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FEDERAL GEOGRAPHIC DATA COMMITTEE

Theme Strategic Plan for Geodetic Control Theme

National Oceanic and Atmospheric Agency, National Ocean Service, National Geodetic Survey

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Theme Strategic Plan for Geodetic Control

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NGDA Datasets in **Geodetic Control**

Geodetic Control NGDA Datasets	**NGDA Dataset Lead Agency**	**Dataset Manager**
Continuously Operating Reference Stations (CORS)	NGS, NOS, NOAA	Dr. Kevin Choi
Airborne Gravity (GRAV-D)	NGS, NOS, NOAA	Ms. Monica Youngman
Geodetic Control Information on Passive Marks	NGS, NOS, NOAA	Mr. Godfred Amponsah
Geoid Models	NGS, NOS, NOAA	Dr. Yan Wang

Continuously Operating Reference Stations (CORS)

Goal 1
Maintain current density of CORS sites and ensure accuracy of metadata with station owners and operators, while ensuring the network is expanded where needed and refined to better tie into the International Terrestrial Reference Frame (ITRF).

Objective 1
The primary objective of CORS is to define, maintain and provide access to the geometric component (Latitude, Longitude, Ellipsoid Heights) of the National Spatial Reference System (NSRS). Since 95% of the stations in the CORS network are independently owned and operated, it is essential that the site owners maintain their stations. Sharing equipment changes with NGS is important because antenna changes and cables or receiver changes can result in coordinate changes which then impact all users of the data.

Anticipated Outcomes
Improved accuracy of the NSRS and related products and services

Action 1
Maintain good relationship with site owners and operators to ensure continued sharing of data. Provide clear and simple guidance to support their operations and assistance when possible with troubleshooting based on experience of NGS and other operators.

Action 2
Provide improved automated tools to flag inconsistencies and inform station operators of this information and demonstrate impact of changes as well as NGS abilities to detect the changes.

Action 3
Identify existing candidate sites not already a part of the CORS network for incorporation into the CORS network based on scientific merit and with an eye to reducing gaps in national coverage.

Action 4
Develop and maintain a plan to accomplish the above actions.

Objective 2
In order to better support international activities in global reference frame realization, NGS plans to build and expand foundational GNSS tracking station network with higher standards. These Foundation CORS (FCORS) sites will improve the NSRS with stronger ties to the International Terrestrial Reference Frame (ITRF). In turn, these stronger ties will better constrain future positions of all other CORS and thereby improve positional accuracy of our products to users in the field.

Anticipated Outcomes
Better spatial distribution of stable GNSS stations in the United States.

Action 1
Identify candidate sites or locations based on scientific merit such as co-location with other space geodesy techniques, geographical distribution, and stable monumentation history.

Action 2
Develop and maintain a plan for development of Foundation CORS (FCORS).

Goal 2
Encourage continued upgrade of equipment to include additional GNSS constellations beyond GPS.

Objective 1
The CORS network requires GPS signals to be tracked by all station operators. With the increasing availability of additional GNSS constellations, supporting these new/newer signals is becoming more important.

Anticipated Outcomes
Defining, maintain, and accessing the NSRS using the broadest number of GNSS signals.

Action 1
Support owners and operators decision to upgrade equipment, provide feedback using data quality tools on new signals. Develop as necessary new tools to support quality controlling these new signals while emphasizing the importance of GPS as the core signal.

Airborne Gravity (GRAV-D)

Goal 1
Define, maintain, and provide access to the National Spatial Reference System (NSRS), specifically for gravity data throughout the United States and its territories. Gravity data are collected, processed and archived in order to provide access via online tools for a number of applications that require knowledge of the local gravity field. Gravity data also used in formation of geoid height models that provide a transformation model between GPS-derived ellipsoid heights and heights above the vertical datum. Accurate heights are critical to many industries, including floodplain definition and management, levee

construction and maintenance, transportation and infrastructure development, and coastal management. See the NGDA Geoid Data set for further details.

Objective 1
Collect and process high quality airborne gravity data for the entire U.S. and territories by 2022 to support modeling of the Earth's geoid, which will serve as a zero reference surface for all heights in the nation. This objective is under the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program.

Anticipated Outcomes
Improved geoid models based on airborne gravity data collection with a final geoid in 2022 accurate to 1 centimeter where possible.

Action 1
In FY17 complete collection of airborne gravity data for a total of 62% of the U.S. and territories.

Action 2
In FY18 complete collection of airborne gravity data for a total of 70% of the U.S. and territories.

Action 3
In FY19 complete collection of airborne gravity data for a total of 79% of the U.S. and territories.

Action 4
In FY20 complete collection of airborne gravity data for a total of 87% of the U.S. and territories.

Action 5
In FY21 complete collection of airborne gravity data for a total of 96% of the U.S. and territories.

Objective 2
Develop a plan to monitor the gravity field over time for changes that affect the geoid more than 1 centimeter. This objective is under the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) program.

Anticipated Outcomes
Published plan on what gravity changes need to be monitored and how airborne gravity will be used to fill that need.

Action 1
Conduct a sensitivity analysis to determine which geophysical changes need to be monitored.

Action 2
Identify which data collection methods are most appropriate to monitoring the identified gravity changes.

Action 3
Create a plan to support the airborne gravity component of the long-term monitoring.

Geodetic Control Information on Passive Marks

Goal 1
Support and modernize the National Spatial Reference System (NSRS) in the development and maintenance of passive control to ensure alignment with the mission of the National Geodetic Survey (NGS). Major parts of the NGS Ten Year Strategic Plan (2013-2023) focus on the need to maintain access to passive control under the current realization of datums. It also stresses the need to align passive control with the future datum realizations, and improve toolkit. Specifically, the following objectives support the goal:

Objective 1
Maintain and support the capability to ingest, analyze, store, and disseminate internal and external survey data in the form of Bluebooking, datasheets and associated products and services.

Anticipated Outcomes
Maintain operational support to meet mission requirement, improve availability and accuracy of the positional information.

Action 1
Continue to accept and ingest survey projects into the NSRS using Bluebooking while improvements are being made.

Action 2
Continue to ingest and disseminate geodetic data on passive marks to the user community.

Action 3
Maintain and improve surveying activities.

Action 4
Maintain and provide technical support to the underlying software.

Action 5
Continue to provide technical support and training to the private sector.

Objective 2
Modernize and improve NSRS.

Anticipated Outcomes
Modernized and improved access to NSRS and associated products and services.

Action 1
Modernize NSRS and improve online services to ingest, analyze, store, and disseminate geodetic control and associated metadata.

Action 2
Design a geospatial database for NSRS and promote emerging geospatial data formats for data collection and dissemination

Action 3
Leverage OPUS-Projects tools and standardize data collection and analysis. Develop visualization tools for data analysis

Action 4
Modernize and improve efficiencies of leveling and vertical control processing.

Action 5
Promote open data standards and web services for data dissemination.

Objective 3
Evaluate and improve the Toolkit.

Anticipated Outcome
A toolkit portal that features modernized and improved access to geodetic tools

Action 1
Evaluate and integrate additional toolkit components into a unified geodetic toolkit.

Action 2
Make the toolkit user-friendly and scientifically precise.

Action 3
Evaluate and implement an online feedback tool for the toolkit

Action 4
Build tools to allow users to easily visualize all types of surveys done on a point.

Geoid Models

Goal 1
Define, maintain, and provide access to the National Spatial Reference System (NSRS), specifically for access to the current vertical datum of the United States and its territories (e.g., NAVD 88). Vertical datums are traditionally realized through a network of vertical control bench marks, which requires field crews to level between them and target areas of interest. Instead, NGS develops so-called “hybrid” geoid height models to facilitate the use of determining vertical control heights through GNSS observations. This process is much more efficient and cost saving than the traditional leveling.

Objective 1
Hybrid geoid models are developed using geodetic control data (available as a separate NGDA data set) in combination with gravity data (another NGDA gravity data set). Because both the other NGDA data sets are continuously being updated, it necessary on an infrequent basis to determine new hybrid geoid models to be consistent with these changes. The current model is GEOID12B. It may be necessary to develop another model in 2018 (possibly GEOID18). After 2022, vertical datums for all US areas will be defined strictly by a geopotential datum defined solely by gravity data.

Anticipated Outcomes
A new hybrid geoid model in 2018 or 2019.

Action 1
Collect new GPS on Bench Marks (GPSBM) data for geoid modeling (e.g. in Louisiana). Provide guidance to support data collection and quality control. Densify the GPSBM data in areas needed.

Action 2
Clean up the collected data, using e.g., outlier detection and removal. The possibility of local /regional network adjustments will also be explored.

Action 3
Develop software for computing the hybrid geoid model and its accuracy estimation. Construct the hybrid geoid website and enable users to download the hybrid geoid grids.

Goal 2
NGS models the Earth's static gravity field and the geoid, which will serve as a zero surface for all heights in the nation. By 2022, the orthometric heights in the geopotential reference frame will be determined to an accuracy of 2 centimeters when using 15 minutes of GNSS data.

Objective 1
Research and develop theory, computation methods, and procedures for the determination of the Earth's gravity field and the geoid for North America and the US territories. Gravimetric geoid models provide an equipotential surface determined gravimetrically using satellite gravity models, GRAV-D airborne and terrestrial gravity data. While the GRAV-D project is in progress, experimental geoid (xGEOID) models have been computed annually using available GRAV-D data since 2014. The xGEOID models will converge to the final geoid model for the geospatial reference system in 2022.

Anticipated Outcomes
Two annual experimental geoid models: Model A does not contain the GRAV-D airborne gravity data while model B does. The models are placed online for user communities to validate and test.

Action 1
Continue research on removing the systematic and random errors in the terrestrial and airborne gravity data. Continue efforts on combining various types of gravity data in an optimal way.

Action 2
Coordinate cooperation between scientists from Canada, Mexico, and the U.S. (as well as internationally). Hold monthly meetings between the three countries.

Action 3
Formulate a common gravity data set for the experimental geoids. The first version will be made by the end of 2017.