White Paper

NASA Earth

Earth Science at Work

NASA Earth Science Division
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NASA helps Americans respond to challenges — wildland fires, hurricanes, and water supplies for farming, for example — by putting actionable science and satellite information into the hands of decisionmakers. NASA does what no other agency can — develop cutting-edge Earth observation missions, combine expert insight into the Earth system with the world's most advanced models, and advance the solutions for monitoring, prediction, and management.

Why it matters

Using the power of science, innovative technologies, engineering, partnerships, and space-based observations, NASA can offer a comprehensive, digital view of Earth. NASA's ability to understand Earth as a system is put to work across commercial and industrial sectors and federal and international agencies to generate the scientific information necessary to inform decisions.

According to a recent report by the World Economic Forum: "By 2030, the potential economic value of EO (Earth observations) could exceed $700 billion globally...better data can inform decision-making, optimize solutions and enable innovation."

How NASA Earth Science helps:

- Our work informs decisions from the local to state to federal to international level.
- We help ensure government efficiency by gathering both commercial and research data and creating products that directly address user needs. We leverage innovation from academia and the private sector to develop novel applications of Earth science information.
- We link technology, research & development, and actionable science to ensure rapid transfer from innovation to impact.

Our objectives

Supporting the U.S. Economy

NASA Earth Science benefits **U.S. agriculture** with continuous measurements of water resources, crop health, and global production that inform business decisions, improve farm and ranch efficiency, and reduce input costs. This work provides a competitive advantage to American farmers from the commodity-trading floor to the grocery shelf.

NASA's Geological Earth Mapping Experiment (GEMx), a joint program with the USGS, maps **rare Earth minerals critical** for use in domestic, technology-dominant industries such as telecommunications, energy generation, and aerospace.

Our objectives (continued)

Helping Americans Cope with Natural Hazards

To prevent hazards from turning into disasters, early warning is key. Satellite data often provides the earliest signals of a problem. NASA is dramatically improving the nation's ability to forecast and respond to severe storms, droughts, fires, and other hazards with advanced capabilities in both our own satellites and the private commercial fleet.

NASA provides its partners and the public with near real-time data products, early warning tools, and the Disasters Mapping Portal, a powerful online interface for the disaster-specific Geographic Information Systems products.

NASA also developed an advanced **landslide forecast** model — allowing us to deliver accurate projection models before a landslide and satellite-derived landslide maps to guide first responders.

NASA is rapidly improving our understanding of **hurricanes**. Tools like our TROPICS CubeSats and GPM satellite collect data to improve near-term forecasts and advance our understanding of hurricane intensification. This research data is used by NOAA's National Hurricane Center and the Joint Typhoon Warning Center.

The growing frequency and severity of **wildland fires** pose significant risks, particularly in Western states. NASA's satellite and airborne fleet help estimate fuel load and other key factors of wildland fire risk. We work directly with the U.S. Forest Service and other agencies during fires, while also leading research to improve fire forecasts, recovery, and understanding of long-term impacts on communities. NASA freely and openly shares information about where fires are actively occurring, using sensors that detect the thermal infrared signals from active fires.

Coastal communities dealing with "sunny day floods" and other aspects of **sea level rise** rely on NASA expertise to provide precise forecasts for the coming decades. In addition to informing coastal infrastructure planning and hazard mitigation, NASA helps the Department of Defense address risks posed to coastal military installations and operations around the world.

Supporting National Security

NASA's Earth observing missions provide information valuable to a wide variety of security interests. Our Space Geodesy Program establishes Earth Orientation Parameters, precise satellite orbits, and the reference frame that underpin the position, navigation, and timing accuracy of its satellites. This same reference frame also underpins the **accuracy of GPS**. Additionally, NASA's Laser Retroreflector Arrays (LRA) and satellite laser ranging support calibration of the new generation of GPS satellites.

Working jointly with the Office of Naval Research and the National Ice Center, NASA helps enhance **situational awareness in the Arctic**, which is important for national security and defines operational areas and trade routes.

NASA's **land surface monitoring** — through the advanced Land Information System (LIS) model that combines satellite and ground-based observations with forecasting techniques — supports U.S. and partner operations around the world.

Supporting Local Community Decisions

Satellite measurements of temperature, humidity, and precipitation help predict **outbreaks of mosquito-borne illnesses** such as West Nile Virus (WNV). NASA supported work to create a WNV forecast tool for South Dakota, Louisiana, Oklahoma, and Michigan.

Water managers across the U.S. face major challenges allocating supplies amid competing demands. NASA leads the way in **understanding freshwater** with satellite observations and models to see from the near surface through the root zone to the deep aquifer. For example, the GRACE satellites have revolutionized the monitoring of large-scale water storage, allowing us to measure how major aquifers in the U.S. are drained and recharged. The U.S. Drought Monitor uses GRACE and other satellites to assess soil moisture.