# National Land Imaging Appropriations

<table>
<thead>
<tr>
<th></th>
<th>FY16</th>
<th>FY17</th>
<th>FY18</th>
<th>FY19</th>
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<tr>
<td></td>
<td>Enacted ($M)</td>
<td>Enacted ($M)</td>
<td>Enacted ($M)</td>
<td>PB ($M)</td>
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<td>Satellite Operations</td>
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<td>71.2</td>
<td>78.5</td>
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<td>Science Research &amp; Investigations</td>
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<td>14.6</td>
<td>14.6</td>
<td>3.0</td>
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<tr>
<td>Total</td>
<td>72.2</td>
<td>85.8</td>
<td>93.1</td>
<td>76.0</td>
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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.
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.
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)

Cloud detection in metadata layer

Landsat 8, path 15, row 33 (WRS2)

Surface Reflectance

185km
Analysis Ready Data (stacked in time)

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

Facilitated time-series analysis
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

- 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](https://github.com/USGS-EROS) (organization account)
  - /lcmap-pycccd
    - python continuous change detection
  - /lcmap-pyclas
    - 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/