NATIONAL PLAN FOR CIVIL EARTH OBSERVATIONS

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Executive Summary

The U.S. Government is the largest provider of environmental and Earth-system data in the world. These data are derived from observations of the Earth, which are used by Federal agencies and their partners to carry out their missions. These data form the foundation of services that protect human life, property, the economy, and national security, and they support research to foster scientific advances. Provided through public funding, they are made open to the greatest extent possible to advance human knowledge, to enable private industry to provide value-added services, and for general public use.

As the Nation's Earth-observation capacity and related data holdings have grown, so has the complexity of the challenge of managing Earth observation systems effectively and taking full advantage of the data they collect. While Earth observations and data are often collected to support the delivery of well-defined products and public services or meet specific research needs, improved coordination and access would ensure that the data are used more broadly. By expanding the use of observations and data beyond the purposes for which they are originally collected, the United States can maximize the impact of the resources invested in Earth-observation systems.

In October 2010, Congress charged the Director of the Office of Science and Technology Policy (OSTP) with establishing a mechanism for addressing this challenge through the production and routine update of a strategic plan for Earth observations. In response, OSTP convened a National Earth Observations Task Force (NEOTF) in February 2011, which produced the National Strategy for Civil Earth Observations in April 2013. The NEOTF also conducted the first assessment of the Federal Earth observations enterprise. The resulting Earth-Observation Assessment (EOA) considered the impact of observing systems on distinct societal benefit areas.

This document, the *National Plan for Civil Earth Observations* (hereafter referred to as the National Plan), incorporates the priorities identified in the EOA to provide strategic guidance for a balanced portfolio approach to managing civil Earth observations to fulfill agency mandates and achieve national objectives. As required by law, this National Plan will be updated every three years to provide greater coordination of Federal civil Earth-observation systems.

The National Plan defines a new framework for constructing a balanced portfolio of Earth observations and observing systems. This framework classifies Earth-observation activities according to two broad categories, "sustained" and "experimental" based on the duration of the anticipated Federal commitment:

- Sustained observations are defined as measurements taken routinely that Federal agencies are committed to monitoring on an ongoing basis, generally for seven years or more. These measurements can be for public services or for Earth-system research in the public interest.
- Experimental observations are defined as measurements taken for a limited observing period, generally seven years or less, that Federal agencies are committed to monitoring for research and development purposes. These measurements serve to advance human knowledge, explore technical innovation, and improve services, and in many cases may be first-of-their-kind Earth observations.

Within the subcategory of sustained observations for public services, the National Plan defines two tiers of measurement groups. Tier 1 measurement groups are those derived from systems identified in the EOA as having high impact on a majority of the societal benefit areas; Tier 2 measurement groups include those derived from the remaining high-impact systems. While the EOA provided higher overall scores to Tier 1 systems, many Tier 2 systems contribute critically, or are essential, to key objectives in one or more societal benefit areas. Some Tier 2 systems are the only observing systems available for accomplishing a particular objective.

These new categories advance the Nation's approach to Earth observations by describing a new framework based on the duration of Federal commitment to the period of observation, which is an essential step for prioritizing the Nation's Earth observations portfolio. This framework is also a step toward addressing a key policy challenge in Earth observations: determining when experimental observations should be transitioned to sustained observations for research or for delivery of public services.

Based on this framework and the results of the EOA, the National Plan establishes the following rank-ordered priorities:

1. Continuity of sustained observations for public services
2. Continuity of sustained observations for Earth-system research
3. Continued investment in experimental observations
4. Planned improvements to sustained observation networks and surveys for all observation categories
5. Continuity of, and improvements to, a rigorous assessment and prioritization process

The overall set of observations resulting from these priorities should yield a balanced Earth-observations portfolio.

While the National Plan provides guidance in setting priorities for the construction of the portfolio, agencies have discretion, in consultation with the Executive Office of the President and Congress, to deviate from the National Plan's rankings of priorities when necessary for managing specific systems in the categories and tiers outlined in this document. The National Plan provides this flexibility while still meeting the Nation's overall civil Earth-observation priorities and objectives.

The National Plan also identifies the following rank-ordered supporting actions that will maximize the benefits derived from the Nation's Earth observations:

1. Coordinate and integrate observations
2. Improve data access, management, and interoperability
3. Increase efficiency and cost savings
4. Improve observation density and sampling
5. Maintain and support infrastructure

6. Explore commercial solutions
7. Maintain and strengthen international collaboration
8. Engage in stakeholder-driven innovation

The National Plan also describes specific agency roles and responsibilities for sustaining observation systems and platforms.

Implementation and coordination of the activities outlined in the National Plan will be conducted through the budget and program-planning activities of the relevant Federal agencies and through interagency processes. Federal agencies will determine implementation schedules, progress reviews, and funding profiles in consultation with the Executive Office of the President.

The primary forum for interagency discussion and coordination of Earth observation, related data management, and related international issues is the United States Group on Earth Observations (USGEO) Subcommittee of the National Science and Technology Council (NSTC) Committee on Environment, Natural Resources, and Sustainability (CENRS). OSTP, in consultation with the USGEO Subcommittee, the NSTC CENRS, and their member agencies, will review and update this National Plan on a three-year cycle. As part of the update process, OSTP will solicit and consider the input of external stakeholders and the general public. For this first National Plan, OSTP sought input from external stakeholders through a publicly released Request for Information.

1. Introduction

The U.S. Government the largest provider of environmental and Earth system data in the world. These data are derived from Earth observations[1] collected by numerous Federal agencies and partners to carry out their missions in support of life, property, and economic and national security, and they are the foundation for scientific advances**.** In accordance with the *National Strategy for Civil Earth Observations* and Executive Order No. 13642, these publicly funded data are made open[2] to the greatest extent possible to advance human knowledge, to enable private industry to provide value-added services, and for general public use.[3]

Conservative estimates indicate that Federal Earth-observation activities add $30 billion to the U.S. economy each year.[4] These investments ensure that decision makers, businesses, first responders, farmers, and an array of other stakeholders have the information they need about natural resources, climate and weather, natural hazards, land-use change, ecosystem health, water, and other characteristics of the planet. Taken together, Earth observations provide the indispensable foundation for meeting the Federal Government's long-term sustainability objectives and advancing U.S. social, environmental, and economic well-being.

As the Nation's Earth-observation capacity has grown, however, so has the complexity and challenge of its most effective use for public benefit. Today, civil Earth observations are funded in the budgets of 11 departments and agencies of the Federal Government, including more than an estimated $2.5 billion in satellite systems and more than $1 billion for airborne, terrestrial (including freshwater), and marine networks and surveys (e.g., buoys, stream gages, and fishery surveys). U.S. Earth observation efforts are

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[1] The term "Earth observations" refers to data and products derived from Earth-observing systems and surveys. The term "observing systems" refers to one or more sensing elements that directly or indirectly collect observations of the Earth, measure environmental parameters, or survey biological or other Earth resources (land surface, biosphere, solid Earth, atmosphere, and oceans). A more detailed definition is provided in Section 2: Definitions and Context.

[2] National Earth Observations Task Force, *National Strategy for Civil Earth Observations*, Washington, DC: Office of Science and Technology Policy, April 2013, p. 24, http://www.whitehouse.gov/sites/default/files/microsites/ostp/nstc_2013_earthobsstrategy.pdf; Executive Order No. 13642 "Making Open and Machine Readable the New Default for Government Information," May 9, 2013, http://www.whitehouse.gov/the-press-office/2013/05/09/executive-order-making-open-and-machine-readable-new-default-government-.

[3] Defense and national-security requirements and considerations are not covered by this National Plan, though the use of defense and national-security assets for civil purposes is included. The Department of Defense is responsible for developing solutions for defense Earth observation requirements to support military operations and makes data available for civil agency use as appropriate. Coordination and oversight of civil agency use of national-security classified collections is performed by the interagency Civil Applications Committee. See the National Earth Observations Task Force, *National Strategy for Civil Earth Observations*, Washington, DC: Office of Science and Technology Policy, April 2013, p. 13.

[4] *Earth Observations and Global Change*, Center for Strategic and International Studies (CSIS), 2008, p. 10. http://csis.org/files/media/csis/pubs/080725_wigbels_earthobservation_web.pdf.

distributed among more than 100 programs under the purview of Federal agencies and non-Federal entities that produce and use these data.[5]

While Earth-system data collected through these observations are currently used to meet critical needs of distinct organizations and stakeholders, improved coordination will ensure that information derived from Earth observations will be used more broadly for both traditional and innovative purposes.

In October 2010, Congress charged the Director of the Office of Science and Technology Policy (OSTP) with establishing a mechanism for addressing this challenge.[6] OSTP convened a National Earth Observations Task Force (NEOTF) in February 2011 under the National Science and Technology Council (NSTC) Committee on Environment, Natural Resources, and Sustainability (CENRS) to inform the OSTP response to Congress. The NEOTF took three actions:

1. The development of a *National Strategy for Civil Earth Observations* (hereafter referred to as the National Strategy) to provide an enduring framework for routine assessment and planning for the Nation's Earth observation infrastructure. The National Strategy was released in April 2013.[7]

2. The development of a data-management framework, including principles and guidelines to improve discovery, access, and use of Earth observations. This framework is contained within the National Strategy.

3. The first assessment of the Federal Earth-observation enterprise, reviewing the impact of 362 observing systems on 13 societal themes. Summary results of the 2012 Earth Observation Assessment (EOA) are presented in this National Plan for Civil Earth Observations (hereafter referred to as the National Plan).

These three actions provided OSTP and CENRS with the foundation for this National Plan, which includes the following elements:

1. Definitions and context (Section 2)

2. Categories for civil Earth observations (Section 3)

3. Priorities and supporting actions for civil Earth observations (Section 4)

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[5] Non-Federal entities encompass State, regional, local, and tribal governments; nongovernmental organizations; academia; citizen scientists; commercial firms; international organizations; and foreign governments.

[6] National Aeronautics and Space Administration Authorization Act of 2010 (Public Law 111–267):
SEC. 702. INTERAGENCY COLLABORATION IMPLEMENTATION APPROACH. -The Director of OSTP shall establish a mechanism to ensure greater coordination of the research, operations, and activities relating to civilian Earth observation of those Agencies, including NASA, that have active programs that either contribute directly or indirectly to these areas. This mechanism should include the development of a strategic implementation plan that is updated at least every 3 years, and includes a process for external independent advisory input. This plan should include a description of the responsibilities of the various Agency roles in Earth observations, recommended cost-sharing and procurement arrangements between Agencies and other entities, including international arrangements, and a plan for ensuring the provision of sustained, long-term space-based climate observations. The Director shall provide a report to Congress within 90 days after the date of enactment of this Act on the implementation plan for this mechanism.

[7] National Earth Observations Task Force, *National Strategy for Civil Earth Observations*, Washington, DC: Office of Science and Technology Policy, April 2013.

4. Agency roles and responsibilities for sustained observations from airborne, terrestrial, and marine platforms (Section 5)
5. Agency roles and responsibilities for civil Earth observations from space (Section 6)
6. Summary guidelines on implementation and coordination of the National Plan (Section 7)
7. Summary results from the 2012 EOA supporting the identified priorities, EOA caveats, and a list of abbreviations used in this document (Annexes I-III).

As required by law, this National Plan will be updated every three years to ensure greater coordination of Federal civil Earth observation systems.

This National Plan serves as strategic guidance and sets out to fulfill agency mandates and national objectives via a balanced portfolio approach to civil Earth observations. The National Plan provides a framework that allows for the establishment, evaluation, and evolution of a balanced portfolio of observations and observing systems. This new framework builds on recent progress Federal agencies have made in taking fuller advantage of Earth observations across traditional boundaries to address their mission objectives and policy goals.

- **Climate**: Understanding, assessing, predicting, mitigating, and adapting to climate variability and change
- **Disasters**: Reducing loss of life, property, and ecosystem damage from natural and human-induced disasters
- **Ecosystems (Terrestrial and Freshwater)**: Improving the management and protection of terrestrial and freshwater ecosystems
- **Energy and Mineral Resources**: Improving the identification and management of energy and mineral resources
- **Human Health**: Understanding environmental factors affecting human health and well-being
- **Ocean and Coastal Resources and Ecosystems**: Understanding and protecting ocean, coastal, and Great Lakes populations and resources, including fisheries, aquaculture, and marine ecosystems
- **Space Weather**: Understanding, assessing, predicting, and mitigating the effects of space weather on technological systems, including satellites, power grids, communications, and navigation
- **Transportation**: Improving the safety and efficiency of all modes of transportation, including air, highway, railway, and marine
- **Water Resources**: Improving water-resource management through better understanding and monitoring of the water cycle
- **Weather**: Improving weather information, forecasting, and warning
- **Reference Measurements**: Improving reference measurements—the underpinnings of all SBAs—such as geodesy, bathymetry, topography, geolocation, timing, and the fundamental measurement systems and standards supporting them

These SBAs are interconnected at local, regional, national, and international scales and include scientific research, economic activities, and environmental and social domains. Many involve critical government functions, such as the continuity of national government and the protection of life and property.

2.3. Earth Observation Assessment (EOA)

The first EOA was conducted between February and August 2012 under the auspices of the NEOTF. The NEOTF principals designated a working group to collaborate with appropriate subject matter experts (SMEs). OSTP reached out to the subcommittees of CENRS to identify the 13 subject matter leads, who in turn recruited over 300 Federal experts to participate in 26 analytical workshops.

This EOA quantified the impacts of existing observing systems on a set of key objectives defined for each SBA listed in Subsection 2.2. This resulted in the identification of 362 observing systems and surveys, of which 145 were designated as “high impact.” Results for the high-impact systems were grouped in tiers

and ordered based on a numeric impact score derived through the assessment process. These results are presented in Annex I.[11]

The EOA provided two new perspectives to complement the work of previous studies in this area, namely (a) the inclusion of non-satellite systems and (b) a robust analysis of the impact of each system with respect to its delivery of services to society.[12]

The next EOA, which is planned to begin in 2014, will seek additional insight with regard to research priorities and future needs in addition to existing systems.

2.4. Data-Management Framework, Big-Earth-Data Initiative, and Climate Data Initiative

While Earth observations are typically produced for a specific purpose, they are often useful for purposes not foreseen during their development. Earth observation data can be reused, managed, and preserved such that both anticipated and unanticipated users can find, evaluate, understand, and use the data in new ways to achieve added benefit. The National Strategy, therefore, set out a comprehensive data-management framework to promote improved discoverability, accessibility, and usability of Earth observation data.

The National Plan includes improving data access, management, and interoperability as a supporting action. The Big Earth Data Initiative (BEDI) is designed to support this objective (see Section 4.2.2). In addition, the President's Climate Action Plan[13], announced in June 2013, launched a Climate Data Initiative to leverage extensive Federal climate-relevant data to stimulate innovation and private-sector entrepreneurship in support of climate resilience.

2.5. Relationship between the National Plan and Existing Studies

The National Plan can be understood as the first in a series of interagency efforts to analyze Federal-Earth observation priorities. It can also be understood in connection with other internal and external assessments. Of these assessments, an important example is the 2007 National Academies report, *Earth Science and Applications from Space*, known as the Earth Science decadal survey. This and other reports of the National Academies provide substantial material for understanding Earth-observation priorities of

[11] See the National Strategy for a complete description of the assessment process.

[12] The EOA provided an innovative approach to understanding the impacts of Federal Earth-observation systems. The results of the EOA, however, must be considered in the context of the limitations of this assessment, which is the first of its kind. For example, fundamental research about the Earth system underpins each of the 12 SBAs, and each team was invited to consider research priorities critical for its area. The EOA process, however, was fundamentally service-oriented, and the constraints of time and the breadth of the analysis prevented a full accounting of research needs in every area. Therefore the EOA's results for research observation systems may not reflect the full impact of those systems on climate and other research needs. See Annex II for a full list of caveats.

[13] Executive Office of the President, *The President's Climate Action Plan*, 2013, http://www.whitehouse.gov/share/climate-action-plan.

the research community. This National Plan was informed by the results of the EOA, by these reports, and by related interagency deliberation.

2.6 External Input and the Request for Information

In developing this first National Plan, OSTP sought input from external stakeholders through a Request for Information (RFI).[14] Issued in November of 2013, the RFI solicited input on the major themes, categories, and priorities for the National Plan. OSTP received responses from a range of stakeholders, including individuals, academic institutions, private-sector companies, and industry organizations. Using both qualitative and quantitative approaches, OSTP analyzed the RFI responses and incorporated input into the National Plan where appropriate. OSTP will seek and incorporate external input in future editions of the National Plan.

[14] Office of Science and Technology Policy, *National Plan for Civil earth Observations; Request for Information*, Office of the Federal Register, 2013, https://www.federalregister.gov/articles/2013/11/12/2013-26890/national-plan-for-civil-earth-observations-request-for-information; see the USGEO web page for a list of public responses to the RFI for the development of the National Plan for Civil Earth Observations, http://www.whitehouse.gov/administration/eop/ostp/library/shareyourinput/earthobsrfi.