

USGS Response to the Midterm and Roundtable Discussions

National Academies of Sciences,
Engineering and Medicine

*Committee on Earth Sciences
and Applications from Space*

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USGS Response to the Mid-term Decadal Survey Assessment Report

The USGS is grateful for your work, that of your fellow Committee members, and that of NASEM's staff.

The USGS takes its role very seriously in meeting the needs of a large and growing community of users in federal, state, and local public services, industry, academia, and the non-profit sector, as they directly contribute to the Nation's environmental and economic well-being on a day-to-day basis.

The USGS analysis of the Midterm Report indicates it overlooked or misunderstood some key findings of the 2017 Decadal Survey. As a result, much of the Report's analysis regarding the Landsat program and the Landsat Next mission is, in our view, concerning.

USGS Response to the Mid-term Decadal Survey Assessment Report

Mid-decadal Recommendation: NASA should clearly articulate the substantial societal value and urgency of implementing the full set of the 2017 Earth science and applications from space decadal survey (NASEM 2018) priorities as well as its need for appropriate resources to do so. **It is imperative that NASA's Earth Science Division develop the framework to quickly assess and communicate what must be sacrificed when requirements imposed by its other stakeholders supplant the science and applications community's priorities as expressed in the decadal survey.** (Chapter 2)

USGS: The assumption in the highlighted language implies that requirements of "other stakeholders" are automatically less of a priority to the nation than those of "the science and applications community's priorities as expressed by the decadal survey." And that these requirements "must be sacrificed" as a result.

The Decadal Survey commended the USGS user needs documentation process. Yet the language above assumes the Decadal's own stated science priorities are the most valid source of user needs for the science and applications communities. While these needs are important, these science priorities alone undervalued the importance of continuous observations and operational land imaging. The user needs requirements for Landsat Next are very comprehensive and well validated across the public services and research communities, while those done via the Academy tend to focus more on cutting-edge research.

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Recommendation: NASA's Earth Science Division should pursue funding needed to cover the increase in Landsat Next's scope and budget that was not anticipated at the time of the 2017 Earth science and applications from space decadal survey (NASEM 2018). Otherwise, the increased Landsat Next budget substantially limits resources available to achieve the Earth science vision laid out in the 2017 decadal survey. (Chapter 3)

USGS: Concur with NASA ESD pursuing the funding needed to cover the full scope of Landsat Next. The USGS is also requesting increased funding to meet this mission's ground system need. However, the USGS does not believe the increase in Landsat Next's scope and budget should have been unanticipated.

The Decadal Survey set the Program of Record (POR) as the foundation and highest priority for NASA investment and anticipated ongoing out-year investment to support it. The Decadal included a budget line for future Landsat continuity within a broader funding line for outyear POR expenses. However, this placeholder was clearly not an actual mission profile, as it was flat, was never executable, nor did it account for costs associated with technology refresh and cost escalation, nor the need to meet evolving observational requirements and emerging applications.

In contrast to that approach, the Mid-term Report seemed to take issue with the budget for the POR, and singled out Landsat Next in a budgetary graphic (next slide) with new decadal missions representing it as apparently outside the POR and implying it was a new mission unforeseen by the original 2017 Decadal. This represents how the Mid-term Report seemed to disregard the Decadal Survey's prioritization of operational, services-oriented remote sensing missions over other more research-focused missions.

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Figure S-1 of the Mid-term report singled out Landsat Next in a budgetary graphic with new decadal missions, representing it as apparently outside the POR and implying it was a new mission unforeseen by the original 2017 Decadal Survey.

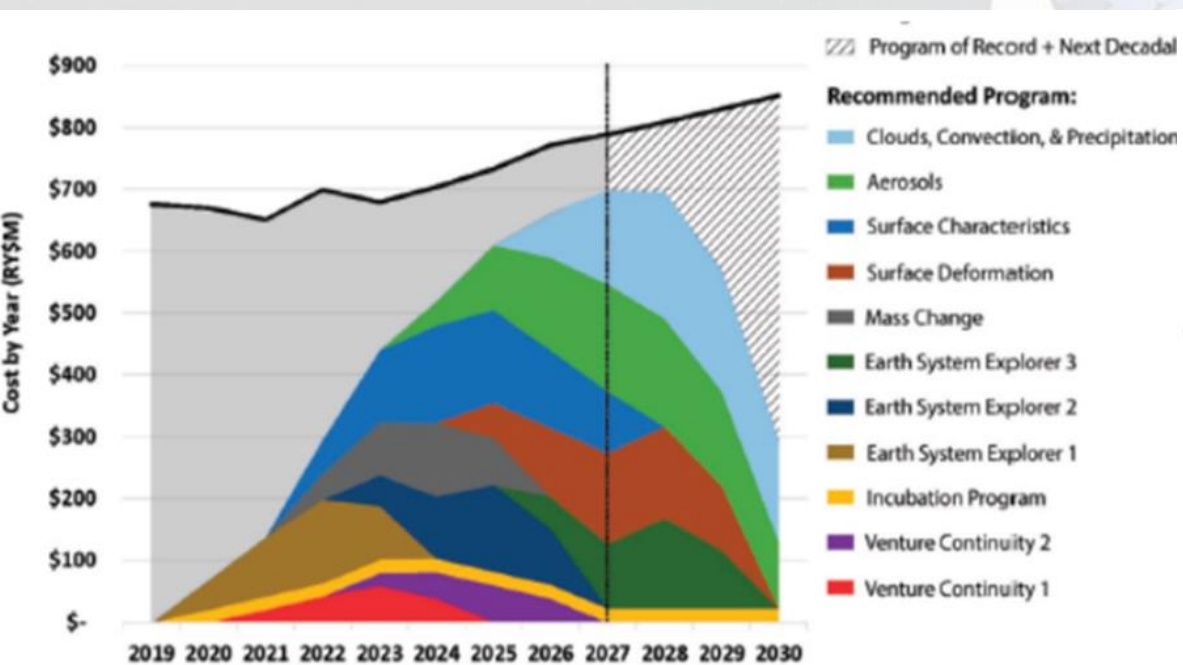


Figure S-1: The Decadal Survey's recommended flight program spending for fiscal year (FY) 2019–2030

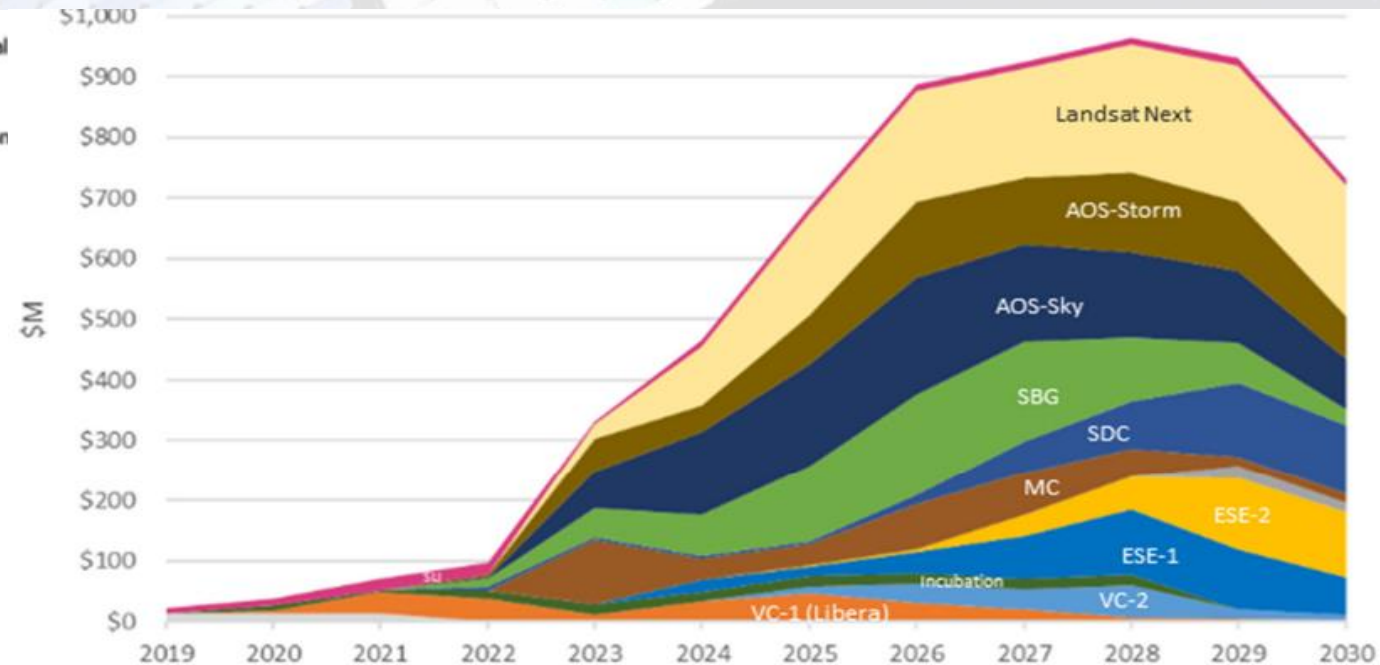


Figure S-1: NASA ESD's actual FY 2019–2023 and planned FY 2019–2030 new expenditures based on the President's FY 2024 budget request

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Recommendation: The committee acknowledges the significant challenge of balancing the needs and priorities of users of an operational Landsat program with the priorities of the Earth system science and applications community as a whole. The latter is represented in the decadal survey, whereas the former is the community whose needs and priorities were solicited in developing the concept for Landsat Next. When such substantial increases to one program element are not accompanied with an overall budget increase, the result is a significant impact on the rest of the program. Yet, NASA's decision to proceed with the Landsat Next program was made without advice by the National Academies or other appropriate organization on how to best address its impact on programmatic balance and other decadal survey priorities.

USGS: The Decadal commended the USGS user needs documentation process; yet the Mid-term Report assumes the Decadal's own stated science priorities are the most valid source of user needs for the science and applications communities. While these needs are important, these science priorities alone undervalue the importance of continuous observations and operational land imaging—used by researchers around the world.

Landsat Next supports the growing public services, research, and educational needs of the land imaging user community and continues Landsat's history of technology infusion and improvements in observing capabilities. Yet the Mid-term Report was critical of this approach and seemed to question why NASA and the USGS didn't settle for older, less capable technology. The Mid-term Report thus seemed to equate the concept of observational continuity with technological stasis.



(Continued on next slide)

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With respect to Landsat continuity, the 2017 Decadal Survey recommended that NASA and the USGS consider a more streamlined “block buy” approach to land imaging missions, akin to that of Europe’s Copernicus-Sentinel 2 satellite program. NASA and the USGS approached the Landsat Next mission accordingly and approved an innovative “triplets constellation” design of three satellites operating in tandem. This design incorporates advanced proven technology and greater capability and resiliency than a single satellite. On a per-satellite basis, the Landsat Next mission costs less than either Landsat 8 or Landsat 9, while providing enhanced capabilities to meet documented user needs.

The Mid-term Report inaccurately focused only on the Landsat Next mission as a “budget challenge” for NASA’s Earth Science Division, when there have been other missions posing challenges as well. In fact, under the NASA-USGS Sustainable Land Imaging Program, Landsat is a well-managed and executed mission that has had a proven track record for cost realism throughout its mission life cycle.

Finally, Landsat’s benefit to society has never been greater. A recent Landsat Value Study found that the annual economic benefit of Landsat around the world is estimated at \$25 billion! And that Landsat Next will deliver an additional \$8 billion to bump that up to a total of \$33 billion. The mission is vitally important to a large variety of science research and operational applications ranging from agriculture and forestry to water resource management and wildfire monitoring and response.

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Recommendation: Prior to the next decadal review, NASA, the National Oceanic and Atmospheric Administration, and the U.S. Geological Survey should engage a broader Earth sciences constituency by

- Identifying Earth observation stakeholders, improving understanding of their short and long-term needs, and encouraging participation of the community of stakeholders in the next decadal survey.

USGS: Concur. The Decadal Survey endorsed the USGS National Land Imaging Program Requirements, Capabilities and Analysis (RCA) for Earth Observation user needs collection process, and that process remains an important driver for the program, which benefitted through the derivation of the user needs for Landsat Next.

Recommendation: Through requests for information and workshops, NASA, the National Oceanic and Atmospheric Administration, and the U.S. Geological Survey should more actively engage the Earth system modeling community to devise strategies to more fully exploit existing and potential Earth observations for advancing model parameterizations and predictions. (Chapter 5)

USGS: Concur. The USGS National Land Imaging Program is investing in land change projection techniques that utilize the 52-year Landsat data archive and apply algorithms developed by Academia to project land cover change into the future.

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Final Observations from the USGS

It's important that the next Decadal Survey take into account the perspectives of the operational user community and the systems they rely on for their Earth science applications.

It should also reflect that the research community makes extensive use of operational Earth observation systems. Participants for the next Decadal should reflect a mix of research and operational users.

Thank you for the Committee's consideration of these matters. The USGS looks forward to continuing the dialogue with you and our numerous stakeholders on how to provide the best possible value to the public for an operational land imaging program.

Backup Slides



Landsat was included in the 2017 Decadal Survey

Landsat was definitively included in the 2017-2027 Earth Science Decadal Survey Program Of Record (POR). The Decadal spoke to the high value of Landsat and considered Sustainable Land Imaging (SLI) as part of the POR:

- In the SBG Targeted Observable section: “POR Assumptions. It is assumed that the Sustainable Land Imaging program continues to provide Landsat-class land imagery to complement the measurements described here.”
- On page 212: “NASA may want to consider Landsat-10 and Landsat-11 to follow the example of Sentinel-2 for a block buy of two imagers with a wider-swath (300 km) and multispectral visible, near-infrared, shortwave infrared, and thermal data, which would increase the equatorial revisit frequency to 2.0 days for the harmonized data.
- On page 350: “In considering the measurement approaches needed to address the identified objectives, the panel assumes that operational systems, as well as those in the Program of Record (POR), will continue and will provide several key measurements. Assumptions of particular note are the continuation of the Joint Polar Satellite System (JPSS) weather satellites ...; the continuation of Landsat-8 (followed by Landsat-9 through Landsat-11)...”

Provided to the Mid-Decadal Team on November 2, 2023



A PRIORITIZED PROGRAM FOR SCIENCE, APPLICATIONS, AND OBSERVATIONS

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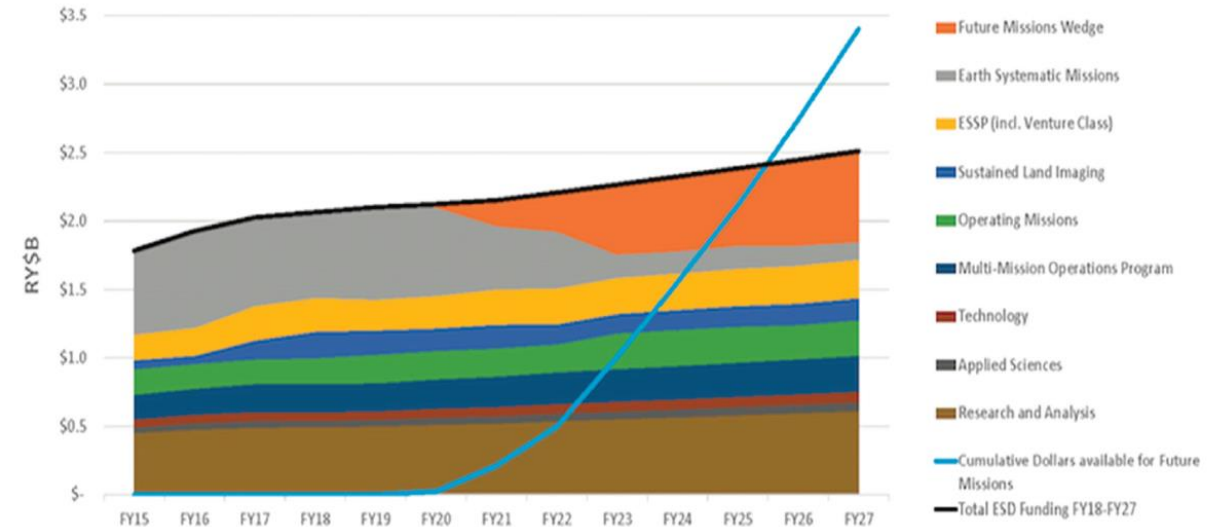


FIGURE 3.3 Baseline budget scenario assumes that the POR budget grows with inflation. Flight program funding for decadal survey priorities is unavailable until FY 2020. The cumulative total budget available for flight program investment in ESAS 2017 priorities is \$3.4 billion through FY 2027. Labels shown in the legend refer to budgetary components within NASA's Earth Science Division (ESD). NOTE: ESSP = Earth System Science Pathfinder.

The SLI funding profile above represents approximately \$1.23 billion from FY18 - FY27

Figure 3.3 above includes a “Sustained Land Imaging” funding wedge. The Decadal Survey assumed a flat 2017 budget for SLI of \$123M in 2017 dollars through 2035.

The Landsat Next budget profile is reasonable given its history

The notional Landsat funding profile provided by NASA to the Decadal – a flat \$123 million per year – did not adequately account for the costs associated with Landsat technology refresh and cost escalation, nor the need to meet evolving observational requirements and emerging applications.

The joint NASA/Interior Sustainable Land Imaging (SLI) program first envisioned by Mike Freilich in 2015 – and endorsed with a new ten-year SLI Landsat Next Annex in 2022 by Karen St. Germain – envisioned a multi-tiered “sustainable” program with on-ramps for new technology designed to meet evolving user needs.

The world of the 2030s will be different, requiring improved Earth observations – Landsat Next will maintain Landsat’s historic radiometric quality while supporting the monitoring of smaller agricultural fields and forests; more rapid clear views of crop health and productivity, water quality, snow/ice state and wildfire; and support emerging applications in water quality, snow hydrology and soil mapping.

Landsat Next is projected to cost on the order of \$1.5 billion over its development – a cost close to historical first-mission costs (such as Landsat 8 at \$1.1 billion) when inflated into the 2020s.

Landsat history shows that “continuity evolves” – each new mission is enhanced with improved technology to better meet evolving user needs while sustaining continuity



The “Landsat 10” funding profile was notional and not realistic

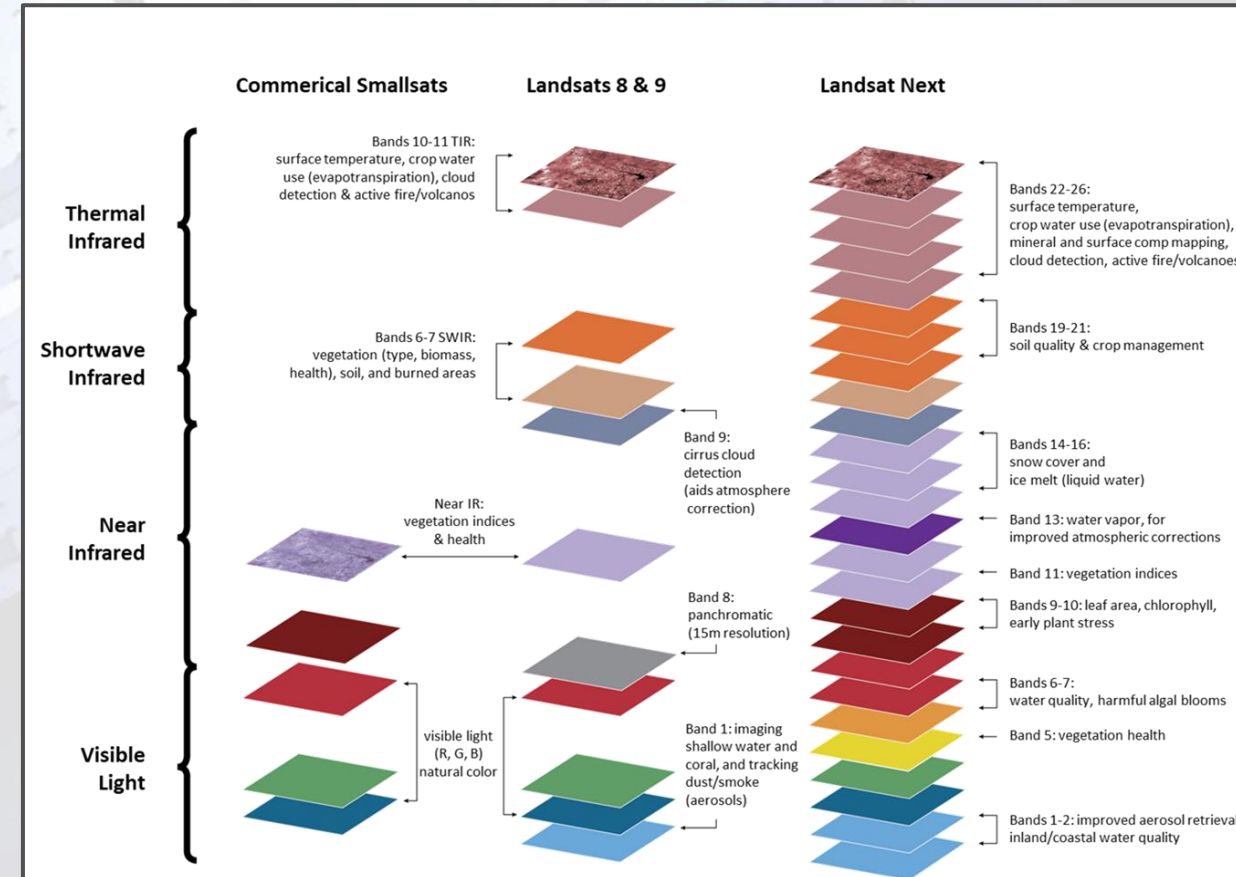
Prior to Landsat Next pre-formulation, the budget for “Landsat 10” was held as part of a notional Sustainable Land Imaging (SLI) budget and didn’t reflect a truly executable project profile

The flat funding wedge for SLI seemed to assume that the next Landsat mission would deliver the same capability as Landsat 9, but at reduced levels of funding, as even the Landsat 9 profile typically was well in excess of \$123 million per year:

- \$131M in FY17; \$179M in FY18; \$166M in FY19; \$128M in FY20
- Applying inflation to the Landsat 9 funding peak translates to **\$246M** in FY29 dollars

The SLI Architecture Study Team’s work in 2018-2019, based on a comprehensive *Decadal Survey-endorsed* USGS user needs assessment, and extensive NASA technology development, recommended a completely new architecture for Landsat Next, which was further refined by NASA and USGS project offices in 2020-2021, resulting in the current three-satellite Landsat Next “Triplets” mission concept currently in NASA acquisition development Phase A.

Multi-spectral → Super-spectral



Landsat Next will provide more than **twice as many spectral bands** as Landsat 8/9, with **spatial resolution improved by a factor of 2**, and **significantly improved repeat coverage**