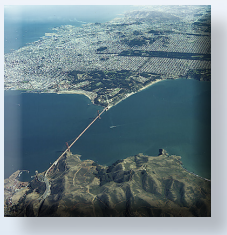
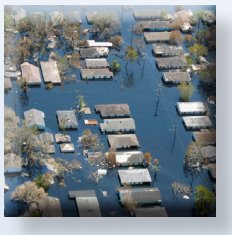
2024

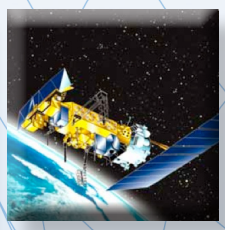
National Geodetic Survey

Research Plan 2024

Positioning America for the Future








National Oceanic and Atmospheric Administration • National Geodetic Survey

Research Plan (FY24)

Introduction

The National Geodetic Survey (NGS) is authorized by Congress to establish and maintain the **National Spatial Reference System (NSRS)**, a consistent national coordinate system to support mapping, charting, navigation, infrastructure development, resource evaluation surveys, and scientific applications. This mission is vital to the nation's economic, social, and environmental needs. Through the **Coastal Mapping Program (CMP)**, NGS defines the official shoreline of the United States and maps the coastal zone and waterways, providing a vital service to the marine transportation industry, coastal planners, and stewards of the coastal environment. The system of geodetic control NGS developed supports all navigational infrastructure and provides specialized products for the Federal Aviation Administration (FAA), critical to maintaining a safe and efficient navigable airspace and airspace infrastructure. NGS is committed to pursuing an integrated approach to Earth system science, service, and stewardship.

This research plan is aligned with the NOAA FY22–26 strategic plan's vision of building a climate ready nation and recognizes the intrinsic connection between weather, water, and climate systems, linked through the hydrologic cycle, driven by ocean, land, and atmospheric processes. This requires a multidisciplinary approach, centered around geodesy using satellite observations, rooted in open science and open source methods, and driven by stakeholder needs.

Overview

The purpose of this document is to communicate the NGS commitment to research and vision for investment of budget allocations over both the short- (i.e., next two years) and long-term (i.e., next decade) planning horizons. Providing long-term research themes allows governmental partner agencies, academic collaborators, and commercial industry insight into NOAA's plans to prepare and address the nation's geodetic control needs for the next 10–15 years.

The long-term research activities are based on the outcomes of the current short-term research projects that are mainly focused on establishing, preserving, and improving the NSRS: including high-resolution geoid models, precise satellite orbits, and continuously updated national shoreline services.

NGS uses NOAA's Readiness Levels (RLs) methodology to report and coordinate progress on research efforts for successful transition of research to operations (R2O), application (R2A), or any other specialized use (R2X). These project progress metrics are used in collaboration with NOAA's sister agencies across the geodetic and geospatial research fields (e.g., NGA, NASA and USGS).

Short-term Research Activities

Following the current NGS strategic plan, the short-term efforts will focus on implementing research on NSRS modernization, with the planned public release of the modernized NSRS by the end of 2025. Short-term research efforts will include:

Modernizing the NSRS

Incorporate data and new algorithms into tools and services for users to determine latitude, longitude, and height coordinates relative to an ellipsoid model of Earth that is linked to a global dynamic reference system. Also, the NSRS will support the development of a geopotential datum that enables end-users to measure land elevations and water depths using a vertical reference system calculated from gravity observations, including tidal water level heights that are crucial for marine navigation and coastal zone management.

Enhancing Services for Land Surveyors and Local Communities

Include the time-dependent nature of the modernized NSRS in public-facing services (e.g., OPUS) and data collection standards to enable geospatial professionals and others to access the NSRS. These services can transform three-dimensional (3D) positional coordinates across time and among several popular terrestrial reference frames, including mark motion velocity models. Survey epoch coordinates (SECs) will estimate a mark's location at the date of the survey and reference epoch coordinates (RECs) will provide static views of most marks at conveniently chosen, common epochs (such as every five or ten years).

Updating and Expanding the Coastal Mapping Program (CMP)

Provide systems for defining the National Shoreline and nearshore bathymetry with all the relevant metadata to allow NOAA to deliver updated products to the public faster with valuable information and with interoperability capabilities. In addition to charting, the CMP layers are used to: define our nation's territorial limits; manage our coastal resources; support NOAA's homeland security; and support emergency response.

Engaging the Global Community

Communicate the benefits of the modernized NSRS to international communities where NGS is an active member including: The International Federation of Surveyors (FIG) and its working groups, the Committee of Experts on Global Geospatial Information Management (UN-GGIM), and the International Global Navigation Satellite System (GNSS) Service (IGS). NGS supports, educates, and facilitates geodetic research with regional partners, such as the Pacific and Mesoamerican/Caribbean communities. NGS also serves as one of the primary analysis centers that contributes precise GNSS satellite orbit and Earth Orientation Parameter (EOP) solutions to the IGS.

Long-term Research Activities

After the release of the NSRS, NGS will transition its research focus to our national geospatial infrastructure needs for the next decade. NGS recognizes the need to lead and adapt new procedures, technologies, and standards into NOAA's geospatial products. NGS will support automation of workflows and ingestion tools for new data formats to continuously update NOAA's interoperability services.

Develop the Next Generation of the NSRS

Focus on the next-generation reference system and explore alternate positioning, navigation, and timing (PNT) technologies (e.g., eLORAN and Ground-Based Augmentation Systems), leveraging the 200 years of long-term data in the NGS archives to supplement the current GNSS-centric approach. The next-generation reference system research will integrate government, academic, and private-sector systems into a common Geospatial Knowledge Infrastructure (with interoperable compliance). These efforts will include enhancing coverage for the contiguous Pacific-North American-Atlantic area and providing more accurate coordinate functions that account for land and marine deformation. Additionally we will develop tools to conduct leveling and total station corrections and mixed network adjustments.

Enhance Marine and Riverine Geodesy

Create tools and services to support coastal and marine application and allow seamless transitions between tidal and geopotential reference systems from land to

water and from water to land. NGS will work closely with other program offices within NOAA and with the US Geological Survey (USGS) to accurately determine the position and trend of their hydrological and coastal ocean models and observations. This spatial infrastructure will support risk reduction efforts by improving coastal zone management and weather/water predictions. NGS will also investigate alternative means for marine navigation, including the use of gravity, magnetics, timing, inertia, and attitude technologies.

Advance Space Geodesy

Investigate in conjunction with other U.S. government agencies that are participating in the Satellite Needs Working Group, new approaches and technologies for observing changes in the Earth's shape and orientation from satellite down to land and from land into space. These studies will also examine the contribution and impact of the atmospheric, ionospheric, and environmental factors on observation systems such as NOAA CORS network data and other GNSS station observations around the world. Outcomes from this research will provide improved timely solutions for satellite orbit calculations, positioning, ionospheric/tropospheric observations, land and seafloor deformations, and water levels.

Develop a National Deformation Model

Develop a deformation model of the Earth's surface using various ground and remote sensing observation methods. In addition to updates to the geodetic network, the deformation products and the reference system correctors can be used for monitoring subsurface physics-based Earth processes that will be linked into inter-agency geohazard monitoring programs (such as earthquakes and tsunamis), ground water activities, and sea level rise observations. The deformation research will support high-accuracy infrastructure on a national level, and provide a valuable indicator to the associated efforts of the warning centers within NOAA and sister agencies on potential risks from various natural disasters.

Enable Cyberinfrastructure

Research on approaches to expand the existing hybrid IT infrastructure (on premise and cloud) to enable larger datasets to be ingested at lower-latency, higher sampling rate, and higher resolution. This research will create more reliable automated workflows and provide a broader range of products to the public at a faster rate, including real-time services. In addition, the geodesy community of practice will be invited to test tools and services developed outside of NGS (i.e., from other government agencies, academia and industry) in a "sandbox" environment. This collaboration will provide IT resources to the community and feedback to NOAA on cutting-edge new research around the world. In an effort to enable automatization of workflows, standardization of inputs will be evaluated using different Artificial Intelligence and Deep Learning tools.

Increase Academic and Industry Engagements

Promote greater collaboration with experts in geodesy and related fields in academia and industry. Engagement activities will include co-authoring peer-review publications, participation in national and international scientific forums, and offering grants for cooperative research. Outcomes from such collaborations can produce new theory and algorithms for positioning and geophysical applications, and better understanding of new emerging techniques. To increase the academic courses in geodesy within the United States, NGS will routinely provide access to materials and access to beta versions of its tools and services for American professional organizations, as well as academic researchers and their students.