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EO-1 Prototyping for Environmental Applications

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Background

The Earth Observing One (EO-1) Mission, launched in November, 2000 as part of NASA's New Millennium Program, is in it's ninth year of operation. From the start it was recognized that a key criteria for evaluating the EO-1 technology and outlining future Earth science mission needs is the ability of the technology/strategy to characterize terrestrial surface state and processes. The EO-1 Science Validation Team conducted a range of investigations to ascertain how well the employed technology and acquisition strategy served to enhance the extraction of scientifically viable information. Investigators engaged in NASA's Terrestrial Ecology, Carbon Science, Land Use Change and other programs using the EO-1 Hyperion imaging spectrometer have achieved results with accuracies far exceeding those reached with the current space borne fleet of multispectral sensors.

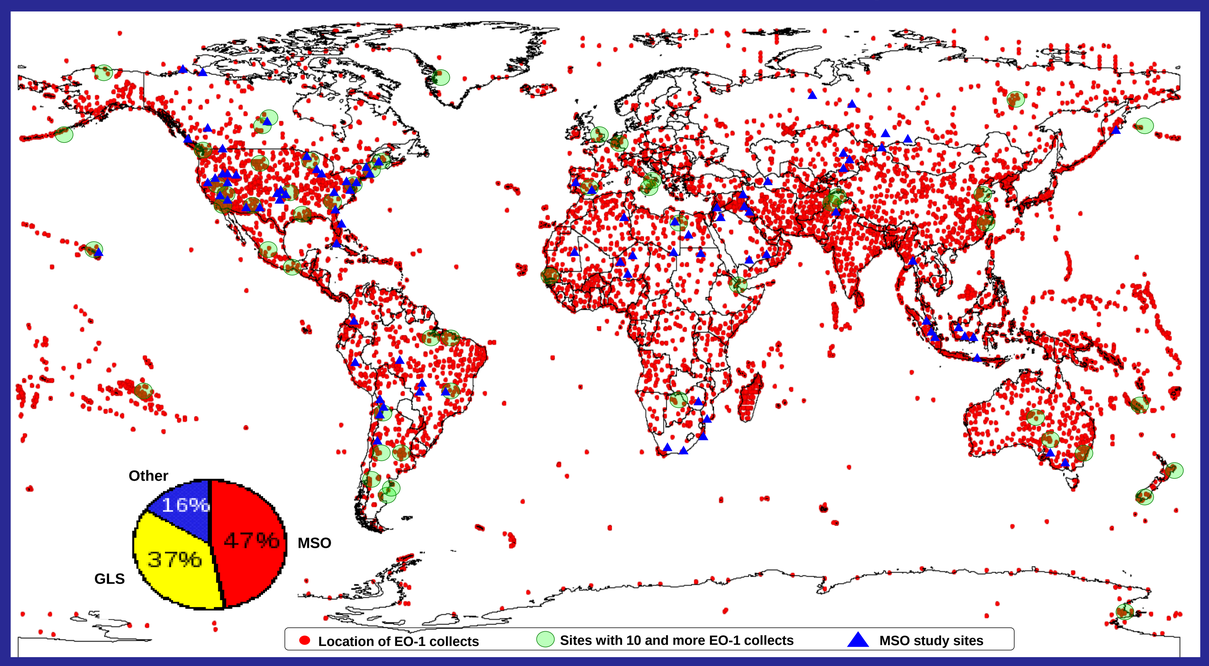
Current Status

EO-1 is participating in a broad range of investigations, demonstrating the utility of imaging spectroscopy in applications relating to forestry, agriculture, species discrimination, invasive species, desertification, land-use, vulcanization, fire management, homeland security, natural and anthropogenic hazards and disaster assessments and has provided characterization for a variety of instruments on EOS platforms. By generating a high spectral and spatial resolution data set for the corral reefs and islands, it is contributing for realizing the goals of the National Decadal survey and provides an excellent platform for testing strategies to be employed in the HyspIRI mission.

Preparing for HyspIRI

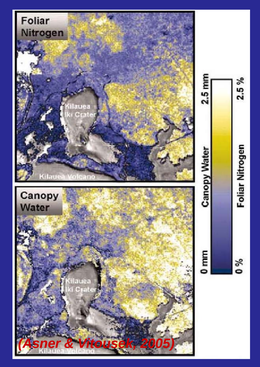
Tools and prototypes for new science products are being developed to provide vegetation biophysical parameters such as LAI and fAPAR at <100 m spatial resolution for selected EOS validation sites. These will be used to resolve variability in heterogeneous areas (e.g. agriculture, narrow shapes, urban and developed lands) and for managed ecosystems less than 10 km^2. A set of invariable reference targets (e.g. sun, moon, deserts, Antarctica) are being characterised to allow cross-calibration of EO sensors, comparison of land products generated by multiple sensors and retroactive processing of time series data. Such products are needed to develop Science Requirements for the next generation of hyperspectral satellite sensors and to address global societal needs .

To date, over 45000 EO-1 scenes have been acquired

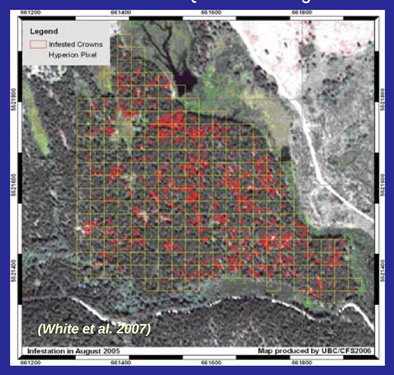


Science Applications: Hyperion can serve for refining spectral indicators for assessment of vegetation status and health

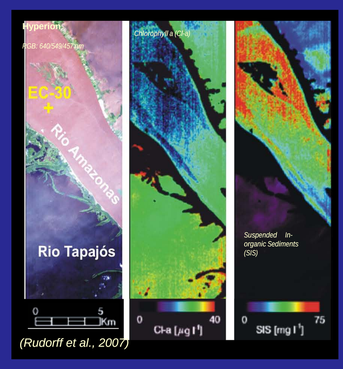
Foliar nitrogen and water content for areas with Myrica Faya, Hawaii



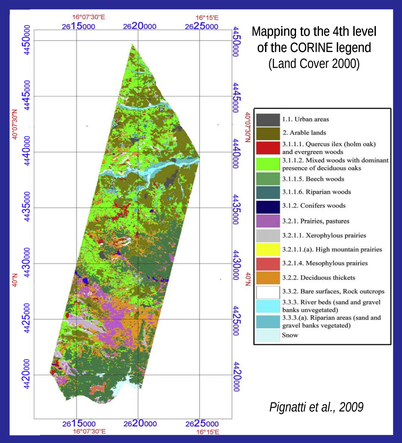
Detection of mountain pine beetle damage, Hyperion moisture stress indices (MSI) overlaid on a QuickBird image



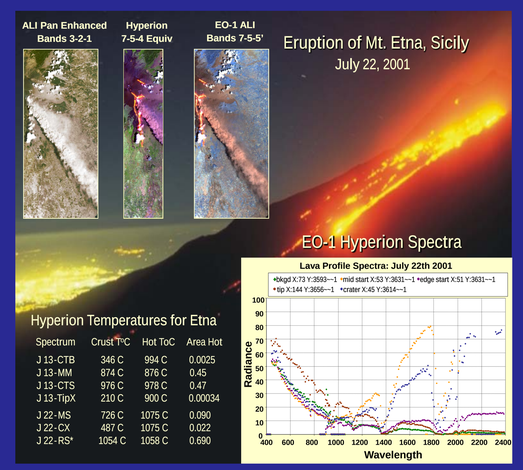
Composition of TAmazon Floodplain Waters, Hyperion Derivative Analysis



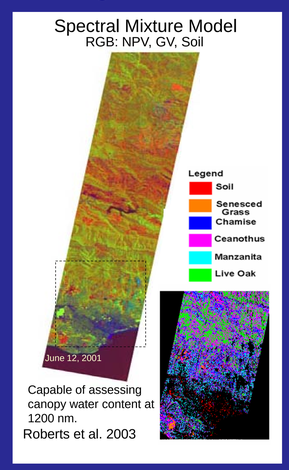
Mapping land cover diversity in a fragmented ecosystem



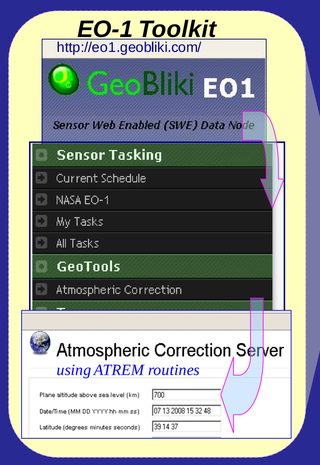
Environmental Disaster Assessment



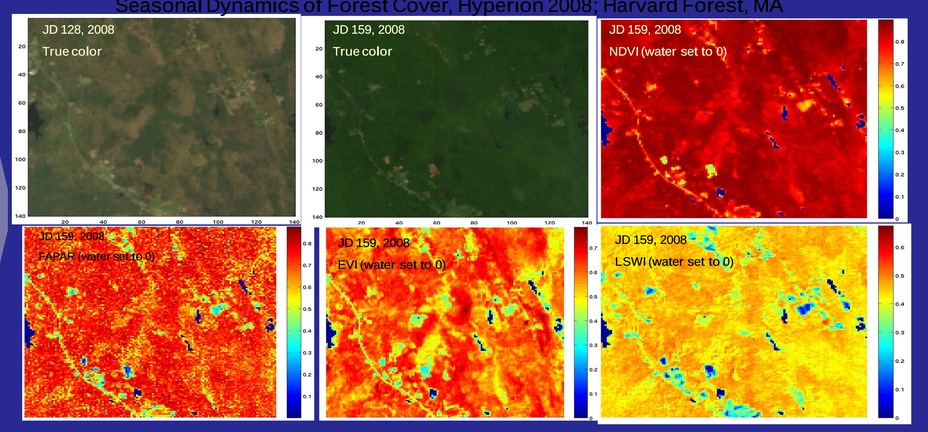
Fire Danger Assessment



EO-1 Toolkit



Seasonal Dynamics of Forest Cover, Hyperion 2008; Harvard Forest, MA



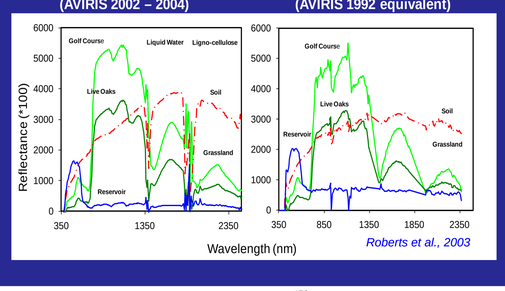
Hyperion Characteristics and Performance

Spectral Bands

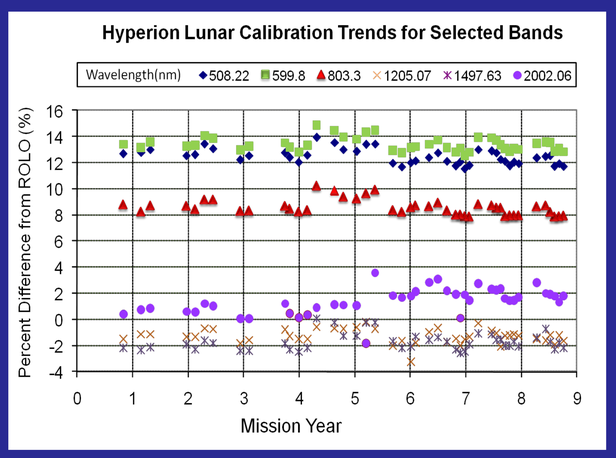
	Band #	Wavelength (nm)
VNIR	1 - 7 *	356 - 417
	8 - 55	426 - 895
	56 - 57	913 - 926
	58 - 70	936 - 1058
SWIR	71 - 76	852 - 902
	77 - 78	912 - 923
	79 - 224	933 - 2396
	225 - 242	2406 - 2578

Hyperion Data Specification	
Spatial Resolution	30 m
Swath Width	7.5 km
Spectral Range	400 - 2400 nm
Spectral Resolution	10 nm

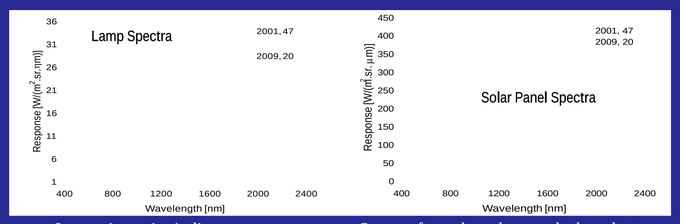
State of the Art Performance (AVIRIS 2002 – 2004) / Hyperion Performance (AVIRIS 1992 equivalent)



Hyperion Calibration and Stability

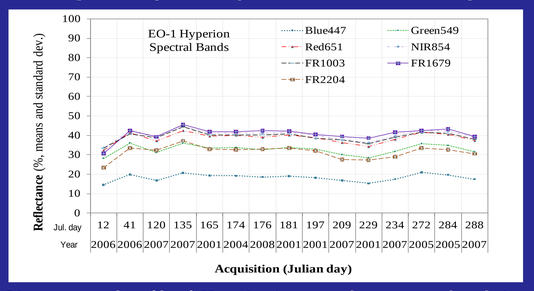


Hyperion lunar calibration trends are compared to the Robotic Lunar Observatory Model (ROLO).



Lamps intensity indicates some degradation over the entire spectral range

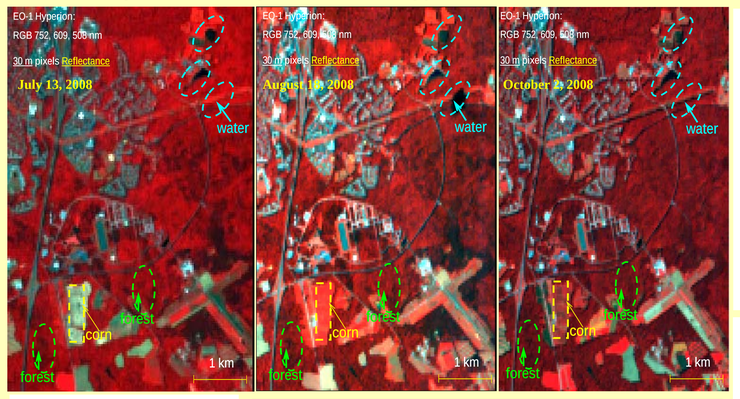
Spectra from the solar panel show large degradation in the shorter wavelengths

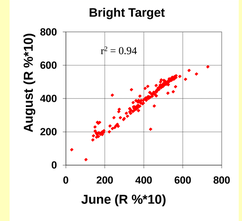


Linear temporal profile of Hyperion 's spectra demonstrates the relative stability of the spectral characteristics, as indicated for selected bands over the Railroad Valley Playa

Technology Applications: EO-1 Prototype L2 Tools and Reflectance Products spectral indicators of chlorophyll, water content, albedo, fAPAR, LAI, ...

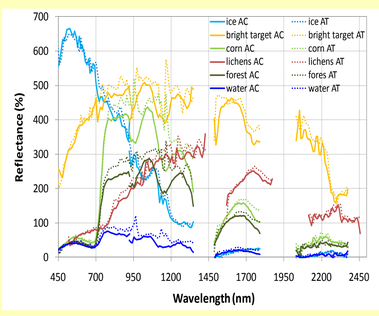
Seasonal Dynamics of Major Land Cover Types, USDA ARC, Greenbelt, MD

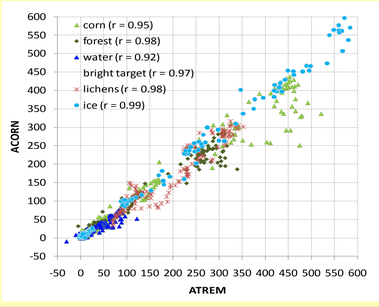




Cover Type	Hyperion, 2008	V1	PRI	REIP	Dmax	WBI	Albedo
Corn	13-Jun	1.03	-0.04	712	0.36	0.96	0.461
	18-Aug	1.81	-0.06	722	0.75	1.09	0.197
	3-Oct	1.15	0.04	721	0.51	0.98	0.155
Forest	13-Jun	1.12	-0.06	712	0.89	1.00	0.257
	18-Aug	1.56	-0.03	722	0.51	1.01	0.140
	3-Oct	1.61	-0.10	712	0.42	0.94	0.127
Water	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

Comparison of ATREM and ACORN





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