National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

JPL is able to apply its technologies, facilities, and expertise to assist our partners in product improvement and problem solving to reduce risk.

Remote Sensing Overview

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Airborne Remote Sensing for Earth Science Applications

Andrew Aubrey, JPL

Division 38

Instruments & Science Data Systems

Passive Remote Sensing Methods

Passive remote sensing – measures sunlight radiance reflected from surface

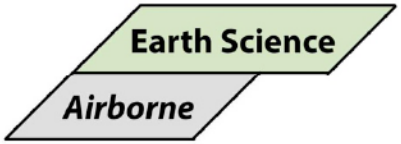
- Spectra are the fingerprints of surface materials
- In column atmospheric gases absorb at characteristic wavelengths
- Thus surface composition and atmospheric investigations are possible

AVIRIS: Airborne Imaging Spectrometer (classic)

- Extremely wide wavelength detection Range: visible to infrared
- Spectral resolution ~10 nm windows (224 total)
- Whiskbroom Scanner (new generation AVIRIS-ng = pushbroom)
- 1 milliradian (0.05 degree) instantaneous FOV
- Extremely fine spatial resolution (1000 meters = 1m x 1m pixels/4000 meters = 4m x 4m pixels)

New JPL Airborne Imaging Spectrometers

- AVIRIS-next generation (5 nm spectral resolution)
- PRISM –designed for ocean color measurements (enables high resolution Bio-optical investigation)

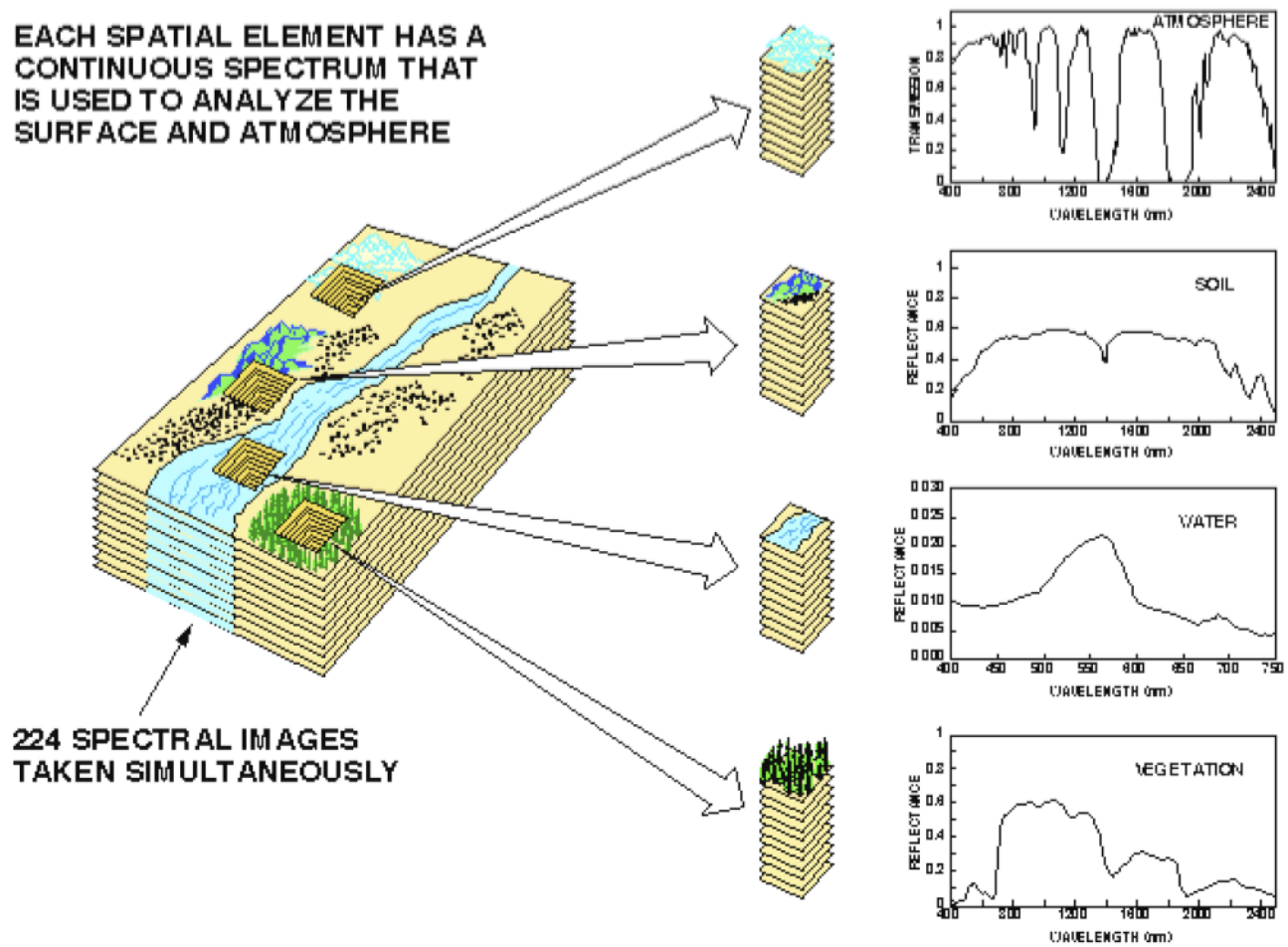


Twin Otter Platform for Airborne Investigation

NASA ER-2 Platform for Airborne Investigation

Imaging Spectroscopy Approach

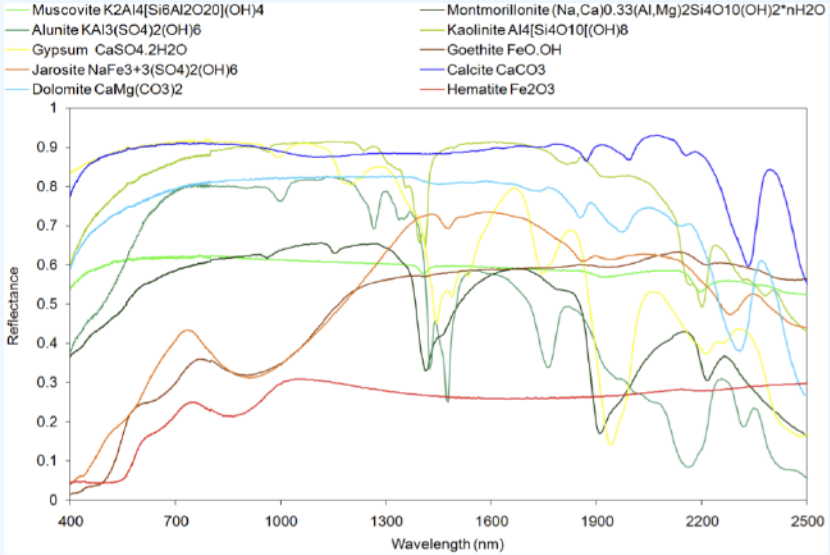
(Image courtesy Robert Green, JPL)



Instruments & Science Data Systems Division 38

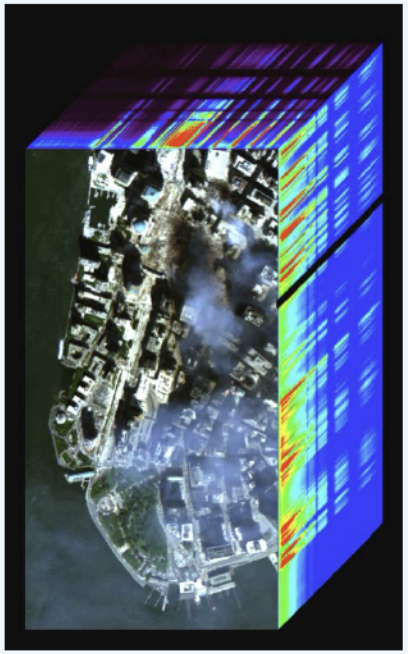
Spectra are the Fingerprints of Materials

(Courtesy Robert Green, JPL)



Full Spectrum Enables: Detection, Identification, Quantification and Monitoring

Results



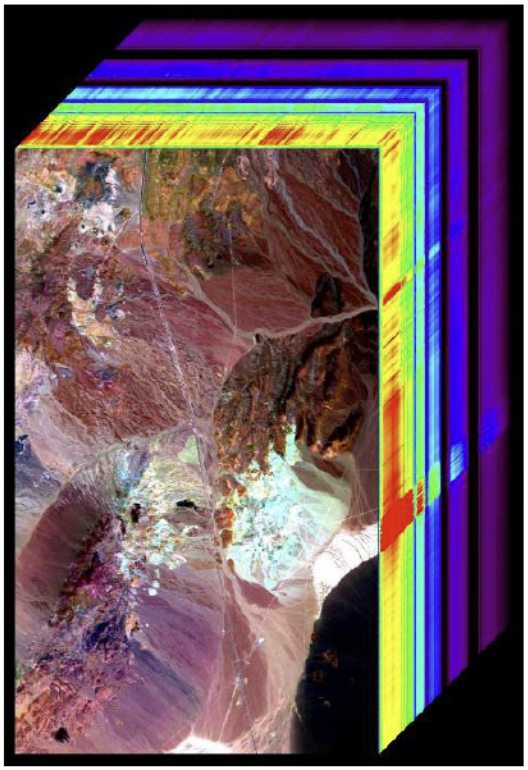
AVIRIS Assessment of Asbestos, Fires, and Debris World Trade Center September 16, 2001

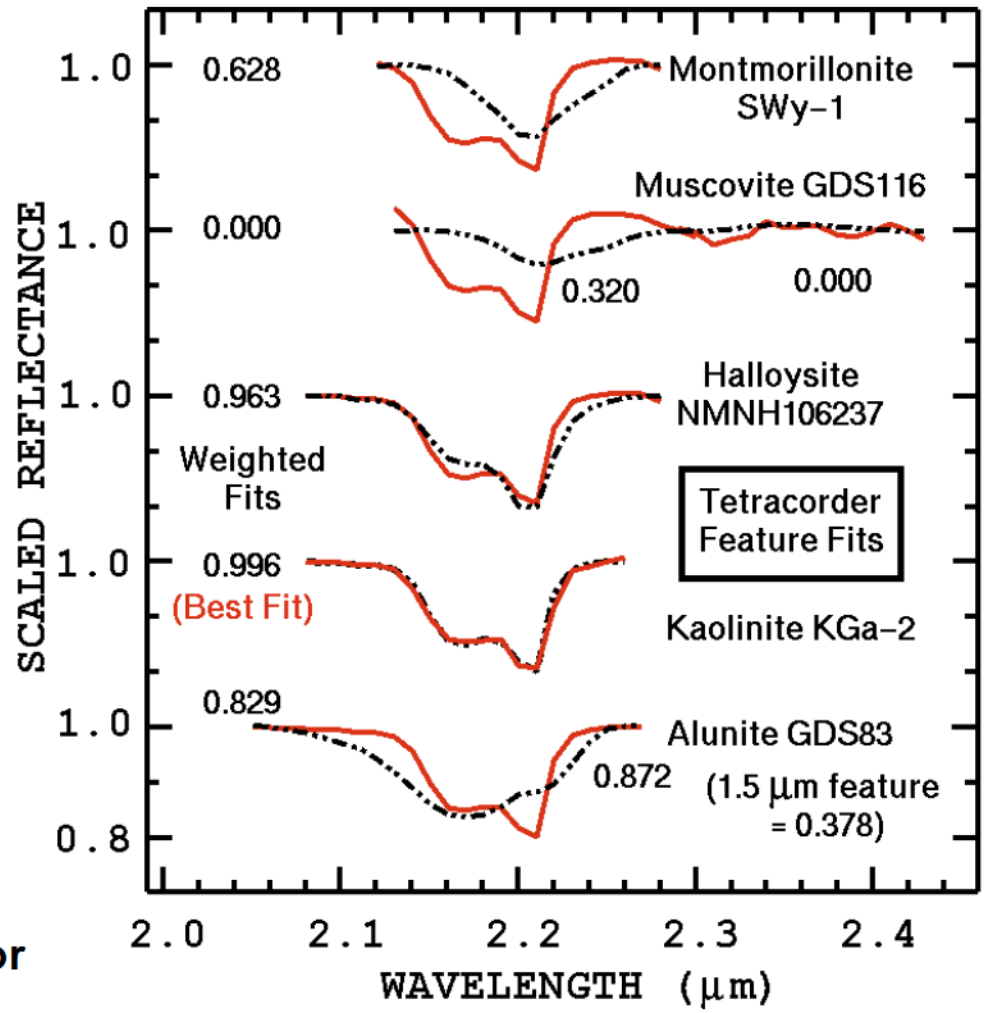
- **AVIRIS: Airborne Visible & InfraRed Imaging Spectrometer**
  - Built in 1987 – remains gold standard for imaging spectrometers
  - Enables Scientific studies
    - Geology (mineralogy)
    - Ecosystem sciences (invasive species)
    - Disaster evaluation (GOM)
    - Agriculture (land cover/use)
    - $10M instrument cost
- **AVIRIS-ng: currently being built**
- **PRISM: Portable Remote Imaging Spectrometer – current project**
  - Coastal zone & coral reef science focus
  - Narrower spectral range than AVIRIS (300-900 nm)

Name	JPL AVIRIS
Platform	Airborne
Spectral Range	360-2510nm
Number of Bands	224
Spectral Resolution	10 nm
Ground Sample Distance	2-20 meters
Telescope Diameter	20 cm
Dispersion	Grating
Swath	34 degrees
FrameRate	10 hz
Build Time	36 Months
Cost	$10M

Remote Measurement via Spectral Fitting

Surface mineralogy Cuprite, NV



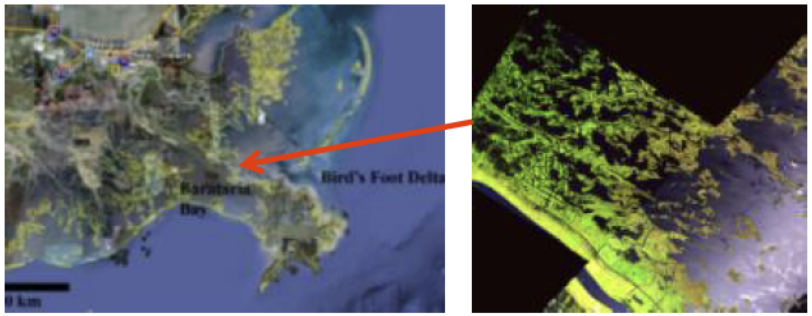


Detect, Identify, Measure, Monitor

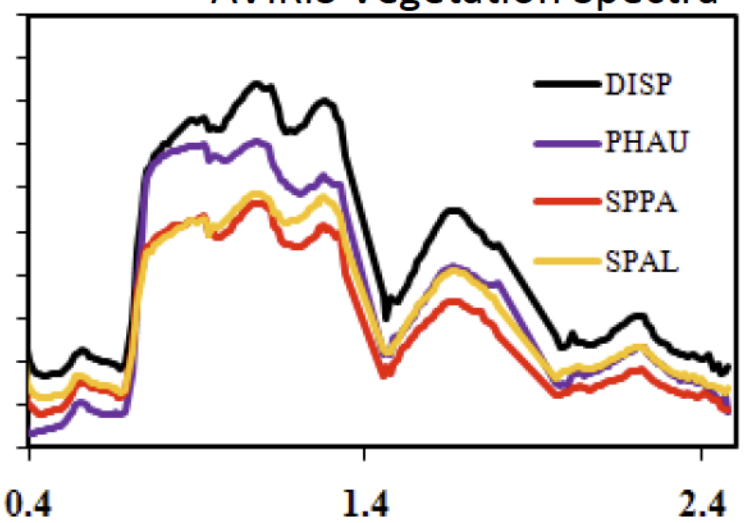
(Courtesy Robert Green, JPL)

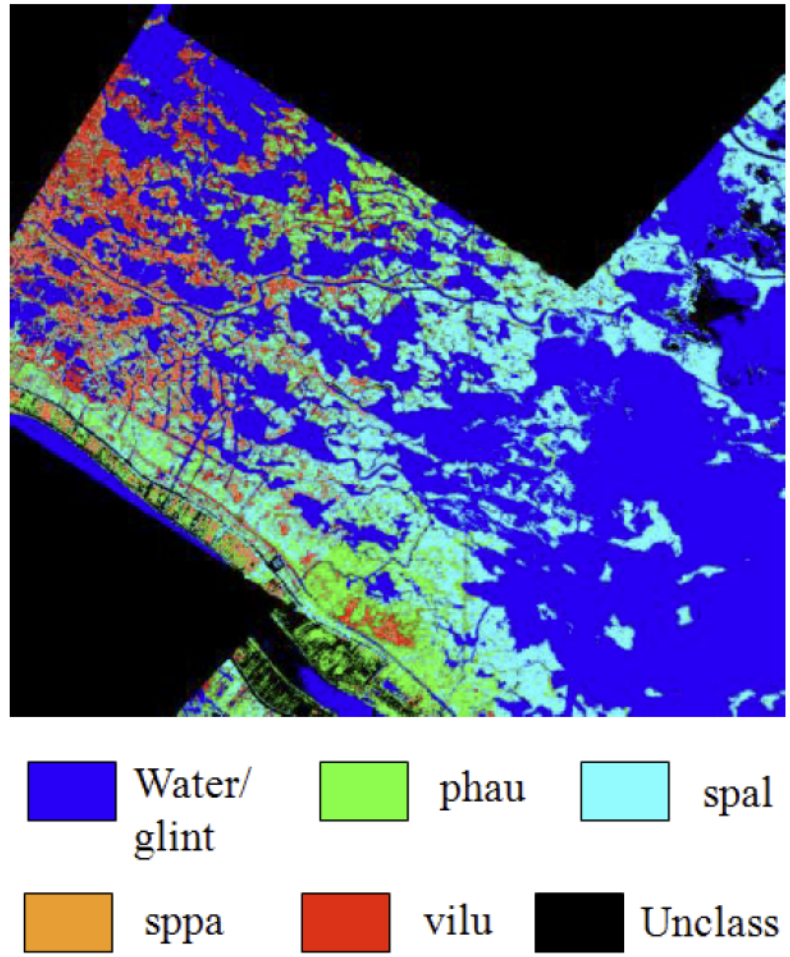
Instruments & Science Data Systems Division 38

Imaging Spectroscopy Mapping Wetland Dominants 2010 LA (AVIRIS)



AVIRIS Vegetation Spectra





Vegetation mapped cleanly across scene boundaries

- ***Phragmites (phau)***
- ***Spartina alterniflora (spal)***
- ***Spartina patens (sppa)***
- ***Vigna luteola (vilu)***

(Courtesy D. Roberts, UCSB)

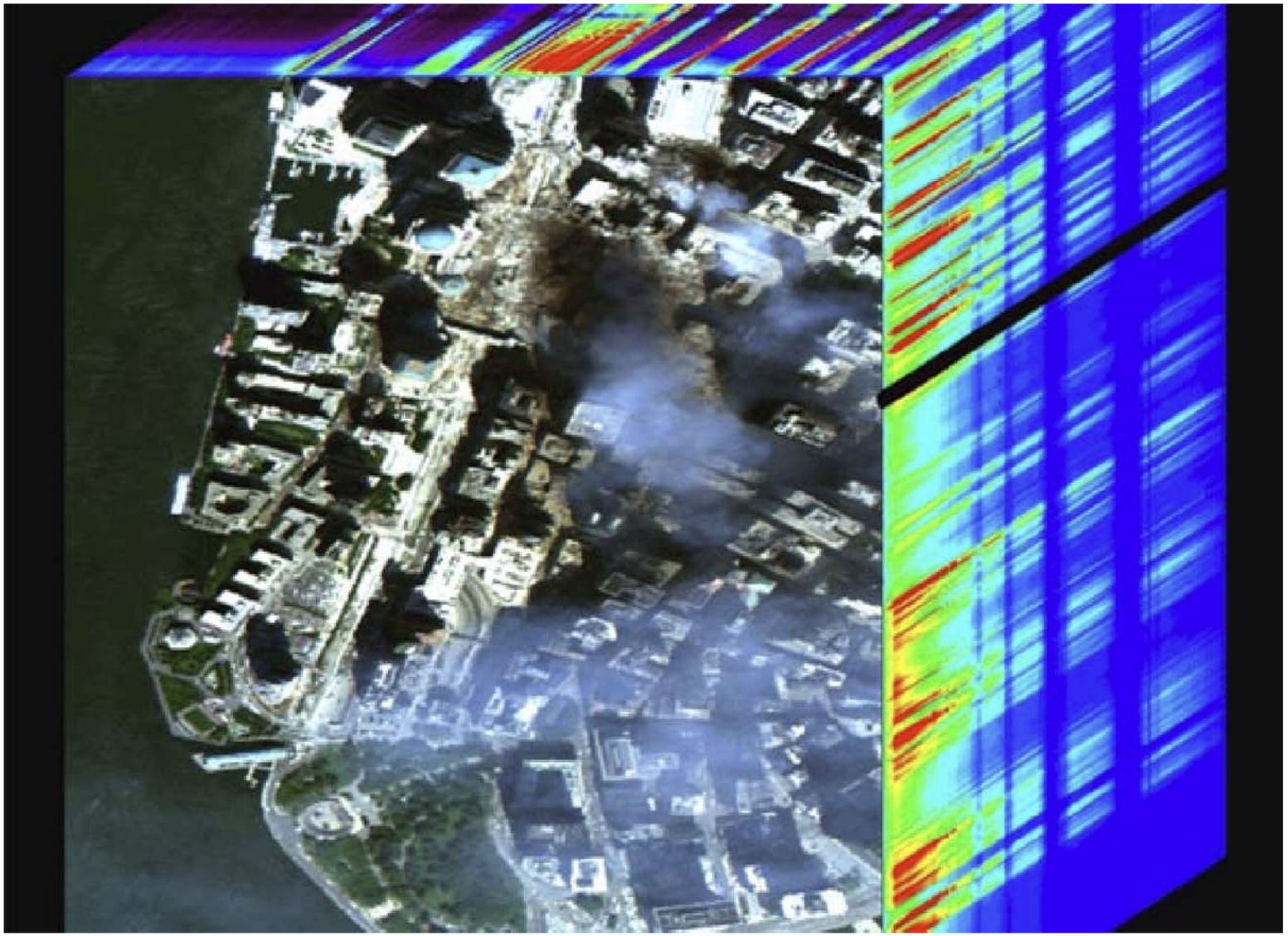
Instruments & Science Data Systems Division 38

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Earth Science
Airborne

World Trade Center Response

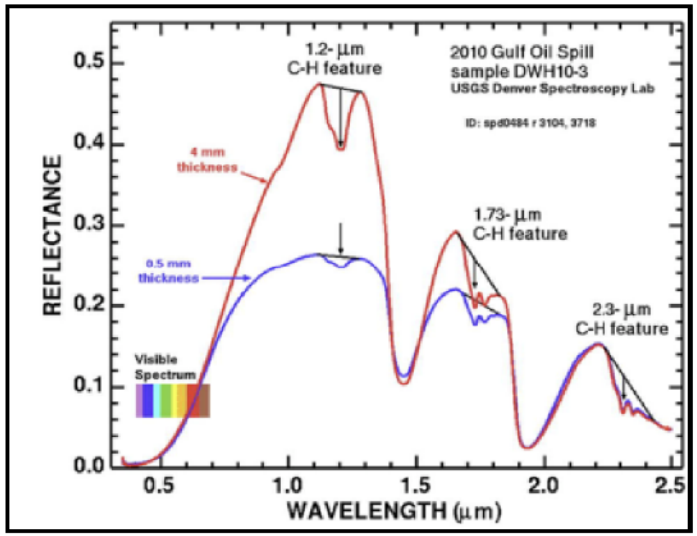
- ✧ image "cube" (9/16/2001)
- ✧ Each pixel contains a full spectrum revealing plume composition

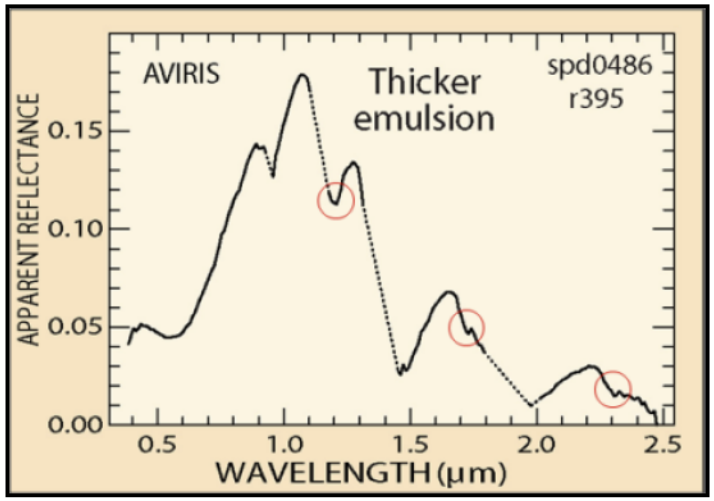


Deepwater Horizon Response I

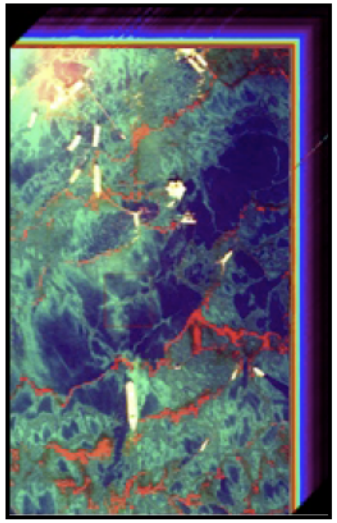
- **AVIRIS dataset used as primary flux indicator for Deepwater Horizon**
- **Images used by USGS/NASA to estimate surface flux – lower bound Σflux**

~ Spectroscopic Basis C-H Bond Absorptions ~

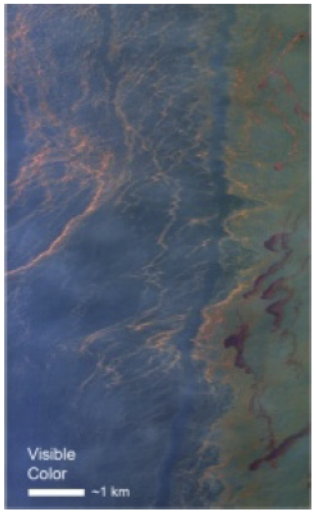




Composite



Visible

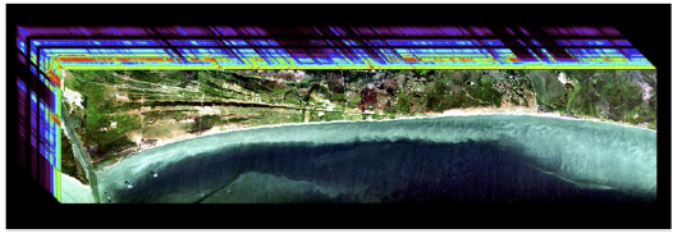


Instruments & Science Data Systems
Division 38

Deepwater Horizon Response II

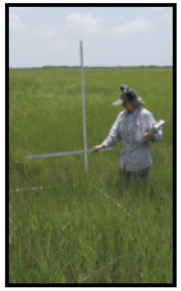
- AVIRIS dataset also used to image coastal vegetation
- Temporal data allows for estimate of negative effects of spill on coastal ecosystem

Coastal Vegetation imaged by AVIRIS

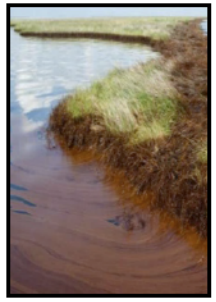


AVIRIS ER-2

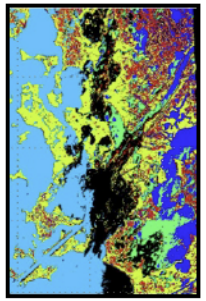
Pre Oil



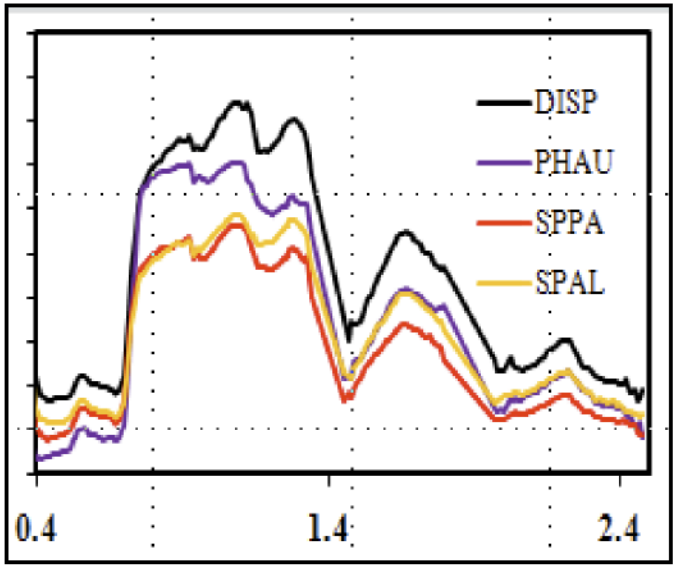
Post Oil



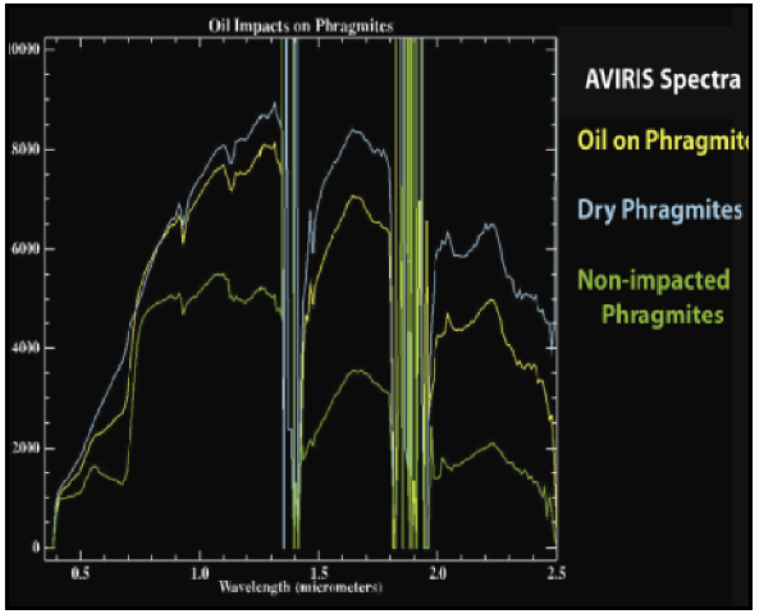
Species Map



AVIRIS Vegetation Spectra



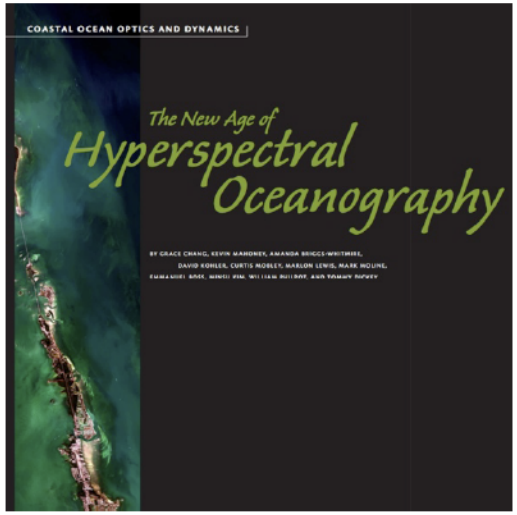
AVIRIS Oil Impacted Vegetation Spectra

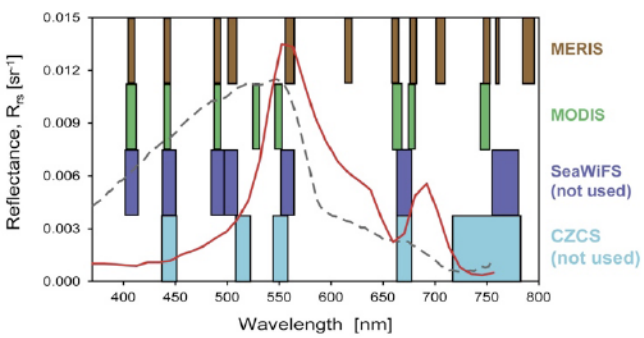


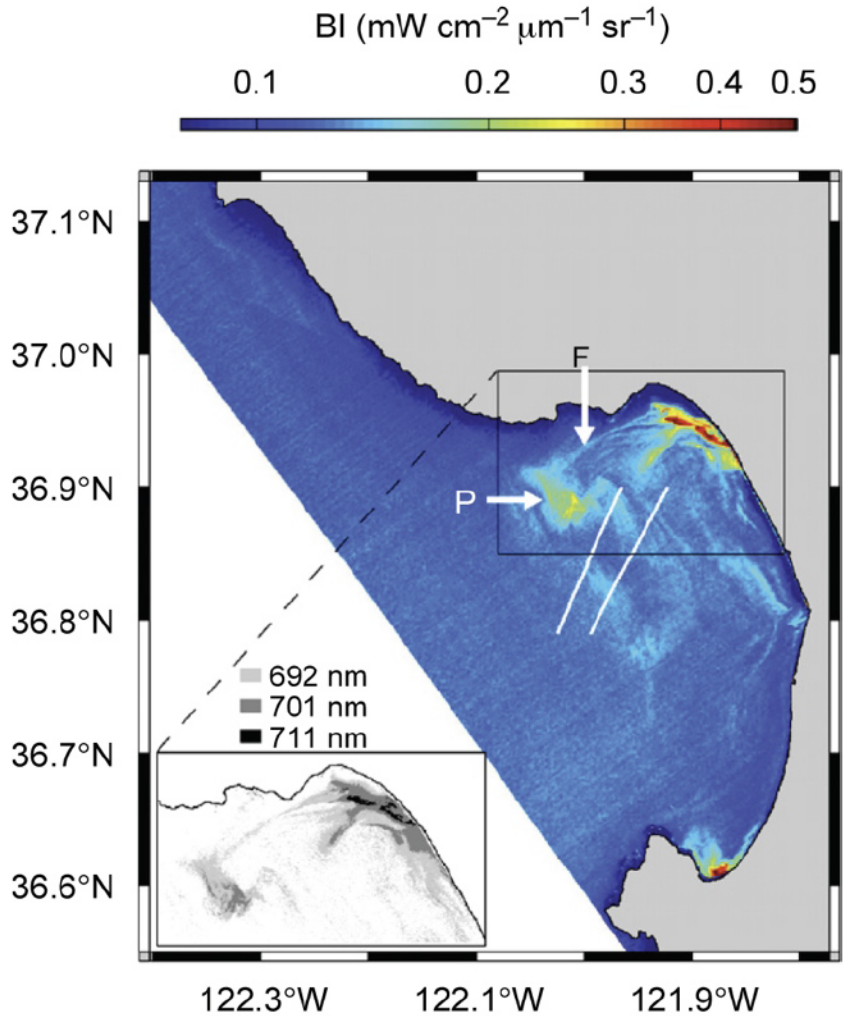
Instruments & Science Data Systems Division 38

AVIRIS Ocean Color Studies

- **AVIRIS data used to detect and monitor Harmful algal Blooms (HABs) & PP**







Instruments & Science Data Systems
Division 38

National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

These laboratory activities are carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration. Copyright 2013 California Institute of Technology.
Government sponsorship acknowledged.