

# Landsat and LDCM Status

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# Landsat Data Continuity Mission

L A N D S A T   D A T A   C O N T I N U I T Y   M I S S I O N



*Extending the legacy of global land observation*

- **LDCM Goal:** LDCM is a science mission that will continue the acquisition, archival, and distribution of multi-spectral imagery affording global, synoptic, and repetitive coverage of the Earth's land surfaces at a scale where natural and human-induced changes can be detected, differentiated, characterized, and monitored over time.



# Major LDCM Mission Characteristics

- 5 year mission design life with 10 years of consumables
- Support seasonal, global, image data collection (Similar to Landsat 7)
- World Reference System – 2 (WRS-2), mid-morning equatorial crossing, 16 day repeat
- Collect, ingest, and archive at least 400 global WRS-2 scenes/day for U.S. archive
- 30 m GSD for VIS/NIR/SWIR, 15m GSD for PAN
- 9 spectral bands
- Instrument data will be quantized in 12-bits



# Major LDCM Mission Characteristics

- Provide “standard”, orthorectified data products within 24 hours of observation
  - Products available via the web at no cost
- Data calibration consistent with previous Landsat missions
- Continue International Cooperator (IC) downlinks
- Support priority imaging and a limited off-nadir collection capability (+/- one path/row)
  
- **LDCM launch planned for July 2011**
  - **Followed by 90 day on-orbit checkout and acceptance**



# LDCM is a NASA /USGS Partnership

- NASA will:
  - Acquire the space segment, mission operations systems, and launch services
  - Perform overall mission systems engineering and integration
  - Manage space segment early on-orbit evaluation phase - from launch to acceptance
- USGS will:
  - Acquire and operate the ground system including data networks, image collection scheduling, archive, processing, and distribution systems
  - Perform ground system integration and support mission integration
  - Operate and maintain the LDCM mission following on-orbit acceptance
  - Co-chair and fund the Landsat Science Team

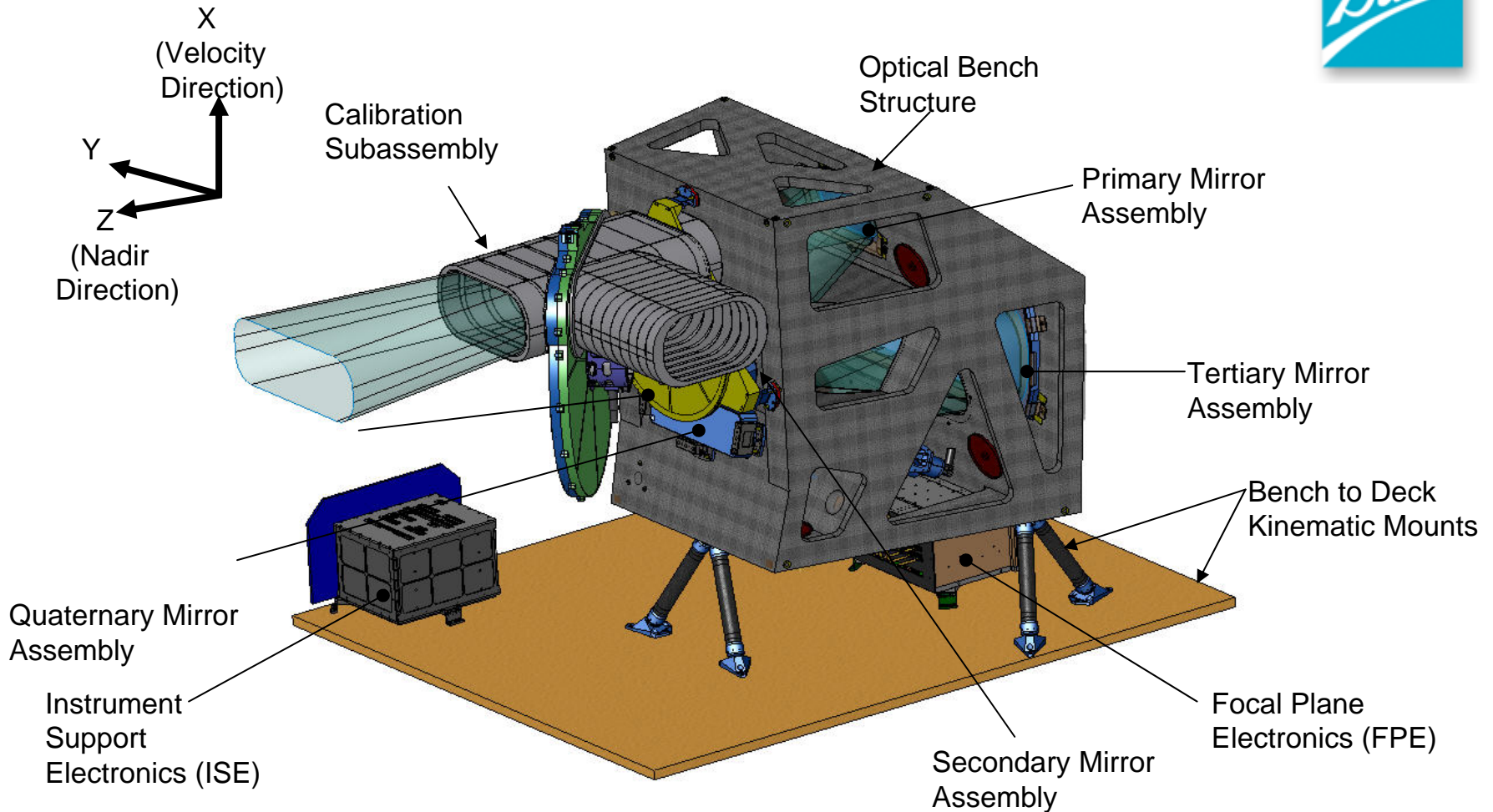


# Status of Major LDCM Components

Component	Lead	Comments
Instrument: Operational Land Imager (OLI)	NASA	Awarded to Ball Aerospace, Summer 2007
Launch Vehicle	NASA	Lockheed Launch Services for an Atlas V, Fall 2007
Spacecraft	NASA	General Dynamics Advanced Information Systems, Inc., April 2008
Mission Operations	NASA	RFP for command/control, scheduling, long-term trending/analysis, and flight
Flight Operations	USGS	RFP for on-orbit mission operations
Ground System	USGS	Design reviews underway for the overall ground system, data processing, archive, and user portal segments



# OLI Instrument



- Pushbroom VIS/NIR/SWIR sensor
- Four mirror telescope with front aperture stop
- Focal plain assembly consists of 14 passively cooled sensor chip assemblies





# LDCM-Landsat 7 Spectral Bands Compared

LDCM Operational Land Imager (OLI)		
Band Number	Wavelength (μm)	Resolution (m)
8 (pan)	.500-.680	15
1*	.433-.453	30
2	.450-.515	30
3	.525-.600	30
4	.630-.680	30
5	.845-.885	30
9**	1.360-1.390	30
6	1.560-1.660	30
7	2.100-2.300	30

Landsat 7 ETM+		
Band Number	Wavelength (μm)	Resolution (m)
8 (pan)	.52-.90	15
1	0.45-0.52	30
2	0.53-0.61	30
3	0.63-0.69	30
4	0.78-0.90	30
5	1.55-1.75	30
7	2.09-2.35	30
6 (thermal)	10.40-12.50	60

\* New Deep Blue Band  
 \*\* New Cirrus Band



*OLI does not include thermal imaging capabilities*



# LDCM Standard L1T

- Standard Product
  - TOA reflectance
  - Precision and terrain corrected
  - 16-bit/OLI band
  - 16-bit QC band
  - Generated for all OLI data that can be processed to meet product specifications
  - Generated for all global acquisitions
  - Full resolution browse
  - Reprocessing – driven by algorithm, software, and/or calibration parameter file (CPF) update
    - Routine product generation of forward acquisitions
    - On-demand reprocessing of previously acquired



# LDCM Standard L1T\*

- Parameters based on maintaining consistency with heritage Landsat products
- Pixel size: 15m/30m
- Media type: Download (no cost)
- Product type: L1T (precision & terrain corrected)
- Output format: GeoTIFF
- Map projection: UTM
- Datum: WGS84
- Orientation: North up
- Resampling: Cubic convolution
- Accuracy ~12m 90% (CE) global



\* A L0R product will also be available  
– specs are TBD



# U.S. Landsat Archive Overview

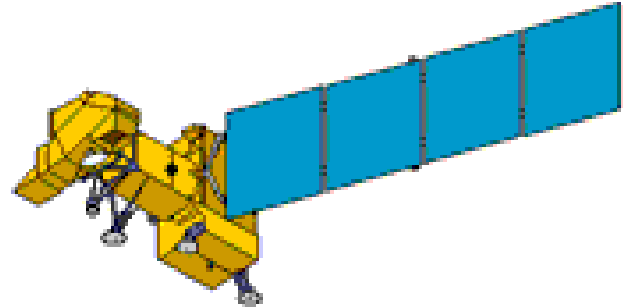
(Marketable Scenes through December 31, 2007)

- **ETM+:** Landsat 7
  - 786,700 scenes
  - 730TB RCC and L0Ra Data
  - Archive grows by 260GB Daily
- **TM:** Landsat 4 & Landsat 5
  - 734,627 scenes
  - 368TB of RCC and L0Ra Data
  - Archive Grows by 40GB Daily
- **MSS:** Landsat 1 through 5
  - 649,423 scenes
  - 19TB of Data



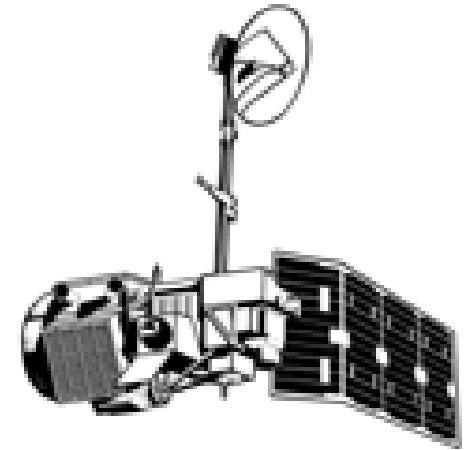
# Landsat 7 Status: Health and Safety

- MOC @ GSFC
- SLC-off
- Keeping an eye on:
  - Gyros
- Spacecraft
  - Gyro 3 Failure (Shut down May 5, 2004)
    - Working additional improvements for software gyro
  - Other Spacecraft Issues (non-critical)
    - Solid State Recorder – 4 memory boards
    - Electrical Power Subsystem – shunt #14 and shunt #6
    - Fuel Line Thermostat
- ETM+
  - Scan Line Corrector Failure (May 31, 2003)
  - Bumper Mode Operations (April 1, 2007)
- Projected mission end – December 2010 (under evaluation)

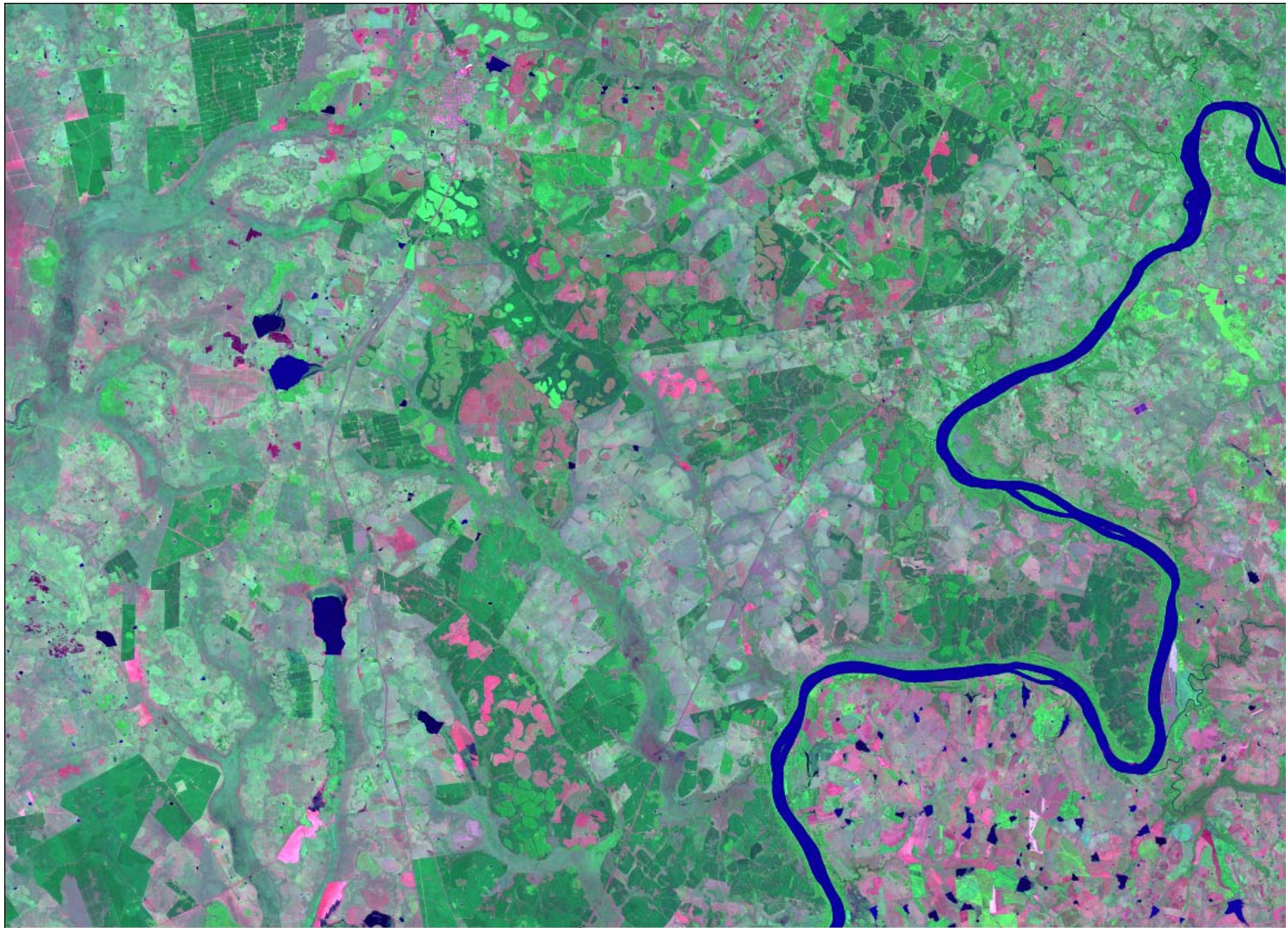


# Landsat 5 Status: Health and Safety

- MOC @ Columbia, MD
- Fixed array operations
- International Cooperators 's fully supported
- Keeping an eye on:
  - Fixed Array/Power/Battery
  - Transmitter
  - Star Tracker
- Spacecraft Condition
  - Battery 2 Anomaly – Oct 2007
  - Star Tracker Issue – June 2007
  - Solar Array Drive
    - Fixed array operations – Aug 2006
- TM Condition
  - Functioning normally in bumper-mode
- Without mechanical failures, Landsat 5 is expected to deplete its fuel reserves around September, 2010.







January 10, 2008 Landsat 5 Acquisition over Argentina/Brazil

# Updated Landsat Data Policy -

- Revised Landsat data policy approved by USGS and NASA in January 2008
  - “In accordance with OMB Circular A-130, USGS Data Policy, and in compliance with the cost of fulfilling user requests (COFUR), **unenanced, pre-selected Landsat data products are provided by the USGS for retrieval via the Internet at no charge to users.** Other Landsat products that may be ordered by users from the NSLRSDA are provided at no more than COFUR.”





# What the new policy means...

- All Landsat data (archive and new acquisitions) will be available to anyone at no charge by January 2009.
- Phased implementation:
  - July 2008 - All new global Landsat 7 ETM+ acquisitions will be available at no charge (North America and Africa new acquisitions are already available)
  - September 30, 2008 – The full Landsat 7 ETM+ archive (since 1999)
  - December 2008 – All Landsat 5 TM data (since 1984 and including new acquisitions)
  - January 2009 – All archived Landsat 4 TM (1982-1985) and Landsat 1-5 MSS (1972-1994)
- In February 2009 when the entire Landsat archive can be ordered at no-charge, all data sales will end. At this point, only a L1T standard product can be obtained and there will only be electronic access – no media.



# Parameters of Standard L1T

- Parameters based on achieving consistency with Global Land Survey products
- Pixel size: 15m/30m/60m
- Media type: Download (no cost), CD/DVD (\$50)
- Product type: L1T (precision and terrain corrected)
- Geodetic Control: Global Land Survey 2005
- Terrain Correction: GLS DEM (best available from SRTM, NED, CDAD, DTED, GTOPO 30)
- Output format: GeoTIFF
- Map projection: UTM
- Datum: WGS84
- Orientation: North up
- Resampling: Cubic convolution
- Accuracy: ~30m RMSE (US), ~50m RMS (global)



# Free Landsat Data...

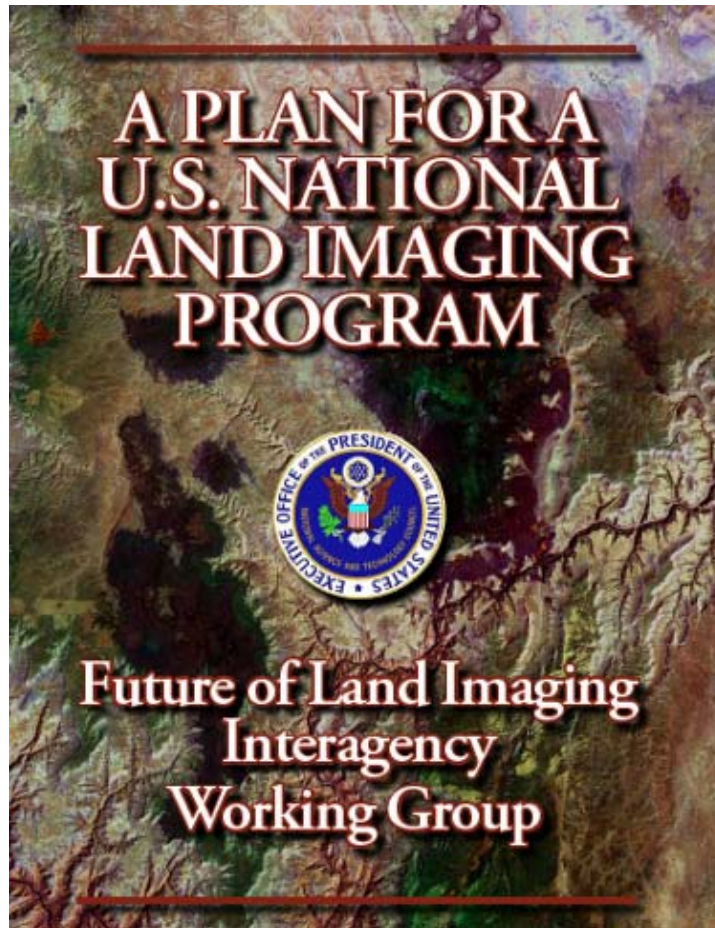
- Newly acquired Landsat 5 and 7 data with <20 percent cloud cover and 9 or above quality ratings will be automatically processed and placed on-line for downloading.
- Archive scenes and new acquisitions with higher cloud levels and lower quality will be available at no charge via an on-demand ordering and downloading capability.
- Decisions regarding data processed to TOA reflectance and provision of full spatial resolution browse are TBD.
- Landsat holding accessible via GloVis ([glovis.usgs.gov](http://glovis.usgs.gov)) or Earth Explorer ([earthexplorer.usgs.gov](http://earthexplorer.usgs.gov))



# Landsat Archive Calibration Strategy

- Use Landsat 7 as the anchor to calibration Landsats 1-5
  - Thematic Mappers
    - L5 TM to L7 ETM+
    - L4 TM to L5 TM
  - TM to MSS
    - L5 TM to MSS
    - L4 TM to MSS
  - L1 to L5 MSS
    - L4/5 MSS
    - L4 to L3 MSS – the critical step
    - L1 to L3 MSS – capturing the first decade

# National Land Imaging Program



1. The U.S. must commit to continue the collection of moderate-resolution land imagery.
2. The U.S. should establish and maintain a core operational capability to collect moderate-resolution land imagery through the procurement and launch of a series of U.S.-owned satellites.
3. The U.S. should establish the National Land Imaging Program, hosted and managed by the Department of the Interior, to meet U.S. civil land imaging needs.



# For More Information

- **Web sites**
  - **USGS - [landsat.usgs.gov](http://landsat.usgs.gov)**
  - **NASA – [ldcm.nasa.gov](http://ldcm.nasa.gov)**
- **Science and data questions:**
  - **Tom Loveland (USGS)**
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- Feng Gao, ERT, Inc
- Randy Wynne, Virginia Tech
- Mike Wulder, Canadian Forest Service
- Eileen Helmer, USFS
- Martha Anderson, USDA ARS
- Warren Cohen, USFS
- Bob Bindschadler, NASA
- Rama Nemani, NASA
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- Alan Belward, EC JRC
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