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INSIGHT

Landsat Next on the Horizon

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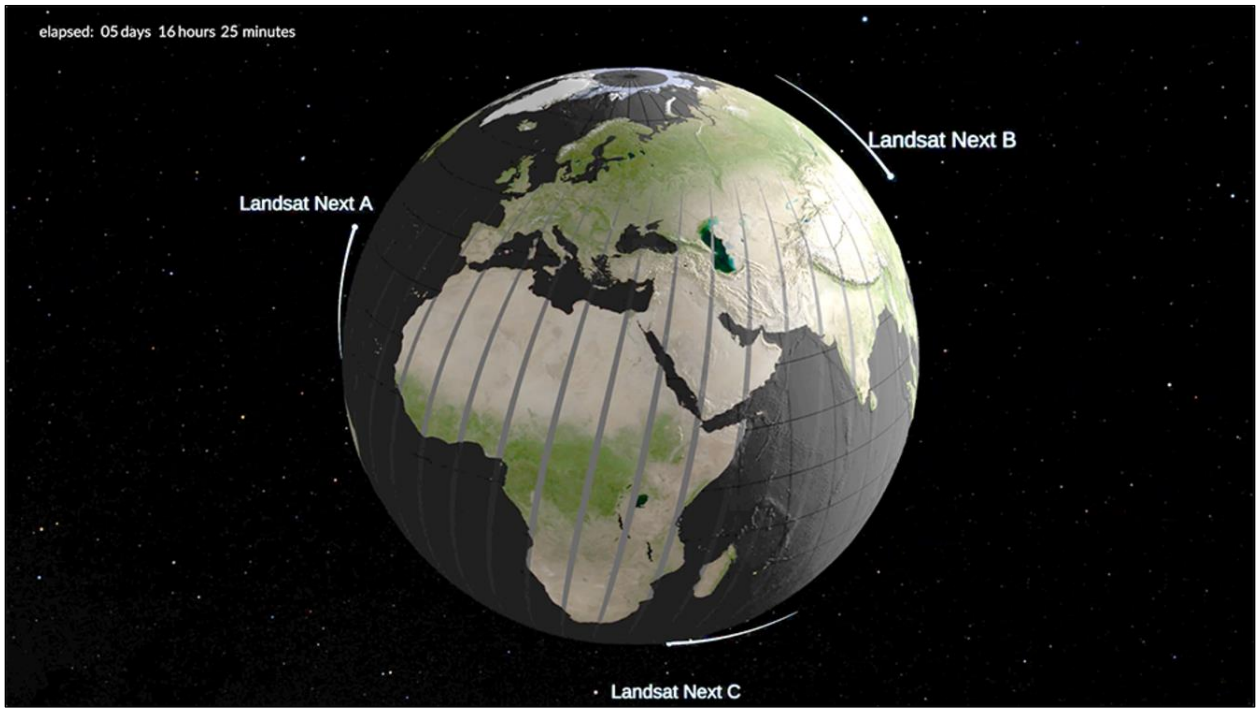
In December 2022, the National Aeronautics and Space Administration (NASA) and the U.S. Geological Survey (USGS) presented initial details about Landsat Next, the next proposed launch in the Landsat series of Earth-observing satellites that began on July 23, 1972. Landsat Next is to be a constellation of three observatories, sent into orbit on the same launch vehicle in late 2030 (see **Figure 1**), which are to collectively provide, on average, about 10 times more data than its predecessor mission, Landsat 9.

Figure 1. Schematic of Landsat Next Constellation



Source: U.S. Geological Survey (USGS), "Landsat Next," at https://www.usgs.gov/landsat-missions/landsat-next.

Landsat sensors detect and record visible near-infrared, shortwave-infrared, and thermal-infrared energy digitally and transmit images to ground stations, where they are processed and stored in a data archive.

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Landsat images are intended to be consistent with archived data to allow long-term comparisons of changes in the Earth's land features. In 2008, the USGS began making all Landsat data available for download at no charge and without restrictions. Recently, the USGS has released Landsat data via the commercial cloud.

Sustainable Land Imaging Program

In 2016, NASA and the Department of the Interior (DOI), which includes the USGS, entered into an interagency agreement to redefine their long-term Landsat collaboration through the Sustainable Land Imaging Program (SLIP) and outline responsibilities for future Landsat satellites. Under SLIP, the agencies are to develop a multi-decadal, spaceborne system to provide high-quality global land-imaging measurements compatible with the existing Landsat record. In practice, NASA develops Landsat satellites and instruments, launches the spacecraft, and checks the mission performance. Then, the USGS takes over satellite operations and manages and distributes the data from the Earth Resources Observation and Science Center. SLIP's memorandum of understanding also calls for jointly developing program strategy and architecture, identifying user needs, and defining mission requirements.

Current Landsat Observations

Landsat 9 was the first Landsat satellite launched under SLIP. Currently, Landsat 8 and 9 add nearly 1,500 new images a day to the Landsat archive. Landsat 8 and 9 each carry two sensors: an operational land imager (OLI), which observes many of the same spectral bands of radiation as Landsat 7, but with improvements, and a thermal infrared sensor (TIRS) that can measure land surface temperature. Both instruments have a 5-year mission design life, and the spacecrafts were launched with more than 10 years of fuel. For more information, see CRS Report R46560, *Landsat 9 and the Future of the Sustainable Land Imaging Program*.

Other countries have remote sensing satellite systems that are compatible with Landsat in certain areas and differ in others. For example, the European Space Agency Copernicus Earth Observation Program's Sentinel-2A and Sentinel-2B satellites share many of the technical characteristics of Landsat 8 and 9, though Sentinel-2 satellites provide additional unique features (e.g., red-edge and water vapor spectral bands) and do not have thermal infrared capability. Collectively, these satellites represent a system of systems, as called for by the National Academy of Sciences in the 2018 decadal strategy for Earth observation from space.

Resolution Improvements Projected for Landsat Next

Under SLIP, a Joint Agency Sustainable Land Imaging Architecture Study Team evaluated an acquisition strategy for a follow-on mission to Landsat 9 that would best satisfy assessed user needs, mission architecture, and mission requirements. NASA and the USGS state that the result, the planned Landsat Next constellation, will improve the temporal, spatial, and spectral resolutions by two to three times (see **Table 1**), while maintaining radiometric resolution (e.g., how much information is perceived by a satellite's sensor). The sensors on Landsat Next will have 26 spectral bands (see **Figure 2**), including refined versions of the 11 Landsat "heritage" bands, 5 bands with similar characteristics to Sentinel-2 bands, and 10 new spectral bands to support emerging Landsat applications.

Table 1. Resolution Differences Between Landsat 8 and 9, Sentinel-2 A & B, and Landsat Next

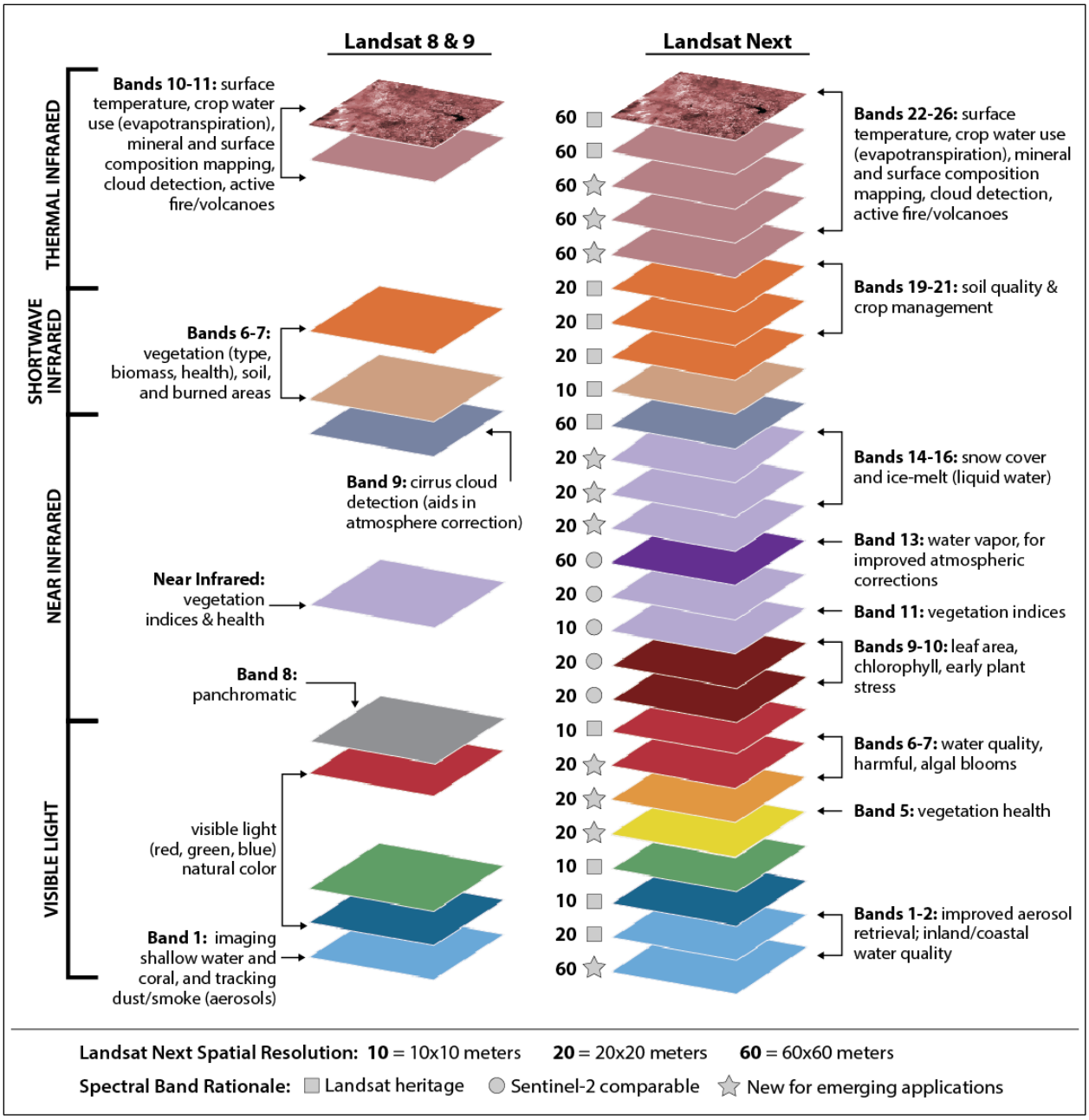
Resolution	Definition	Landsat 8 and 9	Sentinel-2 A and B	Landsat Next
Temporal[a]	Amount of time between visits of a sensor to a specific observation area (e.g., the time between satellite orbits over the same location)	16 days per satellite or 8 days in tandem (swath width of 185 kilometers)	10 days per satellite or 5 days in tandem (swath width of 290 kilometers)	16 days per satellite or 6 days collectively (swath width of 165 kilometers)
Spatial	Size of the area on Earth's surface represented by each pixel (finer resolution allows greater detail within the targeted area)	30x30 meters for 9 OLI bands and 100x100 meters for 2 TIRS bands	10x10 meters for 3 bands; 20x20 meters for 6 bands; 60x60 meters for 4 bands	10x10 meters for 5 bands; 20x20 meters for 13 bands; 60x60 meters for 8 bands
Spectral	Ability of a sensor to discern different wavelengths of electromagnetic radiation (e.g., more wavelength bands provide finer resolution)	11 bands (including 2 thermal bands)	13 bands (no thermal bands)	26 bands (including 5 thermal bands)

Source: CRS using NASA, USGS, and European Space Agency websites.

Notes: OLI = operational land imager; TIRS = thermal infrared sensor.

a. Clouds can obscure imagery of parts of the Earth at any given time, affecting temporal resolution.

Figure 2. Spectral Comparison of Landsat 8 and 9 and Landsat Next



Source: CRS using USGS, "Landsat Next," at https://www.usgs.gov/landsat-missions/landsat-next.

Moving Landsat Next Forward

Landsat Next's life cycle progress, including mission formulation, design, construction, launch, and operations, is contingent on multiple years of federal appropriations. In November 2022, the mission passed Key Decision Point A, entering the formulation phase to complete concept and technology development. For FY2024, NASA requested the first funds to initiate Landsat Next ($95.7 million), and the USGS requested an increase of $12 million for its SLIP line item compared with FY2023 for Landsat Next ground system development. Congress may debate the sufficient amount and timing of funding for

both agencies to support Landsat Next. Congress also may consider conducting oversight of mission progress to ensure Landsat Next meets user needs and requirements and the desired launch date.

Author Information

Anna E. Normand
Specialist in Natural Resources Policy

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