

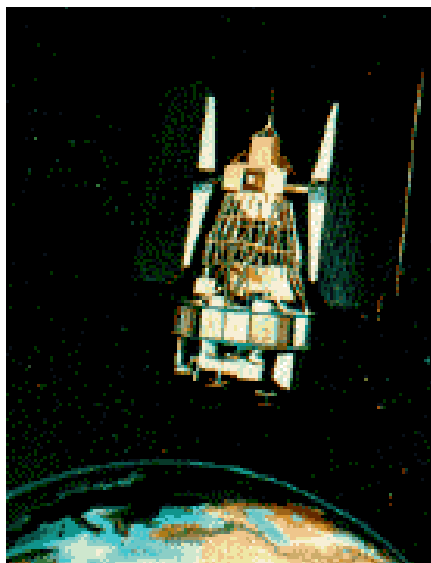
Update on Landsat Program and Landsat Data Continuity Mission

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NASA GSFC, Code 923

November 21, 2002

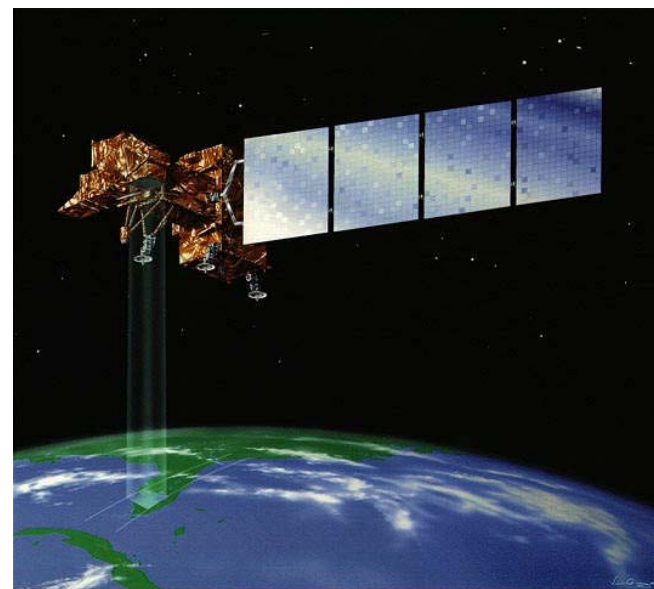
Celebrate!

LDCM


- 1 July 23, 1972
- 2, January 22, 1975
- 3, March 5, 1978



- 4, July 16, 1982
- 5, March 1, 1984



-7, April 15, 1999

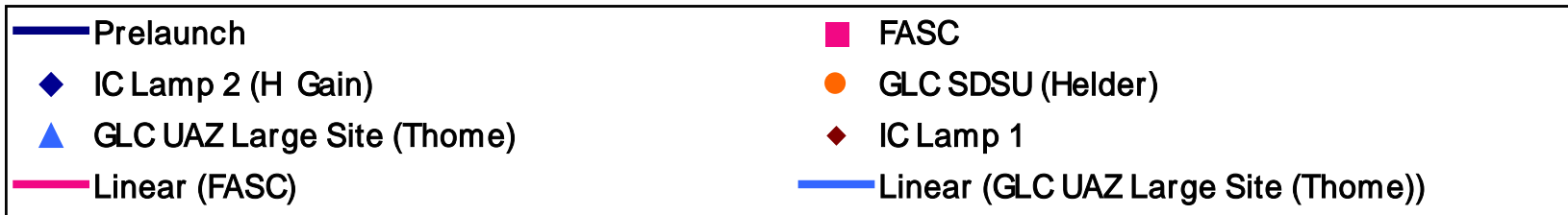
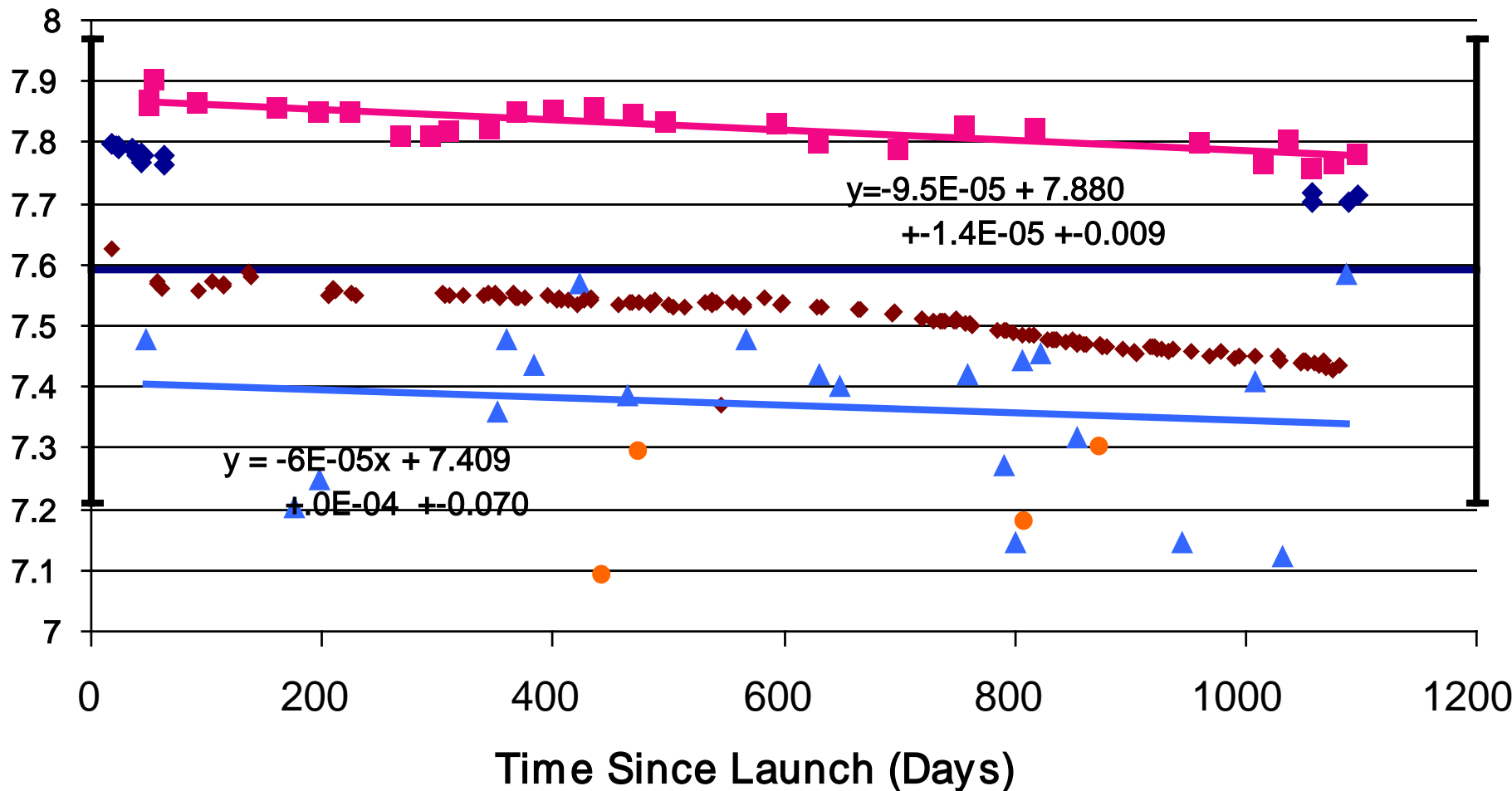
Landsat is 30 years old!
And Thematic Mapper is 20!



The title "Landsat-7 Mission Status" is centered at the top of the slide. To its left is a graphic of several overlapping, curved bands in shades of yellow, green, and blue, representing satellite data or orbits. The background of the slide features a faint world map.**LDCM**

- **Landsat-7 Spacecraft and ETM+ Instrument continue to perform well - no significant anomalies.**
- Since 1999, 270,000+ full scenes ingested into the US archive
- 47,000 scenes sold from the US archive
- ETM+ calibration stable to ~1% per year
- Absolute calibration accurate to $\pm 5\%$ at-sensor radiance
- Geodetic precision continues better than 50 meters RMS

Landsat-7 ETM+ Band 5 Radiometric Calibration Results Scaled to High Gain



Landsat-5 Status

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- **Landsat-5 TM (18+ years old!) continues acquiring imagery**
- 29,700 TM scenes added to US archive since July, 2001
- Landsat-5 now successfully operating in “Bumper Mode”...



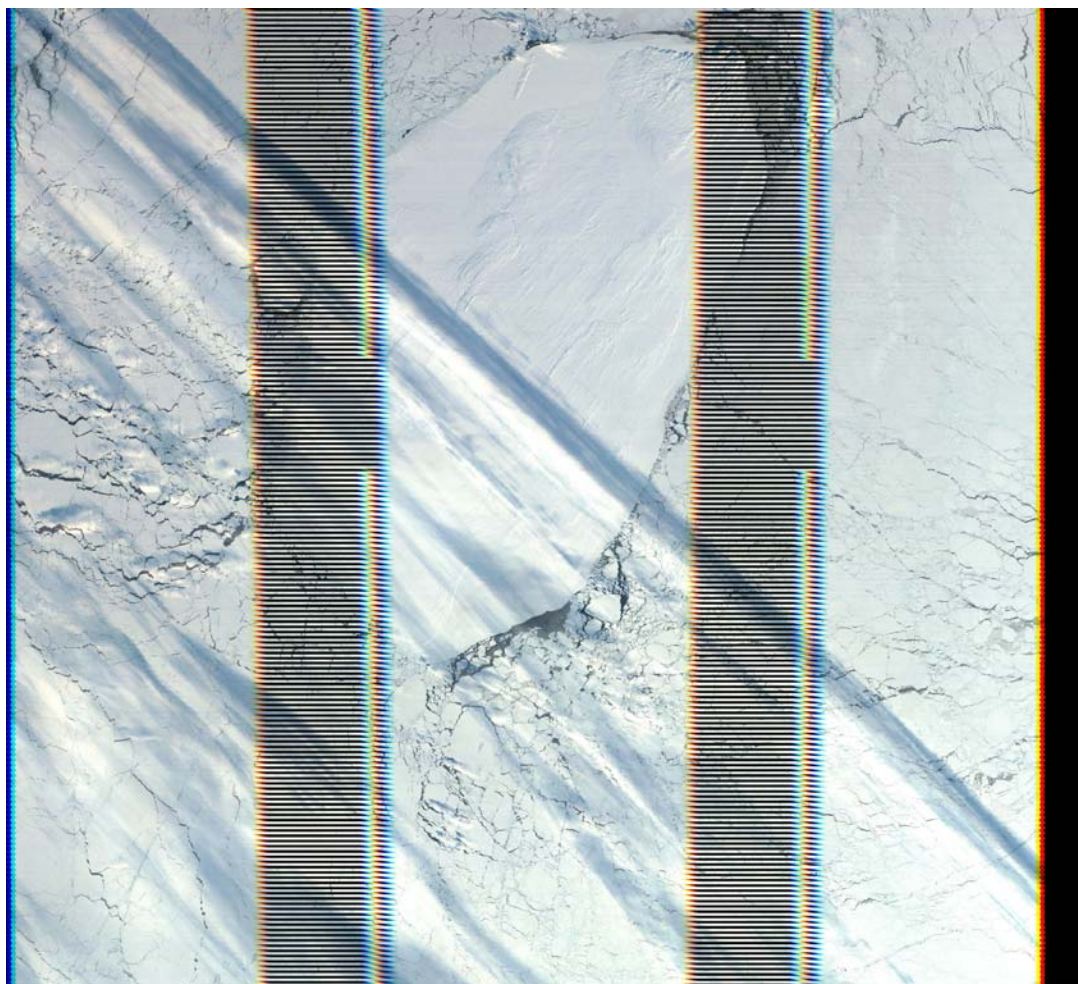


L5 TM Bumper Mode

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- L5 TM lost synchronization between scan mirror and calibration shutter in early 2002 - “caterpillar tracks” on imagery
- USGS switched the TM to backup bumper mirror mode to extend TM useful life
- Bumper mode geometric algorithms successfully developed, tested, and documented Mar–Jun 2002
 - Requires frequent scan mirror calibration update to track scan mirror behavior changes due to bumper wear

Loss of Mirror/Shutter Synch in SAM Mode

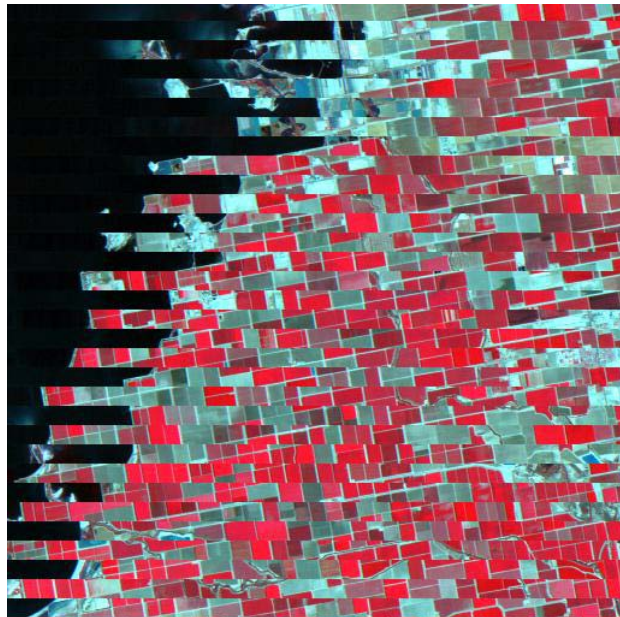
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- Scan mirror period grows until cal shutter can't slow down enough to maintain synch
 - Caused by scan mirror bumper wear
- Cal shutter obscures Earth-view scan
 - “Caterpillar Tracks” anomaly

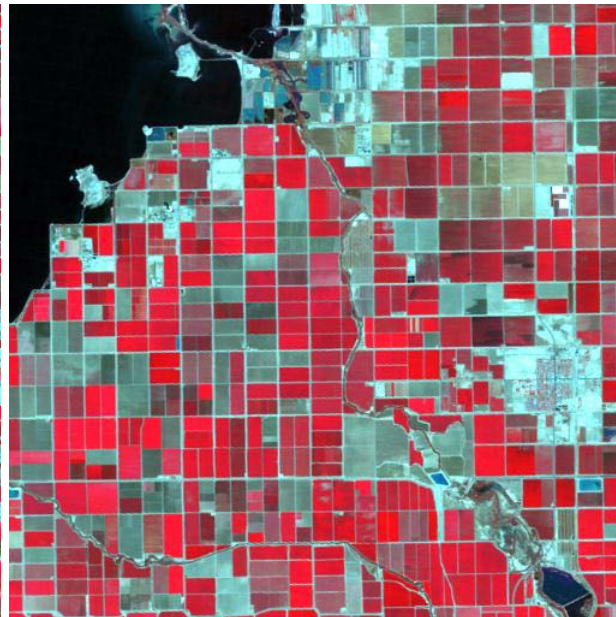
Bumper Mode Geometric Correction

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- Algorithms developed to geometrically calibrate and correct TM bumper mode data
 - <http://landsat7.usgs.gov/pdf/ATBD-BumperModel-v1-1.pdf>



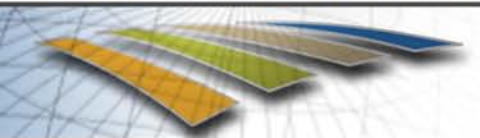
Uncorrected TM
Bumper Mode Data



Corrected TM Bumper
Mode Data



Corresponding ETM+
Data



Landsat Data Continuity Mission



Background

LDCM

- LDCM is the follow-on mission to Landsat 7
- NASA and the Dept. of Interior (DOI) / U.S. Geological Survey (USGS) are interagency partners in the LDCM
 - By virtue of an October, 2000 revision to a 1994 Presidential Decision Directive
- NASA and the DOI/USGS plan to implement the LDCM by procuring data from a **privately owned and privately operated** remote sensing system
 - In accordance with Congressional guidance and the Land Remote Sensing Policy Act of 1992 (PL 102-555)

Mission Objectives**LDCM**

- Provide continuity in the multi-decadal land use/land cover change measurements of the Landsat Program for scientific research
- Facilitate expansion of the commercial remote sensing marketplace and commercialization of Landsat data



Data Procurement Strategy

LDCM

- A two-step data procurement strategy has been implemented
- The first step is formulation with multiple contractors
 - An RFP for formulation studies was released in Nov., 2001
 - Called for the formulation of preliminary system designs
 - Two firm fixed-price contracts (\$5M each) were awarded in March, 2002
 - Resource 21 of Englewood, CO
 - DigitalGlobe of Longmont, CO
 - Formulation culminates with preliminary design reviews in Nov., 2002
- The second step is implementation
 - A single contract will be awarded for the acquisition and delivery of LDCM data for a five-year period (with a costed option for an additional five years)
 - A draft implementation RFP was released Oct. 07, 2002 for comment
 - Release of final RFP expected in Jan., 2003
 - Open to third-party “responsible” bidders as well as formulation contractors
 - Operational delivery of LDCM data to begin no later than 45 months after contract award; March, 2007 assuming June, 2003 award



Early Formulation Results

LDCM

Preliminary Design Concepts

- Both formulation contractors have publicly announced plans to develop remote sensing systems capable of acquiring multispectral image data having finer spatial resolutions (that is, smaller ground sample distances) than required for the LDCM
 - Both contractors plan to sell the finer resolution data commercially
 - The DOI/USGS EROS Data Center would only distribute Level 1 products where the data had been aggregated and resampled to the maximum ground sampling distances specified for the LDCM (that is, 30m for multispectral data with a 15m sharpening band and a 120m cirrus cloud detection band)

DigitalGlobe System Overview

LDCM

Team



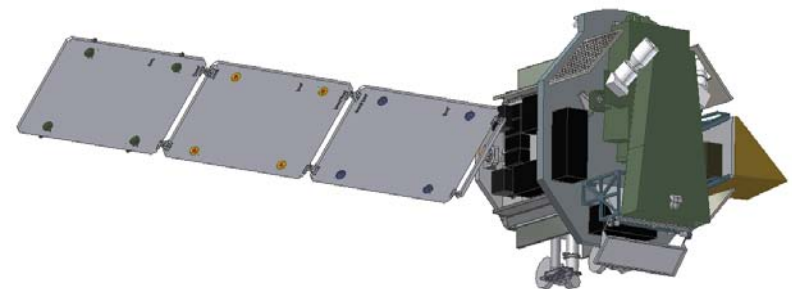

Business Approach

- Complements existing QuickBird hi-res business
 - Wide-area coverage, frequent revisits & additional spectral bands
- Augment QuickBird and SPOT in supporting world-wide agricultural market
 - Also supports environmental monitoring, disaster relief, etc.

Space Segment Overview

- "M5" system
 - 4 satellite constellation
- Multi-spectral
 - 5m nadir GSD
 - Off-nadir capability
 - 185km swath width
- Constellation operational Q3 2007

Space
Segment
Concept



Resource21 Overview

LDCM

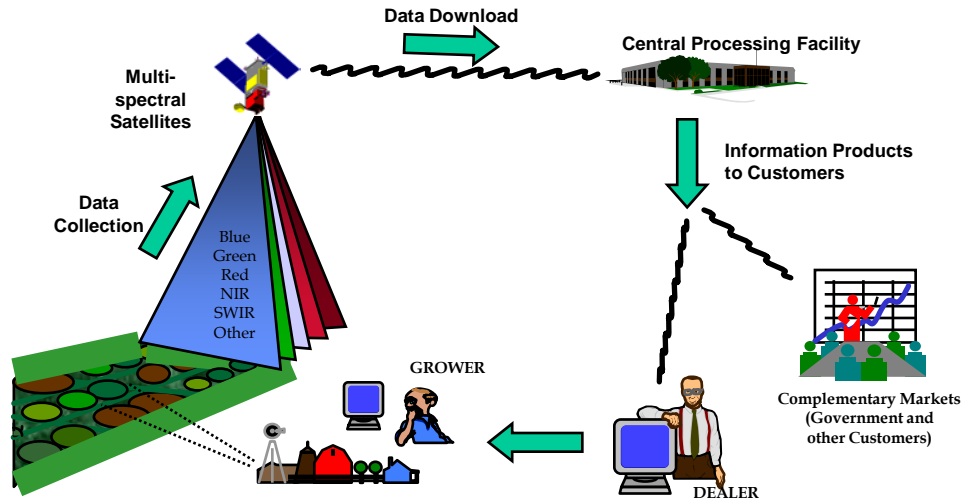
Team



BAE SYSTEMS



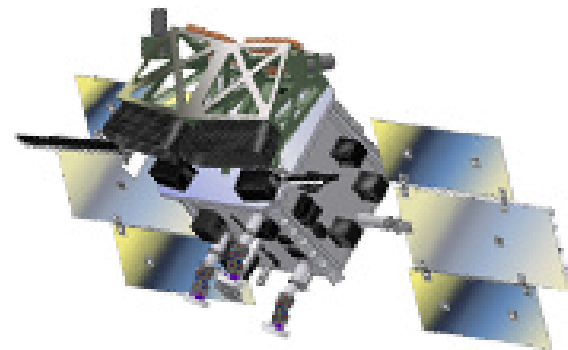
Business Approach



Space Segment Overview

- 1 or more satellites
- Multi-spectral
 - 5+ bands
 - 10m/20m GSD
- International Cooperator support

Space Segment Concept





RFP Elements

LDCM

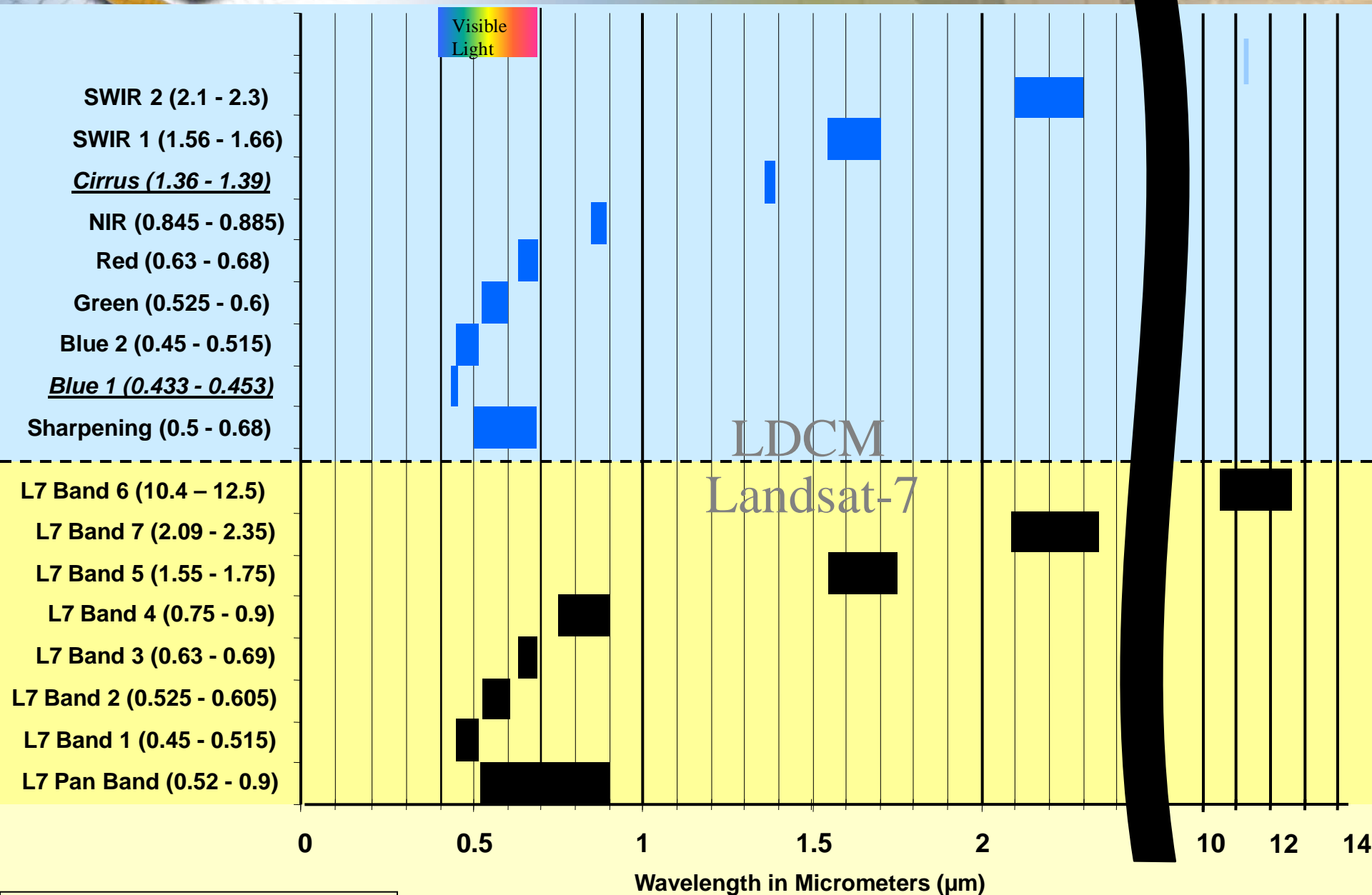
- Key RFP Elements for the User Community:
 - LDCM Data Specification- defines quality and quantity of multispectral data required for delivery to the US Government
 - LDCM Data Policy - defines rights for access to data and data products

Data Specification

LDCM

- Seasonal coverage of global land mass is the goal:
 - 16 day repeat coverage required for U.S.,
 - 250 global scenes per day (average) to an active archive,
 - March 2007 beginning of delivery for 5 years with 5 year option.
- Sensor or aggregated data delivered to the USGS/EDC.
- Spectral bands include both heritage-based and new bands:
 - 6 reflective bands with 30 m resolution (heritage-based)
 - 1 sharpening band with 15 m resolution (heritage-based)
 - 2 new reflective bands – coastal/aerosol (443 nm, 30-m resolution) and cirrus detection band (1375 or 1875 nm, 120-m resolution)
 - No thermal band
- Radiometric enhancements (SNR, dynamic range) based on newer technologies, e.g. EO-1 (pushbroom instrument technology).

Landsat 7 vs. LDCM Band Comparison



LDCM
Landsat-7

NOTE: Underlined/Italicized are optional bands

A graphic showing several overlapping, curved bands of color (yellow, green, blue) representing satellite data or orbits, set against a grid background.

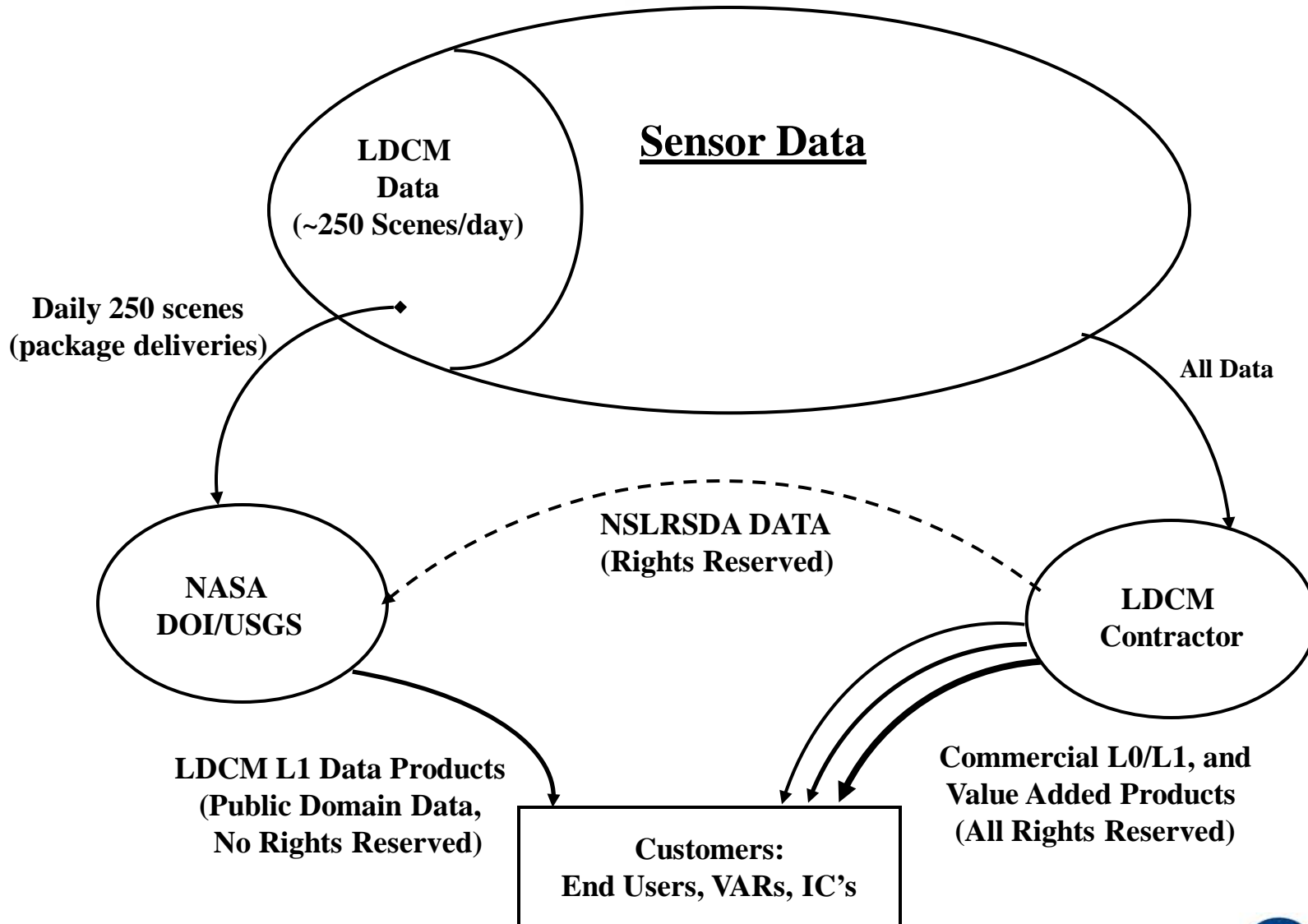
LDCM Data Policy

LDCM

- The LDCM Data Policy maintains Landsat 7 Data Policy tenants:
 - Ensures non-discriminatory access to Level 1 data products derived from Government-procured LDCM data
 - Precludes restrictions on sharing and secondary distribution of LDCM Level 1 data products
- The LDCM Data Policy protects the LDCM contractor's commercial rights to data exceeding quantity or specifications of LDCM data procured by NASA / USGS
- No special provision for International Ground Stations

Procurement Strategy – Envisioned Results

LDCM





Roles & Responsibilities

LDCM

- NASA will:
 - Procure data from an LDCM Contractor
 - Require the Contractor to deliver the procured data to the DOI/USGS EROS Data Center in Sioux Falls, SD
 - The average daily delivery shall provide coverage of 250 Landsat scenes
 - Validate that the data quality and quantity meet LDCM specifications

- DOI/USGS will:
 - Receive and archive the LDCM data at the EROS Data Center
 - Allow the general public to search the LDCM data archive on a nondiscriminatory basis and to order Level 1 data products (that is, radiometrically corrected data registered to cartographic projections)
 - Produce and distribute ordered data products in accordance with an **LDCM Data Policy**
 - **Charge no more than \$50 per scene for a Level 1 data product**



Invitation to Comment

LDCM

- Final RFP to be released in early January, 2003
- LDCM Award expected by June, 2003
- The RFP can be found at the following web site:
 - <http://prod.nais.nasa.gov/cgi-bin/eps/sol.cgi?acqid=102577>
 - A link to the web site providing the RFP can be found at the LDCM Home Pages: <http://ldcm.nasa.gov> or <http://ldcm.usgs.gov>
- Please send comments in writing to Jim Becker, Contracting Officer either by:
 - Facsimile at: 301-286-7434
 - Or
 - Email at: jbecker@pop200.gsfc.nasa.gov