



Determining Accurate Elevations: Datums & Tools, Today & Tomorrow

Maryland Association Floodplain and Stormwater Managers
Linthicum Heights, MD

Christine Gallagher
Oct. 20, 2016

Overview

- NGS Mission
- Important of Heights and Vertical Datums
- NGS Products and Services
- Future Plans – New Datums
- More Resources

NGS' Mission

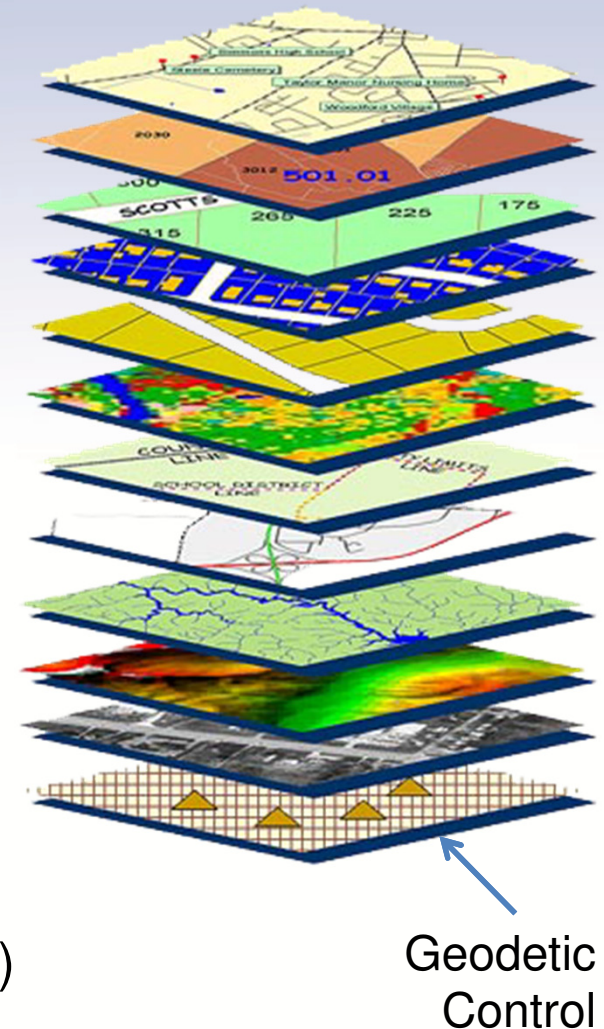
To define, maintain and provide access to the **National Spatial Reference System (NSRS)** to meet our Nation's economic, social, and environmental needs.

.....

Current realization of NSRS:

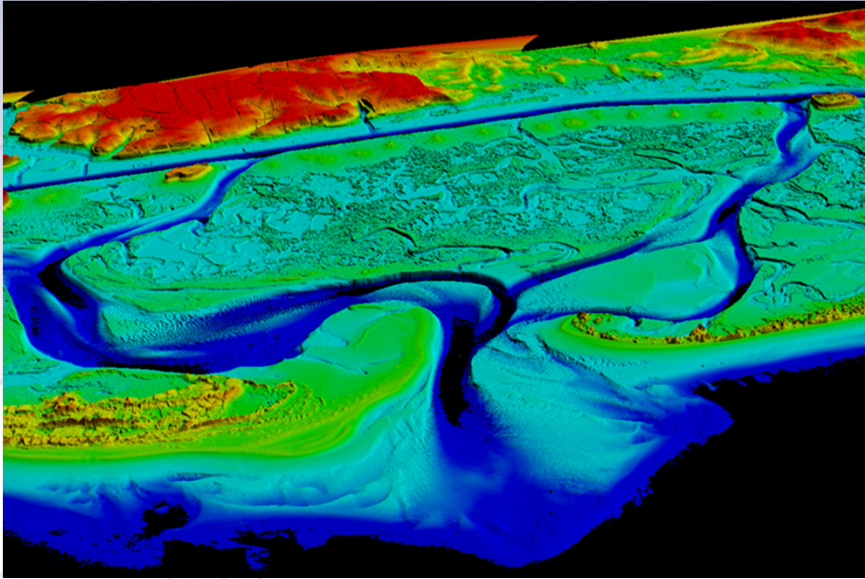
North American Datum of 1983 (**NAD 83**)

North American Vertical Datum of 1988 (**NAVD 88**)



Height Matters

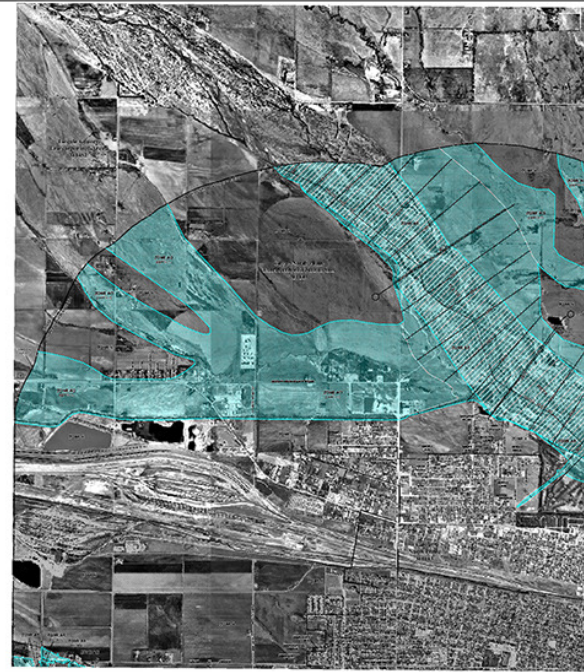
geodesy.noaa.gov



NOTES TO USERS

The data on this map were derived from a variety of sources, including satellite altimetry, ground-based surveys, and other data. The data are not guaranteed to be accurate and are provided as-is. The user assumes all liability for any use of the data.

NOAA and the National Geodetic Survey do not warrant the accuracy, reliability, or completeness of the information provided on this map. The user assumes all liability for any use of the data.



LEGEND

FLOOD INSURANCE RATE MAP

Legend

Flood Hazard Symbols

Panel 1 of 2

Panel 2 of 2

Panel 3 of 2

Panel 4 of 2

Panel 5 of 2

Panel 6 of 2

Panel 7 of 2

Panel 8 of 2

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Panel 98 of 2

Panel 99 of 2

Panel 100 of 2

FIRM
FLOOD INSURANCE RATE MAP
OF
NORTH PLATTE,
NEBRASKA
AND VICINITY
PANEL 1 OF 2
REVISED TO
REFLECT LOWRIS
DATED MAY 4, 2006



Missouri River Flooding 1993 North of Jefferson, City, MO
Missouri Dept. of Transportation



Vertical Datums

Ellipsoidal Datums



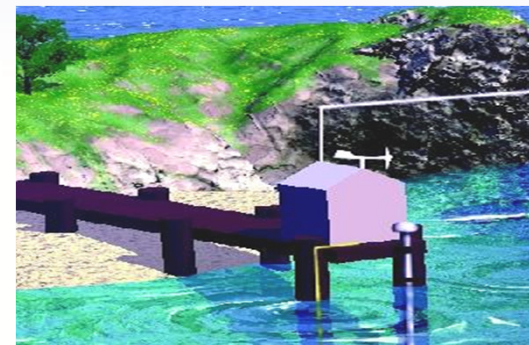
**WGS 84,
NAD 83 (NSRS)
+17 others**

Orthometric Datums



**NAVD 88,
NGVD 29**

Local Tidal Datums



**MHHW,
MHW,
MTL,
DTL,
LMSL,
MLW,
MLLW**

NGS Programs, Products & Services

- GPS Positioning
- Traditional Land Surveying
- Tools to Transform Coordinates
- Remote Sensing and Imagery
- Education/Training Resources

The screenshot shows the NOAA National Geodetic Survey website. At the top, the NOAA logo and the text "National Geodetic Survey Positioning America for the Future" are visible. Below this is a navigation menu with links for "NGS Home", "About NGS", "Data & Imagery", "Tools", "Surveys", and "Science & Education". A search bar is located on the right side of the menu. The main content area features a "Notices" section with several announcements, including the 2017 Geospatial Summit, experimental geoid models, and updated software tools. A "Most Popular" section lists various resources like "Antenna Calibration" and "CORS". An "Upcoming Events" section highlights the 2016 North American Comparison of Absolute Gravimeters and a regional conference on coastal resilience. On the right side, there are three promotional banners: "Looking for Bench Marks?", "NGS 2017 Geospatial Summit April 24-25", and "Geodetic Datums". A "GPS on Bench Marks" banner is also visible. At the bottom left, there is a "NGS Public News Subscription Service" box with a "Click here to subscribe or unsubscribe" link. The date "October 14, 2016" is displayed in the top right corner of the page content.

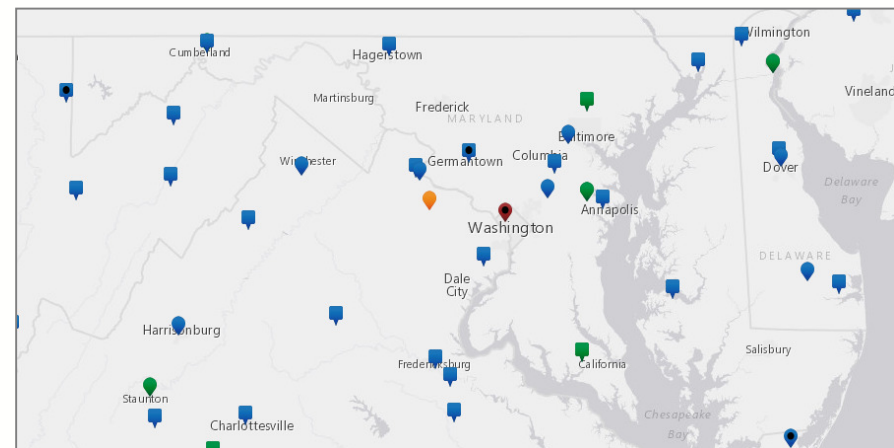
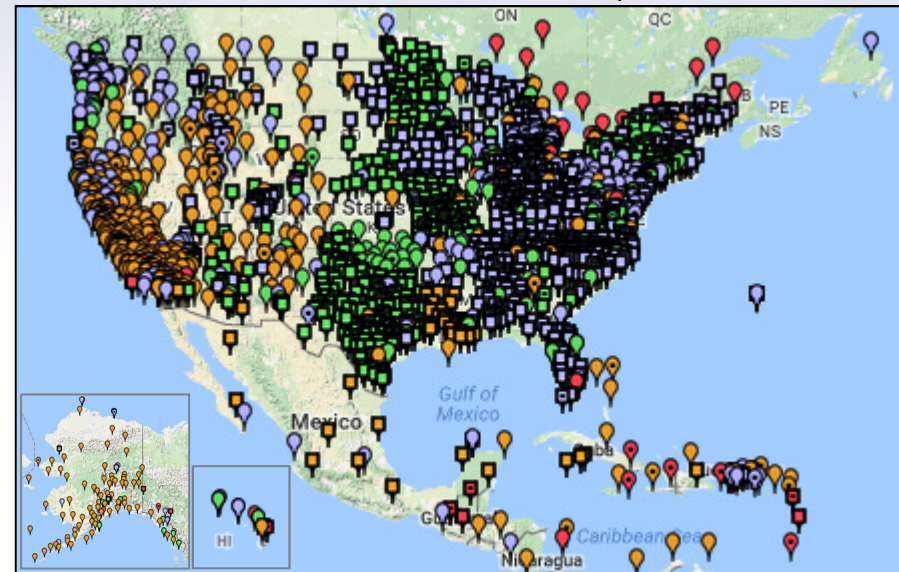
Continuously Operating Reference Stations (CORS)

- **Enable** accurate positioning
- **Provide** interface between land and ocean observing systems
- **Contribute** to local and global sea-level rise calculations



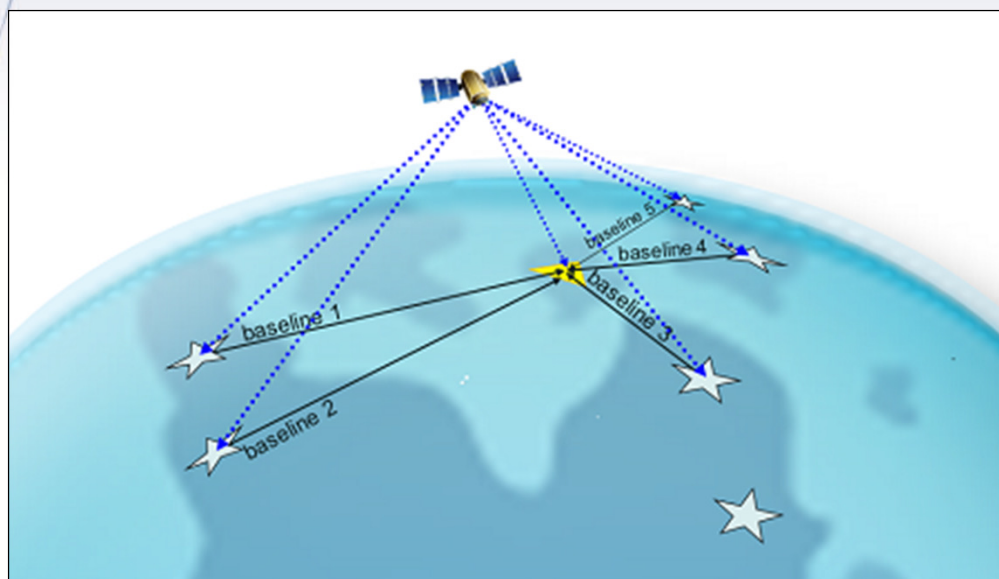
2016 CORS Network

~ 1850 Operational Stations



Online Positioning User Service (OPUS)

<http://www.geodesy.noaa.gov/OPUS//>



**Fast, easy, consistent
access to NSRS**

- Over 2.8 millions solutions processed since 2002
- Processed automatically on NGS computers
- Solution via email in minutes

More OPUS Products

OPUS-Static (OPUS-S)

- 2 to 48 hr (anywhere)

OPUS-Rapid Static (OPUS-RS)

- 15 min to 2 hr (per CORS)

OPUS-Share

- Share results with others

OPUS-Projects

- Network of multi-stations/occupations

Shared Solution

PID: BBB01
 Designation: LARRIMORE 2006
 Stamping: Larrimore 2006
 Stability: May hold commonly subject to ground movement
 Setting: Object surrounded by mass of concrete
 Description: This station is established to posthumously commemorate National Geodetic Survey Lead Computer Specialist CRAIG B. LARRIMORE for his success in promoting access and maintenance for the National Spatial Reference System. This mark demonstrates the initial use of the internet to automatically upload, process, adjust, archive, and display field survey data, made possible through Craig's efforts.
 Note: The station resides within a memorial garden on private property. Recovery is not recommended.
 Observed: 2006-01-12T15:59:00Z
 Source: OPUS - page 5 1209.04 [See Also Original](#)



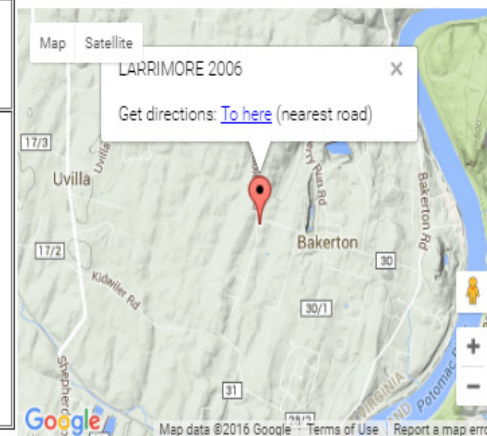
Close-up View

REF_FRAME: NAD_83(2011)	EPOCH: 2010.0000	SOURCE: NAVD88 (Computed using GEOID12B)	UNITS: m	SET PROFILE	DETAILS
LAT: 39° 21' 51.77107" ± 0.019 m	UTM 18 SPC 4701(WV N)				
LON: -77° 46' 21.55804" ± 0.009 m	NORTHING: 4360880.958m 97391.754m				
ELL HT: 98.923 ± 0.021 m	EASTING: 261128.820m 748846.721m				
X: 1045792.598 ± 0.009 m	CONVERGENCE: -1.75938721° 1.10165396°				
Y: -4825830.607 ± 0.024 m	POINT SCALE: 1.00030260 0.999995111				
Z: 4023736.628 ± 0.017 m	COMBINED FACTOR: 1.00028708 0.999993559				
ORTHO HT: 132.591 ± 0.039 m					

CONTRIBUTED BY

[Irishna.tadepalli](#)
 National Geodetic Survey

Horizon View





Survey Marks and Datasheets

National Geodetic Survey


[NGS Home](#)
[About NGS](#)
[Data & Imagery](#)
[Tools](#)
[Surveys](#)
[Science & Education](#)


[Search](#)

Finding Survey Marks and Datasheets


NGS provides Information about survey marks (including bench marks) in text **datasheets** or in GIS **shapefiles**. Note some survey markers installed by other organizations may not be available through NGS. To learn more about survey marks, visit our **Frequently Asked Questions (FAQs)**. Visit here for **updates to the Datasheet format**.

Select a data format:


 **Datasheets** can be viewed in word processors or as text files. [View an example datasheet online.](#)

 **Shapefiles** can be used in GIS software.

Select a retrieval method:

 **Interactive Map:**
Zoom to your location of interest and search for geodetic control: Use **NGS Data Explorer** or **DS World**.

 **Archived Control:**
Download data for an entire state at once (generated once a month). Read more about **archived datasheets** and **archived shapefiles**. Archived control by state is recommended for large downloads (>20).

 **Search By:**
Submit queries based on location (e.g. county) or mark information (e.g. station name).

Mark Recovery

You may find or "recover" a survey mark and review information about it online. Sometimes, you may want to update the information about a mark you find by reporting its current condition or submitting a photograph. This can be very helpful if you find physical evidence that the mark is destroyed. [Learn more about submitting a recovery note online.](#)



Retrieval Options

Interactive Map



Click to browse map for survey control

In the menus below click the icons for different formats.

 for text Datasheets or  for GIS Shapefiles.

Archived Control

Monthly Archives by State:  

Search By

Station Name(s)	 
PIDs - Permanent Identifiers	 
County	 
Radial Search	 
Rectanqular Search	 

NGS
database
includes
more than
1 million
positioned
points,
which are
part of the
NSRS.

FAQs: Floodplain maps

How do I find more information about a **bench mark on my flood insurance rate map (FIRM)?**

Can I use NGS tools like **OPUS or geoid models to complete an elevation certificate or otherwise determine the elevation of my home/property?**



Frequently Asked Questions
National Geodetic Survey

Data & Imagery Tools Surveys Science & Education Search

FAQs
frequently asked questions

Popular topics and questions are listed below, or use "control-F" (or "command-F" on a Mac) to enter a term in a search window.

If you still have a question after scanning these FAQs, please contact the **NGS' Communications and Outreach Branch**.

Popular FAQ Pages
Aeronautical Survey Program
Continuously Operating Reference Systems (CORS)
New Datums
Online Positioning User Service (OPUS)
Survey Marks, Bench Marks and Datasheets
What is a Geoid?

Questions about... **...Floodplain maps**

<http://geodesy.noaa.gov/faq.shtml>

Transformation Tools

NOAA's VDATUM

- **Ellipsoidal** datums,
- **Orthometric** datums, and
- **Tidal** daums

NGS Geodetic Toolkit

- **NADCON**: NAD27 to NAD83
- **VERTCON**: NGVD29 to NAVD88
- **GEOCON**:
 - **GEOCON11**: NAD83 (NSRS2007) to NAD83(2011)
 - **GEOCON**: NAD83 ("HARN") to NAD83(NSRS2007)



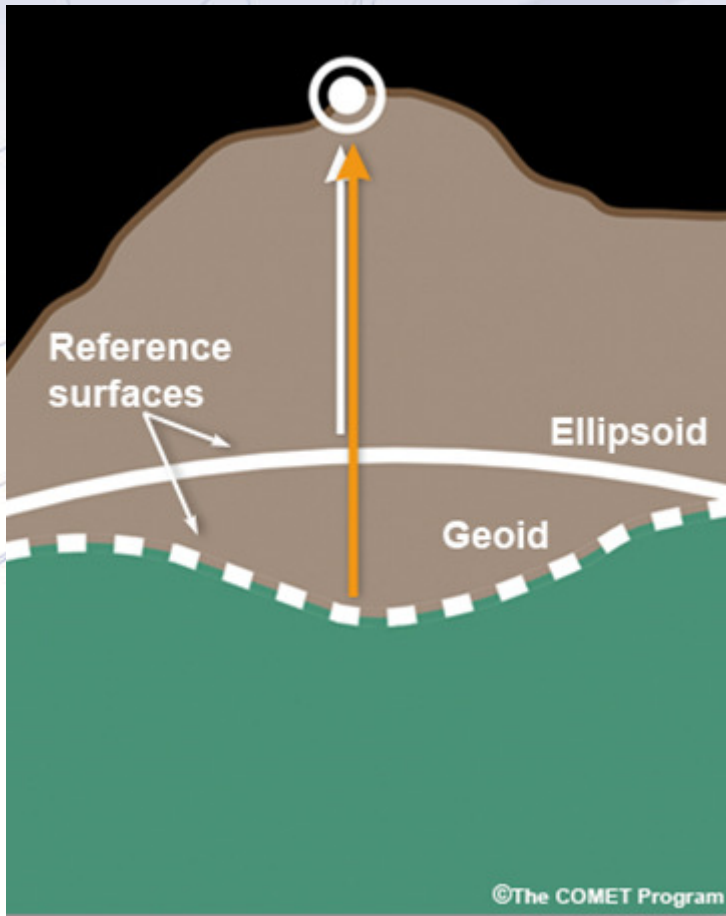
Learn more!

5 min. YouTube video on VDATUM

50 min. webinar on VDATUM

60 min. webinar on NADCON5

FAQs: GPS Derived Orthometric Heights



Which Geoid for which NAD 83?

NAD 83 (2011)

Geoid12B

NAD 83 (2007)

Geoid09

NAD 83 (19xx)

Geoid03

Geoid99

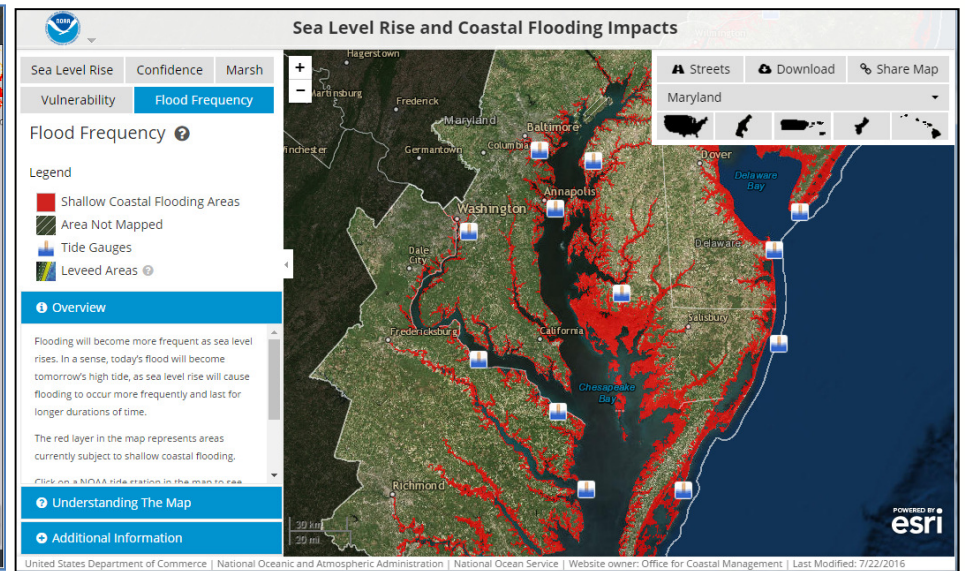
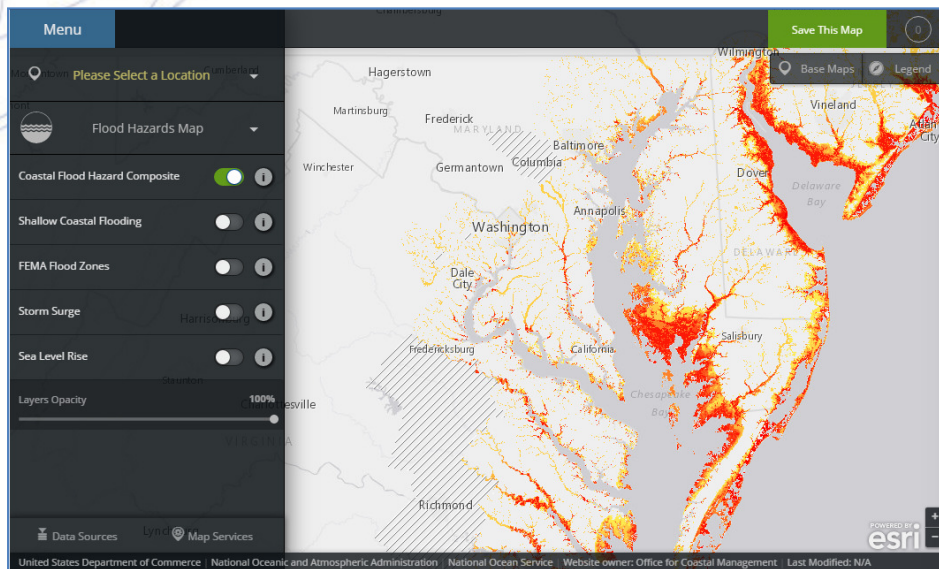
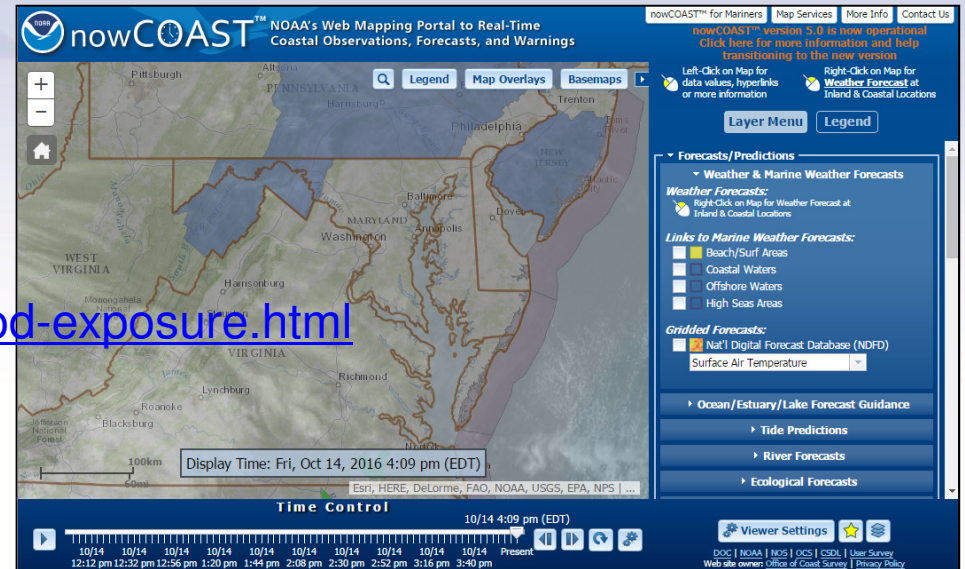
Geoid96

DRAFT

FAQs: Accurate Transformations Matter

NSRS supports other NOAA tools:

- NowCOAST
<http://nowcoast.noaa.gov/>
- Coastal Flood Exposure Mapper
<https://coast.noaa.gov/digitalcoast/tools/flood-exposure.html>
- SLR and Coastal Flooding Impacts
<https://coast.noaa.gov/slr/>



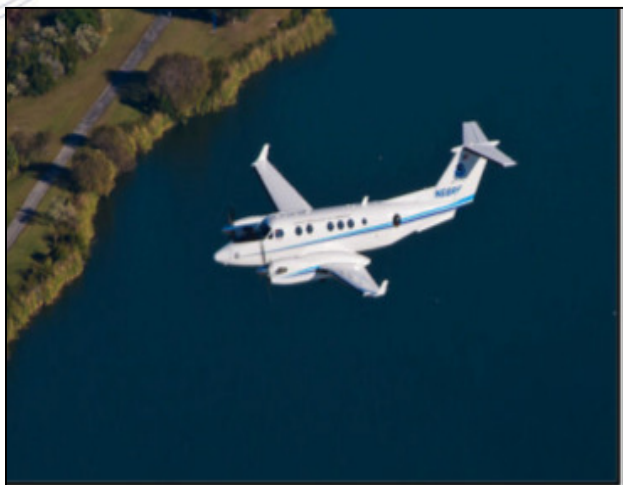
Coastal Mapping Program

NGS produces the Nation's shoreline to define territorial limits.

Up-to-date shoreline:

- is an integral component of NOAA Nautical Charts
- supports wide range of coastal applications

To survey the shoreline, NGS uses remote sensing technologies (imagery, lidar, radar, etc.) from various sources (aircraft, satellites) and continually assesses new technologies and workflows.



Emergency Response Imagery

http://storms.ngs.noaa.gov/eri_page/index.html

NGS collects **high-resolution, geo-referenced imagery** after disasters such as hurricanes, tornados, and earthquakes.



Edisto Beach, South Carolina

Before (left) and after (right) Hurricane Matthew (October 2016)

Modernizing the NSRS

Repairing NAD 83

- Align with international frames
- Align with bordering countries
- Better account for land velocities



Repairing NAVD 88

- Correct cross-country error/bias
- Address that subsidence, uplift, freeze/thaw invalidates bench mark elevations



New Datums Are Coming in 2022!

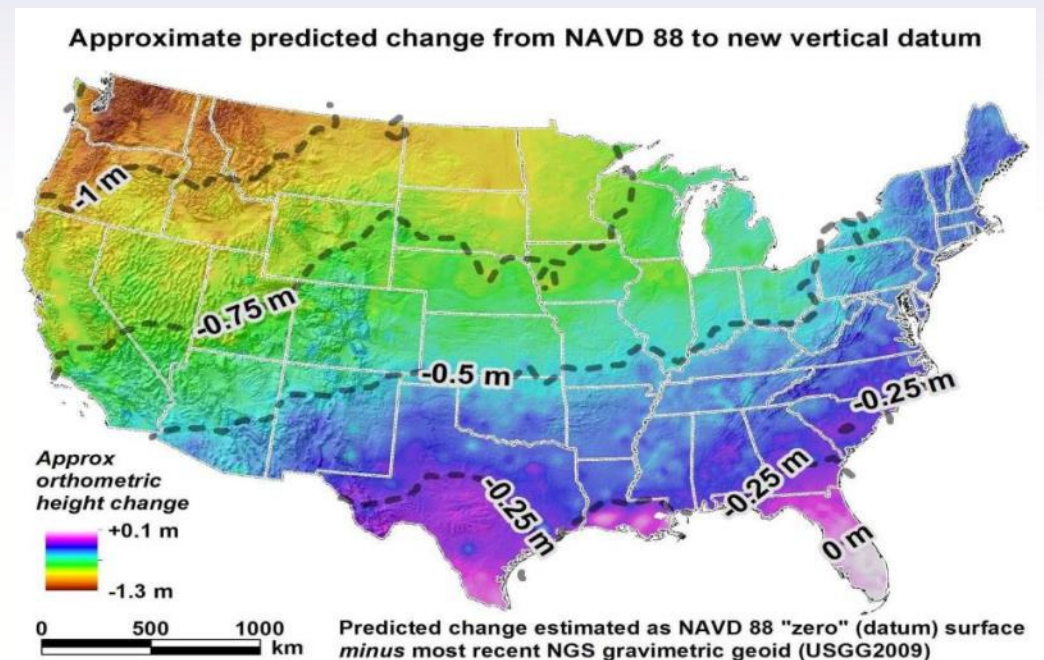
- Both a new **geometric** and a new **geopotential** (vertical) datum will be released in **2022**.
- The realization of the new datums will be through **GNSS receivers**.
- **NGS will provide the tools** to easily transform between the new and old datums.



How will the new datums affect you?

The **new geometric datum** will change latitude, longitude, and ellipsoid height by between **1 and 2 meters**.

The **new vertical** (geopotential) **datum** will change heights on average **50 cm (20")**, with a **1-meter (39") tilt** towards the Pacific Northwest.



New Datums: What to do now

- **Require/provide complete metadata for all mapping contracts.**

How did they get the positions/heights? Document it!

- **Move to newest realizations.**

NAD 83(2011) epoch 2010.00

GEOID12B (hybrid geoid)

- **Move from NGVD 29 to NAVD 88.**

Understand the accuracy of VERTCON in your area.

- **Move away from passive marks to GNSS.**

Especially, move away from classical passive control.

- **Keep original (“raw”) GNSS observation files**

Improve quality of future transformations.

NGS Workshop, Conference, and Training Opportunities

- **Training Classes**
- **Workshops and Conferences**
- **NGS Online Learning Resources**

http://www.geodesy.noaa.gov/web/science_edu/training/

**NOS Online Learning Resources
cover NGS programs and more.**

<http://oceanservice.noaa.gov/multimedia/>



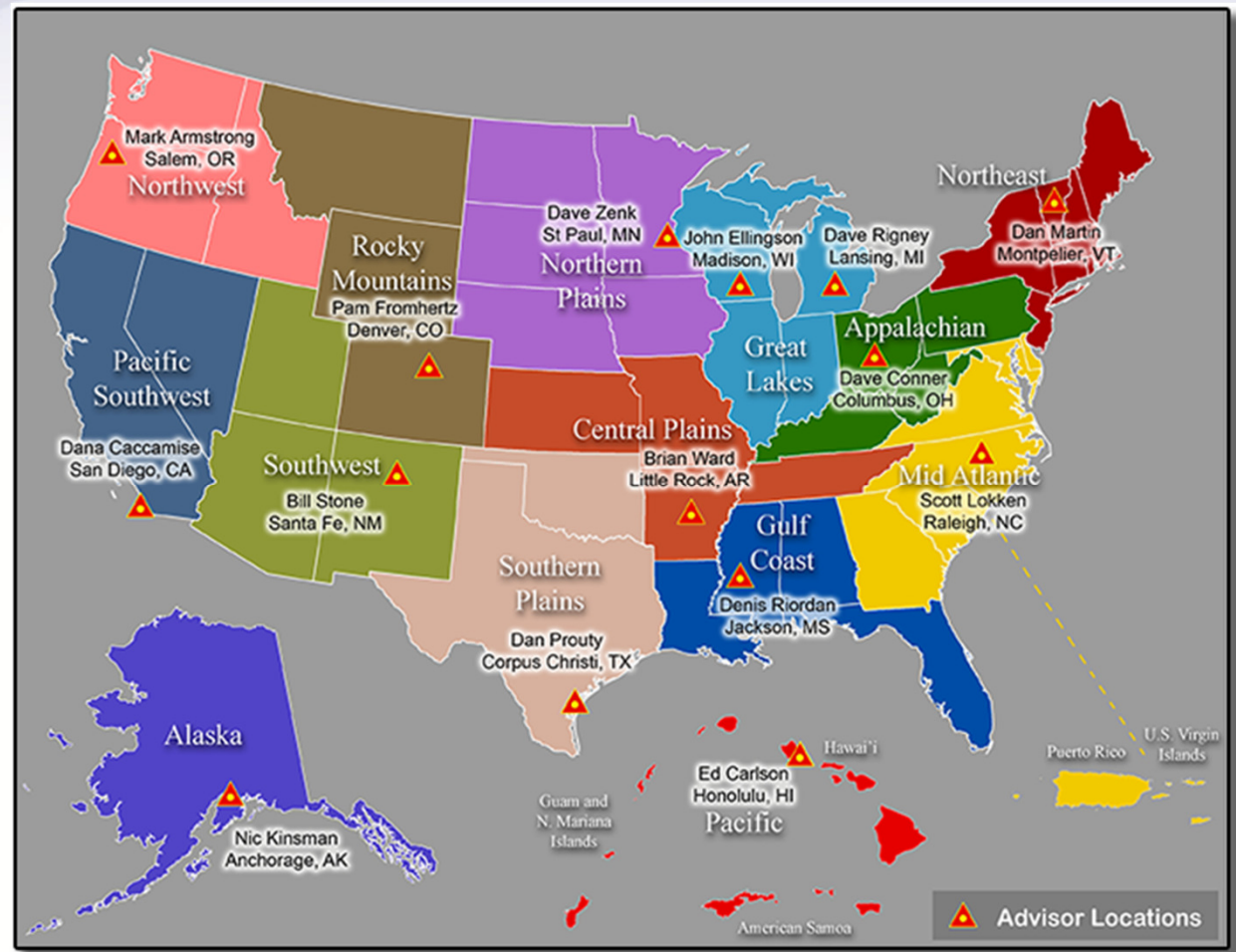
NGS Geodetic Advisor Program

<http://www.geodesy.noaa.gov/ADVISORS/>

The **NGS Geodetic Advisor Program** places **NOAA employees** around the country.

Geodetic advisors **guide and assist** the state's geodetic and surveying programs.

Advisor program is **transitioning** to a regional approach for more coverage but fewer advisors.



Online Education Resources

http://www.ngs.noaa.gov/corbin/class_description/NGS_Video_Library.shtml

Educational Videos

- Topics related to geodesy and mapping.
- Just two - five minutes each!

Online Lessons

- Heights & Vertical Datums;

More coming soon!

- GPS Positioning;
- Introduction to Gravity;
- Gravity for Geodesy.

Video Library

NGS, in partnership with **The COMET Program**, has developed short videos about topics related to geodesy and mapping. View or download our featured video or previous videos. Please visit the **COMET YouTube Channel** to view the **entire playlist**.



What are Geodetic Datums?



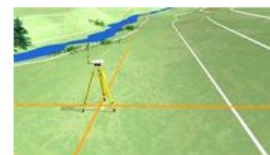
How Were Geodetic Datums Established?



What is the Status of Today's Geodetic Datums?



What's Next for Geodetic Datums?



Precision and Accuracy in Geodetic Surveying



Two Right Feet? U.S. Survey Feet vs. International Survey Feet



Geospatial Infrastructure for Coastal Communities: Informing Adaptation to Sea Level Rise



Best Practices for Minimizing Errors during GNSS Data Collection



The Importance of Accurate Coastal Elevation and Shoreline Data



NOAA's VDatum Tool: Transforming Heights Between Vertical Datums

NGS Webinar Series

http://geodesy.noaa.gov/web/science_edu/webinar_series/

Join the webinar:

- Second Thursday each month
- 2:00-3:00 p.m. eastern time
- Certificates of Attendance

Online resources:

- Recorded webinars
- Presentation slides
- NGS.Webinar@noaa.gov

NGS Webinar Series
National Geodetic Survey

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Webinar Series
Overview
Webinars
Archived Webinars
Frequently Asked Questions (FAQ)

Contact information
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Sign-up for webinar announcements

Upcoming Webinars

OCTOBER 13 2016
2 pm eastern time
Improvements to Online Map Products
Brian Shaw, NGS
NGS processes data from many continuous GNSS sites (CORS Program), and users frequently share GNSS-derived positions with the public (OPUS Share). This presentation will highlight new, beta CORS and OPUS Share maps that greatly increase end-users' ability to access geodetic information of interest on a device of their choice. **REGISTER**

NOVEMBER 10 2016
2 pm eastern time
Using Calibration Base Lines
Kendall Fancher, NGS
NGS is modernizing its Calibration Baseline (CBL) Program for Electronic Distance Measuring Instrumentation (EDMI), which provides a locally accessible, national standard for distance measurement. This presentation will introduce the program and proposed changes, as well as solicit live feedback. **REGISTER**

Recorded Webinars

SEPTEMBER 8 2016
NADCON5: your tool for easy, consistent coordinate transformations
Dr. Dru Smith and Dr. Andria Bilich, NGS
NADCON5 is a tool that will allow users to transform coordinates between various 2-dimensional horizontal datums and 3-dimensional geometric reference frames. This presentation discusses the motivations for building NADCON5, as well as the supporting data and products. 59 mins **PPT 4.5 MB**

AUGUST 11 2016
Understanding Information on NGS Datasheets
John Ellingson, NGS
NGS datasheets include detailed information about survey control marks around the country. This presentation outlines how to find the information you need from a datasheet and how to avoid misusing it. 59 mins **PPT 12.4 MB**

Sign up for the NGS ListServe

<http://www.geodesy.noaa.gov/>

Instructions for Subscribing to the NGS News Mail List

Choose the email account you would like to use for your incoming email subscription. From that email account, send an email to the NGS News mailing list at ngs.news-join@list.woc.noaa.gov Use the following as your subject line: subscribe NGS.news

Shortly after sending your "subscribe NGS.news" message, you will receive an automated reply from the mailing list service with a subject line similar to: Subscribe NGS.news Confirm 111111 {where 111111 is a random number assigned to your request}. The email will instruct you to confirm your request by replying to the confirmation message.

You will receive one final message welcoming you to the NGS News mailing list. The email will include a help message explaining how to get help and how to unsubscribe from the list.

National Geodetic Survey
Positioning America for the Future

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June 18, 2016

Notices

- ADJUST and UTILITIES** - An updated version of ADJUST (and its utilities) has been released 06.08.2016
- NGS releases New Document for FAA Users Titled: NOAA Technical Memorandum NOS NGS 72: A Comparison between OPUS Projects and PAGE-NT using Airport Surveys** 12.18.2015
- Update to NOS NGS 3 with Alternative Method to Leveling for Crossing Rivers or Other Barriers** 11.20.2015
- NGS Announces Improvements to GEOCON and GEOCON11 Software Transformation Tools** 10.27.2015
- 2015 Experimental Geoid Models xGEOID15A and xGEOID15B Now Available** 10.01.2015

In The News

- 06/16/2016 - NOS Navigation Services Leaders to Meet Counterparts in Cuba**
National Geodetic Survey (NGS) | National Centers for Coastal Ocean Science (NCCOS) | Integrated Ocean Observing System (IOOS) | Office of Coast Survey (OCS)
Directors and subject experts from NOS navigation services offices traveled to Havana this past weekend for meetings from June 13-16. The sessions kicked off implementation of the work plan agreed to in March, in the Memorandum of Understanding (MOU) between NOS and Cuba's National Office of Hydrography and Geodesy... more
- 06/09/2016 - Did the Earth Move? Twelve Million NOAA Data Files Will Tell**
Data from NOAA's Continuously Operating Reference Stations (CORS) are frequently used for commercial surveying, engineering, and scientific activities. The data must be periodically reprocessed to take advantage of the latest geophysical models. NGS scientists complete this reprocessing, called REPRO, to determine... more
- 06/02/2016 - Height Modernization Partners' Annual Meeting**
Last week, NGS and its Great Lakes partners hosted the annual Height Modernization partner meeting in La Crosse, Wisconsin. This year's meeting was held in conjunction with... more

Most Popular

- Antenna Calibration
- Contact Us
- CORS
- FAQs
- Geodetic Advisors
- Geodetic Tool Kit
- LOCUS
- NAD 83(2011) epoch 2010.00
- NGS Data Explorer
- OPUS
- Publications
- Storm Imagery
- Survey Mark Datasheets
- UFCORS

Upcoming Events

NGS Public News Subscription Service
[Click here to subscribe or unsubscribe.](#)

Looking for Bench Marks?

Coming in 2022: New Datums!
Learn more...

GPS on Bench Marks

Geodetic Datums
See our videos!


Questions?

Christine.Gallagher@noaa.gov

Constituent Resource Manager, NGS

Back-up slides

Improving Tools



BETA

This is a BETA Release Site

Coordinate Conversion

National Geodetic Survey

NGS Home | About NGS | Data & Imagery | Tools | Surveys | Science & Education

Conversion from lat-long | Conversion to lat-long | Conversion of multiple coordinates | Web services | Downloads

Choose a location to generate projected coordinates

Enter decimal degrees or drag map marker


Lat:

Lon:

or degrees-minutes-seconds

Lat:

Lon:

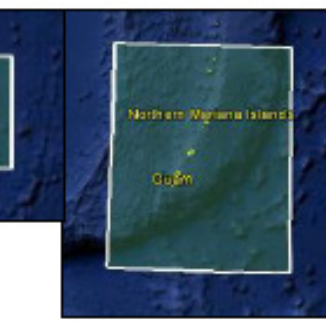
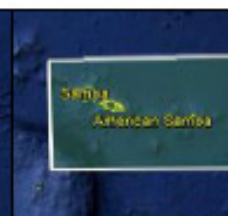


Choose a datum

NAD83 NAD27/Old HI/PR 40/AS 62/GU 63

GRAV-D Data Collection Scope

- Entire U.S. and territories
 - Total Square Kilometers: 15.6 million
 - ~200 km buffer around territory or shelf break if possible
 - Initial target area for 2022 deadline



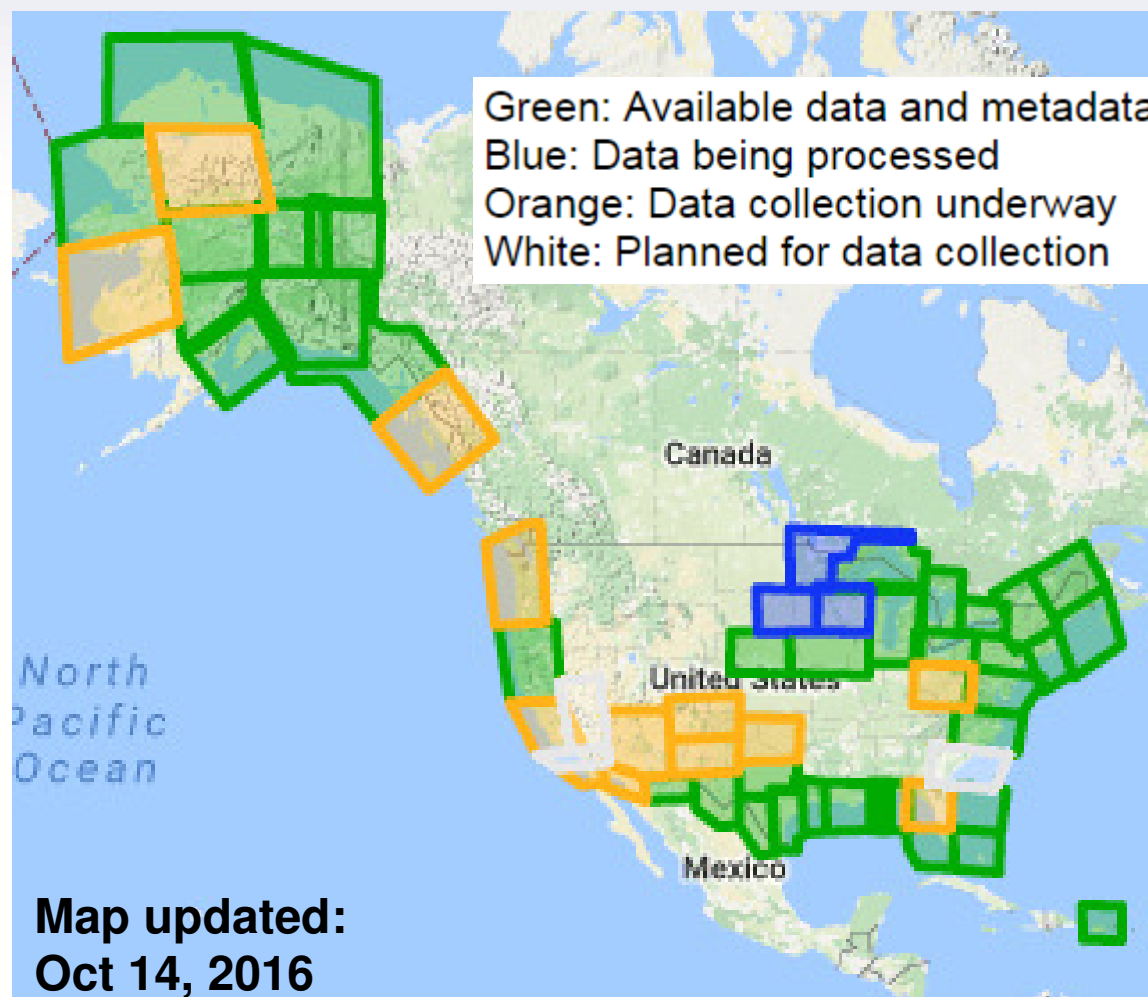


Gravity for the Redefinition of the American Vertical Datum (GRAV-D)

<http://www.geodesy.noaa.gov/GRAV-D/>

Project to collect gravity data to redefine the U.S. vertical datum by 2022 (at current funding levels)

Target: 2-centimeter accuracy relative to sea level (orthometric heights) using GPS/GNSS and a geoid model.





BETA

This is a BETA Release Site

xGEOID16 Evaluation Computation

National Geodetic Survey

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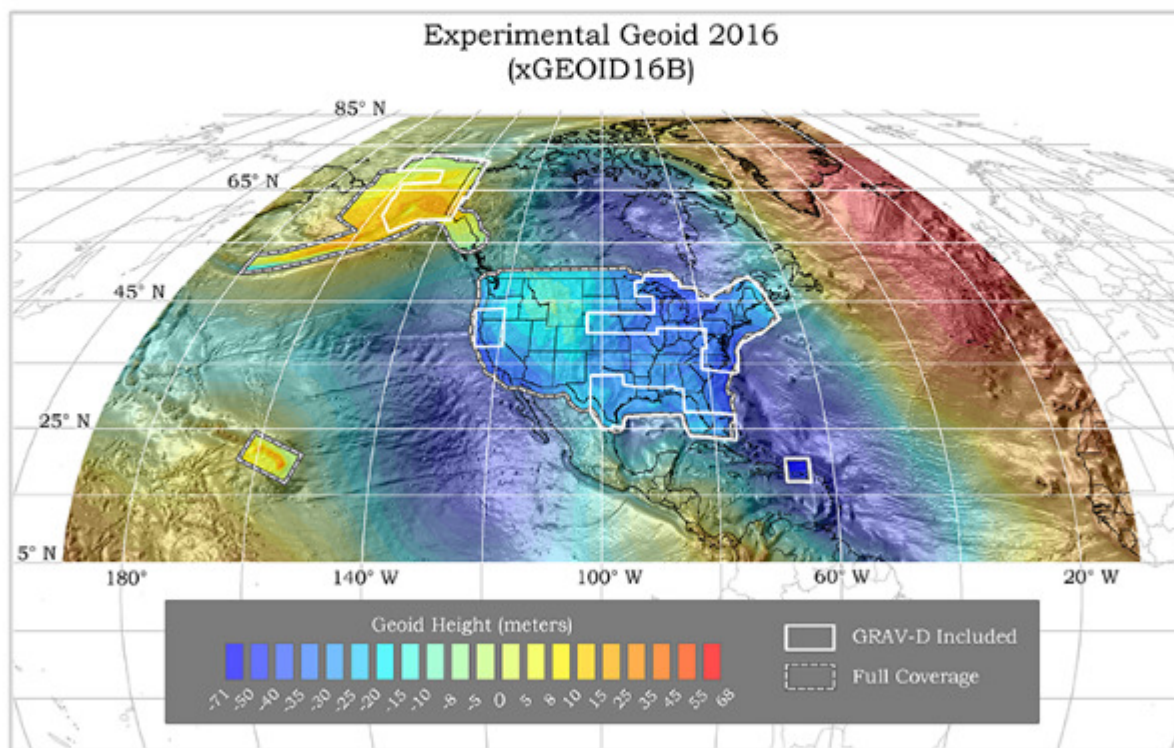


Fig. 1 shows the xGEOID16B model that covers the area from 5 to 85 degrees latitude and 170 to 350 degrees longitude. The white boxes correspond to the regions where GRAV-D airborne gravity data were included based on their suitability as of December, 2015