




New Datums are Coming in ~~2022~~ (2024-2025)




National Geodetic Survey

Positioning America for the Future

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New Datums

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Events

- Industry Engagement
- 2019 Summit
- 2017 Summit
- 2015 Summit
- 2010 Summit

Delayed Release of the Modernized NSRS

NOAA's National Geodetic Survey (NGS) is announcing a delay in the release of the modernized National Spatial Reference System (NSRS).

In 2007, NGS began planning for the modernized NSRS, acquiring its first airborne gravimeter, creating and initiating the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) project and by 2008 had codified its modernization plans into a Ten Year Plan. At that time, the target completion date was 2018. By 2013, that date seemed unlikely, due to both the broadening of the GRAV-D coverage area and the experience of five years of operational planning and execution.

In 2013, NGS revised its 2008 Plan, and targeted 2022 as the date of the release of the modernized NSRS. This date was reinforced with a 2018 Strategic Plan revision. By 2017, confidence in hitting the 2022 target was high enough to reach final agreement with Canada and Mexico on a naming convention for certain components, to include "2022" in their names.

Since 2017, operational, workforce, and other issues have arisen and compounded, causing NGS to recently re-evaluate whether a successful roll-out by 2022 is possible. The most significant impacts have been in workforce hiring and retention, and in meeting GRAV-D data collection milestones, which underpin the NSRS modernization efforts.

NGS is currently conducting a comprehensive analysis of ongoing projects, programs, and resources required to complete NSRS modernization and will continue to provide regular updates on our progress. To get the latest news on NSRS modernization and track our progress, subscribe to **NGS News** or visit our **"New Datums" web pages**.

Further details, and more answers are available on this [FAQ](#)

Website Owner: National Geodetic Survey / Last modified by NGS Infocenter Jun 22 2020

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What's Being Replaced?

Horizontal

- **NAD 83(2011)**
- NAD 83(PA11)
- NAD 83(MA11)

Latitude

Longitude

Ellipsoid Height

State Plane Coordinates

Vertical

- **NAVD 88**
- PRVD 02
- VIVD09
- ASVD02
- NMVD03
- GUV D04
- IGLD 85

Heights

SPCS2022 in North Carolina

- New State Plane Coordinate System in 2022
 - Will replace SPCS 83
 - Referenced to new terrestrial reference frames
- Two conflicting desires for SPCS2022 coordinates:
 - Change coordinates as little as possible
 - Preserve systems based on SPCS 83 coordinates (sft)
 - E.g., parcel numbering system, FEMA flood mapping tiles
 - Change coordinates by large amount
 - Reduces confusion with SPCS 83 coordinates
 - Satisfies NGS policy on SPCS2022

SPCS2022 characteristics

- Characteristics pertinent to North Carolina:
 - Minimize distortion at **ground surface**
 - Lambert Conformal Conic: **1-parallel definition**
 - Central parallel defined to **nearest arc-minute**
 - Central parallel scale ≤ 6 **decimal places**
 - Coordinates must change $\geq 10,000$ m (**$\sim 33,000$ ft**)
 - Grid origins rounded to **nearest 1000 m**

New Reference Frame Names

North American Datum of 1983 (NAD83) becomes:

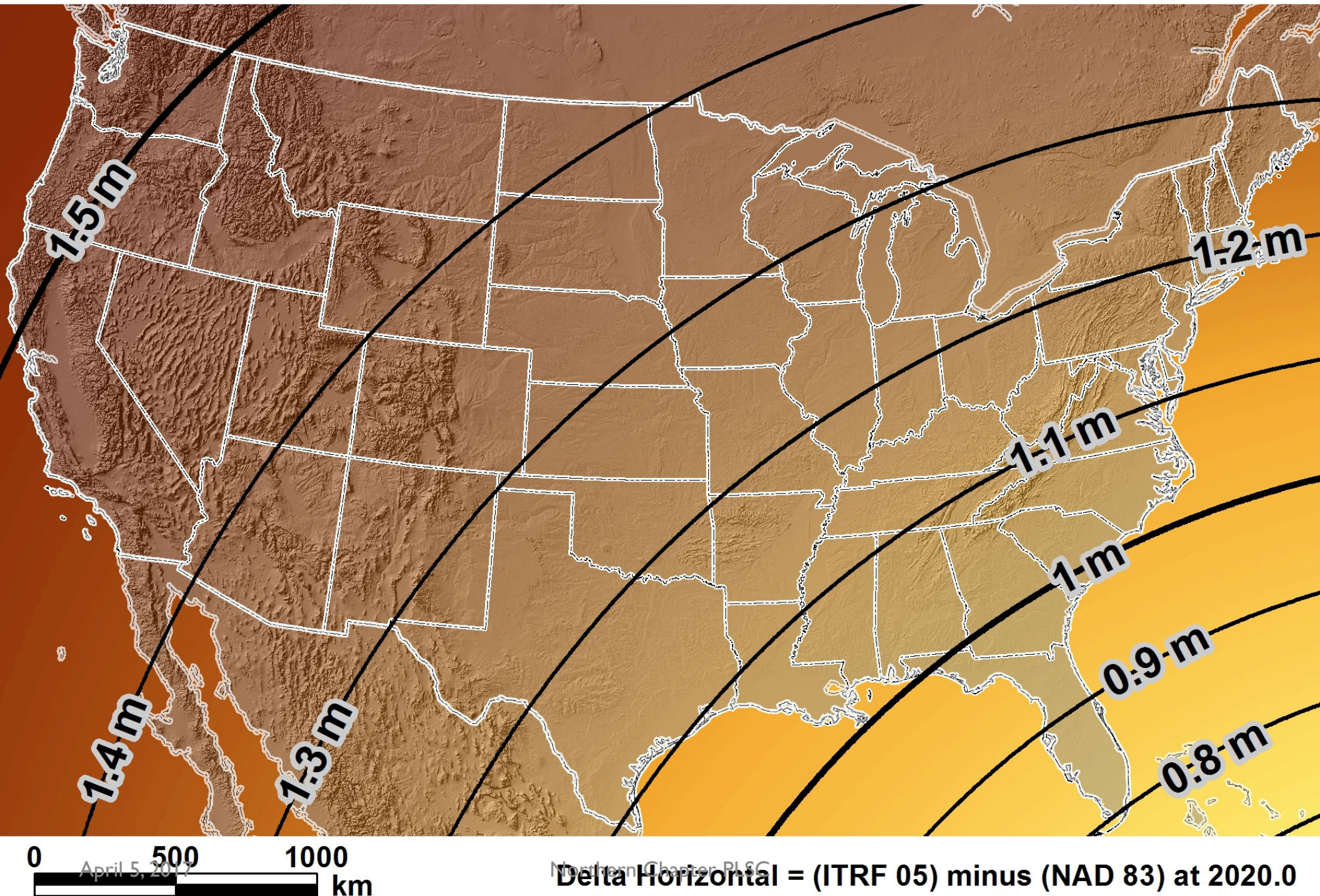
- North American Terrestrial Reference Frame (NATRF2022)
- Caribbean Terrestrial Reference Frame (CATRF2022)
- Mariana Terrestrial Reference Frame (MATRF2022)
- Pacific Terrestrial Reference Frame (PATRF2022)

North American Vertical Datum of 1988 (NAVD88) becomes:

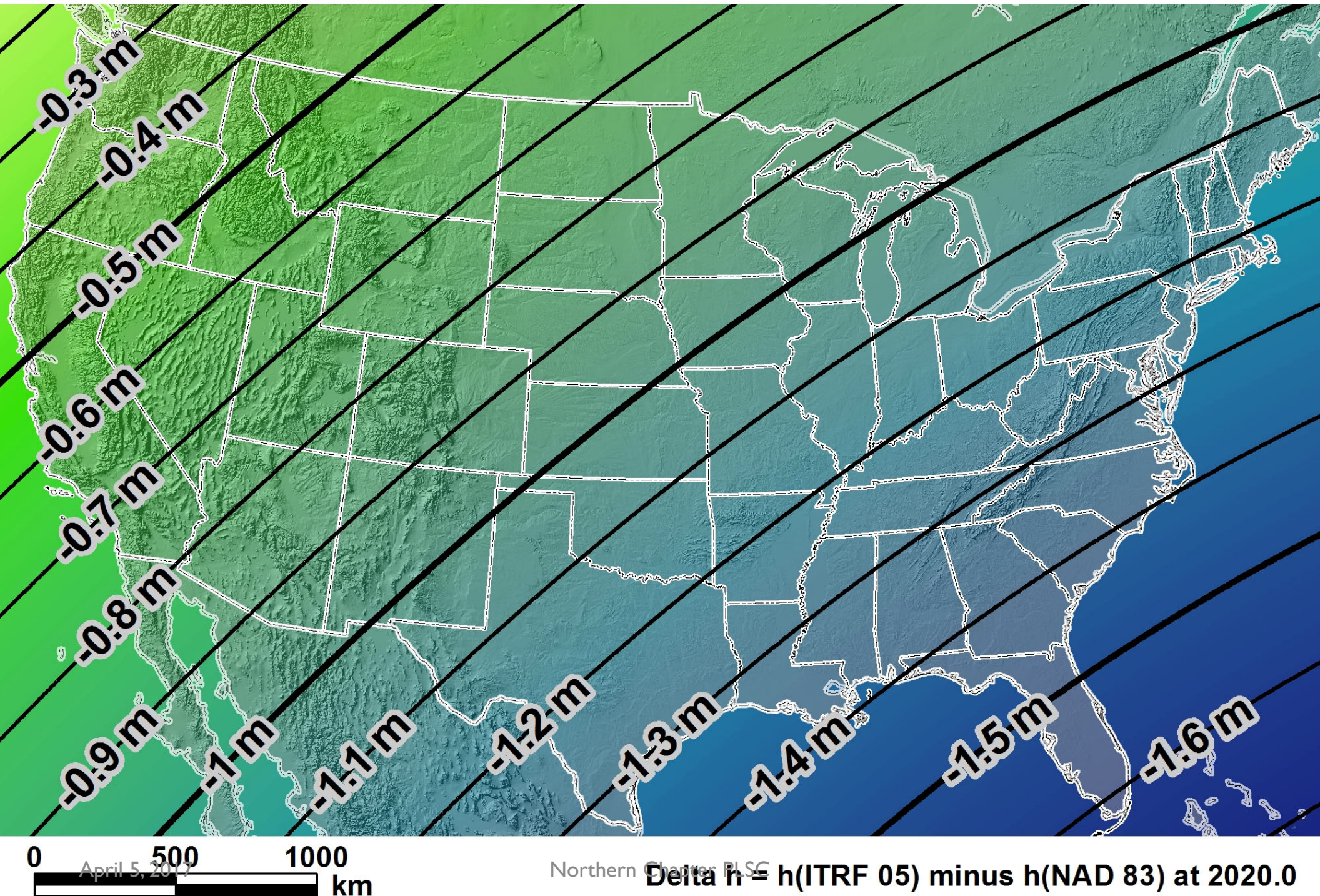
- North American-Pacific Geopotential Datum of 2022
(NAPGD2022)

(Realized by GEOID2022)

Estimated horizontal change from NAD 83 to new geometric datum

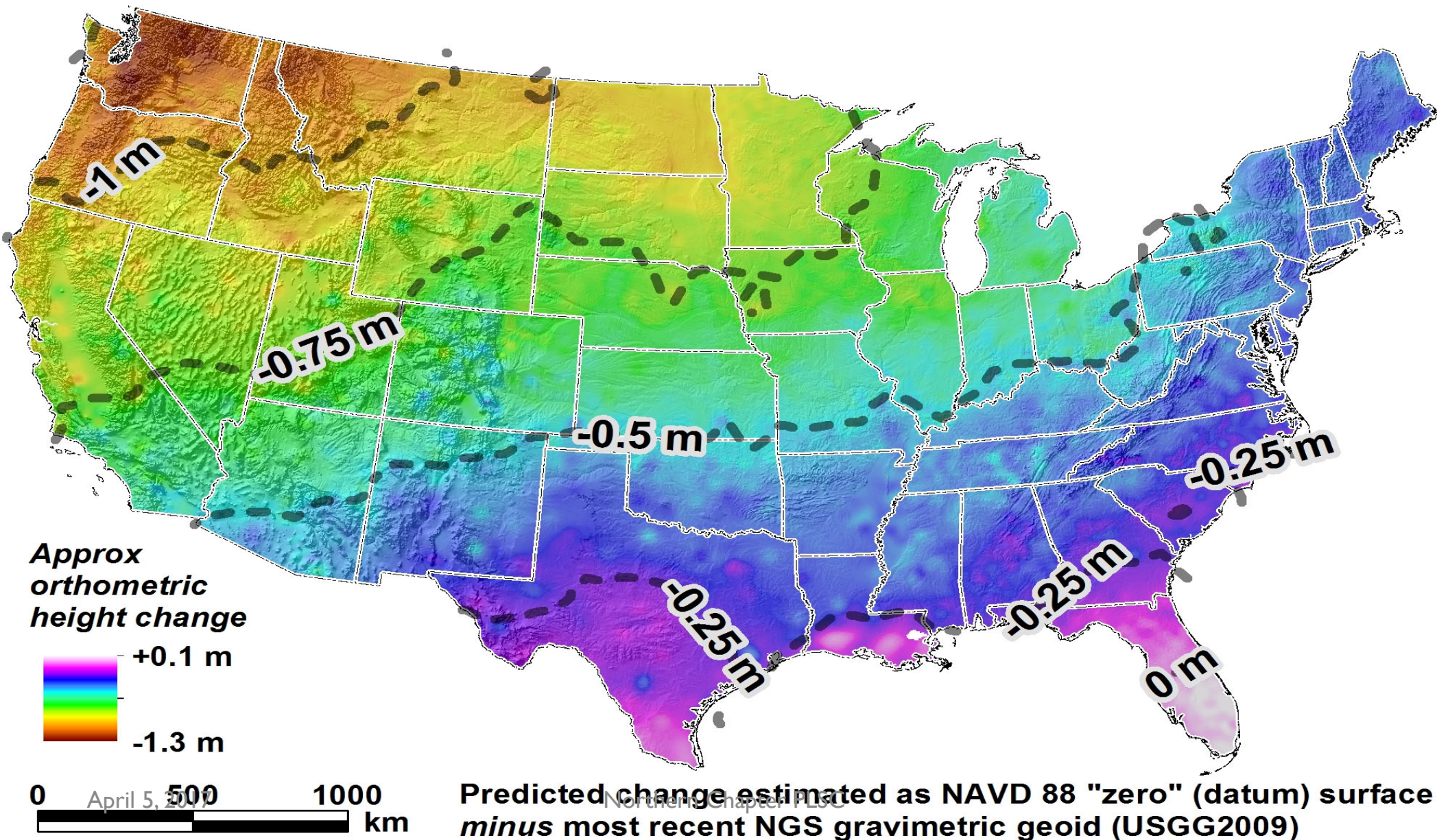


Estimated ellipsoid height change from NAD 83 to new geometric datum

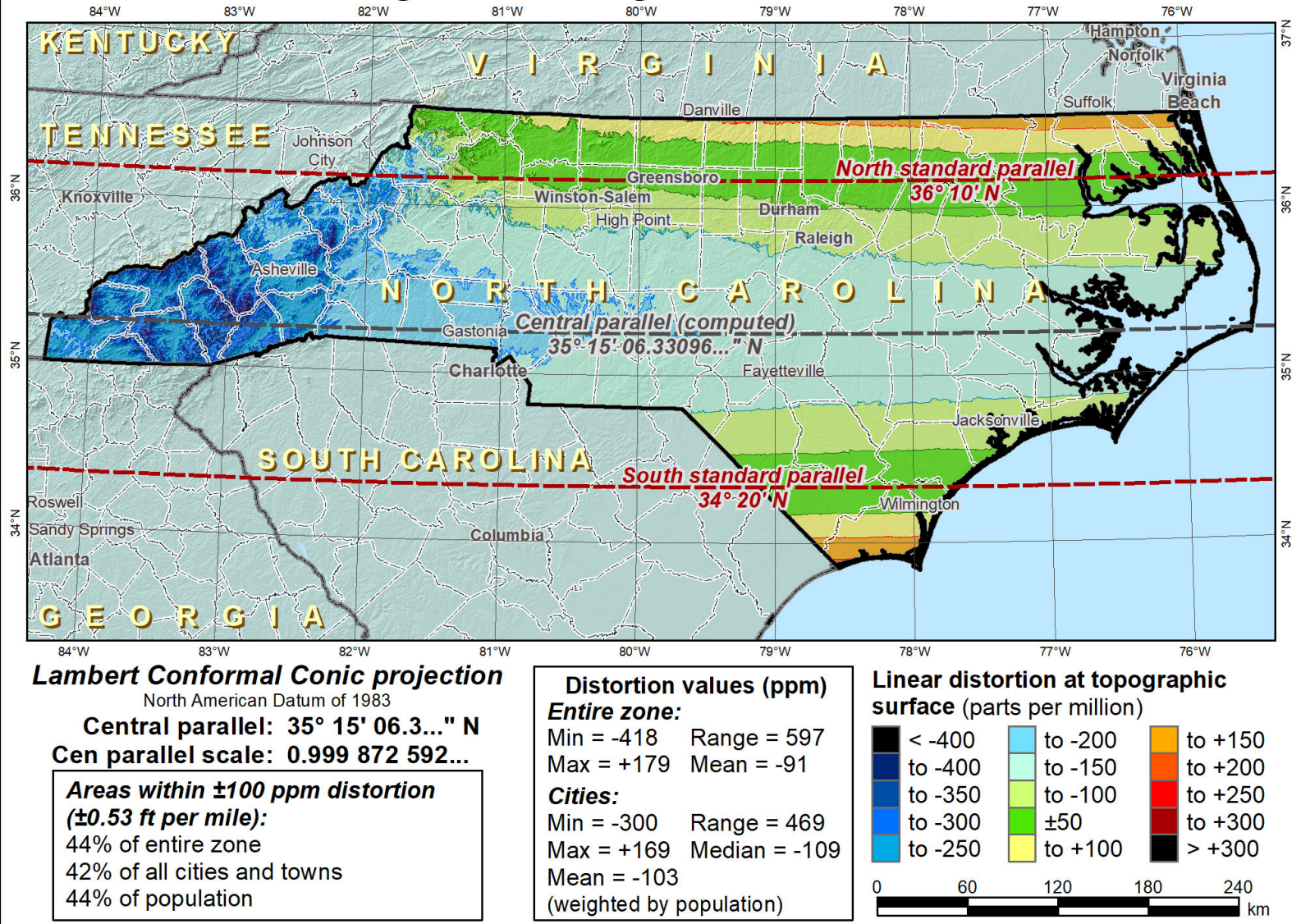


New Vertical Datum

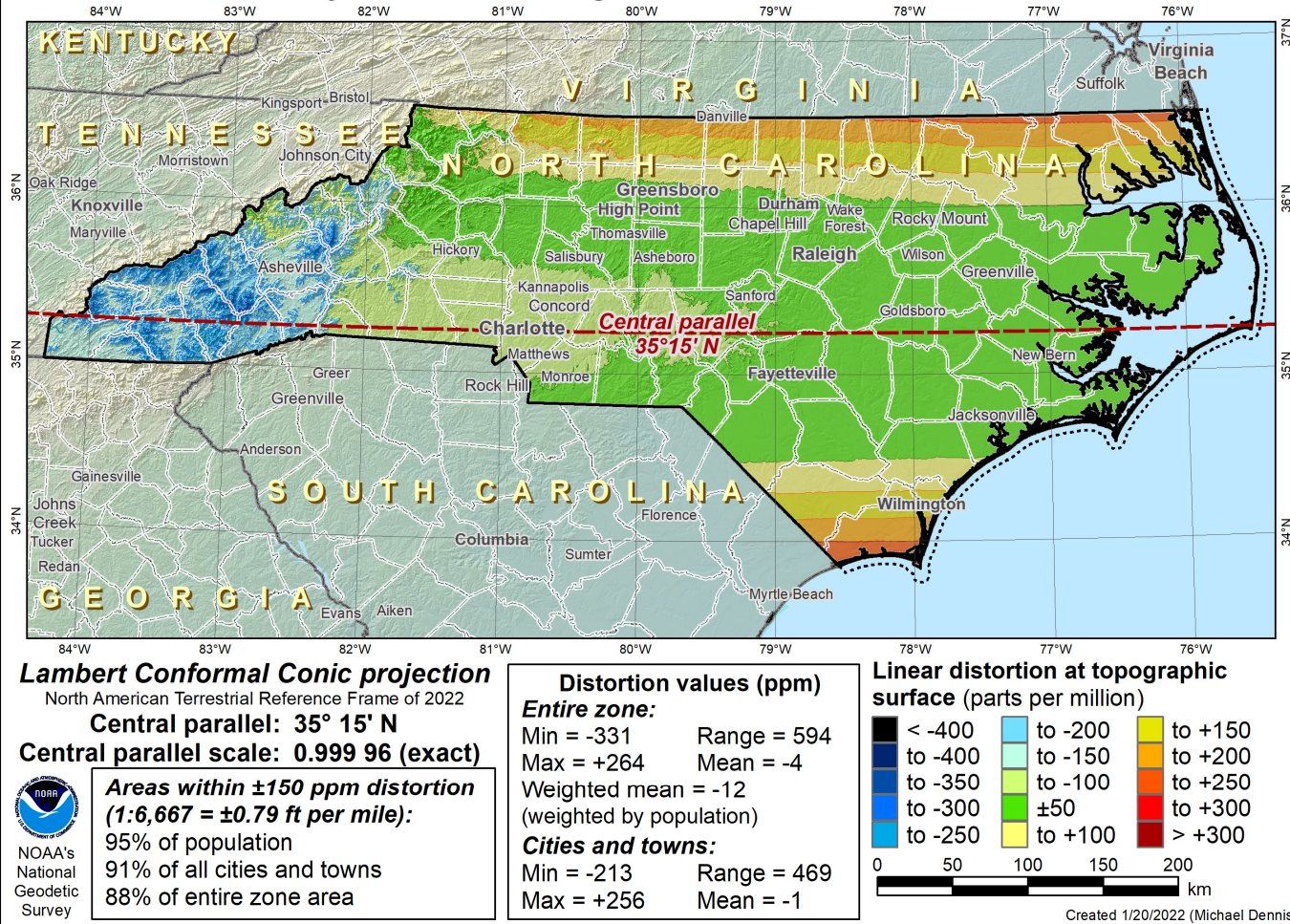
Approximate predicted change from NAVD 88 to new vertical datum



Existing SPCS 83 design: North Carolina Zone



Preliminary SPCS2022 design: North Carolina Statewide Zone



Lambert Conformal Conic projection (1-parallel)

Central parallel and latitude of grid origin: 35°15'N

Central meridian: 281°00'E (79°00'W)

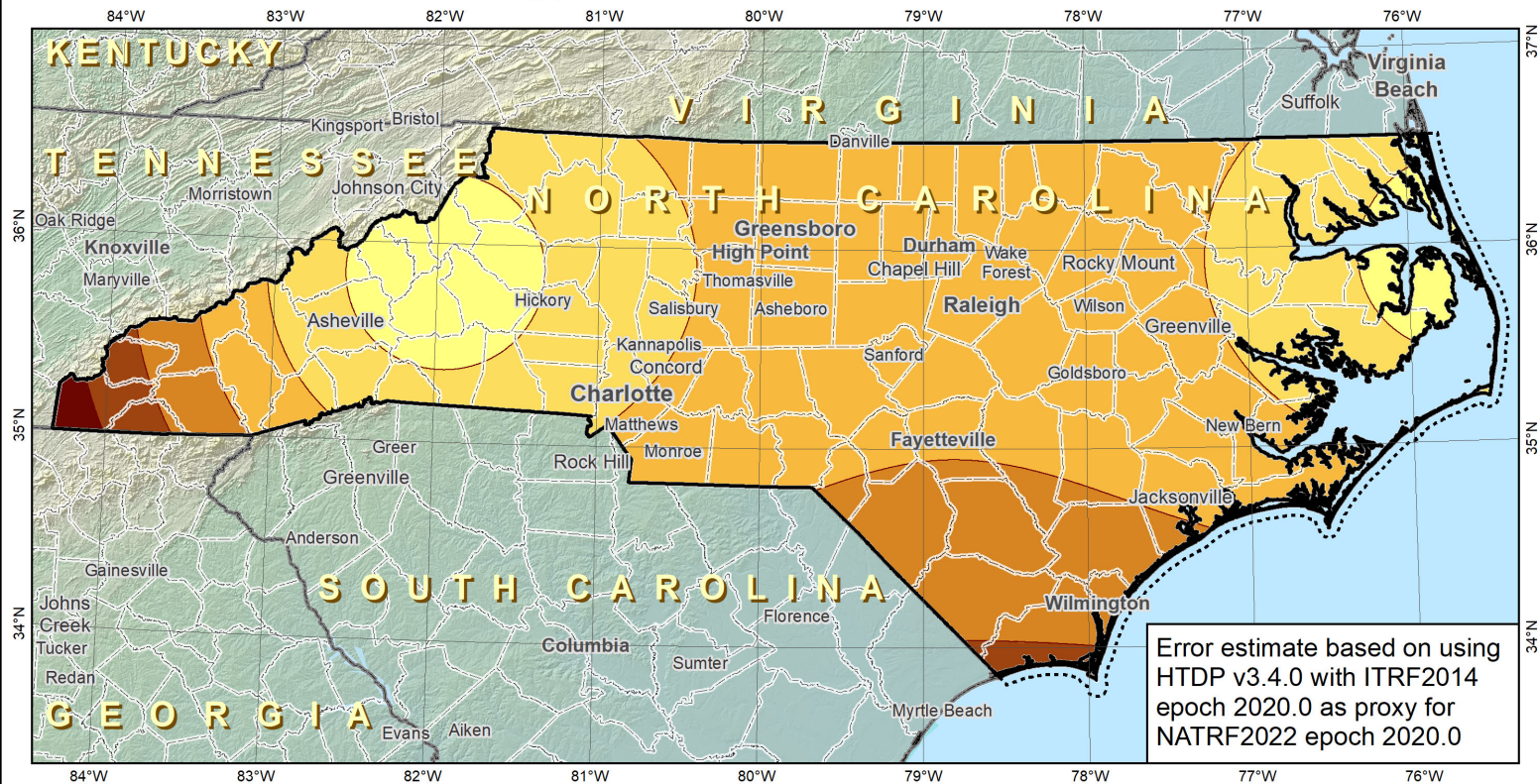
Central parallel scale: 0.99996 (exact)

False northing: 200,000 m (~656,167.979003... ift)

False easting: 1,000,000 m (~3,280,839.895013... ift)



Estimated horizontal error of approximate transformation between SPCS 83 and SPCS2022



Transformation parameters (for SPCS 83 U.S. survey feet and SPCS2022 international feet):

Scale, $s = 1.00009$

Translation north, $tN = 110,207$

Translation east, $tE = 1,280,658$



NOAA's
National
Geodetic
Survey

Horizontal transformation error (feet):

Max = 1.45 Standard deviation = 0.22

Mean = 0.57 Root mean square = 0.61

Transformation equations

SPCS83 to SPCS2022:

$N2022_ift = s * N83_sft + tN$

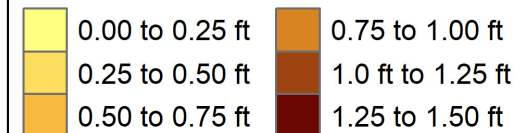
$E2022_ift = s * E83_sft + tE$

SPCS2022 to SPCS83:

$N83_sft = (N2022_ift - tN) / s$

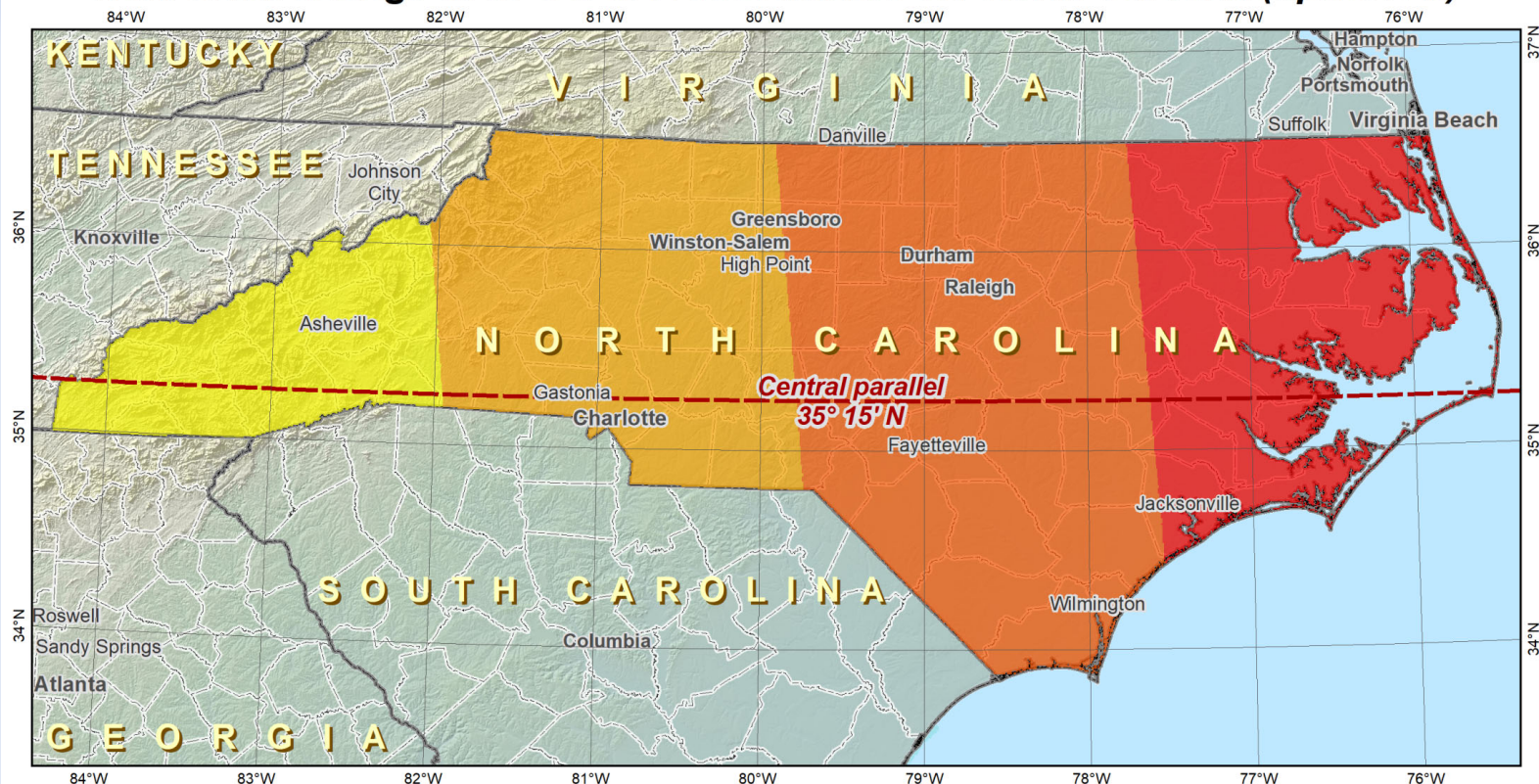
$E83_sft = (E2022_ift - tE) / s$

Estimated horizontal error of approximate transformation (feet)



Created 1/20/2022 (Michael Dennis)

Horizontal change in SPCS2022 coordinates for North Carolina (option 2b)



Lambert Conformal Conic projection

North American Terrestrial Reference Frame of 2022

Central parallel: 35° 15' N

Central parallel scale: 0.999 95 (exact)



NOAA's
National
Geodetic
Survey

**Areas within ±100 ppm distortion
(1:10,000 = ±0.53 ft per mile):**

- 90% of population
- 78% of all cities and towns
- 76% of entire zone area

Option 2b: Reference frame plus parameter change:

False northing = 200,000 m

False easting = 1,000,000 m

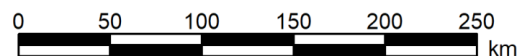
(same central meridian as
SPCS 83)

Maximum relative change:

Delta north = 77 ft

Horizontal change in coordinates

- 1,285,445 to 1,285,500 sft
- 1,285,500 to 1,285,550 sft
- 1,285,550 to 1,285,600 sft
- 1,285,600 to 1,285,650 sft



ELLIPSOID – GEOID RELATIONSHIP

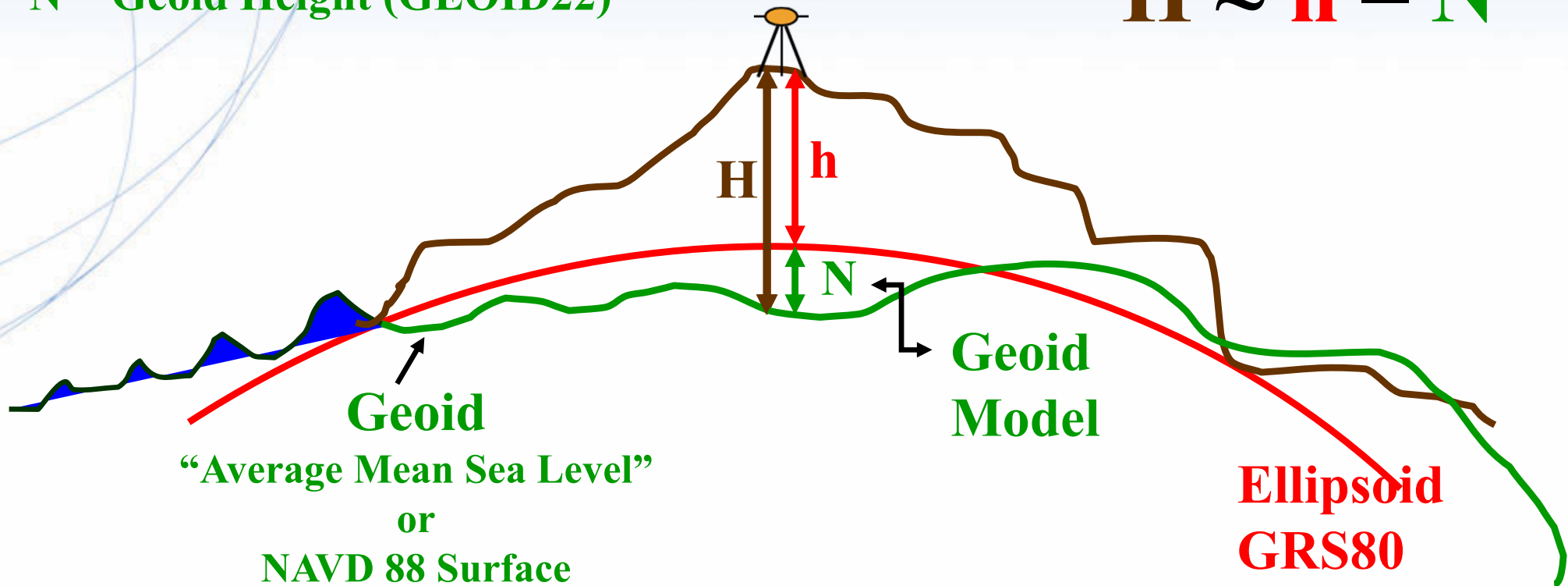
H = Geopotential Height (NAPGD2022)

h = Ellipsoid Height (NATR2022)

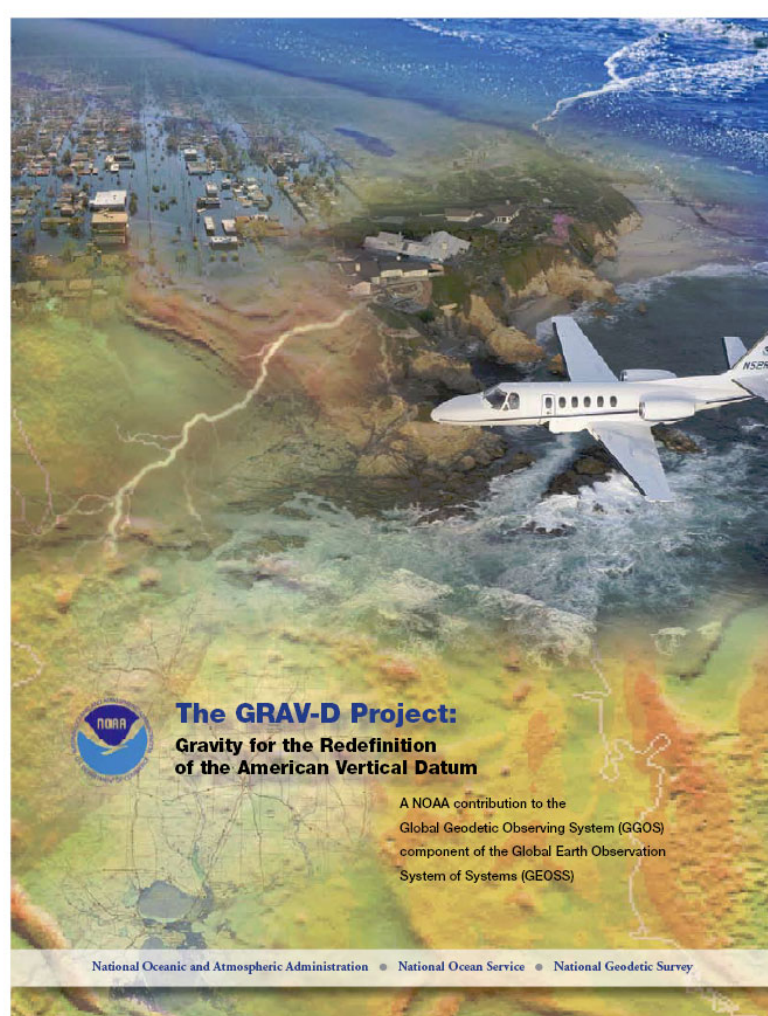
N = Geoid Height (GEOID22)

$$H = h - N$$

$$H \approx h - N$$



GRAV-D Project Overview



- **Overall Target:** 2 cm accuracy orthometric heights from GNSS and a geoid model
- **GRAV-D Goal:** Create gravimetric geoid accurate to 1 cm where possible using airborne gravity data
- **GRAV-D:** Two thrusts of the project
 - Airborne gravity survey of entire country and its holdings
 - Long-term monitoring of geoid change

Gravity Data Collection

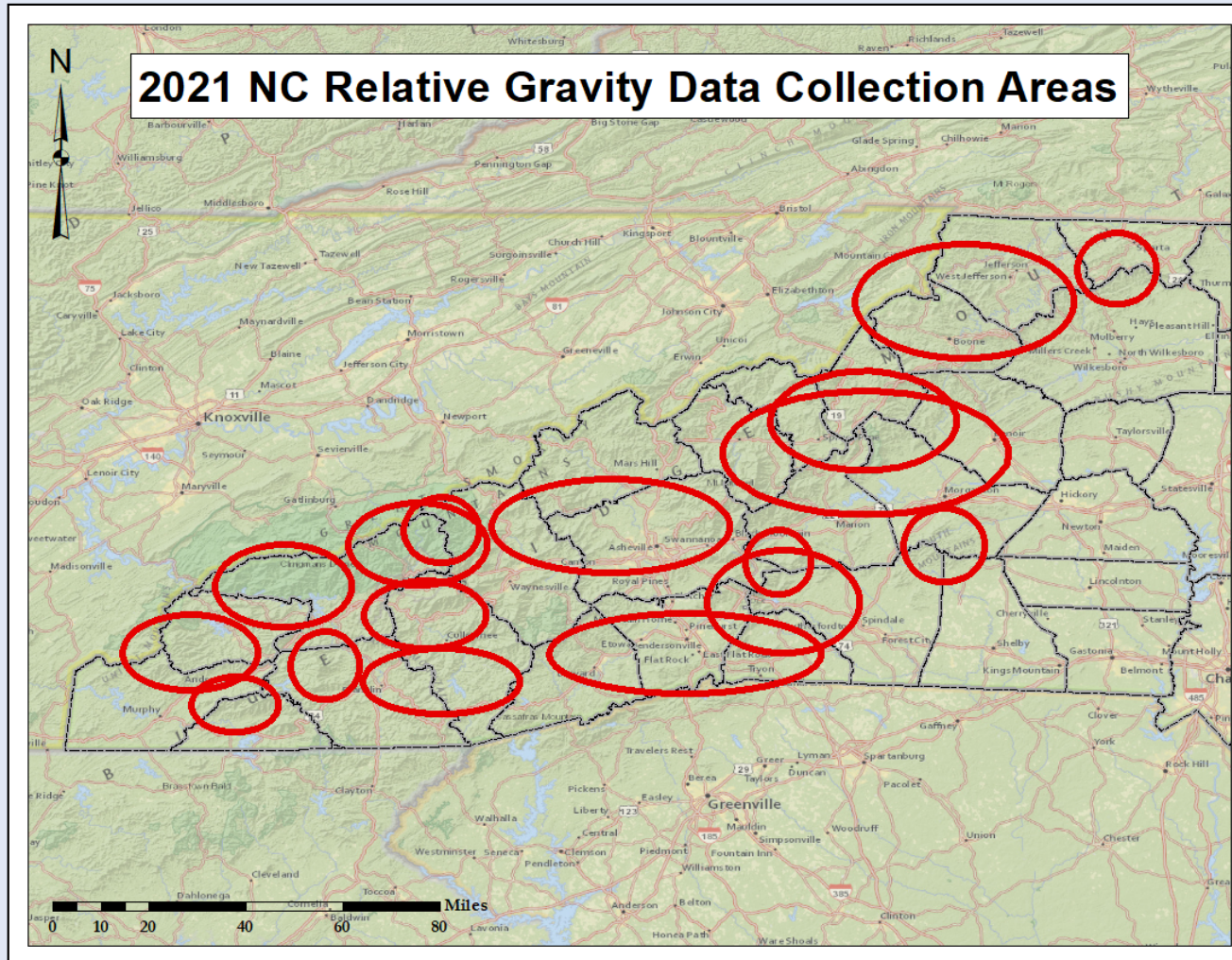
- New gravity marks established (relative and absolute)
 - One hundred and twenty (120) in western North Carolina (relative)
 - Partnered with NGS to establish eleven (11) new absolute gravity stations in western North Carolina (NC)
 - Observations completed in western NC on 11/14/19



North Carolina Emergency Management

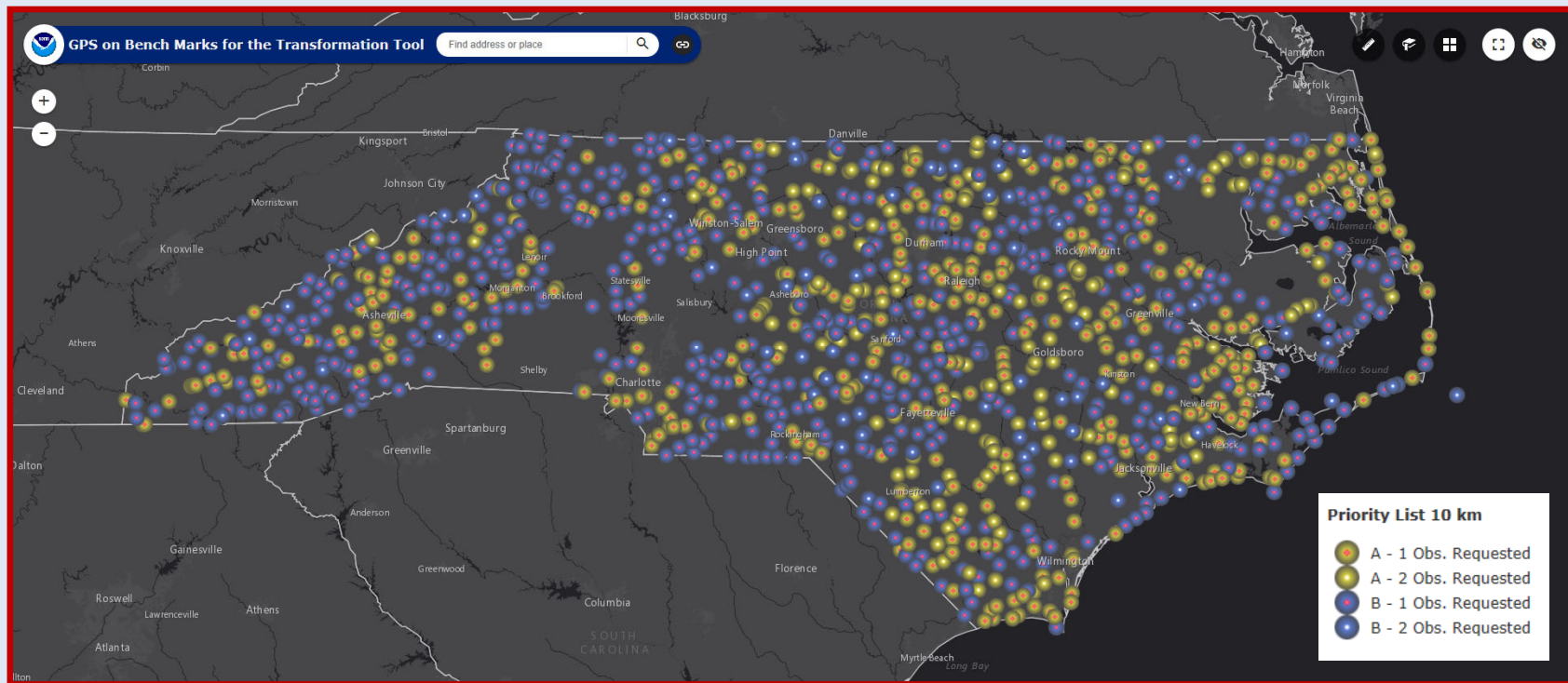


Gravity Data Collection



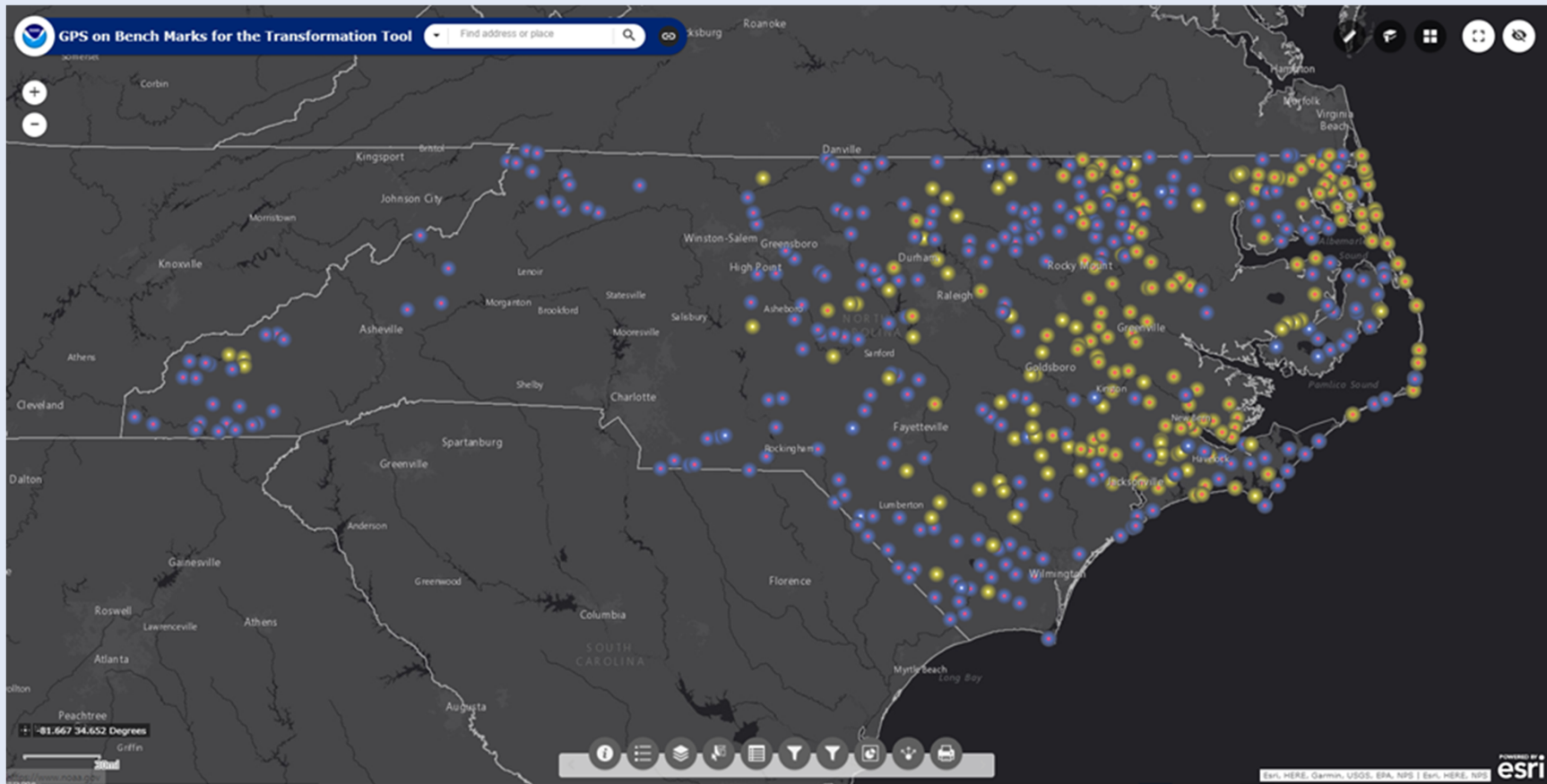
National Geodetic Survey GPS on Bench Marks 2020/2021

- 2020
 - NGS has prepared a list of geodetic monuments that we review for possible GNSS data collection



National Geodetic Survey GPS on Bench Marks 2020/2021

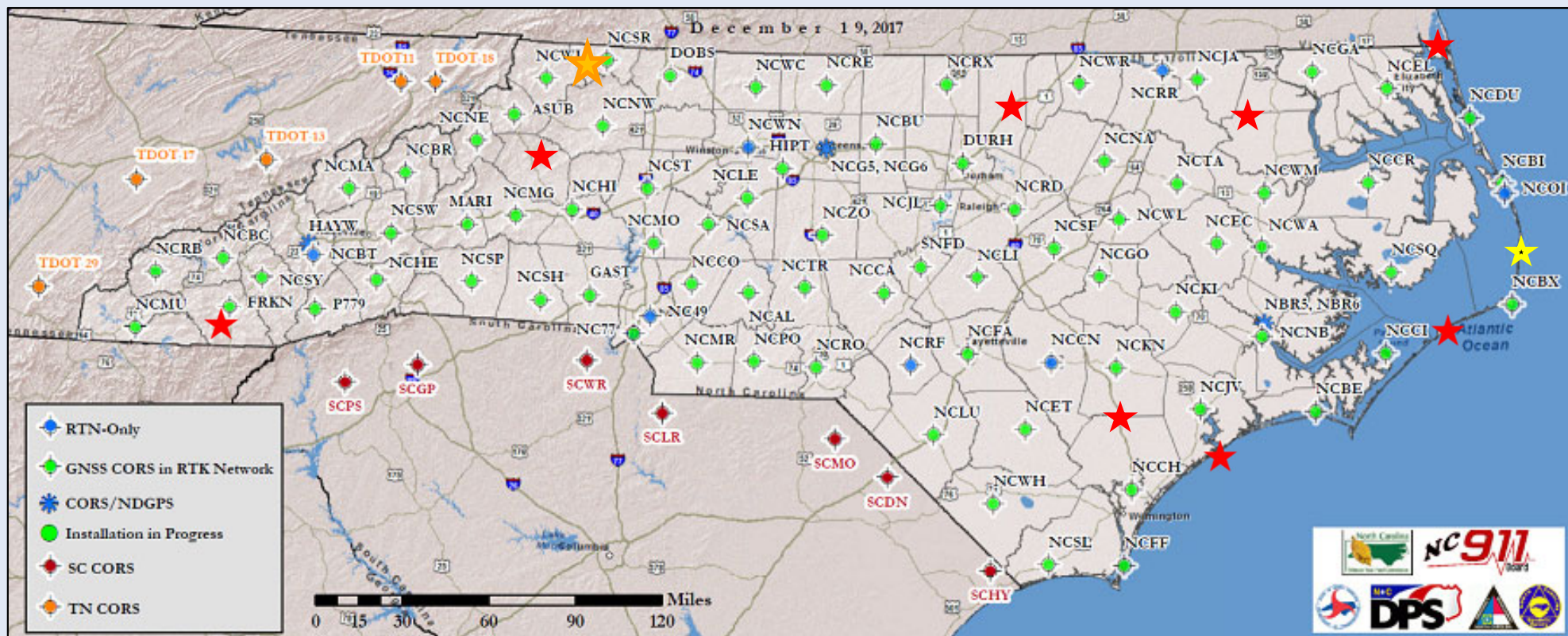
- 2021 (status as of 12/31/2021)



North Carolina Emergency Management



North Carolina (NC) Continuously Operating Reference Station (CORS) Network



North Carolina Emergency Management

Future CORS location =
CORS installed =
Earthquake CORS =



OPUS-Projects 5.0

- Inclusion of previously processed GNSS vectors
 - Single-base Real Time Kinematic (RTK) vectors
 - Network RTK vectors
 - Vectors processed in other software

The screenshot shows the NOAA National Geodetic Survey website. At the top, the NOAA logo and name are displayed, along with the text "NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION" and "UNITED STATES DEPARTMENT OF COMMERCE". Below this, a banner reads "NGS Releases BETA OPUS Projects 5.0 — Now accepting RTK data!" and "NOAA's National Ocean Service sent this bulletin at 09/16/2021 11:24 AM EDT". The main heading is "National Geodetic Survey". Below this, a section titled "Test New Features in BETA OPUS Projects 5.0" contains text about uploading GNSS vectors and a "BETA" badge. A "Getting started:" section lists two bullet points: "Use sample data that are available online and in the GVX file format." and "Talk to your vendor about converting your own GNSS vector data to the GVX file format." Below this, a section titled "Learn More about OPUS Projects 5.0" mentions a webinar from May 20, 2021, and a "View Recorded Webinar" button. Another section titled "OPUS-Projects for RTK/RTN Vectors" explains that GNSS vectors can be uploaded to a survey network for least-squares adjustment and submission to NGS for publication. A "Feedback" section at the bottom encourages users to provide feedback on the new features, with a "Feedback" button and contact information for NGS. The footer includes the NOAA's National Geodetic Survey website URL and a link to "Stay Connected with NOAA's National Ocean Service" and "Manage Subscriptions".

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
UNITED STATES DEPARTMENT OF COMMERCE

NGS Releases BETA OPUS Projects 5.0 — Now accepting RTK data!
NOAA's National Ocean Service sent this bulletin at 09/16/2021 11:24 AM EDT

National Geodetic Survey

**Test New Features in
BETA OPUS Projects 5.0**

Users can now upload GNSS vectors into OPUS projects, including vectors derived from either a single-base real-time kinematic (RTK) setup or from a real-time network (RTN), for evaluation, quality assessment, and inclusion in a GNSS survey network for least squares adjustment. Use the new GNSS Vector Exchange (GVX) file format to transfer data from various manufacturer hardware to OPUS Projects 5.0.

Getting started:

- Use [sample data](#) that are available online and in the GVX file format.
- Talk to your vendor about converting your own GNSS vector data to the GVX file format.

Learn More about OPUS Projects 5.0
For an overview of the new features check out the recent [NGS webinar](#) from May 20, 2021.

OPUS-Projects for RTK/RTN Vectors
NGS is developing OPUS-Projects so that GNSS vectors, including those from real-time kinematic (RTK) surveys, can be uploaded to a survey network for least-squares adjustment and submission to NGS for publication. This has required developing a standardized GNSS vector exchange format known as GVX.

*Technical Content Rating: Advanced - Prior knowledge of this topic is suggested.


NGS Welcomes Your Feedback
NGS continually works to improve our services and releases beta versions of new or improved products for external testing and feedback. Please look for the new [Feedback](#) icon that appears on the right side of our OPUS pages. Click the icon to answer a short survey with your feedback, which will be used to make future improvements to OPUS. Or try uploading and working with GVX files in Beta OPUS Projects 5.0 and email your feedback to ngs.feedback@noaa.gov.

Send feedback on Beta OPUS Projects 5.0 at any time, by emailing ngs.feedback@noaa.gov.

NOAA's National Geodetic Survey
geodesy.noaa.gov

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Coordinate and Conversion and Transformation Tool (NCAT)

 **NGS Coordinate Conversion and Transformation Tool (NCAT)**
National Geodetic Survey

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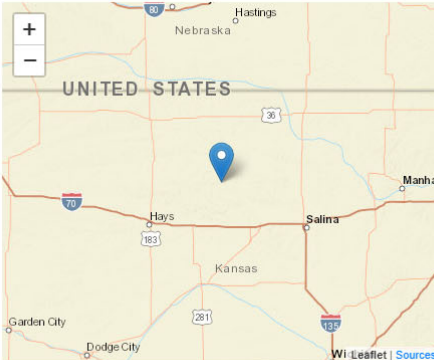
Single Point Conversion | Multipoint Conversion | Web services | Downloads | About Conversion Tool

Convert/Transform from:

☒ Horizontal ☐ Horizontal+height ☐ XYZ

Select the type of horizontal coordinate:

☒ Geodetic lat-long ☐ SPC ☐ UTM ☐ USNG



Enter lat-lon in decimal degrees

Lat:
Lon:

or degrees-minutes-seconds

Lat:
Lon:





or drag map marker to a location of interest

Input reference frame (historically called 'horizontal datum'): Output reference frame (historically called 'horizontal datum'):

Don't see a reference frame in the list? Click here to learn more.

SPC zone:

Submit

Export Results to:    

Click blue bar(s) to expand/collapse

Converted Coordinate

Reference Frame:



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To Learn More

Visit the New Datums web page

NOAA
50 YEARS

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New Datums: Replacing NAVD 88 and NAD 83

To improve the National Spatial Reference System (NSRS), NGS will replace all three North American Datum of 1983 (NAD 83) frames and all vertical datums, including the North American Vertical Datum of 1988 (NAVD 88), with four new terrestrial reference frames and a geopotential datum.

The new reference frames will rely primarily on Global Navigation Satellite Systems (GNSS), such as the Global Positioning System (GPS), as well as on a gravimetric geoid model resulting from our Gravity for the Redefinition of the American Vertical Datum (GRAV-D) Project.

These new reference frames will be easier to access and to maintain than the current NSRS, which relies on physical survey marks that deteriorate over time.

[Delayed Release Message](#)

[Background](#) [What to Expect](#) [Get Prepared](#)

[Blueprint Documents](#) [Track our Progress](#) [Naming Convention](#)

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



FEDERAL REGISTER

The Daily Journal of the United States Government



N Notice

Deprecation of the United States (U.S.) Survey Foot

A Notice by the National Institute of Standards and Technology on 10/17/2019



AGENCY:

The National Institute of Standards and Technology and the National Geodetic Survey (NGS), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce (DOC).

ACTION:

Notice; request for comment.

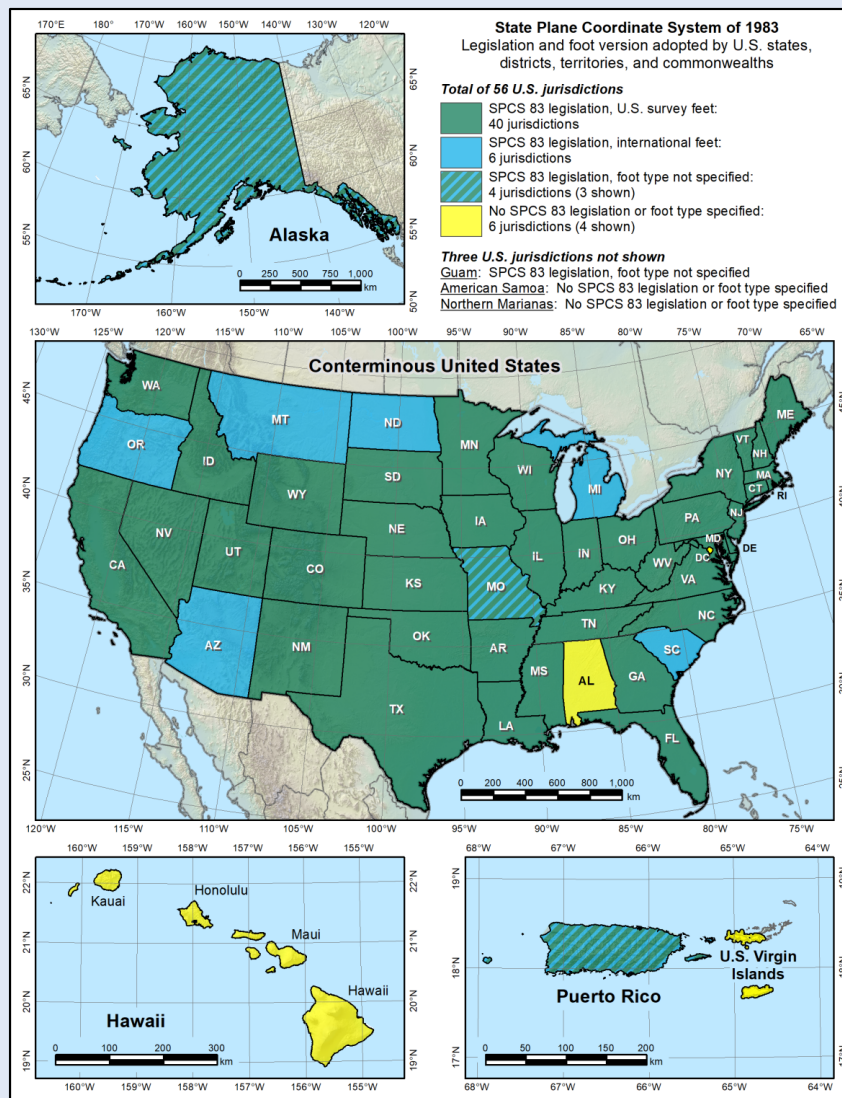
SUMMARY:

The National Institute of Standards and Technology (NIST) and the National Geodetic Survey (NGS), National Ocean Service (NOS), National Oceanic and Atmospheric Administration (NOAA), are taking collaborative action to provide national uniformity in the measurement of length. This notice announces a decision to deprecate the use of the "U.S. survey foot" on December 31, 2022. After that date, the "U.S. survey foot" will be superseded by the "foot" (formerly known as the "international foot"), which is already in use throughout the U.S. This notice describes the plan, resources, training, and other activities of NIST and NOAA that will assist those affected by this transition, and invites comments and other information from land surveyors, engineers, Federal, State and local government officials, businesses, and any other member of the public engaged in or affected by surveying and mapping operations.



North Carolina Emergency Management

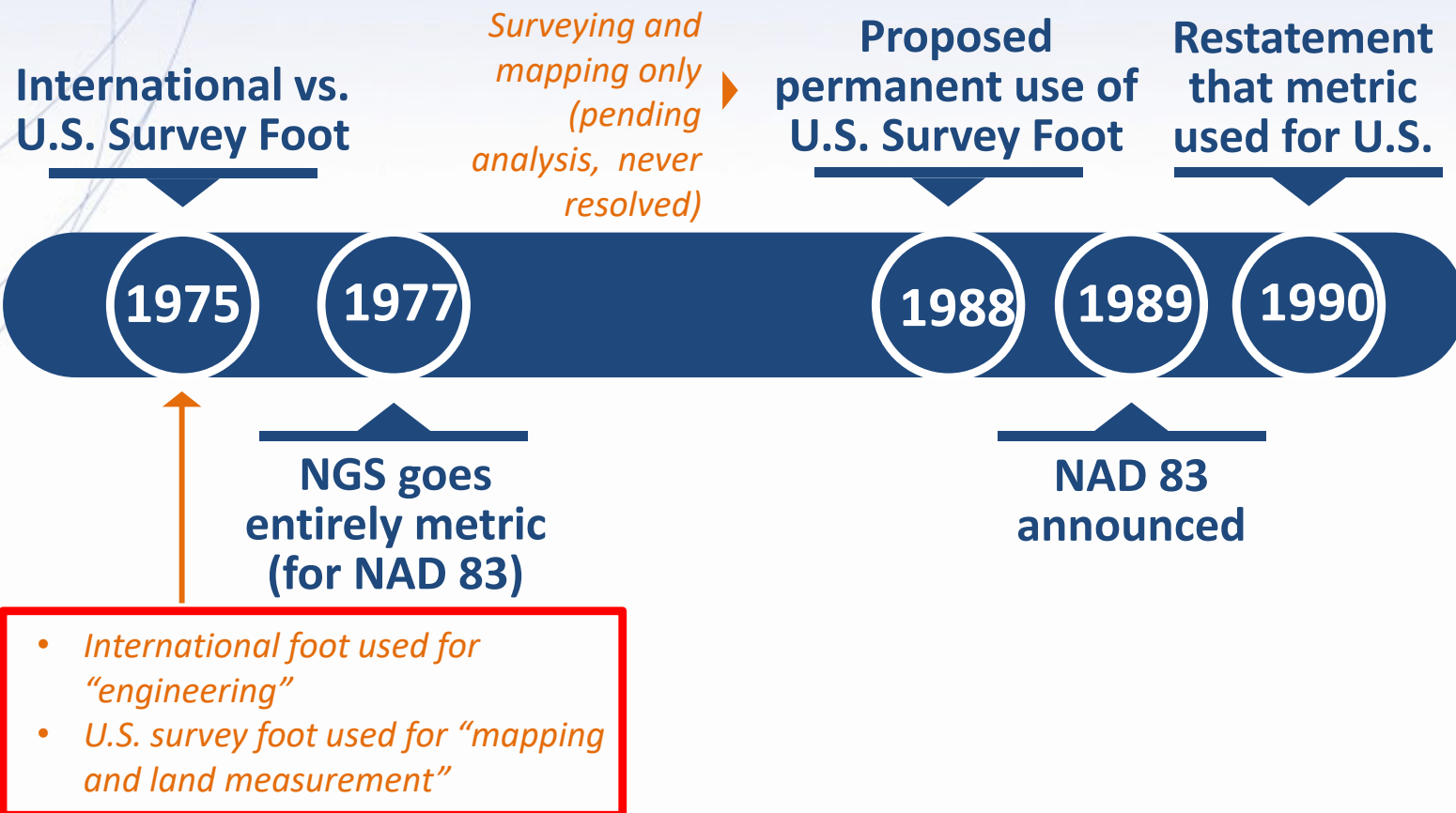




North Carolina Emergency Management



More Federal Register Notices



Kicking the can (Federal Register) 1959

“Any data expressed in feet derived from and published as a result of **geodetic surveys** within the United States will continue to bear the following relationship as defined in 1893:

$$1 \text{ foot} = 1200/3937 \text{ meter}$$

The foot unit defined by this equation shall be referred to as the **U.S. Survey Foot** and it shall continue to be used, for the purpose given herein, **until such a time as it becomes desirable and expedient to readjust the basic geodetic survey networks in the United States, after which the ratio of a yard, equal to 0.9144 meter, shall apply.”**

https://geodesy.noaa.gov/PUBS_LIB/FedRegister/FRdoc59-5442.pdf

Signed by NBS and C&GS directors, approved by Secretary of Commerce, June 25, 1959

A tale of two feet

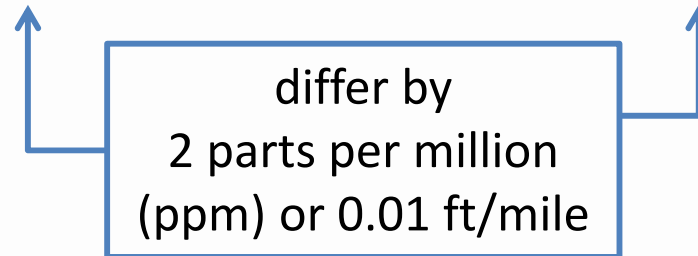


Two versions of “foot” in current use:

“Old” U.S. survey foot ➡ “New” international foot

1 ft = 0.3048006096... m

1 ft = 0.3048 m *exactly*



A real problem with real costs

An NGS proposal

- **Only one foot after 2022 (1 foot = 0.3048 meter)**
 - Make official through NIST
 - ***NO*** option for U.S. survey foot
- **NGS will help with the transition**
 - Will fully support backward compatibility
 - Use “correct” foot for SPCS 83 and SPCS 27
 - Automatically done by NGS products and services
- **Guiding ideas**
 - Best opportunity to make the change
 - Of all changes in 2022, this is the least significant
 - Will make things better
 - About the ***future***, not the past

Get Prepared

Get Prepared

1. Transform Data

Tools will be available to transform your coordinates from historic datums (NAVD 88, NAD 83, etc.) to coordinates in the modernized NSRS at the first reference epoch of the modernized NSRS (2020.00) using **NGS Coordinate Conversion and Transformation Tool (NCAT)**.

NOTE: Depending on your accuracy requirements, consider saving original observation files and/or plan for re-observations.

2. Record Metadata

Knowing the datums and epochs for your geospatial files will simplify your datum transformations, so require complete metadata in all surveying and mapping contracts.

3. Perform GPS on Bench Marks Operations

Obtain accurate NAD 83 ellipsoid heights on NAVD 88 bench marks to improve the transformation tool for the new geopotential ("vertical") datum.

4. Review State Plane Coordinate System of 2022 (SPCS2022) requirements

SPCS2022 policy and procedures documents and forms give the requirements for developing SPCS2022. The procedures and forms include contact information and instructions for requesting and proposing SPCS2022 zones.

5. Prepare to update legislation, as needed

The National Society of Professional Surveyors (**NSPS**), the American Association of Geodetic Surveying (**AAGS**), and NGS created **template legislation** to aid states in transitioning their legislation to new wording. Contact NSPS, AAGS, your state affiliate, or your local chapter for more information. Examples of new state legislation are available for **download**. The map below shows the status of legislation for the State Plane Coordinate Systems of 1983 and 1927 for all U.S. states and territories.

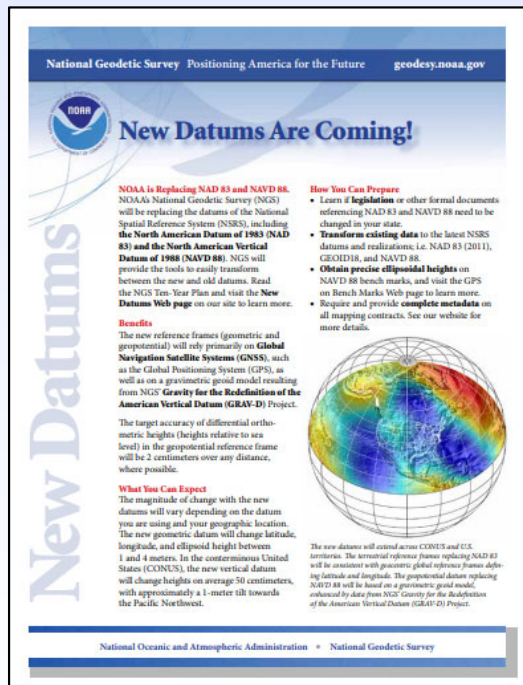


Questions?

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Risk Management/Geodetic Survey
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Direct line: 919-948-7844

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