

HYPERION
The First Space Based
Hyperspectral Imager

by

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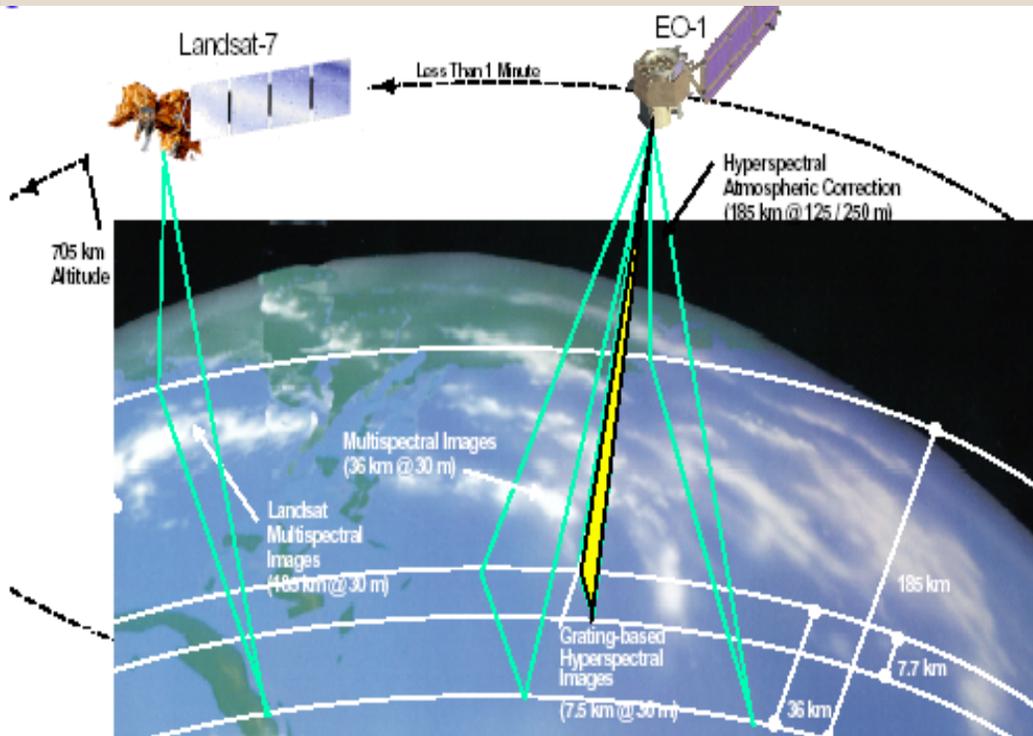
Lunch of Earth Observing-1 (EO-1) satellite

NASA launched EO-1 on November 21, 2000 as a one year experimental (Technology & Instrument validation) mission based on comparisons with ETM+ data

Sensors on board EO-1

- Hyperion-First space-based hyperspectral sensor by TRW Inc
- Advanced Land Imager (ALI) –Multispectral Imager
- Atmospheric Corrector (AC) –Multispectral Imager

EO-1 Orbit Properties

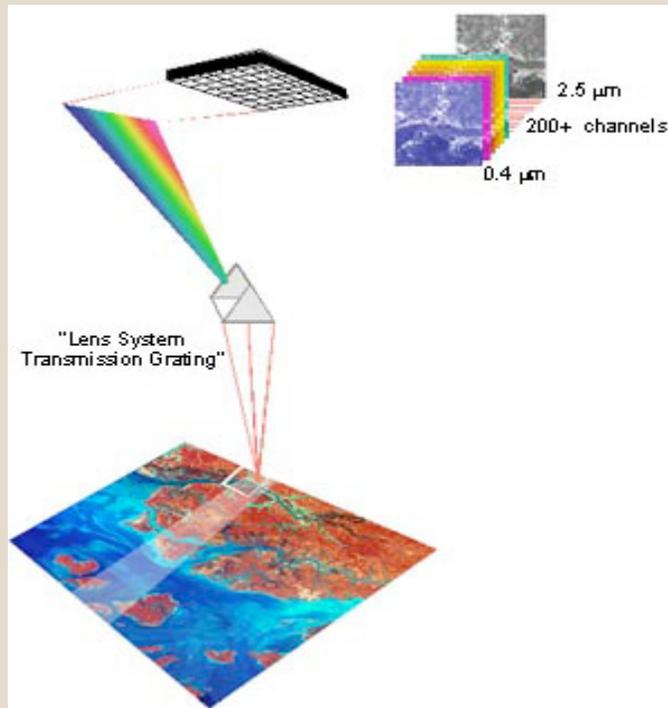


Landsat 7 and EO-1 Satellites in orbit motion

- ❑ EO-1 trails Landsat-7 by 60secs with the same Ground track in a sun-synchronous orbit at an altitude of 705 km
- ❑ It has an orbit inclination of 98.2 deg. with an orbital period of 98.9 min.
- ❑ It has crosstrack FOV OF 0.63deg and IFOV of 0.043mrad
- ❑ It's velocity at nadir point is 6.74 km/s with a mean equatorial crossing time of between 10:00 am and 10:15 am in the descending (daytime) node. it completes over 14 orbits per day,

Hyperion Imaging /spectral Filtering Techniques

Hyperion Data Properties

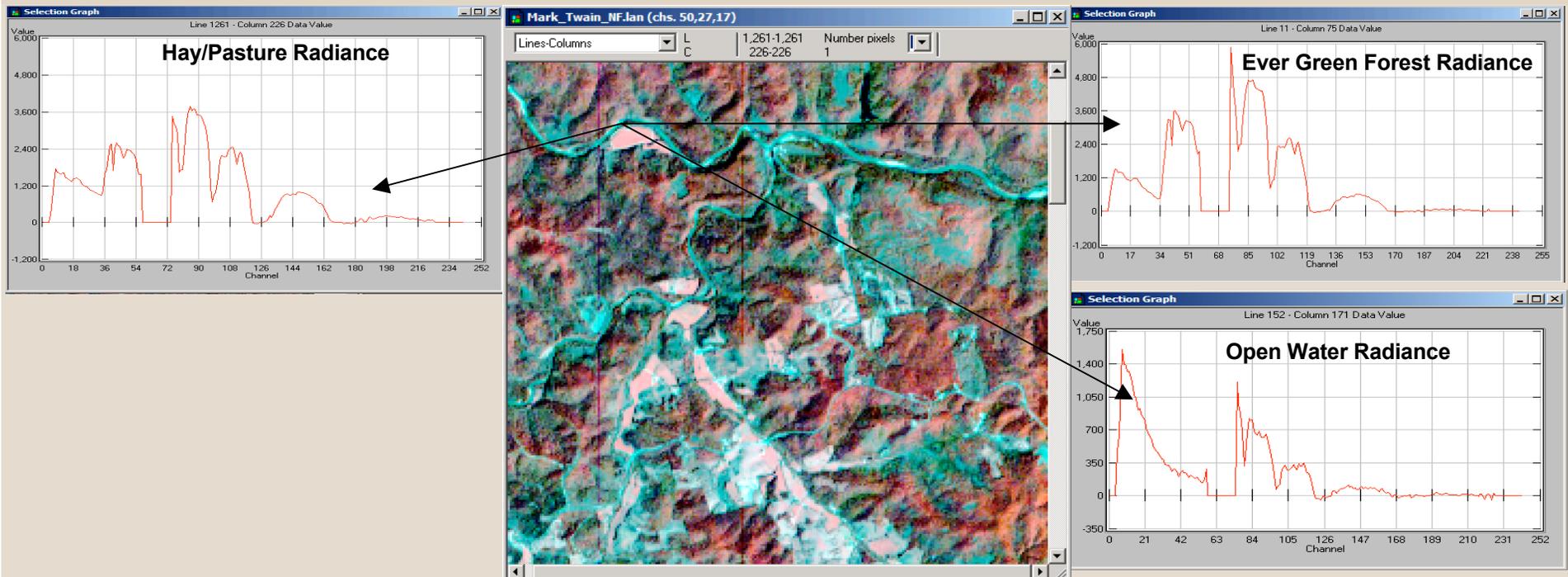


| Parameters | Hyperion |
|---------------------|-----------------------|
| Spectral Coverage | Continuous |
| Number of Bands | 220 |
| Spectral Range | 0.4-2.4 μm |
| Spectral Resolution | 10 nm |
| Swath Width | 7.6 km |
| Spatial Resolution | 30meters |
| Land Area/Image | 7.7x(42or185)km |

Hyperion uses the pushbroom imaging Technique.

It employs the dispersive grating approach to disperse scene reflectance into two focal planes, in the process splitting incoming radiance into 100s of narrow distinct contiguous bands at a spectral resolution of about 10nm

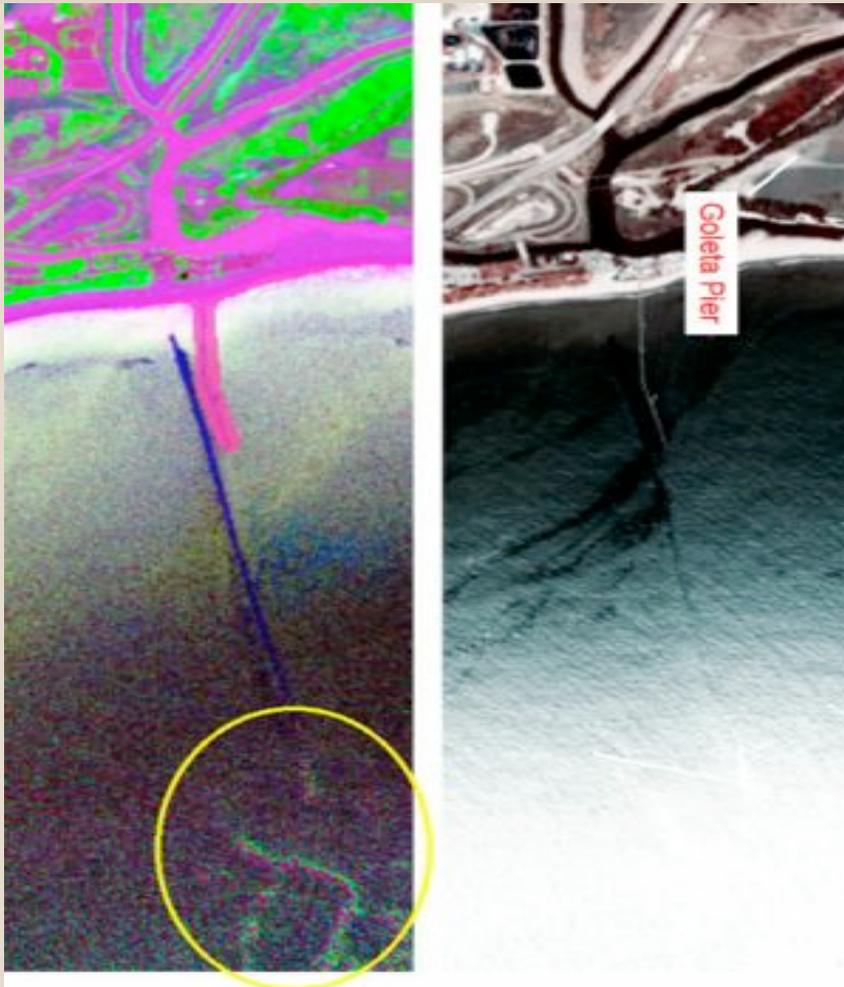
Benefit of High Spectral Resolution



Hyperion image of Mark Twain National Forest Area in Missouri

Spectral Response analysis windows show different spectral responses for different materials within the same or close pixels. This unique capability of Hyperion hyperspectral data allows for the detection of more than one material within mixed pixels

Some unique Applications; Eco System Monitoring



Hyperion Data

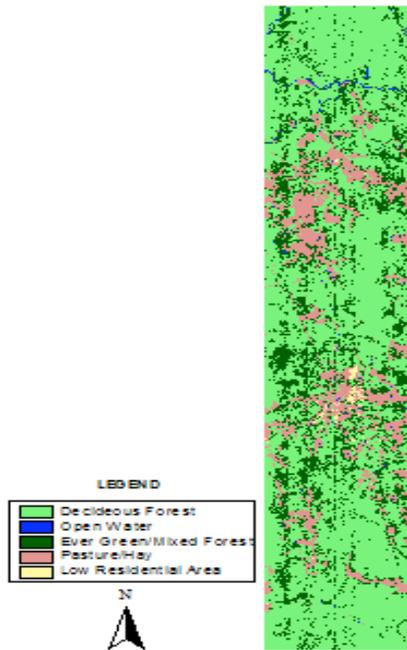
Color Infrared

This image shows a color infrared view which does not reveal the suspended sediments that clearly show up in the (SRI International) processed view of Hyperion data

One can identify materials on and/or below the water surface such as spills, effluents, reefs, navigational hazards, debris, marine life, and mines, etc. and clearly shows an egress of effluent emerging from the sewer pipe.

Hyperion Data Classification

Mark Twain National Forest
Land Cover Map



Classification Analysis

| Classifier \ Feature Extraction | ML | ECHO |
|---------------------------------|----------|----------|
| | Training | Training |
| NWFE | 89.4 | 93.5 |
| | 82.8 | 93.1 |
| DBEF | 95.4 | 98.9 |
| | 85.5 | 92.7 |
| DAFE | 91.3 | 97.4 |
| | 84.5 | 96.1 |

Conclusion;

Any of the above feature extraction methods combined with ECHO classifier gave the highest classification results.

ECHO; Extraction and Classification of Homogeneous Objects , ML; Maximum Likelihood, NWFE; Nonparametric Weighted Feature Extraction
DBEF; Decision Boundary Feature Extraction, DAFE, Discriminant Analysis Feature Extraction

Some Applications

Hyperion Hyperspectral data have has a wide range of applications which can be grouped into various category.

- ❑ Mineral Exploration
- ❑ Vegetation Communities or Species Mapping
- ❑ Hazardous Material Remediation
- ❑ Eco System Monitoring
- ❑ Agriculture
- ❑ Resource Evaluation
- ❑ Water Quality Research.
- ❑ Agriculture and Environmental Management

References

NASA affiliated organizations/websites.
USGS website
TRW Space & Technology Division