The Landsat Data Continuity Mission (LDCM)

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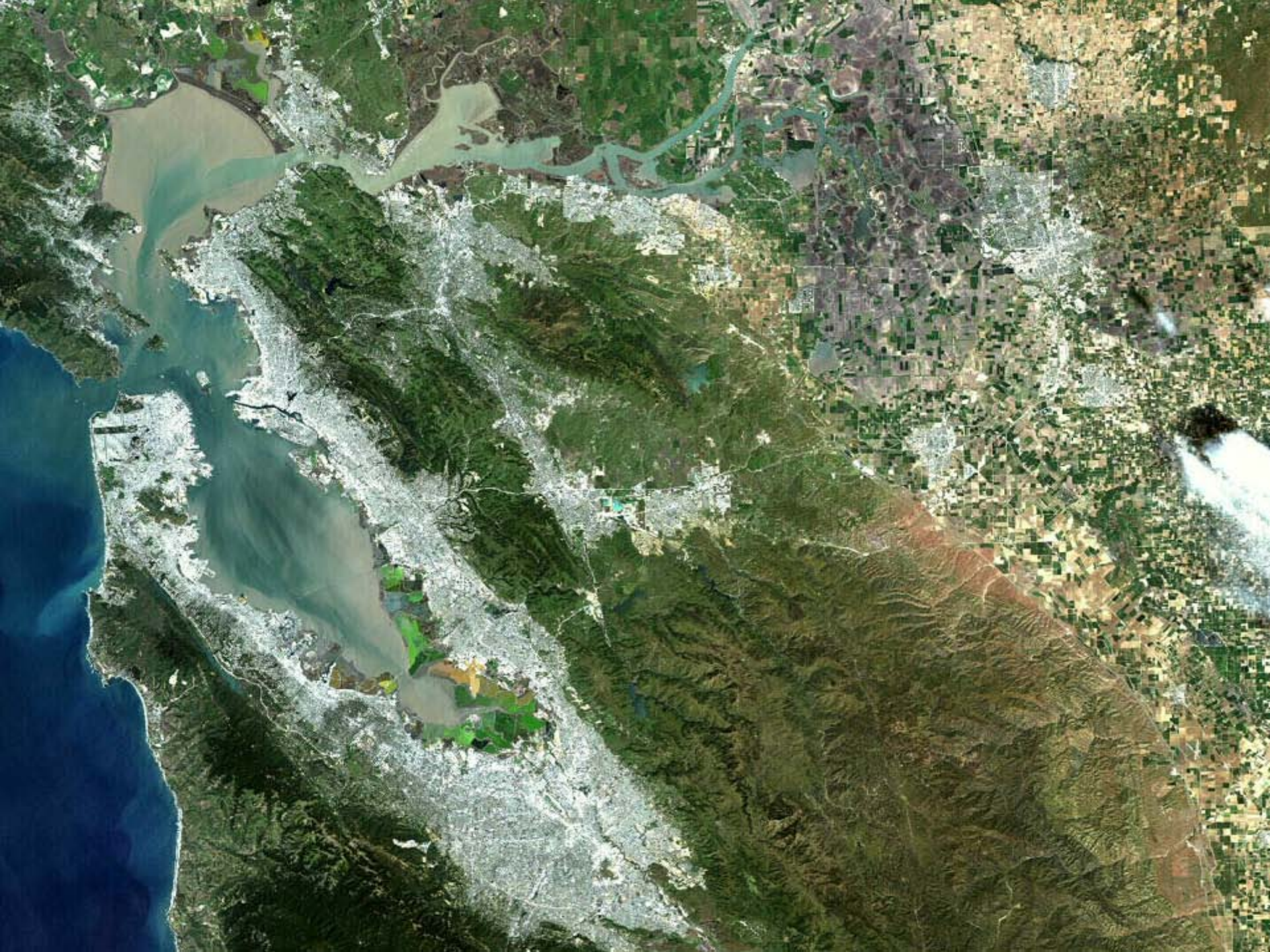


Landsat-7 Technical Specification

Landsat Data Continuity Mission

Near Polar Orbit

Inclination: 98.2 degrees

Period: 98.8 minutes

Descending Node Time: Sun Synchronous, 10:00am±15 min.

Identical Ground Track to Terra

Repeat Cycle: 16 days

Mission Lifetime: 5 years+

Launch Date: 4/15/99

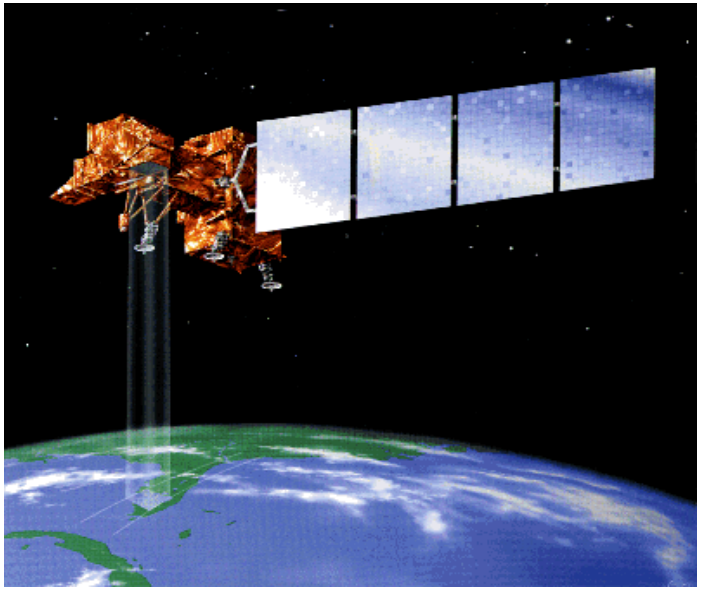
Spectral Channels:

15m pan (1)

30m VNIR-SWIR (6)

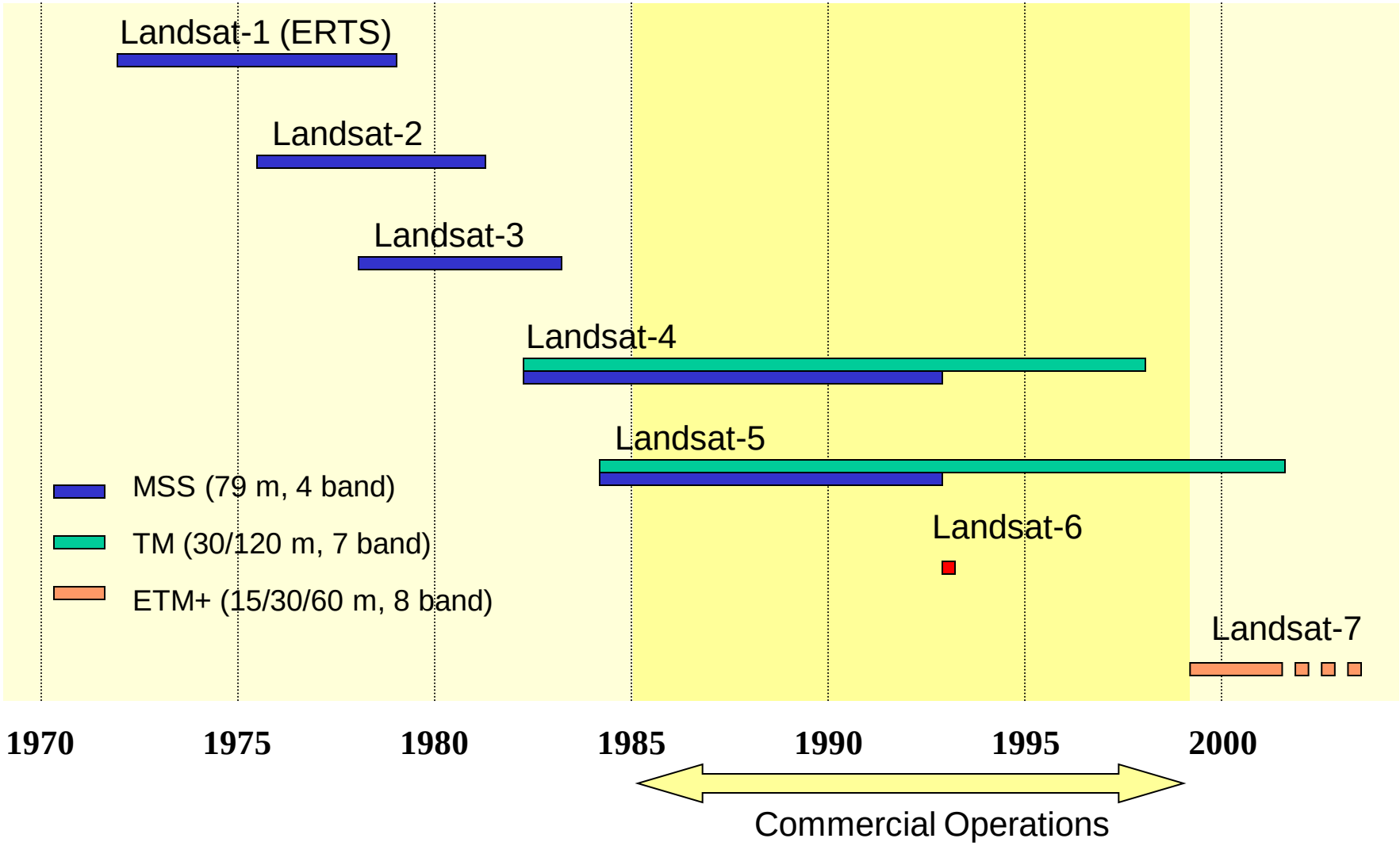
60m TIR (1)

Image size: 185 x 185 km



History of the Landsat Program

Landsat Data Continuity Mission



Background

- **Land Remote Sensing Policy Act of 1992 (PL 102-555)**
  - Directed assessment of four options for a Landsat-7 successor:
    - the private sector,
    - a Government-private sector cooperative effort,
    - the U.S. Government, and
    - an international consortium
  - Stated preference for a private sector system

Chronology

June 1999: RFI to potential vendors to assess market for purely commercial data buy:

- No respondent believed in a commercially viable market for 15/30m data
- Respondents favored contractor owned systems, with innovative funding arrangements

March 2000: First draft of LDCM Data Specification

- Ad-hoc working group from GSFC, USGS, MIT/LL, SSC
- First draft publicly released for comment November 2000

January-May 2001: Public workshops on LDCM Data Spec and Mission

- Consensus that Landsat data should be treated as public good
- Concern over high price of COFUR
- Unrestricted data policy vital for science
- Reiteration that no viable purely commercial market exists for 30m data

August 2001: Draft RFP released for comment

October 2001: Final RFP to be released

LDCM Approach

Landsat Data Continuity Mission

- NASA and the USGS collaborated on LDCM RFP framed around the LDCM Data Specification:
  - Providing Landsat-quality data starting no later than the 2006 Northern Hemisphere growing season
  - Defining the data as the principal deliverable (Science Data Buy),
  - Desiring to share cost, risk, and rewards, and
  - Making available relevant new technologies, such as EO-1 sensor(s), to data providers

- Bidders may propose <u>any reasonable means</u> of producing the data, but NASA/USGS must have insight and must validate:
  - The approach; sensor/system design, operations concept
  - The implementation, and
  - The data

LDCM Acquisition Approach

Two-phased acquisition approach (from D-RFP):

Phase I: Formulation

- multiple offerers selected for funding
- "study phase" for various technical and trade studies
- culminates in preliminary design

Phase II: Implementation

- downselect to 1 contractor via new round of proposals
- final design, fabrication, launch, and OIV
- 5 years of operations (possibly up to 10)

LDCM Operations: Spring 2006 – onward

Data Specification Philosophy

Landsat Data Continuity Mission

- Specifies the amount, quality of data required from an end-to-end LDCM system, including data products and data access

- Avoids specifying how to acquire the data
  - Avoids specifying particular technologies
  - Specification is not a design document

- Premise: The LDCM will be required to provide multispectral digital image data affording global coverage of the Earth's land mass on a seasonal basis and in a manner that ensures continuity of the Landsat-7 mission.

- Specifications based on Landsat 7 ETM+ on-orbit performance, ETM+ specifications, and mature technology infusion from EO-1

- http://ldcm.gsfc.nasa.gov

ALI image

Washington DC

LDCM Data Products

Landsat Data Continuity Mission

- Raw Data sent to “active” archive (250 scenes/day)

- Products generated from raw data:
  - Level 0 (may not be publicly available – only for calibration)
  - Level 1R (calibrated)
  - Level 1Gs (calibrated, geometrically corrected, projected)
  - Level 1Gp (precision geolocated)
  - Level 1Gt (orthorectified)

- Subscenes (quads), WRS-2 scenes, subintervals (5 scenes) required

- Data available for search/order within 48 hours of acquisition

- Requirements for delivery times, volumes, browse, media

- All algorithms must be documented and publicly available

LDCM Data Acquisition

Landsat Data Continuity Mission

- 250 scenes per day delivered to active archive

- Scene scheduling left to LDCM operator, but must produce comparable results as the Landsat-7 Long Term Plan
  - concentrates acquisitions during seasonal change
  - minimizes cloud-cover by using cloud predictions
  - includes “niche community” acquisitions

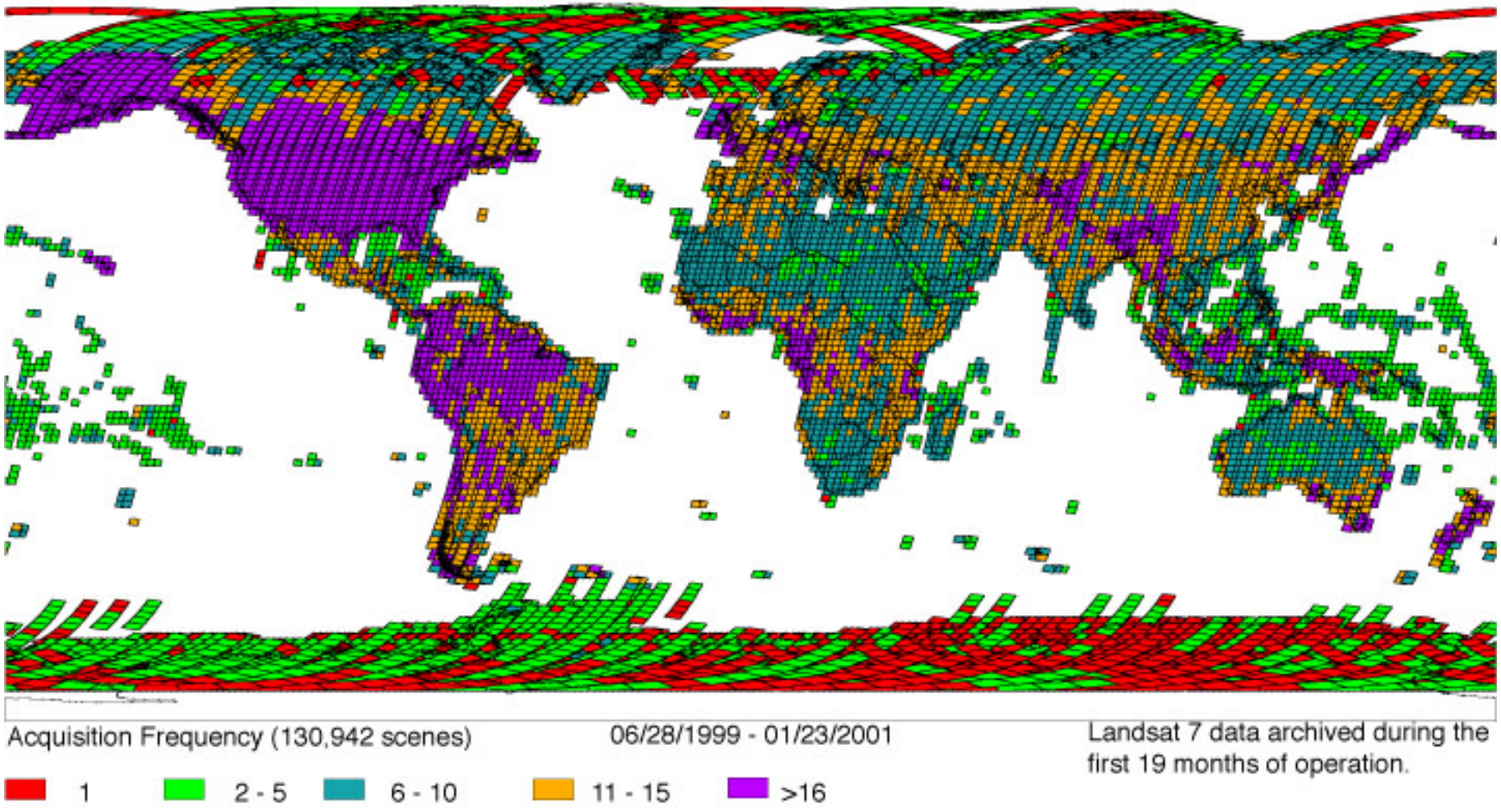
- Requires coverage every 16 days for the U.S.

- Requires LDCM to follow WRS-2 Path-Row system

- All data must eventually be transferred to NLRSDA (the USGS long-term archive)

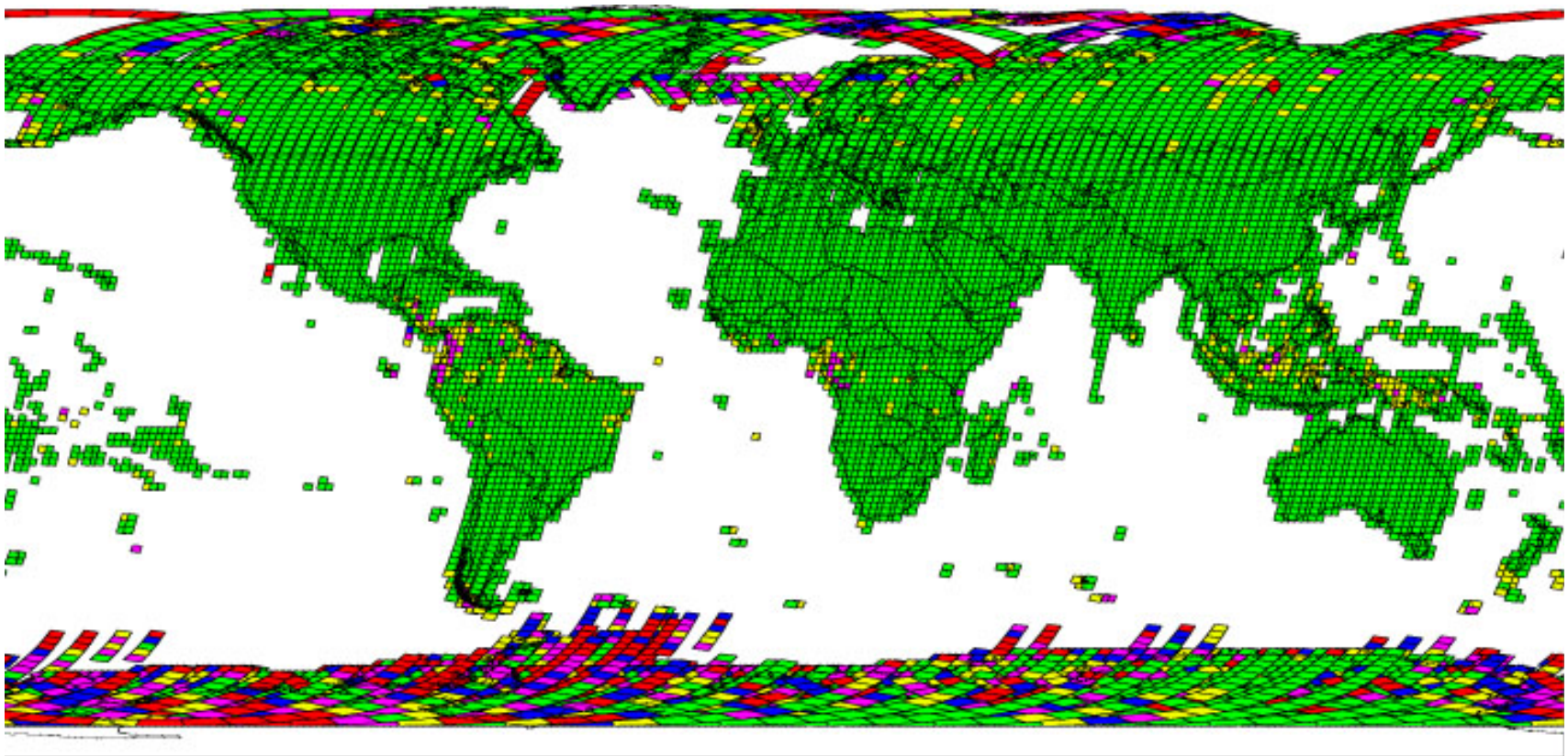
Data Archived at EDC Thru 1/23/2001

Landsat Data Continuity Mission



Cloud Free Data in EDC Archive

Landsat Data Continuity Mission



This map shows the lowest available cloud cover for each of the 15,940 unique path/row combinations in the US Landsat 7 Archive. (June 28, 1999 - January 23, 2001)

12 International Ground Stations; over 160,000 scenes downlinked to IGS'

130,942 scenes in the EDC archive as of 1/23/01

10% or less cloud cover - 47,964 (37%)

20% or less cloud cover - 60,058 (46%)

30% or less cloud cover - 70,130 (54%)

LDCM Spectral Bands (Draft RFP – Aug '01)

Landsat Data Continuity Mission

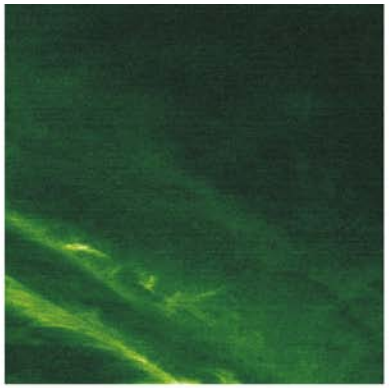
Band	Center Wavelength (nm)	Ground Sampling Distance (m)	Band Heritage/Usage
Coastal/Aerosol*	443	30	ALI/MODIS
Blue	482	30	ETM+ Band 1
Green	562	30	ETM+ Band 2
Red	655	30	ETM+ Band 3
NIR	865	30	ETM+ Band 4/ALI
SWIR 1	1610	30	ETM+ Band 5
SWIR 2	2200	30	ETM+ Band 7
Sharpening	590	15	ETM+ Pan Band
Thermal 1*	10800	120	ETM+ /AVHRR
Thermal 2*	12000	120	ETM+ /AVHRR
Cirrus*	1375	120	MODIS

* Optional – trade studies for Formulation Phase

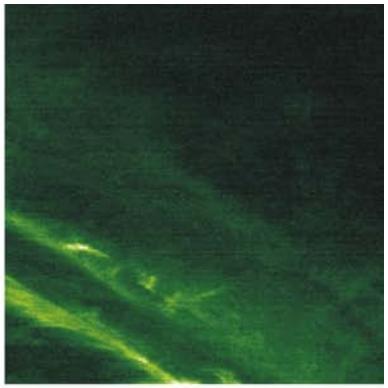
Cirrus Cloud Band, 1375 nm, New Bern, NC

Landsat Data Continuity Mission

CIR 20 m GSD

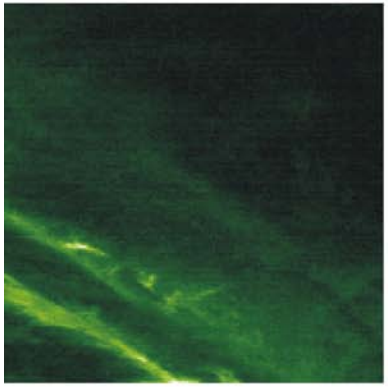


20 m GSD

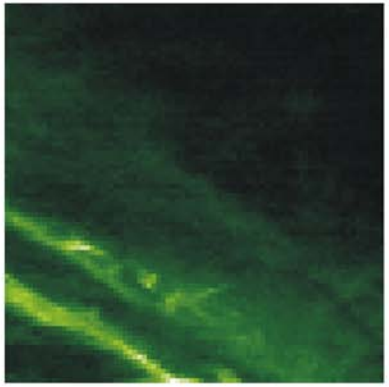


40 m GSD

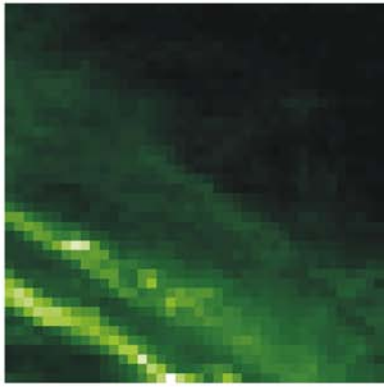
July 26, 1999
AVIRIS data



60 m GSD



120 m GSD



240 m GSD

120 m GSD would provide similar cloud mask to higher spatial resolution datasets

LDCM Radiometry and Geometry

Landsat Data Continuity Mission

Calibration:

- Requires 5% absolute radiometric accuracy; 3% goal for VNIR-SWIR
- 2% required, 1% goal for the thermal band

SNR/Dynamic Range:

- Modest improvements in both dynamic range and SNR.
- Requires performance comparable to 10-11 bit system, with goal comparable to 11-12 bit system

Geodetic Accuracy:

- Level 1Gs products: 65 m (90% circular error)
- Level 1Gt products: 12 m (90% circular error)
- Comparable to ETM+ current performance (on a good day)

Data Policy

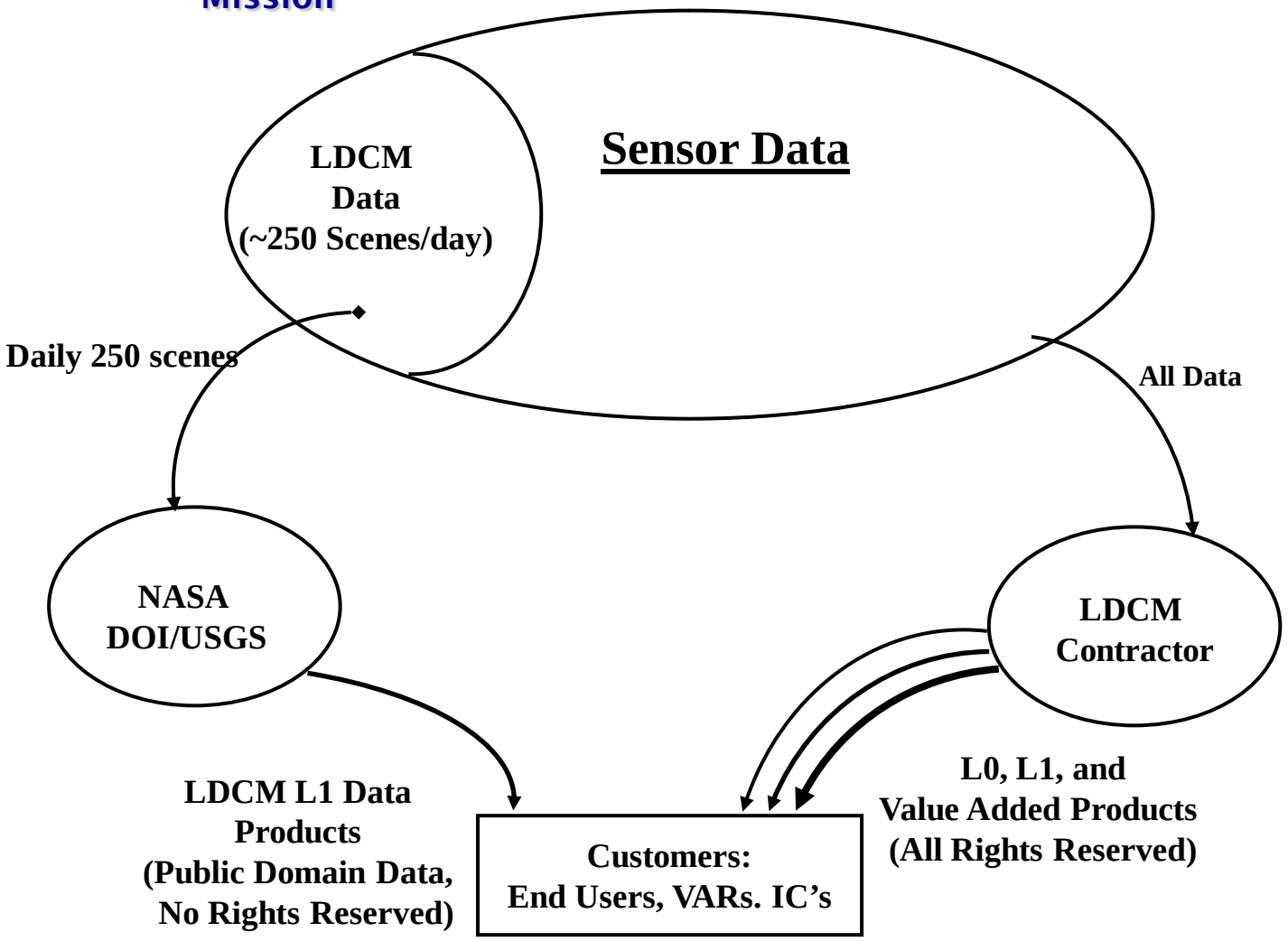
- Critical to scientific and commercial success of the mission

- Policy goals include reduction in end-user cost, formulation studies include contractor costing approach

- Mandates unrestricted redistribution of LDCM data products (like Landsat-7)

- Protects commercial rights to distribute data exceeding LDCM specifications.

Landsat Data Continuity Mission



Backup Charts

First LDCM Workshop

- NASA/USGS held a Landsat Data Continuity Mission (LDCM) workshop on January 9-10, 2001
- Approximately 200 people from the U.S., Canada, and Europe attended the LDCM workshop
- Participants were from the data providers, science, user, academic, and value-added resellers/data distributor communities
  - Good mix broadened the exchange of ideas/opinions
- Timing was right, engaged Landsat community in the formulation process
- The format was a series of five panels that addressed the LDCM data specification and other aspects of the mission

Second LDCM Workshop

- Conducted workshop on Mon. and Tues. as an ASPRS User Group Meeting
- 98 Registered Participants
- Reviewed LDCM procurement expectations
  - Need to fully specify system requirements in RFP emphasized; e.g., international cooperator interfaces, long term data archival, data policy
- Reviewed first revision of LDCM Data Specification
  - General approval of revisions
  - Clarification still needes on a few specs