

The Second National Civil Earth Observation Assessment: Societal Benefit Areas, Subareas, and Key Objectives

The 2010 NASA Authorization Act instructed the Director of the Office of Science and Technology Policy (OSTP) to establish a mechanism to ensure greater coordination of civilian Earth observations, including the development of a strategic implementation plan that is updated at least every three years. In response to this instruction, OSTP implemented an assessment-based planning framework and completed its first National Civil Earth Observation Assessment (EOA 2012).

OSTP’s July 2014 *National Plan for Civil Earth Observations* incorporated the priorities identified in EOA 2012 to provide strategic guidance for a portfolio approach to managing civil Earth observations that will fulfill agency mandates and achieve national objectives. OSTP intends to update the National Plan every three years through the U.S. Group on Earth Observations (USGEO) Subcommittee of the National Science and Technology Council Committee on Environment, Natural Resources, and Sustainability.

In support of the next National Plan, the second National Civil Earth Observation Assessment (EOA 2016) will identify the inputs and relative contributions of the portfolio of observing systems currently relied upon by Federal agencies to meet key civil objectives. EOA 2016 will employ a value-tree hierarchy to trace the pathways through which Earth-observing systems contribute value across 13 societal benefit areas (SBAs) (Figure 1).

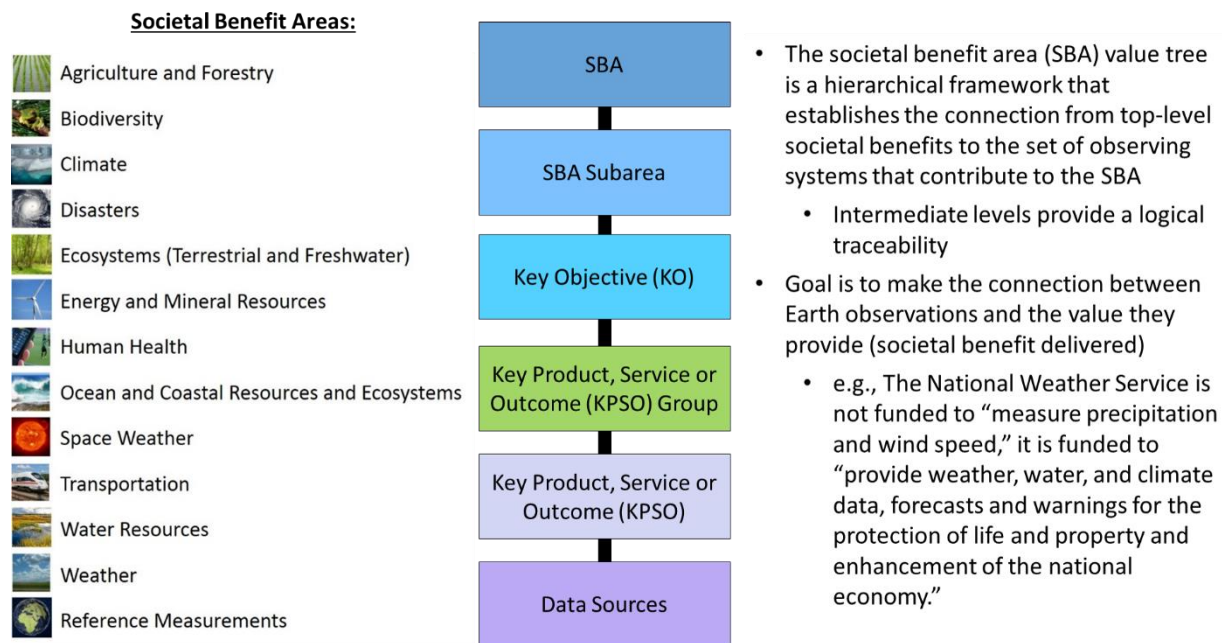


Figure 1. EOA 2016 Value Tree Network

The value trees developed by interagency teams of Federal experts consist of SBA subareas; key objectives (KOs); and key products, services, and outcomes (KPSOs) that contribute to achieving those KOs (see Figure 2).

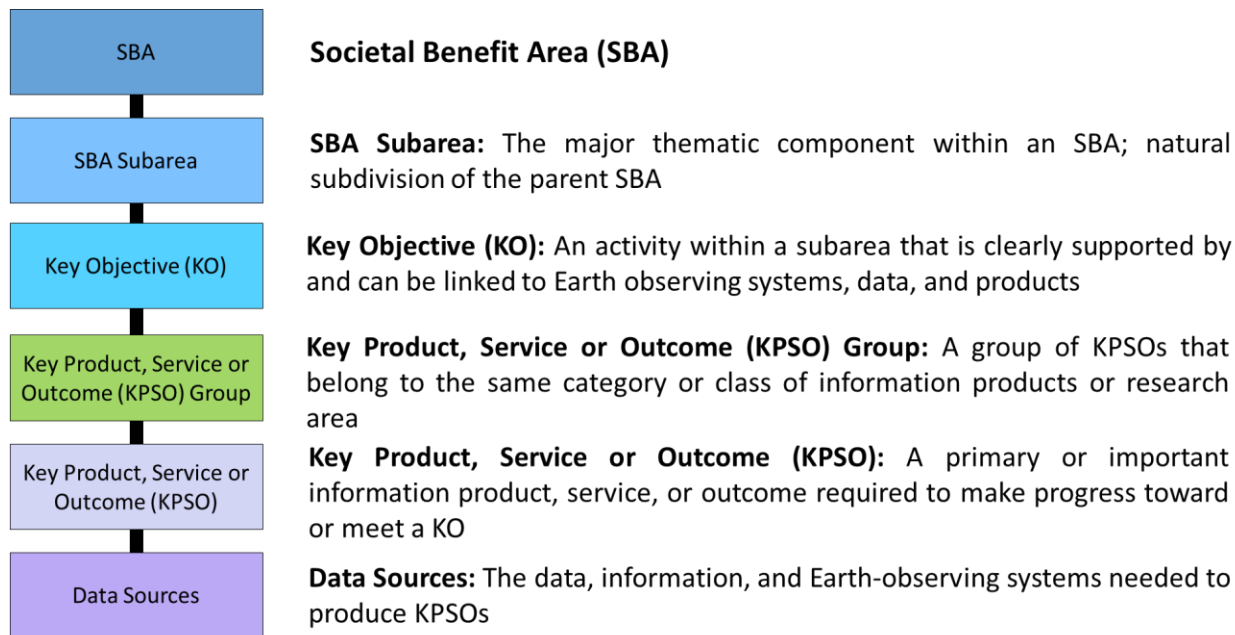


Figure 2. Descriptions of EOA 2016 Value Tree Levels

Subareas are natural thematic subdivisions of the overall SBAs; KOs are Federal activities within subareas in which Earth observations contribute in part or in whole to societal benefits; KPSO Groups are groups of KPSOs that belong to the same category or class of products or research area, and KPSOs are the important products, services, or research outcomes required to make progress toward meeting KOs. This value-tree hierarchy provides a logical traceability from societal benefit at the top of the tree and Earth-observation systems at the bottom.

OSTP proposed 13 SBAs for use in EOA 2012 based upon the nine SBAs used by the international Group on Earth Observations at that time and added four additional SBAs (Oceans and Coastal Resources and Ecosystems, Reference Measurements, Space Weather, and Transportation). The 13 SBAs were adopted by the National Science and Technology Council Committee on Environment, Natural Resources, and Sustainability and approved by OSTP in February of 2012. The same 13 SBAs will be used again in EOA 2016.

During the 2015 and 2016 calendar year, more than 300 Federal subject-matter experts participated in EOA 2016 as SBA team members. The team members developed the top of the SBA value tree for each of the 13 SBAs (see Figure 3). The teams were led by OSTP-designated agency experts, and collectively developed 218 unique KOs in 48 unique subareas across the SBAs. The list of unique objectives, provided at the end of this document, represents a robust set of goals for civil Earth observations that cut across agency missions.

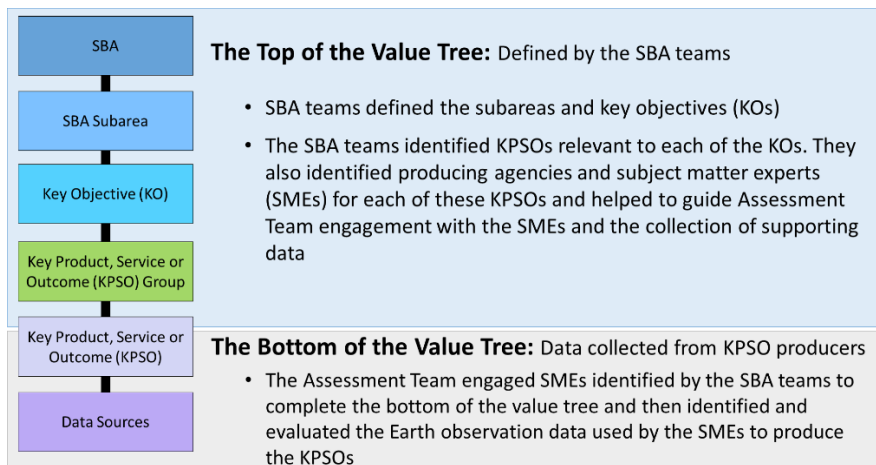
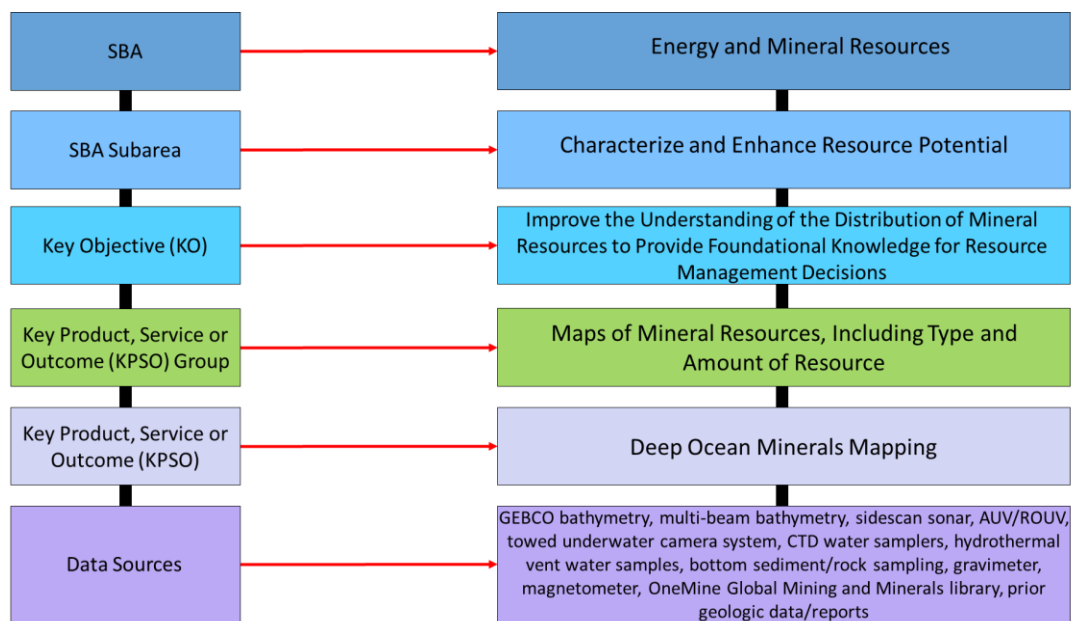


Figure 3. EOA 2016 Value Tree Responsibilities

EOA 2016 is assessing the relative contributions of Earth-observing systems to the development of information products, services, and research using an expert elicitation process. The methodology for EOA 2016 traces information pathways from direct observations and intermediate products (such as models), to end products used to improve decision-making (see Figure 4 for an example from EOA 2016). It is also useful for assessing the interdependence of multiple Earth-observing systems for their contributions to the development of blended information products.



Note: This is one example pathway that traces the provision of societal benefit through a key product that helps satisfy a key objective within a specific subarea of one SBA.

Figure 4. EOA 2016 Notional Value Tree Example

As EOA 2016 is still in progress, it's KOs and subareas may change. Please turn to the next page to view the 13 SBAs and their subareas and KOs. Due to their size, some of the SBAs have been split across multiple pages.

Agriculture and Forestry	<i>Animal health and production</i>	Improve animal production
	<i>Conservation of resources to promote sustainable processes</i>	Control surface losses from erosion and pollution due to water and wind
		Maintain soil health and reduce trace gas emissions from soil
		Manage effects of human activity (harvesting, thinning, and irrigation)
		Manage impacts of agriculture and forestry on the water supply
	<i>Enforcement and support</i>	Monitor compliance with Federal laws (farm, insurance, conservation, and leases)
		Provide support to firefighters, aviators, law enforcement agents, farmers, and agencies
		Provide support to government investigations and civil actions
	<i>Productivity: condition and trend of managed ecosystems</i>	Adapt sustainable agriculture and forestry systems to the current and new climatic regimes
		Develop scientific and technical knowledge to better protect, manage, and use agricultural lands, forests, grasslands, and pasture and rangelands
		Mitigate effects of climate change by changing management regimes
		Promote sustainable multi-use management of forests, grasslands, pastures, and rangelands
		Understand current agricultural production nationally and globally
	<i>Resilience to disasters and disturbance events</i>	Improve robustness of agriculture and forests to long-term threats (drought, insects, etc.)
		Improve robustness of water supplies
		Manage wildfire risk

Biodiversity	<i>Communities and species</i>	Identify and prioritize for restoration degraded, imperiled, or extirpated communities and species
		Identify, assess, and maintain healthy, resilient, and diverse natural communities and species that provide critical goods and services
		Identify, prioritize, and reduce threats to critical communities and habitats
		Understand internal and external processes that affect the status and trends of communities and species over space and time
	<i>Ecosystems and habitats</i>	Identify and prioritize degraded or extirpated critical habitats for restoration
		Identify, assess, and maintain healthy, resilient, and diverse habitats that support critical communities and species
		Identify, prioritize, and reduce threats to critical habitats
		Understand internal and external processes that affect the structure and function of habitats over space and time
	<i>Genotypes and phenotypes</i>	Identify and prioritize degraded, imperiled, or extirpated genotypes for restoration
		Identify, assess, and maintain sufficient genotypic and phenotypic diversity to support short- and long-term resilience of species, ecosystems, and ecosystem services
		Identify, prioritize, and reduce threats to critical genotypes
		Understand internal and external processes that affect the status and trends of genotypes and phenotypes over space and time

Climate	<i>Assessing the impacts of and adapting to climate variability and change</i>	Assess, predict, and project the impacts of climate change, including extreme events, on natural systems and regions and underserved and vulnerable geographies and populations
		Engage decision makers and the public about observed climate changes, the past and current state of the climate, and anticipated trends, predictions, and projections for the future
		Improve understanding of the impacts of climate change, including extreme events, on specific sectors of the economy and evaluate adaptive strategies
	<i>Drivers and mitigation of climate change and variability</i>	Assess, attribute, and project changes to sources and sinks of natural and anthropogenic atmospheric forcing agents and pollution constituents
		Evaluate the impacts, risks, and benefits of mitigating the effects of climate change
	<i>Understanding, predicting, and projecting Earth's climate system</i>	Establish, maintain, and improve the climate record
		Improve understanding and attribution of interannual to multi-decadal modes of climate variability
		Improve understanding and quantification of past climate extremes, including abrupt changes in climate
		Improve understanding of changes in atmospheric circulation and extremes and reduce uncertainty in climate sensitivity and climate feedbacks, including cloud and vapor feedbacks
		Understand and constrain climate forcings, including processes influencing sources and sinks of greenhouse gases and aerosols
Understand and model ocean variability and change, including the ocean's physical, biogeochemical, and dynamic conditions, and understand and model the role of oceans in climate change		
Understand and simulate the sensitivity, feedbacks, and dominant processes controlling the variability and evolution of the Earth's cryospheric systems, including sea ice, land ice, glaciers, and permafrost, and use knowledge to improve predictive capabilities		

Disasters	<i>Efficient recovery</i>	Facilitate community rebuilding
		Improve fundamental understanding of post-event hazards
		Restore and protect ecosystems and cultural resources
		Restore and upgrade critical infrastructure
	<i>Pre-event preparedness and mitigation</i>	Educate the public to address hazards and related risks
		Establish hazard-contingency planning
		Improve integrity of buildings and infrastructure
		Improve fundamental understanding of hazards
		Improve land-use decisions
	<i>Protect health, safety, and security through effective international, national, State, and local response to disaster</i>	Provide early detection, advisories, and warning for disasters
		Provide situational awareness
		Restore and protect lifeline systems (transportation, power, water, communication, medical, and levees)

Ecosystems	<i>Role of ecosystems in climate change mitigation and adaptation strategies</i>	Document changes over time and predict future greenhouse gas and carbon cycling, as well as ecosystem capacity to provide climate change mitigation and adaptation
		Inform decisions related to ecosystems valued for climate change mitigation, carbon storage, and sequestration
		Inform policy strategies and practical applications related to carbon trading
		Research and understand how drivers of change, including greenhouse gas and carbon cycling, may impact climate change mitigation and adaptation strategies
		Research and understand how ecosystems' species relate to climate change mitigation and adaptation strategies and greenhouse gas and carbon cycling
	<i>Role of ecosystems in maintaining clean and plentiful water</i>	Assess the economic value of natural protection of water sources to inform water-quality trading decisions
		Document changes over time in ecosystems' ability to provide clean and plentiful water
		Inform decisions related to the restoration, protection, and use of ecosystems critical to the production of clean and plentiful water
		Provide information to decision-makers about managing drivers of change to avoid ecosystems no longer being able to provide clean and plentiful water
		Provide predictive tools to predict future ability of ecosystems to provide clean and plentiful water
		Research and understand how drivers of change will impact ecosystems' ability to provide clean and plentiful water
		Research and understand how ecosystems' species provide clean and plentiful water
		Research and understand the true value of the provisioning of clean and plentiful water

Ecosystems (cont'd)	<i>Role of ecosystems in mitigating natural hazards</i>	Document changes over time in ecosystems' ability to mitigate natural hazards
		Inform decisions related to the restoration, protection, and development of ecosystems important to mitigation of natural hazards
		Provide future scenario tools predicting future ability of ecosystems to mitigate natural hazards
		Research and understand how drivers of change will impact ecosystems' ability to mitigate natural hazards
		Research and understand how ecosystems' species impact the ability for an area to mitigate natural hazards
		Research and understand socioeconomic consequences of not protecting critical ecosystem resources
	<i>Role of ecosystems in providing clean and healthy air</i>	Document changes over time in ecosystems' ability to provide clean and healthy air
		Inform decisions related to managing drivers of change
		Provide predictive tools to predict ability of ecosystems to provide clean and healthy air
		Research and understand ecosystems' capacity to mitigate air pollution
		Research and understand how air-quality issues impact an area's ecosystem-based tourism and quality of life
		Research and understand how drivers of change impact ecosystems' ability to provide clean air
		Research and understand how ecosystems' species impact clean air

Ecosystems (cont'd)	<i>Role of ecosystems in providing recreational, cultural, aesthetic, spiritual, and existence value</i>	Document changes over time in ecosystems' ability to provide recreational opportunities, as well as cultural, aesthetic, spiritual, and existence value
		Inform decisions related to ecosystems valued for their recreational opportunities, as well as cultural, aesthetic, spiritual, and existence value
		Provide predictive tools to predict future ability of ecosystems to provide recreational opportunities, as well as cultural, aesthetic, spiritual, and existence value
		Research and understand how drivers of change may impact the recreational, cultural, aesthetic, spiritual, and existence value of ecosystems
		Research and understand how ecosystems' species provide recreational opportunities, as well as cultural, aesthetic, spiritual, and existence value
		Research and understand the public-health and socioeconomic benefits of access to nature
		Research and understand the relevance of existence value of ecosystems to the American public
	<i>Role of ecosystems in the production of food, fuel, shelter, medicines, and other materials</i>	Document changes over time in ecosystems' ability to provide food, fuel, shelter, medicines, and other materials
		Identify areas that should be protected so that their unrealized potential, such as discoveries of new foods, fuels, medicines, and other materials, can be realized by future generations
		Inform decisions related to ecosystems critical to the production of food, fuel, shelter, medicines, and other materials
		Inform decisions related to the restoration and protection of critical pollinator habitat
		Provide tools to predict future ability of ecosystems to provide food, fuel, shelter, medicines, and other materials
		Research and understand ecosystems' species in relation to their ability to provide the conditions necessary to commercially produce food, fuels, medicines, and other materials
		Research and understand how drivers of change may impact ability to harvest materials necessary for our existence

Energy and Mineral Resources	<i>Characterize and enhance resource potential</i>	Design, site, and operate safe, secure, and efficient nuclear power plants and repositories
		Enhance domestic fossil fuel supplies to promote U.S. economy and energy security
		Enhance energy infrastructure needed to support fossil fuel supplies (storage, processing, and transport)
		Enhance resiliency of coastal communities and promote coastal restoration by identifying offshore sand and gravel resources on the U.S. outer continental shelf
		Improve deployment, integration, and operation of renewable energy generation
		Improve the understanding of potential new resources that could be added to future energy supplies
		Improve understanding of the distribution of mineral resources to provide foundational knowledge for resource-management decisions
		Inform decisions regarding potential domestic and global resource supply to support domestic and international policy and inform decisions about minerals development in the private sector
		Promote the development of geothermal resources to diversify the Nation’s energy supply and meet renewable energy targets for electric power generation (renewable portfolio standards)
		Support the safe, secure, and efficient operation of the electric power grid
		Support the safe, secure, and efficient production of nuclear fuel extending from ore extraction and processing to fuel enrichment, fabrication, and recycling
		Support U.S. national security and global diplomacy through analysis of domestic and global energy supplies

Energy and Mineral Resources (cont'd)	<i>Evaluate and enhance sustainability</i>	Adapt extraction plans to environmental changes
		Advance understanding to enhance the long-term sustainability of nuclear power
		Enhance the long-term safety, security, and efficiency of the electric power grid
		Ensure a continuous supply of critical strategic-mineral commodities
		Evaluate risks to the safe, secure, and sustainable operation of the electric power grid
		Evaluate risks to the safe, secure, and sustainable use of nuclear power
		Increase public awareness about the relative benefits and risks of nuclear power as a critical component of the domestic energy supply
		Mitigate greenhouse gas emissions from fossil fuel utilization
		Promote the development of new technologies to ensure sustainable supply of geothermal resources for electric power generation
		Provide maximum renewable power in a sustainable manner
		Support deployment of renewable energy technologies to diversify energy supply and reduce greenhouse gas emissions
		Understand potential constraints on fossil fuel supplies from water availability

Energy and Mineral Resources (cont'd)	<i>Understand and mitigate environmental impacts</i>	Enable environmentally responsible resource-development decisions on current and future mining
		Improve the understanding of environmental contamination of mines and watersheds, including risk of contaminant migration, to inform development and mitigation strategies for current and future mining activities
		Improve the understanding of the fate of fossil fuel resources released into the environment
		Improve understanding of fossil fuel development impacts on water resources, ecosystems, and land use
		Mitigate environmental impacts of legacy (or decommissioned) fossil fuel development sites
		Mitigate the impact of the deployment of renewable energy systems
		Promote environmentally responsible development of fossil fuel resources
		Promote responsible development of geothermal resources for electric power generation
		Reduce risk of release of fossil fuel energy resources to the environment
		Remediate historical mined areas to mitigate impacts on water quality and ecosystems
		Understand and mitigate the environmental impacts of nuclear-fuel production extending from ore extraction and processing to fuel enrichment, fabrication, and recycling
		Understand and mitigate the environmental impacts of nuclear-power generation and decommissioning, as well as disposal of spent fuel and waste
		Understand and mitigate the environmental impacts of operating and maintaining the electric power grid

Human Health	<i>Air quality</i>	Improve understanding of population-level exposure to air pollutants and their impact on health, and quantify health burden attributable to ambient air pollutants, including quantifying source-specific health impacts
		Mitigate atmospheric deposition of persistent organic pollutants and heavy metals
		Mitigate human-health risks from exposure to hazardous air pollutants
		Mitigate human-health risks from exposure to criteria air pollutants
		Reduce vulnerabilities to, and mitigate human-health impacts of, unexpected air-pollution episodes and events
	<i>Environmental effects</i>	Identify, characterize, and understand the role of environmental drivers in the emergence, spread, and transmission of disease to humans and in non-human reservoirs
		Identify, characterize, and understand the role of human drivers on ecosystem changes that affect the emergence, transmission, and spread of disease
		Mitigate the emergence, spread, and transmission of disease to humans and in non-human reservoirs
		Mitigate the role of human-driven ecosystem changes on the emergence, transmission, and spread of disease
		Protect humans from exposure to radiologic agents in the environment that cause adverse health effects
	<i>Extreme weather and climate change</i>	Improve understanding of population-level exposure to extreme-weather events (e.g., temperature and precipitation extremes) and their impact on human health, and quantify health burden attributable to extreme-weather events
		Minimize adverse human-health impacts from UV exposure
		Project human-health burden (near- and long-term) of climate-sensitive exposures resulting from climate change (e.g., air quality, temperature, and precipitation extremes; aero-allergens)

Human Health (cont'd)	<i>Water quality</i>	Identify environmental factors that cause proliferation of water-borne pathogens and algal blooms, and changes in pollutant concentration and dispersal
		Improve understanding of the interaction of climate drivers and human activities on the development of hypoxia in municipal water-distribution systems
		Improve understanding of the impacts of harmful algal blooms, water-borne pathogens, and pollutants on human activities, human health, and the environment
		Mitigate impacts on human health from harmful algal blooms, water-borne pathogen proliferation, and pollutants in fresh- and salt-water sources
		Reduce the impact of hypoxic water in municipal water-distribution systems

Ocean and Coastal Resources and Ecosystems	<i>Aquaculture</i>	Ensure that aquaculture practices are ecologically sustainable
		Ensure that aquaculture practices are economically viable
	<i>Protected and sensitive areas</i>	Identify at-risk sites, locations, and categories (e.g., mangroves, seagrass, and coral reefs)
		Identify vulnerable or sensitive areas, including detecting new threats
		Sustain and enhance protected areas
	<i>Protected species</i>	Identify species that are at risk
		Measure and mitigate threats to protected species, including protecting and conserving critical habitats and keeping levels of takes of protected species sustainable
		Recover species at risk to sustainable levels and ensure sustainable levels of at-risk species, including protecting and conserving critical habitats
	<i>Resilient coastal ecosystems</i>	Ensure resilience of coastal ecosystems to key challenges and threats
		Protect and enhance the health and ecosystem services provided by coastal estuaries, marshes, and wetlands; barriers, beaches, and dunes; coastal and nearshore submerged habitats; and coral reefs
	<i>Sustainable fisheries</i>	Ensure long-term economic value of commercial and recreational fisheries
		Prevent overfishing of wild stocks
Rebuild overfished or depleted stocks to productive levels		

Space Weather	<i>Human health</i>	Improve forecasting, specification, and characterization of the space-radiation environment that affects human health
		Protect health of air travelers from space-weather effects
		Protect health of space travelers from space-weather effects
	<i>Position, navigation, and timing and communication</i>	Improve the forecasting and specification of the ionospheric conditions that impact GNSS systems
		Improve the forecasting and specification of the ionospheric conditions that impact high-frequency communication
		Provide for and ensure the safe/reliable/robust operation of space-based communication systems
		Provide for and ensure the safe/reliable/robust operation of terrestrial-based communication systems
		Provide ubiquitous positioning, navigation, and timing
	<i>Recreation, education, and tourism</i>	Enable tourists and tourism providers to predict aurora
		Improve aurora forecasting and specification
		Provide solar, geomagnetic, and ionospheric information to support the use of amateur radio
		Provide images and video to educate the public on solar activity and space weather

Space Weather (cont'd)	<i>Spacecraft and aircraft</i>	Ensure accurate tracking of space objects
		Assess equipment anomalies and provide design guidelines for aircraft
		Assess equipment anomalies and provide design guidelines for spacecraft
		Improve the forecasting and specification of the atmospheric conditions that impact spacecraft orbits
		Improve the forecasting and specification of the space-environment conditions that impact spacecraft and aircraft systems
		Improve understanding of space-environment effects on satellite and aircraft systems
		Mitigate impacts of space weather on launch operation
		Mitigate impacts of space weather on spacecraft operation
	<i>Terrestrial infrastructure</i>	Improve forecasting and specification of geomagnetic activity
		Improve understanding of geomagnetic activity on terrestrial infrastructure
		Provide reliable operation of electrical power, pipeline, and rail infrastructure
		Provide reliable surveying, mining, and drilling

Transportation	<i>Environmental impacts</i>	Adapt transportation system to changing climate
		Support and improve sustainability principles that minimize environmental impacts of transportation systems
	<i>Infrastructure</i>	Support planning, design, inspection, maintenance, and improvement of air transportation systems and infrastructure
		Support planning, design, inspection, maintenance, and improvement of surface and maritime transportation systems and infrastructure
	<i>Operations</i>	Assess and identify system conditions and support response efforts following natural and anthropogenic events
		Support efficient, safe, and secure commercial, recreational, and government maritime operations
		Support efficient, safe, and secure operation of air transportation
		Support efficient, safe, and secure transportation of hazardous materials by rail, pipeline, truck, maritime, and air
		Support the efficient, safe, and secure operation of the nation's rail systems
		Support the efficient, safe, and secure use of the nation's highway systems
Support the efficient, safe, and secure use of state and local transit systems		

Water	<i>Water availability</i>	Ensure water availability for societal and ecosystem needs
		Improve characterization and understanding of surface and groundwater systems
	<i>Water extremes</i>	Improve drought-risk management and reduce the cost of drought damages by better characterizing the causes, likelihood, and severity of droughts, and by improved monitoring of current drought and prediction of future drought
		Improve the nation's flood resilience and reduce flood casualties and damages by better characterizing the likelihood and extent of flood inundation and by improving flood early-warning systems
		Improve understanding of drivers of the frequency and severity of droughts and floods through advanced models of hydrologic thresholds and extremes
	<i>Water quality</i>	Determine whether the quality of surface waters and groundwater available to meet human needs and support healthy ecosystems is getting better or worse
		Ensure that the quality of the nation's fresh waters are safe for human needs and will protect and sustain healthy ecosystems
		Improve understanding of the sources of contaminants and other environmental factors that influence the quality of the nation's freshwaters to determine which strategies will most effectively protect and restore these waters to meet human needs and sustain healthy ecosystems
	<i>Water use</i>	Develop a better understanding of the essential components of the water budget associated with agricultural use
		Improve management of water resources for societal use by better characterizing the withdrawal, consumptive use, transfers, and return of water by human activities
		Improve understanding of water requirements for aquatic and water-dependent ecosystems to ensure protection of water resources

Weather	<i>Weather effects on economic productivity</i>	Support planning and decision-making in supply-chain management, construction, and recreation
		Support quantitative insurance and reinsurance pricing for weather-related hazards
		Support the delivery of weather information for telecommunications and futures markets
		Support the delivery of weather information on economically productive natural resources
	<i>Weather effects on human safety and property</i>	Improve the understanding, prediction, and detection of weather-based threats to life, limb, and property
		Reduce loss of life and injury and damage to property due to regularly occurring weather and other atmospheric events
		Support effective weather response, planning, mitigation, and resource allocation at Federal, state, and local levels
	<i>Weather effects on quality of life</i>	Support recreation, general health and happiness of the public, and municipal-activity planning
		Support the ability to understand, plan for, and mitigate changes in air and water quality

Reference Measurements	<i>Reference measurements</i>	Support and sustain operations
		Maintain inter-relations and interoperability
		Improve and expand future capabilities