NSRS Modernization

Preparing for New Datums

Oregon GNSS User Group (OGUG) Annual Meeting
June 21st, 2024

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Organizational Structure

-Department of Commerce (DoC)
(~47,000 employees)

↓

-National Oceanic and Atmospheric Administration (NOAA)

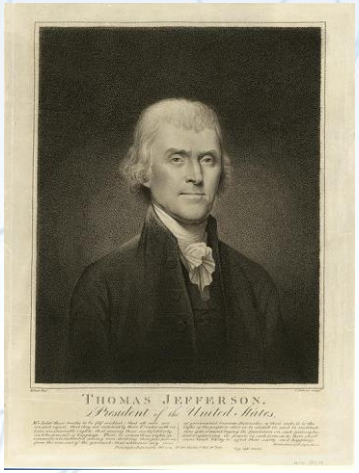
↓

-National Ocean Service (NOS)

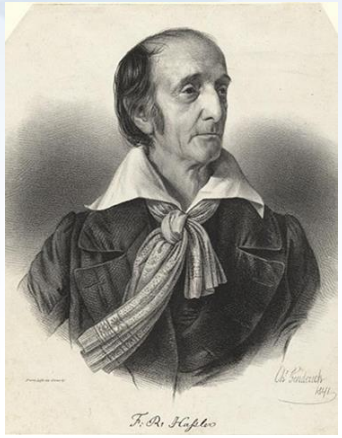
↓

-National Geodetic Survey (NGS)
(~175 employees)

Our Nation's First Civilian Science Agency



1807
Thomas Jefferson
Survey of the Coast



1811
Ferdinand Hassler
Superintendent

1836
U.S. Coast
Survey

1878
U.S. Coast and
Geodetic Survey

1970
NOAA is established

The NSRS Supports:

National Oceanic and Atmospheric Administration
NSRS positioning data provides the reference for NOAA's nautical charts, among many other geospatial applications.

Federal Emergency Management Agency
FEMA uses NSRS elevations to determine flood zones for the National Flood Insurance Program.

United States Army Corps of Engineers
USACE uses NSRS elevations to determine levee heights and positions in their Levee Safety Program.

United States Geological Survey
USGS uses the NSRS to geospatially reference their Topographic Maps and interior water data for the nation.

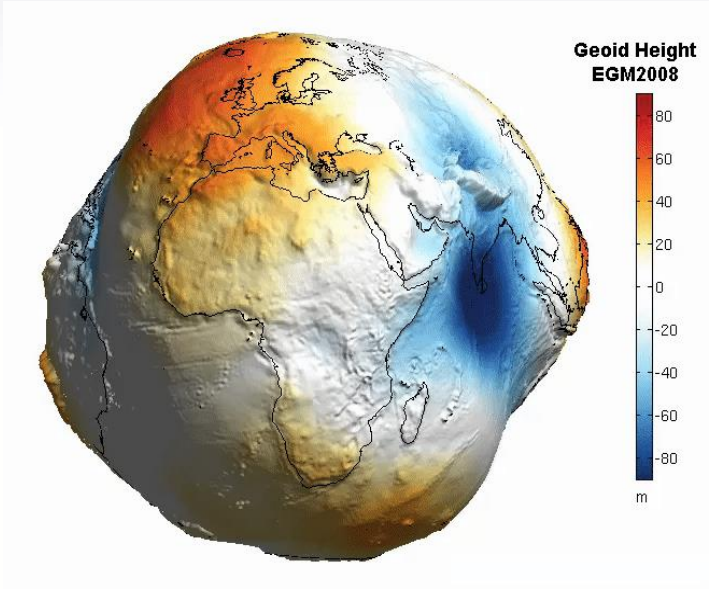
National Geospatial Intelligence Agency
NSRS gravity data contributes to NGA's geospatial mission.

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.

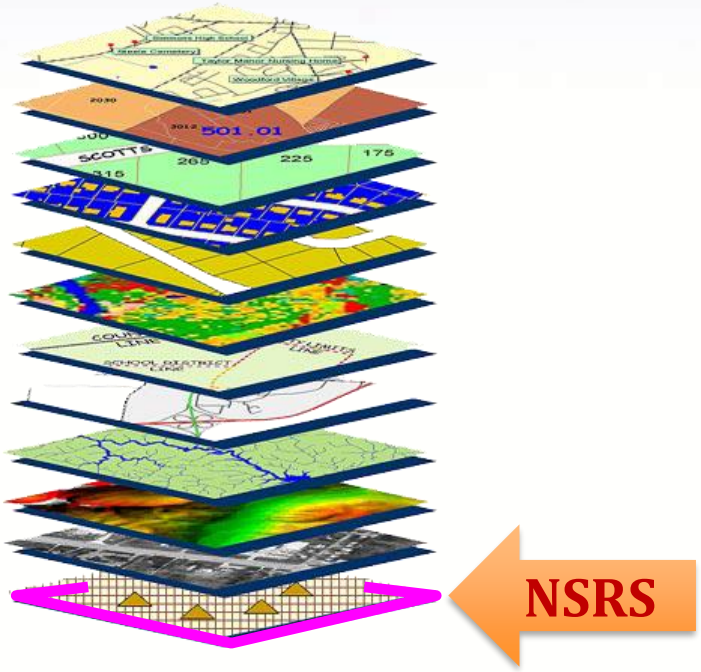
……

The **NSRS** is a consistent coordinate system that defines latitude, longitude, height, scale, gravity, orientation, and shoreline throughout the United States.



The NSRS Provides Consistent Coordinates Throughout the Nation

The National Spatial Reference System (NSRS) provides the positioning framework - or foundation - for all geospatial products.

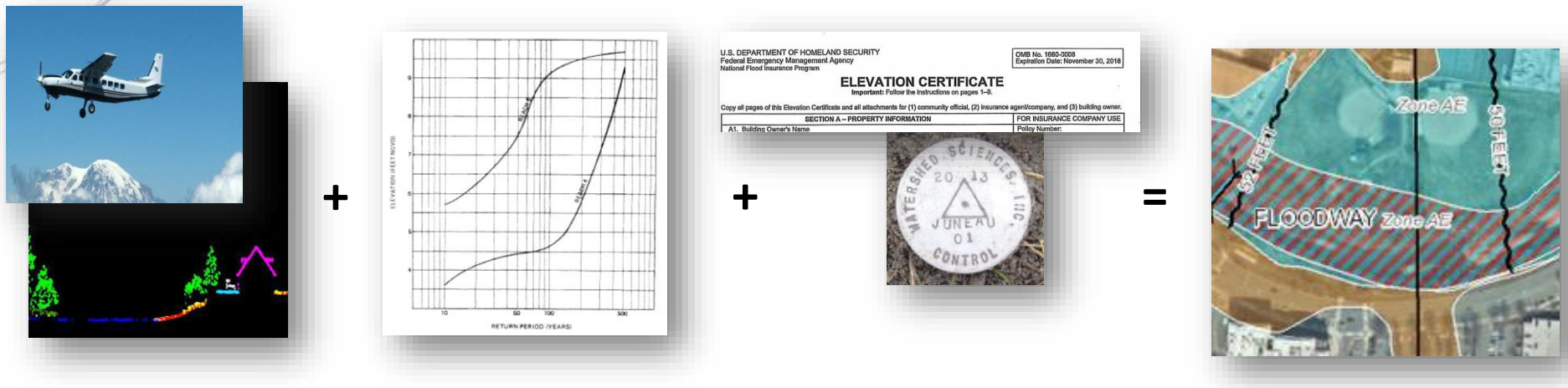


The National Spatial Reference System (NSRS)

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



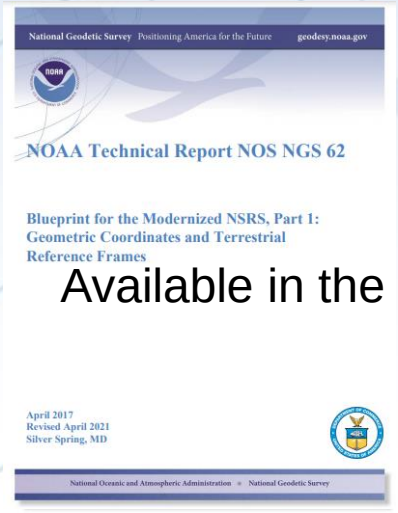
Reliable FIRMs require data from disparate sources and dates be consistently aligned

A Couple of Things Before We Dive In

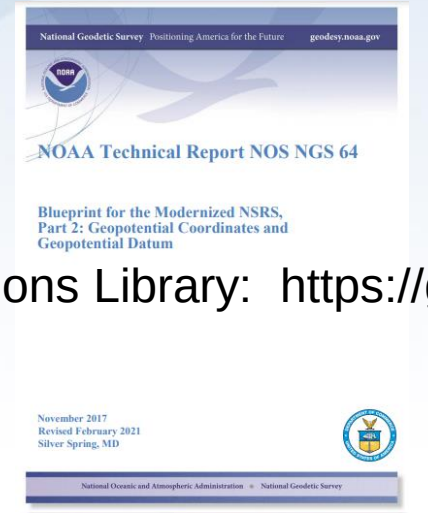
Please consider inviting a **National Geodetic Survey (NGS) Speaker** to upcoming meetings or conferences with attendees that would be interested in learning more about this topic

The National Spatial Reference System of 2022 (NSRS2022) Blueprints part I, II, and III are now published and available: https://www.ngs.noaa.gov/geospatial-summit/2019/presentations.shtml

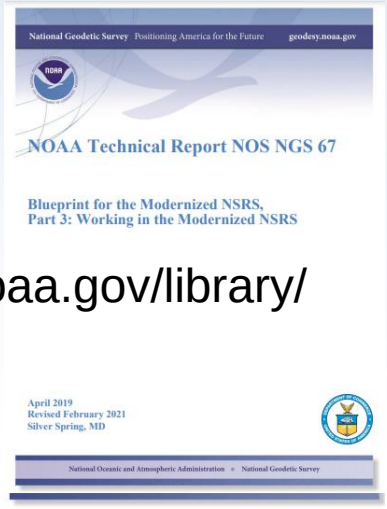
All 3 blueprint documents were Updated



Geometric:
Sep 2017
Revised April 2021
NOAA TR NOS NGS 62
61 pages



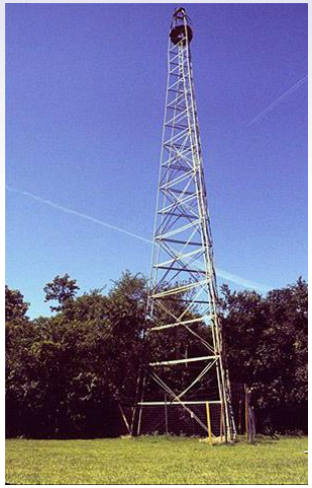
Geopotential:
Nov 2017
Revised Feb 2021
NOAA TR NOS NGS 64
53 pages



Working in the Modernized NSRS:
April 2019
Revised Feb 2021
NOAA TR NOS NGS 67
133 pages

Available in the NGS Publications Library: https://geodesy.noaa.gov/library/

NSRS Evolves with New Technology



Evolution of the NSRS

NAD27 → NAD83 (1986) → NAD83 (2011)

The NSRS of Today *(simplified)*

Primary elements:

- Horizontal: North American Datum of 1983 - **NAD 83 (2011) epoch 2010.00** coordinates
- Vertical: North American Vertical Datum of 1988 - **NAVD88 (GRS80, Geoid 12B)** orthometric heights

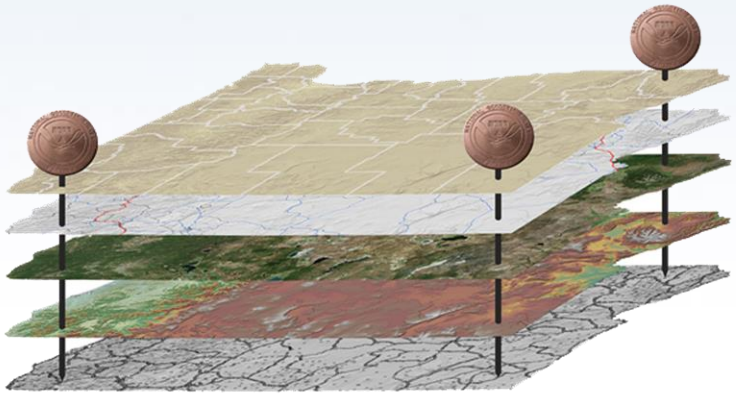
These elements are **geodetic datums** that define the shape and size of the earth to enable precise positioning

System based on connections to published passive control

The National Spatial Reference System (NSRS)

NGS defines, maintains and provides access to the NSRS to meet our Nation's economic, social & environmental needs

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



Today's NSRS

- North American Datum of 1983

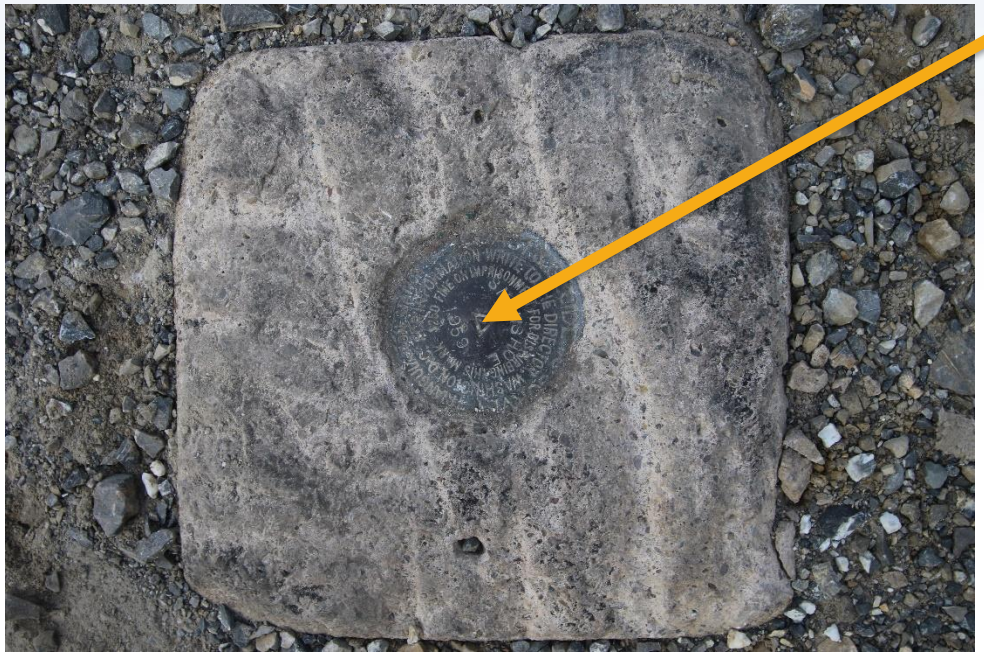
  NAD 83 (2011) epoch 2010.00

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

Geodetic Control – Terminology

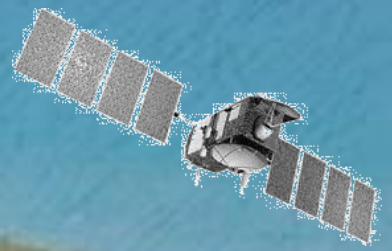
Passive Control

- *All marks* are **passive**—they sit there and hold a **point**



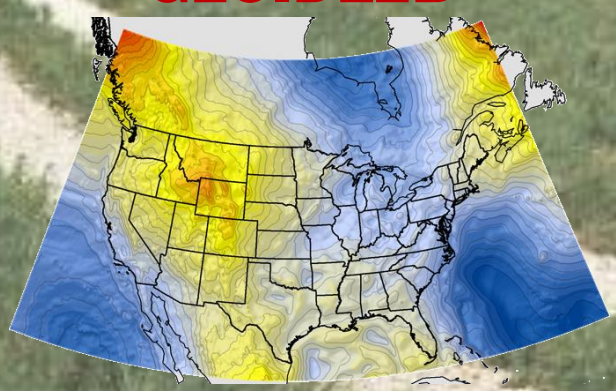
Passive Control

NGS Supports Access to NAVD88 Heights



official path

GEOID12B



The NGS Data Sheet

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CJ0146  TIDAL BM    -  This is a Tidal Bench Mark.
CJ0146  DESIGNATION -  JOHNSON
CJ0146  PID         -  CJ0146
CJ0146  STATE/COUNTY-  SC/CHARLESTON
CJ0146  COUNTRY     -  US
CJ0146  USGS QUAD   -  CHARLESTON (1983)
CJ0146
CJ0146                        *CURRENT SURVEY CONTROL
CJ0146 ______________________________________________________________________
CJ0146* NAD 83(2001) POSITION- 32 45 05.94606(N) 079 53 51.69504(W)   ADJUSTED
CJ0146* NAVD 88 ORTHO HEIGHT -     2.446 (meters)        8.02   (feet) ADJUSTED
CJ0146 ______________________________________________________________________
CJ0146  GEOID HEIGHT    -      -33.300 (meters)                      GEOID12B
CJ0146  LAPLACE CORR    -       -3.01  (seconds)      8.02   (feet) DEFLEC12B
CJ0146  DYNAMIC HEIGHT  -        2.443 (meters)                      COMP
CJ0146  MODELED GRAVITY -  979,535.3   (mgal)                       NAVD 88
CJ0146
CJ0146  HORZ ORDER      -  THIRD
CJ0146  VERT ORDER      -  FIRST     CLASS I
CJ0146
CJ0146.The horizontal coordinates were established by classical geodetic methods
CJ0146.and adjusted by the National Geodetic Survey in March 2004.
CJ0146.
CJ0146.The orthometric height was determined by differential leveling and
CJ0146.adjusted by the NATIONAL GEODETIC SURVEY
CJ0146.in June 1991.
CJ0146
CJ0146.Significant digits in the geoid height do not necessarily reflect accuracy.
CJ0146.GEOID12B height accuracy estimate available here.
CJ0146
CJ0146.This Tidal Bench Mark is designated as VM 4219
CJ0146.by the CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES.
CJ0146
CJ0146.The Laplace correction was computed from DEFLEC12B derived deflections.
CJ0146
CJ0146.The dynamic height is computed by dividing the NAVD 88
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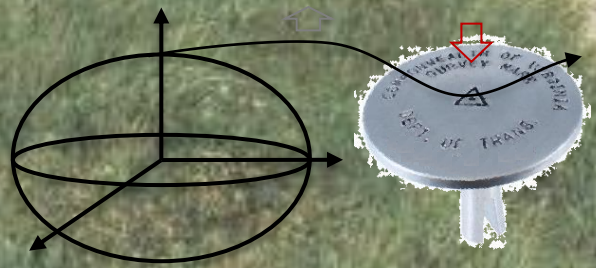
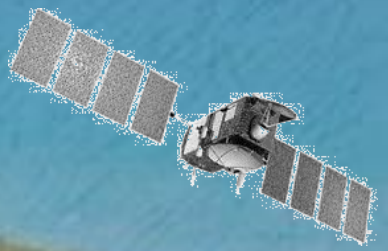
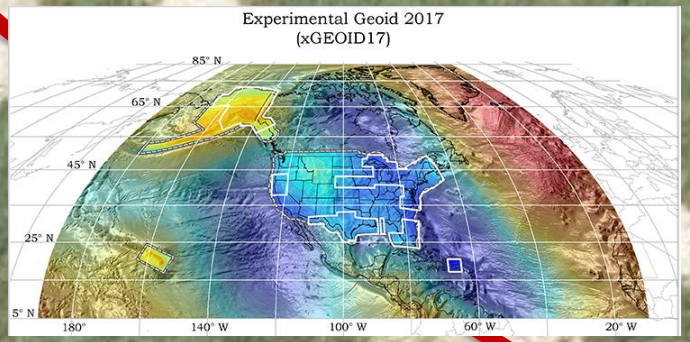


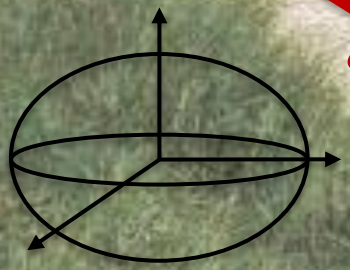
NGS Will Support Access to NAPGD 2022 Heights

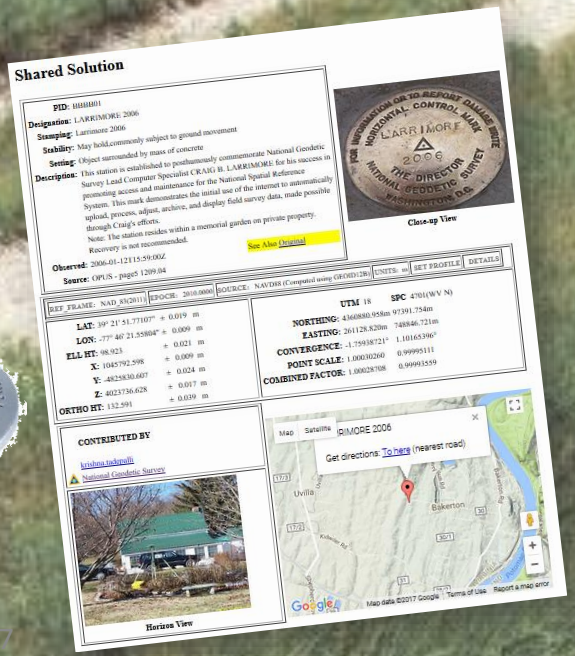


GEOID 2022



official path





Continued Role of Passive Control

Calibration sites for GNSS technology, Real Time Network validation, and verification of datum transformation tool results.

Sites for **monitoring** motion to enhance velocity models (via repeat/campaign GNSS occupations)

Convenience for local project control, in areas with limited GNSS coverage (e.g. cities, forests), or in the event of GNSS failure (e.g. geomagnetic storms)

The NSRS of Tomorrow (2022)

Primary elements are:

- The Horizontal Component is The North American Terrestrial Reference Frame of 2022 (**NATRF2022**) BPI – Geometric Coordinates

**plus the Caribbean, Pacific, and Mariana plates*

- The Vertical Component is The North American-Pacific Geopotential Datum of 2022 (**NAPGD2022**) BPII – Geopotential Coordinates

The New reference system is:

- Time-dependent and geocentric
- Defined by relationships to a global/international ideal frame
- Primarily accessed via GPS technology and a newly refined semi-dynamic geoid model

The National Spatial Reference System (NSRS)

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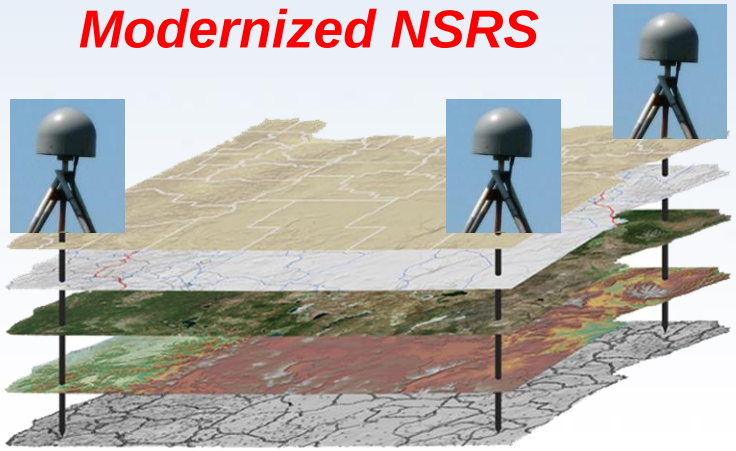
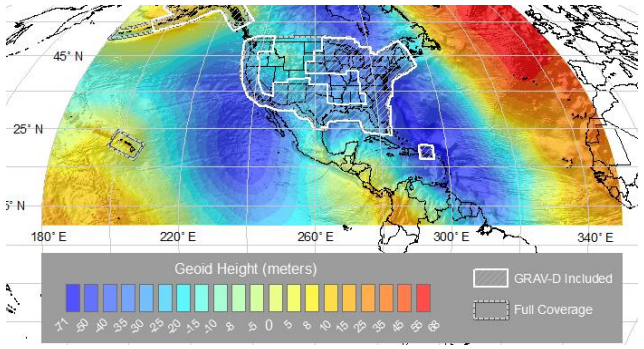
Latitude • Longitude • Elevation
• Gravity • Shoreline Position
+ changes over time

North American Terrestrial Reference Frame (NATRF 2022)
Caribbean Terrestrial Reference Frame (CATRF 2022)
Pacific Terrestrial Reference Frame (PATRF 2022)
Marianas Terrestrial Reference Frame (MATRF 2022)

North American Pacific Geopotential Datum (NAPGD2022)

Modernized NSRS





Geodetic Control – Terminology

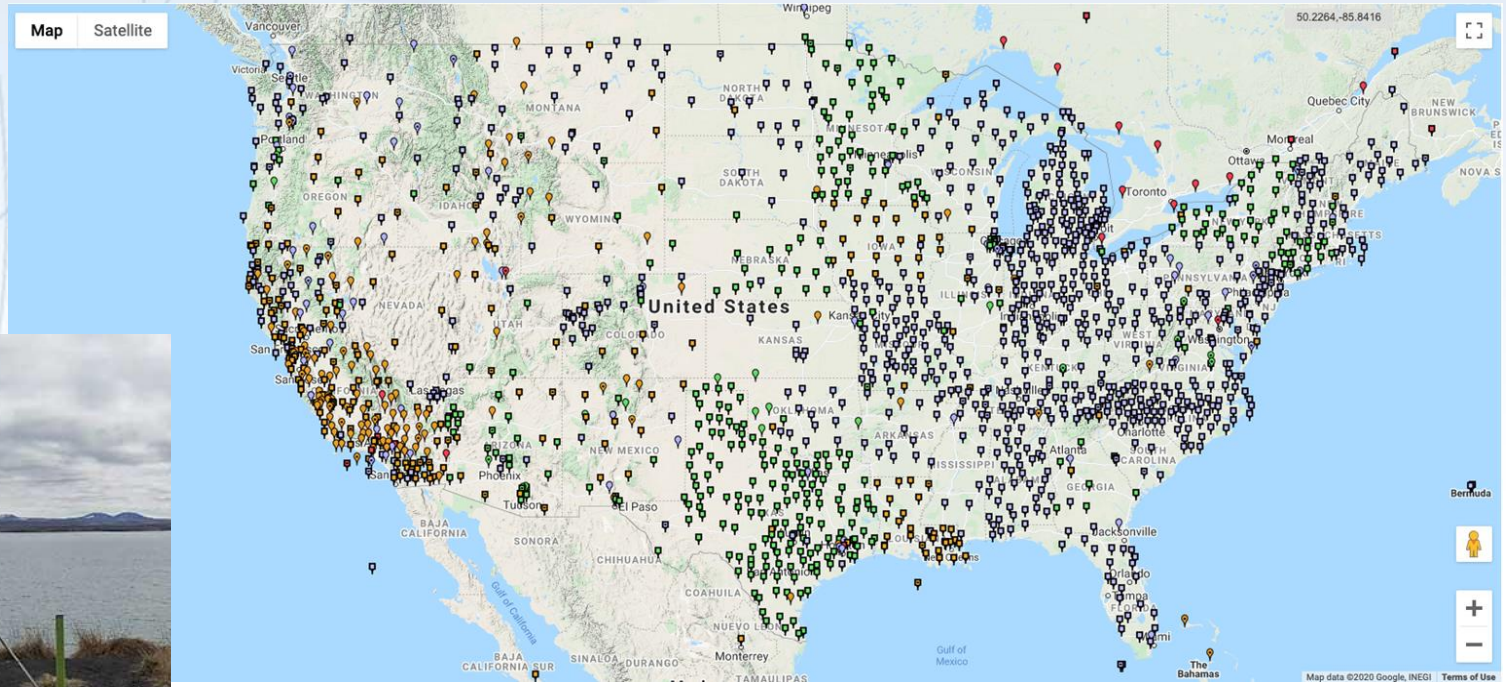
Active Control

- *Some marks* have permanently installed equipment that enables nearly continuous observations

  (they still sit there and hold a **point**)

Active Control

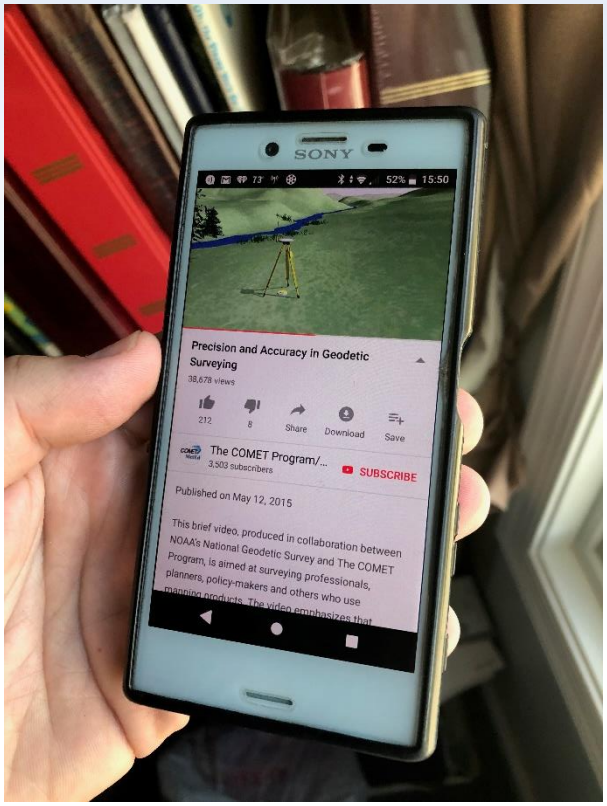
The NOAA CORS Network (NCN)



- **Enables** **cm-level positioning using GNSS data and OPUS**
- **Contributes** **to local and global sea-level rise calculations**

The Modernized NSRS is our "smartphone"

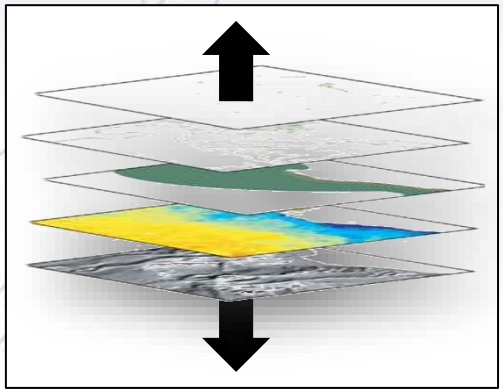
- You resisted it for a while…
- It was a little cumbersome to get used to…
- But soon you were hooked!



NSRS Considerations – The 4 C's

Requirements

CONSISTENCY



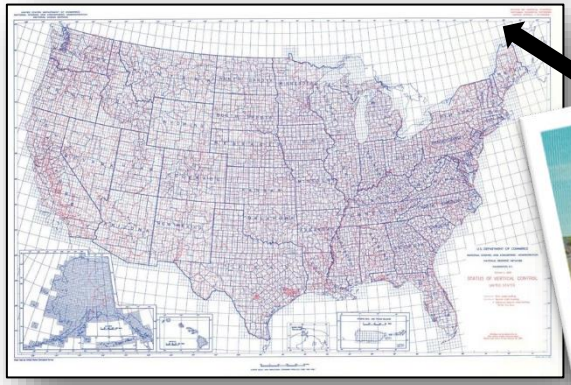
CONVENIENCE

Expectations

Semi-CONSTANT Coordinates

stamped with elevation

COHERENCE with Sea Level



National Spatial Reference System (NSRS) Modernization

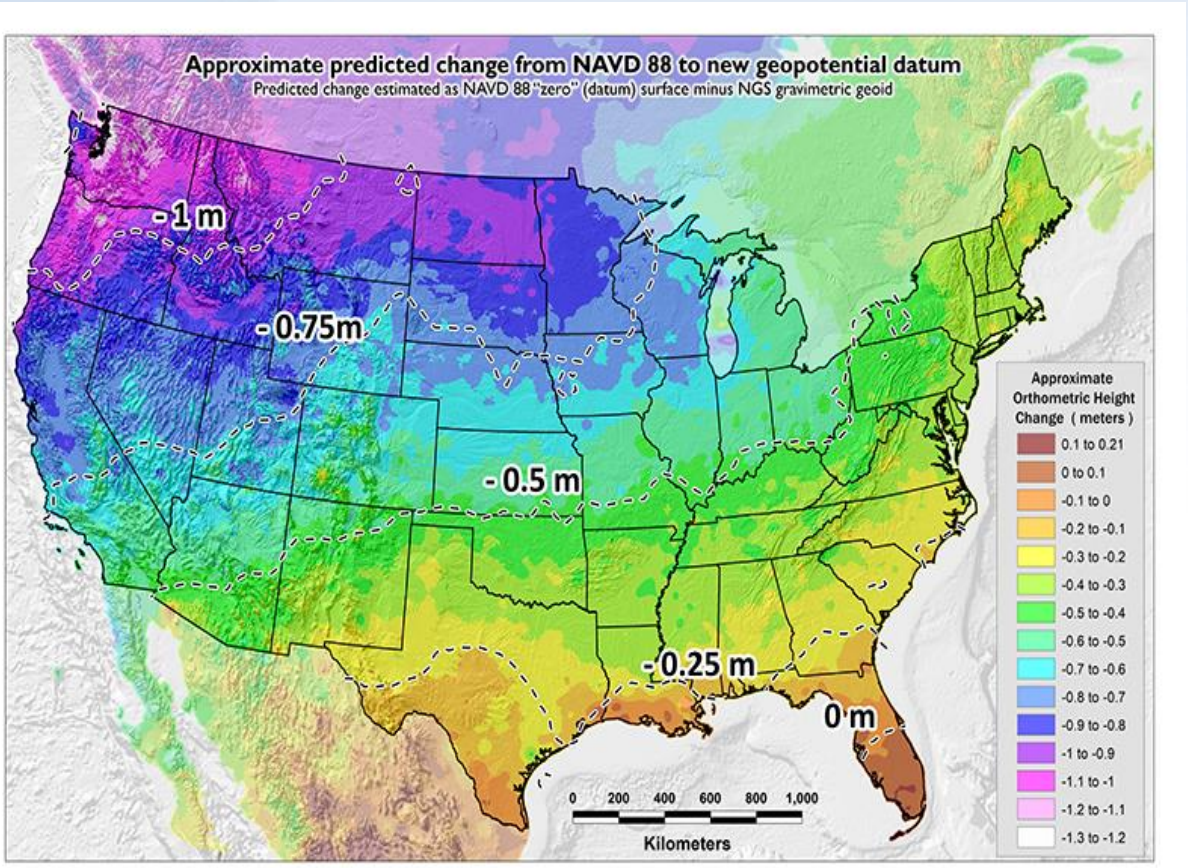
Why Modernize?

Current Datums (NAD83 & NAVD88):

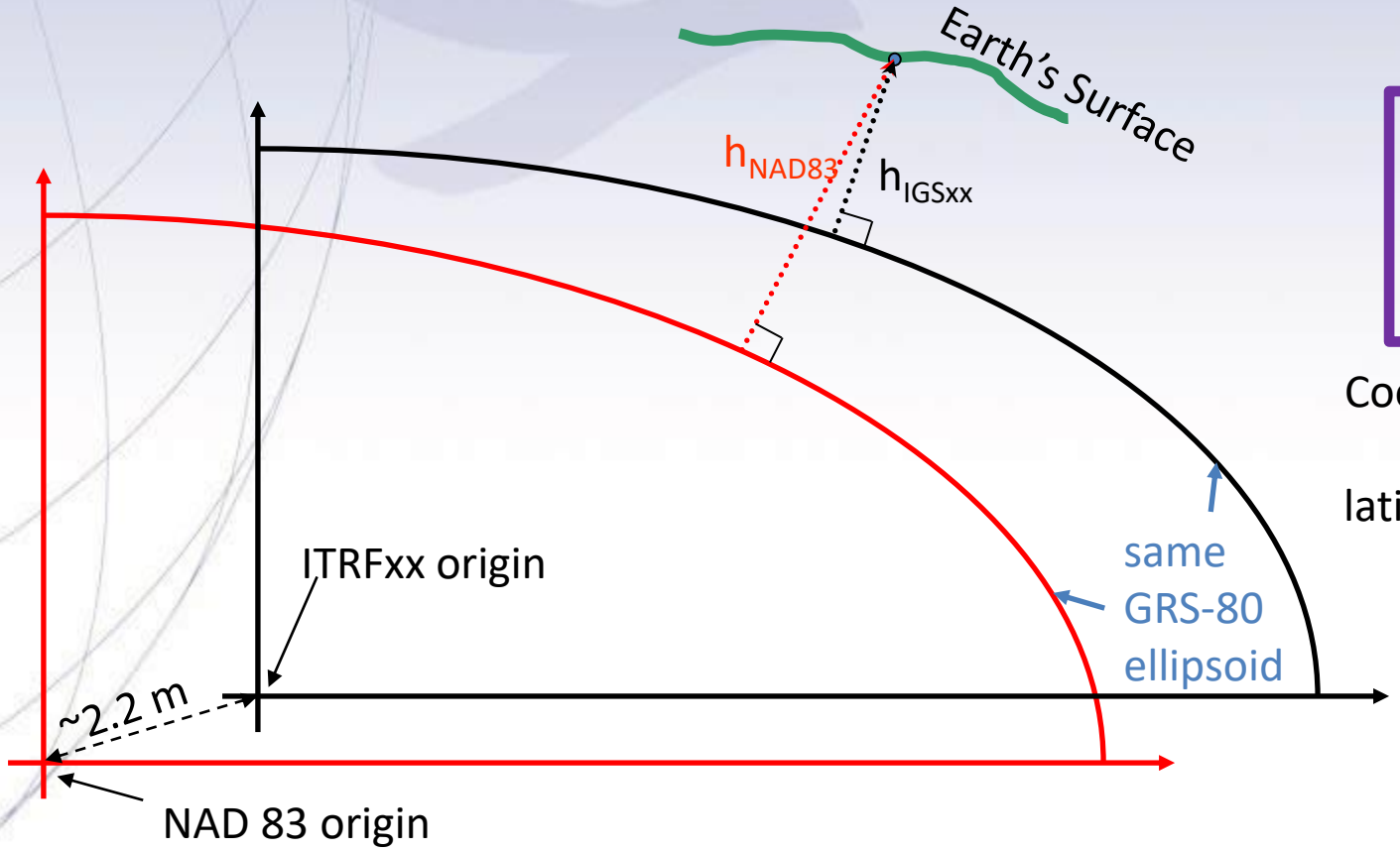
- were defined *before* GPS technology and rely on physical survey marks in the ground that have moved
- Not currently aligned with the earth's center-of-mass.

Modernization will:

- Improve **accuracy, access, and alignment** of our positioning systems
- Cause a shift in coordinates



NAD 83's non-geocentricity



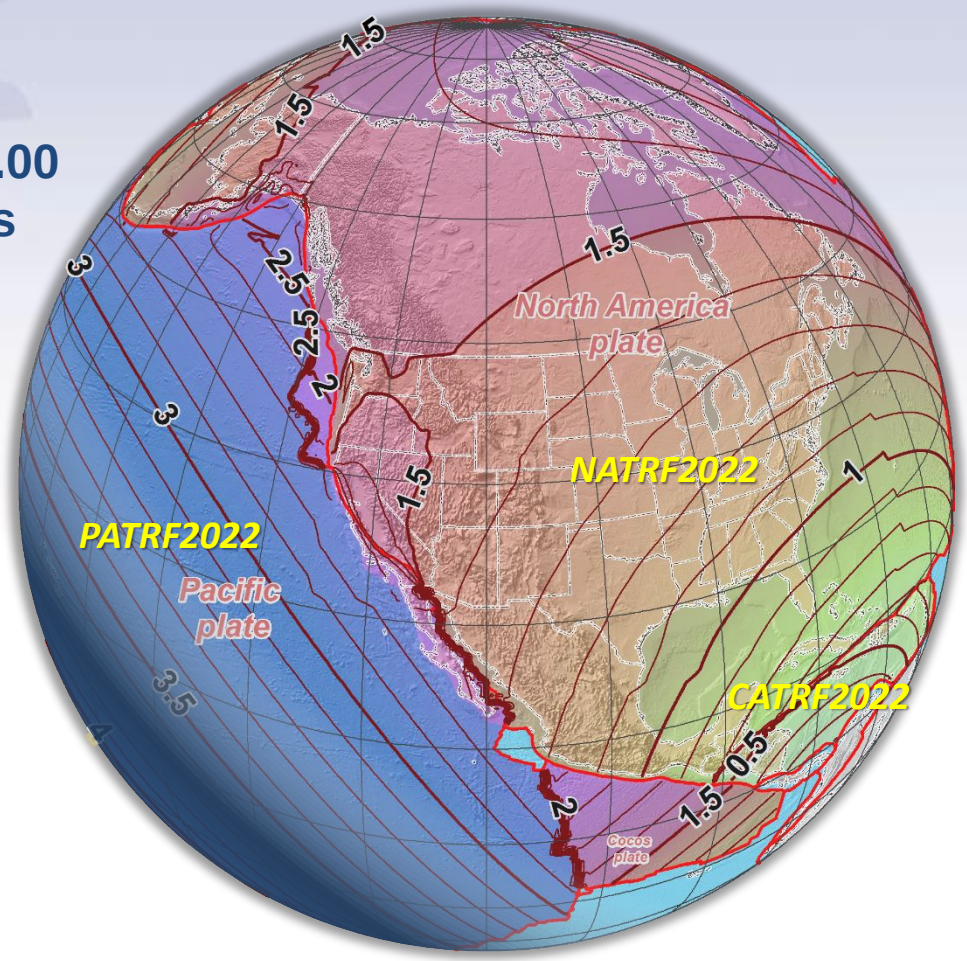
$\phi_{NAD83} - \phi_{ITRFxx}$
$\lambda_{NAD83} - \lambda_{ITRFxx}$
$h_{NAD83} - h_{ITRFxx}$

Coordinates Smoothly varying by latitude and longitude

NAD 83 (2011/PA11/MA11) epoch 2010.00 → 2022 Terrestrial Reference Frames

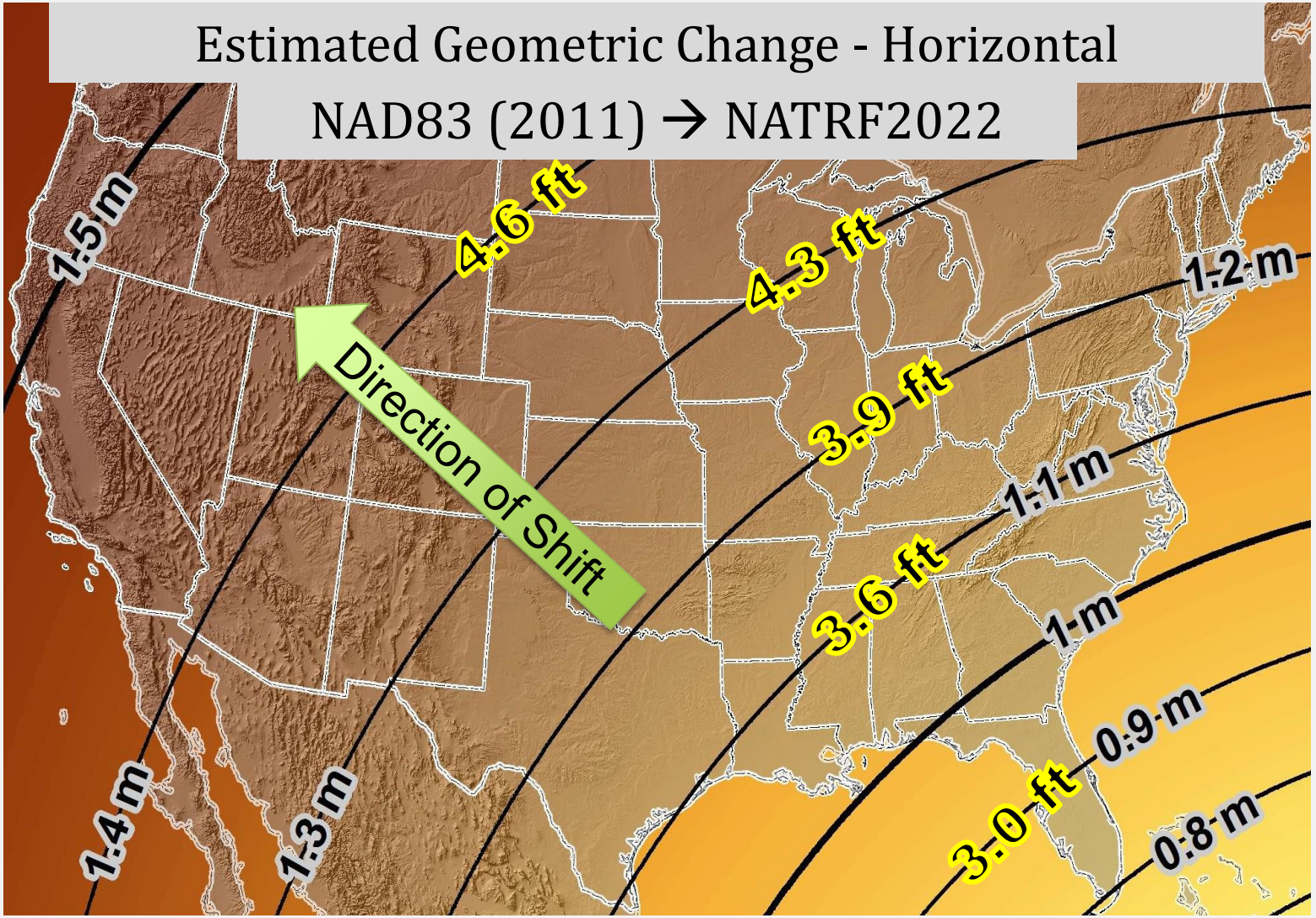
***Horizontal change** at epoch 2022.00*

(contours in meters)



Estimated Geometric Change - Horizontal

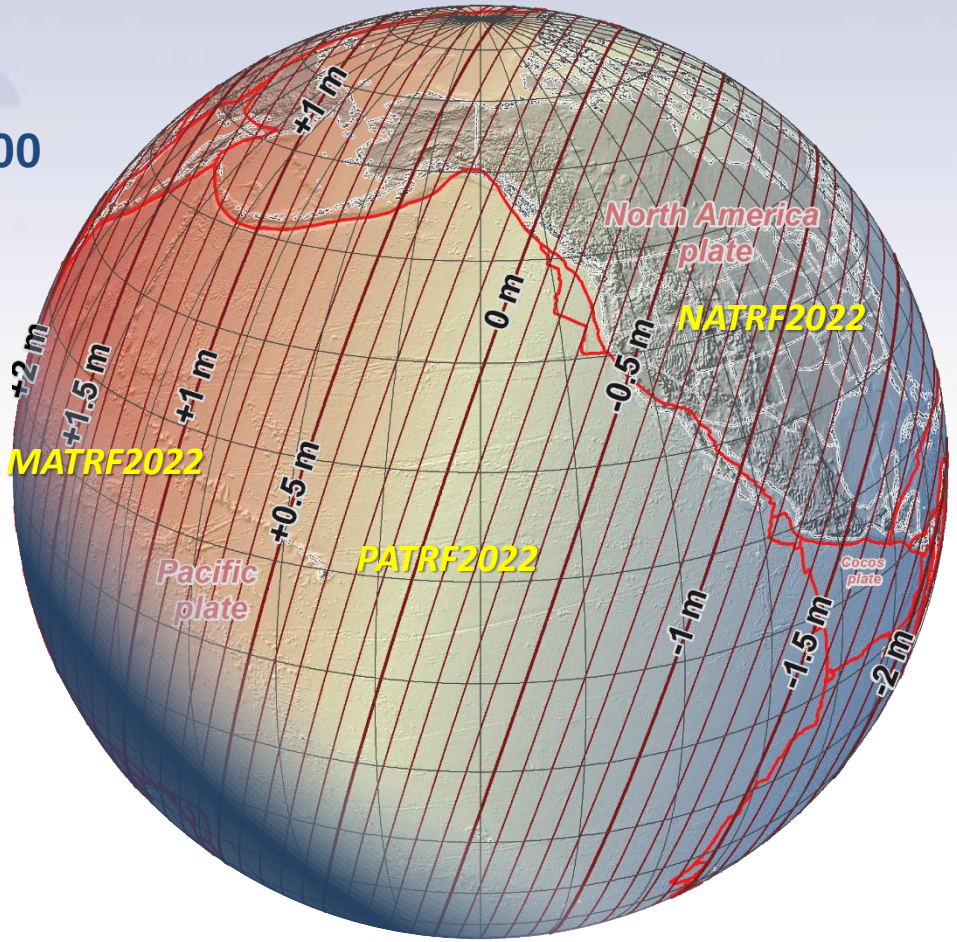
NAD83 (2011) → NATRF2022



NAD 83 (2011/PA11/MA11) epoch 2010.00 → 2022 Terrestrial Reference Frames

*Change in **ellipsoid heights** at epoch 2022.00*

(contours in meters)



NATRF2022

North American Terrestrial Reference Frame of 2022

will replace

NAD83

North American Datum of 1983

Technically, not just NATRF2022 but also its 3 sister TRFs…

Replacing the NAD 83s

The Old	The New
NAD 83 (2011)	NATRF2022 - The North American Terrestrial Reference Frame of 2022
NAD 83 (2011)	CATRF2022 - The Caribbean Terrestrial Reference Frame of 2022
NAD 83 (PA11)	PATRF2022 - The Pacific Terrestrial Reference Frame of 2022
NAD 83 (MA11)	MATRF2022 - The Mariana Terrestrial Reference Frame of 2022

Four "Plate Fixed" TRFs in Modernized NSRS

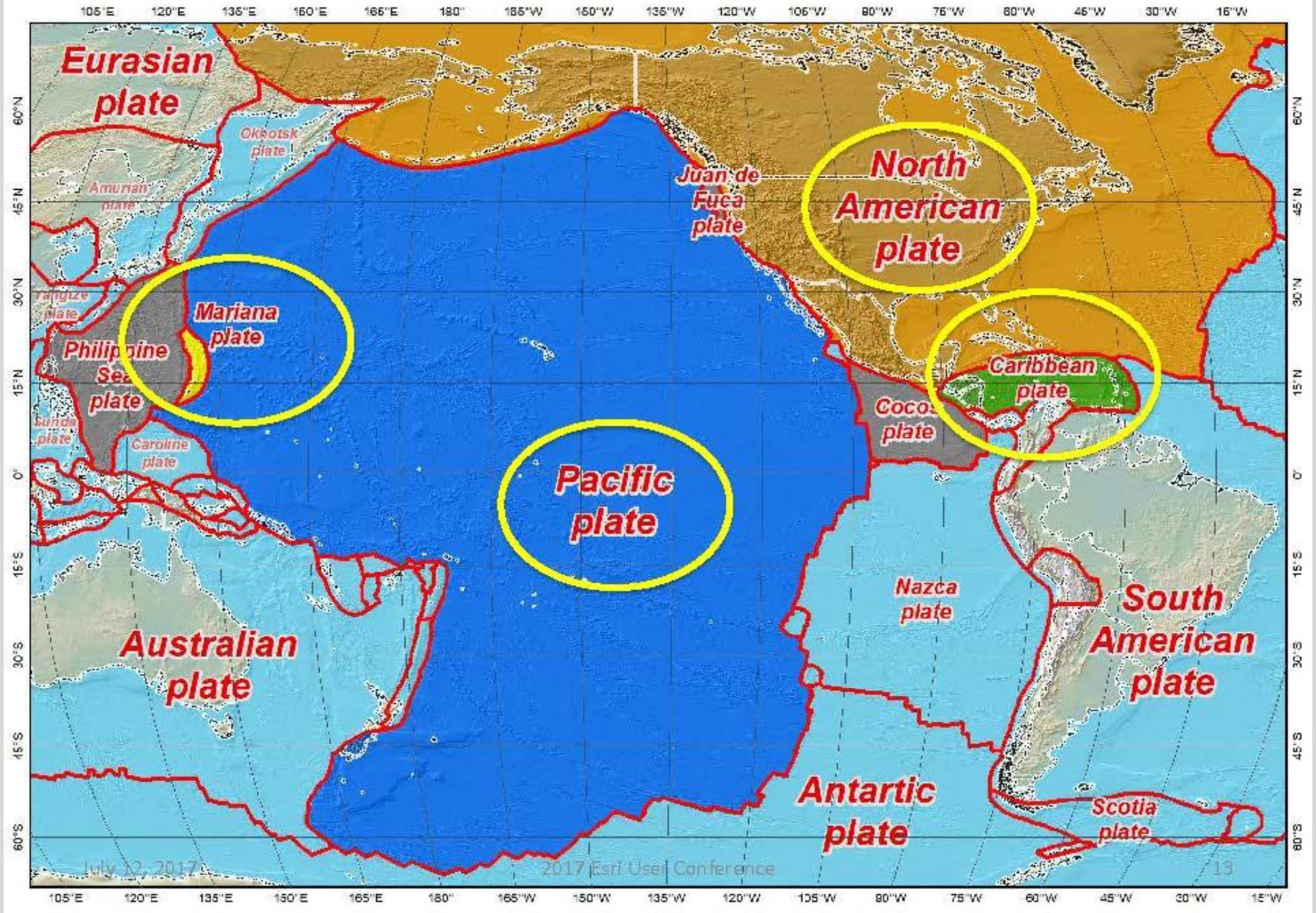
North American Terrestrial Reference Frame of 2022
(NATRF2022)

Pacific Terrestrial Reference Frame of 2022
(PATRF2022)

Caribbean Terrestrial Reference Frame of 2022
(CATRF2022)

Mariana Terrestrial Reference Frame of 2022
(MATRF2022)

The four tectonic plates "fixed" for the 2022 terrestrial reference frames



National Geodetic Vertical Datum of 1929

NGVD29

was replaced by

North American Vertical Datum of 1988

NAVD88

Which will be replaced by

North American-Pacific Geopotential Datum of 2022

NAPGD2022

(pronounced: nap-jee-dee)

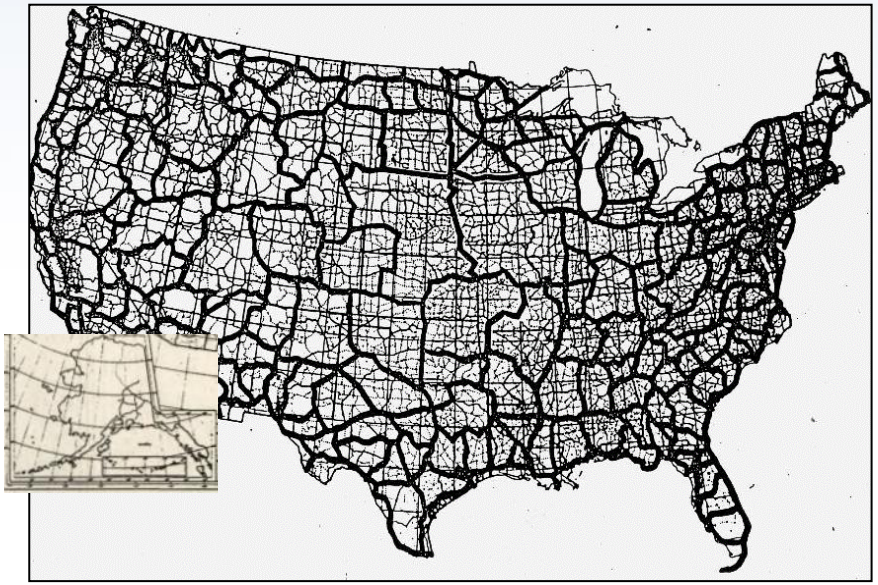
Modernization of the National Spatial Reference System

FROM NAVD 88 TO NAPGD 2022

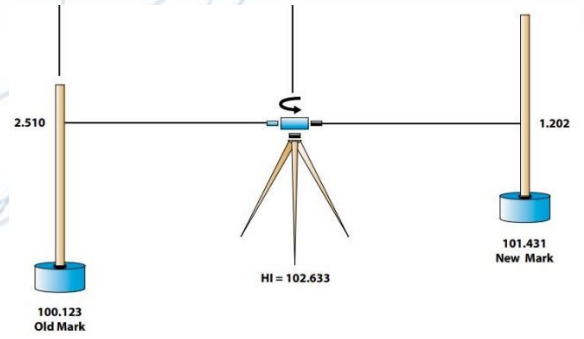
Developing the Previous Vertical Datums Required a LOT of Leveling!

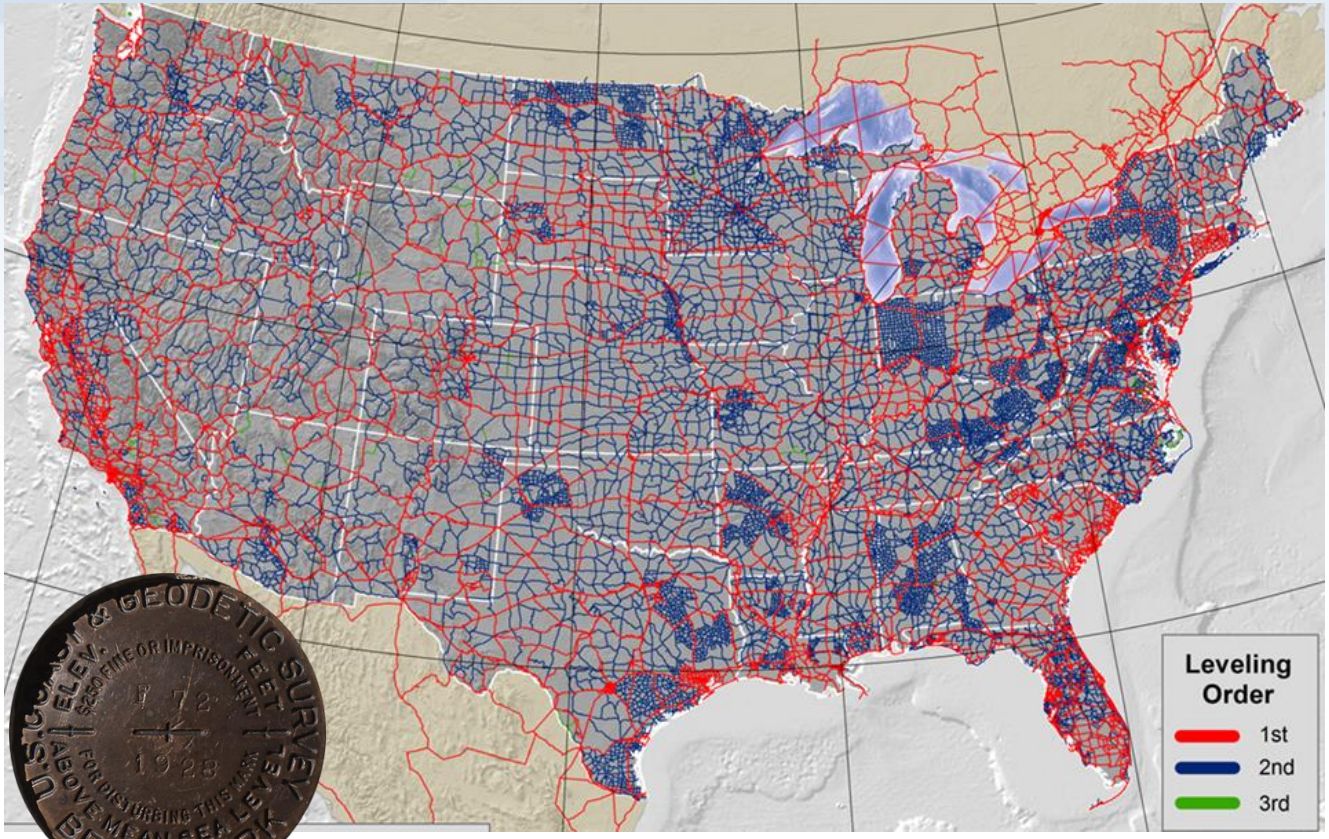
NGVD 29

NAVD 88

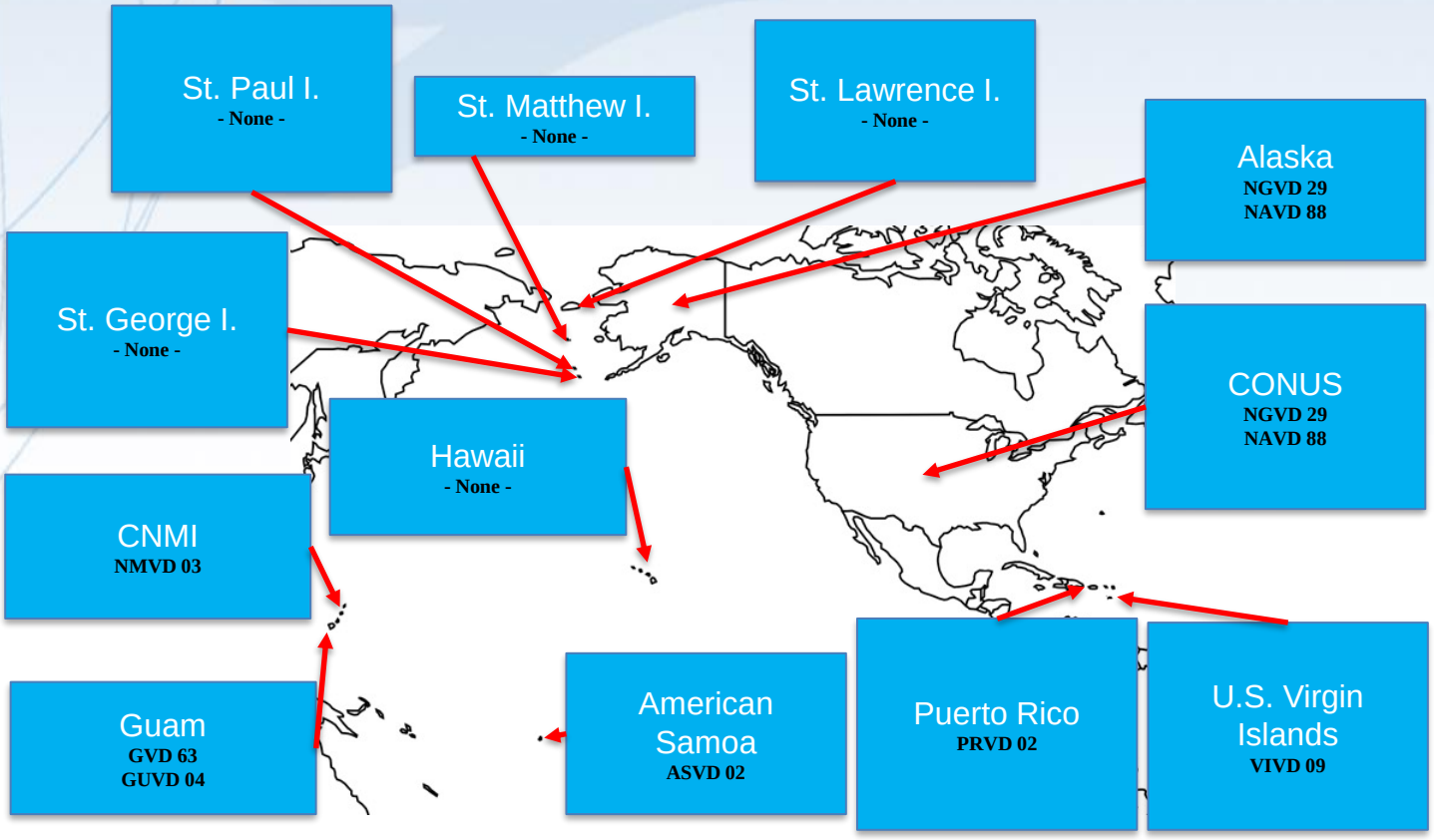


North American Vertical Datum of 1988 (NAVD88)





Vertical Datums of the NSRS



Replacing NAVD 88

	The Old:
Orthometric Heights	NAVD 88
Normal Orthometric Heights	PRVD 02
	VIVD09
	ASVD02
	NMVD03
	GUVD04
Dynamic Heights	IGLD 85
Gravity	IGSN71
Geoid Undulations	GEOID18
Deflections of the Vertical	DEFLEC18

The New:

The North American-Pacific ***Geopotential Datum*** of 2022 (NAPGD2022)

Will include:

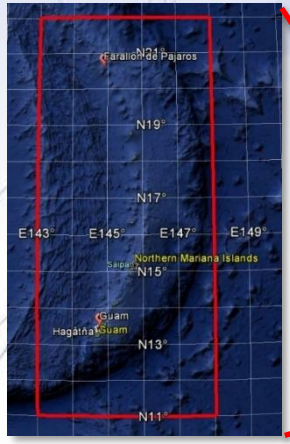
- GEOID2022
- DEFLEC2022
- GRAV2022
- DEM2022
- More

A HUGE component of this effort is GRAV-D:
Gravity for the Redefinition of the American Vertical Datum

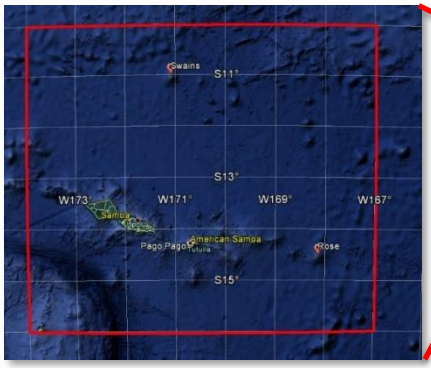
***GRAV-D Data Collection Has Been COMPLETED and Is Being Processed and Analyzed!**

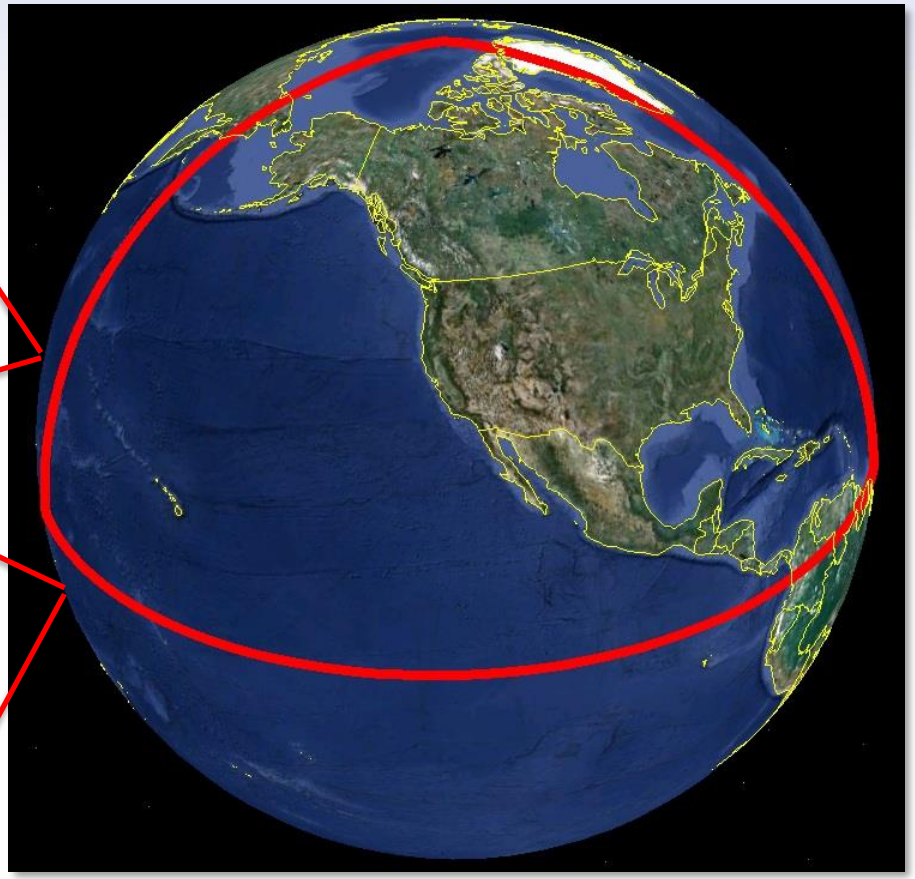
Extent of NAPGD2022 gravimetric geoid model

Guam and Northern Marianas Islands

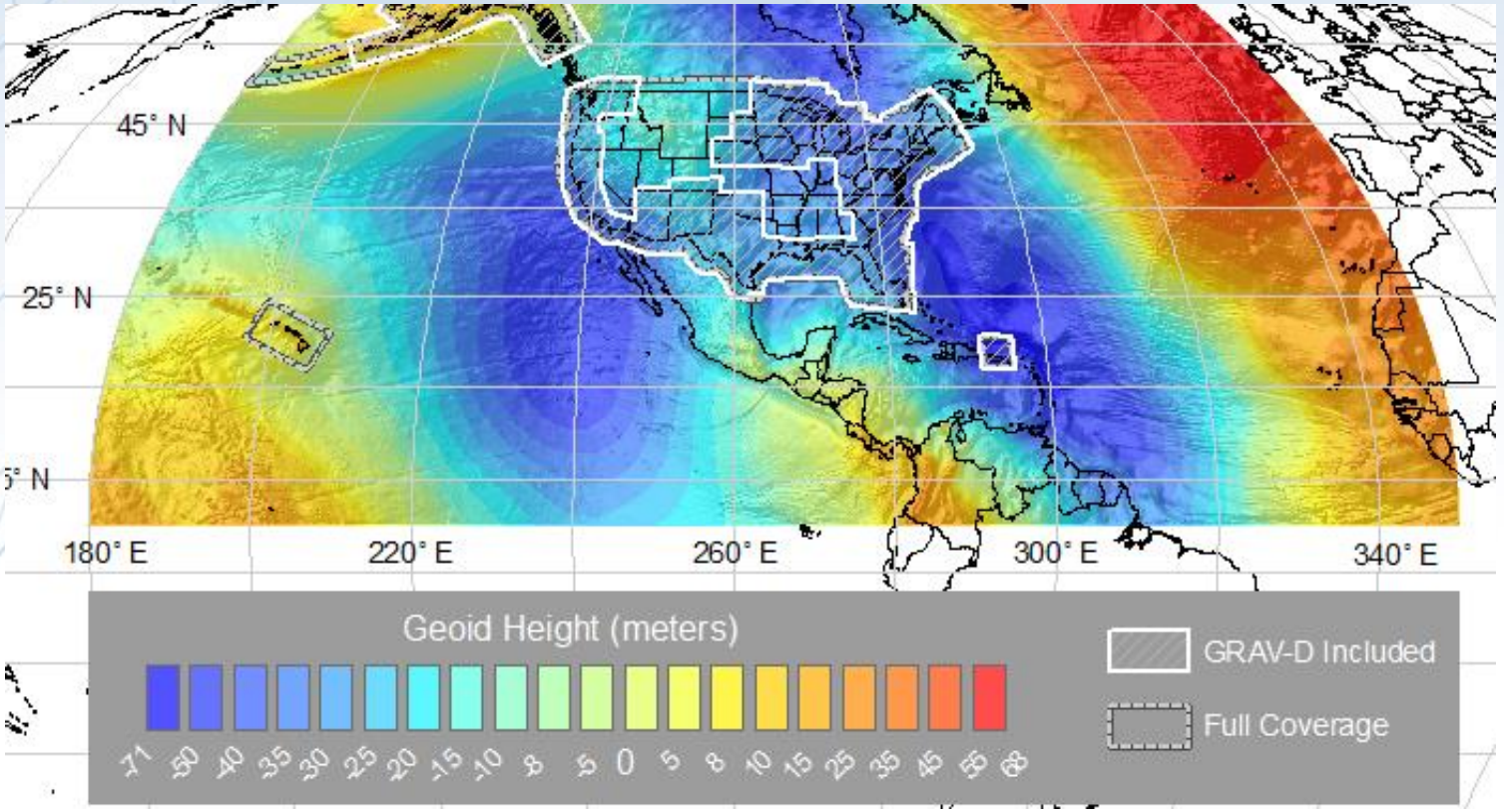


American Samoa





Replacing ALL Vertical datums of the NSRS with:



The North American Pacific Geopotential Datum of 2022 (NAPGD2022)

NAPGD2022

- Geopotential
  - gravity based
  - no leveling used to define it (none!)
- GNSS is your access
  - collect data & submit it to OPUS
  - no leveling necessary
- Global Mean Sea Level (GMSL) based
  - geoid change when sea level threshold crossed

NAVD88 geoid
vs
NAPGD2022 geoid

Two types of geoid models

- **Gravimetric**

- **Hybrid**

Gravimetric → Hybrid

- **Gravimetric** geoid is created from "scratch" with various types of gravity data

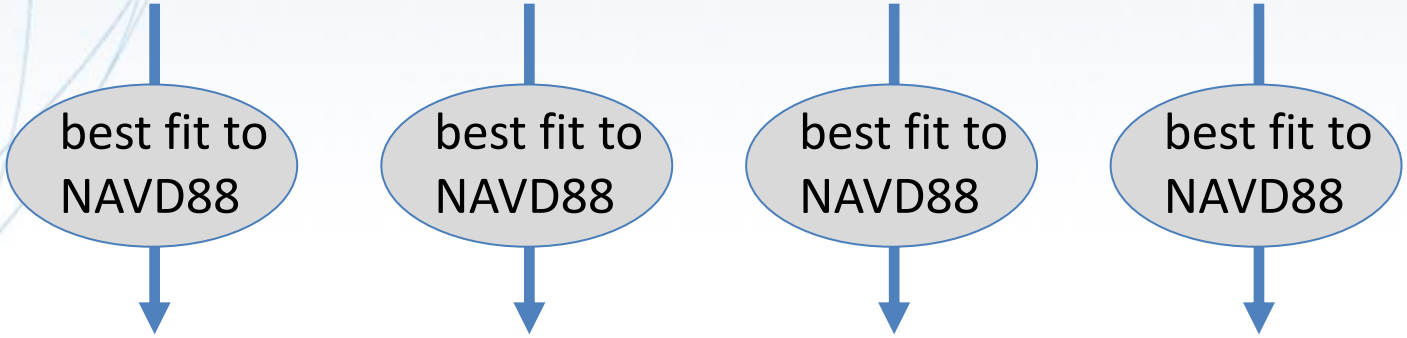
–USGG2003, USGG2009, USGG2012, xGEOID19

- **Hybrid** geoid is simply a gravimetric geoid then best fit to some vertical datum… like NAVD88

–GEOID03, GEOID09, GEOID12B, GEOID18

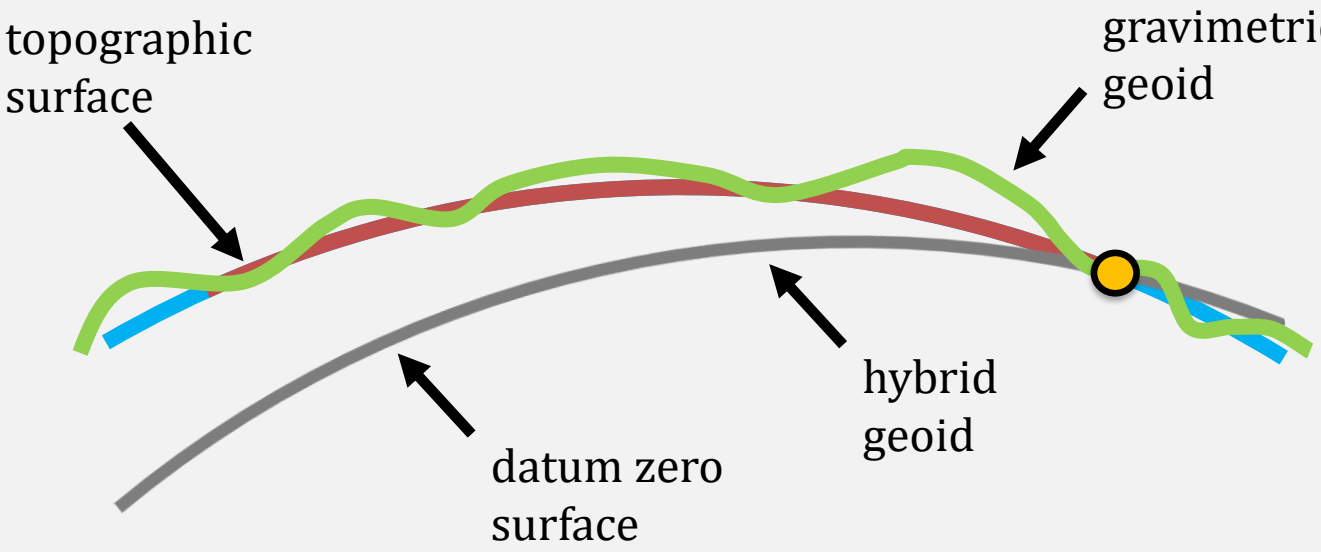
Gravimetric → Hybrid

–USGG2003, USGG2009, USGG2012, xGEOID19



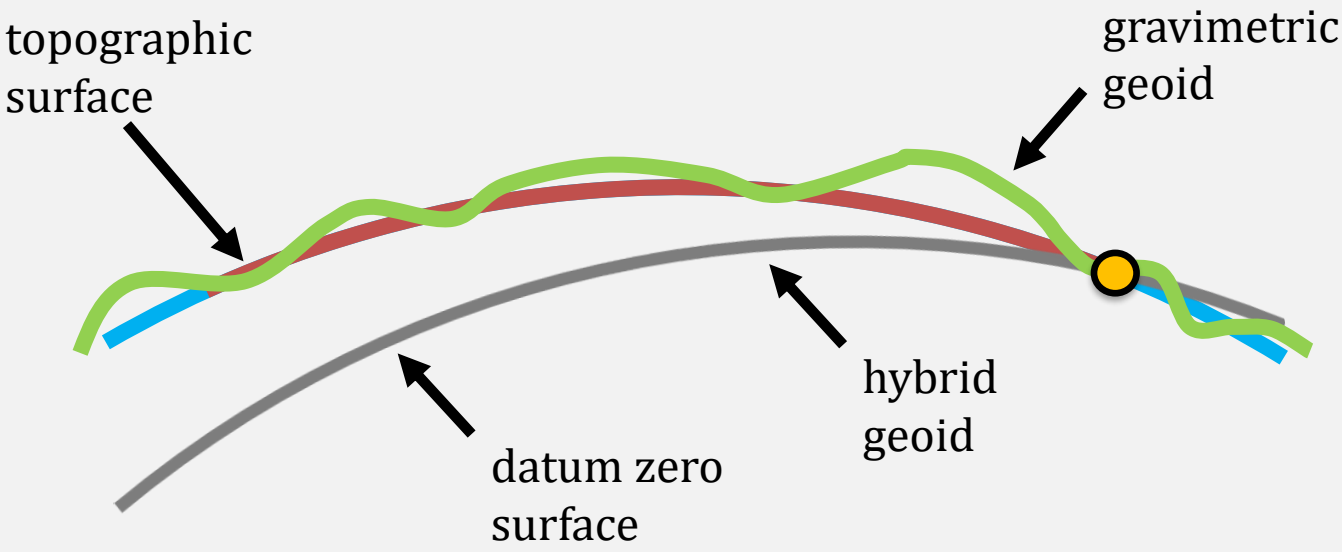
–GEOID03, GEOID09, GEOID12B, GEOID18

Gravimetric vs. Hybrid Geoid



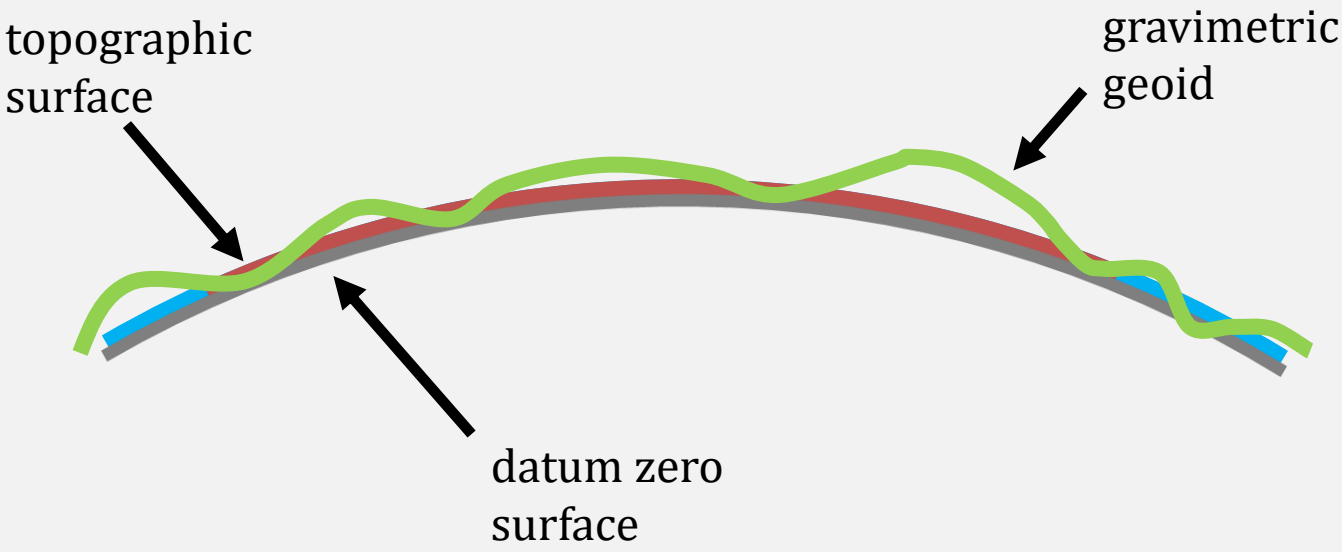
Concept

NAVD88 uses a Hybrid Geoid



Concept

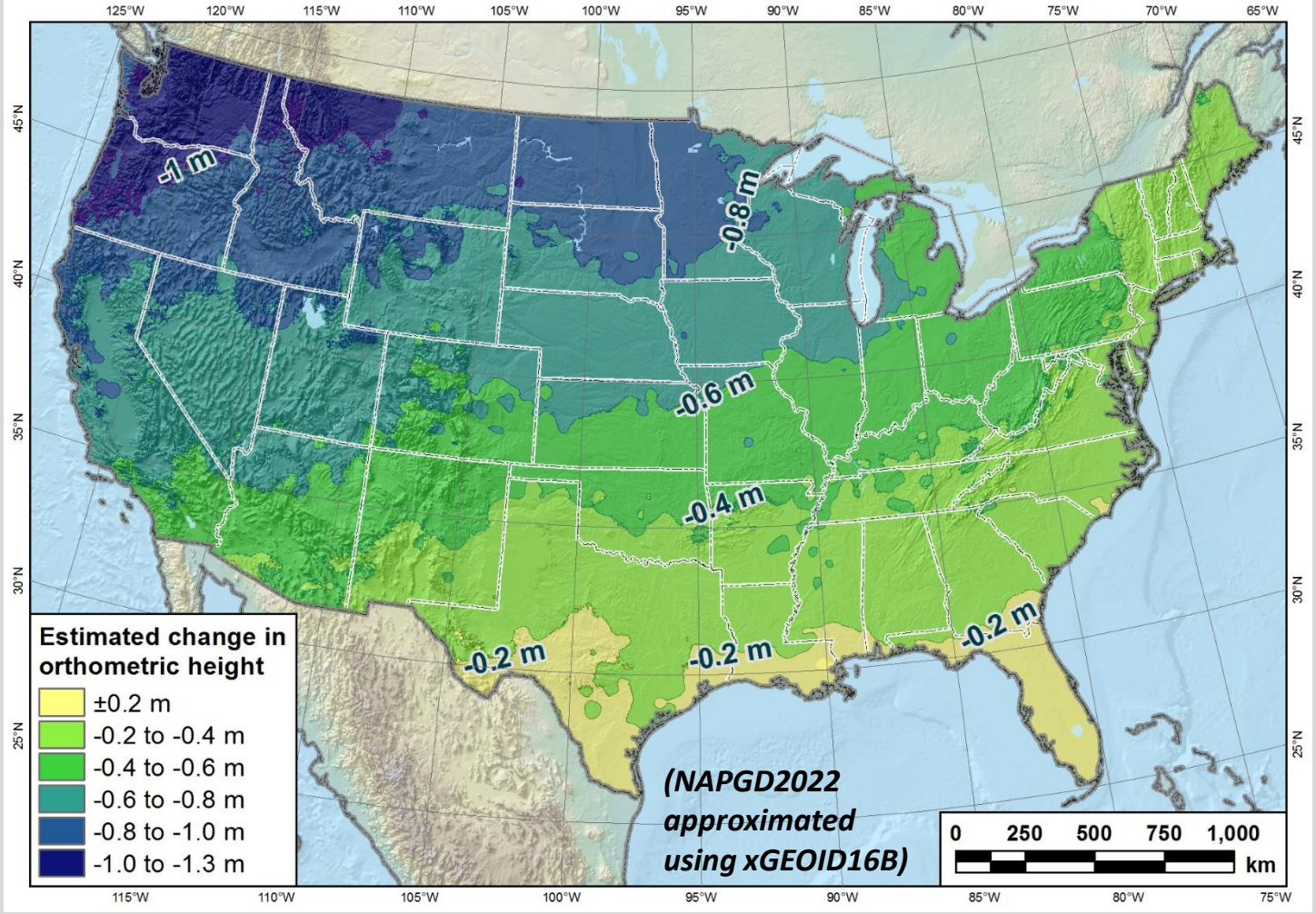
NAPGD2022 uses a Gravimetric Geoid



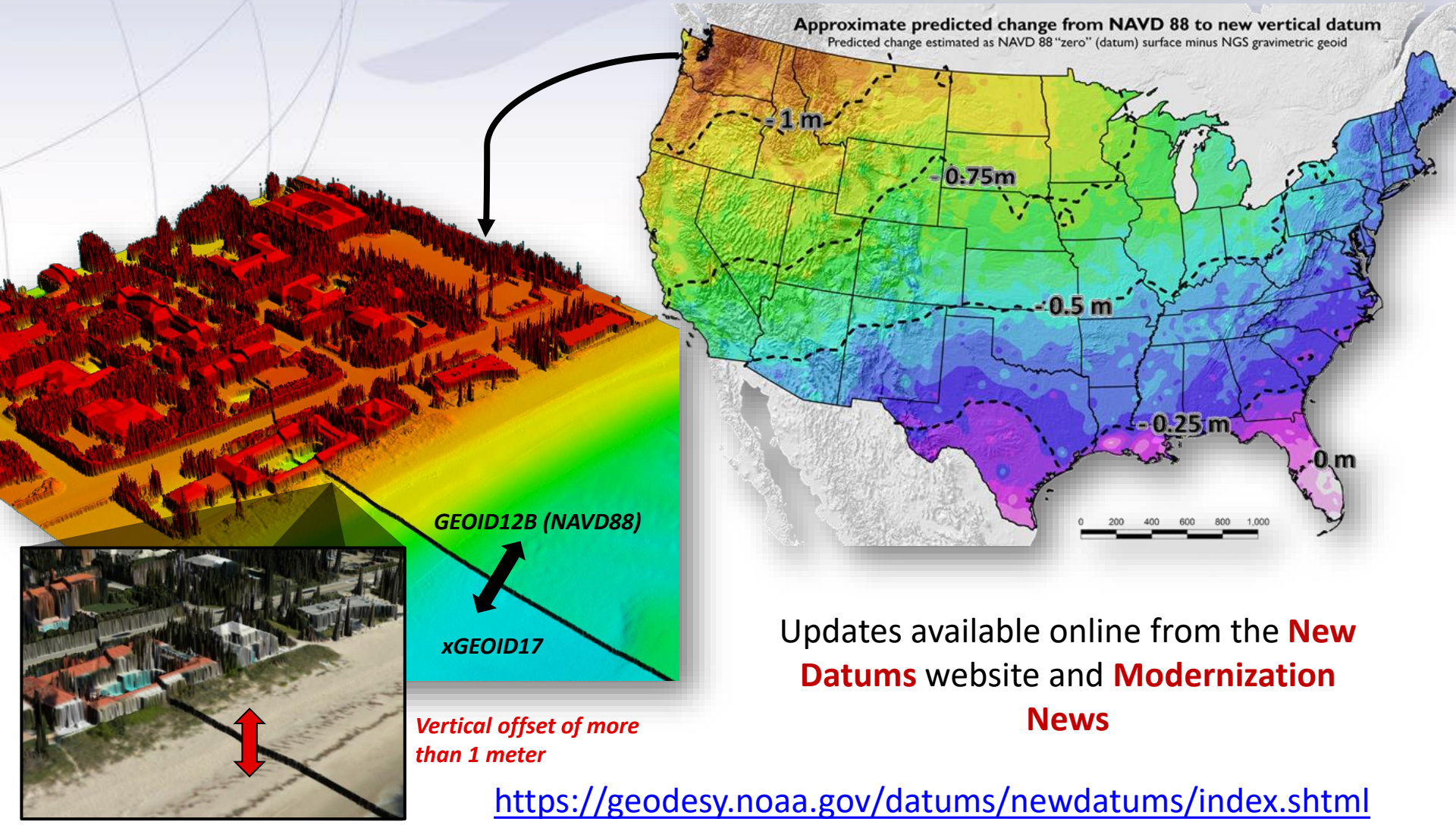
Concept

- Datum zero surface aligned to Global Mean Sea Level (GMSL)

Estimated change in orthometric heights from NAVD88 to **NAPGD2022**



NSRS Modernization: Vertical Change



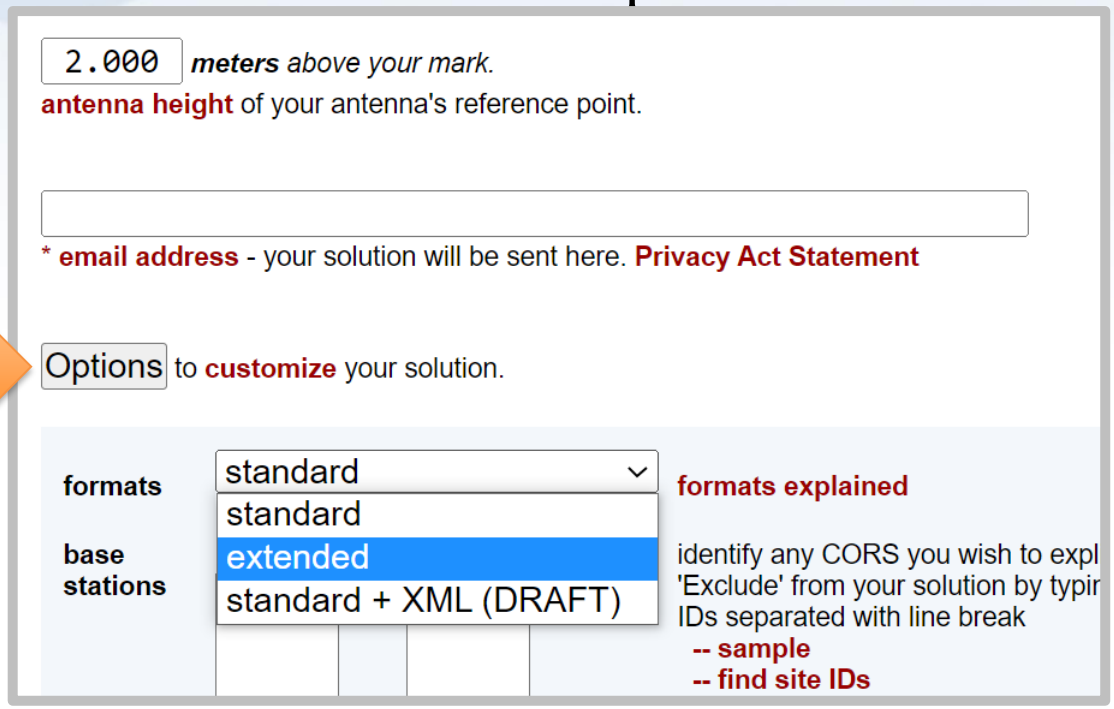
Vertical offset of more than 1 meter

Updates available online from the **New Datums** website and **Modernization News**

https://geodesy.noaa.gov/datums/newdatums/index.shtml

Estimated change in orthometric heights from NAVD88 to NAPGD2022

- OPUS Extended Solution Report



Estimated change in orthometric heights from NAVD88 to NAPGD2022

- OPUS Extended Solution Report
  - Scroll all the way to the bottom…

********** New Reference Frame Preview **********

We are replacing the nation's NAD 83 and NAVD 88 datums, to improve access and accuracy of the National Spatial Reference System. More at https://geodesy.noaa.gov/datums/newdatums/

Below are approximate coordinates for this solution in the new frames:

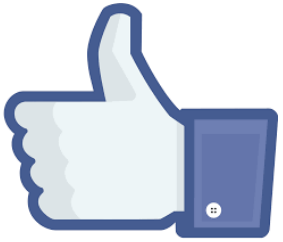
APPROX ORTHO HGT: 247.321 (m) [PROTOTYPE (Computed using xGeoid19B,GRS80,ITRF2014)]

Preparing for NAPGD2022

- Inventory heights in your data/datasets
  - Have you mix & matched geoid models?
    - Are you tracking levees or other flood control?
    - Are you managing subsurface utilities?
      - » Access covers, junction boxes, cleanouts, etc.
    - **Maybe** geoid differences aren't even significant?
  - ***Know your goals, know your data.***

Preparing for New Datums

- Know the epoch of your data/datasets
  - consider how you will track this
    - full to-the-second timestamp on every feature?
      - Modern survey equipment makes this possible
    - labeling a year for each dataset?
      - Easy to add to workflows, datasets/databases, folders
    - something in-between that works for your needs?



2023.1957
2023:27
20230127

Epoch nomenclature is your choice

Preparing for New Datums

- Reprocessing your data

– perfect world = everyone reprocesses everything

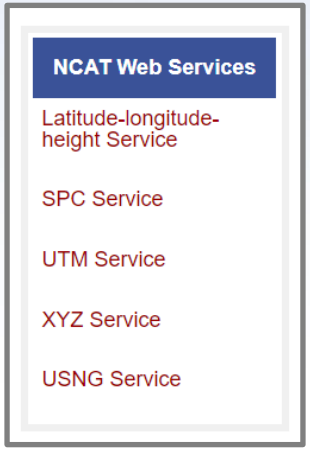
  - ***unrealistic!*** … and unnecessary for majority users

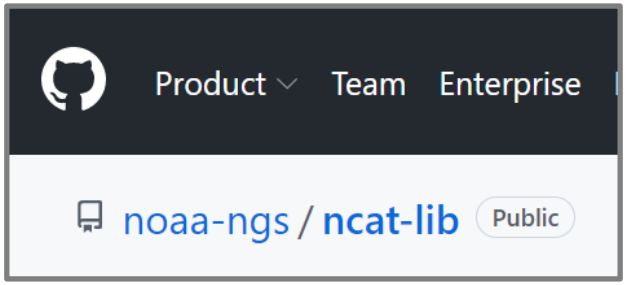
Preparing for New Datums

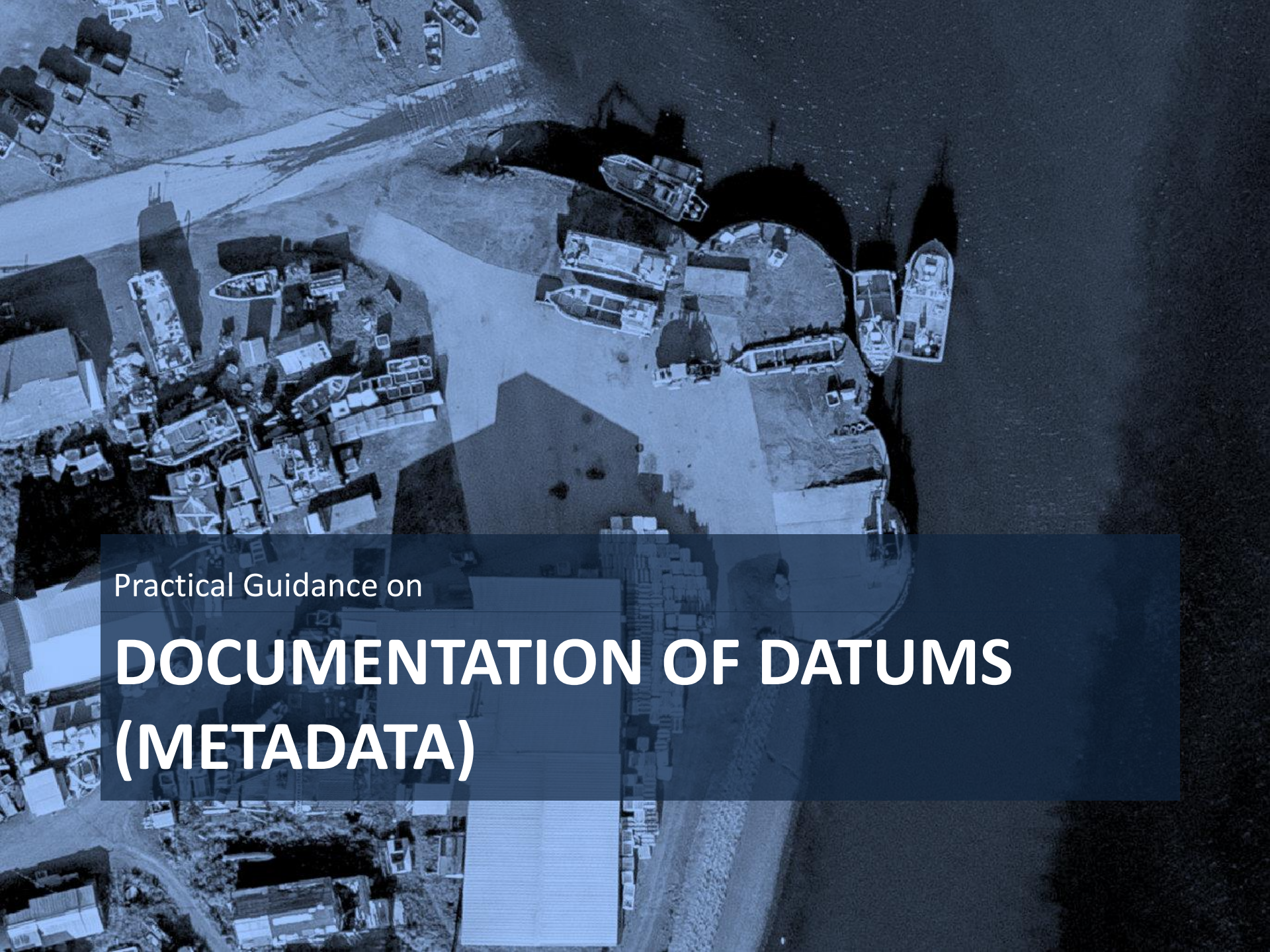
- Transforming your data

– **NCAT** - NGS Coordinate Conversion and Transformation Tool

  - available now: ASCII upload, Web Services, GitHub
  - ask your software provider(s) about integration
    - we envision this as most popular method of access
    - Industry Workshops held in 2021 and 2022
      - » All the well known commercial names attended
      - » Plus some open-source advocates







Practical Guidance on

DOCUMENTATION OF DATUMS (METADATA)

Use Complete Nomenclature

NAD83

NAVD88

MLLW

Use Complete Nomenclature

NAD83(2011) epoch 2010.00

H. Datum — Realization/Adjustment — Reference Epoch

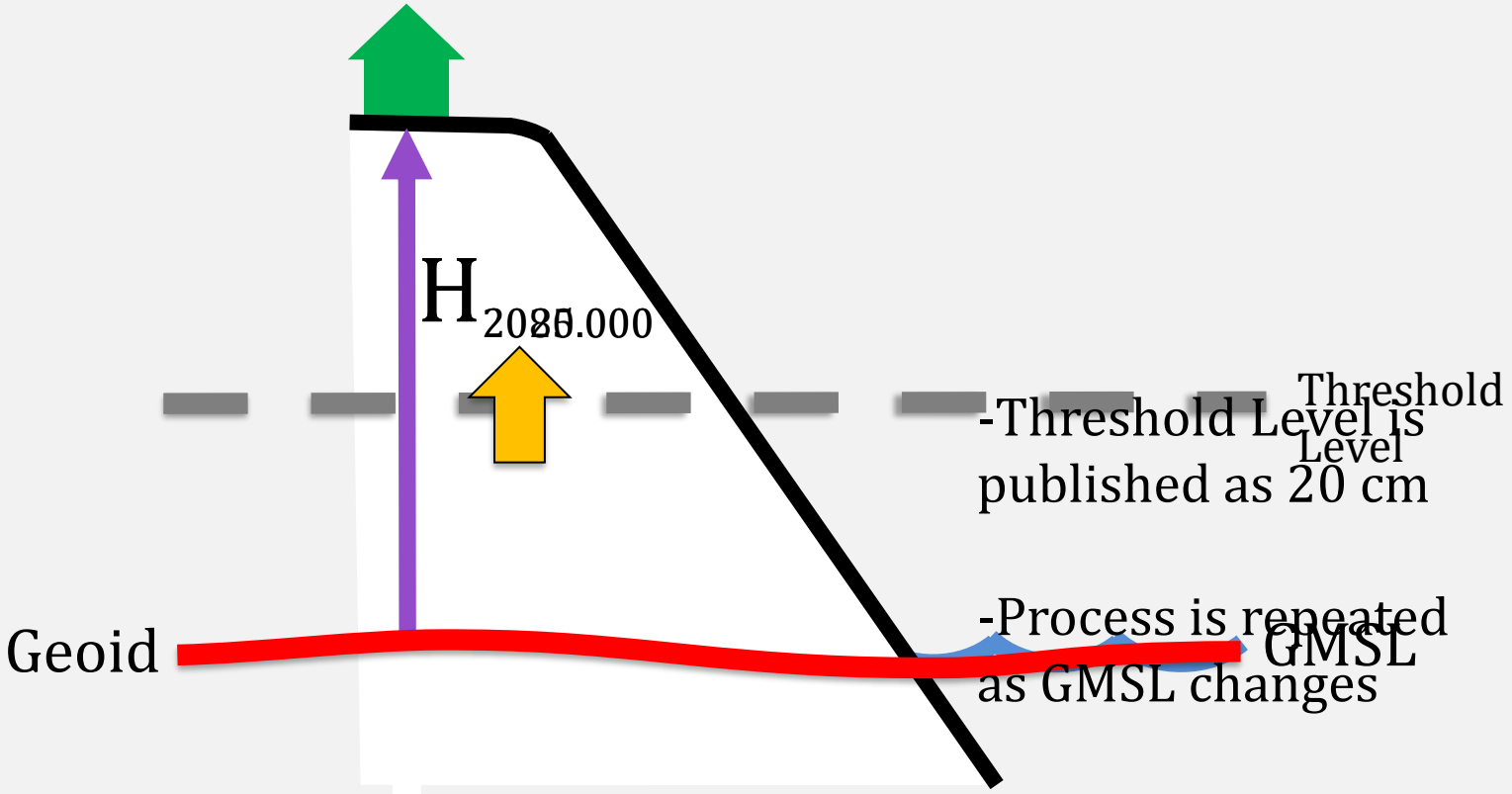
NAVD88 *(GRS80, Geoid12B)*

V. Datum — Reference Ellipsoid — Geoid Model

MLLW(9452210; 1960-78 #2128)

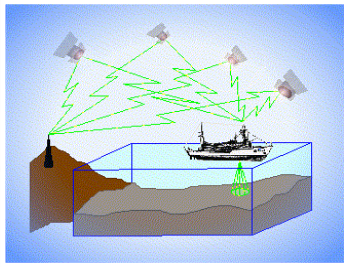
Tidal Datum — NOAA Tide Station — National Tidal Datum Epoch & Published Sheet Number (if available)

Sea Level Change and the Geoid

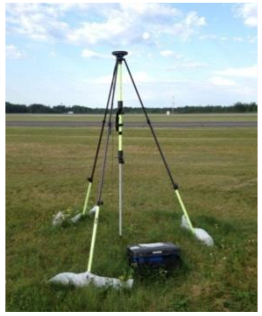


3 Categories of Vertical Datums

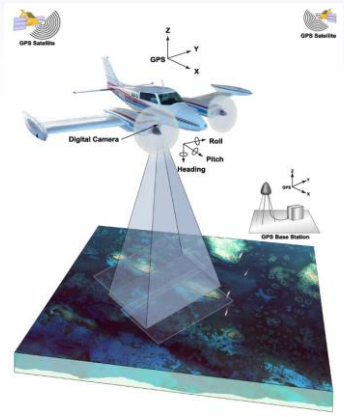
Ellipsoidal



Raw Hydrographic Surveys vertically referenced with RTK-GPS

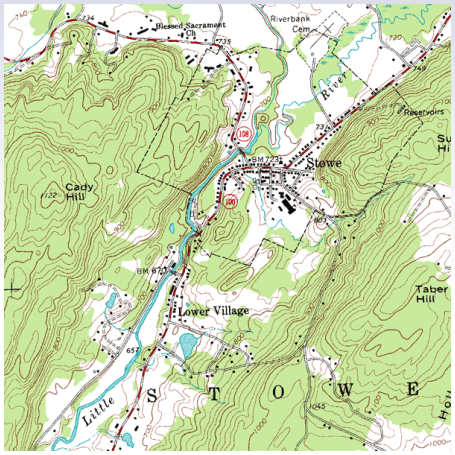


Native GPS measurements



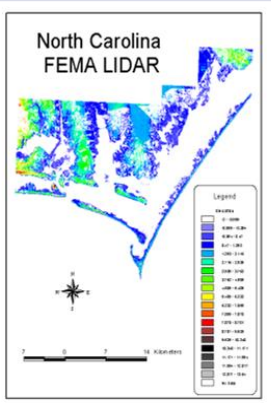
Raw Lidar

Orthometric



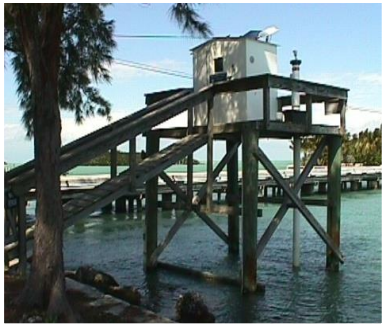
USGS Topography

Engineering and Development Site Surveys

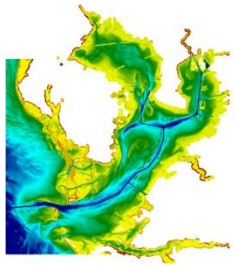


FEMA Flood Insurance Rate Maps

Tidal

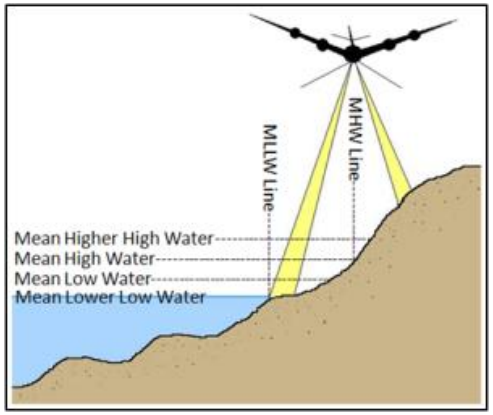


Daily and Extreme Water Levels



NOAA Bathymetry (MLLW)

Shoreline Mapping (MHW) and Regulatory Boundaries at the Coast



Modernizing the NSRS

- Updating ***all*** NSRS coordinates
  - Replace existing datums with new datums
  - Replacing existing SPCS83 with new SPCS2022
  - Accounting for coordinates changing with time
- Improving NGS products and services
- Simplifying customer contributions
- Making the NSRS:
  - ***More*** accurate
  - ***More*** accessible
  - ***More*** efficient

Rollout in 2025

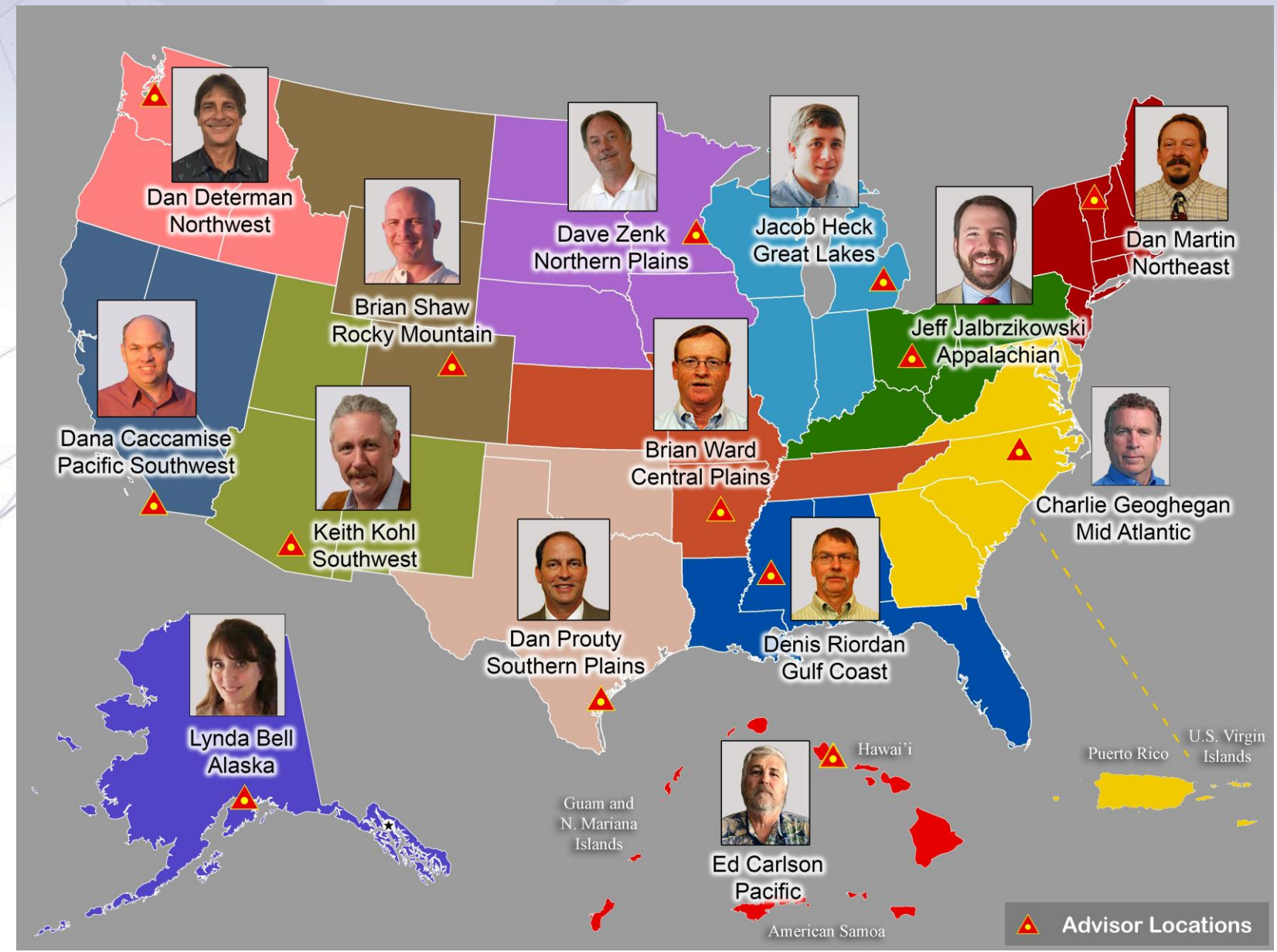
Main Benefits of Modernized NSRS

- Fast, Accurate, Consistent Elevations Everywhere
- Improved Public Safety
  - Flood Plain Maps
  - Emergency Route Planning
- More Accurate Positioning
  - For Precision Agriculture, Autonomous vehicles, Smart Cities, etc.

Additional

TRAINING AND RESOURCES

NGS Regional Advisor Program



Resources from geodesy.noaa.gov

National Geodetic Survey

Positioning America for the Future

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New Datums
- Home
- What to expect
- Get prepared
- Track our progress
- Naming Convention
- Watch videos
- Related projects
- Learn more
- New Datums FAQ
- Contact Us

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Events
- Industry Engagement
- 2017 Summit
- 2015 Summit
- 2010 Summit

New Datums: Replacing NAVD 88 and NAD 83

NAD 83 and NAVD 88 will be replaced in 2022, and there are many related projects to make sure the transition goes smoothly. Read the NGS Ten-Year Plan to learn more and continue to visit this web-page for more information.

What to Expect | Get Prepared

Track our Progress | Naming Convention

Watch Videos | Related Projects

Why is NGS replacing NAD 83 and NAVD 88?

NAD 83 and NAVD 88, although still the official horizontal and vertical datums of the National Spatial Reference System (NSRS), have been identified as having shortcomings that are best addressed through definin new horizontal and vertical datums.

Specifically, NAD 83 is non-geocentric by about 2.2 meters. Secondly, NAVD

Click icon on home-page

Online Resources from ngs.noaa.gov

Vertical Datums

National Geodetic Survey

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- Datums ▶
- Ecosystems and Climate
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- Geoid
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- Webinar Series

- Publications
- Webinars
  - Geodetic/Tidal
  - GPS-Derived Heights
- **Tutorials**
  - NOAA's NOS (Datums)
  - CO-OPS (Tides)
  - COMET (Heights and Vertical Datums)
- **Science**
  - Height Modernization
  - Leveling
  - Geoid
  - GRAV-D
- Survey Mark Datasheets
- Historical Images
- Contact Us

Vertical Datums

A vertical datum is a surface of ze… that those heights be in a consis… zero elevation surface and metho… many different types of vertical da… datums and geodetic datums.

- What is a datum?
- New Datums
- Vertical
- FAQs

Tidal datums are determined by … examples of these are Mean Sea… (MHHW).

…gage over time. Some simple …V) and Mean Higher High Water

Mean Sea Level (MSL) is a tidal … Oceanographic Products and S… (NTDE) based on data collected … at the tide station at which it was … including LMSL at other tide stati…

…nter for Operational …tional Tidal Datum Epoch …to Local Mean Sea Level (LMSL) …ed with any other vertical datum, …d States is 1983-2001.

Geodetic datums are predomina… …of surveying known as geodetic leveling, determining the height … …ound known as bench marks. These height differences can onl… …narks if at least one datum origin point is chosen to serve as the absolute level of the vertical datum. It is frequently the practice of those responsible for defining a geodetic datum, to choose a datum origin point that is also at a tide gage so a relationship between the tidal and geodetic datums exists, though this is by no means a requirement.

In the United States and its territories, NOAA's National Geodetic Survey (NGS) responsibilities include defining and providing access to and the maintenance of geodetic vertical datums. These datums are part of the overall National Spatial Reference System (NSRS). Currently five vertical

Educational Videos & Online Tutorials

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Video Library

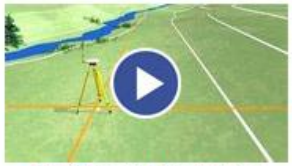
NGS, in partnership with The COMET Program, has developed short videos about topics related to geodesy and mapping. View or download our featured video or previous videos. Please visit the COMET YouTube Channel to view the entire playlist.


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

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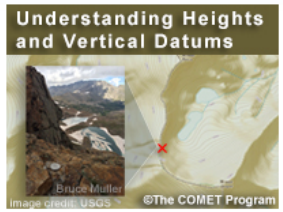
Lesson/Resource Listing » Description

Understanding Heights and Vertical Datums



Languages: English
Publish Date: 2015-03-31
Skill Level: 0
Completion Time: .75 - 1.00 h
Includes Audio: yes
Required Plugins: none
Topics: Geospatial
Included in Courses: Elements of Hydrography Distance Learning Course

Reviews: (21 reviews)
Read or add reviews

BEGIN LESSON

Add to Queue | Your Queue»

Take the quiz?
Begin Quiz

Share this resource: 2

Videos are ~3-5 minutes

Vertical Datums Tutorial is ~1 hour

Email Subscriptions

Stay informed!

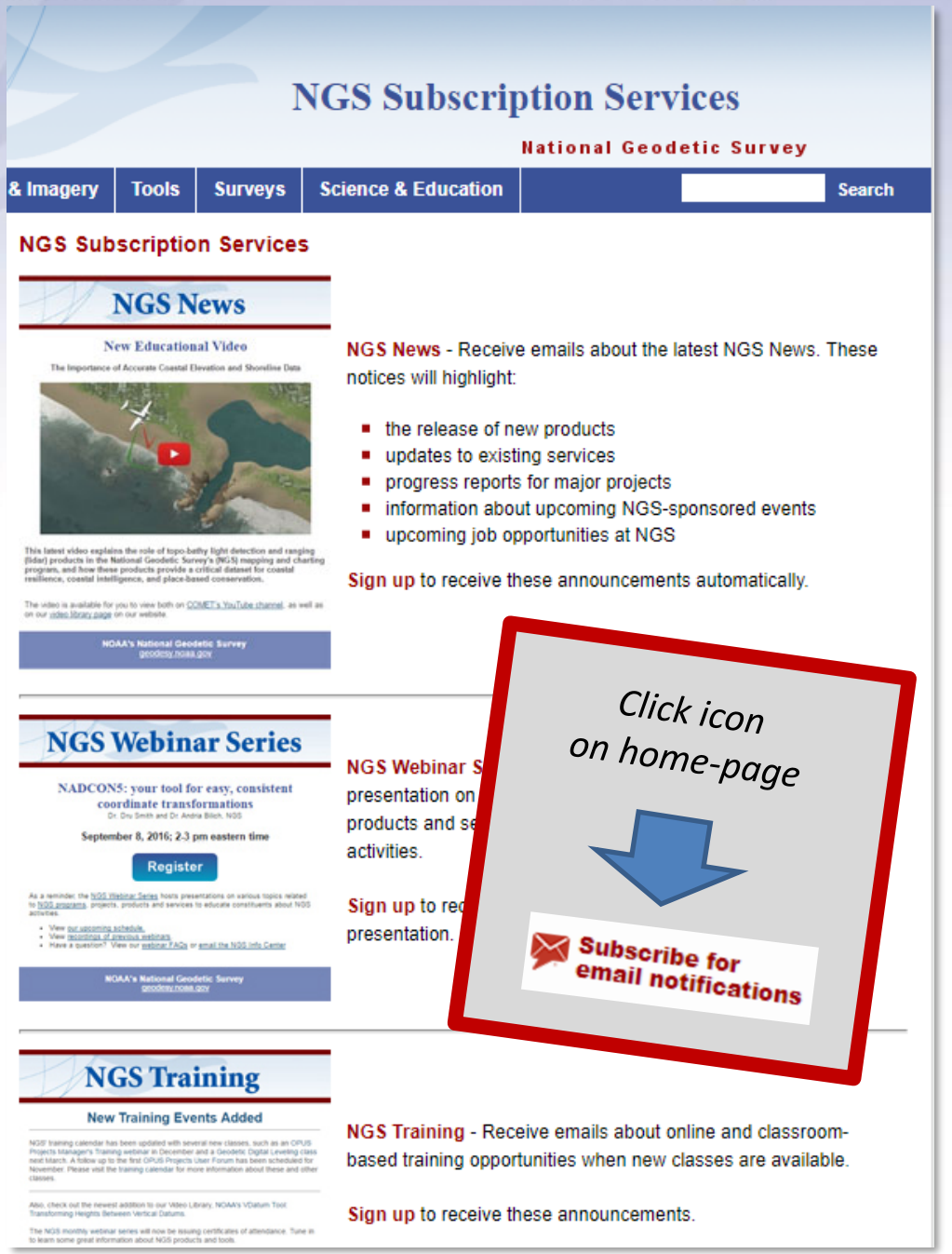
- **NGS News**

  Includes quarterly NSRS Modernization newsletter

- **NGS Webinar**

- **NGS Training**

Only 1-2 messages / month



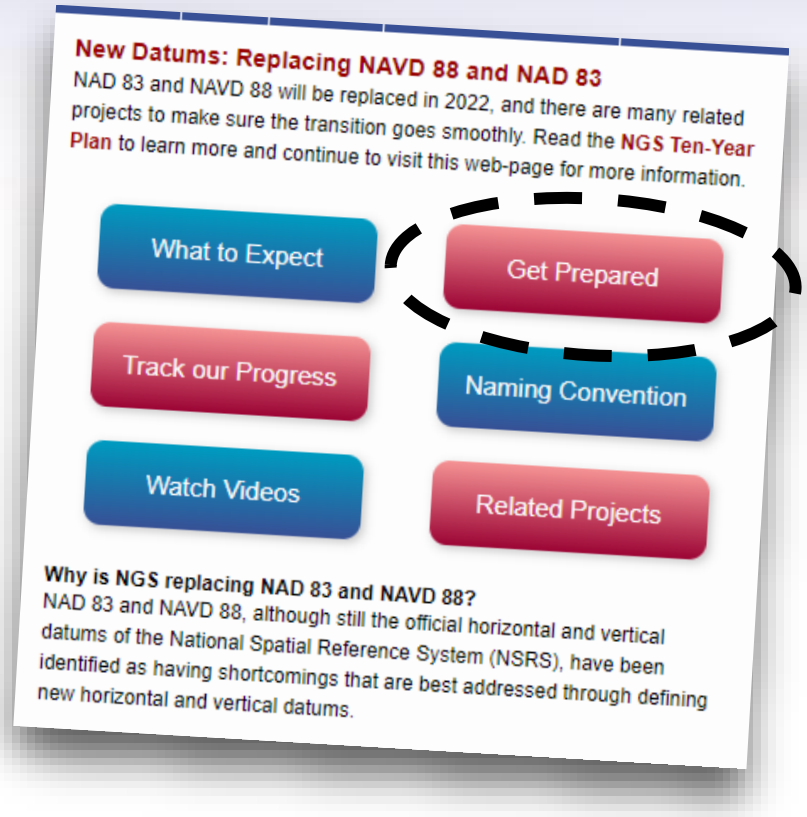
What can everyone do?

- Be aware and help spread the word about upcoming **NSRS modernization**:
  - Proactively ask agencies, surveyors, and engineers about what preparations they are taking to learn about and prepare for the upcoming changes
- **Reach out** to NGS for support as needed
- Lead by example and exercise **best metadata practices**

Get Prepared

More active NSRS users

- Metadata, metadata, metadata..
- Use current datums / realizations
- Keep original ("raw") GNSS observation files



NSRS Modernization

Yes, we are delayed.

Delayed Release of the Modernized NSRS

- *How long will the delay be?*
  - Our website or newsletter is best source of projected timeframe, current estimate is **middle of 2025**.
- *Will the names stay the same?*
  - Yes, terms containing "2022" such as "NATRF2022" and "NAPGD2022" will remain the same.
- *Will all previously proposed products be released along with the new datums?*
  - No, they will not.

Data

- Upon release, the modernized NSRS will consist of this *data*:
  - The NOAA CORS Network (NCN) operating on **ITRF2020**
  - **NATRF2022, PATRF2022, MATRF2022, CATRF2022** defined relative to ITRF2020
  - **NAPGD2022**, including:
    - GM2022, GEOID2022, DEFLEC2022, GRAV2022
  - Geometric (XYZ / $\phi\lambda$h) and orthometric (H) **reference epoch coordinates** (RECs) at 2020.00 at those passive control with the observations to support such coordinates
  - Geometric (XYZ / $\phi\lambda$h) and orthometric (H) **survey epoch coordinates** (SECs) at survey epochs between about 1994 and 2020 at those passive control with the observations to support such coordinates
  - **State Plane Coordinates** of 2022 (SPCS2022), plus UTM and USNG
  - **NADCON**
    - Connecting NAD 83(2011/MA11/PA11) epoch 2010.00 to N/P/M/CATRF2022 epoch 2020.00
  - **VERTCON**
    - Connecting NAVD 88, PRVD02, ASVD02, NMVD03, GUVD04 and VIVD09 to NAPGD2022 epoch 2020.00

Tools

- At a minimum, NGS is targeting these tools upon release:
  - A **Data Delivery System** capable of yielding:
    - RECs on some kind of datasheet
    - Information on CORSs
- A downloadable version of LASER
- **A browser-based online multi-GNSS service:**
  - Like OPUS-S
  - Like OPUS-Projects 5.x
- **NCAT** and **Vdatum** capable of invoking **NADCON**, **VERTCON** and **SPCS2022**

What will come after

- Work will continue to and through the rollout of the modernized NSRS. Tools released after the initial release of the modernized NSRS include:
  - Integrating leveling, classical data and gravity into OPUS
  - Full integration of all old tools into NCAT and Vdatum
  - SECs for pre-1994 (AKA "pre-NCN") years, plus SECs for post-2020

Timeline

- Resources are being diverted from tool building to the assurance of quality ***data*** first and foremost
- As such, based on this new approach, NGS still anticipates the release of all data, and limited tools, by the **middle of 2025**.

Site	Targeted Users	Description
Live: geodesy.noaa.gov (www.ngs.noaa.gov)	All NSRS users	•Holds the "current NSRS" until FGCS vote to replace the "current NSRS" with the "modernized NSRS"
Beta: beta.ngs.noaa.gov	Anyone who wants to test new frames or tools	•Will hold "modernized NSRS" before switch •Products assumed to be complete and correct •For testing •Subject to change or deletion
Alpha: alpha.ngs.noaa.gov	Vendors or software developers	•"Incomplete, early, possibly incorrect" •Not everything will go on alpha

THANK YOU!

*use any major search engine: "NGS advisors"
https://geodesy.noaa.gov/ADVISORS/

Dan Determan
Northwest Regional Geodetic Advisor
dan.determan@noaa.gov
206-526-6874

Thank You

Again, what is replacing NAVD 88? ***North American-Pacific Geopotential Datum of 2022 or NAPGD2022**

While the focus today is on NAVD 88, I'm going to talk about the effort to replace both NAD 83 and NAVD 88 because in many ways they are **connected.**

NSRS Modernization:

1. First, we are replacing the horizontal datum - NAD 83 - with **four new reference frames**:
   1. North American Terrestrial Reference Frame of 2022 (NATRF2022);
   2. Caribbean Terrestrial Reference Frame of 2022 (CATRF2022);
   3. Pacific Terrestrial Reference Frame of 2022 (PATRF2022); and
   4. Mariana Terrestrial Reference Frame of 2022 (MATRF2022)
2. Second, we are replacing the **vertical datum** - NAVD 88 - with a new geopotential datum.
   - It will be called the North American-Pacific Geopotential Datum of 2022 or **NAPGD2022**.
   - It will include a new geoid model - **GEOID2022** along with a few other products. (Deflection of Vertical, Surface Gravity Model, Intra-Frame Velocity Model, etc.)
   *Again, to get more technical details, there are technical publications called **Blueprints 1, 2** and **3** and an accompanying recorded webinar on our website.

*In addition to its new names and new primary elements, the modernized NSRS has **other significant changes.**

1. It is **geocentric** and defined by relationships to a **global/international** ideal frame;
   - This direct relationship to ITRF/IGS will improve the spatial framework for GNSS-based technology, such as UAS/UAVs
2. It is **time-dependent,** meaning coordinates in the new system will reflect where that position is at a specific epoch in time.
   - This introduction of time-dependency provides **better** ways to assess mark stability and to use the NSRS to monitor gradual change, such as subsidence or uplift.
3. Primarily **accessed via GPS technology** and a newly **refined semi-dynamic geoid model**
   - Accessing the datums **via GPS** will take advantage of advances in technology and increase convenience of access to NSRS while simultaneously reducing our dependence on physical marks in the ground that were deteriorating over time and being damaged/destroyed.
   - The **semi-dynamic geoid model** will allow us to account for gradual change in the earth's surface caused by things like subsidence or uplift.

Notable Improvements (in no order):

- Removes nation-wide tilt and bias in the present vertical datum
- Time-dependency provides better ways to access mark stability and use the NSRS to monitor gradual change such as subsidence or uplift
- New vertical datum aligns with international neighbors such as Canada, thus facilitating precise positioning in border areas
- GPS gateway opens consistent NSRS access to remote and isolated parts of the United States
- More systematic ties between NAPGD2022 and tidal datums will significantly improve the quality of geospatial data in coastal environments with sea level trends
- Direct relationships to ITRF/IGS improve the spatial framework for GNSS-based technology, such as UAS/UAVs