



NAVD 88 No More: A Modernized Vertical Datum for the Future

*MAFSM 2018 Annual Conference
November 8, 2018*

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Communications Branch Chief, NGS

Polls

Who is a surveyor or engineer?

**Did you know that NAD 83 and NAVD 88 are
being replaced in 2022?**

Should you care about this change?

Outline

- 1. Measuring Elevations Today**
- 2. Measuring Elevations in the Future**
- 3. NGS Tools and Coordination Efforts**
- 4. Learning More**

1. Measuring Elevations Today

The National Spatial Reference System (NSRS)

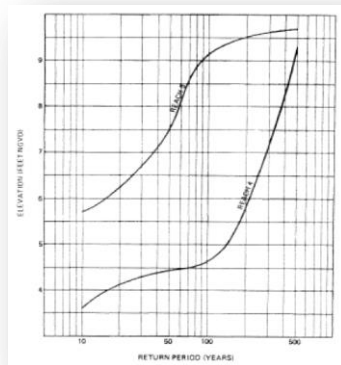
A **common** and **consistent** geospatial framework to meet the economic, social, and environmental positioning needs of our Nation.

Foundational elements include:

Latitude • Longitude • Elevation •
Gravity • Shoreline Position
+ changes over time



+



+

U.S. DEPARTMENT OF HOMELAND SECURITY
Federal Emergency Management Agency
National Flood Insurance Program

OMB No. 1560-0008
Expiration Date: November 30, 2018

ELEVATION CERTIFICATE

Important: Follow the instructions on pages 1-8.

Copy all pages of this Elevation Certificate and all attachments for (1) community official, (2) insurance agent/company, and (3) building owner.

SECTION A - PROPERTY INFORMATION		FOR INSURANCE COMPANY USE
A1. Building Owner's Name		Policy Number



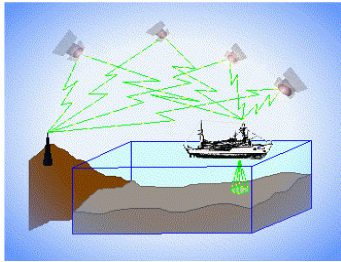
=



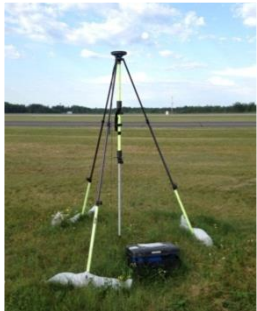
Reliable FIRMs require data from disparate sources and dates be consistently aligned

3 Categories of Vertical Datums

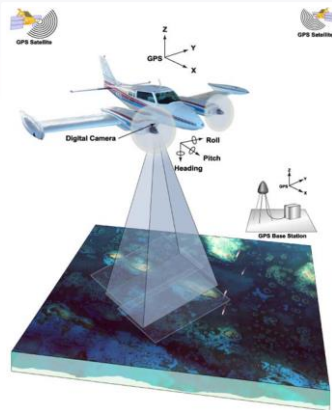
Ellipsoidal



Raw Hydrographic Surveys vertically referenced with RTK-GPS



Native GPS measurements



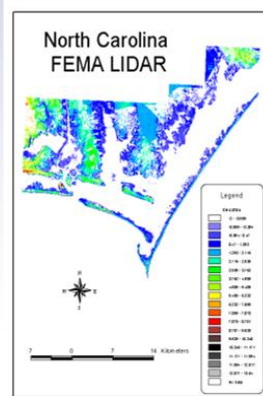
Raw Lidar

Orthometric



Engineering and Development Site Surveys

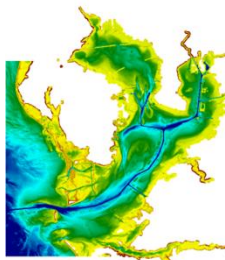
USGS Topography



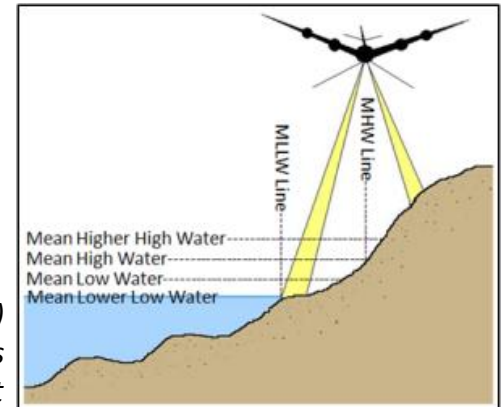
FEMA Flood Insurance Rate Maps

Tidal

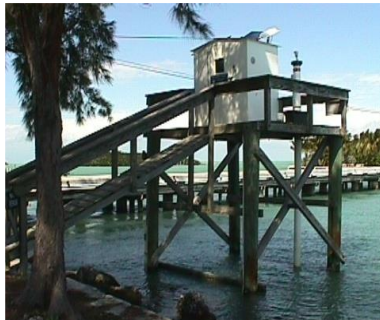
NOAA Bathymetry (MLLW)



Shoreline Mapping (MHW) and Regulatory Boundaries at the Coast



Daily and Extreme Water Levels



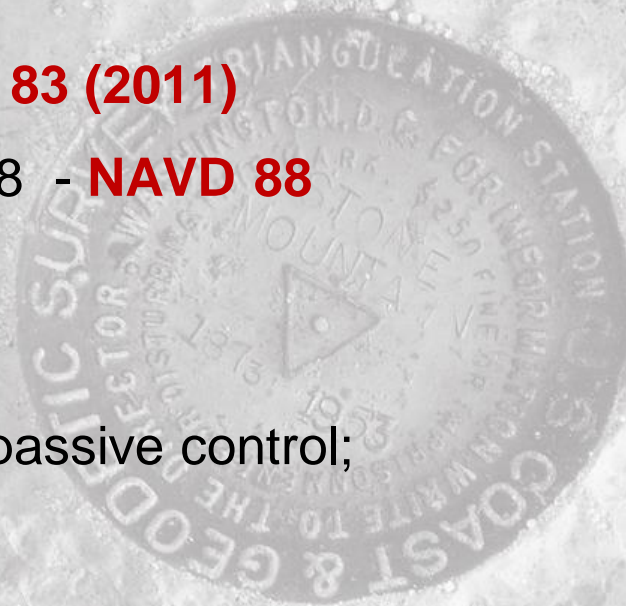
The NSRS of Today (*simplified*)

Primary elements:

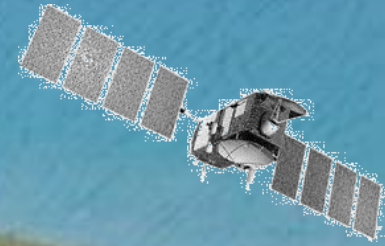
- North American Datum of 1983 - **NAD 83 (2011)**
- North American Vertical Datum of 1988 - **NAVD 88**

Current reference system is:

- Defined by relationships to published passive control;
- NOT time-dependent; and
- Primarily accessed via passive control

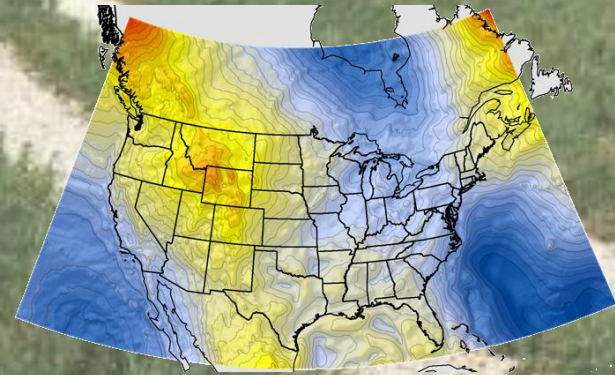


NGS Supports Access to NAVD88 Heights



official path

GEOID12B



The NGS Data Sheet

PROGRAM = datasheet95, VERSION = 8.12.3
 National Geodetic Survey, Retrieval Date = SEPTEMBER 27, 2017

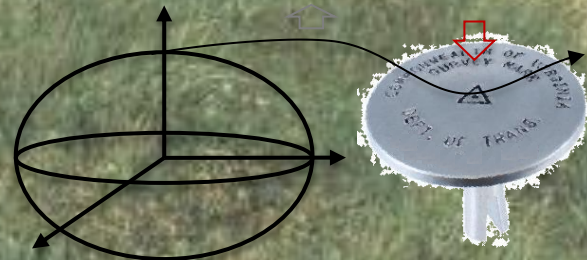
CJ0146 ***** This is a Tidal Bench Mark. *****
 CJ0146 TIDAL BM - JOHNSON
 CJ0146 DESIGNATION - JOHNSON
 CJ0146 PID - CJ0146
 CJ0146 STATE/COUNTY - SC/CHARLESTON
 CJ0146 COUNTRY - US
 CJ0146 USGS QUAD - CHARLESTON (1983)

*CURRENT SURVEY CONTROL

CJ0146	NAD 83(2011) POSITION-	32 45 05.94606(N) 079 53 51.69504(W)	ADJUSTED
CJ0146	NAVD 83 ORTHO HEIGHT -	2.446 (meters)	8.02 (feet)
CJ0146	NAVD 83 ORTHO HEIGHT -	2.446 (meters)	8.02 (feet)
CJ0146	GEOID HEIGHT -	-25.300 (meters)	GEOID12B
CJ0146	LAPLACE CORR -	-2.01 (seconds)	REFLEC12B
CJ0146	DYNAMIC HEIGHT -	2.443 (meters)	NAVD 83
CJ0146	MODELED GRAVITY -	979,535.3 (mgal)	COMP

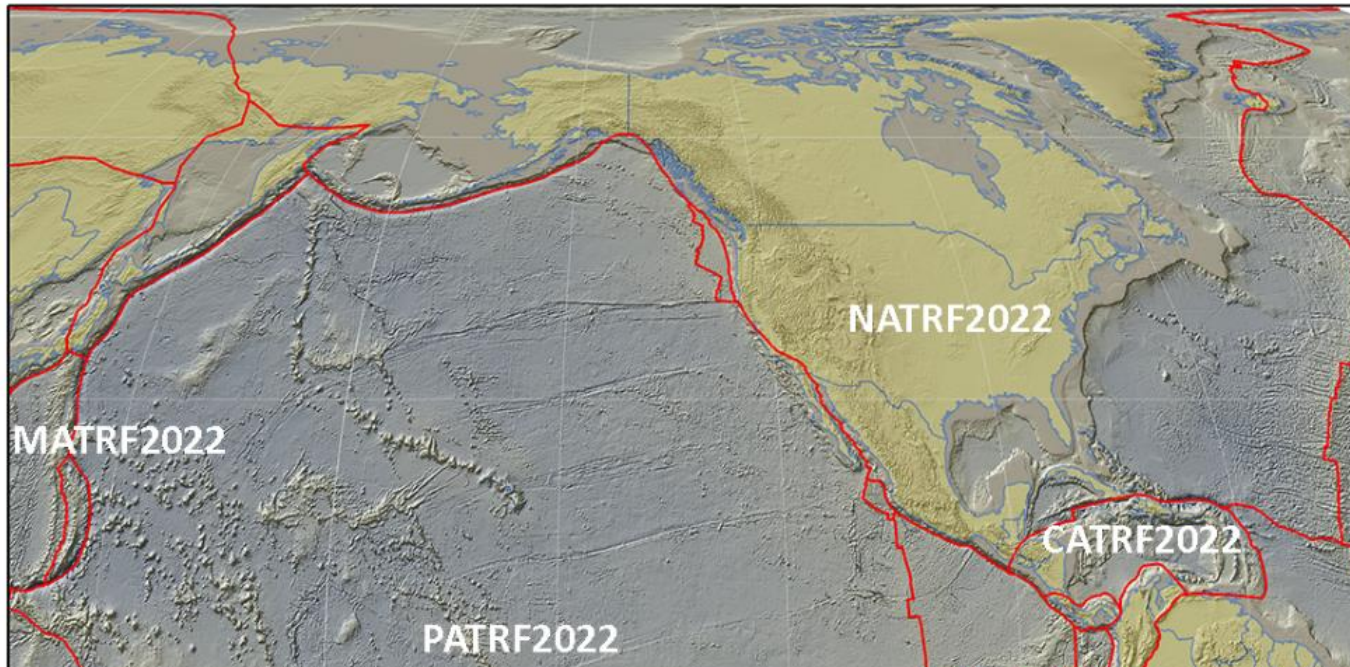
CJ0146 HORIZ ORDER - THIRD CLASS I
 CJ0146 VERT ORDER - FIRST

CJ0146 The horizontal coordinates were established by classical geodetic methods and adjusted by the National Geodetic Survey in March 2004.
 CJ0146 The orthometric height was determined by differential leveling and adjusted by the NATIONAL GEODETIC SURVEY in June 1991.
 CJ0146 Significant digits in the geoid height do not necessarily reflect accuracy.
 CJ0146 GEOID12B height accuracy estimate available here.
 CJ0146 This Tidal Bench Mark is designated as VM 4219
 CJ0146 by the CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES.
 CJ0146 The Laplace correction was computed from REFLEC12B derived deflections.
 CJ0146 The dynamic height is computed by dividing the NAVD 83



2. Measuring Elevations in the Future

New Reference Frames



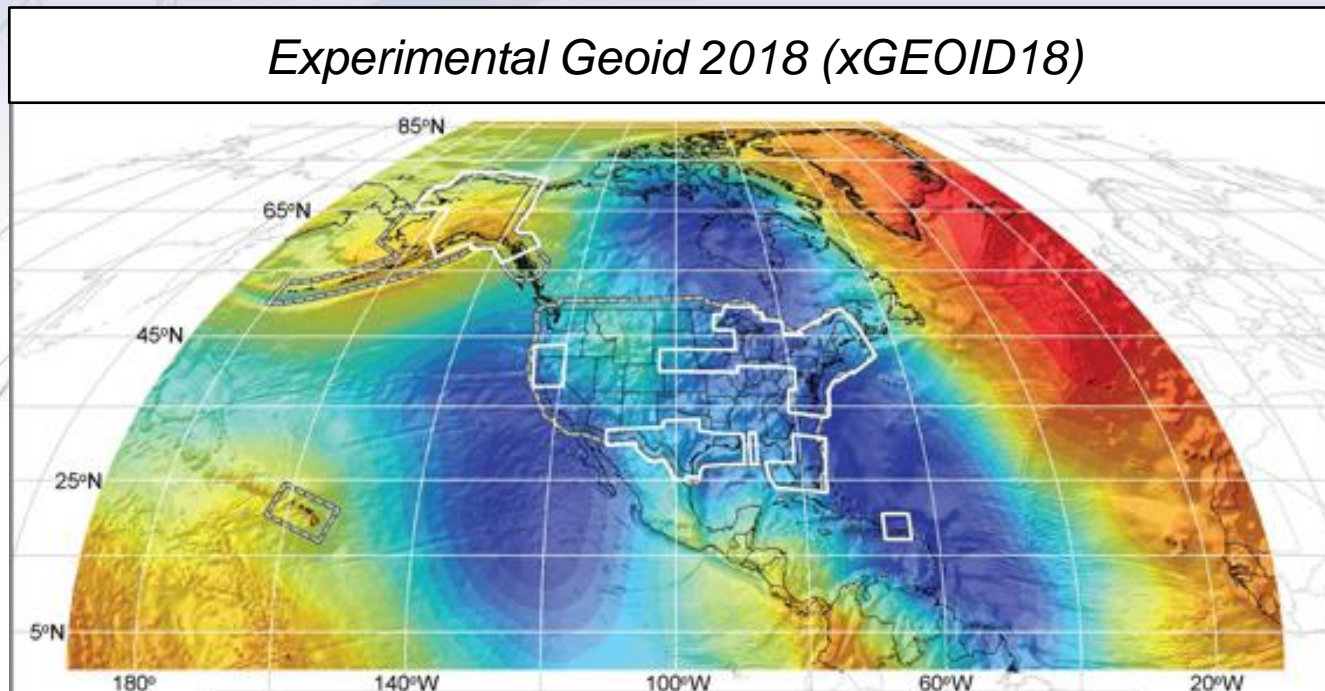
North American Terrestrial Reference Frame of 2022 (**NATRF2022**)

Additional Frames For:

- **Caribbean Plate (CATRF2022)**
- **Pacific Plate (PATRF2022)**
- **Mariana Plate (MATRF2022)**

Read More: [Blueprint for 2022, Part 1: Geometric Coordinates](#)

New Geopotential Datum



North American-Pacific Geopotential Datum of 2022 (NAPGD2022),
including **GEOID2022**

Read More: [Blueprint for 2022, Part 2: Geopotential Coordinates](#)

The NSRS of Tomorrow (2022)

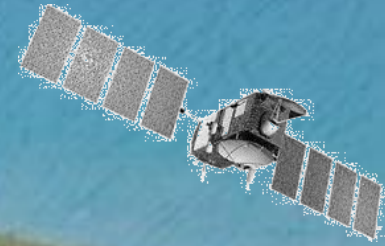
Primary elements:

- North American Terrestrial Reference Frame of 2022 (**NATRF2022**)
plus the Caribbean, Pacific, and Mariana plates
- North American-Pacific Geopotential Datum of 2022 (**NAPGD2022**)

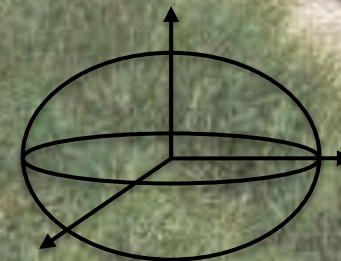
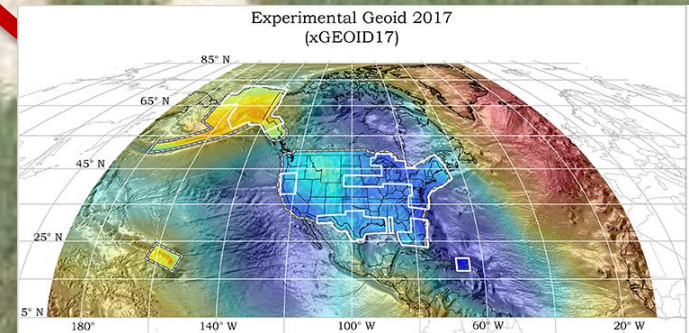
New reference system is:

- Geocentric and defined by relationships to a global/international ideal frame;
- Time-dependent; and
- Primarily accessed via GPS technology (and geoid model)

NGS Will Support Access to NAPGD 2022 Heights



GEOID 2022



Shared Solution

PID: 14H1811

Designation: LARRIMORE 2006

Stability: Larrimore 2006

Setting: May hold commensally subject to ground movement

Description: Object surrounded by mass of concrete. This station is established to permanently 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. [See Also \[Internal\]](#)

Observed: 2006-01-12T15:59:02Z

Source: CPLIS - page# 1209.04

Close-up View

REF FRAME: NAD 83(2011) **EPOCH:** 2010.0000 **SOURCE:** NAVD83 (Computed using GRS(1980)) **UNITS:** m **SET PROFILE:** DETAILS

LAT: 39° 21' 51.77107" ± 0.019 m

LONG: -77° 40' 21.55804" ± 0.009 m

ELL HT: 68.523 ± 0.021 m

X: 1045792.598 ± 0.009 m

Y: -4825830.687 ± 0.024 m

Z: 4023736.628 ± 0.017 m

ORTHO HT: 132.591 ± 0.039 m

UTM 18 SFC 4701(WV N)

NORTHING: 4460880.958m 97491.754m

EASTING: 261128.820m 748846.724m

CONVERGENCE: -1.75938721° 1.10164296°

POINT SCALE: 1.0003240 0.99995111

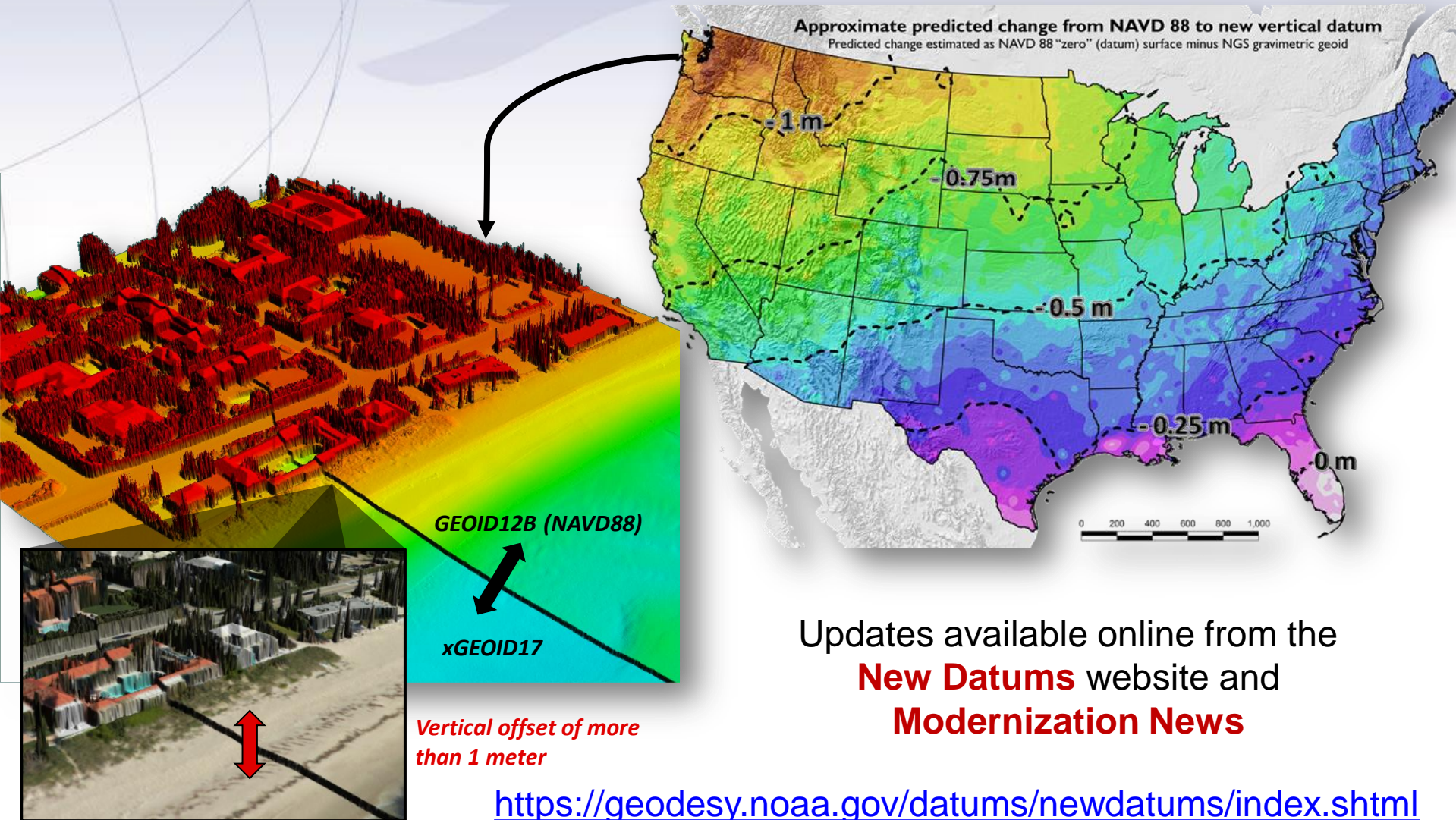
COMBINED FACTOR: 1.00028708 0.99981559

CONTRIBUTED BY: [John A. Anderson](#)
National Geodetic Survey

Horizon View



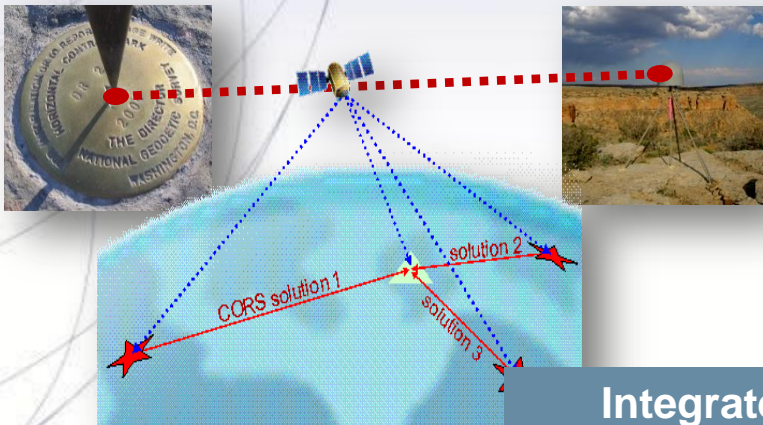
Vertical Change (Offset)



3. NGS Tools and Coordination Efforts

Tools to Access the NSRS

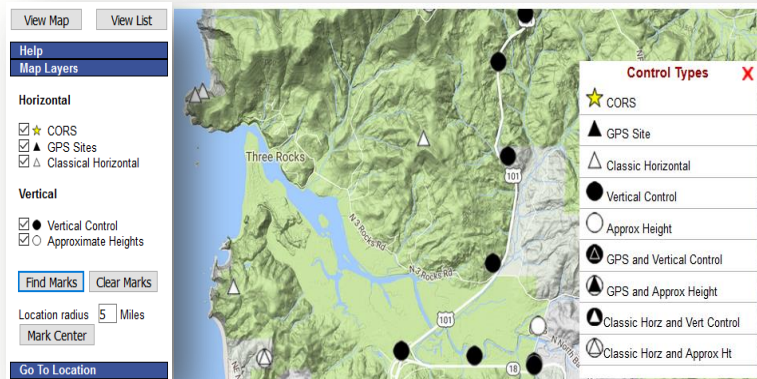
Online Positioning User Service (OPUS) Tool Suite



Continuously Operating Reference Stations (CORS)



Integrated Database (IDB) of Published & OPUS Shared Control (NGS Data Explorer)



Transformation Tools

NGS Coordinate Conversion and Transformation Tool (NCAT)*

The screenshot shows the NGS Coordinate Conversion and Transformation Tool (NCAT) web interface. At the top, it features the NOAA logo and the title "NGS Coordinate Conversion and Transformation Tool (NCAT) National Geodetic Survey". Below this is a navigation menu with options like "NGS Home", "About NGS", "Data & Imagery", "Tools", "Surveys", and "Science & Education". A search bar is also present. The main content area has tabs for "Single Point Conversion", "Multipoint Conversion", "Web services", "Downloads", and "About Conversion Tool". Under "Single Point Conversion", there are radio buttons to select the source coordinate system: LLh (selected), SPC, UTM, XYZ, and USNG. Input fields for latitude and longitude are provided, with a note to "Enter lat-lon in decimal degrees". A map of the United States is shown with a red pin indicating the location of interest. Below the map, there are fields for "Ellipsoid Height (m)", "Input datum" (set to NAD83(2011)), and "Output datum". A note at the bottom states "Converted coordinates will be in output datum."

Vertical Datum Transformation (VDatum)*

The screenshot shows the Vertical Datum Transformation (VDatum) web interface. At the top, it features the NOAA logo and the title "VERTICAL DATUM TRANSFORMATION INTEGRATING AMERICA'S ELEVATION DATA". Below this is a navigation menu with options like "Home", "About VDatum", "Download", "Online", "Docs & Support", and "Contact Us". The main content area has a "Welcome to VDatum!" section, followed by a "Download" button and a list of features. The features section lists: "Coordinate Systems: Geographic, UTM, State Plane Coordinates (SPC), and geocentric (ECRT)", "Horizontal Datums: NAD27, NAD83(1986), and NAD83(HARN); and ellipsoidal datums such as ITRF, WGS84, and NAD83 serializations", and "Vertical Datums: NAVD83, ITRF88, ITRF89, ITRF90, NEOS 90, PNEOS 90, IZ, ITRF93, ITRF94, ITRF96, ITRF97, IGS07, ITRF2000, IGS05, ITRF2008, IGS08, WGS84(TRANS1), WGS84(G730), IGS05, WGS84(G1674), NAD83(FACP00), NAD83(MARP00), NAVD88, NGVD29, PRVD02, VVD09, ASVD02, GUVDD4, IGS1996, and IGS1984". There are also links for "Download", "Animated tutorial!", and "The VDatum Demonstration Project in Tampa Bay, Florida".

Web Services*

The screenshot shows the National Geodetic Survey Web Services page. At the top, it features the NOAA logo and the title "National Geodetic Survey Positioning America for the Future". Below this is a navigation menu with options like "NGS Home", "About NGS", "Data & Imagery", "Tools", "Surveys", and "Science & Education". A search bar is also present. The main content area has a "Web Services" section with a "Home" link. Under "Web Services", there are links for "Hybrid Geoid Height Service API", "Gravity Predictor using GRAV-D API", and "NGS Data Explorer API". There is also a link for "NGS Coordinate Conversion and Transformation Tool (NCAT) API". Below this, there is a "Tools & Software" section with a link for "PC Products". The "Web Services" section also includes a description: "Explore our publicly available Web services that provides users access to NGS APIs. The results of all NGS web services are in JSON format." There is a "GEOID API - The Hybrid Geoid Height Service" section with a description: "Web service that distributes the geoid height of the NGS hybrid geoid models in a concise and portable way. The web service provides the geoid height (of a model specified by its model ID) at any given latitude and longitude. Learn more". A map of the United States is shown with a red pin indicating the location of interest. Related content is listed as "GEOID Models".

Document Datums (Metadata)

NAD83(2011) epoch 2010.00

H. Datum

Realization/Adjustment

Reference Epoch

NAVD88 (*GRS80*, *Geoid12B*)

V. Datum

Reference Ellipsoid

Geoid Model

NOAA/Federal Coordination

Coordination

- Federal Geographic Data Committee (FGDC)
- Federal Geodetic Control Subcommittee (FGCS)
- Geospatial Summits



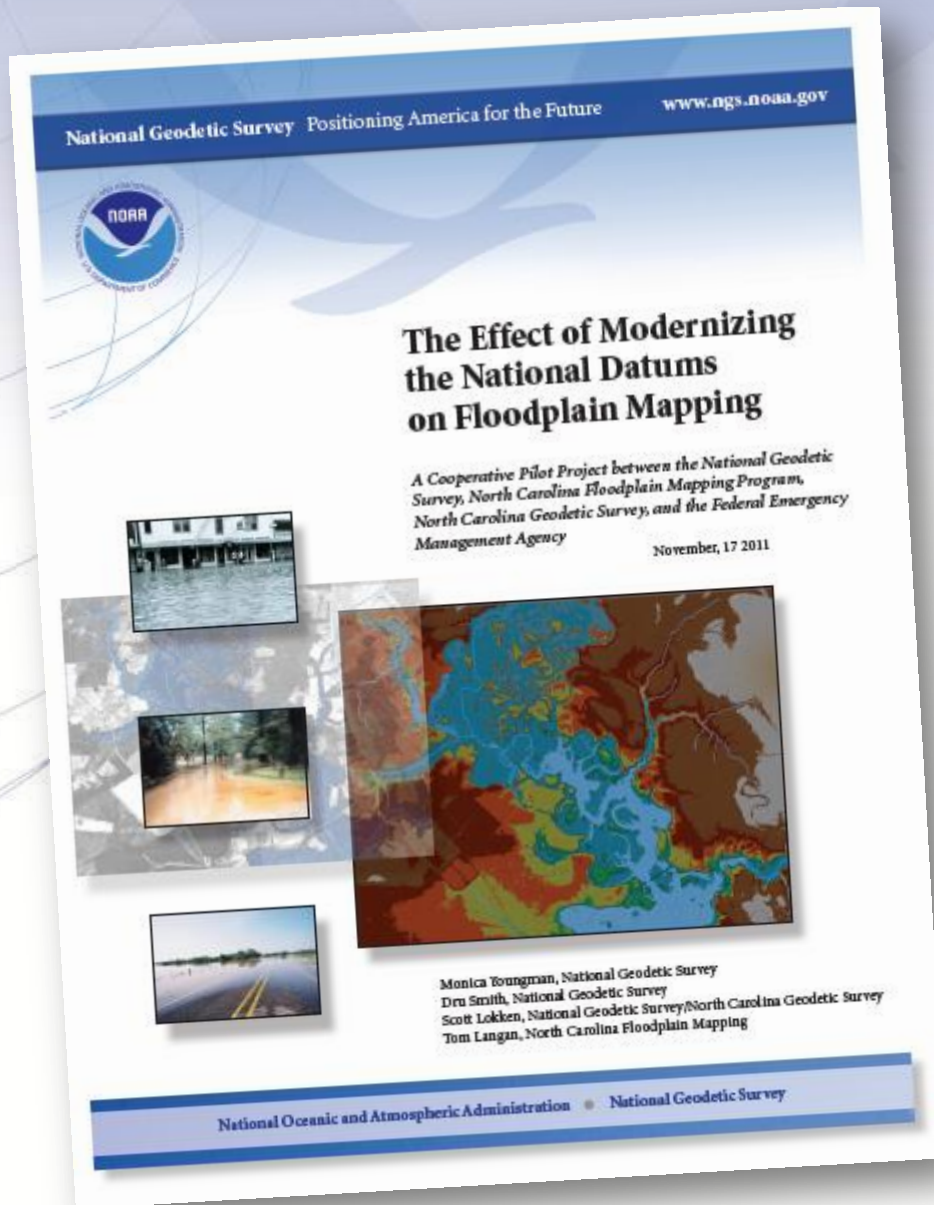
2017 Geospatial Summit FEMA Feedback

- Kimberly Pettit, FEMA GIS Coordinator
- Prepared with Paul Rooney



watch online

NOAA/FEMA Coordination



Cooperative Pilot Study (2011):

- NGS and FEMA;
- North Carolina Floodplain Mapping Program, and
- North Carolina Geodetic Survey.

Key Outcomes:

- Recommendation of FEMA **implementation plan** to account for coordinate and height shifts.
- Improved relative positional accuracies and greater understanding of height uncertainties **will enhance quality of flood mapping.**

NOAA/Industry Coordination

2018 Industry Workshop Outcomes

- anticipated alpha/beta products
- standardized formats / documentation.

Next Steps - Save the Date!

- 2019 Geospatial Summit
- May 6-7, 2019 in Silver Spring, MD



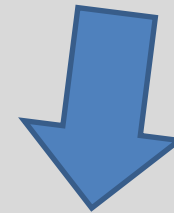
*2018 NSRS Modernization Industry Workshop
Attendees (Silver Spring, MD).*

4. Learning More

Resources from geodesy.noaa.gov

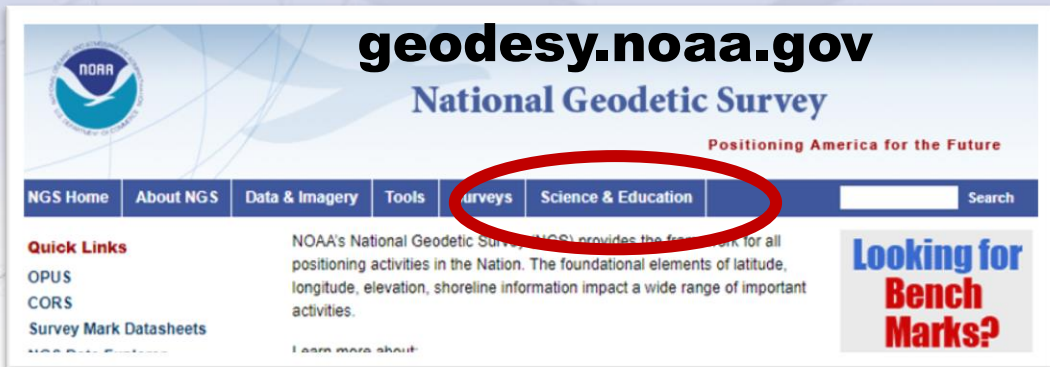
The screenshot shows the NOAA National Geodetic Survey website. At the top left is the NOAA logo. The main header reads "National Geodetic Survey" with the tagline "Positioning America for the Future". Below this is a navigation menu with links for "NGS Home", "About NGS", "Data & Imagery", "Tools", "Surveys", and "Science & Education", followed by a search bar. The main content area features a "New Datums" section with a list of links on the left and a main text block on the right. The text block is titled "New Datums: Replacing NAVD 88 and NAD 83" and explains that NGS will replace the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88) with a new geometric reference frame and geopotential datum in 2022. It also mentions that the new reference frames will rely primarily on Global Navigation Satellite Systems (GNSS) and a gravimetric geoid model. Below the text are several buttons for "Background", "What to Expect", "Get Prepared", "Policy Decisions", "Track our Progress", "Naming Convention", "FAQs", "Watch Videos", and "Related Projects".

Click icon on home-page



The graphic features a globe in the background. The text reads "Coming in 2022: New Datums! Learn more...".

Science and Education



With The COMET Program

Educational Videos (12)

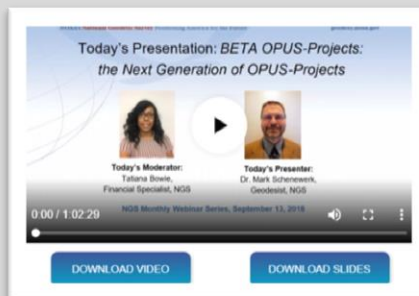


Online Lessons (4)



Monthly Webinar Series

SAVE THE DATE:
 November 15th at 2 pm
*Vertical Datum Changes for
 Floodplain Mapping*



Email Subscriptions

National Geodetic Survey
Positioning America for the Future

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

Quick Links
 OPUS
 CORS
 Survey Mark Datasheets
 NGS Data Explorer
 OPUS Projects
 Geodetic Tool Kit
 State Plane Coordinates
 Antenna Calibration
 UFCORS
 GEOID
 GPS on Bench Marks
 Geodetic Advisors
 Storm Imagery
 Publications
 2019 Geospatial Summit
 FAQs
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Coming in 2022: New Datums!
Learn more...

NOAA's National Geodetic Survey (NGS) provides the framework for all positioning activities in the Nation. The foundational elements of latitude, longitude, elevation, shoreline information impact a wide range of important activities.

Learn more about:

- Data and tools we provide
- Activities in your area
- Applications of geodesy

GNSS & GPS Data
Get coordinate information and the tools you need to work independently. [Learn More](#)

Remote Sensing
Download data and critical information into nautical charts. [Learn More](#)

Land Surveying
View guidelines and get tools to support land surveyors. [Learn More](#)

Geodesy
NGS works closely with the global researchers advancing geodetic science. [Learn More](#)

Training & Education
Classes and educational resources on scientific topics relating to geodesy. [Learn More](#)

Datums & Transformations
NGS defines datums to help align data and tools to transform coordinates. [Learn More](#)

Looking for Bench Marks?

Emergency Response
 Post Event Aerial Imagery:
 Hurricane Michael
 Hurricane Florence
 Tropical Storm Gordon
 Previous Storm Imagery

Notices
Save the Date:
 Next Geospatial Summit on May 6-7, 2019

In the News
 10/5/2018 - Interactive Map Supports NOAA Sentinel Site Program
 09/28/2018 - NGS Scientists Describe Positional Reference System Changes
 09/21/2018 - Hurricane Florence Damage Assessment
[Previous News Stories](#)

**From NGS Homepage:
geodesy.noaa.gov**



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NGS News

NGS Training

NGS Webinar Series

NGS GPS on Bench Marks

Your observations are making a difference! The color ramp in the map above reflects accuracy improvements in a hybrid geoid model from your recently submitted GPS observations. The improvements will be realized when NGS releases GEOID18.

NOAA's National Geodetic Survey
geodesy.noaa.gov

NGS Regional Advisor Program



Recap

1. **NGS and NAVD 88** are critical to floodplain mapping.
2. NAVD 88 is going to be **replaced in 2022**.
3. The tools to **access NSRS** and **transform/convert data** that you used today will be expanded for 2022.
4. **Spread the word** to help coordinate, educate and prepare!



**DON'T
FORGET!**



THANK YOU!

Christine.Gallagher@noaa.gov