

National Land Imaging Program

Requirements, Capabilities, and Analysis for Earth Observations—From User Needs to Earth Observation Solutions



At the core of the Nation’s land imaging enterprise, the Requirements, Capabilities, and Analysis for Earth Observations (RCA-EO) project serves as the backbone for understanding user needs and shaping the future of Earth observation (EO) systems, products, and technology development. Understanding user needs and continuously tracking observing system capabilities is essential for EO because it ensures that the U.S. Government investments remain aligned with the real-world decisions, applications, and societal benefits they are intended to support.

The RCA-EO project collects data users’ land imaging needs, focusing on what needs to be measured rather than specific technology. Collecting this data has resulted in a comprehensive understanding of civil land imaging user needs across scientific and operational applications. Over the past 10 years, the RCA-EO project has interviewed hundreds of subject matter experts, yielding more than a thousand user needs.

The RCA-EO project’s analytical tools, models, and methods help inform the development of land imaging systems and products, determine appropriate data purchases, and prioritize partnerships for access to data from missions outside of the USGS. Our tools and databases support decisions with credible, needs-based information.

Our comprehensive approach starts with community engagement to understand user needs. We can then analyze and measure how effectively government EO investments meet those needs. This work informs U.S. Geological Survey (USGS) and Department of the Interior programs, missions, and decisions.

The path from user needs to action in the RCA-EO project. This example demonstrates how RCA-EO incorporated the mineral mapping community's need for additional spectral bands during the 2018 Landsat architecture study (Wu and others, 2019).

RCA-EO: From User Needs to Action

Mineral Mappers Need Additional Spectral Bands

Connect

We aim to build relationships within the land imaging community to best understand and represent future imagery needs. This gives data users a say in the kinds of data they can access. Through extensive research, networking, and communications, RCA-EO canvases the EO user community to find out how optical remote sensing data are currently used and what might be needed in scientific areas of interest including agriculture, forestry, geology and minerals, fires, energy, water quality, and many more.

Collect

We collect technology-agnostic imagery user needs, also called requirements, through face-to-face interviews with scientific subject matter experts and other users of land imaging data to understand their data needs. In these sessions, we ask technical and non-technical questions about land imaging data needs, which includes five core attributes.

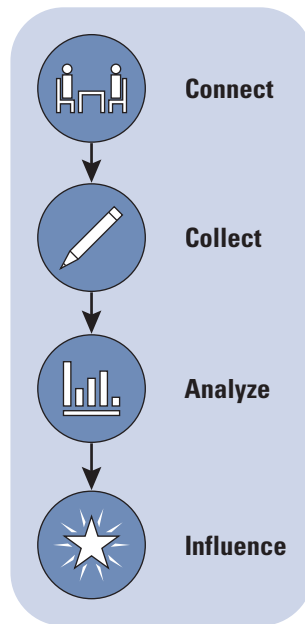
In addition to information about user needs, we collect publicly available details about remote sensing imagery and systems including U.S. Government, international, and commercial satellites.

Five Core Attributes

- geophysical features
- geographic area
- spatial resolution
- observation frequency
- data accuracy and quality

System Specification Information

- sensor spectral bands
- satellite geographic coverage
- sensor spatial resolution
- satellite altitude
- satellite revisit

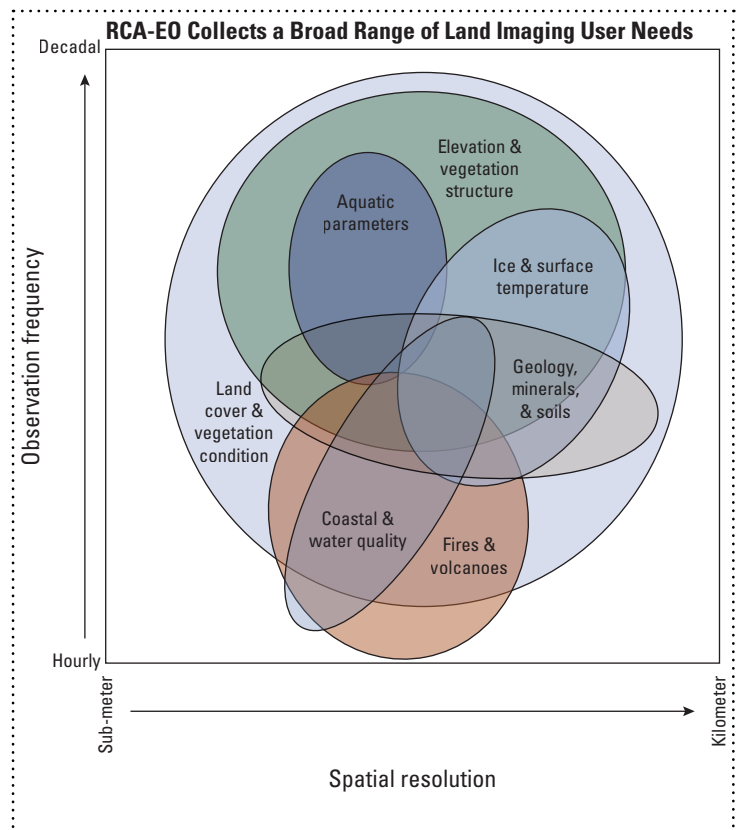


The Surface **Mineral Mapping** and Assessment project was selected as a **key user need** for determining a future Landsat architecture

Spectral band information from the project was collected to represent the geology and mineral mapping community's desire for **red edge and additional shortwave infrared and thermal infrared bands** to support identification of specific minerals (like neodymium)

The project was **included in the 2018 Landsat architecture study** for consideration

Red edge 2 along with shortwave infrared (SWIR) and thermal infrared (TIR) spectral bands were recommended additions to future Landsat missions to meet the needs of the mineral mapping community



RCA-EO user needs data are distributed across a wide range of spatial resolutions, observation frequencies, and geophysical phenomena.

Analyze

We perform various analyses to evaluate how different remote sensing systems, products, and data support diverse user communities.

EO Characterization and Modeling.—We first characterize EO systems, products, and data by documenting their specifications including spatial resolution, altitude, temporal frequency, and spectral bands. In addition to simple single-sensor systems, we can model sets of satellites (virtual constellations) and more advanced data products across U.S. Government, international, or commercial systems.

User Needs Analysis.—After characterization and modeling, we perform user needs analyses to understand how well a satellite system or product meets the needs of users by evaluating factors such as spatial resolution, temporal frequency, geographic coverage, and spectral accuracy.

Influence

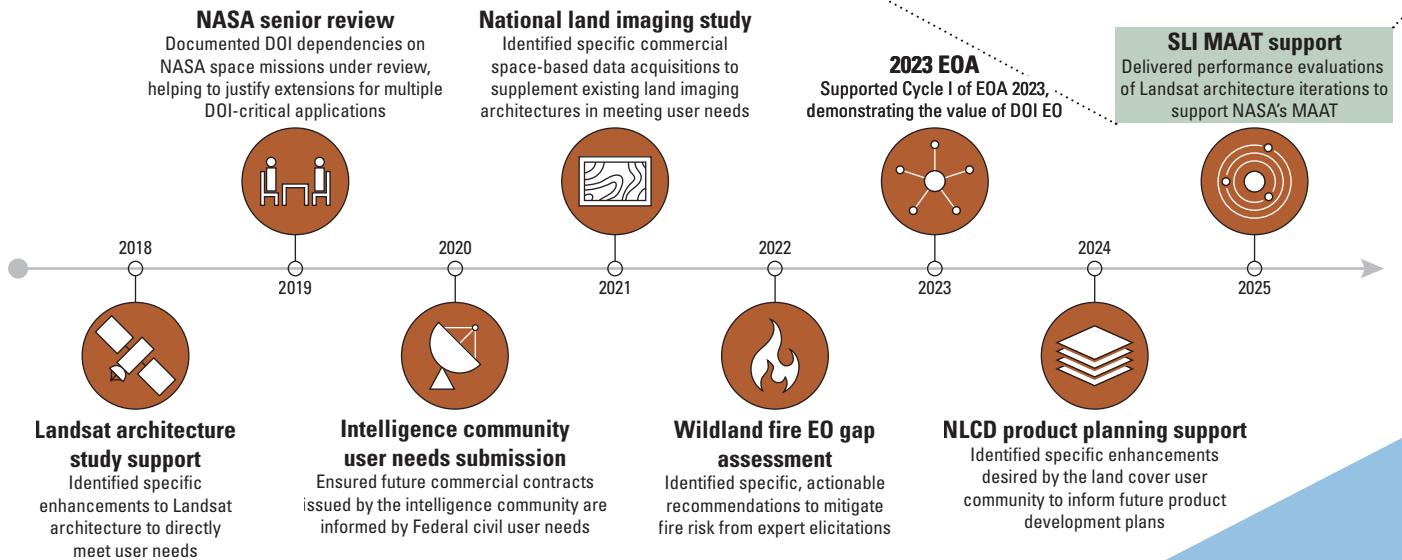
We use our analysis results to develop actionable recommendations to the National Land Imaging Program about strategic investments, mission planning, and product development. This helps RCA-EO identify investments that can benefit the most users. For more than 10 years, we have been helping to shape the priorities of the National Land Imaging Program through user-driven analyses.



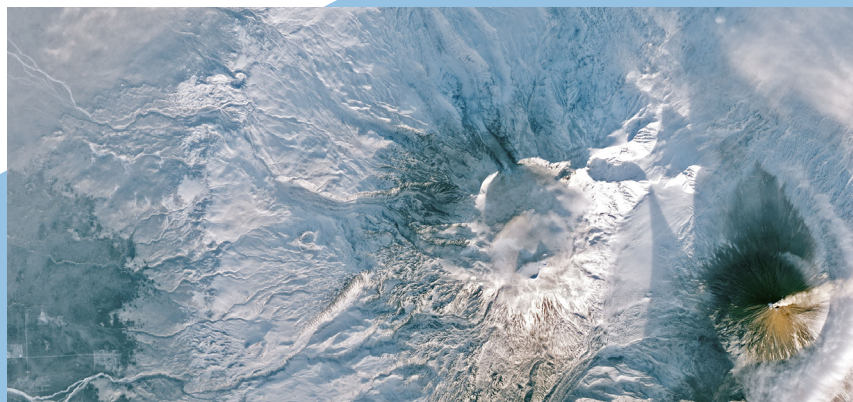
Project Milestone Highlight: Landsat Mission

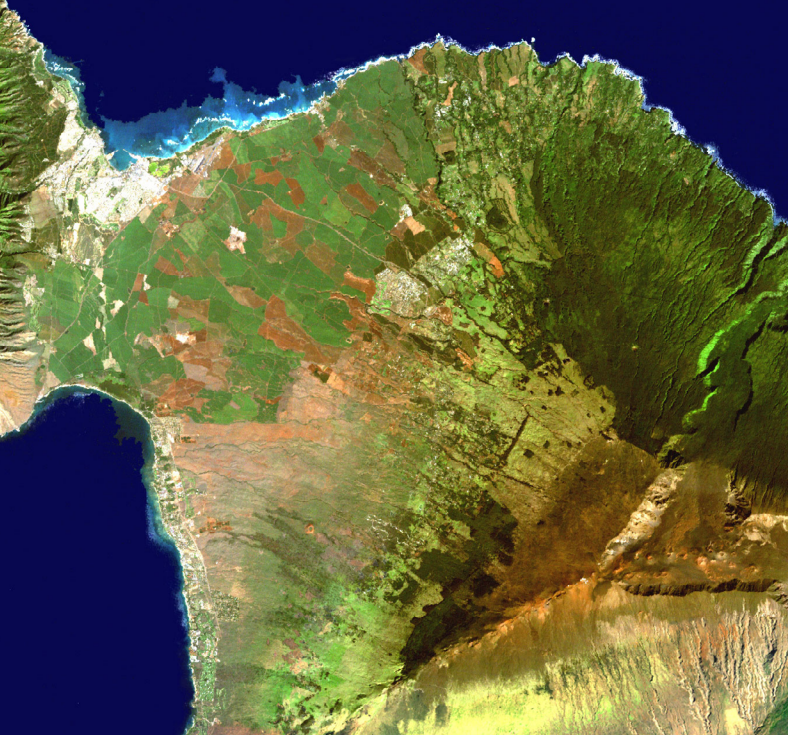
In the summer of 2025, the RCA-EO team supported the National Aeronautics and Space Administration's Sustainable Land Imaging Mission Alternatives Assessment Team to develop recommendations for future Landsat mission planning by evaluating **more than 300 variations of mission architectures on more than 400 land imaging user needs.**

RCA-EO Project Milestones



Timeline of RCA-EO project milestones from 2018 to 2025. [DOI, Department of Interior; EO, Earth observation; EOA, Earth Observation Assessment; MAAT, Mission Alternatives Assessment Team; NASA, National Aeronautics and Space Administration; NLCD, National Land Cover Database; SLI, Sustainable Land Imaging]





Reference

Wu, Z., Snyder, G., Vadnais, C.M., Arora, R., Babcock, M., Stensaas, G.L., Doucette, P., and Newman, T., 2019, User needs for future Landsat missions: Remote Sensing of Environment, v. 231, accessed May 29, 2026, at <https://doi.org/10.1016/j.rse.2019.111214>.

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Aeronautics and Space Administration (NASA), public domain

Image captions:

Top of page 3: Illustration of the Landsat 8 satellite in space over the southeastern United States, USGS.

Bottom of page 3: Satellite image of an ash and smoke plume coming from an active volcano on the Kamchatka Peninsula, Russia, captured by Landsat 8 in 2018, USGS.

Top of page 4: Satellite image of Maui, Hawai'i, captured by Landsat, USGS.

Middle of page 4: Illustration of the Suomi National Polar-orbiting Partnership satellite in space, NASA.

Bottom of page 4: Satellite image of the Apostle Islands and the surrounding area, Wisconsin, captured by Landsat 8, USGS.

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