



NATIONAL EARTH OBSERVATION ASSESSMENT SUMMARY OF 2016 RESULTS

A Report by the
U.S. GROUP ON EARTH OBSERVATIONS SUBCOMMITTEE
of the
NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

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About the U.S. Group on Earth Observations Subcommittee

The United States Group on Earth Observations (USGEO) is chartered as a subcommittee of the National Science and Technology Council (NSTC) Committee on Environment. The Subcommittee's purpose is to plan, assess and coordinate federal Earth observations, research, and activities; foster improved Earth system data management and interoperability; identify high-priority user needs for Earth observations data; and engage international stakeholders by formulating the United States' position for, and coordinating the United States participation in, the intergovernmental Group on Earth Observations (GEO). More information is available at <http://usgeo.gov>.

About this Document

This document was developed by the USGEO Subcommittee to provide a publicly available summary of the results of the 2016 Earth Observation Assessment as a reference in advance of the next Earth Observation Assessment expected late in 2023.

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Abbreviations and Acronyms

EOA	Earth Observation Assessment
GPS	Global Positioning System
KO	Key Objective
NASA	National Aeronautics and Space Administration
NEOTF	National Earth Observations Task Force
NOAA	National Oceanic and Atmospheric Administration
NSTC	National Science and Technology Council
OSTP	Office of Science and Technology Policy
SBA	Societal Benefit Area
USGEO	United States Group on Earth Observations

Introduction

Background

Congressional direction in the NASA Authorization Act of 2010 calls for the Director of the Office of Science and Technology Policy (OSTP) to establish a mechanism for the production and triennial update of a strategic plan for Earth observations. In response, OSTP created the National Earth Observations Task Force (NEOTF), which, published the *National Strategy for Civil Earth Observations* in 2013. The Strategy established that “the foundational element for the National Plan is an internal assessment of existing and planned observing systems in providing environmental observation to benefit society across societal benefit areas.”¹ In 2012, the NEOTF completed the first National Earth Observation Assessment (EOA), and the results were the formative basis for priorities developed in the first *National Plan for Civil Earth Observations*, which was published by OSTP in 2014.²

In 2013, OSTP rechartered the United States Group on Earth Observations (USGEO) subcommittee, giving it more responsibilities with regard to the domestic Earth observation portfolio. With the rechartering of USGEO, OSTP transferred the assessment responsibilities to USGEO. The 2016 EOA was conducted by USGEO with technical support from Institute for Defense Analyses, Science and Technology Policy Institute.

Methodology

The 13 Societal Benefit Areas (SBAs) identified in the 2013 *National Earth Observation Strategy* served as the organizing theme for EOA 2012 and 2016. Table 1 lists the SBAs. EOA 2016 employed a value tree hierarchy approach, which provides a model to describe the relative contribution of individual Earth-observing systems to the Federal Government’s ability to meet key objectives (KOs) across the 13 SBAs. This hierarchy creates a logical relationship between the general concept of societal benefit within an individual SBA and the key federal objectives that relate to the delivery of societal benefit under the SBA, as well as specific products, services, or research that helps to achieve those federal objectives. The hierarchy connects these products, services, or research to data or information products that rely on identified Earth-observing systems.

¹ OSTP, *National Strategy for Civil Earth Observations* (Washington, D.C.: Executive Office of the President, April 2013), 15. Available online at: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/nstc_2013_earthobsstrategy.pdf.

² OSTP, *National Plan for Civil Earth Observations*, (Washington, D.C.: Executive Office of the President, July 2014). Available online at: https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/NSTC/2014_national_plan_for_civil_earth_observations.pdf

Table 1: Societal Benefit Areas, listed alphabetically, with brief descriptions of supported activities.

Societal Benefit Area	Activities Supported by Earth Observations
Agriculture and Forestry	Improving productive capacity of land and animal production and health, promoting sustainability of resources, and ensuring resilience to disasters and disturbances
Biodiversity	Monitoring, assessing, and protecting genotypes and phenotypes, communities and species, and ecosystems and habitats
Climate	Understanding Earth’s climate system and the drivers and mitigation of variability and change, predicting and projecting the future climate, and assessing and adapting to the impacts of climate variability and change
Disasters	Supporting pre-event preparedness and mitigation, effective disaster response, and efficient recovery
Ecosystems (Terrestrial and Freshwater)	Understanding and improving the ability of ecosystems to provide clean air and water, plentiful food and energy, recreation and culture, and hazard reduction
Energy and Mineral Resources	Characterizing and enhancing resource potential, understanding and mitigating environmental impacts, and evaluating and enhancing sustainability for the electric grid and all energy sources
Human Health	Minimizing and mitigating the effects of threats to public health due to air quality, water quality, extreme weather and climate change, and other environmental factors
Ocean and Coastal Resources and Ecosystems	Ensuring resilient coastal ecosystems and sustainable fisheries, supporting aquaculture, and protecting designated species and areas
Space Weather	Preparing for and responding to space weather events and their effects on position, navigation, timing, communication, terrestrial infrastructure, spacecraft and aircraft, and human health; as well as supporting space weather-related activities (e.g., aurora viewing)
Transportation	Providing safe and efficient transportation by supporting operations; planning, maintaining, and improving infrastructure; and preparing for environmental impacts
Water Resources	Ensuring the availability and quality of fresh water, studying water use; monitoring and forecasting water extremes
Weather	Providing improved weather information, forecasts, and warnings
Reference Measurements	Locating and orienting all other measurements in space and time

Caveats

The results of EOA 2016 quantify the relative reliance of the civil federal Department and Agencies on individual observing systems, sensors, networks, and surveys. Due to the federal nature of the assessment, it does not fully include private, business, state, tribal and local governments objectives. The EOA development process captures the input of mostly federal practitioners, managers, and scientists that rely upon Earth observations to meet mission requirements and research objectives.

As EOA 2016 does not include cost data associated with each input, the results convey the impact, not the total value of the observing inputs.

The EOA is a snapshot of (then) currently available sources of data, whether they are from current systems or archived data from historical systems.

In EOA 2016 there was a more consistent inclusion of research objectives but there is still progress to be made to accurately capture the contribution of Earth observation research inputs and research objectives to societal benefit.

Results

The EOA 2016 provide a quantitative assessment of the Nation's then-current portfolio of Earth observations (data and measurements derived from the systems, platforms, sensors, networks, surveys, and sampling programs that measure the Earth and its processes). These observations contribute to the provision of critical products, public services, and cutting-edge research in the Nation's public interest. EOA 2016 measured the degree to which federal civil Departments and Agencies rely on specific Earth observations to meet key objectives organized into the 13 SBAs. In conducting the assessment, USGEO involved more than 1000 federal subject matter experts who identified 1,323 different Earth observation inputs. While a large number, it is not a comprehensive inventory of all possible inputs; instead, it is the set of inputs that supported the SBAs.

There are many types of EOA 2016 inputs, including human, mechanical, and electronic instruments; *in situ*, stationary, and mobile devices; and remotely sensed (via satellite, balloon, and piloted and unmanned aircraft) data and imagery. They also span a range of geographic scales from local to regional, hemispheric, and global.

In overall rankings, the Global Positioning System (GPS) and the Landsat optical sensors are assets upon which there is the greatest reliance in providing societal benefit with sustained observations that support public service and Earth system research. GPS was the most impactful system in EOA 2016 government applications. The Landsat optical sensors are the second most impactful input, supporting many SBAs and especially Climate, Agriculture and Forestry, Ecosystems, and Water Resources. Table 2 lists the top five percent of Earth observation inputs by overall impact in this assessment. The colors in each row show the impact of the Earth observations inputs relative to the 13 SBAs.

Agencies used the EOA 2016 results to better understand user communities' application of their Earth observing systems, surveys, databases, products, services, and research, maximizing their value and informing agency programmatic decisions.

The Field Work/Field Campaigns input listed separately at the bottom of Table 2 encompasses a wide range of heterogeneous activities in civil Earth observations. Taken individually, they do not have the highest impact overall or within each SBA, but when considered in the aggregate fall in the highest impact category for ten of 13 SBAs.

Table 2. Ranked list of Earth observation inputs for the top scoring five percent. Darker shades of blue denote higher impact for an SBA (see the color scale below the table).

Earth Observation Inputs (Top 5%)	Agriculture and Forestry	Biodiversity	Climate	Disasters	Ecosystems	Energy and Mineral Resources	Human Health	Ocean and Coastal Ecosystems and Resources	Reference Measurements	Space Weather	Transportation	Water Resources	Weather
Global Positioning System (GPS)	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
Landsat Optical	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Light Blue
National Elevation Dataset (NED)	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue
Next Generation Weather Radar (NEXRAD)	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
USGS Streamgages	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
Geostationary Operational Environmental Satellite (GOES) Imager	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
National Water Level Observation Network (NWLON)	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Dark Blue	Dark Blue
Commercial Airborne Lidar	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue	White	Light Blue	Dark Blue	Light Blue
National Agricultural Imagery Program (NAIP)	Dark Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Dark Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Light Blue	Light Blue
Global Climate Observing System (GCOS) Surface Network (GSN)	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
NWS Cooperative Observer Program (COOP)	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
NWS Radiosonde Observations (RAOBS)	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
Airborne High-Resolution Imagery	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
NOAA Ships	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue
Terra Moderate-Resolution Imaging Spectroradiometer (MODIS)	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
Public Observer Networks/Citizen Reporting/Crowd Sourcing	Light Blue	Dark Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Light Blue	Light Blue
Aqua Moderate-Resolution Imaging Spectroradiometer (MODIS)	Light Blue	Light Blue	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Dark Blue	Dark Blue
Farm Operator Surveys	Dark Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Light Blue	Light Blue
National Hydrography Dataset (NHD) Data	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Light Blue	Light Blue
Commercial Maps	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	Light Blue	White	Light Blue	Light Blue	Light Blue

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Earth Observation Inputs (Top 5%)	Agriculture and Forestry	Biodiversity	Climate	Disasters	Ecosystems	Energy and Mineral Resources	Human Health	Ocean and Coastal Ecosystems and Resources	Reference Measurements	Space Weather	Transportation	Water Resources	Weather
Polar-orbiting Operational Environmental Satellites (POES) Advanced Very High-Resolution Radiometer (AVHRR)													
SNOWpack TElemetry (SNOTEL)													
Argo Floats													
USGS Geomagnetic Observatories													
Commercial Fisheries Dependent-Data Surveys													
MetOp Advanced Very High-Resolution Radiometer (AVHRR), European Space Agency (ESA)													
Geostationary Operational Environmental Satellite (GOES) X-Ray Sensor (XRS)													
Automated Weather Observing System (AWOS)													
DMSP Special Sensor Microwave Imager Sounder (SSMIS)													
Global Sea Level Observing System (GLOSS)													
MetOp Advanced Scatterometer (ASCAT) (ESA)													
Global Climate Observing System (GCOS) Upper Air Network (GUAN)													
Local Weather Stations													
Energy Information Administration Survey Data													
Health Surveillance Data													
Jason													
National Infrared Operations (NIROPS) Phoenix Sensor (Aircraft)													
Gravity Recovery and Climate Experiment (GRACE) Satellite													

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Suomi National Polar-Orbiting Partnership (SNPP) Visible Infrared Imaging Radiometer Suite (VIIRS)													
Physical Oceanographic Real-Time System (PORTS)													
United States Census Data													
Polar-orbiting Operational Environmental Satellites (POES) Advanced Microwave Sounding Unit A (AMSU-A)													
Very-Long-Baseline Interferometry (VLBI) Stations													
Biodiversity Information Serving Our Nation (BISON) Data													
Geostationary Operational Environmental Satellite (GOES) Energetic Particle System (EPS)													
NOAA Global Drifter Program Data													
WeatherReady Nation Information													
Advanced Composition Explorer (ACE) Solar Wind Electron Proton Alpha Monitor (SWEPAM)													
Landsat Archives													
State/Local Water Quality Samples													
Road Weather Information System (RWIS)													
Air Quality System (AQS)													
State/Local Parcel Data													
Bathymetry Data													
State and Regional Mesonets													
National Observer Program (NOP) Data													
Landsat Thermal													
Community Collaborative Rain, Hail and Snow Network (CoCoRAHS)													

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USGS Continuous Water-Level Recorders (Groundwater)	Contributing	Contributing	Contributing	Contributing	Contributing	Very High	Contributing	Contributing	High	Does not Contribute	Contributing	Very High	Does not Contribute
Shuttle Radar Topography Mission (SRTM)	Contributing	Contributing	High	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing
Open Tree of Life	Does not Contribute	Very High	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute	Does not Contribute
Commercial High-Resolution Satellite Imagery - Worldview 1/2/3	High	Contributing	Contributing	High	Very High	Contributing	Contributing	Contributing	Contributing	Does not Contribute	Contributing	Contributing	Contributing
Automated Surface Observing System (ASOS)	Contributing	Contributing	High	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Does not Contribute	Contributing	Contributing	Contributing
Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC)	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Contributing	Very High
Field Work/Field Campaigns	Very High	Very High	Very High	Very High	Very High	Very High	Very High	Very High	High	Does not Contribute	Very High	Very High	Contributing

Color scale for Table 2.

