

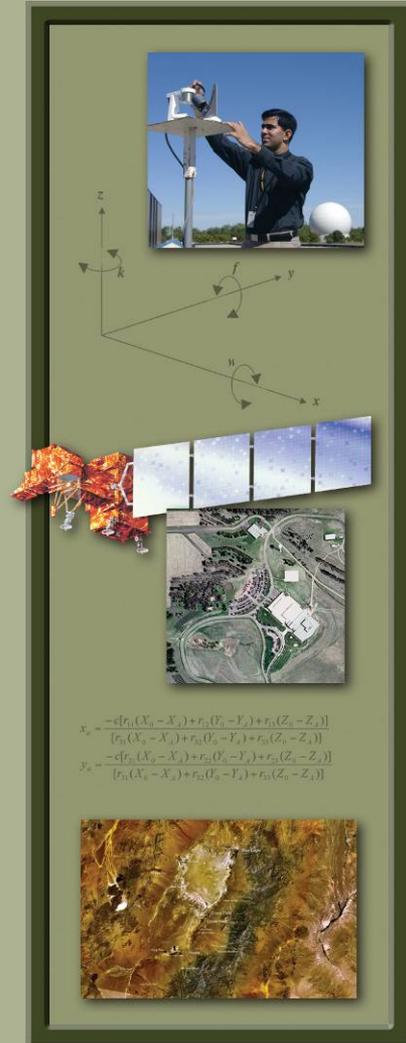
Coordination Overview

October 2009

Remote Sensing Technologies (RST) Project

<http://calval.cr.usgs.gov/>

Greg Stensaas, stensaas@usgs.gov

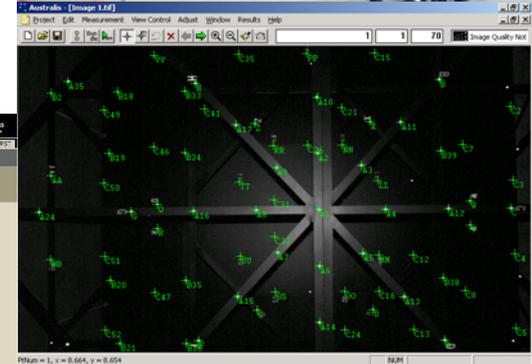


Remote Sensing Technologies Project Characterization Tasks

- **Satellite Characterization and Calibration**
 - ◆ US system calibration and characterization group
 - ◆ Joint Agency Commercial Imagery Evaluation (JACIE) Team
 - ◆ Remote Sensing System data assessment
- **Aerial Mapping Sensor Characterization and Calibration**
 - ◆ Film Camera Calibration
 - ◆ Small/Medium Format Digital Camera Calibration
 - ◆ Digital Aerial System Product Characterization
 - ◆ In situ calibration for analog and digital sensors
 - ◆ USGS Quality Assurance Plan for Digital Aerial Imagery
- **Range Characterization and Calibration Sites**
- **Ground Instrumentation Sites**
- **Assessment of Remote Sensing Technologies**
- **Commercial Data Acquisition and Management**

USGS Calibration, Characterization, and Image Quality Assurance

- USGS has a strong history of sensor calibration (Landsat and Photography)
- USGS Optical Sciences Lab (OSL)
 - ◆ Responsible for calibration services for film camera in U.S. since '73
- ASPRS panel of experts >> USGS should address digital aerial sensor and satellite calibration processes (2000)
 - ◆ Interagency Digital Imagery Working Group (IADIWG)
- U.S. Digital Camera Calibration responsibilities centered at USGS (2002) <http://calval.cr.usgs.gov/>
 - ◆ Validating Laboratory and *In-Situ* calibration methods
 - ◆ Establishing Calibration Processes and Guidelines
 - ◆ USGS Plan for Quality Assurance of Digital Aerial Imagery
- Successful Joint Agency Commercial Imagery Evaluation (JACIE) 8th Annual Workshop
 - ◆ Workshop information @ <http://calval.cr.usgs.gov/jacie.php>
 - ◆ Aerial and Satellite
 - ◆ Characterization & Application
 - ◆ International Scope
- Catalog of Worldwide test sites
 - ◆ http://calval.cr.usgs.gov/sites_catalog_map.php



Civil Commercial
Imagery Evaluation
Workshop



USGS Calibration, Characterization, and Image Quality Assurance

USGS Plan for Quality Assurance of Digital Aerial Imagery

- **Manufacturer Sensor Type Certification**

- ◆ Working with International Partners to establish a common practice
- ◆ Canada, Asia, Europe (EuroSDR), Australia, ...

- **Data Provider Product Certification**

- ◆ Developing Cal/Val Range Stds. & 6 National Ranges
- ◆ Dual use for hi-res ortho & satellite, & LiDAR cal/val

- **Image Quality Guidelines and Processes**

- ◆ Spec and Check Tool development
- ◆ Contracting and QA guidelines



Spec development and QA check tool



USGS EROS Lidar derived 3D image map



USGS Cal/Val Basemap range: hi res image and LiDAR data



Geometric Targets and Control

Landsat Data Gap Study Team (LDGST)

- The Earth observation community is facing a probable gap in Landsat data continuity before LDCM data arrives
- A data gap will interrupt a 34+ yr time series of land observations
- **LANDSAT DATA GAP STUDY- Technical & Implementation Report**
Initial Data Characterization, Science Utility and Mission Capability Evaluation of Candidate Landsat Mission Data Gap Sensors



Landsat Data Gap Study Team Activities

Gregory S. Brown, USGS; Cynthia Chantre, Jet Propulsion Lab; SAIC; David Clark, USGS Center for EOS
(with permission from Greg S. Brown, SAIC/USGS)

Landsat Data Gap Background

The Landsat suite of satellites has collected the longest continuous archive of multi-spectral data of any land-observing space program. From the Landsat program's inception in 1972 to the present, the Earth science user community has benefited from a historical record of remotely sensed data. The archive of Landsat data constitutes the longest continuous record of satellite-based observations and, as such, is an invaluable resource for monitoring global change and the use of Earth observations in decision making tools that benefit society. Potentially, the capabilities of currently operational Landsat satellites will be lost before the launch of the follow-on Landsat Data Continuity Mission (LDCM), thus producing a gap in the Landsat data record and the National Satellite Land Remote Sensing Data Archive (NSLRSDA).

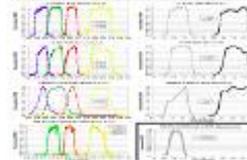


Landsat Data Gap Study Team

In anticipation of a gap, the federal agencies responsible for Landsat program management, National Aeronautics and Space Administration (NASA) and Department of Interior (DOI) U.S. Geological Survey (USGS), convened a Landsat Data Gap Study Team (LDGST). The Study Team assessed the basic characteristics of multiple systems and identified sensors aboard the China-Brazil Earth Resources Satellite (CBERS-2), and the Indian Remote Sensing (IRS-P6) Resource Sat-1 satellite as the most promising sources of Landsat-like data. The sensors include the combination of CBERS-2 Infrared Multi-spectral Scanner (IRMSS) and High Resolution Charged Coupled Device (HRCCD), as well as the IRS-P6 Advanced Wide Field Sensor (AWIFS) and IRS-P6 Linear Imaging Self Scanning Sensor (LISS-III).



Relative Spectral Response (RSR) Profiles



USGS Earth Resources Laboratory
RL/Earth Resources

China-Brazil Earth Resources Satellite (CBERS-2)

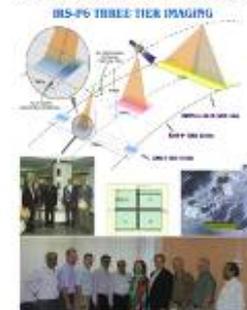
The second China-Brazil Earth Resources Satellite (CBERS-2) was launched in October 2003. The spacecraft carries identical payload as CBERS. It carries three remote sensing instruments: the High Resolution CCD Camera (HRCCD), the Infrared Multi-spectral Scanner (IRMSS), and the Wide Field Imager (WFI). The CCD camera and the WFI operate in the VNIR regions, while the IRMSS mainly operates in the SWIR. The three instruments are used together to provide images with different resolution and coverage.



Instrument	Resolution	Swath	Revisit
HRCCD	2.5m	140km	1 day
IRMSS	30m	140km	1 day
WFI	250m	140km	1 day

ResourceSat-1 (IRS-P6)

The Indian Remote Sensing ResourceSat-1 satellite (IRS-P6) is a three-axis body-stabilized satellite. It has an operational life of five years, in a near-polar, Sun-synchronous orbit, at a mean altitude of 817km. Its payload consists of three sensors: Medium Resolution Linear Imaging Self-Scanner (LISS-III), Advanced Wide Field Sensor (AWIFS), and a high-resolution multi-spectral Linear Imaging Self-Scanner camera (LISS-IV). All three sensors work on the 'push-broom scanning' concept, using linear arrays of Charge Coupled Devices (CCDs). In this mode of operation, each line of image is electronically scanned and contiguous lines are imaged by the forward motion of the satellite. Unique to the ResourceSat-1 is that these three sensors with different resolutions and swath widths are on the same platform.



LISS-IV

Instrument	Resolution	Swath	Revisit
LISS-III	235m	1410km	1 day
AWIFS	560m	1410km	1 day
LISS-IV	5.6m	1410km	1 day



Landsat Cross-calibration Activities

- **Recently completed or continuing Cross-calibration Activities**

- ◆ L7 ETM+ and L5 TM sensor
- ◆ L5 TM and L4 TM sensor
- ◆ L7 ETM+/L5 TM and EO-1 ALI sensor
- ◆ L7 ETM+/L5 TM and Terra MODIS sensor
- ◆ L7 ETM+/L5 TM and IRS-P6 AWiFS/LISS-III sensor
- ◆ L7 ETM+/L5 TM and CBERS-2A CCD sensor
- ◆ L7 ETM+/L5 TM and ALOS AVNIR-2 sensor

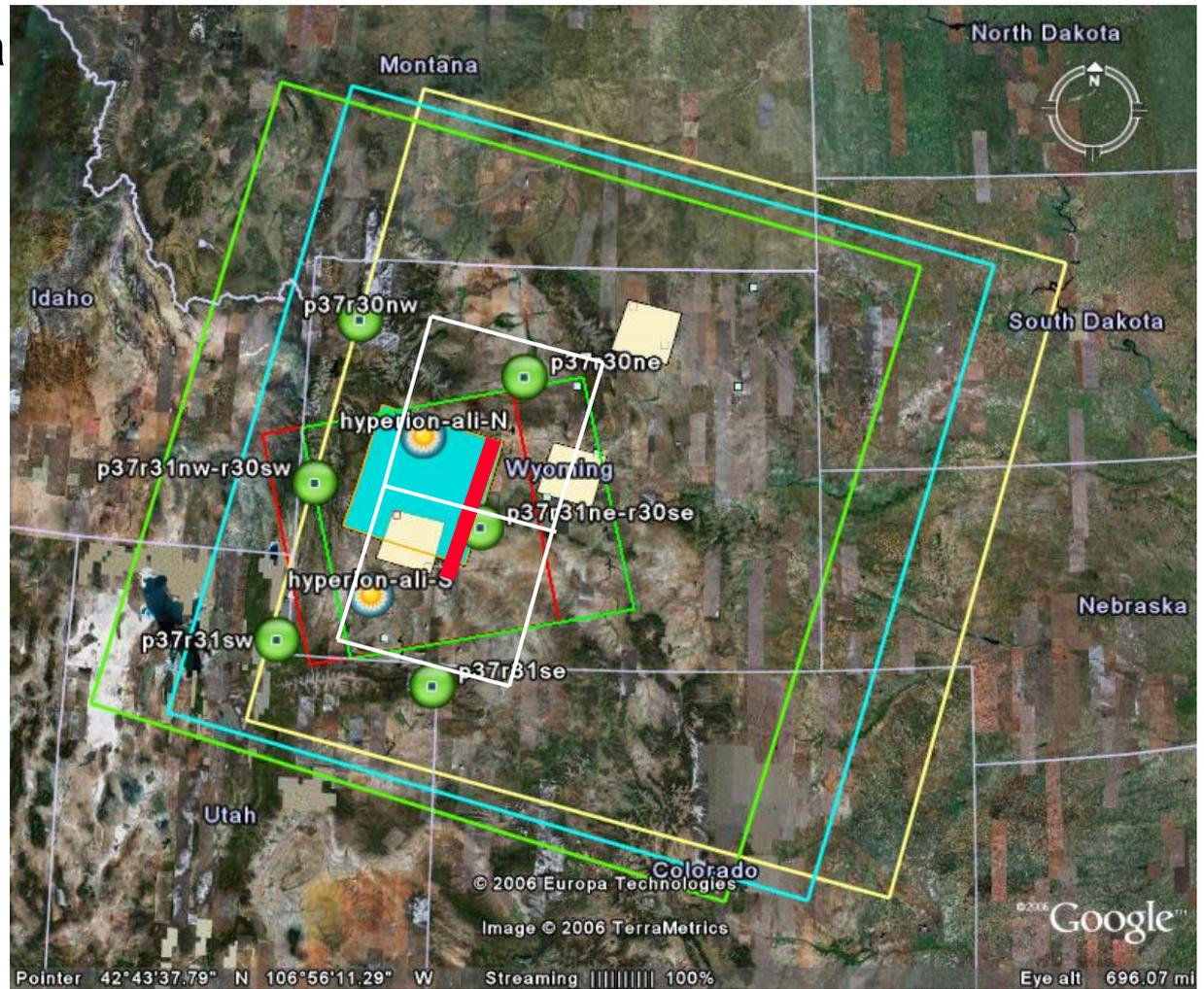
- **On-going or planned Cross-calibration Activities with L7 and L5**

- ◆ Beijing1, CBERS-2B, DMC, THEOS, ResourceSat, RapidEye, SPOT
- ◆ QuickBird, Worldview, GEOEYE, TopSat
- ◆ AVHRR MetOP, ENVISAT MERIS, MODIS
- ◆ ASTER DEM, Cartosat-1 and -2

Multiple Satellites Used in Science

- Example of data to support Sagebrush study in Wyoming, USA
Data included:

- ◆ Landsat-5
- ◆ Landsat-7
- ◆ EO-1 ALI
- ◆ EO-1 Hyperion
- ◆ ASTER
- ◆ IRS AWiFS
- ◆ IRS LISS-III
- ◆ Surrey DMC
- ◆ DG QuickBird



Civil Commercial Imagery Evaluation Workshop



- **Joint Agency Commercial Imagery Evaluation (JACIE) 8th Annual Workshop held March 31-April 2, 2009 @ Fairfax Marriott, Fairfax, VA**
 - ◆ NASA, NGA, NOAA, USGS, USDA Collaboration
 - ◆ Next workshop – March 16, 2010 in Fairfax, VA request for abstract is out
- **Workshop information @ <http://calval.cr.usgs.gov/jacie.php>**
 - ◆ Enhanced scope to **medium resolution Satellite & Aerial sensors** useful to the remote sensing community – U.S. and International systems
 - ◆ Request for a short Lidar and SAR session
- **Independent assessment of product quality and usability**
- **New applications and understanding of remotely sensed data**

System Characterization and Calibration

- Lead/Host 2009 JACIE Conference with NGA and USDA
 - ◆ NOAA and NASA participants
 - ◆ JACIE process evolving to support a National role
- Assess data from JACIE selected systems
 - ◆ Characterize systems key to USGS LRS and National Science
 - ◆ Stay abreast of technologies and rapidly changing field
 - ◆ Arrange test downlinks, analysis of potential Multi-Mission Data and Landsat Data Gap planning (future work to be funded separately)
- Continue key work already begun to harmonize data quality internationally
 - ◆ CEOS/GEOS support
 - ◆ CEOS WGCV Leadership and involvement
 - ◆ NASA LCLUC is a great tie to system characterization work

Land Cover Land Use Change Proposal

- The Remote Sensing Technologies (RST) project successful in getting the grants from NASA ROSES Grant from May 2008-April 2010
- Research titled “Cross-calibration of the current Landsat sensors with foreign Landsat-class sensors for long-term monitoring of land surface processes”
- Interdisciplinary group of researchers from the USGS EROS, NASA GSFC, and South Dakota State University (SDSU)
- Extend theoretical and applied understanding of radiometric cross-calibration of multiple sensors in support of continued long-term studies of the Earth





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Remote Sensing Technologies - Satellite

Test Site Catalog

Catalog of World-wide Test Sites for Sensor Characterization

In an era when the number of Earth-observing satellites is rapidly growing and measurements from these sensors are used to answer increasingly urgent global issues, it is imperative that scientists and decision makers rely on the accuracy of Earth-observing data products. The characterization and calibration of these sensors are vital to achieve an integrated Global Earth Observation System of Systems (GEOSS) for coordinated and sustained observations of Earth. The U.S. Geological Survey (USGS), as a supporting member of the Committee on Earth Observation Satellites (CEOS) and GEOSS, worked with partners around the world to establish an online Catalog of prime candidate worldwide test sites for the post-launch characterization and calibration of space-based optical imaging sensors. The online Catalog provides easy public Web site access to this vital information for the global community. Through greater access to and understanding of these vital test sites and their use, the validity and utility of information gained from Earth remote sensing will continue to improve. ([More Info...](#))

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Click on Continent of Interest:

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Test Sites Gallery



Remote Sensing Technologies - Satellite

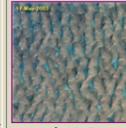
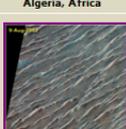
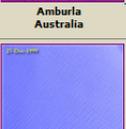
Test Site Gallery

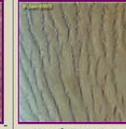
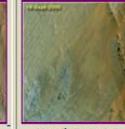
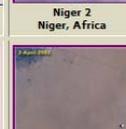
Gallery of Images for the Radiometry Sites

Choose A Radiometric Site ▾

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 Algeria 1 Algeria, Africa	 Algeria 2 Algeria, Africa	 Algeria 3 Algeria, Africa	 Algeria 4 Algeria, Africa	 Algeria 5 Algeria, Africa
 Amburla Australia	 Arabia 1 Arabia, Middle East	 Arabia 2 Arabia, Middle East	 Barreal Blanco South America	 Bonneville USA, North America
 Dome C Antarctica	 Dunhuang China	 Dunrobin Australia	 Egypt 1 Egypt, Africa	 Egypt 2 Egypt, Africa
 Ivanpah USA, North America	 La Crau Europe	 Lake Frome Australia	 Libya 1 Libya, Africa	 Libya 2 Libya, Africa
 Libya 3 Libya, Africa	 Libya 4 Libya, Africa	 Lspec USA, North America	 Lunar Lake USA, North America	 Makhtesh Ramon Israel, Asia

 Mali 1 Mali, Africa	 Mauritania 1 Mauritania, Africa	 Mauritania 2 Mauritania, Africa	 Namib Desert 1 Namibia, Africa	 Namib Desert 2 Namibia, Africa
 Negev Israel, Asia	 Niger 1 Niger, Africa	 Niger 2 Niger, Africa	 Niger 3 Niger, Africa	 Railroad Valley USA, North America
 Rogers Dry Lake USA, North America	 Secura Desert Peru, South America	 Sonoran Desert North America	 Sudan 1 Sudan, Middle East	 Taklamakan Desert Xinjiang, China
 Tinga Tingana Australia	 Tuz Golu Turkey, Asia	 Uyuni Salt Flats South America	 Warrabin Australia	 White Sands USA, North America
 Winton Australia	 Yemen 1 Yemen, Middle East			

Instrument Farm Sensors

- CORS: Constantly Operating Reference Station: National Geodetic Survey/NOAA
- GSOS: GPS Surface Observing System: Forecast Systems Lab/NOAA
- SURFRAD: Surface Radiation Budget Network: Surface Radiation Research Branch/NOAA
- CRN: Climate Reference Network: National Climatic Data Center/NOAA
- SCAN: Soil Climate Analysis Network: Natural Resources Conservation Service/USDA
- CIMEL Sun Photometer - **AERONET (AERosol RObotic NETwork)**
- Carbon Flux Towers owned by EROS
- USGS Seismologic station
- New Canadian Reference Climate Station (RCS) Network
- NEON support (very limited due to funding)
- Only site in the US with more than 4 networks (8 networks)

Implementing the Commercial Remote Sensing Space Policy (CRSSP)

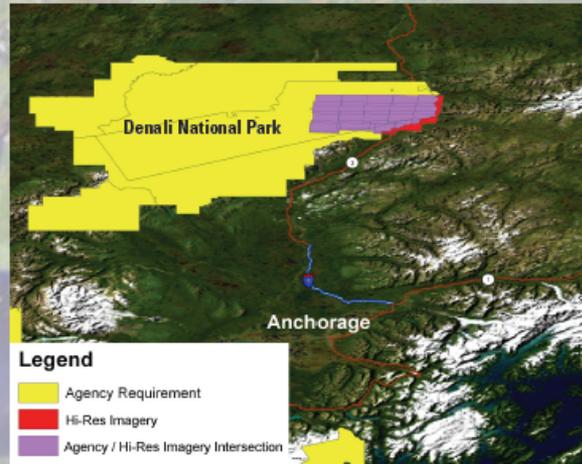
Helping Federal Users Get the Imagery They Need

Federal users needing aerial or satellite imagery enter their requirements into the web-accessed CRSSP Imagery Derived Requirements (CIDR) tool. (<http://cidr.cr.usgs.gov>)

The requirements are then analyzed by USGS staff. The CIDR database is used to find potential agency/interagency partnerships. USGS and NGA commercial imagery holdings (as well as commercial vendors) are searched for existing imagery that may meet the users' requirements.

Federal users are informed of how to obtain existing data and/or potential partnerships.

If imagery does not exist, users can procure the data from commercial vendors through contracts such as the USGS Commercial Remote Sensing Data Contracts.



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If new imagery is acquired, users are encouraged to share the imagery with other federal agencies by providing a copy to the USGS. (The USGS acts as a clearinghouse for commercial imagery.)

New Technologies Assessment

- **Aerial system sensor and data assessment**
 - ◆ NDOP technology briefings
 - ◆ Joint camera and LiDAR cal/val process (IFTN/LFTN)
 - ◆ Need more aerial remote sensing for system and science application assessments
 - ◆ Potential for UAV sensor assessments
- **Potential remote sensing data alternatives**
 - ◆ Trying to maintain understanding of all satellite datasets
 - ◆ Strong push for hyperspectral and SAR data characterization and integration
- **Satellite cross calibration and data integration**
 - ◆ Need university technology grants
- **GEO DA-09-01 - CEOS WGCV QA4EO Quality Assurance Guidelines**
- **Working with ASPRS Primary Data Acquisition Division and Standards committee**
 - ◆ PDAD has digital aerial quality assurance committee

Common requirements, joint efforts

- a. Joint System and Production Quality Assessment
- b. Hardware, Software, and Data Component requirements
- c. Range Support
- d. Image Assessment tools
- e. Calibration of long focal length digital camera lenses
- f. Additional research requirements

