



Upcoming Changes to Federal Survey Control and Standards

Presented at
CCAO/CEAO Winter Conference
Columbus, OH
Dec 6, 2016

Presented by:

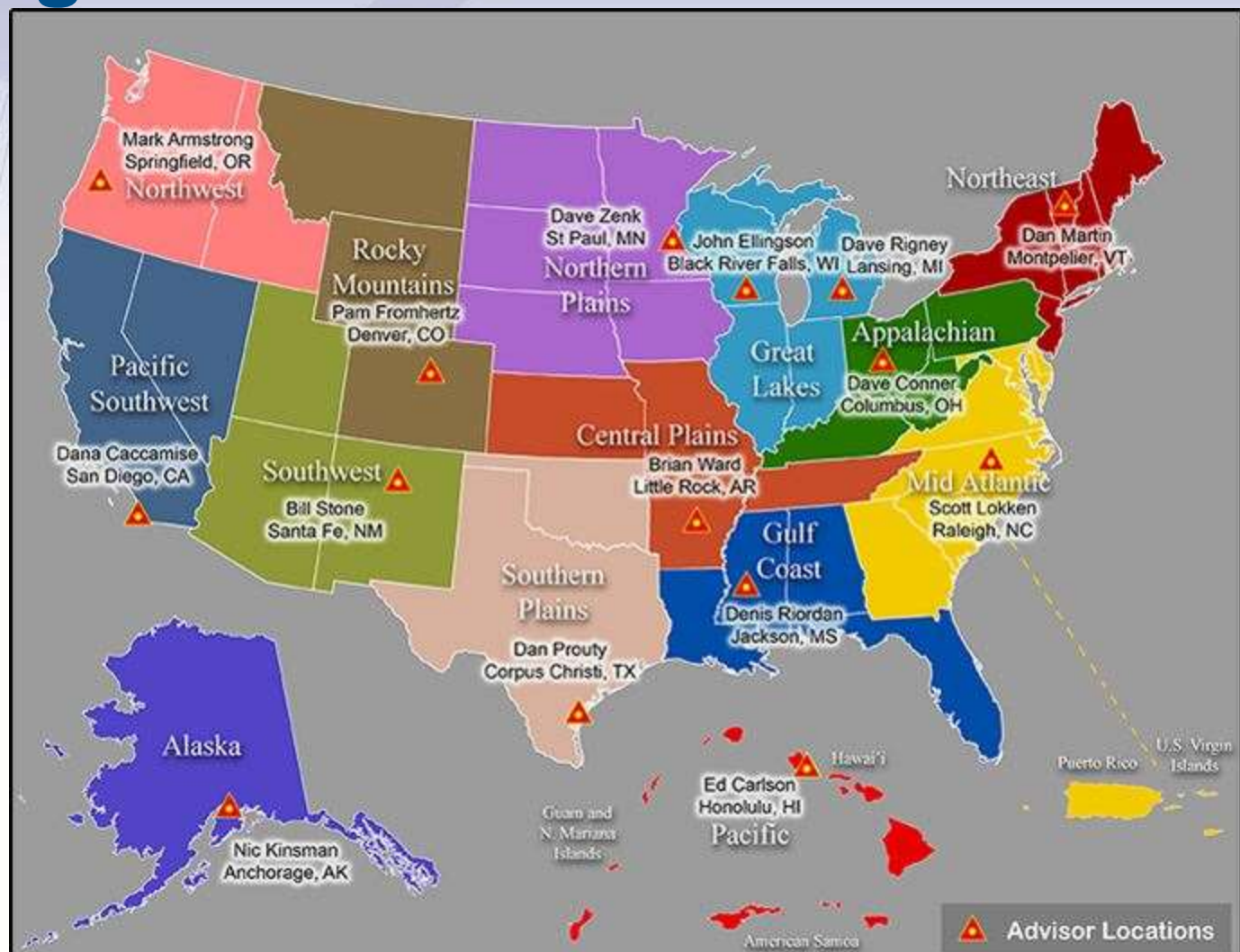
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National Geodetic Survey, NOAA

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NGS Regional Geodetic Advisors

Serve as liaison
between NGS
and the user
community



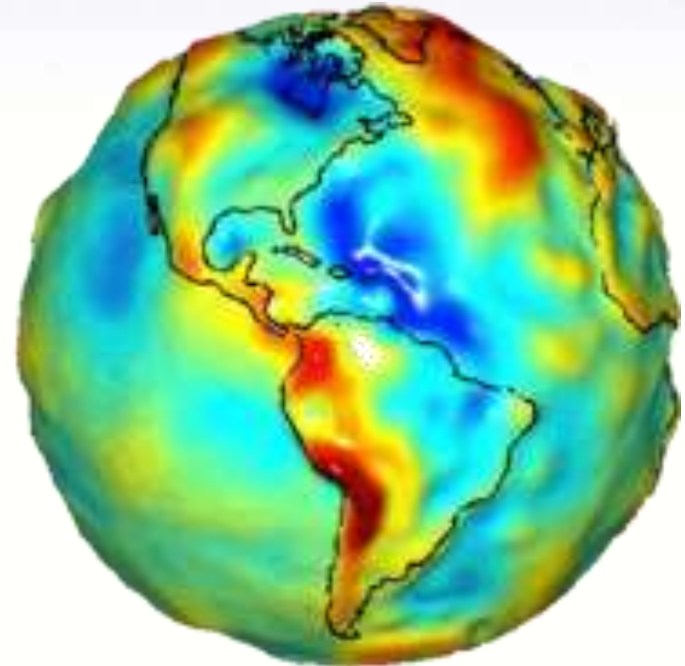
NGS is part of NOAA

a small part

... ~200 vs 10,000 people

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

The National Spatial Reference System (NSRS) is a consistent coordinate system that defines latitude, longitude, height, scale, gravity, and orientation throughout the United States.





National Geodetic Survey

Positioning America for the Future

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November 30, 2016

Notices

Save the date!

The National Geodetic Survey will host the 2017 Geospatial Summit April 24-25, 2017 in Silver Spring, Maryland 06.30.2016

2016 Experimental Geoid Models xGEOID16A and xGEOID16B Now Available 07.21.2016

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 12.10.2015

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

In The News

11/17/2016 - Chesapeake Bay Sentinel Site Cooperative Tour
NGS hosted a tour of two sites in the **Chesapeake Bay Sentinel Site Cooperative**- Jug Bay Wetland Sanctuary and Smithsonian Environmental Research Center- for more than a dozen NOAA scientists, managers, and educators to show high-accuracy geospatial infrastructure... [more](#)

11/10/2016 - Preparing for the International Great Lakes Datum (IGLD) 2020

Senior researchers from the National Geodetic Survey (NGS) and the Center for Operational Oceanographic Products and Services (CO-OPS) met with their Canadian counterparts at the 101st Meeting of the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data in Burlington, Vermont. They discussed the draft plan... [more](#)

11/03/2016 - New Educational Video on VDatum

NGS developed a new educational video in collaboration with The COMET ® Program to add to its growing video library suite, "NOAA's VDatum: Transforming Heights between Vertical Datums"... [more](#)

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Federal
Geodetic
Control
Subcommittee
of the **fgdc**

Looking for Bench Marks?

NGS 2017 Geospatial Summit

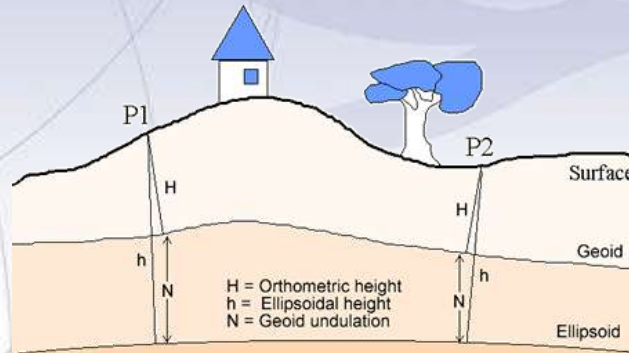
April 24-25

Coming in 2022: New Datums!
[Learn more...](#)



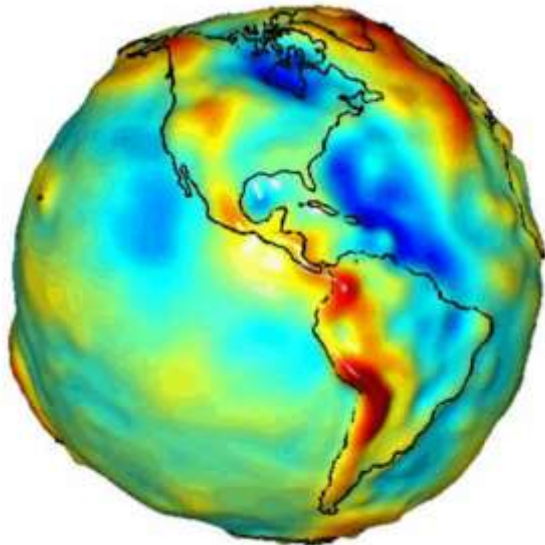
Geodetic Datums
[See our videos!](#)

What is Geodesy?



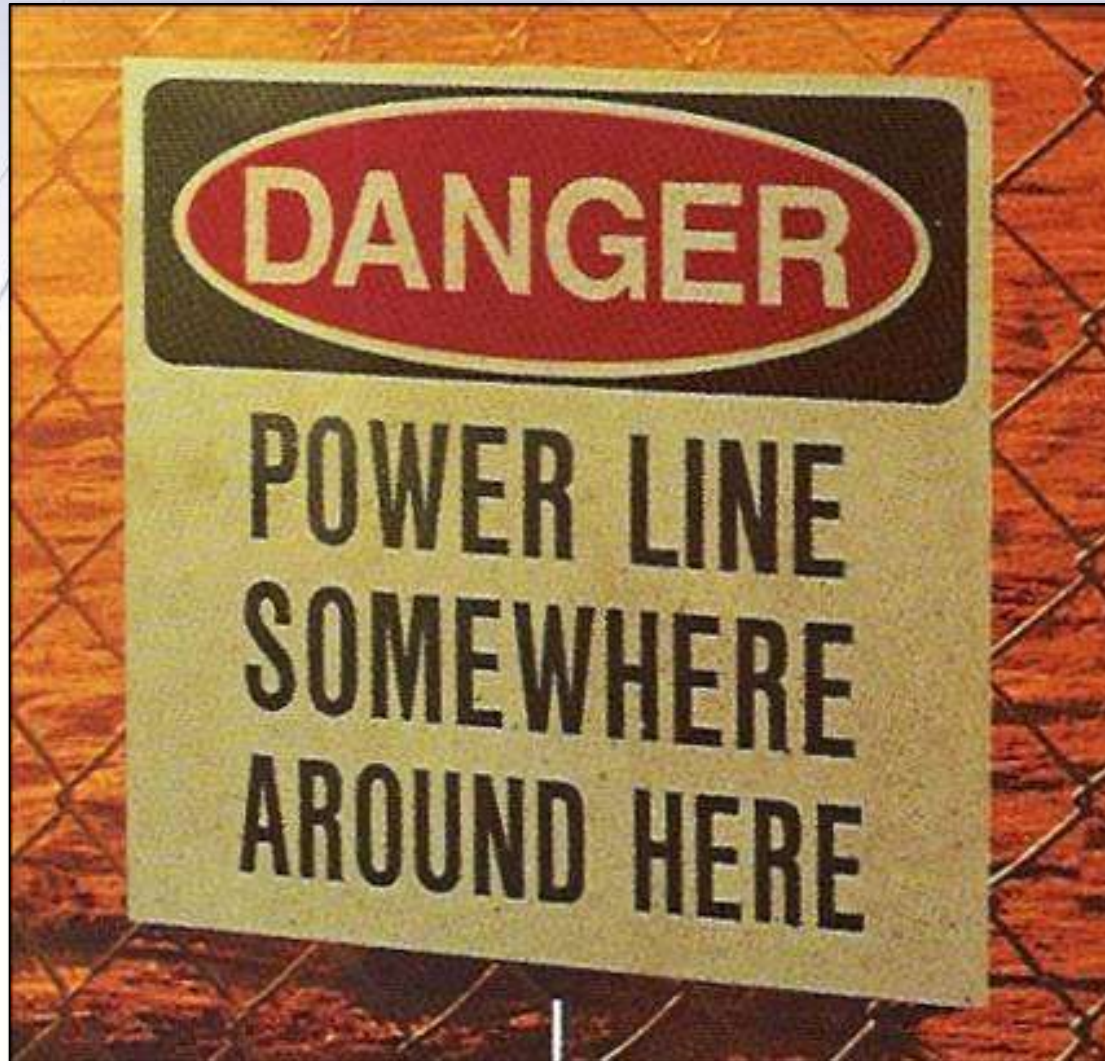
Geodesy is a foundational science that defines position & height

Why is Geodesy important?



The Earth has an irregular surface and is difficult to model.
Accurate positions are required for a wide variety of applications

Why should we care about *geodesy*?

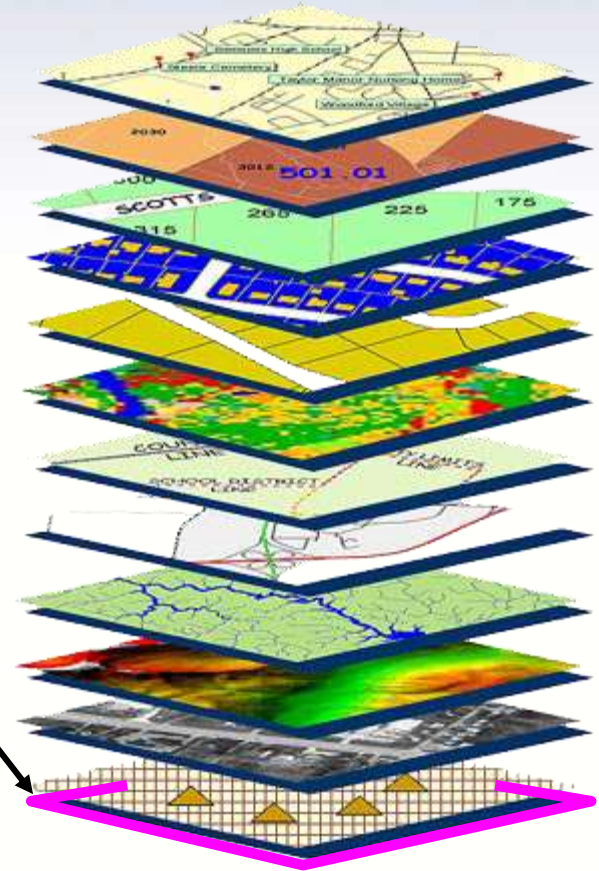


Accurate positioning begins with *accurate* coordinates

**Geodetic control is the
foundation for all geospatial
products...**



Source: Zurich-American Insurance Group



NGS and the NSRS continue to evolve

The National Geodetic Survey (NGS) has been around for a long time



1807

United States
Coast Survey

1878



1970



And the NSRS continues to evolve with us



Passive
Control
(Monuments)



Active
Control
(CORS)



SIDNEY est 2001

Ohio Geodesy Firsts

- **Geodesy program in the U.S.**, est. 1952 at OSU
- **Network GPS Project**, worldwide, Summit County 1983
- **Local government agency with GPS** survey capability, worldwide, at Franklin County early 1980's
- **Statewide Real Time GPS network**, 2004
- Others ... ?

IMPROVING POSITIONAL ACCURACY

NETWORK	TIME SPAN	NETWORK ACCURACY	LOCAL ACCURACY
NAD 27	1927-1986	10 METERS	1 part in 100,000
NAD83(86)	1986-1990	1 METER	1 part in 100,000
HARN	1990-1997	0.1 METER	B-order (1 part in 1 million) A-order (1 part in 10 million)
CORS	1996 -	0.01 meter	0.01 meter

Example Coordinate Shifts

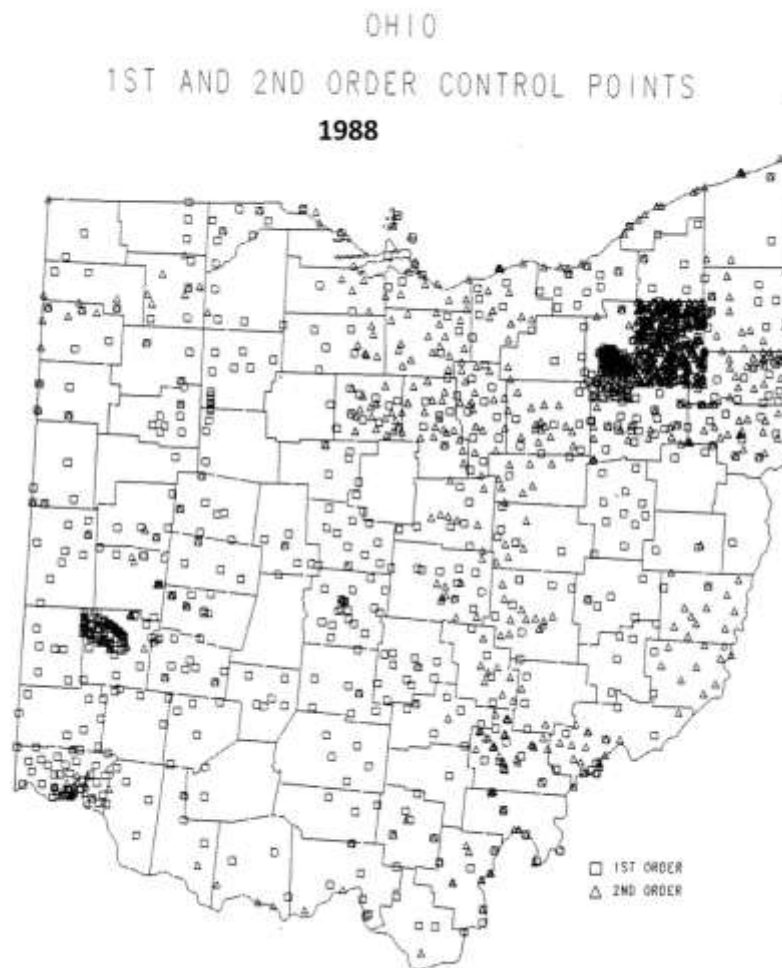
Actual shifts at central Ohio station SMITH (JY0742)

NAD 27 vs NAD 83 (1986)	~ 13 meters
NAD 83 (1986) vs NAD 83 (1995)	~ 20 cm
NAD 83 (1995) vs NAD 83 (2007)	~ 1.5 cm
NAD 83 (2007) vs NAD 83 (2011)	~ 2.3 cm

The future = ?

New datums, both horizontal and vertical

Horizontal control *published* by NGS



Prior to *most* GPS projects



Change due to GPS projects

PROFESSIONAL
SURVEYOR
December 2004 Vol. 24 No. 12
Magazine

RTK Blankets Buckeye State



A **GITC** PUBLICATION
AMERICA

Then came GPS CORS

Followed by RTK

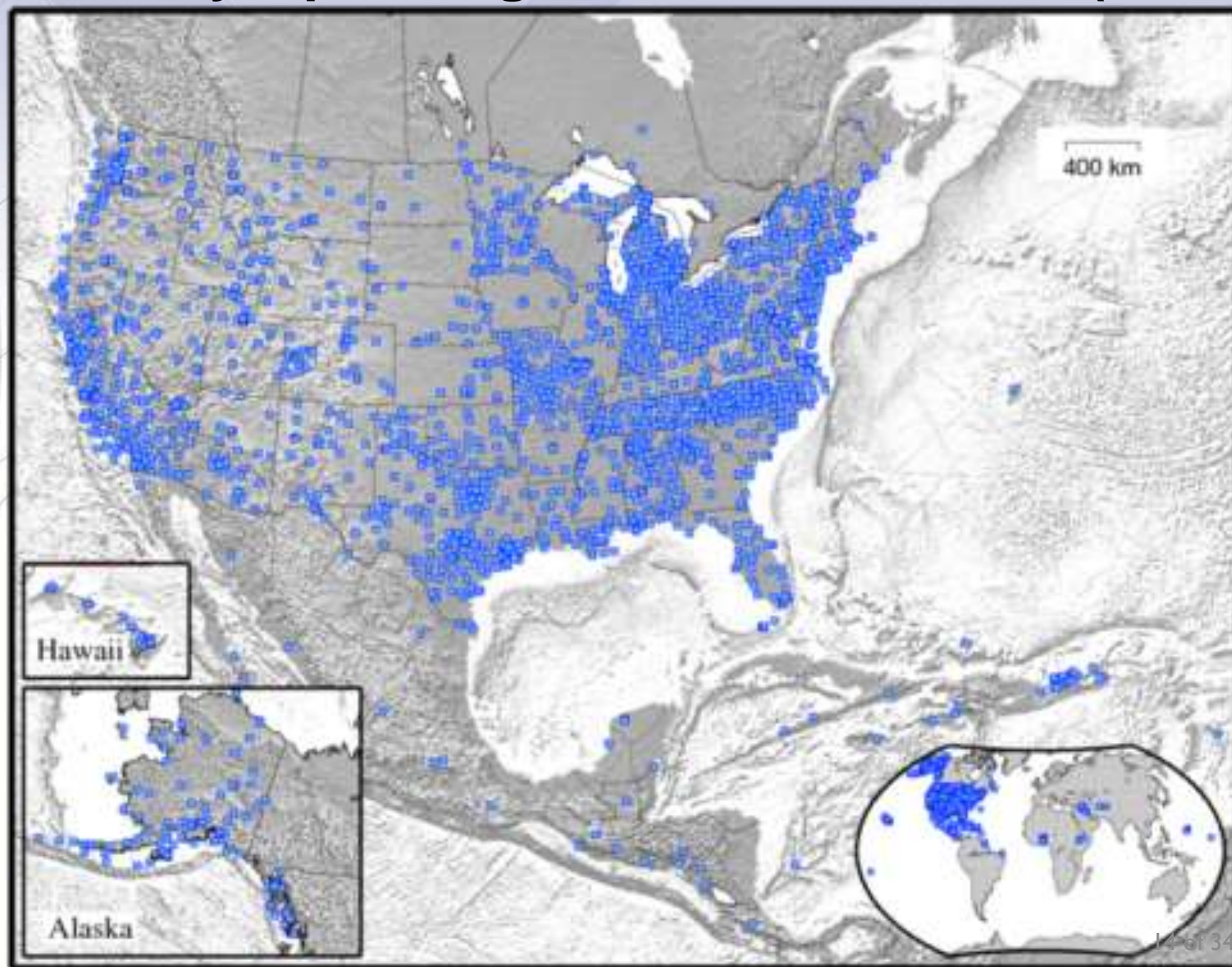
**Enabling cm *precision*
In Real Time ...**

**Anywhere,
Anytime!**

**Metadata ever more
important!**

Continuously Operating Reference Stations (CORS)

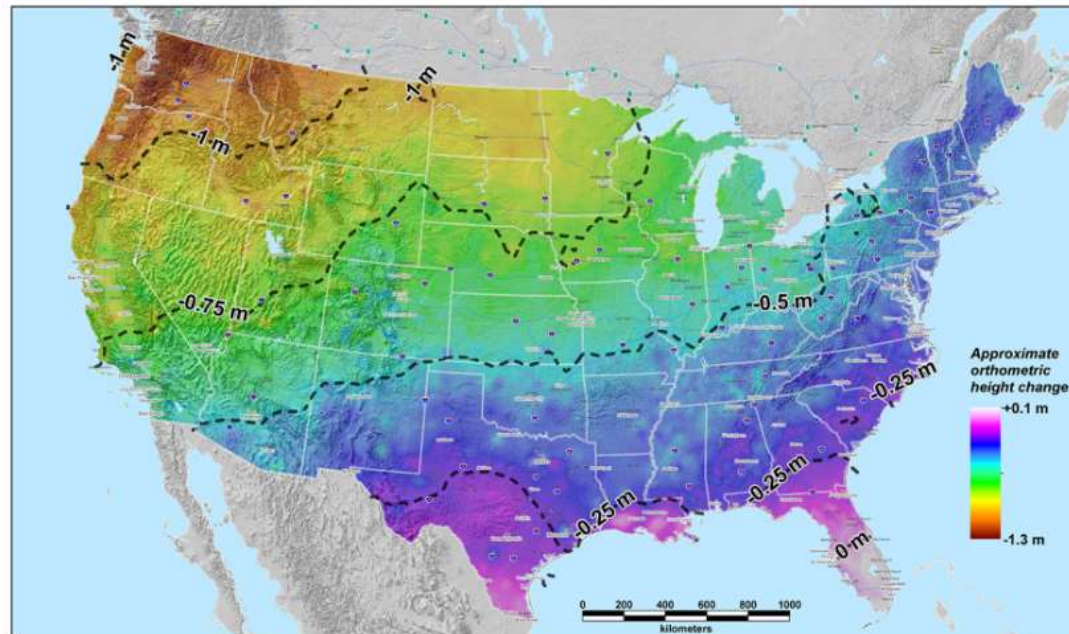
~ 2000
Stations



New Datums Are Coming in 2022

- **To replace NAD 83 and NAVD 88**
- **New geometric (horizontal) and geopotential (vertical) datums**
- **Realized through GPS and a geoid model**
- **Target: 2-centimeter accuracy** relative to sea level (orthometric heights) using GPS/GNSS and a geoid (gravity) model from NGS' *GRAV-D* project.
- **NGS will provide transformation tools** to easily transform between new and old datums.

Approximate predicted change from NAVD88 to new vertical (geopotential) datum



Predicted change estimated as NAVD88 "zero" (datum) surface minus NGS gravimetric geoid



New Datums

National Geodetic Survey

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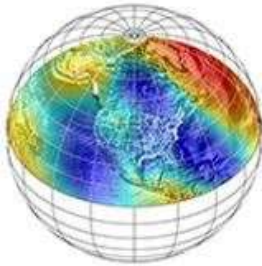
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Replacing NAVD 88 and NAD 83

NAVD 88 and NAD 83 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.

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Why is NGS replacing NAD 83 and NAVD 88?

NAVD 88 and NAD 83, 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 defining new horizontal and vertical datums.

Specifically, NAD 83 is non-geocentric by about 2.2 meters. Secondly, NAVD 88 is both biased (by about one-half meter) and tilted (about 1 meter coast to coast) relative to the best global geoid models available today. Both of these issues derive from the fact that both datums were defined primarily using terrestrial surveying techniques at passive geodetic survey marks. This network of survey marks deteriorate over time (both through unchecked physical movement and simple removal), and resources are not available to maintain them.

The new reference frames (geometric and geopotential) will rely primarily Global Navigation Satellite Systems (GNSS) such as the Global Positioning System (GPS) as well as an updated and time-tracked geoid model. This paradigm will be easier and more cost-effective to maintain. Read our white paper for more information.



**NGS
2017
Geospatial
Summit**

April 24-25





New Datum: What to expect

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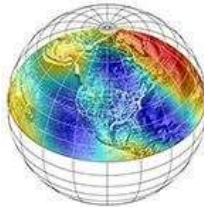
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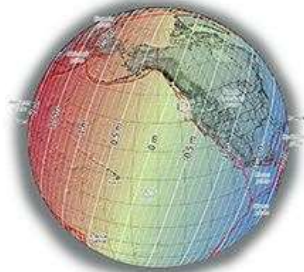
2010 Summit

Your coordinates will change

The magnitude of change will vary based on the datum you are using and your geographic location. View the maps below to see the approximate horizontal and height changes when the new reference frames are adopted.

You can also use online tools to calculate the approximate change in your area. Use **HTDP** to calculate approximate horizontal change and **xGEOID** models to approximate vertical change.

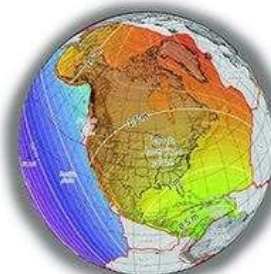
Approximate Ellipsoid Height Change



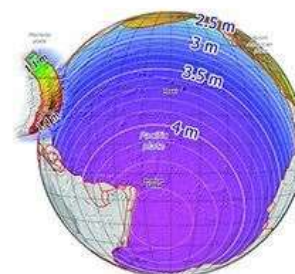
Approximate Orthometric Height Change



Approximate Horizontal Change North American Plate



Approximate Horizontal Change Pacific Plate



Stay Tuned!

Other changes regarding how you access the new datums and transform existing data will await decisions to address challenging technical issues including:

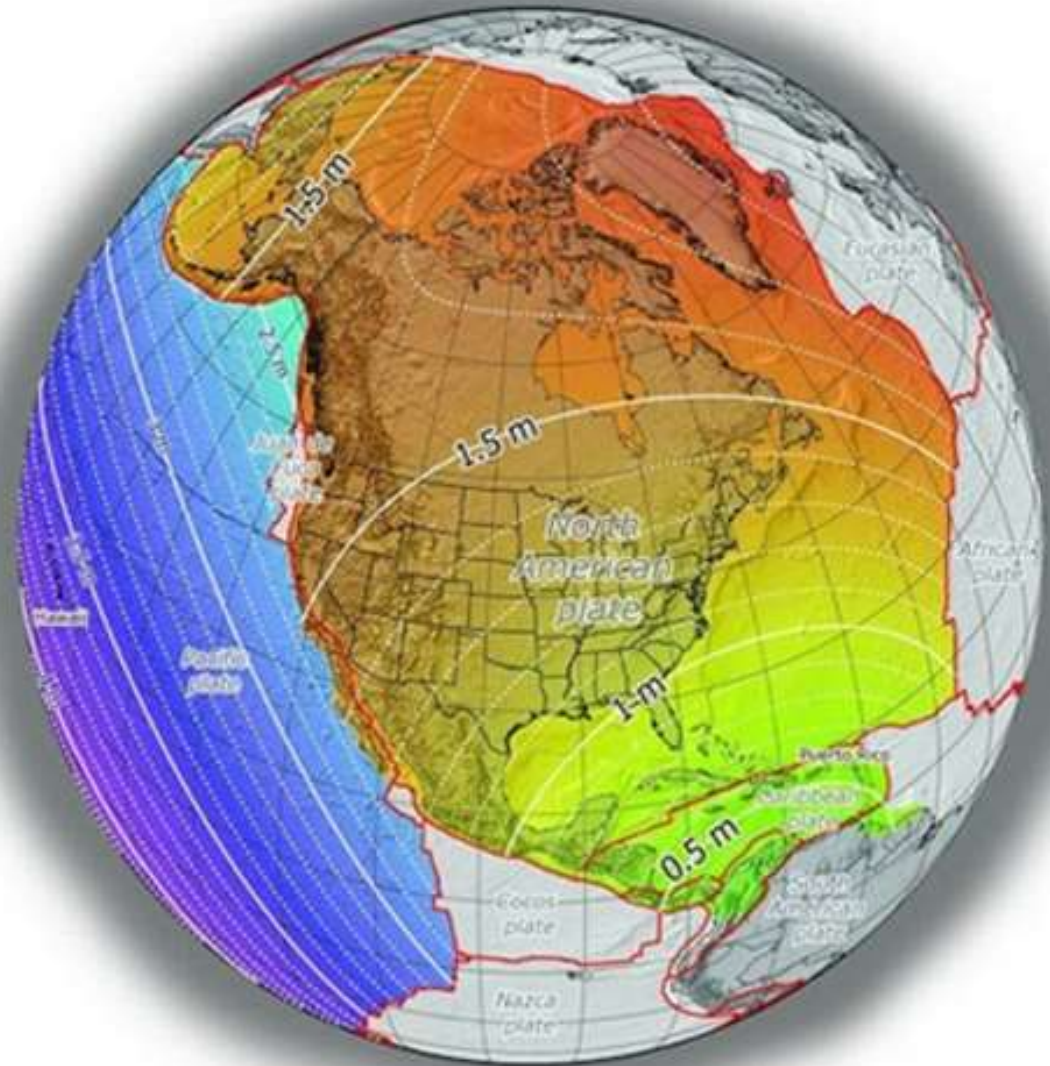
- Adopting a USA-specific reference frame with "plate-fixed coordinates" or "temporal coordinates" using International Terrestrial Reference Frame (ITRF) coordinates and velocities.
- Applying plate rotations models for all applicable frames.
- Determining Continuously Operating Reference Stations or CORS velocities.

How will the new datums affect you?

Published Coordinates Will Change

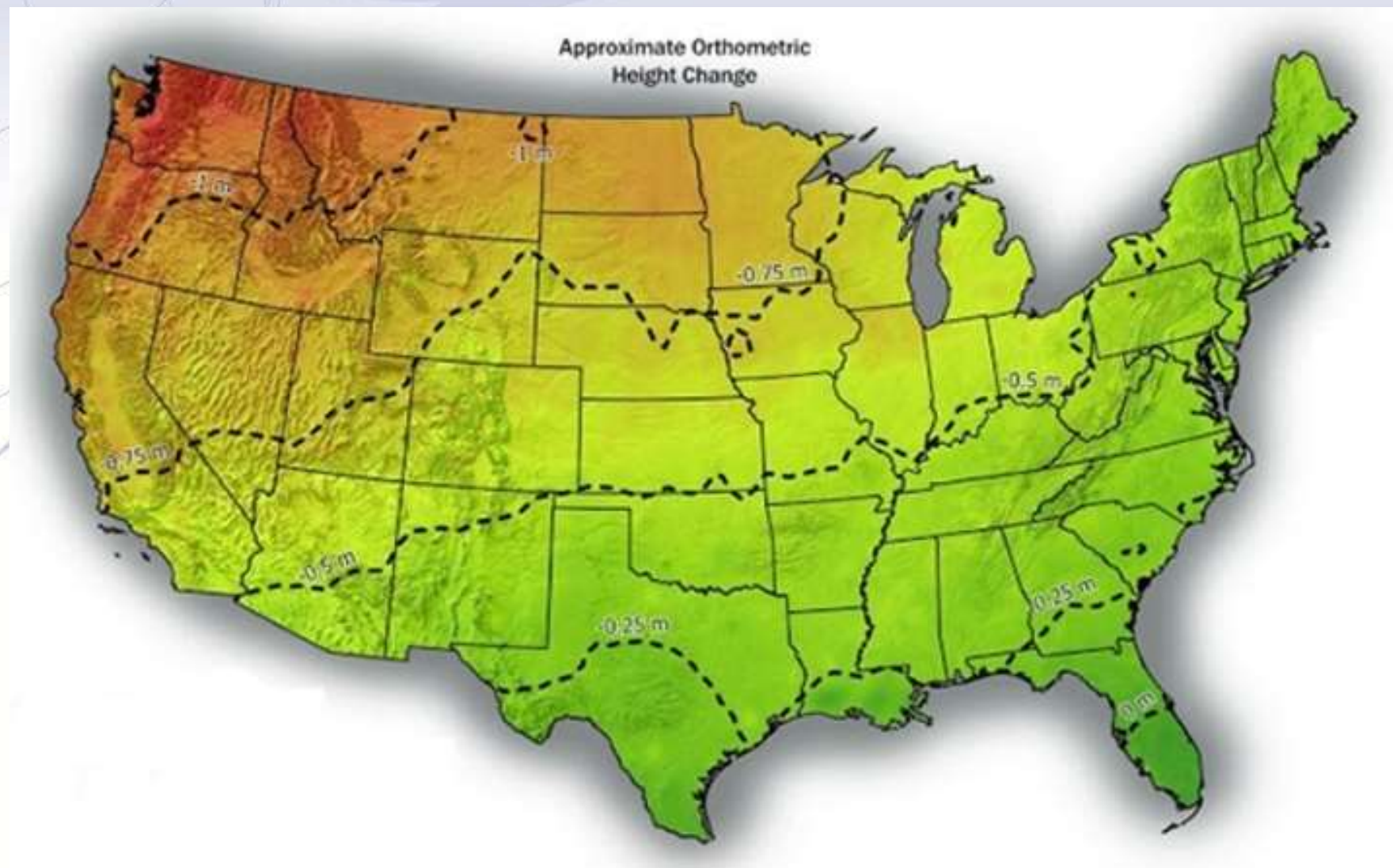
The new geometric datum will change latitude, longitude, and ellipsoid height by 1 - 2 meters (3 - 6 ft)

Approximate Horizontal Change
North American Plate



How will the new datums affect you?

Heights Will Change on average 50 cm (1.6 ft)





New Datums: Get Prepared

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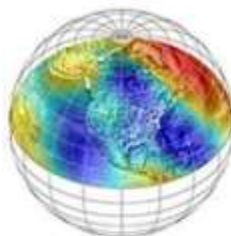
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Move to newest realizations.

Tools will be available to transform your data to the new datums from NAVD 88 and the newest realization of NAD 83. The most recent realization for latitude, longitude and ellipsoid height is NAD 83(2011) epoch 2010.00. With respect to orthometric heights, you should transform any legacy data from NGVD 29 to NAVD 88 (see **VERTCON** accuracy in your area).

Obtain precise ellipsoid heights on NAVD 88 bench marks.

Your **adding GPS on Bench Marks** will improve the transformation tool for the new datums.

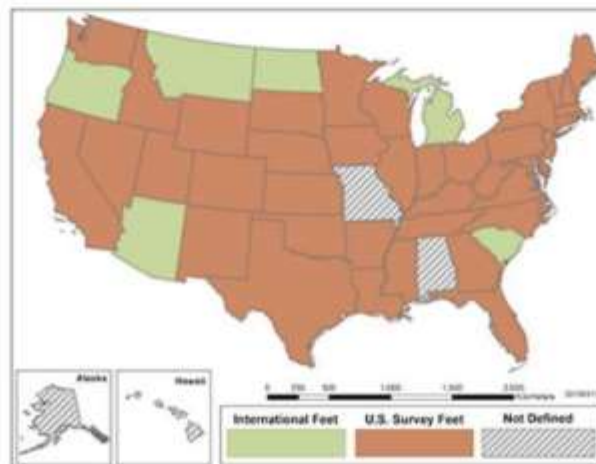
Require/provide complete metadata for all mapping contracts.

Knowing the datums and epochs for your geospatial files will simplify your datum transformations.

Prepare to change legislation, as needed.

Currently, 48 states have legislation defining their state-based coordinate system, specifically referring to NAD 83 by name. In 2022, NAD 83 will be replaced, and its replacement will not be named NAD 83. NGS, the National Society of Professional Surveyors (NSPS), and the American Association of Geodetic Surveying (AAGS) have formed a joint committee to work on new template legislation to aid states in transitioning their legislation to new wording. **See our flyer to learn more.**

State Plane Coordinate System (SPCS83) Legislated Units



What about state plane coordinates?

NGS will likely define State Plane Coordinates (SPCs) through the same projections and zones associated with NAD 83. See our **FAQ** to learn more.

SPCs are converted from meters using the conversion factor as defined by the individual states who have requested that NGS publish SPCs in feet. The two conversion factors are:

The International Foot
1 inch = 2.54 centimeters

The U.S. Survey Foot
1 meter = 39.37 inches

Prepare to change legislation as needed

Ohio Revised Code Ch 157:
Ohio Coordinate System



Your NAD 83-Based State Plane-Legislated Coordinates **Will Not Be Maintained** after 2022!

What will you and your fellow professionals do?
Panic? Ignore the Issue? or Act?
Please let us know!

What is changing?

The North American Datum of 1983 (NAD 83) will be replaced in 2022. The new datum will have a different name.

The North American Vertical Datum of 1988 (NAVD 88) will also be replaced in 2022. Its replacement will also have a new name.

Expected horizontal shifts from NAD 83 to the new datum are in the 1-2 meter range. The National Geodetic Survey will provide a coarse, map-grade transformation tool (such as NADCON and GEOCON) to connect NAD 83 with the new datum.

Who will be affected?

All states and territories will be transitioned to the new datums.

Forty-eight states have a state-specific coordinate system law tied to NAD 83.

Your state law will not reflect the National Spatial Reference System after 2022.

Who can help?

The National Geodetic Survey (NGS), the National Society of Professional Surveyors (NSPS) and the American Association for Geodetic Surveying (AAGS) are here to help your state make these changes in legislation!

You can help by understanding your own state's laws and how these changes will impact you.

Should you change or modify your state law?

NGS, NSPS and AAGS believe it would benefit state surveyors and mapping professionals for laws or regulations to reflect the latest federal geodetic infrastructure, namely **the National Spatial Reference System.**

Why should you change or modify your state law?

1. Federal agencies will adopt the new datum, so national products like **Federal Emergency Management Agency (FEMA) flood insurance rate maps** will no longer reference NAD 83, nor NAVD 88. Using the current (most updated) datum will avoid confusion and increase consistency with federal engineering or constructions projects.

2. Federal resources will no longer be used to maintain or correct issues with data on superseded datums. **Instead, NGS will focus on supporting users of the updated National Spatial Reference System (NSRS).**

3. More geospatial data is being collected and shared every day. A consistent and regularly updated NSRS will provide greater efficiency across surveying and mapping sectors.

What do you think?

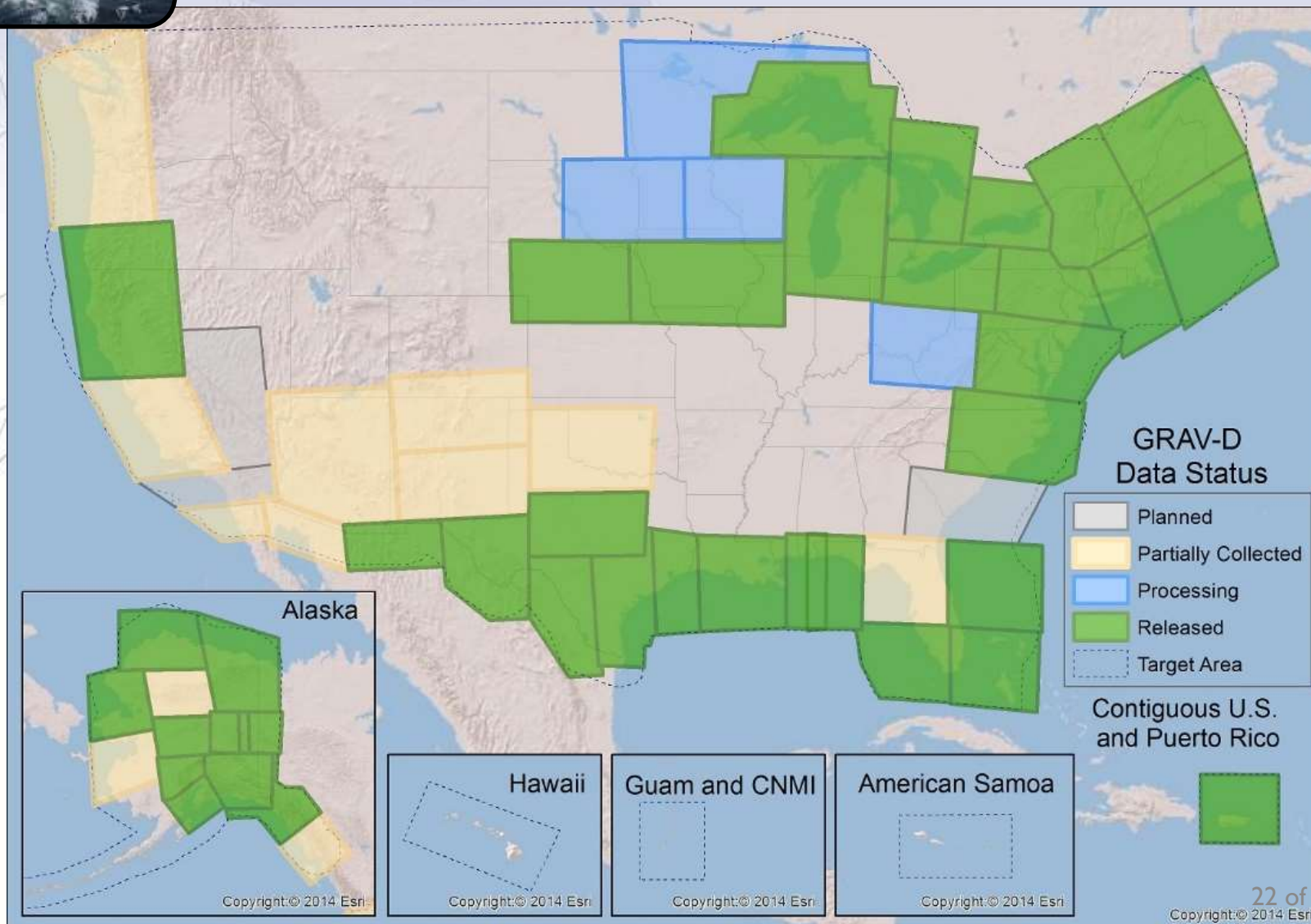
We welcome your feedback! Please provide any feedback you like to one of our committee members, below.

NSPS/AAGS/NGS Advisory Committee on National Spatial Reference System Legislation

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





New Datums: Watch Videos

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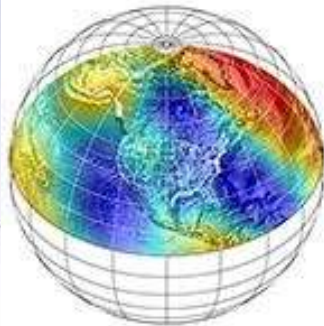
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What are Geodetic Datums

Learn the basic concepts behind geodetic datums, where they are used, and why it is important to know about and use the correct datums.



How Were Geodetic Datums Established?

Explore the history of geodetic datums in the United States, and how they were established at a national level to assure consistency across mapping applications.



What is the Status of Today's Geodetic Datums?

Examine the use of the current primary geodetic datums used in the US, NAD 83 and NAVD 88, the challenges in maintaining these datums, and the inconsistencies that arise when they are used together with the latest satellite-based mapping technologies.

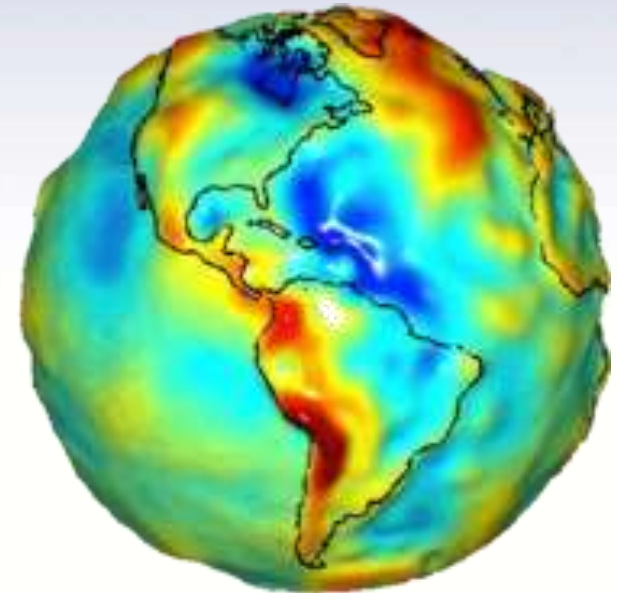


What's Next for Geodetic Datums?

Look at current plans for developing more accurate horizontal and vertical datums, (referred to respectively as geometric and geopotential datums), the expected benefits and impacts, and the importance of preparing now to adopt these new datums.

View more NGS videos by visiting our [NGS Video Library](#).

Questions?



Resources are available and continue to be developed at *geodesy.noaa.gov*