USGS Welcome

Prepared for

38th CEOS Working Group on Calibration and Validation Plenary (WGCV-38)

Presenter

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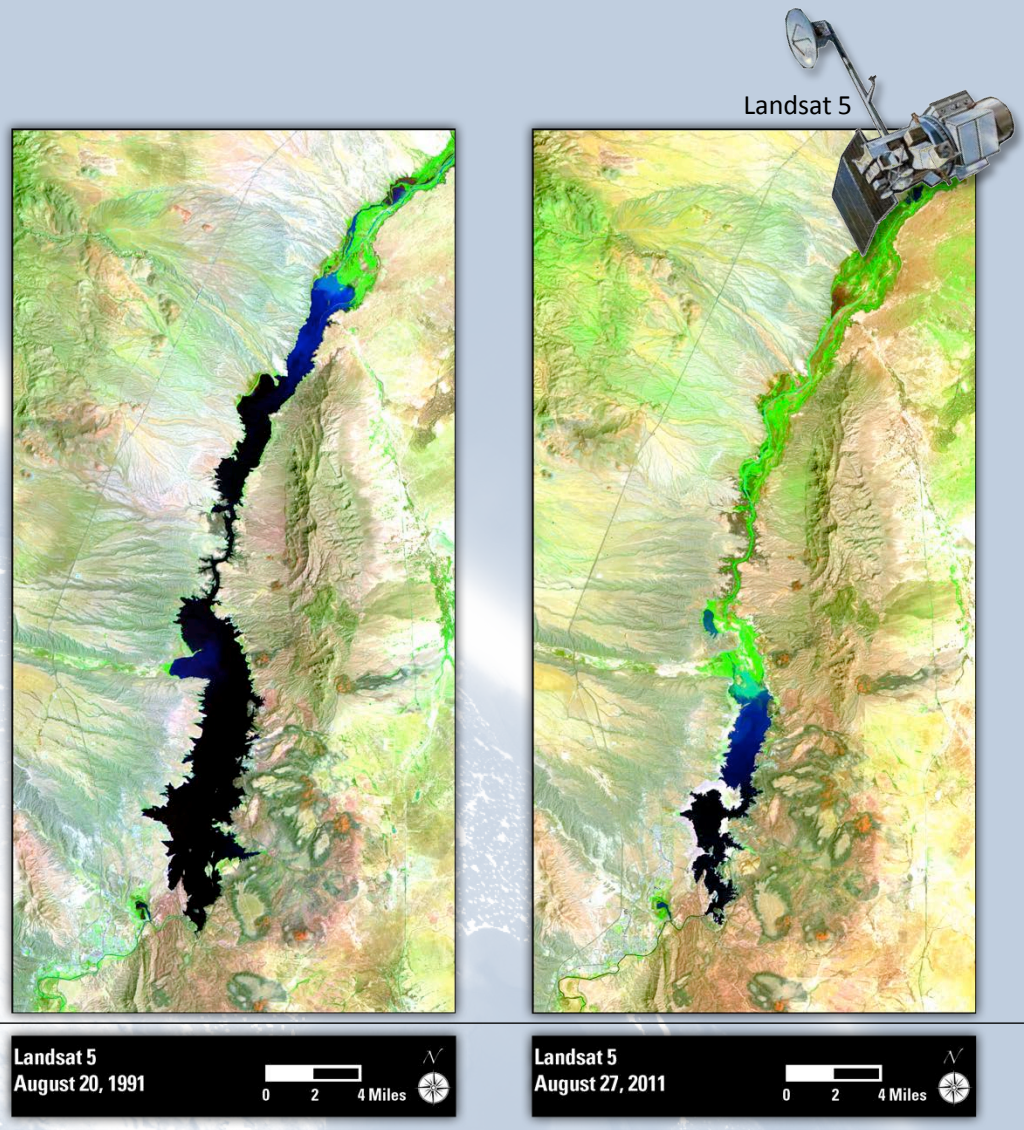
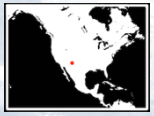
International Liaison
USGS Land Remote Sensing Program

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





Elephant Butte Reservoir along the Rio Grande River.

USGS Land Remote Sensing Program

- Collects, interprets, and provides the Nation with information from satellite and airborne instruments
  - Supports improved water resource management, agriculture, forest monitoring, urban planning, and disaster recovery worldwide
  - Contributes to the scientific community's understanding of the impacts of, and feedbacks between, land use change and climate change
- Provides a comprehensive, permanent, and impartial record of the planet's land surface through the National Satellite Land Remote Sensing Data Archive
- Provides Federal civil agencies access to commercial and classified Earth observing assets, and supports the development of unclassified products derived from these information sources

NASA/USGS Landsat Roles

NASA:

- Develops sensors, satellites, and launches land imaging space systems
- Co-chairs USGS-funded Landsat Science Team
- Performs Earth-system measurements and research using land-image data

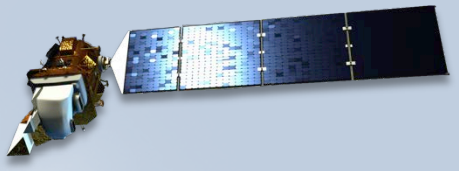
USGS:

- Documents land imaging user requirements
- Develops ground systems for land imaging space systems
- Operates land imaging satellites
- Collects, processes, archives and disseminates land-image data
    - Establishes global land-coverage acquisition strategy
    - Coordinates International Partner ground receiving station network
    - Distributes data and information products at no charge
    - Develops new data products and applications

Operational Status

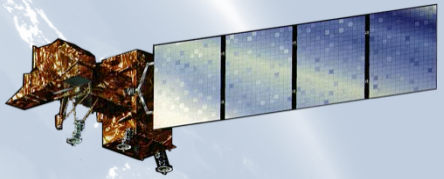
Landsat 8

- Collection increased from approximately 550 to 725 new scenes per day; supports 8-day revisit cycle
- Improvements: better signal-to-noise, new bands (coastal blue, cirrus, thermal)
    - Crisper images; less color saturation
    - Better resolution of snow and ice-covered regions
    - Detection of water-column constituents
    - Better cloud screening



Landsat 7

- Collecting over 400 new scenes per day; about 22% of pixels missing per scene (faulty scan-line corrector)
- L7 collection strategy modified to concentrate on continental coverage; L8 capturing islands & reefs
- Sufficient fuel until 2018; limited subsystem redundancy; satellite could fail at any time



8-day revisit cycle is at significant risk of interruption

Operational Status

(continued)

Landsat-based Information Products

- Standard orthorectified L1T calibrated radiance Landsat scenes
- LandsatLook (full-resolution JPEGs browse/print images)
- New TM/ETM+ surface reflectance Climate Data Record (CDR) products currently available on-demand for any WRS-2 path/row
- New TM/ETM+ surface temperature CDR products under development; will soon be available for evaluation on-demand for North America
- New OLI surface reflectance CDR in development and will be made available on-demand for any WRS-2 path/row
- New OLI surface temperature CDR in development and will be made available on-demand for North America
- Surface Water Extent, Burned Area Extent Essential Climate Variable (ECV) products available soon for evaluation for CONUS and Alaska
- Snow-covered area ECV due late next year for CONUS and Alaska

New Landsat 8 Capabilities

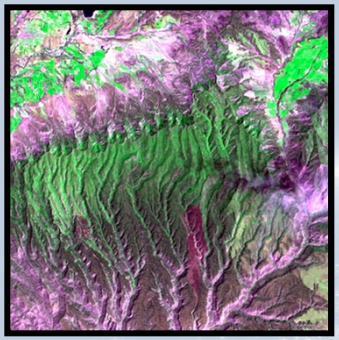
Spectral band improvements

- Landsat 7 has 8 spectral bands (3 VIS, 1 NIR, 2 SWIR, 1 TIR, and pan band)
- Landsat 8 has 11 spectral bands (4 VIS, 1 NIR, 3 SWIR, 2 TIR, and a pan band)
  - New VIS “coastal aerosol” band allows detection of water column constituents (e.g., chlorophyll, suspended materials, etc.)
  - New SWIR “cirrus” band will improve overall image quality because of better cloud screening
  - Addition of a 2nd thermal band will improve the accuracy and precision of temperature measurements. Note, however, that TIR resolution decreases from 60m to 100m.
  - Changes in panchromatic band spectral range will increase the overall use of this band for image sharpening and other applications.

Detection, quantification, and mapping of surface (land and water) characteristics will improve because of:

- 5x improvement of signal-to-noise ratios of spectral measurements
- 12 bit quantization of spectral signals (Landsat 7 was 8 bit)

Mesa Verde National Park Fire Atlas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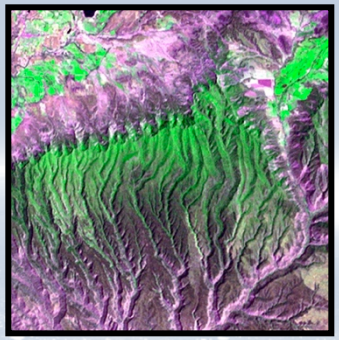
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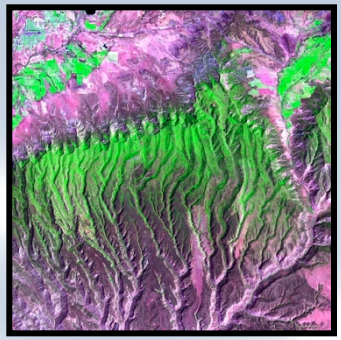
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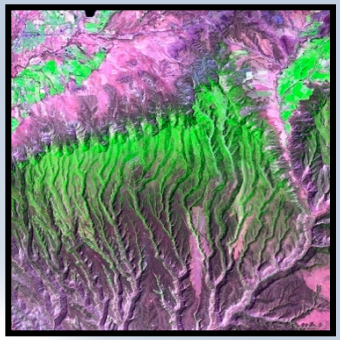
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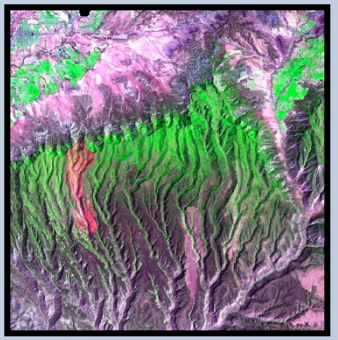
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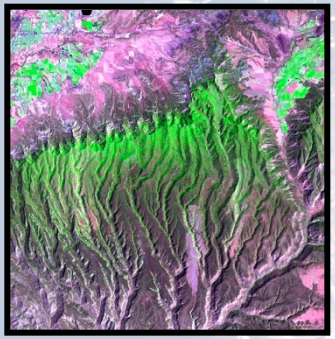
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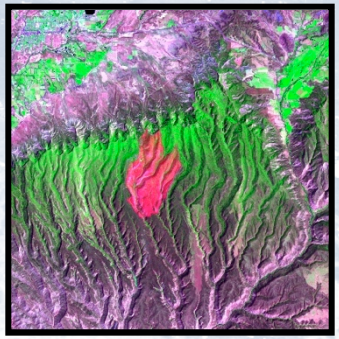

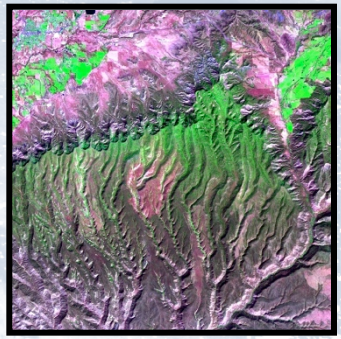

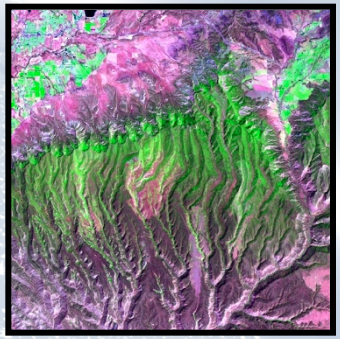
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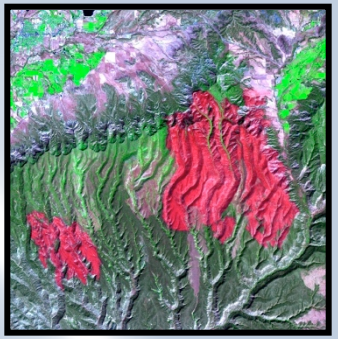
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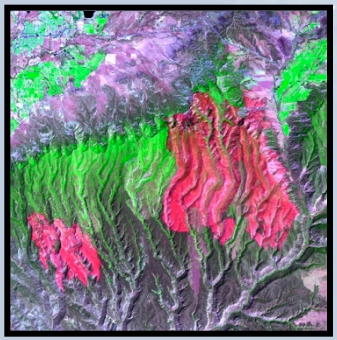
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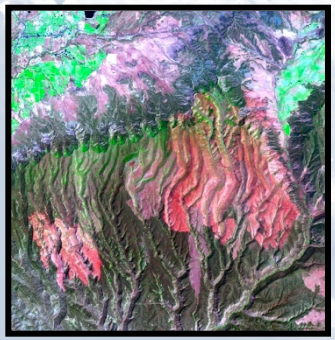
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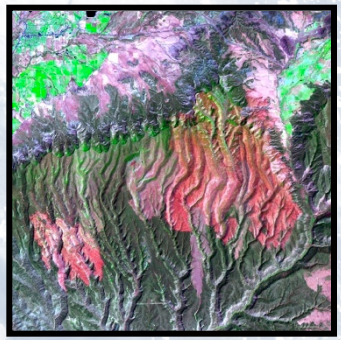
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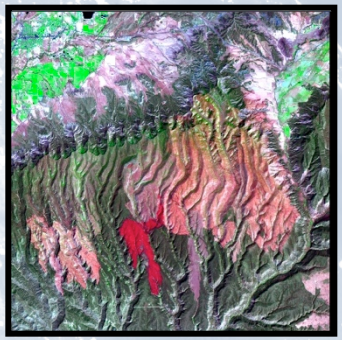
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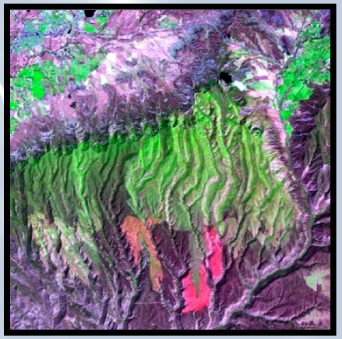
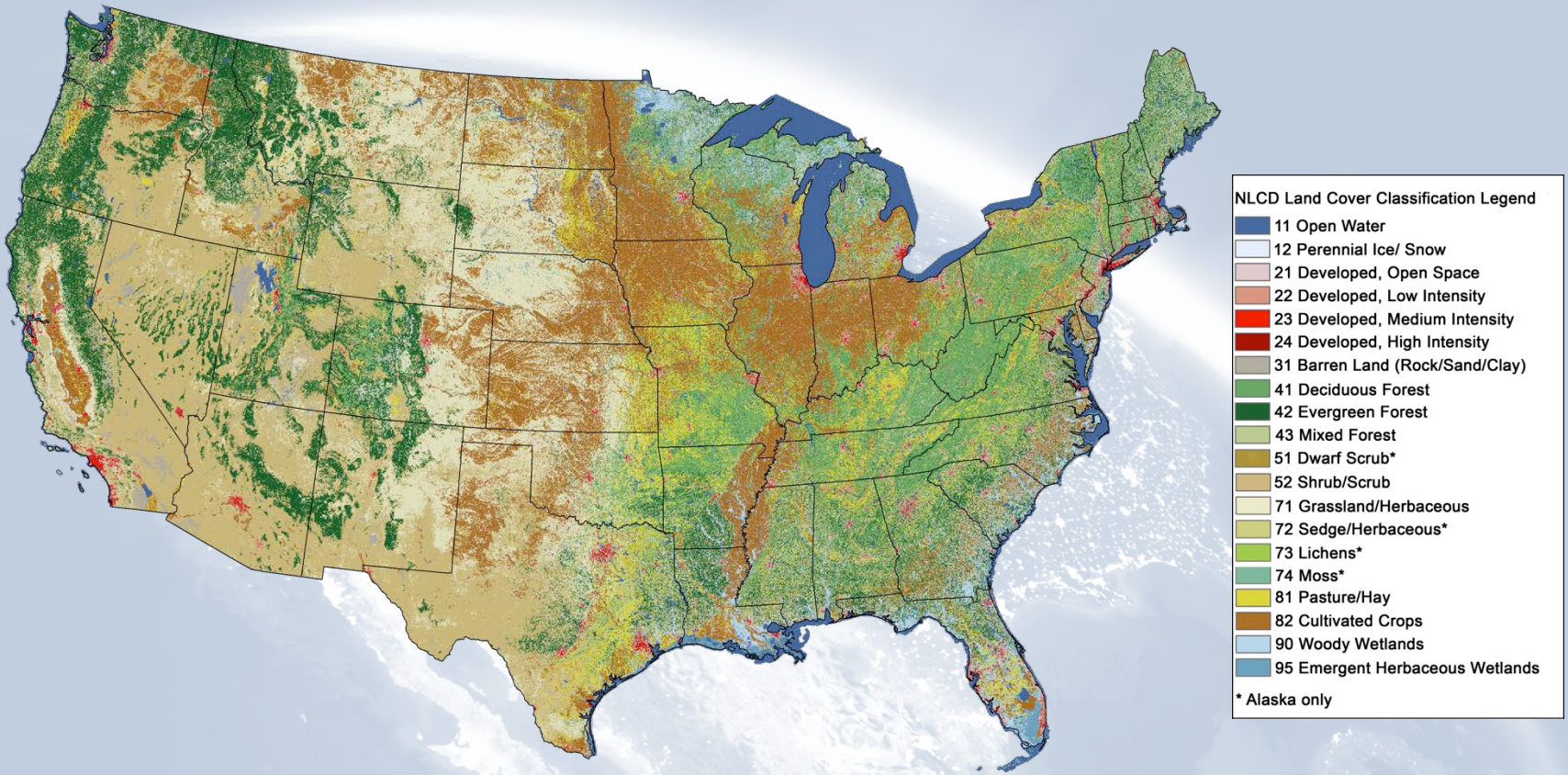

2004

USGS

Landsat Provides the Big Picture

The National Land Cover Database – 2011



USGS

Land Remote Sensing Program current activities

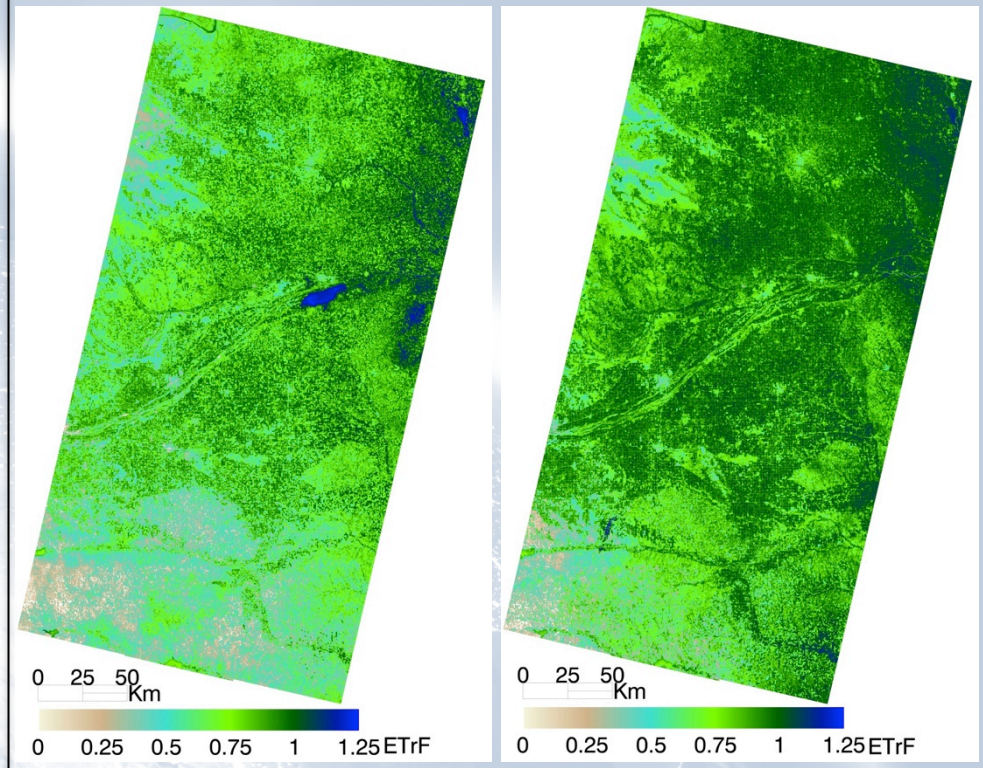
- "Operationalize" decision support applications developed by the Landsat Science Team

- Develop new Landsat-based national-scale analyses useful to natural resource managers and the climate monitoring community*
  - Land surface temperature
  - Wildfire burned area extent
  - Surface water extent
  - Snow covered extent

* Some datasets can be updated every 8 days

Evapotranspiration (from Landsat 8, July 2013)

Evapotranspiration (from Landsat 8, Aug 2013)



Nebraska's Central Platte Natural Resources District uses Landsat-based estimates of water use to manage the Ogallala Aquifer. (METRIC model pioneered by the Idaho Department of Water Resources, University of Idaho, and Landsat Science Team.)

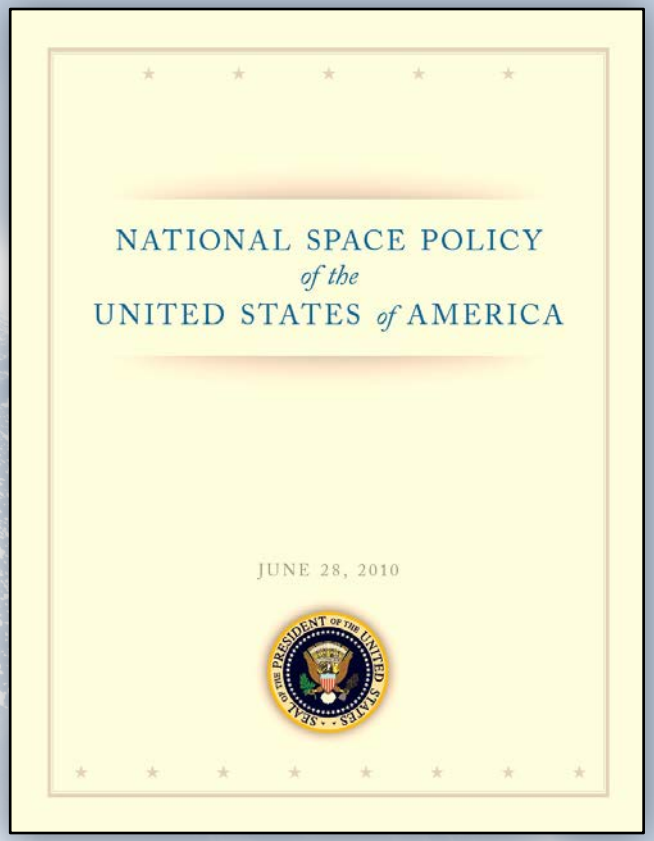
The Role of Interior in U.S. National Space Policy

Land Remote Sensing

"The Secretary of the Interior, through the Director of the United States Geological Survey (USGS), shall: conduct research on natural and human-induced changes to Earth's land, land cover, and inland surface waters, and manage a global land surface data national archive and its distribution;

determine the operational requirements for collection, processing, archiving, and distribution of land surface data to the United States Government and other users; and…

the Director of the USGS and the NASA Administrator shall work together in maintaining a program for operational land remote sensing observations."



Landsat Science Team Definition of Continuity

The USGS-NASA Landsat Science Team defines Landsat data continuity as the collection, archival, and distribution of image data of the Earth's continents and surrounding coastal regions with the content, quality and coverage needed to map, monitor and assess the Earth's characteristics and its response to natural and human-induced change. To accomplish this, continuity includes:

- Long-term calibrated measurements that are consistent across the changing instrument record.
- A continuous record since the initiation of observations with no significant temporal or geographic data gaps.
- Measurements that enable backward and forward assessments of the conditions and changes in the Earth's surface.
- Measurements with comparable spectral, spatial, temporal, and geographic properties that result in sufficiently consistent and accurate documentation of surface characteristic and dynamics.

See "USGS-NASA Landsat Science Team Statement of Landsat Continuity: Priorities for a Future Land Imaging Architecture for Sustained Landsat Observations" (January 23, 2014)

Sustained Land Imaging = Data Continuity

The USGS, glad to see the Administration's commitment to sustained land imaging, is open to whatever solutions ensure long-term data continuity.

"The term **'data continuity'** means the the continued acquisition and availability of unenhanced data which are, **from the point of view of the user –**

(A) Sufficiently consistent (in terms of acquisition geometry, coverage characteristics, and spectral characteristics) with previous Landsat data to allow comparisons for global and regional change detection and characterization; and

(B) compatible with such data and with methods used to receive and process such data." Land Remote Sensing Policy Act of 1992 (PL 102-555)

For the USGS, a sustained Landsat-like **data stream** means more than continuous sensor data; it includes **long-term data archiving, backward-compatible data products, a global data acquisition strategy, an open data policy, rigorous data calibration, and a commitment to data continuity.**

NASA – USGS Collaboration for Land Imaging

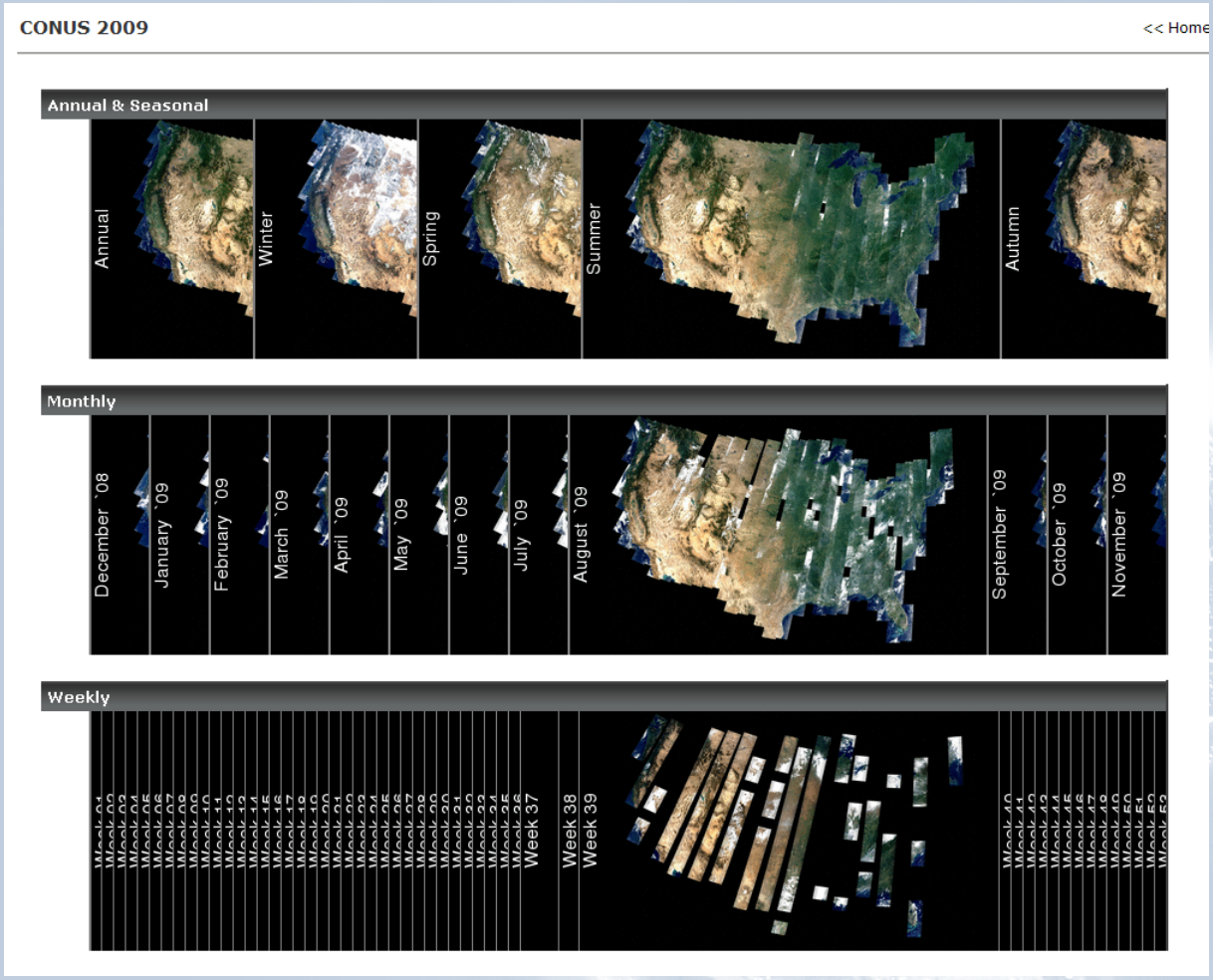
Landsat System Architecture Study Phase

- NASA is leading the overall system architecture study, utilizing its space systems engineering expertise
- USGS is supporting all aspects of the study; USGS represents the consolidated needs and desires of the Landsat user community and provides expert analyses of the data processing and dissemination aspects of the system

Landsat System Architecture Implementation Phase

- NASA will be responsible for the overall system design, as well as the implementation, launch, and commissioning of the system's space-borne elements
- USGS will provide unique expertise and guidance in the design of the operations, ground network, data processing, and data dissemination components of the complete system
- USGS will operate the space-borne assets after NASA commissioning, as well as the downlink, ground processing, archiving, and distribution of the system's information and data products
- USGS will maintain the National Satellite Land Remote Sensing Data Archive, distribute data to users, and administer, on behalf of U.S. Government, data acquisition by foreign ground stations

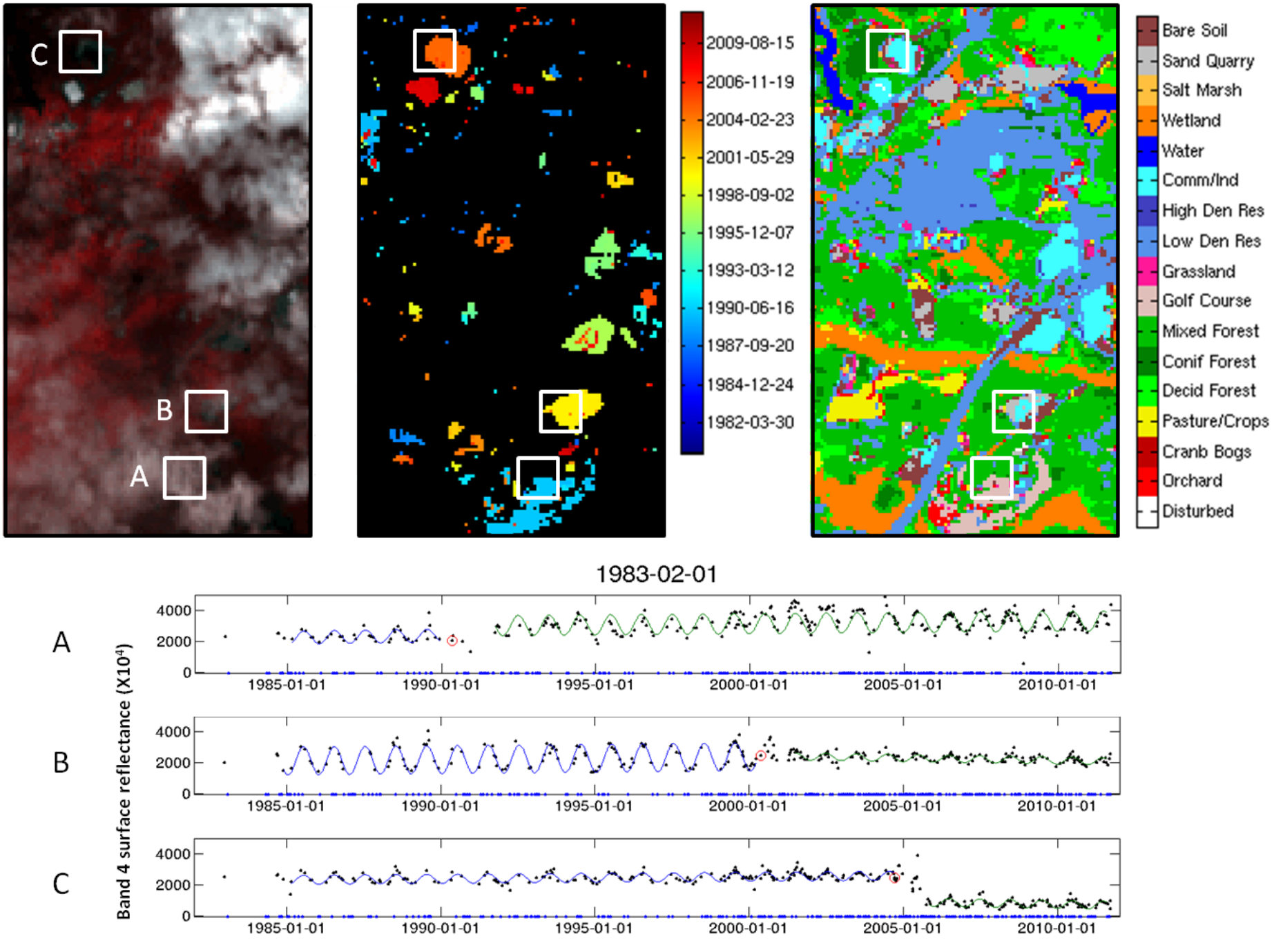
Web-Enabled Landsat 7 Data –2003 - 2012



- WELD provides seamless Landsat 7 ETM+ mosaics for Conterminous US and Alaska
- Developed by David Roy, South Dakota State University

SDSU

- http://landsat.usgs.gov/WELD.php


Landsat surface reflectance
Land cover change map
Land cover classification map
C
B
A
2009-08-15
2006-11-19
2004-02-23
2001-05-29
1998-09-02
1995-12-07
1993-03-12
1990-06-16
1987-09-20
1984-12-24
1982-03-30
Bare Soil
Sand Quarry
Salt Marsh
Wetland
Water
Comm/Ind
High Den Res
Low Den Res
Grassland
Golf Course
Mixed Forest
Conif Forest
Decid Forest
Pasture/Crops
Cranb Bogs
Orchard
Disturbed
1983-02-01
A
B
C
Band 4 surface reflectance (X10⁴)
4000
2000
0
1985-01-01
1990-01-01
1995-01-01
2000-01-01
2005-01-01
2010-01-01

Comparison of Landsat & Sentinel-2