

2017 Decadal Survey for Earth Science and Applications from Space

“ESAS 2017”

SUMMARY

The National Research Council (NRC), led by the Space Studies Board in collaboration with other Earth Science related boards across the NRC, will organize a “decadal survey” that will generate consensus recommendations from the environmental monitoring and Earth science and applications community on an integrated and sustainable approach to the conduct of the U.S. government’s civilian space-based Earth-system science programs. These programs are carried out predominantly by the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the United State Geological Survey (USGS), with supporting and complementary contributions from agencies including the National Science Foundation (NSF), Department of Agriculture (USDA), Department of Energy (DoE), and Department of Defense (DoD).

STATEMENT OF TASK

The National Research Council will appoint a steering committee and supporting study panels to carry out a decadal survey in Earth Science and Applications from Space. The study will generate consensus recommendations from the environmental monitoring and Earth science and applications communities for an integrated and sustainable approach to the conduct of the U.S. government’s civilian space-based Earth-system science programs.

The survey’s prioritization of research activities will be based on the committee’s consideration of identified science priorities; broad national operational observation priorities as identified in U.S. government policy, law, and international agreements (for example, the 2014 National Plan for Civil Earth Observation) and the relevant appropriation and authorization acts governing NASA, NOAA, and USGS; cost and technical readiness; the likely emergence of new technologies; the role of supporting activities such as in situ measurements; computational infrastructure for modeling, data assimilation, and data management; and opportunities to leverage related activities including consideration of interagency cooperation and international collaboration. As the committee starts its work it will be provided the guidance contained in Appendix A. The survey committee will work with NASA, NOAA, and USGS to understand agency expectations of future budget allocations and design its recommendations based on budget scenarios relative to those expectations. The committee may also consider scenarios that account for higher or lower than anticipated allocations.

During this study, the committee’s primary tasks will be:

1. Assess progress in addressing the major scientific and application challenges outlined in the 2007 Earth Science Decadal Survey.
2. Develop a prioritized list of top-level science and application objectives to guide space-based Earth observations over a 10-year period commencing approximately at the start of fiscal year 2018 (October 1, 2017).

3. Identify gaps and opportunities in the programs of record at NASA, NOAA, and USGS in pursuit of the top-level science and application challenges—including space-based opportunities that provide both sustained and experimental observations.
4. Recommend approaches to facilitate the development of a robust, resilient, and appropriately balanced U.S. program of Earth observations from space.

In addition the committee will conduct the following agency-specific tasks:

5. Recommend NASA research activities to advance Earth system science and applications by means of a set of prioritized strategic “science targets” for the space-based observation opportunities in the decade 2018-2027. (A science target in this instance comprises a set of science objectives that could be pursued and significantly advanced by means of a space-based observation.) The prioritization process will begin with the committee identifying the critical measurement capabilities associated with the science target. For each science target, the committee will then identify a set of objectives and measurement requirements/capabilities for space-based data acquisitions. If appropriate and usually only for recommendations associated with major investments, the committee will (via a “CATE” process) assemble notional proof-of-concept missions with the recommended capabilities in order to better understand the top-level scientific performance and technical risk options associated with mission development and execution. In addition:
 - a. The committee will carry out its prioritization with a view towards minimizing mission development and acquisition costs and maximizing the role of competition in implementing flight recommendations.
 - b. For each science target, the committee will establish the context, criteria, and justifications for its recommended prioritization, and identify scientific and/or programmatic developments of sufficient significance that they would warrant reexamination of the committee’s recommendation.
 - c. The prioritization process will include reconsideration of the scientific priorities associated with the named missions from 2007 Earth Science and Applications from Space Decadal Survey.
 - d. In considering budget scenarios for NASA, the committee may consider scenarios that account for higher or lower than anticipated allocations. For NASA, the committee’s recommendations will also include guidance on how to rebalance programs upon failure of one or more of the criteria/assumptions underpinning a mission recommendation.
 - e. The committee may also identify potential interagency and international synergies; proposed augmentations to planned international missions; and adjustments to U.S. missions planned, but not yet implemented.
 - f. The committee may comment on technology investments; new areas of research emphasis; or suborbital, ground, or in situ activities.
6. For NASA, the committee will pay particular attention to prioritizing and recommending balances among the full suite of Earth system science research, technology development, flight mission development and operation, and applications/capacity building development conducted in the Earth Science Division (ESD) of the Science Mission Directorate. In particular, while making clear its assumptions regarding the overall scope

of the NASA ESD program relative to the contributions of the mission agencies NOAA and USGS, the committee will make recommendations on:

- a. The target budgetary balance between Flight and Non-Flight aspects of the ESD portfolio;
 - b. In the Non-Flight portion of the program, the target balance between R&A, Applied Science, and Technology elements;
 - c. In the Flight element, the target budgetary balance between systematic/directed, and competed/cost/schedule-constrained mission programs;
 - d. In the Flight element and considering overall resource constraints, the target budgetary balance between general mission-enabling investments (such as common spacecraft development, highly disaggregated constellations, etc.) and traditional focused single-mission developments;
 - e. In the Flight and Technology elements, the degree that NASA investment decisions could be informed by NOAA and USGS operational satellite measurement objectives,;
 - f. Expanding or modifying the present 3-strand Venture-Class competed program, including examining whether ESD should initiate additional or different Venture Class strands, possibly with different cost caps;
 - g. Decision principles for balancing new measurements against time series extensions of existing data sets; and
 - h. Any changes in scope(s) of the non-flight R&A, Applied Sciences, and Technology Development elements.
7. For NOAA and the USGS, which have a critical requirement for continuity of observations and delivery of services and information to the public and commercial sectors, the decadal survey committee's recommendations will be framed around national needs, including, but not limited to research priorities. The committee's recommendations for NOAA and the USGS will, as far as practicable, align with anticipated budgets at the relevant portion(s) of the agencies, with any deviations from those budgets clearly presented. Recommendations may be organized around 1) how new technology may enhance current operations, and 2) what new science is needed to expand current operations, either to enable new capabilities or to include new areas of interest. In making these recommendations, the committee will consider the need to bridge current operations and support a viable path forward for the uninterrupted delivery of public services through these generational changes. In particular, the committee:
- a. Will, with the expectation that the capabilities of non-traditional providers of Earth observations continue to increase in scope and quality, suggest approaches for evaluating these new capabilities and integrating them, where appropriate, into NOAA and USGS strategic plans. The committee will also consider how such capabilities might alter NOAA's and USGS's flight mission and sensor priorities in the next decade and beyond.
 - b. Will consider which scientific advances are needed to add to NOAA's future predictive capabilities. This includes taking into the account the overlap and interdependencies between water, weather and climate, and encouraging the

development of extended, and diversified forecasts. The committee will similarly consider advances needed to meet the needs of USGS science priorities and data users, for example advising on advances that can support both the natural resource management community and the climate research community.

- c. May offer recommendations concerning “research to operations” (or “innovation for continuity and service improvements across agencies”). For example, the committee may identify areas where NASA technology investments may lead to more efficient or effective NOAA and USGS missions by raising the Technology Readiness Level (TRL) of enabling technologies.
- d. Will consider the agencies’ ability to replicate existing technologies to improve and sustain operational delivery of public services, and also to produce consistent and reliable science and applications data products across different generations of measurement technology, as new measurement innovations are introduced.