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# To Facilitate the Use of HypIRI Data

## *Tools for On-line Products and Analysis*

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<sup>1</sup>JCET/UMBC and <sup>2</sup>NASA/GSFC

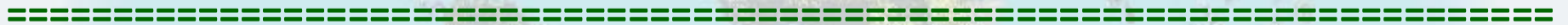
# Product Levels

**Level 0:** Digital Numbers

**Level 1:** 1A - Level 0 reconstructed, time-referenced and annotated with ancillary information;

1B - TOA radiance, Cloud screened images.

**Level 2:** Description - Swath data. Products: surface reflectance (%), Land Surface Temperature (LST, day or night); Surface Spectral Emissivity (day or night)



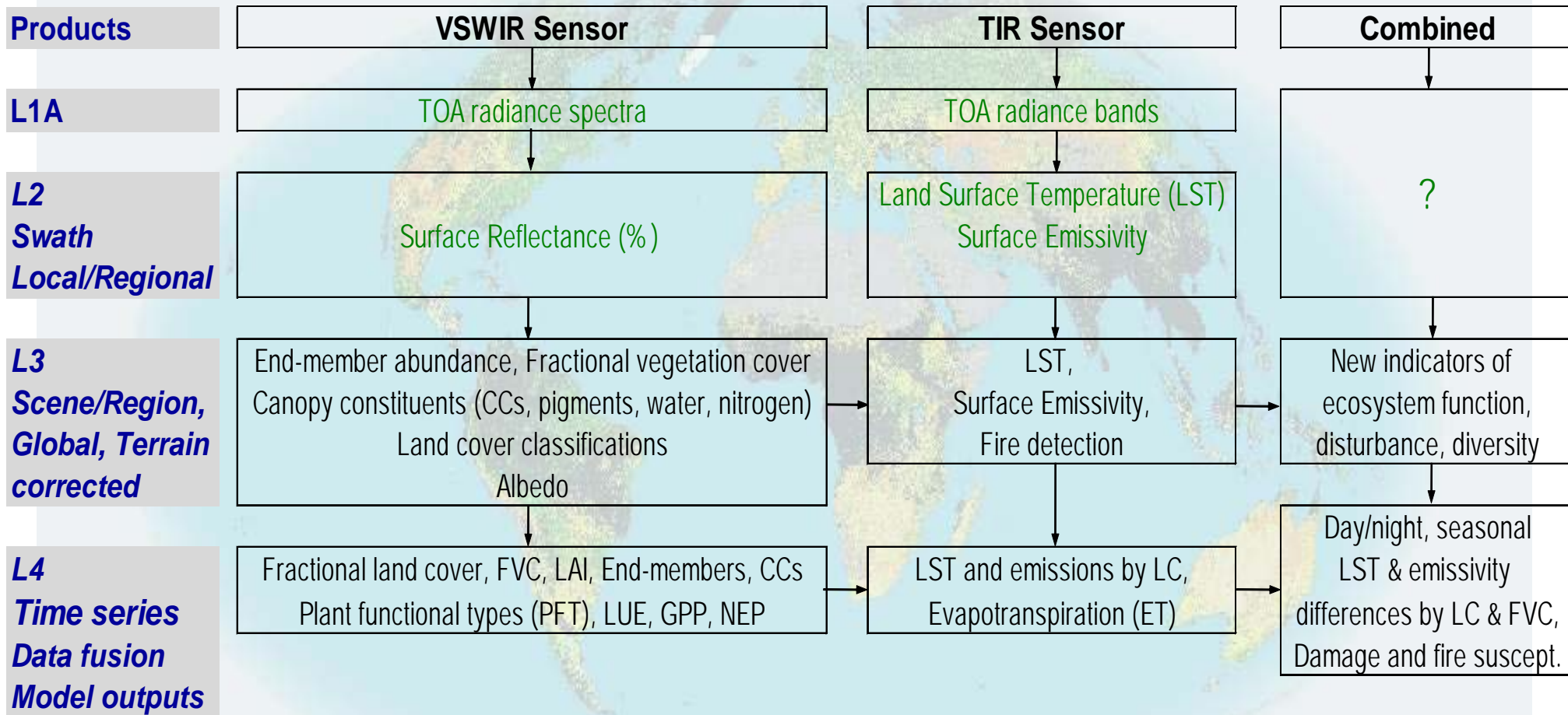
**Level 3:** Description - Swath and Gridded data, Terrain corrected products.

**Level 4:** Description – Time series, Model outputs, Multi-sensor data fusion, Assimilation with other data types (e.g., ET, Fire fuel & fuel moisture)

- Regional Scale (60m-1km): *For specific sites, watersheds, geographical units or global samples of ecosystems*

- Global Scale (gridded, ¼-1 deg+): *For modeling ecosystems/general cover categories*

# HyspIRI Products (Summary)



# Currently Existing Tools and Databases

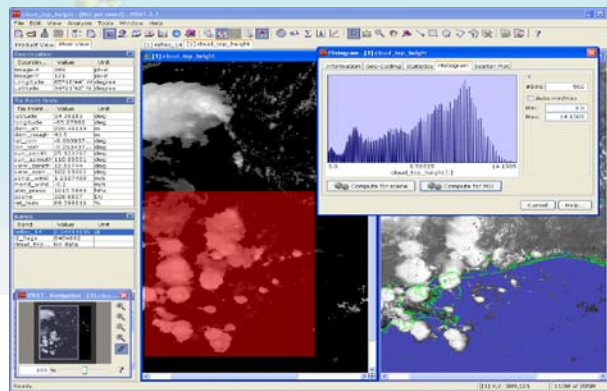
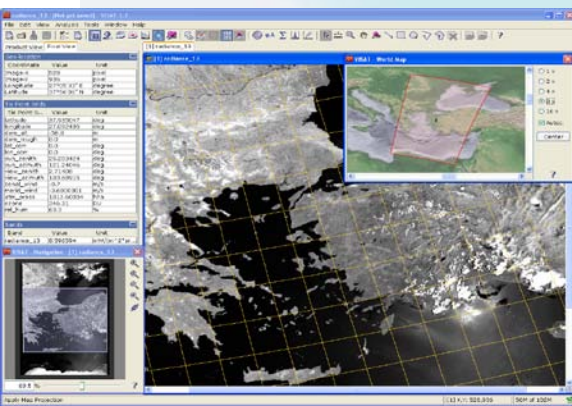
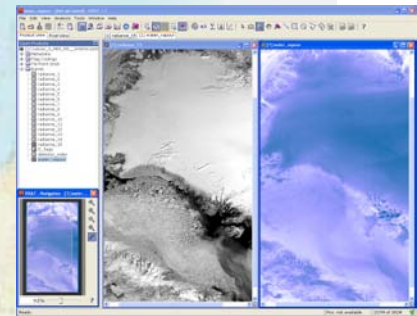
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- Data and sensor co-location tools
- Conversion of L1A to L2 at local to regional scale
- Cloud prediction and detection
- Download of swaths or scenes of data
- Spectral libraries for major cover types, vegetation species
- Tools for spectral analysis and assessments: propriety and non-propriety
- Tools for land cover analysis and determinations: propriety and non-propriety



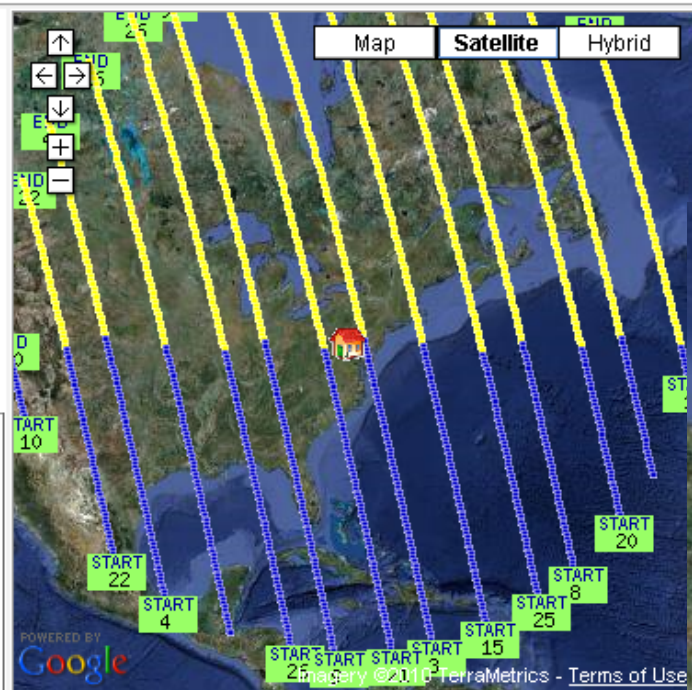
# Current Tools - *Examples*

- Visualization and Image Processing of Environmental Resources (VIPER) - Advanced Spectral Mixture Analysis (UCSB, Roberts et al.)
- WINVICAR (JPL, Hook et al.) – work with thermal emissivity data from ASTER, MASTER, other EOS data as well
- Processing Routines in IDL for Spectroscopic Measurements (PRISM, USGS, Kokaly et al.)
- BEAM (C. Brockman/ESA) – data management, viewing and pre-processing for Envisat, PRISM, CHRIS/Proba, AVNIR, MODIS, MERIS, etc.
- Open Source Software Image Map (OSSIM, OSGeo)
- ENVI, ERDAS Imagine, PCI Geomatica, other ...
- EO-1 tools for tasking, data management and prototyping



# Real Time Satellite Tracking

up in the sky? FAQ Links Send feedback + Google™



Co-locating of HypsIRI data, co-locating with other sensors

#	Day	Mag	Start		Max			End		Map
			LOCAL	Az	LOCAL	Az	Ei	LOCAL	Az	
2	Apr 29	9.3	20:53:35	102	20:58:10	60	7.64	21:02:45	17	<a href="#">Draw &gt;</a>
3	Apr 29	6.8	22:28:00	162	22:34:45	78	77.77	22:41:30	349	<a href="#">Draw &gt;</a>
4	Apr 30	9.2	00:07:40	223	00:12:40	270	9.15	00:17:40	319	<a href="#">Draw &gt;</a>
8	Apr 30	8.5	21:29:30	128	21:35:25	67	19.23	21:41:20	5	<a href="#">Draw &gt;</a>
9	Apr 30	7.6	23:05:55	184	23:12:35	262	40.75	23:19:10	339	<a href="#">Draw &gt;</a>
10	May 1	9.9	00:50:05	269	00:50:55	276	0.25	00:51:55	265	<a href="#">Draw &gt;</a>
14	May 1	9.7	20:33:30	84	20:36:40	55	3.17	20:39:50	27	<a href="#">Draw &gt;</a>
15	May 1	7.3	22:06:20	150	22:12:55	73	44.87	22:19:30	355	<a href="#">Draw &gt;</a>
16	May 1	8.7	23:44:40	207	23:50:30	266	16.58	23:56:25	328	<a href="#">Draw &gt;</a>
20	May 2	9.0	21:08:35	113	21:13:45	63	11.71	21:19:00	11	<a href="#">Draw &gt;</a>
21	May 2	6.8	22:43:50	171	22:50:35	254	71.54	22:57:25	345	<a href="#">Draw &gt;</a>
22	May 3	9.5	00:24:45	236	00:28:40	272	4.99	00:32:45	310	<a href="#">Draw &gt;</a>
25	May 3	8.1	21:44:50	137	21:51:10	69	27.11	21:57:25	1	<a href="#">Draw &gt;</a>
26	May 3	8.1	23:22:05	193	23:28:30	264	27.81	23:34:55	335	<a href="#">Draw &gt;</a>



<http://www.n2yo.com> (April 29, 2010)

# Earth Observing 1 (EO-1) Campaign Manager on-line Tool

NorthCal Fires	Northern California Fires	fire	patrice	Yosemite Telegraph Fire, Basin Complex, Whiskeytown Complex, ...	06/29/2008 02:13 PM	06/29/2008 09:18 PM	0.4	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
NSP	Nationa Signature Program	intel	patrice	TA-03, TA-02, TA-01	03/03/2008 10:25 AM	05/16/2008 12:42 PM	0.2	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
Oceans Innovation	Oceans Innovation Workshop Demo	algae	patrice	Monterey Bay	09/10/2008 06:18 PM	09/16/2008 06:38 PM	1.0	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
Salt Marshes	To determine salinity contents of flooded areas	flooding	patrice	Lancaster, VA	07/26/2008 02:36 PM	07/26/2008 02:36 PM	-	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
SoCal Fires	Southern California Fires	fire	patrice	-	09/06/2007 12:00 AM	06/28/2008 09:23 PM	0.0	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
UAV	NASA Ames Ihkana flight scenario	fire	veri_pat	Flood	09/06/2007 12:00 AM	06/04/2008 02:00 PM	0.0	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
UAV 2	NASA Ames Ihkana Flight Scenario	fire	scott	UAV 2 Test	09/17/2008 12:40 AM	09/17/2008 12:40 AM	-	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
UAV 3	-	fire	UNKNOWN	California	09/18/2008 03:53 PM	09/18/2008 03:53 PM	-	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>

<http://geobpms.geobliki.com/>

Scenario/Campaign Tasking Requests for UAV 3

[Search](#) [Create New](#)

**Title**    **Content**    **Geolocation**    **Scenario Feasibilities**

## Tasking Request:

Title: California  
 Description:  
 Category:  
 Latitude: 41.3  
 Longitude: -123.8  
 Country Code: US  
 Country Name: United States  
 Zone Number: 36  
 Zone Name: Northern California  
 Region Number: 3  
 Region Name: Oregon, California and Nevada  
 Admin Code: CA  
 Admin Name: California  
 Nearby: Notchko, Surgone, Shregegon (historical), Mettah, Pekwan (historical), Pecwan, Johnsons, Waseck, Wright Place, Martins Ferry (historical)  
 Created At: Fri, 19 Sep 2008 02:32:22 -0000  
 Updated At: 2008-09-19  
[Show Map](#)

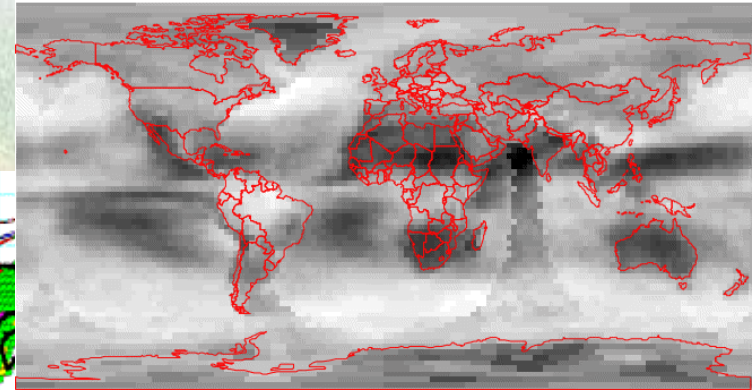


1 Found

USAFRICOM	USAFRICOM Testing	flooding	cappelaere	Zimbabwe	06/19/2008 02:58 PM	06/19/2008 02:58 PM	-	<a href="#">Edit</a> <a href="#">Delete</a> <a href="#">Show</a>
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# Cloud Prediction, utilizing historic data and weather satellites

ISCCP April D2 (%) Cloud Cover



Landsat 7 Science Team

International Satellite Cloud Climatology Project (Rossow et al. 1989)

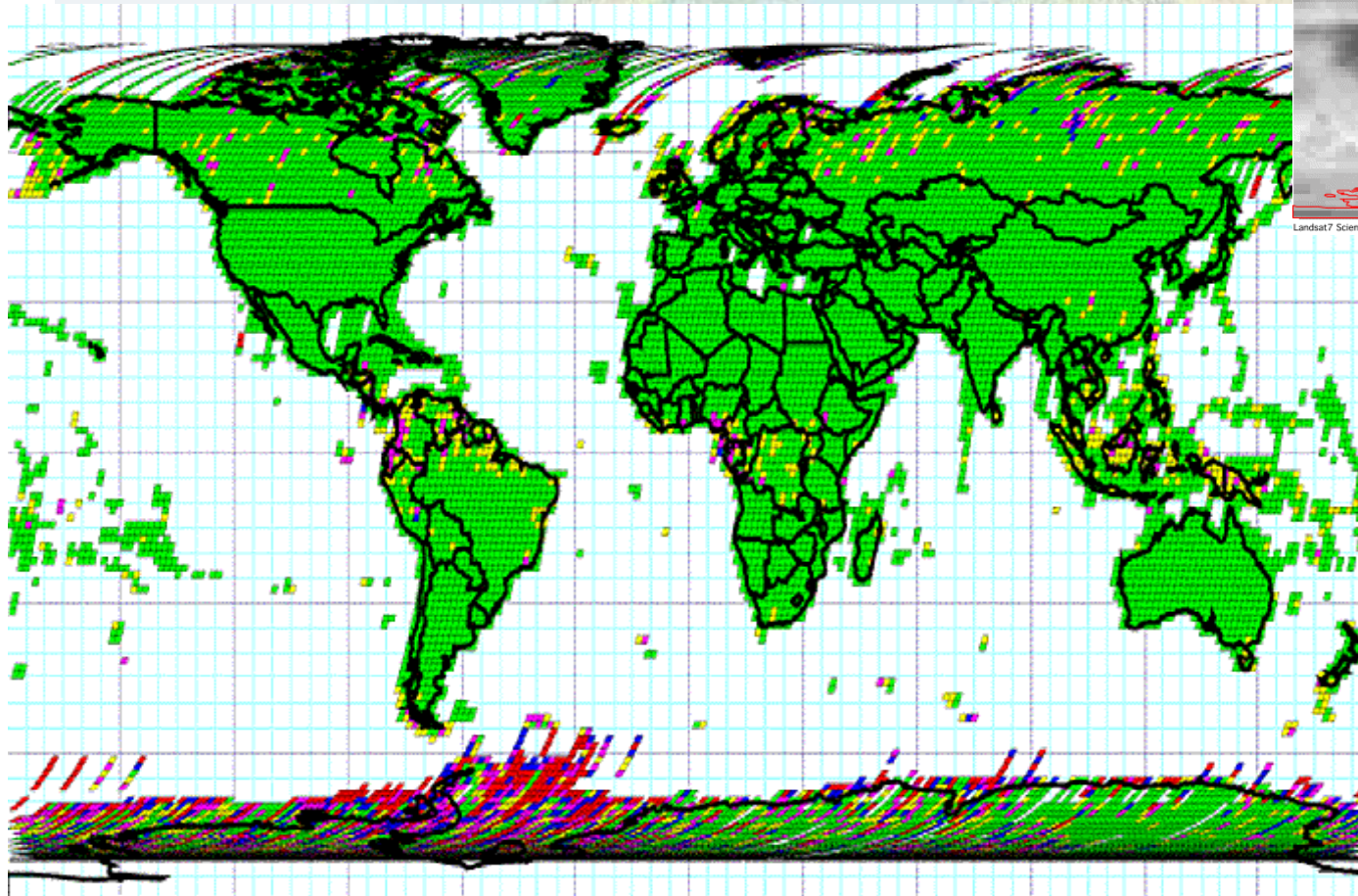
## Hyperion Cloud Cover (HCC)

Band ( $\mu\text{m}$ )	Usage
0.55	Snow/ice/cloud test
0.66	Red reflectance test Vegetation ratio test
0.86	Vegetation ratio test Desert/sand test
1.25	Snow/ice/cloud test Desert/sand test
1.38	High cloud test Ice/low cloud test
1.65	Snow/ice/cloud test Desert/sand test

Mandl, Griffin et al. 2003

Gao et al. 1995, 1998

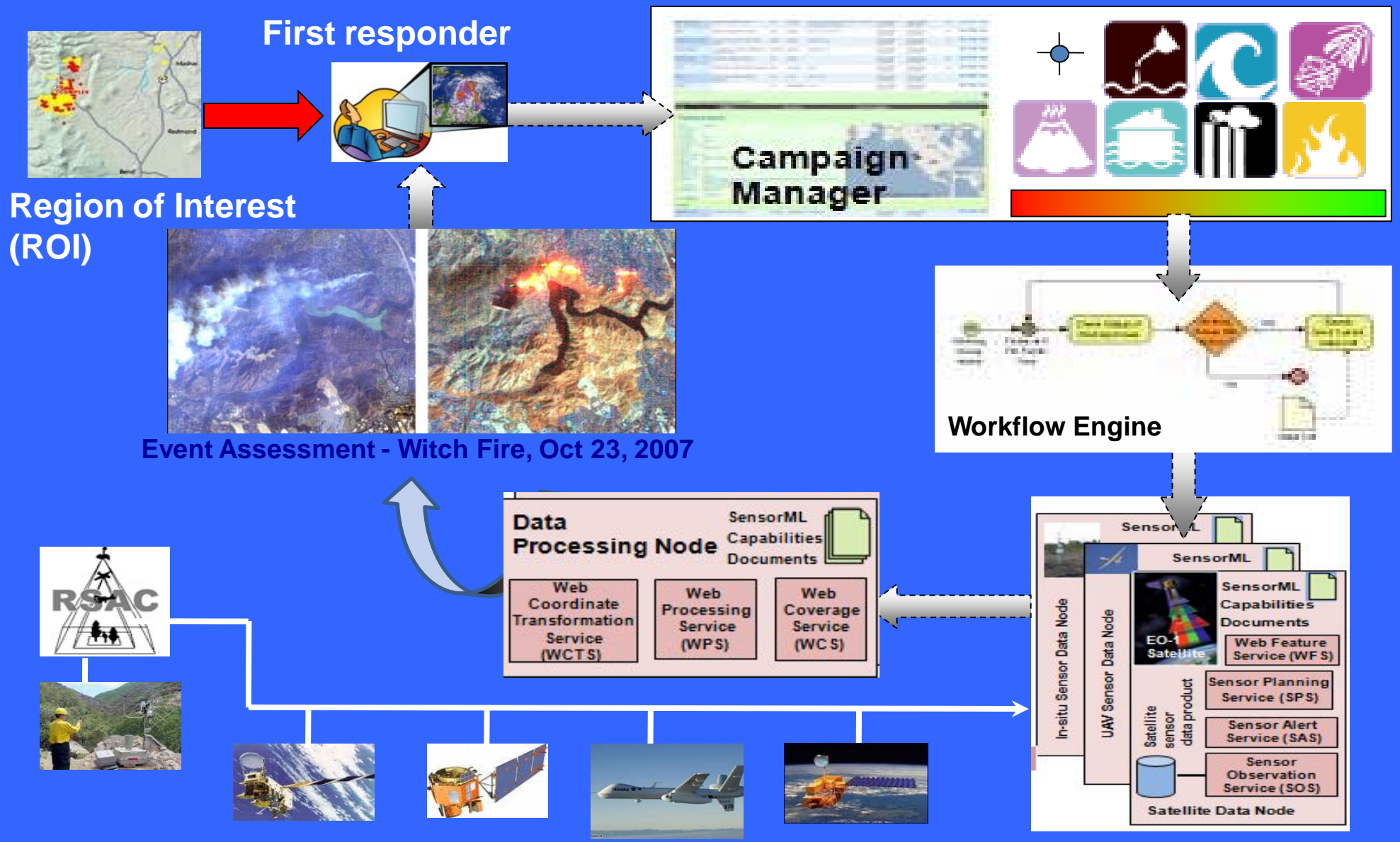
## Landsat 7 Lowest cloud level for acquisitions during the first year



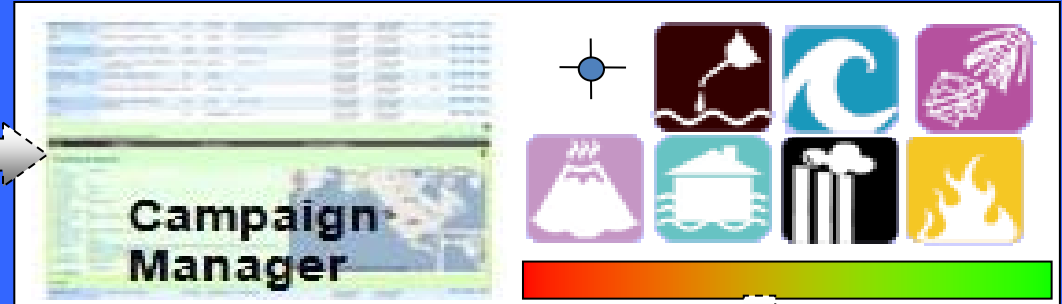
0 - 10%
  11 - 25%
  26 - 50%
  51 - 75 %
  76 - 100%



# EO-1 SensorWebs serve as a Pathfinder for Event Assessments and Enabling of Rapid Response Remote Sensing



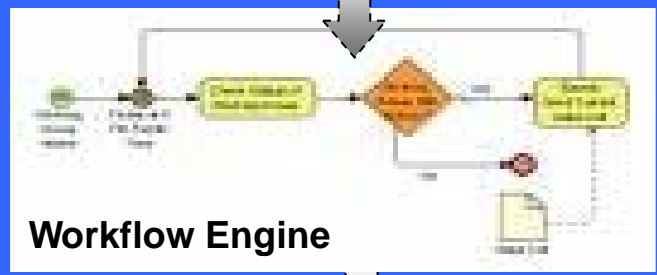
First responder



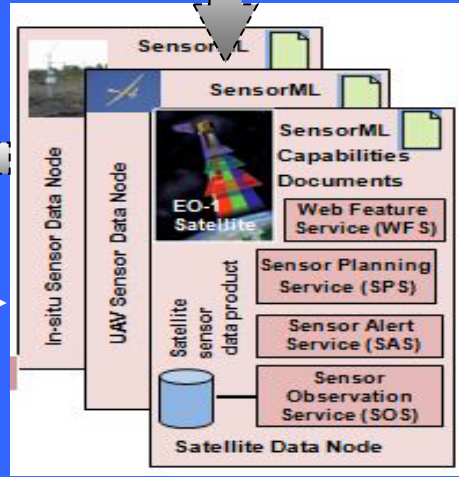
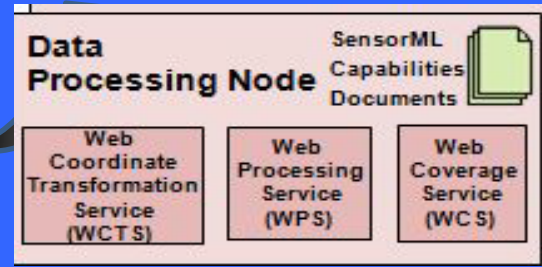
Region of Interest (ROI)



Event Assessment - Witch Fire, Oct 23, 2007



Workflow Engine



# Downloading Whole Scenes

EarthExplorer

Home

Login Register

There are 2 messages. (Updated: 1/12/2010)

The U.S. Geological Survey is dedicated to providing extensive data to the global science community. However, certain data sets require additional procedures to gain access to them. commercial satellite scenes of U.S. sites are licensed only for U.S. users. Please log in to find what additional data sets may be available.

## 1. Select your dataset(s)

Click on  next to the category name to show a list of datasets.

Icon means selected data within the Data Sets can be downloaded at no charge.

- Aerial Photography
- AVHRR
- Cal/Val Reference Sites
- Commercial
- Declassified Data
- Digital Elevation ([Related Links](#))
- Digital Line Graphs ([Related Links](#))
- Digital Maps ([Related Links](#))
- EO-1
  - EO-1 Ali
  - EO-1 Hyperion
- Forest Carbon Sites
- Global Land Survey
- Landsat Archive ([Related Links](#))
  - L7 SLC-off (2003-present)
  - L7 SLC-on (1999-2003)
  - L4-5 TM
  - L1-5 MSS
  - L7 Intl Ground Stations (Search Only)
- Landsat Legacy
- Landsat MRLC

### Selected Datasets

- EO-1 Ali ([Additional Search Criteria...](#))
- EO-1 Hyperion ([Additional Search Criteria...](#))

Clear All

Display Tooltips

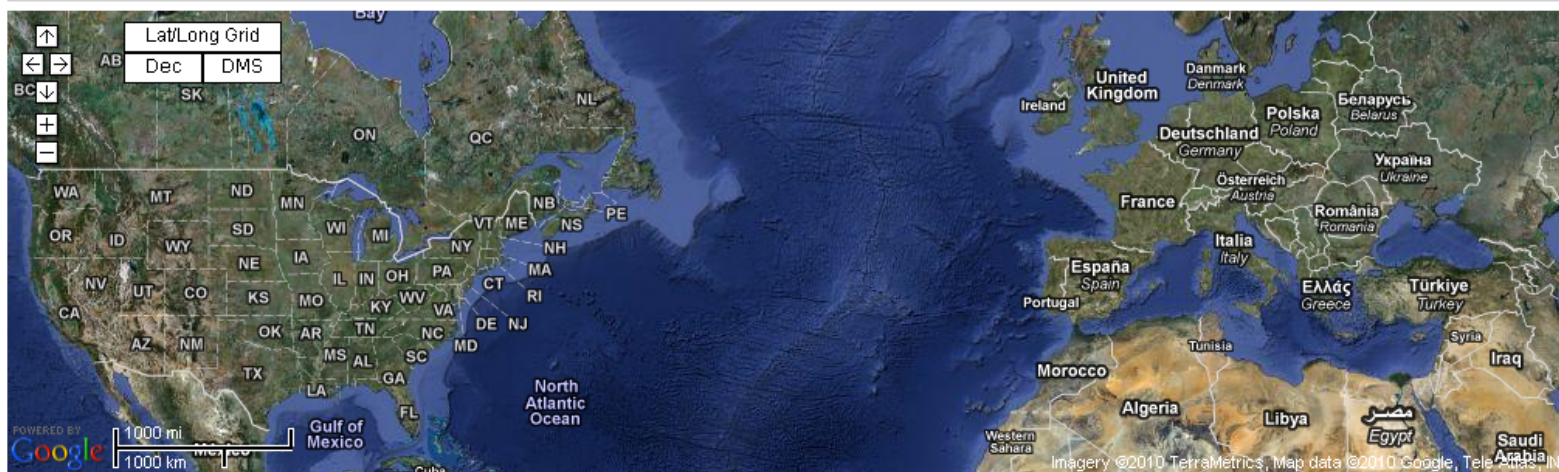
## 2. Enter your search criteria

Address/Place Name/

Zip Code Search:  ([US/World Feature Search](#))

From (mm/dd/yyyy):   To (mm/dd/yyyy):

Search these months only.



[Help](#) [Hide Map](#) [Clear My Area Selection](#) [Add Map to Selection](#)

The up to date Google map is not for purchase or for download; it is to be used as a guide for reference and search purposes only.

### Area Selected

Degree/Minute/Second  Decimal

1. Latitude: ° ' " North  Longitude: ° ' " West

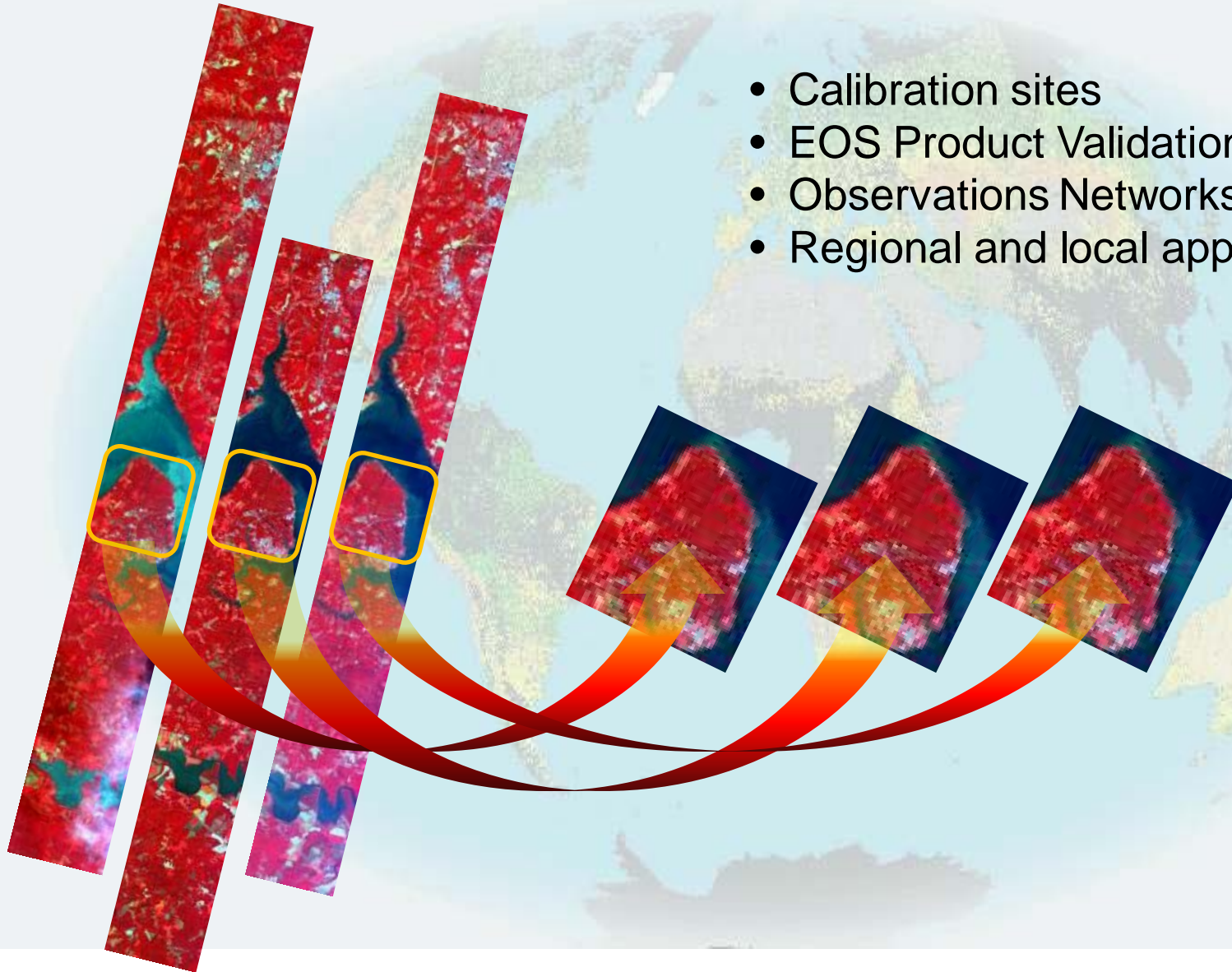
### Number of Results

Find the first  records. [Help](#)

(Note: Results will contain this number of records for each individual data set selected.)

# Tools to Download Regions of Interest

- Calibration sites
- EOS Product Validation sites
- Observations Networks
- Regional and local applications



# Tools and Prototype Reflectance Product Algorithms

albedo; fAPAR; LAI; spectrum derivatives; chlorophyll, N, water content.....

## EO-1 Toolkit

<http://eo1.geobliki.com/>



Sensor Web Enabled (SWE) Data Node

### Sensor Tasking

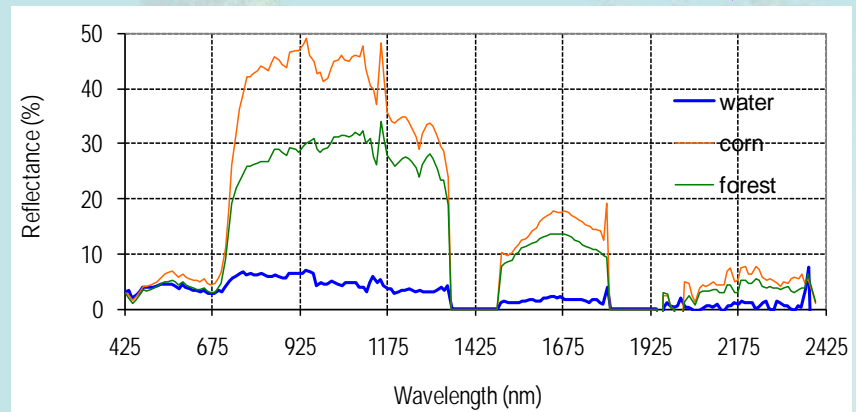
- Current Schedule
- NASA EO-1
- My Tasks
- All Tasks
- GeoTools
- Atmospheric Correction



## Atmospheric Correction Server

Plane altitude above sea level (km)   
Date/Time (MM DD YYYY hh mm ss)   
Latitude (degrees minutes seconds)

## EO-1 Product Prototypes



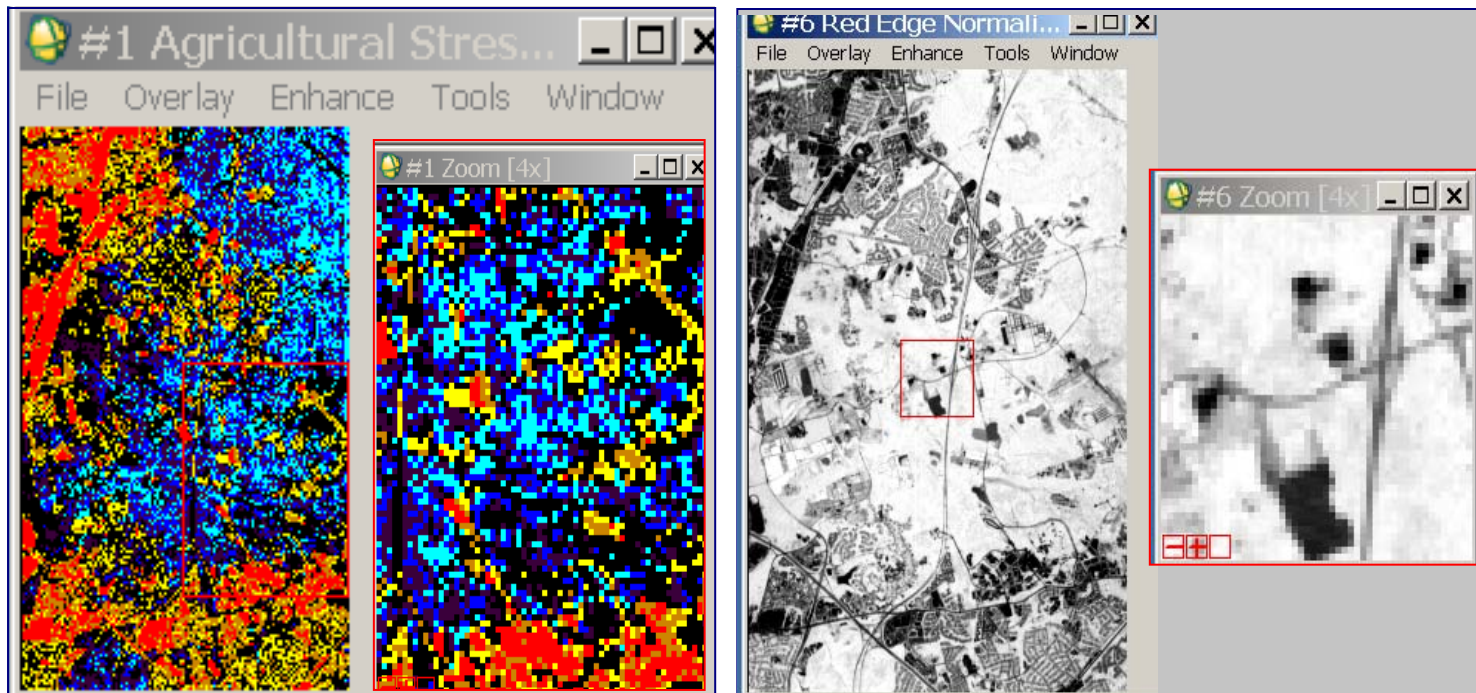
# Developing Higher level EO-1 Hyperion Science Products

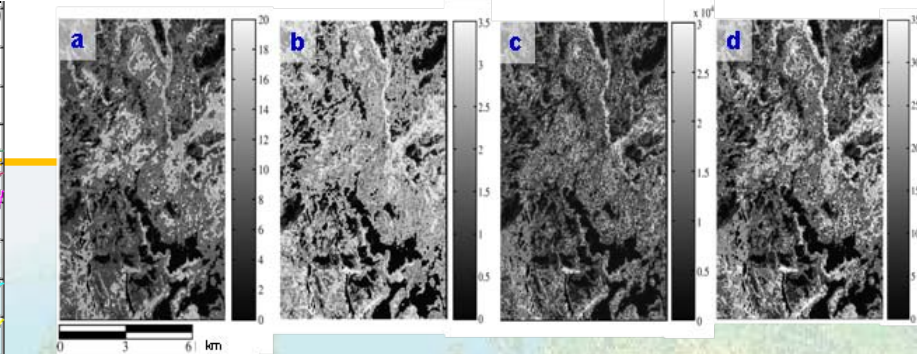
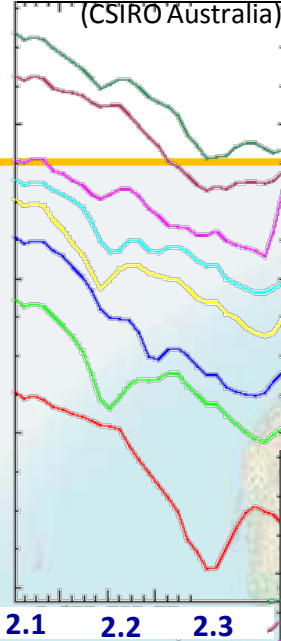
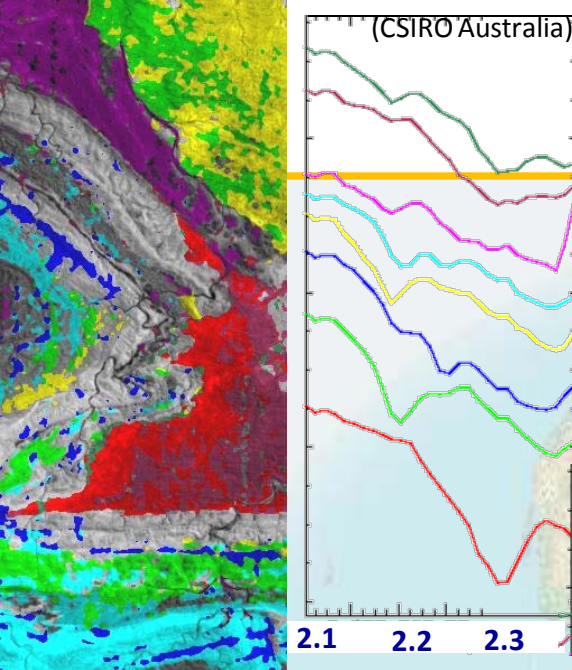
## Vegetation Indices and Albedo for major Crops and Land Cover Types (example for Greenbelt, MD)

Pixel size	Vegetation Indices*						Albedo		
	V1	PRI	REIP	Dmax	NDWI	NDVI	water	corn	forest
30 m	1.81	-0.14	721	0.749	0.14	0.81	0.03	0.20	0.14
60 m	1.88	-0.15	721	0.748	0.15	0.82	0.04	0.20	0.13

\* Reported means, no statistically significant differences established

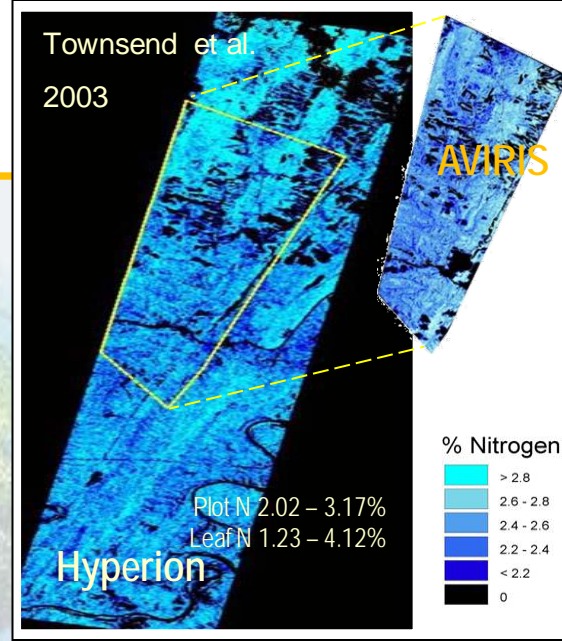
- Enabling conventional users to conduct their own assessments, using software such as ENVI (Agricultural stress and Red edge Greenbelt, MD)





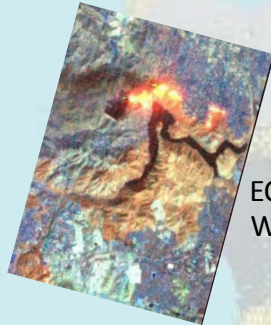
a) canopy height (m); b) Shannon species richness; c) biomass (kg/0.1 ha); d) basal area (m<sup>2</sup>/ha)  
*(Kalacska et al. 2007)*

- Tremolite + mica
- Dolomite
- Unknown
- Mica + chlorite
- Mica 2
- Chlorite/mica
- Mica 1
- Talc/Tremolite



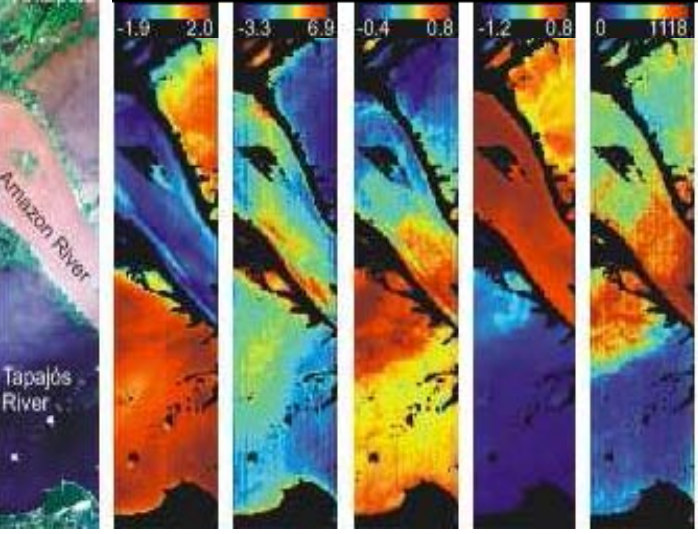
- % Nitrogen
- > 2.8
  - 2.6 - 2.8
  - 2.4 - 2.6
  - 2.2 - 2.4
  - < 2.2
  - 0

Plot N 2.02 - 3.17%  
 Leaf N 1.23 - 4.12%

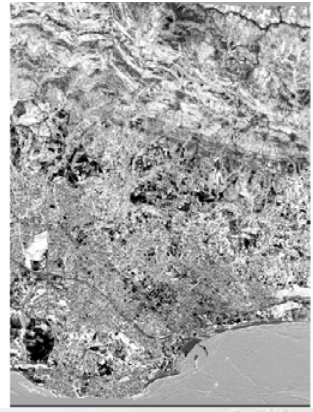


10/23/07  
 EO-1 Hyperion  
 Witch Wildfire

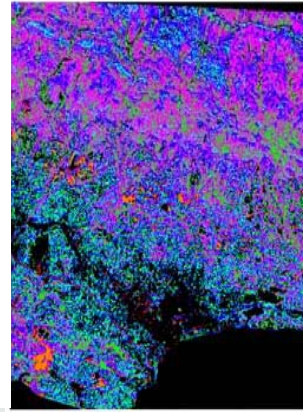
(a) (RGB: 640; 549; 457nm). Hyperion fractional end-member abundance results presented as color images: (b) *f*<sub>clear-water</sub>; (c) *f*<sub>DOM</sub>; (d) *f*<sub>phytoplankton</sub>; (e) *f*<sub>SIM</sub>; (f) RMS error.



Fuel moisture, NDWI



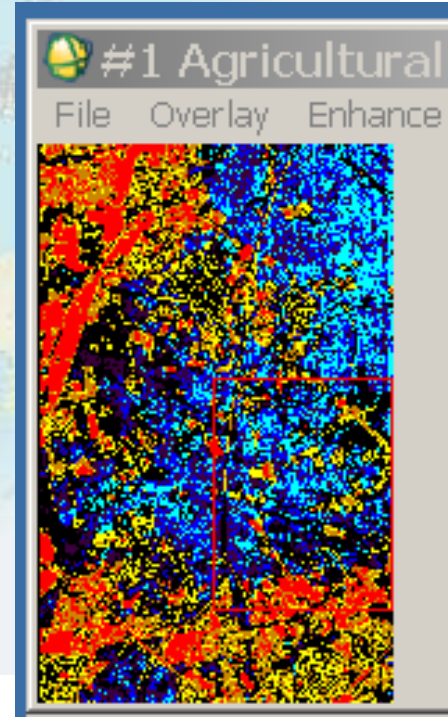
AVIRIS



- Legend
- Soil
  - Senesced Grass
  - Chamise
  - Ceanothus
  - Manzanita
  - Live Oak

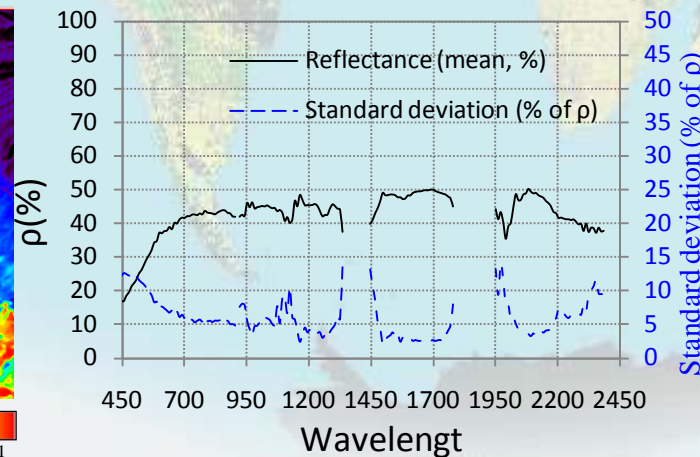
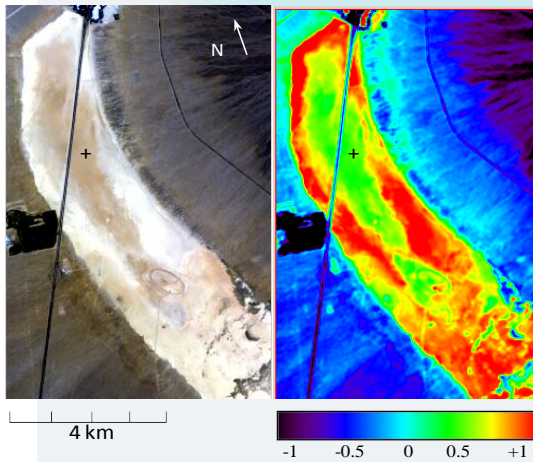
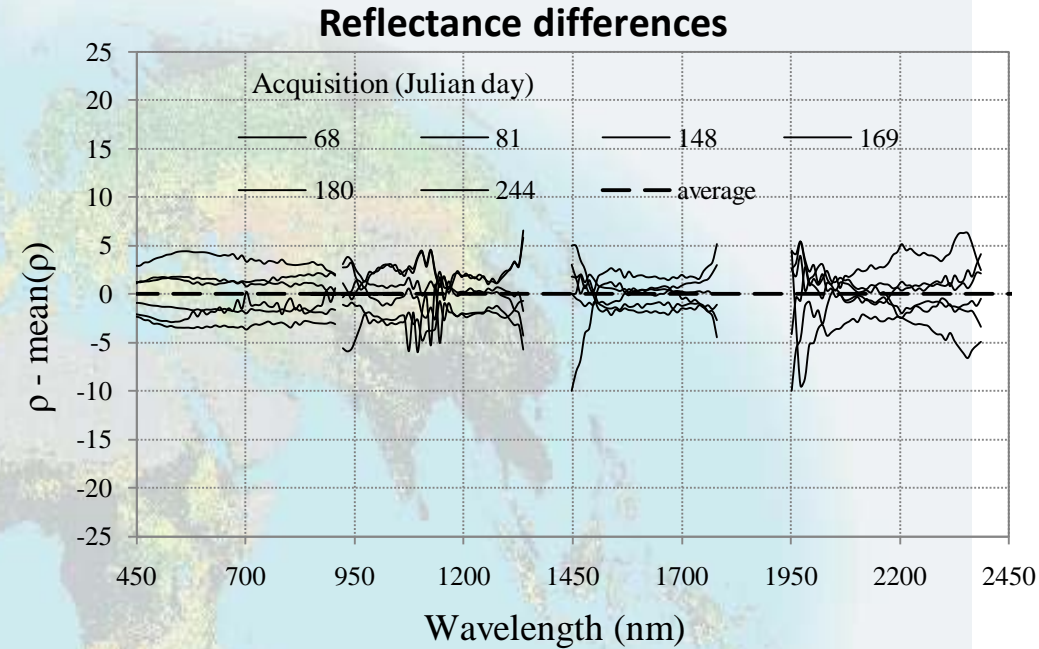
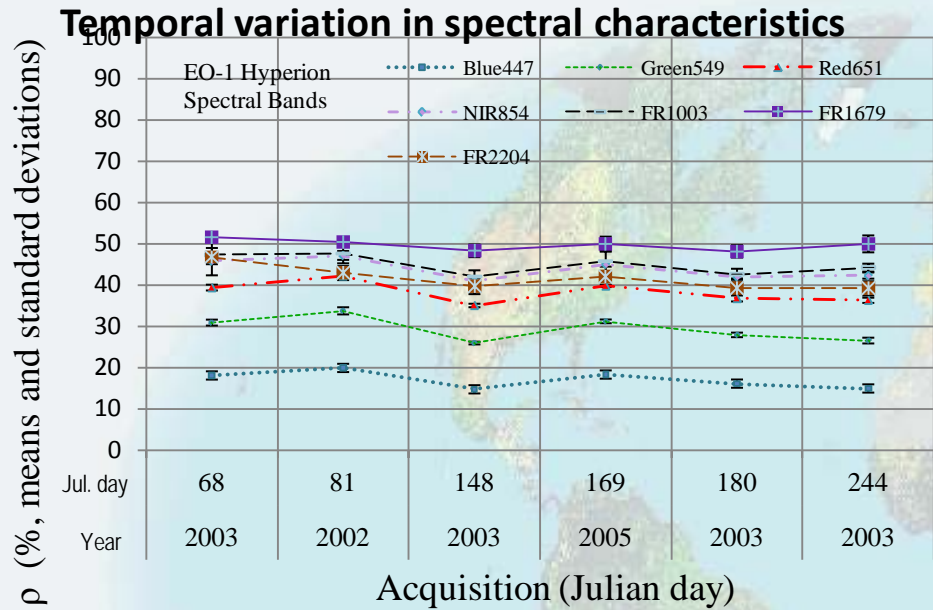
Roberts et al.

2 km



(ENVI/ Asner)

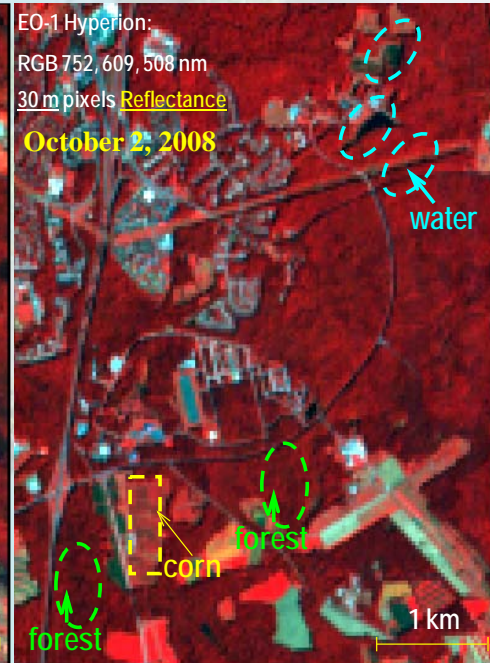
# Time Series for CEOS Cal/Val Sites



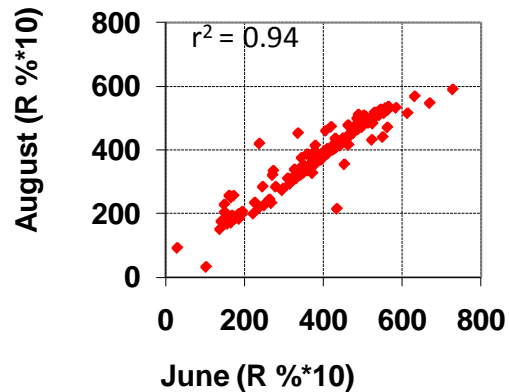
Example from Ivanpah playa: Natural color composite (RGB: 651, 549, 447), Getis Gi\* statistics (band 549), Reflectance Mean and Standard Deviation

# Time Series Composites for EOS Vegetative Sites

## Seasonal Dynamics of Major Land Cover Types, USDA ARC, Greenbelt, MD



**Bright Target**

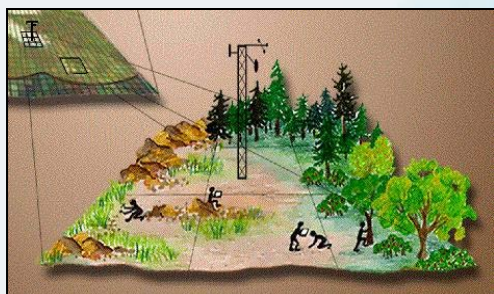


Cover Type	Hyperion, 2008	V1	PRI	REIP	Dmax	WBI	Albedo
Corn	13-Jun	1.03	-0.04	712	0.36	0.96	0.461
	18-Aug	1.81	-0.06	722	0.75	1.09	0.197
	3-Oct	1.15	0.04	721	0.51	0.98	0.155
Forest	13-Jun	1.12	-0.06	712	0.89	1.00	0.257
	18-Aug	1.56	-0.03	722	0.51	1.01	0.140
	3-Oct	1.61	-0.10	712	0.42	0.94	0.127
Water	13-Jun	0.15	0.01	712	0.16	1.23	0.058
	18-Aug	0.52	0.02	712	0.10	1.46	0.031
	3-Oct	0.62	-0.07	712	0.08	0.93	0.036

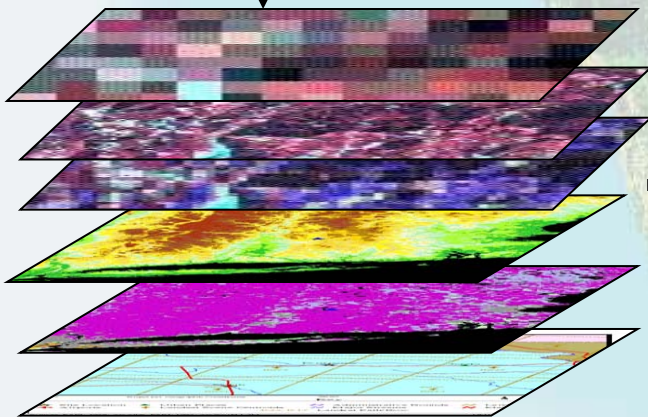


# Calibration and Validation Tools

*Goal: Uncertainty assessment of high spectral and spatial resolution products, Confirmation/validation of high temporal resolution multi-spectral GLCPs and trends*



**Calibration & Validation  
of HypsIRI products to  
field/tower data**



**Simulation of Data and Products from  
Other Sensors**

**Multi-Spectral**

- AVHRR
- Landsat
- MODIS
- VIIRS

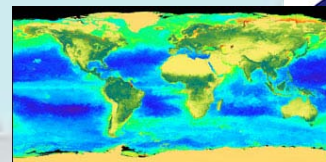
**High Spectral Res.**

- EnMAP, DLR
- PRISMA, ASI
- CHRIS - Proba

**Correlate**

**Provide Context**

**High temporal res. &  
Historic Data and  
Model Outputs**



September 2000

Chlorophyll a Concentration (mg/m<sup>3</sup>)

0.01 1.0 10 60

Normalized Difference Vegetation Index

*After CEOS WGCV/LPV (LCP Simulation and inter-comparison, Morrisette et al. 2006; and Shunlin Liang, UMD)*

# Tools/Products to be Developed

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- Tools combining the use of TIR and High Spectral Resolution Data
- Different tools for local & regional and for continental & global scale L1A to L2, analysis and detection
- Work with time series - download of composites at regions of interest, on-line evaluation of spectra at ROI
- Change Event Delineation and Characterization - incl. clouds, fires, volcanoes, water properties
- Cal/Val tools – at select sites time series collection, simulation of other sensors, simulation of global products
- Spectral database/libraries for major FLC, FVC and PFT types



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**WE NEED YOUR INPUT !**



[Petya.Campbell@nasa.gov](mailto:Petya.Campbell@nasa.gov)