

USGS Report to the 25th CEOS/WGCV Plenary

May 9-12, 2006

Budapest, Hungary

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U.S. Geological Survey, EROS

Sioux Falls, SD



Outline

- **Landsat-5 Status**
- **Landsat-7 Status**
- **EO-1 Status**
- **Landsat Mission Data Gap Studies**
- **LDCM Update**
 - ◆ Landsat Science Team
- **ASTER and MODIS Support**

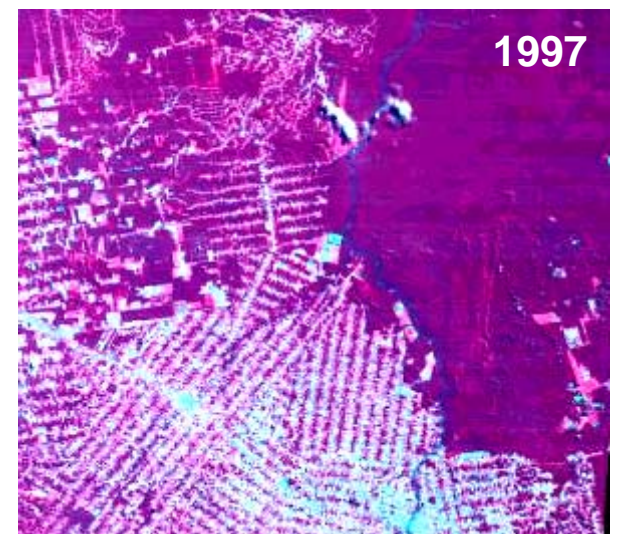
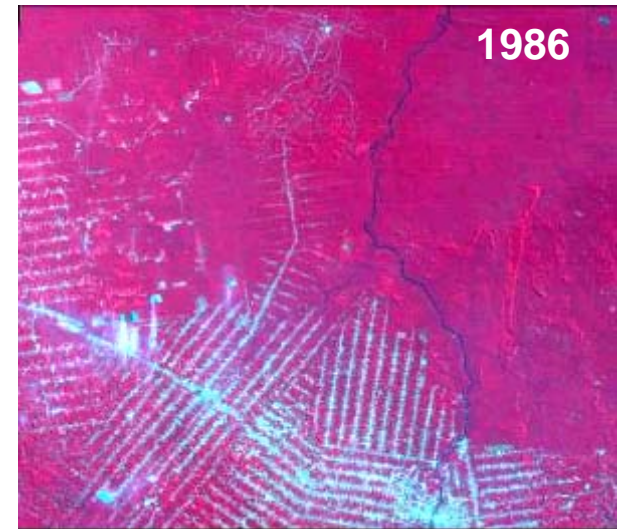


Introduction

- **The Landsat Program provides for and updates a national archive of land remote sensing data for distribution to the U.S. Government, international community, and the general public**
 - ◆ Public Law 102-555, the Land Remote Sensing Policy Act of 1992
 - ◆ Presidential Decision Directive/NSTC-3 (5/5/94; amended 10/16/00)
 - ◆ Management Plan for the Landsat Program

Landsat Importance to Science

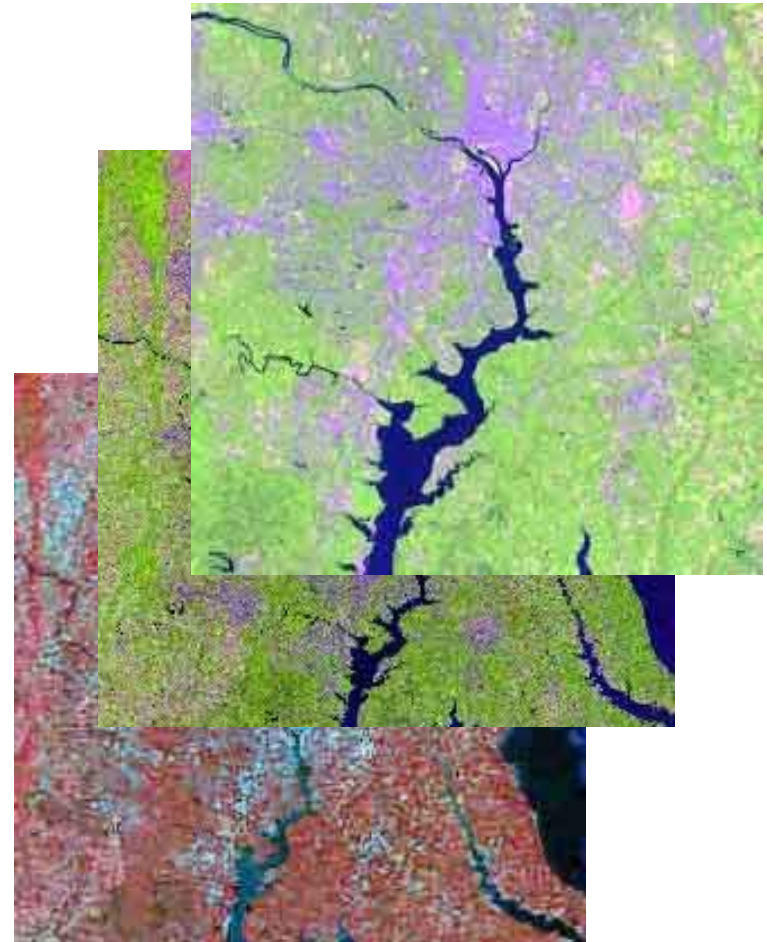
- Change is occurring at rates unprecedented in human history
- The Landsat program provides the only medium resolution inventory of the global land surface over time
 - ◆ at a scale where human vs. natural causes of change can be differentiated
 - ◆ on a seasonal basis
- No other satellite system is capable/committed to even annual global coverage at this scale



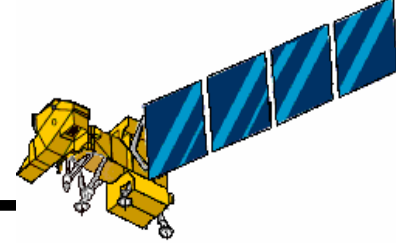
U.S. Landsat Archive Overview

(Orderable Scenes through March 31, 2006)

- **ETM+: Landsat 7**
 - ◆ 603,112 scenes
 - ◆ 535 TB RCC and L0Ra Data
 - ◆ Archive grows by 260 GB Daily
- **TM: Landsat 4 & Landsat 5**
 - ◆ 643,181 scenes
 - ◆ 307 TB of RCC and L0Ra Data
 - ◆ Archive Grows by 40 GB Daily
- **MSS: Landsat 1 through 5**
 - ◆ 641,555 scenes
 - ◆ 14 TB of Data



Landsat-7 Mission Status



- **L7 ETM+ sensor has been on orbit for 7 years**
 - ◆ Scan Line Corrector (SLC) malfunction (May 31, 2003)
 - The SLC anomaly has not impacted the radiometric or geometric performance for existing pixels
 - New capability to improve the SLC-off data products
 - ◆ Phase 0: SLC-off Products – Released in October 2003
 - ◆ Phase 1: SLC-off / on Gap-filled Products – Released May 2004
 - ◆ Phase 2: SLC-off / off Gap-filled Products – Released Nov 2004
 - ◆ Phase 3: Segmentation based Gap-filled Products – coming Jan 2007
 - ◆ On May 5, 2004, Gyro #3 was powered off due to anomalous gyro telemetry
 - ◆ May have to switch to bumper mode operation next year
- **Estimated end of mission: Jan 2011 based on remaining fuel and assuming 9:30AM MLT crossing minimum criteria**

Landsat-5 Mission Status



- **L5 TM sensor have been on orbit for 22 years**
 - ◆ Switch to Bumper Mode operations in May, 2002
 - ◆ Experienced Solar Array Drive malfunction on Nov 26, 2005
 - ◆ Performed Outgassing on March 14, 2006
 - ◆ TWTA problems: 2003, July 26 2005, March 16 2006
- **New capability to improve the data calibration**
 - Effective May 5, 2003, L5 TM data processed and distributed by the USGS EROS is radiometrically calibrated using a new procedure and revised calibration parameters
 - Definitive Ephemeris (DE) generated from available satellite telemetry are now used to generate products. DE improves overall geolocation accuracy and reduces outliers
- **Expansion of International Ground Station (IGS) network**
- **Estimated end of mission: Dec 2009 based on remaining fuel and assuming 9:30AM MLT crossing minimum criteria**

EO-1 Mission Status



- **EO-1 is fully functional after 5 years on-orbit**
- **Operating in a lowered orbit extended mission since Sept 27, 2005**
 - ◆ Use all remaining fuel to lower orbit in a controlled manner while maintaining the current Mean Local Time (MLT)
 - ◆ Orbit perigee lowered 5-6 km
 - ◆ Ceased formation flying with Landsat 7 and left the WRS-2 worldwide grid
 - Drifting across WRS-2
 - Using 35-day predicted ephemeris for scheduling
 - ◆ Maintaining a Mean Local Time (MLT) crossing ~ 10AM
 - Continuing to lower perigee by 1 km every 5-6 weeks
- **Potential to run until 2011 based on remaining fuel**



Landsat Mission Data Gap

- **The Earth observation community is facing a probable gap in Landsat data continuity before LDCM data arrive in 2011**
- **A data gap will interrupt a 34+ yr time series of land observations**
- **Landsat data are used extensively by a broad & diverse users**
 - ◆ Landsat 5 limited lifetime/coverage
 - ◆ Degraded Landsat 7 operations
 - ◆ Either or both satellites could fail at any time: both beyond design life
- **Urgently need strategy to reduce the impact of a Landsat data gap**
 - ◆ Landsat Program Management must determine utility of alternate data sources to lessen the impact of the gap & feasibility of acquiring data from those sources in the event of a gap
 - ◆ A Landsat Data Gap Study Team, chaired by NASA and the USGS, has been formed to analyze potential solutions

Data Gap Study Team Management

- **NASA and USGS lead Landsat Data Gap Study Team**

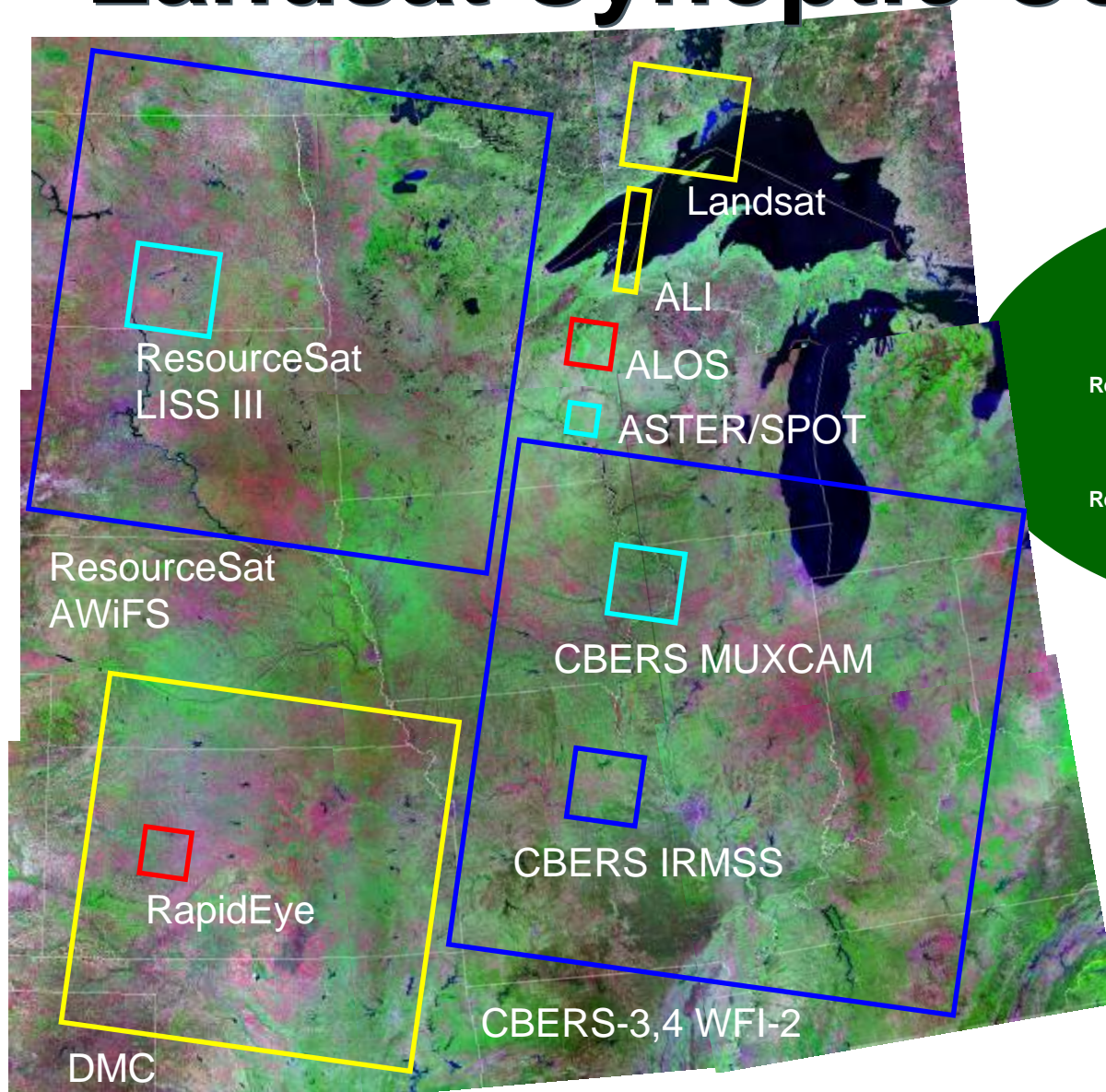
- ◆ Developing a strategy for providing data to National Satellite Land Remote Sensing Data Archive for 1-4 years
- ◆ Technical Committee considering issues that must be resolved to support strategy (data characteristics & quality, data availability and coverage, data processing and archiving requirements, etc.)
 - Committee staffed by USGS/EROS, NASA/GSFC, NASA/SSC
- ◆ Programmatic Committee considering project issues and compiling final strategy document (“GEOSS” data exchange vs. commercial purchase, licensing, project funding, MOUs, data policy, etc.)
 - Committee staffed by USGS and NASA Hq’s.



Systems Considered

- **IRS ResourceSat – 1, 2 (India)**
- **CBERS – 2, 2A, 3, 4 (China & Brazil)**
- **Rapid Eye – 1, 2, 3, 4, 5 (Germany)**
- **DMC (Algeria, Nigeria, UK, China)**
- **Terra/ASTER (US & Japan)**
- **High-resolution U.S. commercial systems**
 - ◆ IKONOS
 - ◆ Quickbird
 - ◆ OrbView-3
- **ALOS (Japan)**
- **SPOT – 4, 5 (France)**
- **EO-1/ALI (US)**

Landsat Synoptic Coverage



| Satellite | Sensor | Ground Sample Distance (m) |
|---------------|-----------|----------------------------|
| RapidEye | REIS | 6.5 |
| ALOS | AVNIR | 10 |
| CBERS-3,4 | MUXCAM | 20 |
| SPOT 5 | HRG | 10/20 |
| Terra | ASTER | 15/30/90 |
| ResourceSat-1 | LISS III+ | 23.5 |
| Landsat 7 | ETM+ | 15/30/60 |
| EO-1 | ALI | 30 |
| DMC | MSDMC | 32 |
| ResourceSat-1 | AWiFS* | 56 |
| CBERS-3,4 | WFI-2 | 73 |
| CBERS-3,4 | IRMSS | 40/80 |

Note: For purposes of scene size comparison only. Locations do not represent actual orbital paths or operational acquisitions.



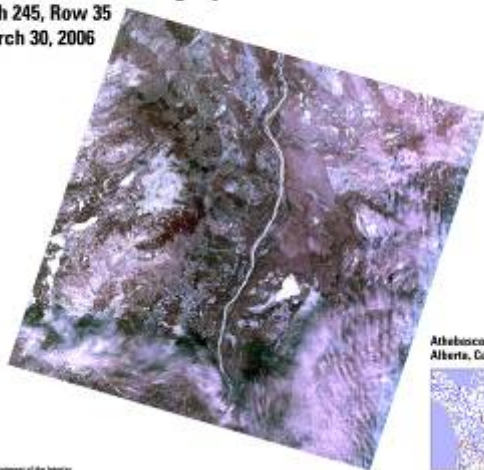
CBERS-2 Test Downlink

- **CBERS-2 test downlink at USGS EROS ground station was very successful**
 - ◆ This is the first time that the CBERS-2 satellite data was down linked in a country other than China and Brazil
- **“CBERS in a box” works**
 - ◆ The CBERS-2 capture and processing system is a small computer that can perform the following tasks
 - ingest the raw data
 - show the image data in a “moving window” display
 - record the raw data in the computer’s hard disk
 - process the raw data to level 1 products
 - generate quick looks to populate the Data Catalog of the system
 - make the level 1 data available to the users

First CBERS-2 imagery downlinked to USGS EROS

Path 245, Row 35

March 30, 2006



Athabasca River,
Alberta, Canada

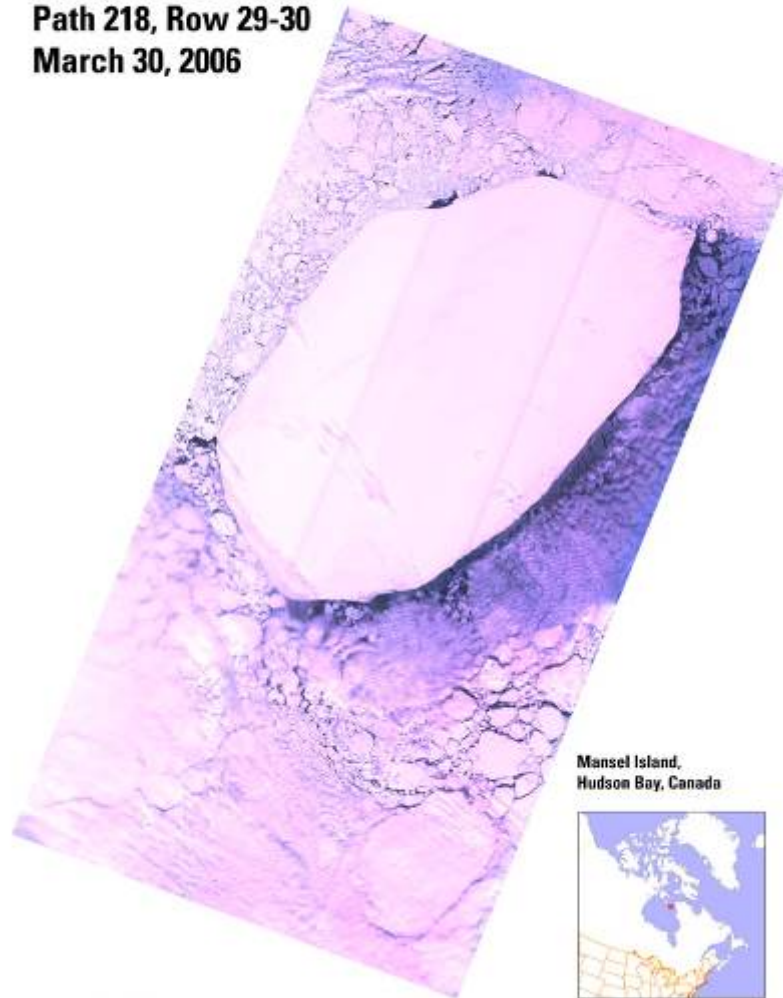


U.S. Department of the Interior
U.S. Geological Survey

CBERS-2 data downlinked to USGS EROS

Path 218, Row 29-30

March 30, 2006



Mansel Island,
Hudson Bay, Canada

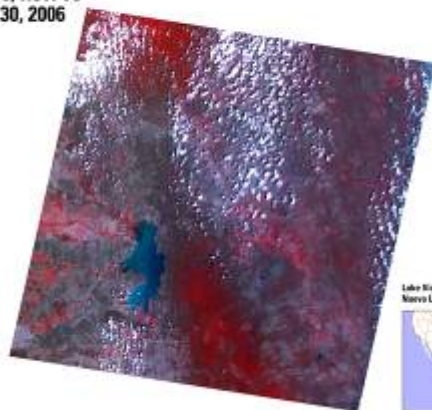


U.S. Department of the Interior
U.S. Geological Survey

CBERS-2 data downlinked to USGS EROS

Path 218, Row 73

March 30, 2006



Lake Ximelá Guzman,
Nuevo Leon, Mexico



U.S. Department of the Interior
U.S. Geological Survey

A vertical strip on the left side of the slide shows a satellite image of a river delta, with green land, blue water, and brown sediment.

Science Team Expertise

- **Applications – with emphasis on those applications that have historically been reliant on Landsat data.**
- **Technical needs – especially those of large operational customers (e.g., global change studies, agricultural surveys, disaster assessment, etc.).**
- **Instrument functions – including long-term calibration and image geometry and radiometer performance.**
- **Data issues – including acquisition strategies, data access requirements and specifications, product characteristics, data management capabilities, data archiving.**

Science Team Responsibilities

- **Provide science-based feedback on critical design issues, including instrument and data systems**
- **Contribute to the specification and design of the data acquisition strategy and data access systems**
- **Conduct experiments on science and applications elements of program**
- **Represent the breadth of user perspectives and their requirements on product formats and product generation issues**
- **Provide insights on long-term issues (e.g., gap-filling options, future missions)**
- **Consider interoperability of Landsat with other systems currently in orbit or planned for launch within the LDCM operational timeframe**
- **Participate in representation tasks (e.g., provide data for demos or presentations and represent mission in selected forums including scientific meetings)**



Science Team Composition

- **Landsat Science Team will consist of approximately 16 members**
 - ◆ Competed and funded seats
 - External scientists (8 research and development contracts @ \$90k average award)
 - ◆ Other competed seats – supported by home organization (travel funds may be provided)
 - Federal agency scientists (3-5)
 - International scientists (2-3)
 - ◆ LDCM Ex Officio Members
 - NASA (Jim Irons, Jeff Masek)
 - USGS (Tom Loveland, John Dwyer)

Science Team Selection Timeline

| Date | Task |
|--------------------------|---|
| April 2006 | Landsat Science Team competition plans announced |
| April 2006 | Solicitation released (45 day period for proposal submission) |
| May 2006 | Review panelists selected and proposal reviews begin |
| July 2006 | Panel recommendations to USGS |
| July 2006 | USGS selects PI's |
| August 2006 | Contracts in place for PI's |
| August or September 2006 | First Science Team meeting (with Landsat 7 team) |

Status of ASTER L1B On-Demand

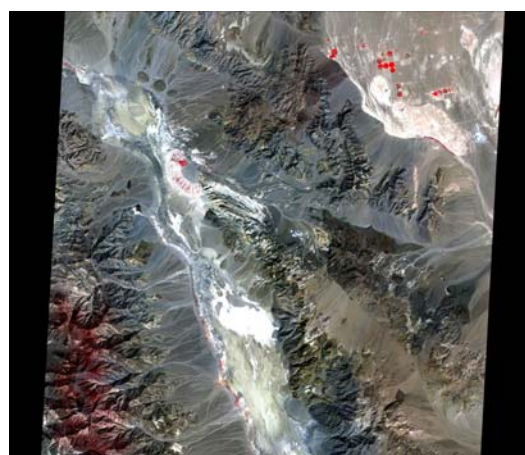
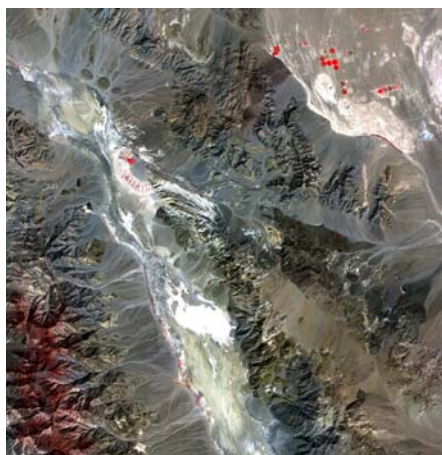
Last year, Japanese and U.S. ASTER partners agreed to develop and implement on-demand production of ASTER L1B data both by ASTER GDS and the LP DAAC.

The approach will leverage the entire L1A archive, increasing the number of L1B scenes available to the user from 400,000 to over 1 million.

The system will be implemented during summer 2006.

L1A

Reconstructed
unprocessed
instrument data



L1B

Registered at-
sensor radiance

Long Term Archiving of EOS Data

Addressed by NASA – USGS MOU.

- A variety of L0 data sets transitioned in 2004 (e.g., GLCC, GTOPO30, NALC, SIR-C).

For MODIS and ASTER, a pilot project is being investigated to build capacity for:

- ◆ On – demand processing from L0 data
- ◆ L2 or higher product generation
- ◆ Product distribution via GLOVIS or Earth Explorer

Options for the LTA product suite being informed by the USGS Archive Advisory Committee data sieve process and the EOSDIS land products review process.



Back-up Slides

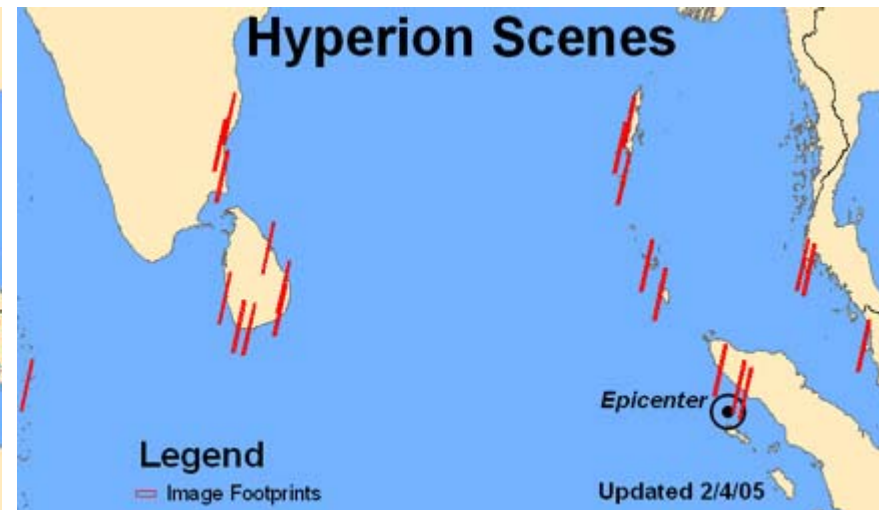
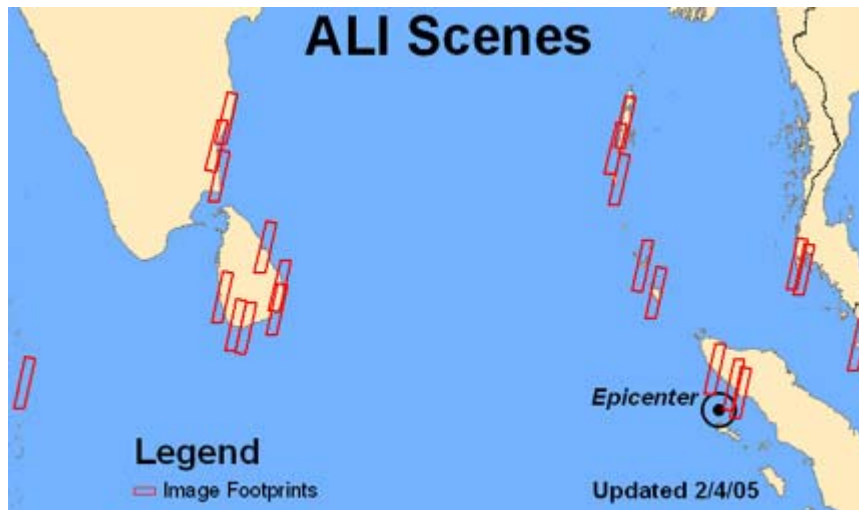
EO-1 Tsunami Support

- **ALI and Hyperion Coverage Maps**

- ◆ Collected in support of areas impacted by the tsunami and earthquake disaster on December 26, 2004
- ◆ Similar maps provided for congressional hearings to show the sensors that have been utilized to help in the relief efforts

- **Twenty-six ALI and Hyperion paired scenes processed**

- ◆ Available on the Emergency Response server
- ◆ <http://gisdata.usgs.gov/website/tsunami/>



EO-1 Tsunami Support



Advanced Land Observing Satellite (ALOS)

- ALOS was launched on Jan 24, 2006 by Japan Aerospace EXploration Agency (JAXA)
- Revisit time is 46 days, but it can observe any area within 2 days
- Orbital altitude/inclination: 692 km/~98 degrees
- Nodal crossing: 10:30 a.m.
- System life: 3 - 5 years
- Three instruments devoted to land imaging
 - ◆ **Panchromatic Remote Sensing Instruments for Stereo Mapping (PRISM)**
 - ◆ **Advanced Visible and Near Infrared Radiometer (AVNIR-2)**
 - ◆ **Phased Array L-band Synthetic Aperture Radar (PALSAR)**
- Availability of data and products, data policy, and pricing is TBD
- Website: <http://alos.nasda.go.jp/>



| | <u>PRISM</u> | <u>AVNIR-2</u> | <u>PALSAR</u> |
|----------------|--------------|--|------------------|
| Spectral bands | 0.52-0.77um | 0.42-0.50um 0.52-0.60um 0.61-0.69um 0.76-0.89um | 1.27GHz (L-band) |
| Resolution | 2.5m | 10m | 10m/100m |
| Swath width | 35km/70km | 70km | 70km/350km |
| Pointing (+-) | 1.5 degrees | 44 degrees | 10-51 degrees |
| Revisit | - | 2 days | 2 days |
| Actual revisit | 46 days | 46 days | 46 days |

Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER)

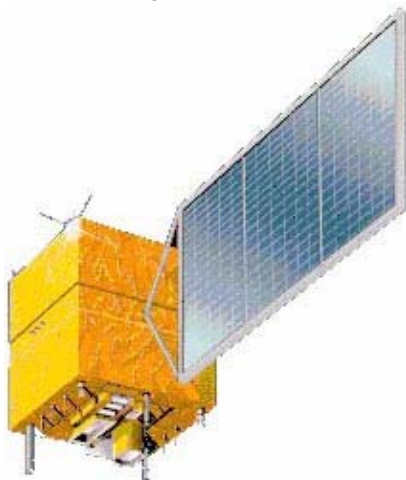
- ASTER was launched on December 18, 1999 on the Terra satellite
- Orbital altitude/inclination: 705 km/98.2 degrees
- Nodal crossing: 10:30 a.m.
- System life: 6 years
- Three instruments are
 - ◆ **Visible and Near-Infrared Radiometer(VNIR)**
 - ◆ **Short Wave Infrared Radiometer (SWIR)**
 - ◆ **Thermal Infrared Radiometer(TIR)**
- Archive data sets are available at \$60/scene
- Website: <http://asterweb.jpl.nasa.gov/>



| | <u>VNIR</u> | <u>SWIR</u> | <u>TIR</u> |
|----------------|-------------|--------------|---------------|
| Spectral bands | 0.52-0.60um | 1.60-1.70um | 8.12-8.47um |
| | 0.63-0.69um | 2.14-2.18um | 8.47-8.82um |
| | 0.76-0.86um | 2.18-2.22um | 8.92-9.27um |
| | | 2.23-2.28um | 10.25-10.95um |
| | | 2.29-2.36um | 10.95-11.65um |
| | | 2.36-2.43um | |
| Resolution | 15m | 30m | 90m |
| Swath width | 60km | 60km | 60km |
| Pointing (+-) | 24 degrees | 8.55 degrees | 8.55 degrees |
| Revisit | - | - | - |
| Actual revisit | 16 days | 16 days | 16 days |

China-Brazil Earth Resources Satellite (CBERS 1-2)

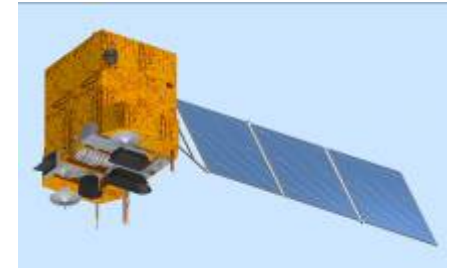
- CBERS-1 launched on October 14, 1999; CBERS-2 on October 21, 2003; CBERS-2B to be launched in May 2007
- Revisit time is 26 days
- Orbital altitude/inclination: 778 km/98.5 degrees
- Nodal crossing: 10:30 a.m.
- System life: 2 years
- Data only downlinked to Brazil and China, may commercialize in future
- Each satellite has 3 cameras (see below)
- Availability of data and products, data policy, and pricing is TBD
- Website: <http://www.cbbers.inpe.br/en/>



| | <u>CCD</u> | <u>IRMSS</u> | <u>WFI</u> |
|----------------|-------------|--------------|-------------|
| Spectral bands | 0.51-0.73um | 0.50-1.10um | 0.63-0.69um |
| | 0.45-0.52um | 1.55-1.75um | 0.77-0.89um |
| | 0.52-0.59um | 2.08-2.35um | |
| | 0.63-0.69um | 10.4-12.5um | |
| | 0.77-0.89um | | |
| Resolution | 20m | 80m/160m | 260m |
| Swath width | 113km | 120km | 890km |
| Pointing (+/-) | 32 degrees | none | none |
| Revisit | 3 days | - | - |
| Actual revisit | 26 days | 26 days | 5 days |

China-Brazil Earth Resources Satellite (CBERS 3-4)

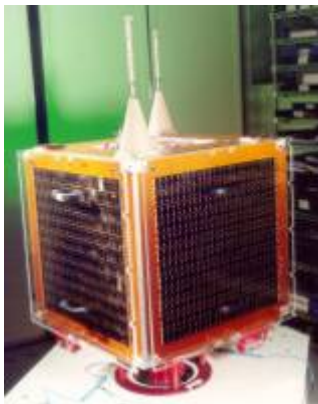
- CBERS-3 to be launched in 2007 or 2008; CBERS-4 after 2007
- Revisit time is 26 days
- Orbital altitude/inclination: 778 km/98.5 degrees
- Nodal crossing: 10:30 a.m.
- System life: 2 years
- Each satellite will have 4 cameras (see below)
- Availability of data and products, data policy, and pricing is TBD
- Website: <http://www.cbers.inpe.br/en/>



| | <u>MUXCAN</u> | <u>PANMUX</u> | <u>IRMSS</u> | <u>WFI</u> |
|-----------------|---------------|---------------|--------------|-------------|
| Sprectral bands | 0.45-0.52um | 0.51-0.75um | 0.76-0.90um | 0.52-0.59um |
| | 1.55-1.75um | 0.51-0.85um | 0.76-1.10um | 0.63-0.69um |
| | 0.52-0.59um | 0.52-0.59um | 1.55-1.75um | 0.77-0.89um |
| | 0.63-0.69um | 0.63-0.69um | 2.08-2.35um | 1.55-1.75um |
| | 0.77-0.89um | 0.77-0.89um | 10.4-12.5um | |
| Resolution | 20m | 5m/10m | 40m/80m | 73m |
| Swath width | 120km | 60km | 120km | 866km |
| Pointing (+-) | 32 degrees | 32 degrees | none | none |
| Revisit | 3 days | 5 days | - | - |
| Actual revisit | 26 days | none | 26 days | 5 days |

Disaster Monitoring Constellation (DMC)

- DMC is a constellation of microsatellites being developed by Surrey Satellite Technology Limited (SSTL) that would provide daily global coverage
- A five satellite constellation could collect 400-600 scenes/day
- Four satellites are currently operational; AISAT-1 was launched on November 28, 2002; UK-DMC, NigeriaSat-1, and BILSAT-1 were launched on September 27, 2003
- An enhanced satellite for China will be launched in 2005
- Orbital altitude/inclination: 686 km/98 degrees
- Nodal crossing: 10:30 a.m.
- System life: 5 years
- Data characteristics are satellite dependent
- Availability of data and products, data policy, and pricing is TBD
- Website: <http://www.sstl.co.uk/>



| | <u>Standard</u> | <u>BILSAT-1</u> | <u>China DMC +4</u> |
|----------------|-----------------|-----------------|---------------------|
| | 0.52-0.60 um | 0.52-0.60 um | 0.52-0.60 um |
| | 0.63-0.69 um | 0.63-0.69 um | 0.63-0.69 um |
| Spectral bands | 0.77-0.90 um | 0.77-0.90 um | 0.77-0.90 um |
| | | pan | pan |
| Resolution | 32 m | 28 m/ 12 m | 32 m/ 4 m |
| Swath width | 600 km | 55 km/ 24.5 km | 600 km/ |
| Pointing (+) | - | 30 | - |
| Revisit | - | 4-5 days | - |
| Actual revisit | 4-5 days | 16 days | 4-5 days |

Standard = AISAT-1, NigeriaSat-1, UK-DMC

Earth Observing-1 (EO-1)

- EO-1 was launched on November 21, 2000 by NASA, and continues today as the EO-1 Extended Mission operated by NASA and the USGS
- Revisit time is 16 days
- Cross track pointing: Three times in a 16 day cycle
- Orbital altitude/inclination: 705 km/98.2 degrees
- Nodal crossing: 10:15 a.m.
- System life: 1 year
- Two instruments devoted to land imaging
 - ◆ **Advanced Land Imager (ALI)**
 - ◆ **Hyperion**
- ALI, 9 multispectral bands at 30 m (0.43-0.45 μ m, 0.45-0.51 μ m, 0.52-0.60 μ m, 0.63-0.69 μ m, 0.77-0.80 μ m, 0.84-0.89 μ m, 1.20-1.30 μ m, 1.55-1.75 μ m, 2.08-2.35 μ m) and 1 pan band at 10 m (0.48-0.69 μ m)
- Swath width: 37 km by 42 km
- Capable of acquiring approximately 20 scenes/day on WRS-2 grid
- Archived data available at \$250 or \$500/scene; data acquisition requests are additional \$1,500/scene
- Website: <http://eo1.usgs.gov/> or <http://eo1.gsfc.nasa.gov/>



RapidEye

- RapidEye to be launched in late 2007, a total of 5 satellites is proposed, all launched at once and 19 minutes apart on orbit
- Commercial effort focused on providing information to the agricultural and cartographic communities
- Revisit time is 1 day, average coverage repeat is < 5 days with all satellites operating
- Orbital altitude/inclination: 622 km/97.8 degrees
- Imaging area: +/- 75 degrees
- Cross track pointing: +/- 25 degrees
- Nodal crossing: 11:00 a.m.
- System life: 7 years
- Multi-Spectral Imager (push-broom scanner), 5 bands (0.44-0.51um, 0.52-0.59um, 0.63-0.685um, 0.69-0.73um, 0.76-0.85um)
- Ground resolution: 6.5 m
- Swath width: 78-80 km by 1,500 km
- Availability of data and products, data policy, and pricing is TBD
- Website: <http://www.rapideye.de/>



ResourceSat-1 (IRS-P6)

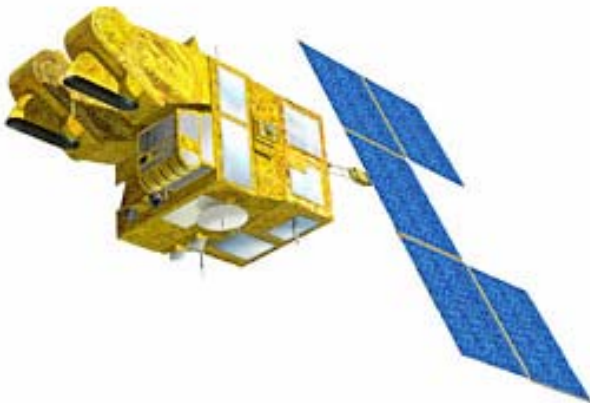
- ResourceSat-1 was launched on October 17, 2003 by Indian Remote Sensing (IRS)
- Orbital altitude/inclination: 817 km/98.69 degrees
- Nodal crossing: 10:30 a.m.
- System life: 5 years
- Three instruments devoted to land imaging
 - ◆ **Linear Imaging Self-Scanner (LISS-IV)**
 - ◆ **Linear Imaging Self-Scanner (LISS-III)**
 - ◆ **Advanced Wide Field Sensor (AWiFS)**
- Space Imaging has distribution rights outside of India
 - ◆ **LISS-III and LISS-IV are \$2,750/scene; AWiFS is \$850/scene**
- Website: <http://www.spaceimaging.com/products/irs/>



| | <u>LISS-IV</u> | <u>LISS-III</u> | <u>AWiFS</u> |
|-----------------|----------------|-----------------|--------------|
| Sprectral bands | 0.52-0.59um | 0.52-0.59um | 0.52-0.59um |
| | 0.62-0.68um | 0.62-0.68um | 0.62-0.68um |
| | 0.77-0.86um | 0.77-0.86um | 0.77-0.86um |
| | | 1.55-1.70um | 1.55-1.70um |
| Resolution | 5.8m | 23.5m | 56m |
| Swath width | 23.9km/70km | 141km | 740km |
| Pointing (+/-) | 26 degrees | - | - |
| Revisit | 5 days | - | - |
| Actual revisit | 24 days | 24 days | 5 days |

SPOT

- SPOT 2 was launched on January 22, 1990; SPOT 4 was launched on March 24, 1998; and SPOT 5 was launched on May 4, 2002
- Orbital altitude/inclination: 822 km/98.7 degrees
- Nodal crossing: 10:30 a.m.
- System life: 3 and 5 years for SPOT 2, and SPOT 4 and 5, respectively
- Instruments on each satellite
 - ◆ **SPOT 2 - High Resolution Visible (HRV)**
 - ◆ **SPOT 4 - High Resolution Visible Infra Red (HRVIR)**
 - ◆ **SPOT 5 - High Geometric Resolution (HRG)**
- Single user price of geometrically (systematic) corrected archive scene (systematic) ranges from \$2,400 (10m/20m) to over \$10,000 (2.5m color)
- Website: <http://www.spotimage.fr/>



| | <u>HRV</u> | <u>HRVIR</u> | <u>HRG</u> |
|-----------------|-------------|--------------|-----------------|
| Sprectral bands | 0.50-0.73um | 0.61-0.68um | 0.48-0.71um |
| | 0.50-0.59um | 0.50-0.59um | 0.50-0.59um |
| | 0.61-0.68um | 0.61-0.68um | 0.61-0.68um |
| | 0.78-0.89um | 0.78-0.89um | 0.78-0.89um |
| | | 1.58-1.75um | 1.58-1.75um |
| Resolution | 10m/20m | 10m/20m | 2.5m/5m/10m/20m |
| Swath width | 60km | 60km | 60km |
| Pointing (+/-) | 27 degrees | 27 degrees | 27 degrees |
| Revisit | 2-3 days | 2-3 days | 2-3 days |
| Actual revisit | 26 days | 26 days | 26 days |



Available Spectral Satellite Systems



Quickbird



Imagery Type: E/O, Pan, MSI
Nationality: USA
Spatial Res: 0.61m Pan
2.4m - 4 x Band MSI
Swath Width: 16.5km
Revisit Time: 3-4 Days
Cost /km²: \$18-35



IKONOS



Imagery Type: E/O, Pan, MSI
Nationality: USA
Spatial Res: 1 m Pan
4m - 4 x Band MSI
Swath Width: 11km
Revisit Time: 2-3 Days
Cost /km²: \$18-35



EROS A1



Imagery Type: E/O Pan
Nationality: Israel
Spatial Res: 1.8m Pan
Swath Width: 12.5km
Revisit Time: 1-2 Days
Cost /km²: \$9.60



SPOT 5



Imagery Type: E/O, Pan, MSI
2 x CCDs (Sensors)
Nationality: France
Spatial Res: 2.5 m & 5m Pan
10m 3 x Band MSI
20m SWIR Band
1km Vegetation
Swath Width: 60-120km
Revisit Time: 2-3 Days
Cost /km²: \$1-3



DOE-MTI



Imagery Type: E/O MSI
Nationality: US Dept of Energy
Spatial Res: 5m 4 x Band MSI
20m 11 x Band MSI (S/LWIR)
Swath Width: 12km
Revisit Time: 7 Days
Cost /km²: Free



IRS 1C



Imagery Type: E/O Pan MSI
Nationality: India
Spatial Res: 6m Pan
23m 3 x Band MSI
71m 1 x Band MWIR
Swath Width: 70km Pan
130km MSI MWIR
Revisit Time: 5 Days Pan
3 Days MSI
Cost /km²: \$0.13 - 0.51



SPOT 1,2,4



Imagery Type: E/O Pan MSI
Nationality: France
Spatial Res: 10m Pan
20m 4 x Band MSI (Vis)
20m 1 x Band SWIR
(SPOT 4, only)
1km 1 x "Veg Band"
(SPOT 4, only)
Swath Width: 60-120km
Revisit Time: 1-2 Days
Cost /km²: \$0.43-0.81



EO1-ALI



Imagery Type: E/O, MSI
Nationality: USA NASA
Spatial Res: 10m PAN
30m 9 x Band MSI
Swath Width: 37 km
Revisit Time: 14 Days
(Co-Fly 1 min behind LANDSAT 7)
Cost /km²: \$0.90



Terra EOS AM-1 (ASTER)



Imagery Type: E/O, MSI
Nationality: USA NASA
Japan NASDA
Spatial Res:
15m 3 x Band MSI (VNIR)
30m 6 x Band MSI (V/MWIR)
90m 5 x Band MSI (M/LWIR)
Swath Width: 60km
Revisit Time: 16 Days
Cost: \$0.02



LANDSAT 7



Imagery Type: E/O, Pan, MSI
Nationality: USA NASA
Spatial Res: 15m Pan
30m 6 x Band MSI
60m 1 x Band LWIR
Swath Width: 185 km
Revisit Time: 14 Days
Cost /km²: \$0.19



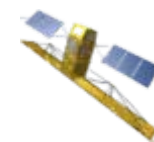
EO1-Hyperion



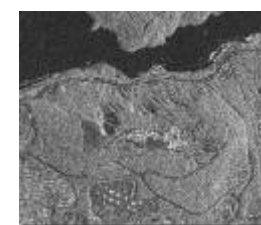
Imagery Type: E/O, HSI
Nationality: USA NASA
Spatial Res: 30m 220 x Band HSI
(V/SWIR)
Swath Width: 7.5 km
Revisit Time: 14 Days
(Co-Fly 1 min behind LANDSAT 7)
Cost /km²: \$1.77 - 2.67



RADARSAT



Imagery Type: Synthetic Aperture Radar (SAR)
Nationality: Canada
Spatial Res: 8-100m (User Select)
Swath Width: 50-500km
Revisit Time: 3 Days
Cost /km²: \$0.40 - 1.20



Mid-Resolution Scene Coverages

| Satellite | Sensor | Scene size (cross) | Scene size (along) | Ration of scene size (cross) - instrument/Landsat |
|---------------|--------------|-----------------------|-----------------------|---|
| EO-1 | ALI | 37 | 185 | 0.22 |
| Terra | Aster - VNIR | 60 | 60 | 0.35 |
| Terra | Aster - SWIR | 60 | 60 | 0.35 |
| Terra | Aster - TIR | 60 | 60 | 0.35 |
| SPOT 5 | HRG | 60 | 60 | 0.35 |
| SPOT 5 | HRS | 60 | 60 | 0.35 |
| ALOS | AVNIR | 70 | 70 | 0.41 |
| RapidEye | REIS | 80 | 80 | 0.47 |
| CBERS-1,2,2A | IRMSS | 120 | 120 | 0.70 |
| CBERS-3,4 | IRMSS | 120 | 120 | 0.70 |
| CBERS-3,4 | MUXCAM | 120 | 120 | 0.70 |
| ResourceSat-1 | LISS III+ | 141 | 141 | 0.82 |
| Landsat 7 | ETM+ | 172 | 185 | 1.00 |
| Landsat 5 | TM | 172 | 185 | 1.00 |
| ResourceSat-1 | AWiFS | 350 | 350 | 2.03 |
| DMC | MSDMC | 600 | 600 | 3.49 |
| CBERS-3,4 | WFI-2 | 866 | 866 | 5.03 |
| CBERS-1,2,2A | WFI-1 | 890 | 890 | 5.17 |

WGISS Test Facility (WTF) Update

Accomplishments

- Added Bondville and ARM-CART Southern Great Plains sites for CEOP
- Added MODIS LAI products for all sites
- Added CHRIS/Proba data for 6 sites
- Added MERIS data for 4 sites
- SRTM data available for all sites
 - DTED-2 for U.S., DTED-1 for non-U.S.
- Disaster Monitoring Constellation (DMC) data available for Railroad Valley