USGS
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Land Remote Sensing

Earth Observing-1 Extended Mission

Overview

Since November 2000, the National Aeronautics and Space Administration (NASA) Earth Observing-1 (EO-1) mission has demonstrated the capabilities of a dozen spacecraft sensor and communication innovations. Onboard the EO-1 spacecraft are two land remote sensing instruments. The Advanced Land Imager (ALI) acquires data in spectral bands and at resolutions similar to Landsat. The Hyperion instrument, which is the first civilian spaceborne hyperspectral imager, acquires data in 220 10-nanometer bands covering the visible, near, and shortwave-infrared bands. The initial one-year technology demonstration phase of the mission included a detailed comparison of ALI with the Landsat Enhanced Thematic Mapper Plus (ETM+) instrument. Specifications for the Operational Land Imager (OLI), the planned successor to ETM+, were formulated in part from performance characteristics of ALI.

Recognizing the remarkable performance of the satellite's instruments and the exceptional value of the data, the U.S. Geological Survey (USGS) and NASA agreed in December 2001 to share responsibility for operating EO-1. The extended mission continues, on a cost-reimbursable basis, as long as customer sales fully recover flight and ground operations costs. As of May 2005, more than 17,800 scenes from each instrument have been acquired, indexed, archived, and made available to the public.

Applications

Multispectral and hyperspectral data from EO-1 are valuable for a variety of applications. Hyperion data contribute to fire monitoring and prediction by providing detailed spectral definition of forest composition and structure, forest canopy, and underlying fire fuels. The mapping of active fire burns has been enhanced by the ability to image cross-track and by the multispectral improvements of the ALI instrument.

For many years multispectral imagery has been the staple data for land use and land cover classification. Hyperion has proven to be beneficial for discriminating coral/sea grass in shallow coral reefs and monitoring ecosystem function. Hyperion also has been effective for identifying basic mineral spectra in arid environments. EO-1 data are a representative prototype for future remote sensing instruments, offering the global science community an important transitional reference for applications involving next generation sensors (Figure 1).

Sensor Capabilities

The EO-1 extended mission operates within constraints imposed by its technology pioneering origins, but it also provides unique and valuable imaging capabilities. The spacecraft has the ability to acquire a target

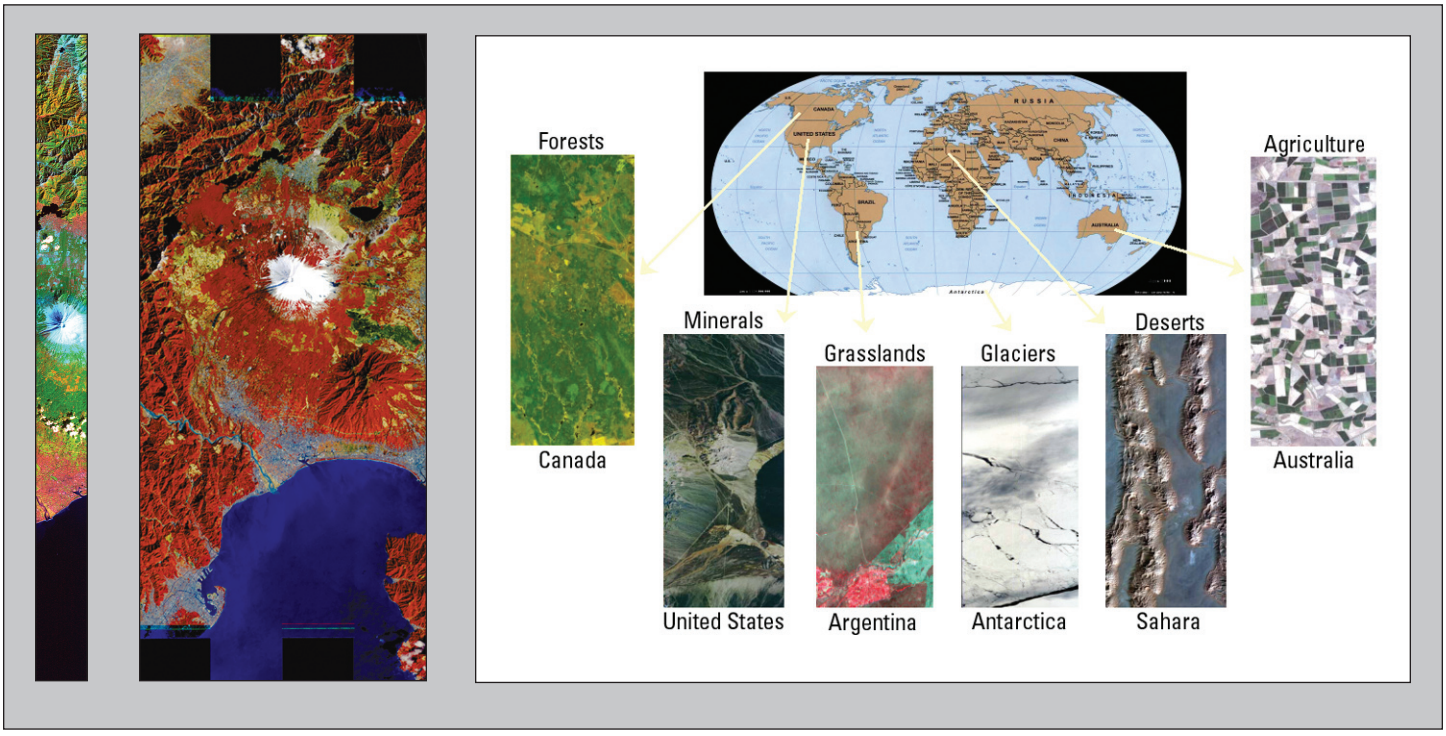

Figure 1. Left: Hyperion centered image collect of Mt. Fuji, Japan, acquired on February 9, 2003. (Scene ID: EO1H1080352003040110PZ) Middle: ALI centered image collect of Mt. Fuji acquired on March 4, 2003. (Scene ID: EO1A1080352003063110KO) Right: EO-1 ALI and Hyperion data are suitable for studying various applications all over the world.

scene three times in a 16-day period with its cross-track pointing capability (Figure 2).

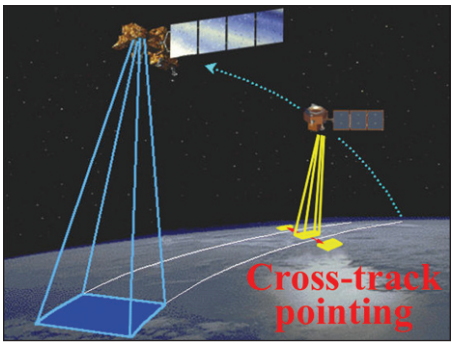

Figure 2. EO-1 flies in formation with Landsat 7, trailing Landsat 7 by approximately one minute. Pointable sensors that are onboard EO-1 allow off-nadir viewing capability outside of the current (nadir) WRS-2 path.

ALI has an improved signal-to-noise ratio in comparison to Landsat 7 ETM+, which is due in large part to ALI's pushbroom scanning technology (Figure 3).

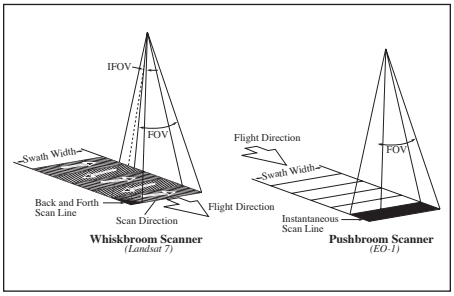

Figure 3. Comparison of EO-1 ALI and Landsat 7 ETM+

The ALI instrument also has additional spectral coverage and greater radiometric dynamic range compared with ETM+, yet ALI data can still be cross-correlated with ETM+ data (Figure 4).

ALI can image a coincident patch on the ground simultaneously with Hyperion (Figure 5).

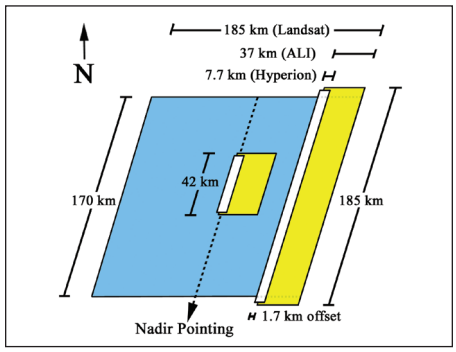

Figure 5. This graphic displays the EO-1 Hyperion (white) and ALI (yellow) ground tracks for a 42 and 185 kilometer acquisition superimposed on a Landsat WRS-2 path/row (blue). Nadir pointing is displayed for the WRS-2.

Extended Mission Roles

NASA and the USGS are operating the EO-1 mission as economically as possible, leveraging the infrastructure and technical strengths of each agency. The NASA Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, manages the mission and operates the spacecraft. The GSFC coordinates data collection among a network of polar and U.S. ground stations. The GSFC periodically adjusts the spacecraft orbit to ensure that it follows the Landsat 7 satellite by one minute. The spacecraft has sufficient fuel to remain in its current Worldwide Reference System-2 (WRS-2) orbit through 2005, at which time NASA will determine when to decommission the spacecraft and conduct de-orbit maneuvers. The U.S. Geological Survey (USGS) National Center for Earth Resources Observation and Science (EROS) is responsible for acquisition scheduling, data reception, order processing, acquisition cataloging, data archiving, product generation, and distribution. The USGS will maintain the entire EO-1 collection in its long-term archive of global land data following decommissioning.

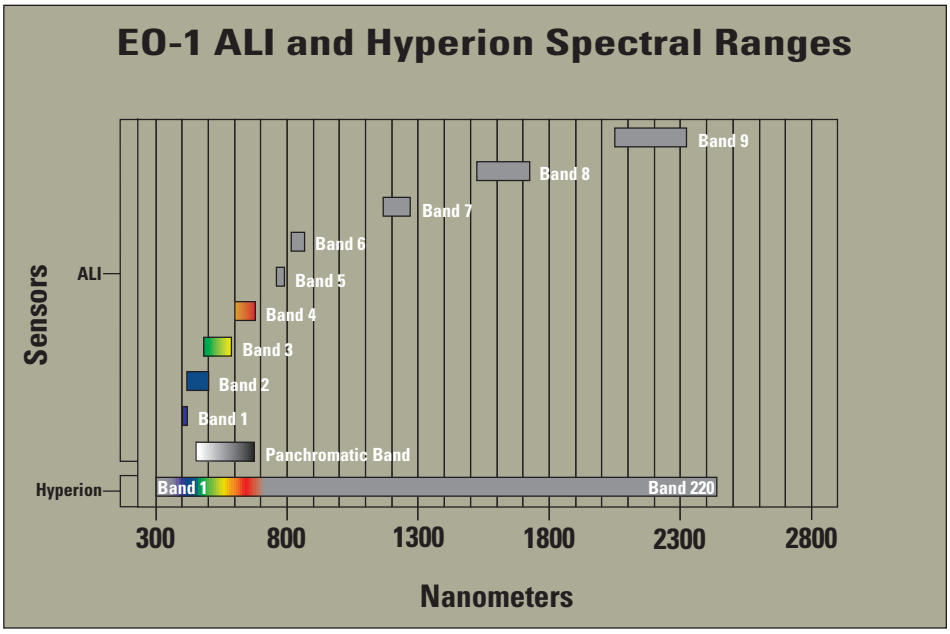

Figure 4. EO-1 Spectral Ranges

Extended Mission Goals

- Sustain and enhance USGS and NASA research and development of applications for hyperspectral and multispectral data.
- Promote opportunities in the remote sensing community to apply evolving imaging technology for government, scientific, and industry applications.
- Add unique land remote sensing data to the USGS National Satellite Land Remote Sensing Data Archive.
- Characterize long-term performance of EO-1 advanced technology sensors.

Data Products and Availability

ALI data are available as systematic radiometrically (Level 1R) and geometrically (Level 1G) corrected products. Hyperion data are available as radiometrically (Level 1R) corrected products.

Archived data products can be searched and ordered online at:
http://earthexplorer.usgs.gov and
http://glovis.usgs.gov

Data Acquisition Requests (DARs) can be submitted online at:
http://eo1.usgs.gov/DARInstructions.php

EO-1 provides the capability for a quick product turnaround by providing priority tasking and expedited processing. Additional costs are required for both of these services.

For More Information

EO-1 products, prices, sensors, and acquisition schedule can be found at:
http://eo1.usgs.gov

Technical information about the EO-1 mission, satellite, and sensors is available at:
http://eo1.gsfc.nasa.gov

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