plume retrievals, night overwater plume retrievals

Heritage (ground) GOES, AVHRR, MODIS

- GOES/AVHRR – U. Hawaii has demonstrated tracking of thermal activity using GOES and AVHRR
  - Rapid response but can only detect large signals
  - Uses 4, 11-12 μm
  - 15 minute resolution

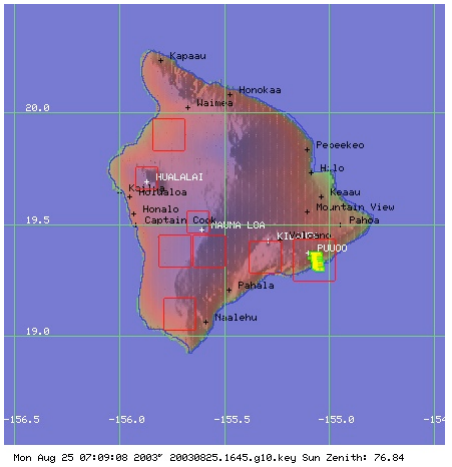


Image courtesy Hawaii Institute of Geophysics and Planetology.

- MODIS – UH Modvolc tracks thermal activity using Normalized Thermal Index (NTI)
  - Rapid response but can only detect large signals
  - Uses B21/22 (3.959 μm) and B32 (12.02 μm)
  - Site specific parametric adjustment can increase sensitivity
  - 4 overflights (day/night) per day

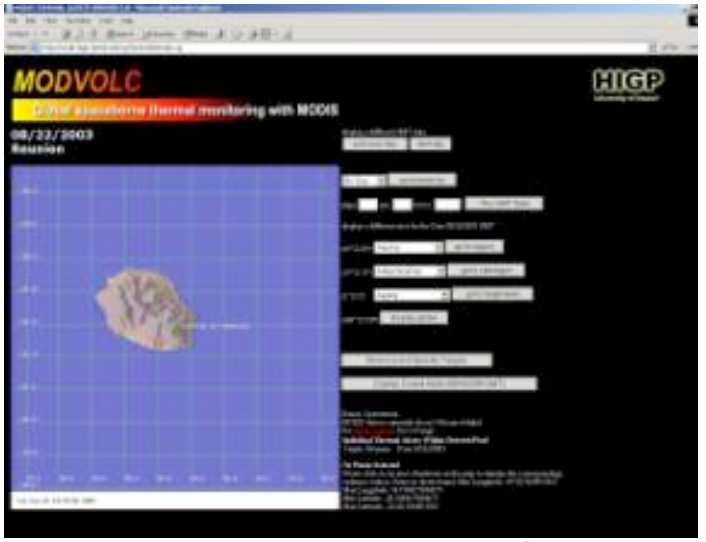
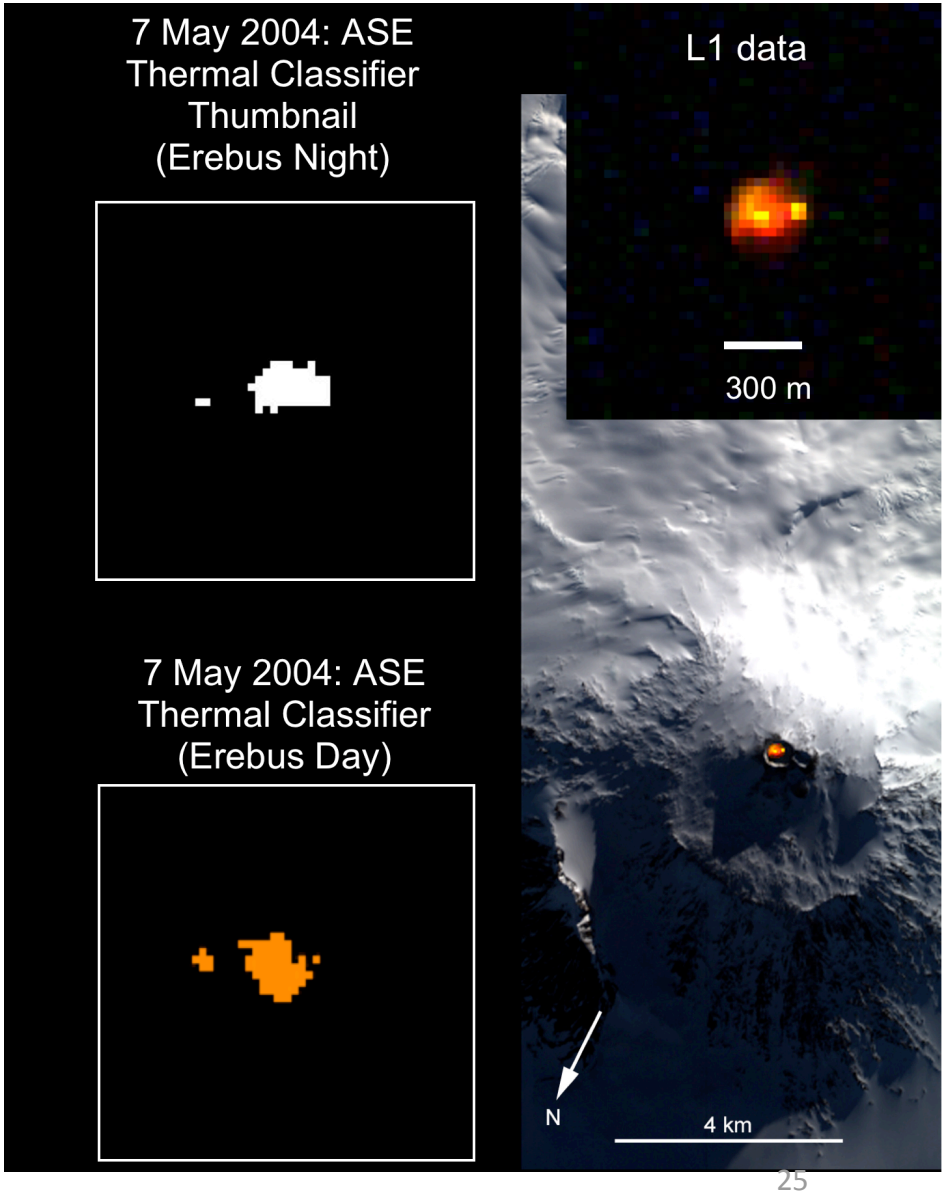


Image courtesy of UH-HIGP

Heritage (onboard) – EO-1/ASE Thermal Detection

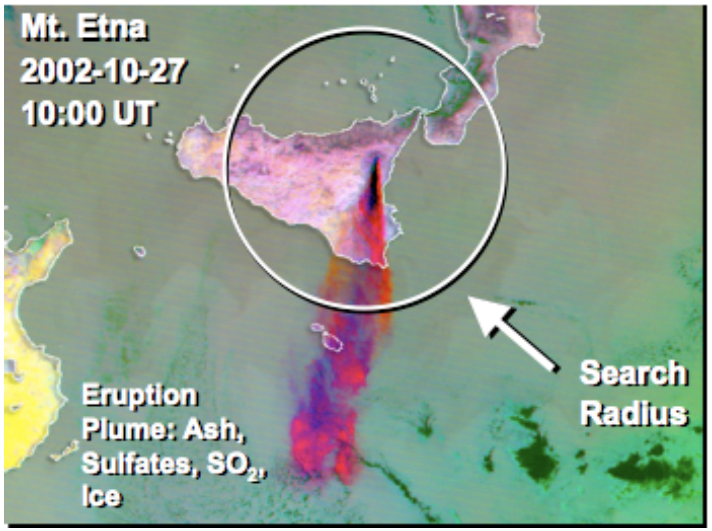
- EO-1
  - Onboard thermal event detection in use since 2004 based on onboard Hyperion spectral signature
  - Uses spectral slope in 1.65-2.28μm
  - Onboard event detection can trigger:
    - Subsequent imaging
    - Alert Notices
    - Generation of thermal summary and quicklook context images
    - Ground-based automatic data product generation and distribution



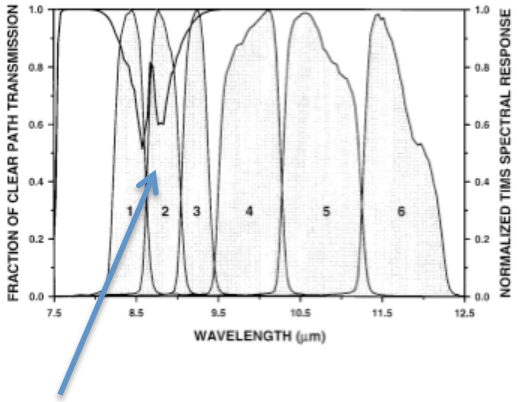
Courtesy [Davies et al. 2006, RSE]

Heritage (ground) Plume tracking

- Volcanic plumes tracked based on spectral signature
- ASTER, MODIS



Images courtesy
V. Realmuto/JPL



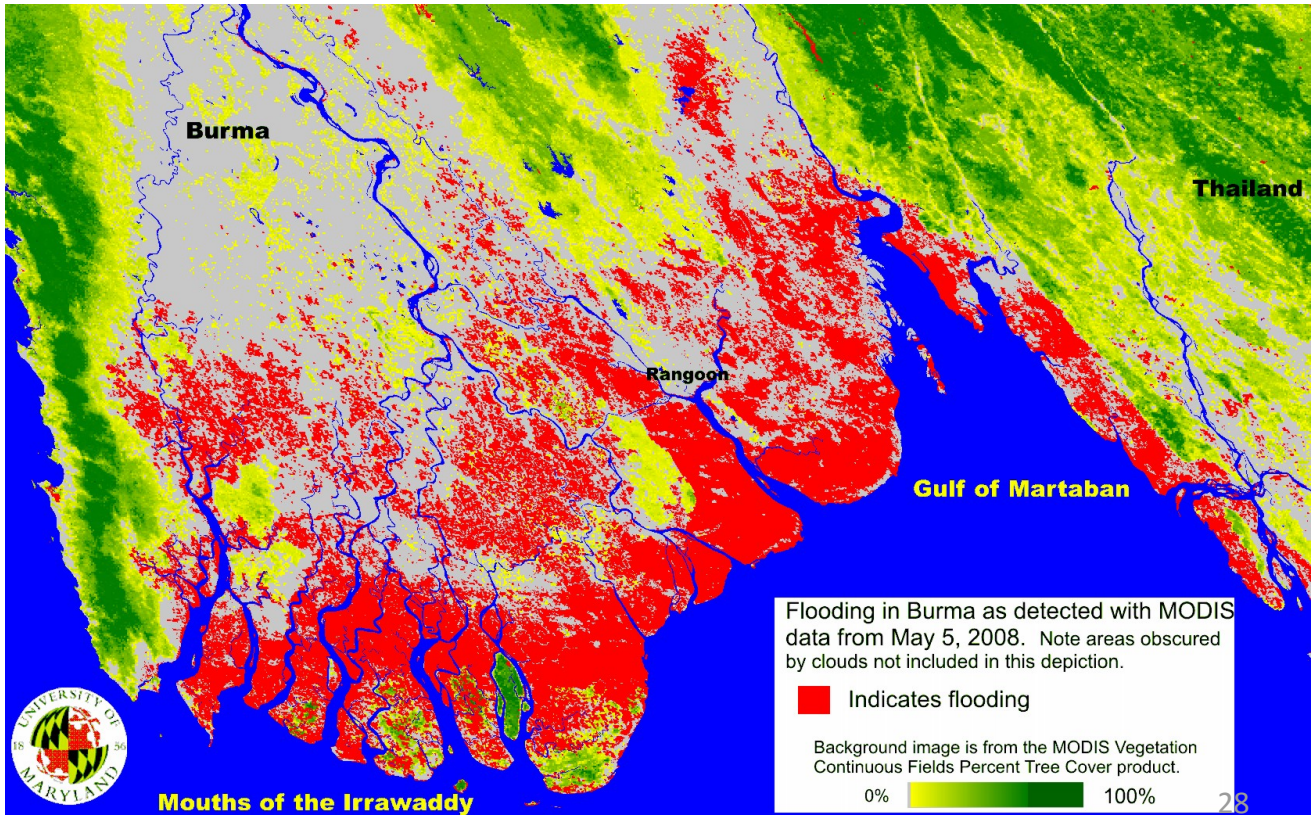
SO2 absorption band
at 8-9 microns

Flood Applications

- Surface Water extent: Detection of increased surface water extent or ground-specified regions of interest trigger generation of water extent maps using VSWIR and TIR
- Products – Surface water extent and cloud products, alerts
- Heritage -
  - MODIS (ground-based) (UMD, DFO)
  - Hyperion (onboard) (JPL/U. AZ)
- Applications – Flood monitoring, disease risk
- Challenges – cloud cover and cloud shadows

Heritage (Ground) MODIS/UMD

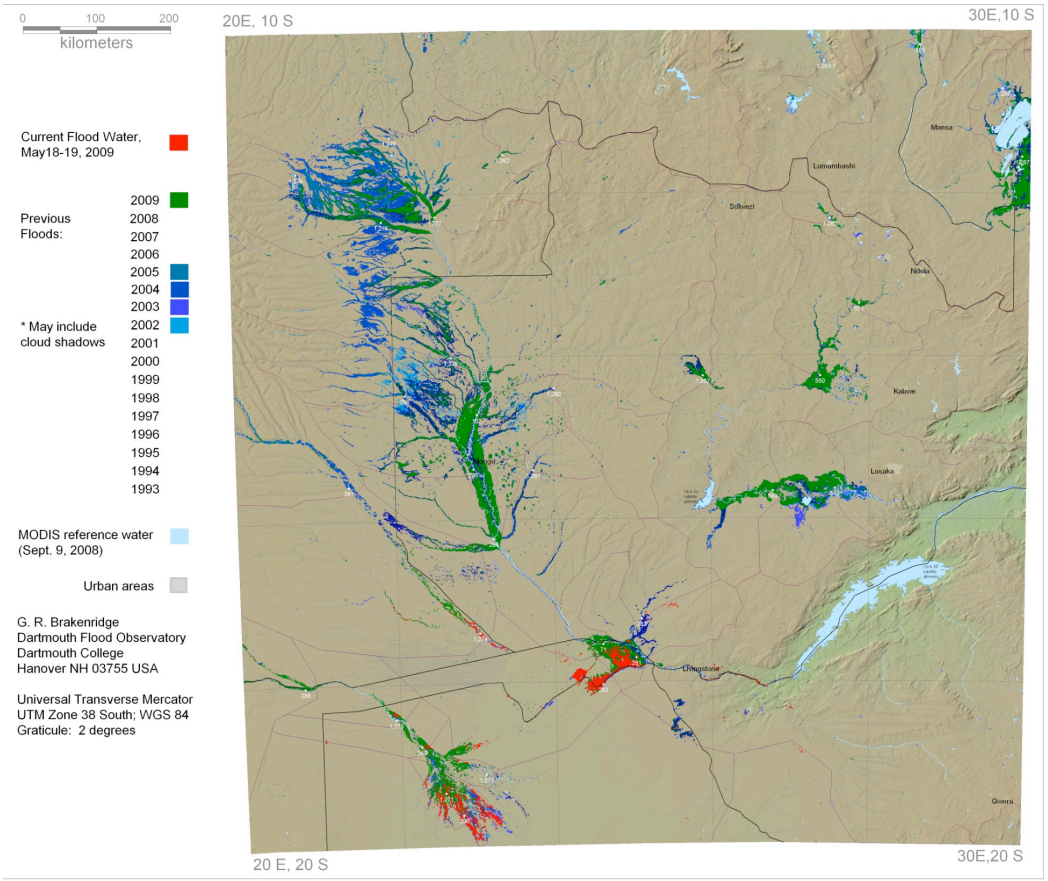
- UMD Flood tracking of Myanmar using MODIS bands 1,2,5,7 (620-2155 nm)



M. Carroll et al.

Heritage (ground) – MODIS (DFO)

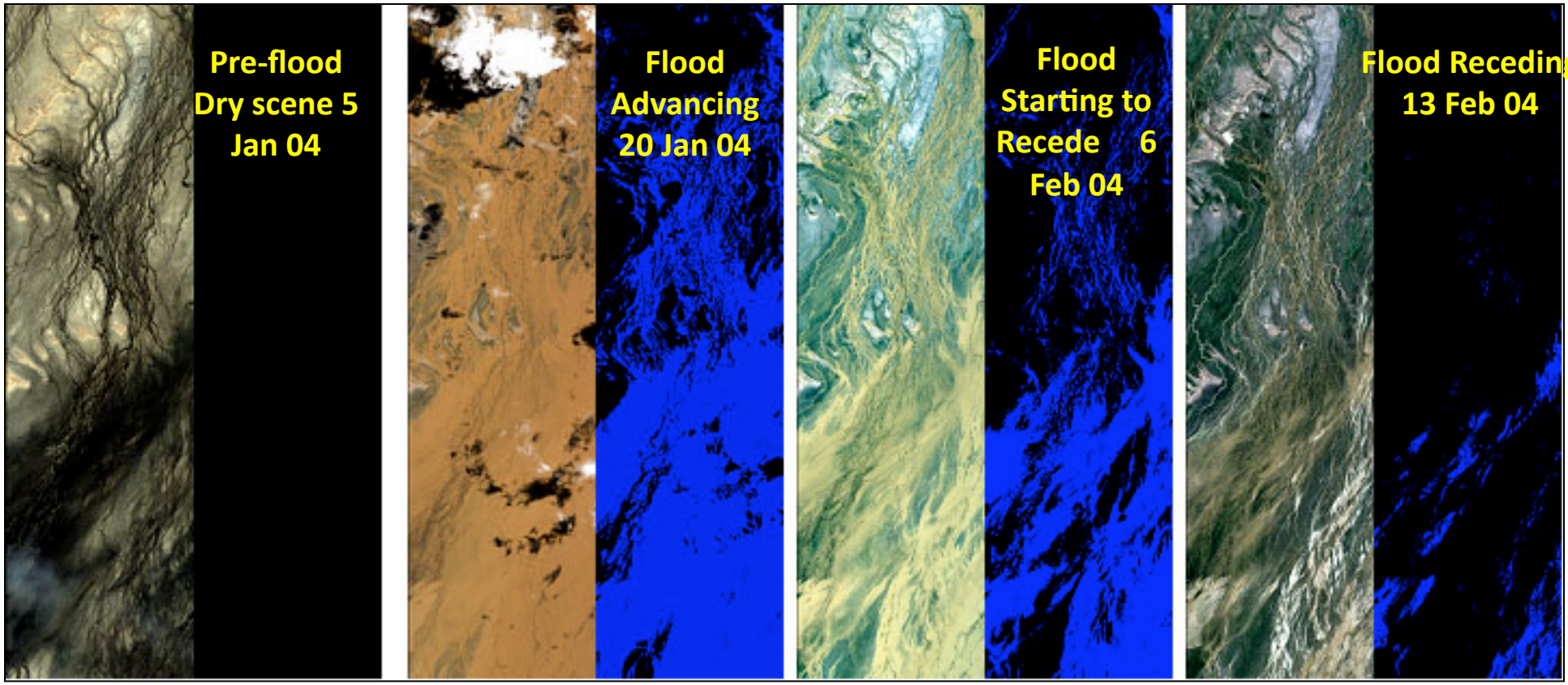
- Uses thresholding of 443 nm MODIS band 2 averaged over several images to counteract cloud shadows



R. Brakenridge et al.

Heritage (Flight) – EO-1/ASE

Onboard Detection of a Rare Major Flood on Australia's Diamantina River



Cause of flooding: Monsoonal rain

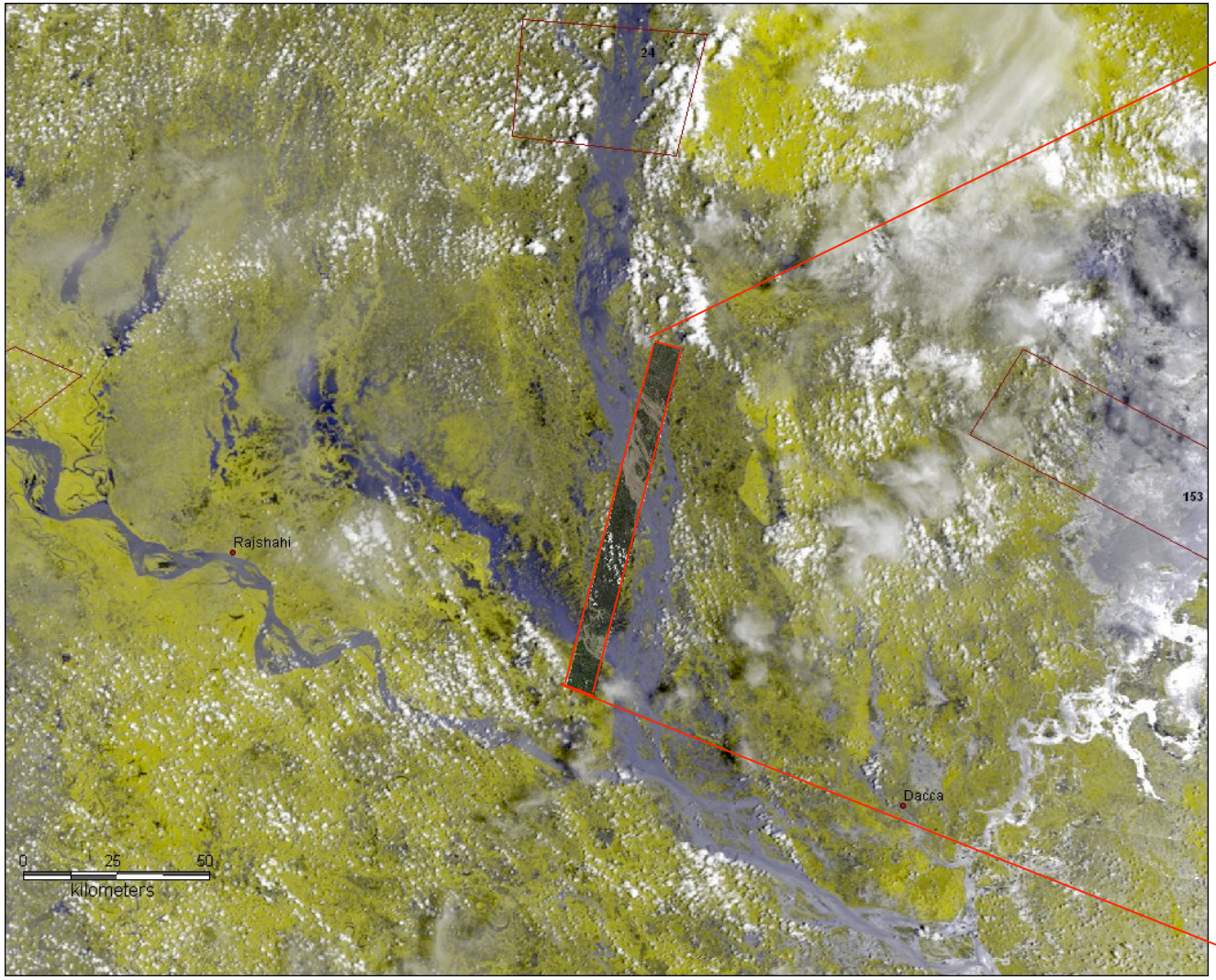
EO-1 Hyperion. Wavelengths used: 0.86 µm and 0.99 µm

F. Ip, V. Baker, et al., RSE 2006, (University of Arizona)

Flood alerts are then used to retask EO-1.

EO-1 Hyperion Image Brahmaputra Aug 6, 2003

MODIS Image Brahmaputra, India Aug 6, 2003



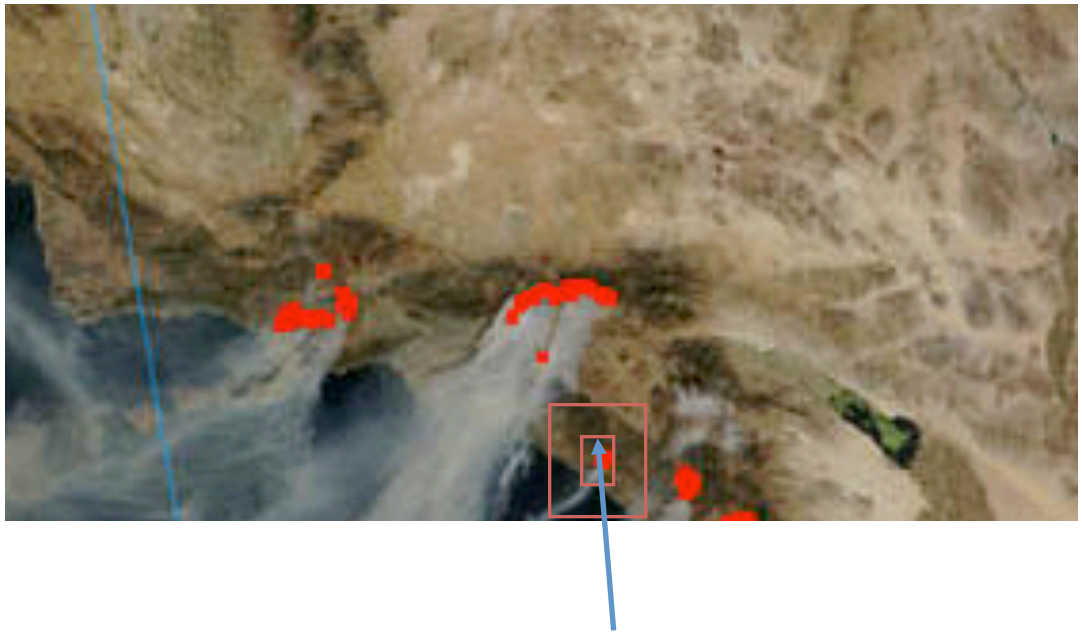
250M resolution

(10M ALI Pan band possible) 30M resolution

Fire Applications

- Active Fire Maps – thermal signature used to track active fires
- Burn Scar Maps – thermal signature or ground-specified region of interest causes burn scar map generation
- Products – Active fire maps, burn scar maps, alerts
- Heritage -
  - MODIS (ground-based active fire detection)
  - Landsat ETM+ (ground-based burn products)
  - Hyperion, ALI (onboard fire detection, burn products)
- Applications – Active fire tracking for firefighter support, burn scar assessment for rehabilitation
- Challenges – cloud cover, smoke

Heritage – ground-based MODIS Active Fire Detection



- Detects hotspots using
  - absolute threshold
    - T_4>360K, 330K(night) or
    - T_4>330K, 315K(night) and T_4-T_{11}>25K(10K @ night)
  - and relative threshold
    - $T_4 > \text{mean}(T_4) + 3\text{stddev}(T_4)$ and $T_4 - T_{11} > \text{median}(T_4-T_{11}) + 3\text{stddev}(T_4-T_{11})$

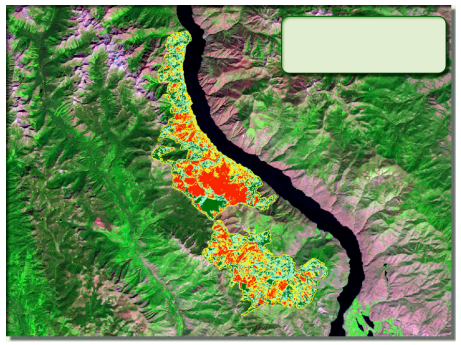
Looks for areas significantly hotter than surrounding area (requires 6 surrounding pixels cloud, water, fire free → 21x21)

C. Justice et al.

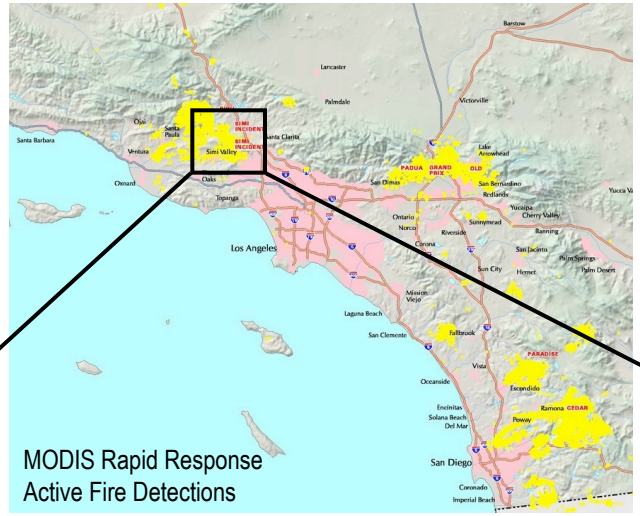
Heritage(ground) – Burn Scar Assessment

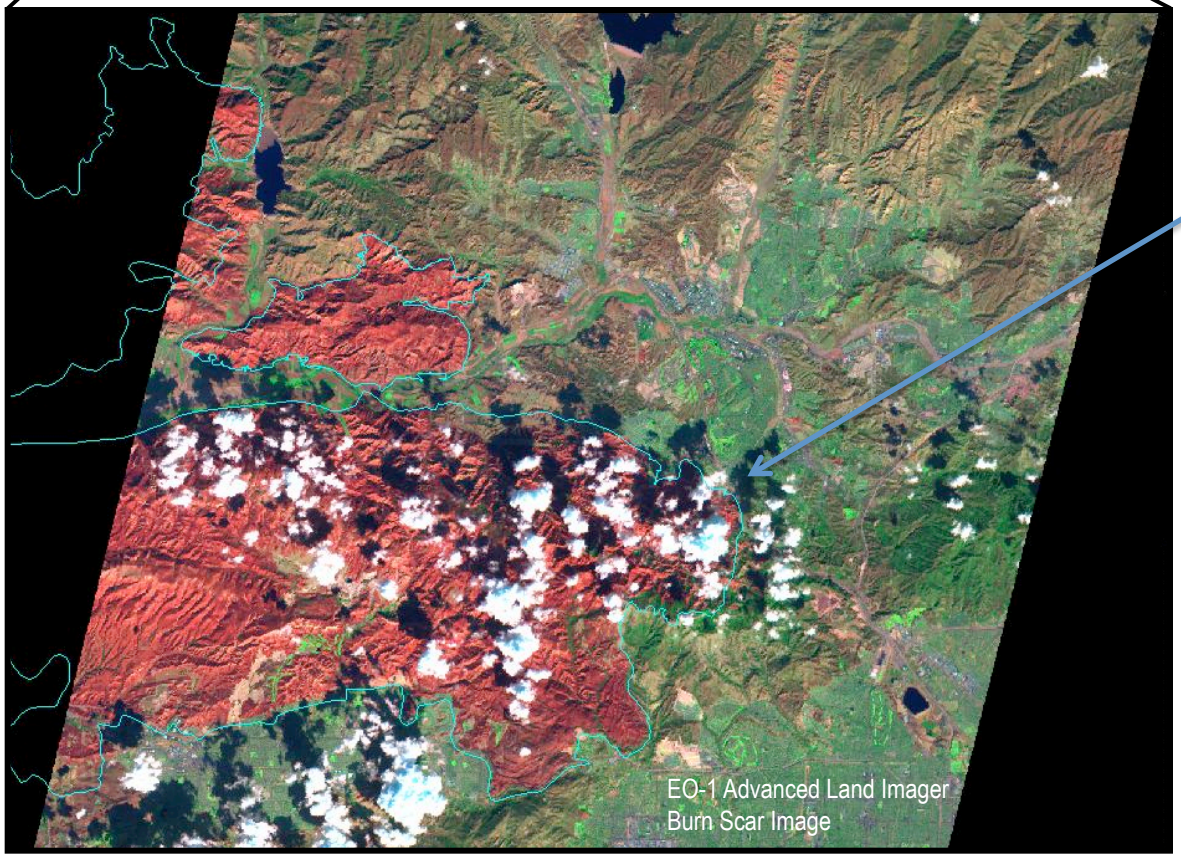
- Burn scar assessment using ASTER, AVHRR, Landsat ETM+, Aviris, ALI, Hyperion
- Normalized Burn Ratio (NBR) = $(R_4-R_7)/(R_4+R_7)$
  - R_4=0.76-0.9μm R_7=2.08-2.35μm
- $dNBR = NBR_{prefire} - NBR_{postfire}$
- Combine with DEM, soil composition, presence of surface rock, standing dead vegetation, where does it flow to
- NBR adapted for ALI, Hyperion

5 class burn severity map from mtbs.gov



Wildfire SensorWeb





NBR ALI Data

POC:
C. Justice,
R. Sohlberg et al.

Summary

- There are many uses for rapid delivery HyspIRI data
  - HyspIRI will deliver an unprecedented combination of spatial, spectral, and temporal resolution
- Significant heritage exists in these application areas using instruments with similar characteristics to generate these products on the ground and in some cases onboard (EO-1)
- We are conducting trade studies to evaluate the utility of onboard product generation with dynamic onboard spatial and spectral sub selection to reduce downlink volume
- Our plan is to work collaboratively with the relevant science working groups in trade studies, product definition, and prototyping
- EO-1 offers a tremendous opportunity to prototype onboard product generation (but no TIR)