



National Land Imaging Update on the USGS ~~Land Remote Sensing~~ Program

Tim Newman

Program Coordinator

Land Remote Sensing Program, USGS

Pete Doucette

Associate Program Coordinator

Land Remote Sensing Program, USGS

U.S. Geological Survey

Department of the Interior

April 3, 2018



National Land Imaging Appropriations

	FY16	FY17	FY18	FY19
	Enacted	Enacted	Enacted	PB
	(\$M)	(\$M)	(\$M)	(\$M)
Satellite Operations	57.6	71.2	78.5	73.0
Science Research & Investigations	14.6	14.6	14.6	3.0
Total	72.2	85.8	93.1	76.0

Landsat operational, development, & assessment status

Landsat 7 (1999-)

- Collecting about 475 new scenes per day; latest fuel estimate projects operating into 2020/2021.

Landsat 8 (2013-)

- Collecting up to 725 new scenes per day; together with Landsat 7 supports 8-day revisit.

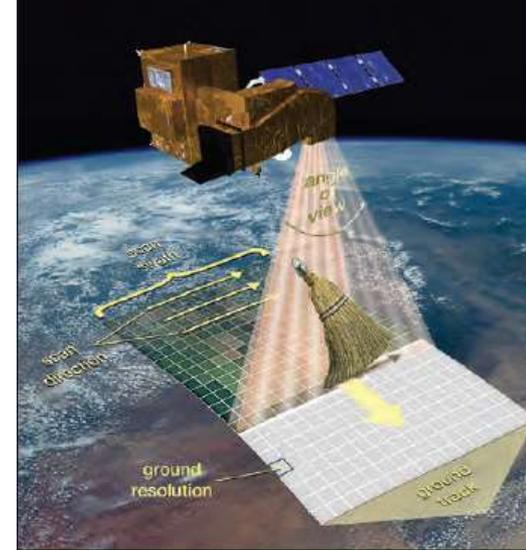
Landsat 9 (December 2020 launch)

- Essentially a copy of Landsat 8
- Upgrade to fully Class B (TIRS thermal instrument was a Class C instrument on Landsat 8)

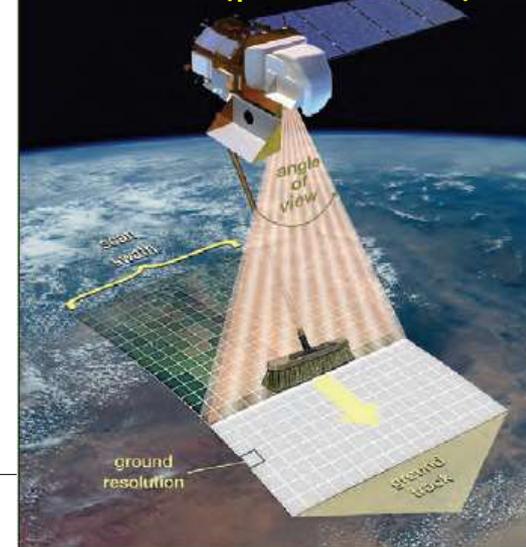
Landsat 10 (~2025-2030 launch)

- Technology and user needs studies underway to support an architecture study to commence mid-2018.
- Everything is on the table at this point.

Landsat 7 (whiskbroom)



Landsat 8 (pushbroom)



Preliminary user needs findings for Landsat 10

- At **minimum**, users needed **continuity** of Landsat data and derived products with **free and open** data access.
- To **better** perform their work, users need **weekly clear** observations, **10m** spatial resolution for (VNIR – SWIR) and 30-60m for thermal, and **additional red edge bands** and **narrower bands in VNIR and SWIR** regions.
- **Ideally**, users want clear imagery every **3 days** at **5-10m** spatial resolution, and **contiguous 10nm-wide VNIR – SWIR** band and **more** (5-8) **thermal** bands.
- Federal and non-Federal needs were similar.

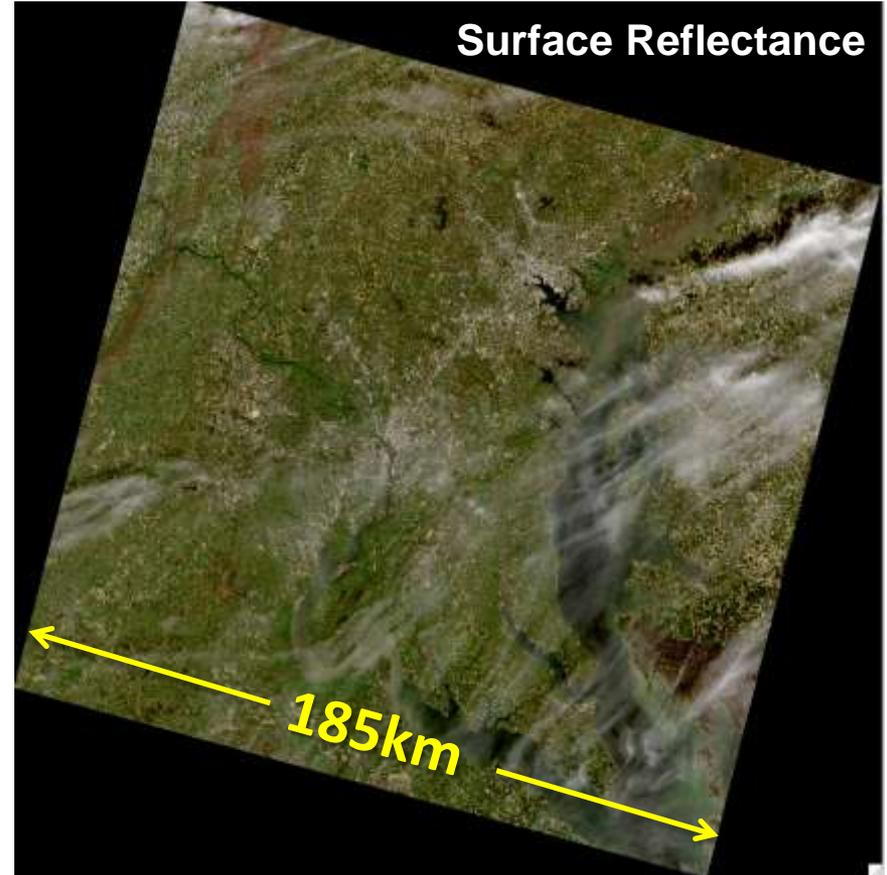
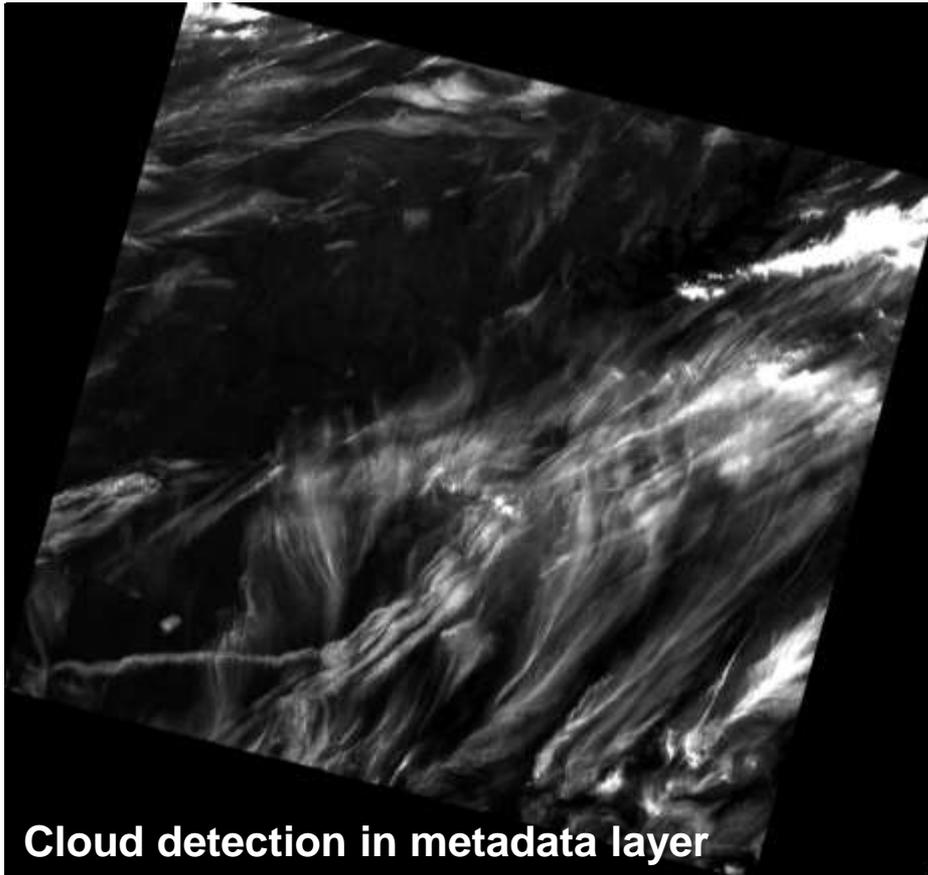
National Academies 2017 Decadal Survey

Earth science applications from space

Highlights for USGS:

- USGS should ensure that its process for **understanding user needs** is continued and enhanced throughout the life of the Sustainable Land Imaging (SLI) Program.
- **Partnerships** and user communities associated with SLI should be protected and continue to expand.
 - Leverage Cloud Service Providers
 - Leverage new imagers with higher spatial resolution than Landsat, but that still retain the capability to do global surveys to support a broader SLI mission
 - Leverage international missions

Analysis Ready Data (ARD) for Landsat (atmospheric correction and QC metadata)

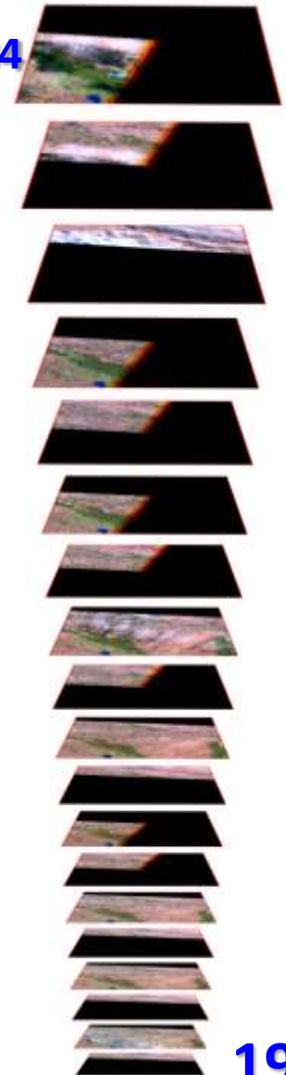
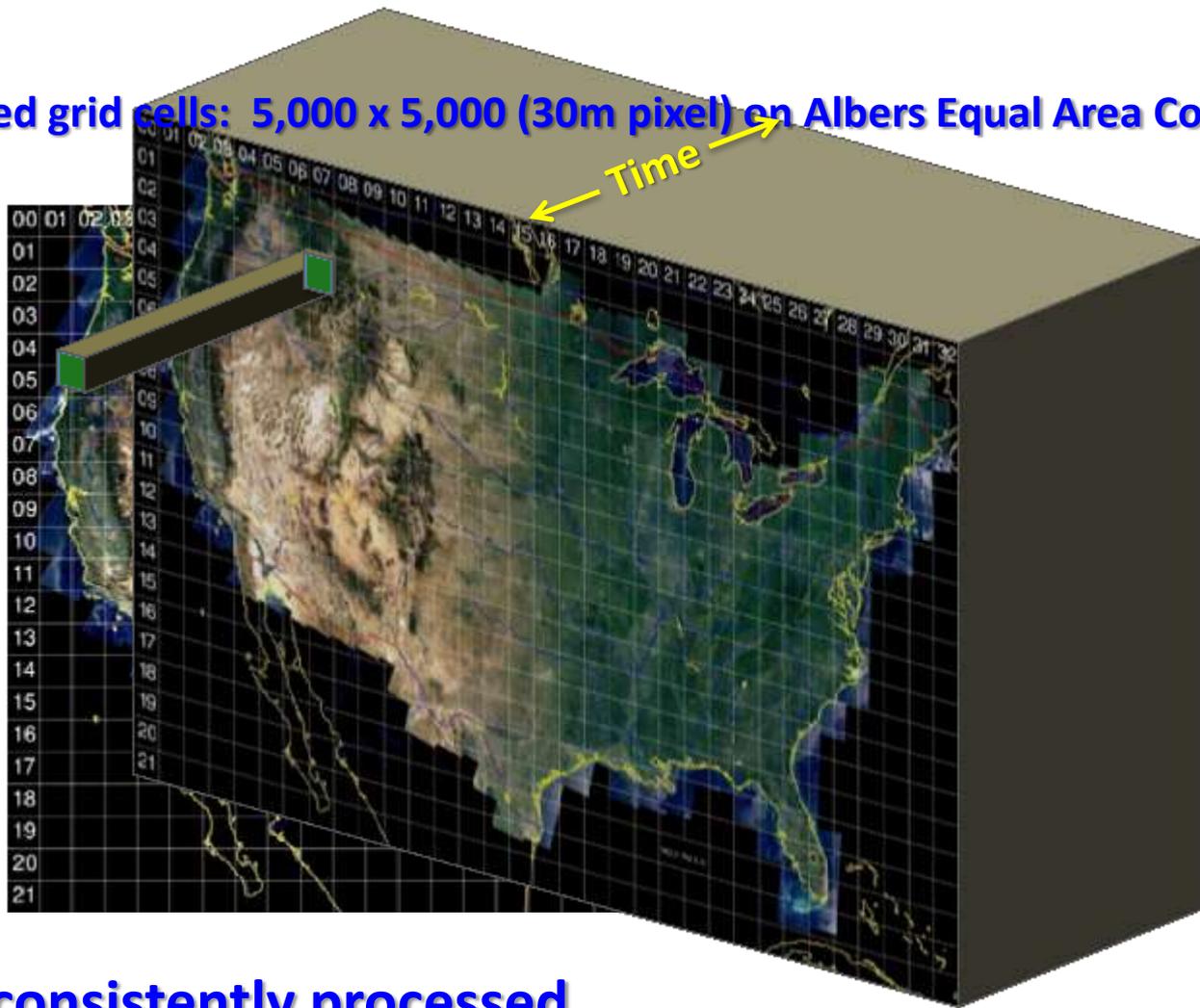


Landsat 8, path 15, row 33 (WRS2)

Analysis Ready Data (stacked in time)

Facilitated
time-series
analysis

Fixed grid cells: 5,000 x 5,000 (30m pixel) on Albers Equal Area Conic/WGS84



A consistently processed
“collection” with geometric and radiometric calibration

1972

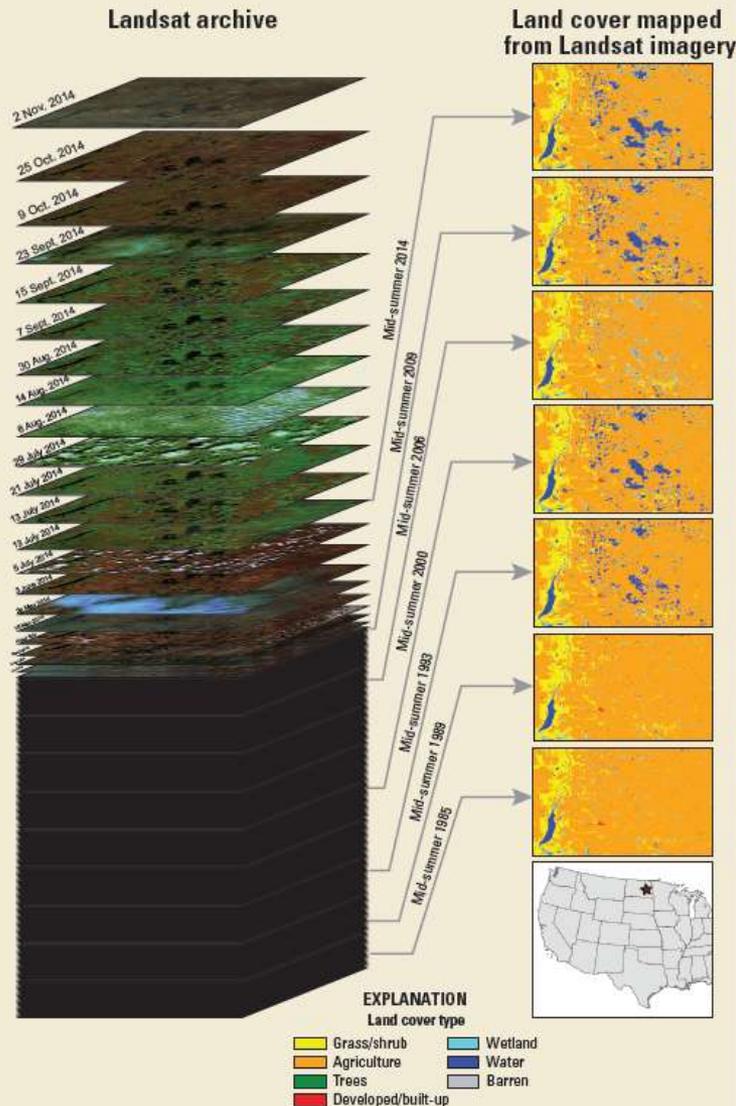


LCMAP – Land Change Monitoring, Assessment, and Projection

"[LCMAP] is a revolutionary approach to land cover mapping relative to what we have done in the past."

—John Dwyer,
Physical Scientist, EROS

Pulling from a time-series stack of the Prairie Potholes Region in North Dakota, researchers documented dramatic annual differences in available surface water in an area with global importance for migratory waterfowl. Dry conditions limited surface water during the mid-to-late 1980s as drought persisted until 1993. Substantial rains then filled depressional areas with water and reinvigorated the wetlands through the rest of the 1990s and into the early 2000s. A short drying period followed through the mid-2000s until 2009, when precipitation again replenished the area.



- Based on Analysis Ready Data (ARD) construct and CCDC.
- Characterize historical land change at any point across the full Landsat record (1972-present).
- Provide near-real time alerts to land managers.
- Understanding trends toward future land change to inform decision makers.

All algorithms on GitHub

- <https://github.com/USGS-EROS> (organization account)
 - [/lcmmap-pyccd](#)
 - python continuous change detection
 - [/lcmmap-pyclass](#)
 - python classification implementation
 - [/espa-surface-reflectance](#)
 - [/ lasrc](#) (Landsat Surface Reflectance Code)
 - Fortran and C versions for Landsat 8
 - [/ ledaps](#) (Landsat Ecosystem Disturbance Adaptive Processing System)
 - Scripts for Landsat 4-7

Installation of Landsat Science Team 2018-2023

21 members: Academia (7), U.S. Gov (6), International (5), Industry (3)

Directives

- Inform Landsat 10 design and development via NASA-USGS **Architecture Study Team (AST)**
- Inform definition and preparation for **Global Analysis Ready Data (ARD)**
- Inform continued development of **Land Change Monitoring, Assessment, and Projection (LCMAP)** initiative
- **Landsat harmonization with comparable and complementary data** (Sentinel 2 and small sats)

Free & open Analysis Ready Data for Landsat

- Modernizing access to the Landsat archive.
- Providing relief from the 80/20 data science paradigm.
- Informing decision makers with timelier analysis.
- What's next....
 - going global with ARD
 - integrating other data to better explain and forecast change
 - adopting better Cloud solutions
 - adapting machine learning tools for time-series analysis

Where to go: <https://earthexplorer.usgs.gov/>