Landsat 10 and Beyond

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Landsat Science Team Meeting
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SLI in FY16 Appropriation

A 3-part program for a sustainable and responsible land imaging program through 2035:

1. **Landsat 9** (fully Class-B rebuild of Landsat 8) to launch likely late CY2020
   - Low programmatic risk implementation of a proven system with upgrades to bring the whole system to Class B

2. **Land Imaging Technology and Systems Innovation**
   - Hardware, operations, and data management/processing investments to reduce risk in next generation missions

3. **Landsat 10**, Class B full spectrum, to launch ~2027-2028
   - Mission architecture to be informed by the technology investments (2015-), leading to definition ~2020
Landsat-9 Project initiated with FY15 funds
- Directed to NASA’s Goddard Space Flight Center (GSFC)
- Project Office established and substantially staffed
- OLI Instrument and L-9 spacecraft procurement actions in work
- TIRS-2 development in progress
- Launch ASAP, likely NET 12/2020 – there is sufficient ($100M) funding authority for FY16

Technology studies underway for L-10 definition and long-term technology infusion
- Detector component development
- Overall instrument size reduction using advanced technologies

NASA solicited, selected, and initiated science investigations focused on construction of multi-system fusion data sets (“Multi-Source Land Imaging Science”)
- “…[W]e solicit for efficient use and seamless combination with Landsat, of satellite sensor data from international Landsat-type moderate resolution (~30 m ground resolution), multispectral sources on continental to global scales. A primary focus is on developing algorithms and prototyping products for combined use of data from Landsat and Sentinel-2 toward global land monitoring. However, we also welcome proposals combining Landsat with other sources of moderate resolution data, such as IRS and/or CBERS...”
- 7 investigations selected, $1.3M/year total, 3-year studies

Copernicus data access agreements with EU signed (including all Sentinel-2 data)
While recognizing the scientific need for continuity with the 43-year Landsat record, we are seeing new trends & opportunities in land remote sensing

- **Evolving user needs for...**
  - Improved temporal revisit
  - Additional spectral coverage & resolution
  - Integration with other modalities (lidar, radar)
- **Increasing use of “small sat” platforms and distributed architectures**
- **Increasing number of commercial imaging systems**
- **Potential synergy with international systems (e.g. Sentinel-2)**
- **High-performance computing and increased emphasis on information rather than images**

Our challenge is to advance the measurement capability, while preserving continuity and constraining program costs
• **USGS assessing user needs for future land imaging**
  – Requirements Capabilities & Analysis for Earth Observations (RCA-EO)
    • Documents land imaging user needs across Federal Agencies
  – Additional input from Landsat Science Team and User Workshops

• **NASA Earth Science Technology Office (ESTO) managing technology developments for SLI**
  – Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities
  – NASA ROSES proposal opportunity now available

• **NASA Space Technology Directorate continuing development of a pathfinder satellite servicing mission [RESTORE–L] with FY16 funding**
  – Refuel Landsat-7 (or another U.S. Govt-owned satellite in low-Earth orbit), potentially extending the Landsat-7 lifetime
Earth Science Technology Office (ESTO)

- Tasked by the NASA Earth Science Division (ESD) to manage technology developments for the Sustainable Land Imaging (SLI) program

Overall objectives of the SLI-Technology (SLI-T) program

- Reduce the risk, cost, size, volume, mass, and development time for the next generation SLI instruments, while still meeting or exceeding the current land imaging program capabilities

- Enable new types of observations that improve temporal, spatial, and spectral resolution capabilities for SLI measurements

- Enable new SLI measurements and architectures which improve operational efficiency and reduce overall program costs of our land imaging capabilities
Example of a Future Technology

Point of Departure - Past
- Three 5-degree Field-of-View Offner Spectrometers

Reduced Envelope - Present
- Two Dyson spectrometers compactly packaged

Miniature - Future
- Photonic spectrometer utilizing planar waveguide circuits (spectrometer-on-a-chip)
FY 15 investments addressed areas identified for follow-on work from the earlier SLI Reduced Instrument Envelope Size (RIES) Study

• **Calibration**
  - Compact onboard calibration system
  - Vicarious calibration system

• **Performance analysis**
  - Compact telescope performance
  - Hyperspectral imager stray light and optical performance analysis

• **Detector performance and characterization**
  - Feasibility of bolometer use for Earth science instruments
  - High speed focal plane electronics and detector characterization
  - CCD performance characterization
NASA’s Research Opportunities in Space and Earth Sciences (ROSES) solicitations utilized to solicit future instrument systems and subsystem technologies

• Uses Landsat science community for inputs and requirements
• Utilizes grants, cooperative agreements and contracts, as appropriate

Advanced Technology Demonstrations (Systems/Instruments)

• 80% of SLI-T funding for the Landsat-Next mission
• Available for infusion to Landsat-Next, future Earth Venture, or technology demonstration opportunities
• Plan 5-year tasks (1-year base + four 1-year options)

Technology Investments (Subsystems/Components)

• 20% of the SLI-T funding for Landsat-Next+1 mission
• Plan 3-year tasks (1-year base + two 1-year options)

ROSES call released on December 18, 2015

• ROSES15 A.47 NNH15ZDA001N-SLIT
• Proposals due on March 30, 2016
• Selections planned for August 2016
Landsat
Continuing to Improve Everyday Life
http://landsat.gsfc.nasa.gov