NATIONAL GEODETIC SURVEY

Shift Happens:

All Latitudes, Longitudes, Heights, and State Plane Zones will be Changing

Presented by
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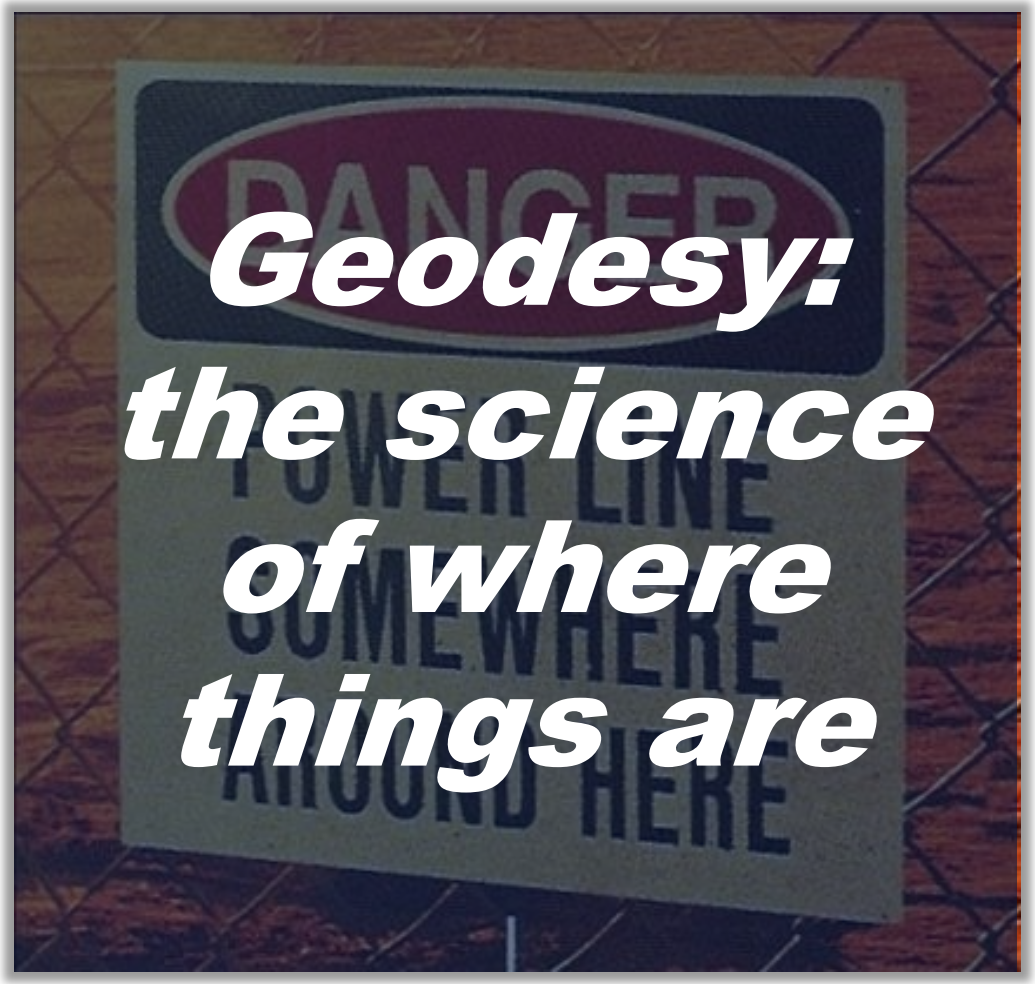
What is the National Spatial Reference System (NSRS)?

...and why should you care?

- A set of consistent nationwide coordinate systems
- Created in **1807** to support commerce and science
- Defined and maintained by NOAA's **National Geodetic Survey**



What is the National Spatial Reference System (NSRS)?

…and why should you care?

- **Basis for positioning in the United States**
  - Where things are
  - How high they are
  - How far apart they are
  - Direction between things
  - Their accuracy
  - *…and how these things change with time*
- **The need has existed since founding of NGS in 1807**

  …and that need has never been greater than it is today

NSRS defines where "ZERO" is and how to measure from zero

The NSRS is being "Modernized"

- ***All*** NSRS coordinates will change
- Modernized NSRS will be more ***accurate***, ***efficient***, and ***accessible***
- How do our customers and partners prepare?
  - Evaluate geospatial workflows
  - Assess dependencies on NGS products and services
  - Proactively identify challenges and opportunities
  - Address potential impacts early to reduce risks to operational efficiency
  - Act now to minimize costs and complexity
    (and reduce more costly changes later)
- Change is coming because Earth is dynamic

NGS is working to make the transition as simple and painless as possible

Why are we modernizing the NSRS?

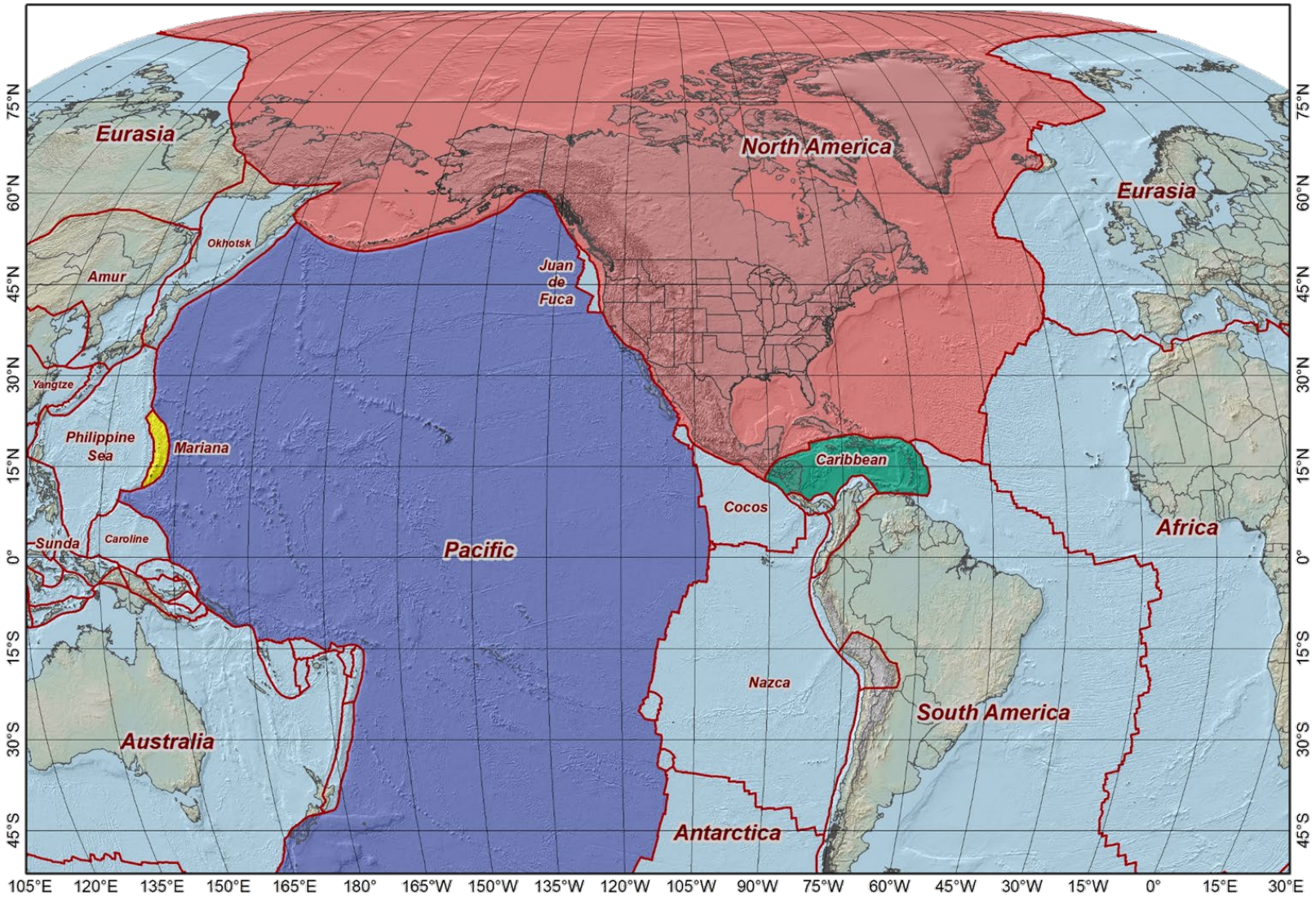


Plate Tectonics!

Things are moving

- **Modernized NSRS accounts for crustal motion**
  - *Tectonic plate rotation*
  - *Local deformation*
  - *Earthquakes*
  - *Subsidence*
- **Earth center well known**
  - *Reduces systematic errors*
- **Global rather than regional**
  - *Compatible with international reference systems*

Current reference systems create challenges

** Hydrography*

Elevation

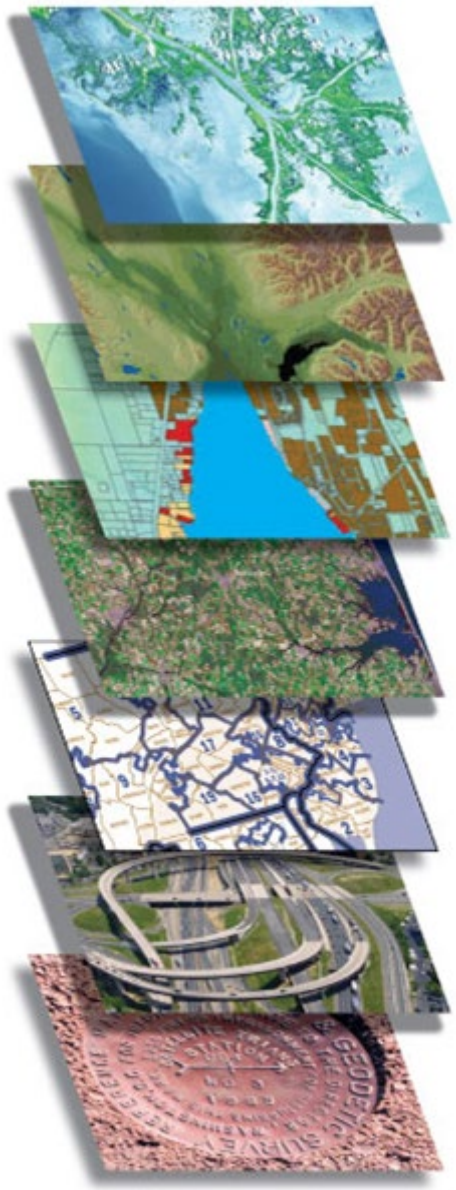
Cadastral

Digital Orthoimagery

Governmental Units

Transportation

Geodetic Control



NAD 27 (1927)
- Gulf of America
- Historical Block Maps and Tract Boundary Data

- **Superseded in 1986**
- **Lower accuracy and regional**
- **Not compatible with GNSS**
- **Based on U.S. survey foot**

NAD 83 (1986)
- Alaska
- Atlantic Coast
- U.S. Virgin Islands / Puerto Rico
- Pacific Coast

- **Superseded in 1990s**
- **Lower accuracy and regional**
- **Not compatible with GNSS**

WGS 84 (EPSG 6326)
- Hawaii
- Guam/CNMI
- American Samoa

- **Poorly defined**
- **Low accuracy (2 m at best)**
- **Combined multiple versions**
- **Not directly accessible**
- **Difficult to verify**
- **Little to no documentation**
- ***Not part of the NSRS!***

NGVD 29 (1929)
- Counties
- Municipalities

- **Superseded in 1990s**
- **Not compatible with GNSS**

The solution:

Use the Modernized National Spatial Reference System

Official and best coordinate systems of the U.S. defined by NGS

The Federal Geodetic Control Subcommittee (FGCS) will approve the adoption

- The subcommittee includes representation from many federal agencies

Its use required for all civilian Federal Government agencies

- OMB A-16
- Geospatial Data Act of 2018

Widely used by state and local government agencies and private industry

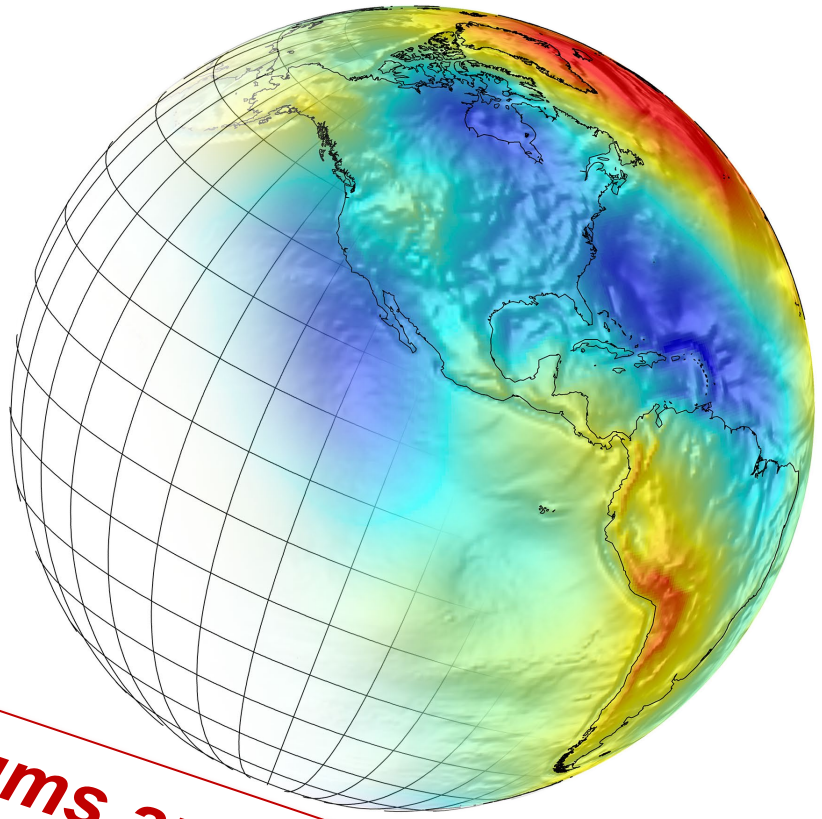
Datum? I don't even know them...

Why Reference Systems Matter (Datum 101 review)

A Geospatial Datum = A Reference for "Where"

A datum is the underlying reference system that defines: Origin, Orientation and Shape

If the Datum Shifts... Everything Shifts



Datums are a fundamental part of the "NSRS"

Why it Matters

- Accurate navigation
- Reliable mapping & surveying
- Consistent data integration across agencies

"Shift & Drift"

Sudden "SHIFT" to give coordinates on Jan 1, 2020

- Horizontal change of about 0.5 to 4 meters (**1.5 to 12 feet**)
- Elevation change of about ±2 meters (**±6 feet**)

Continuous "DRIFT" due to crustal motion

- Up to about 8 cm/yr (**4 inches/yr**) for tectonic plates
- Able to remove most by modeling crustal motion

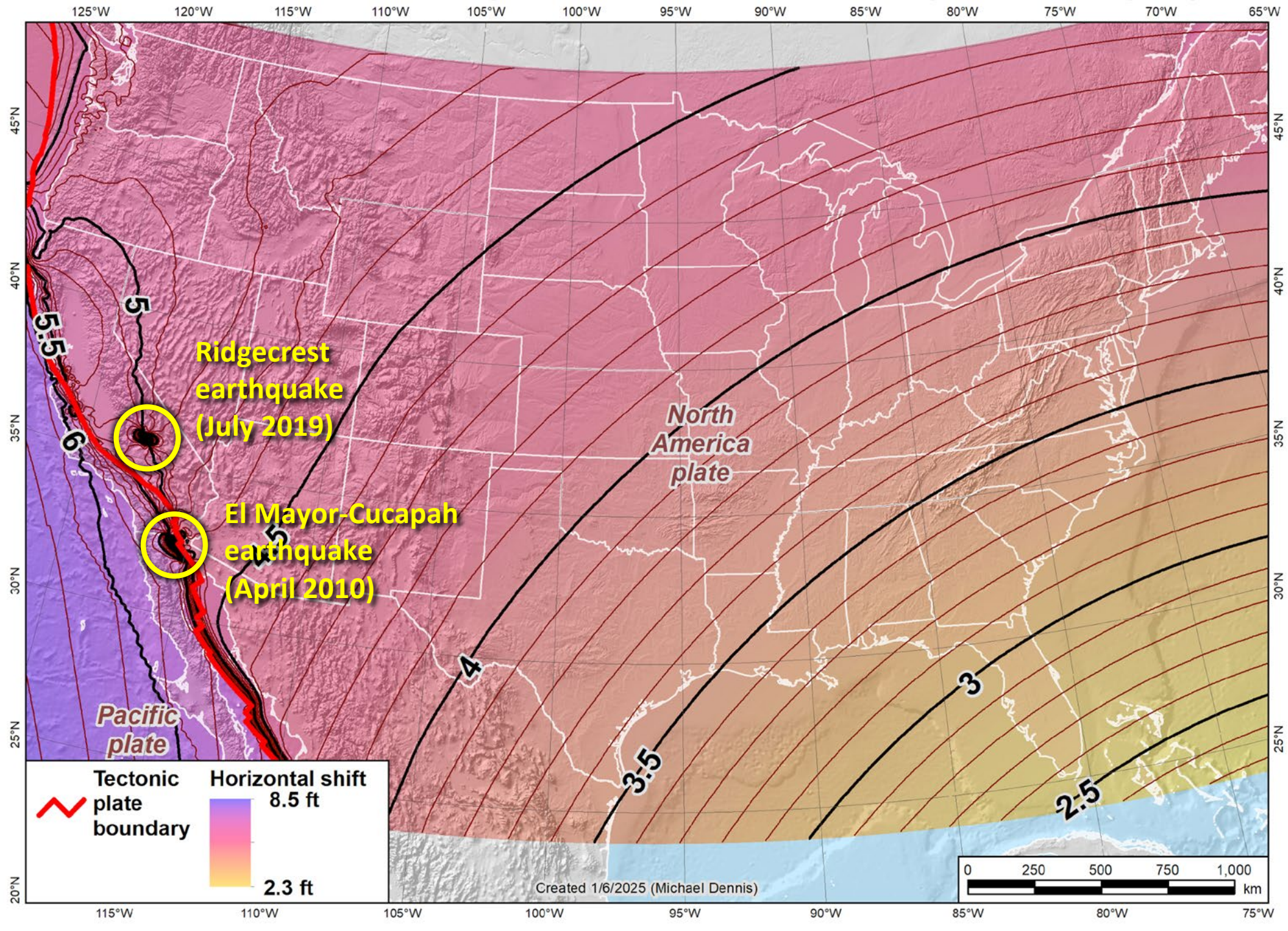
Coordinates in Modernized NSRS will always have a date

Time is part of Modernized NSRS definitions

- Coordinates change with time, but reference system itself stays the same
- Change in coordinates can be minimized (most "drift" can be removed)
- Can determine coordinates at a specific time (to keep datasets consistent)

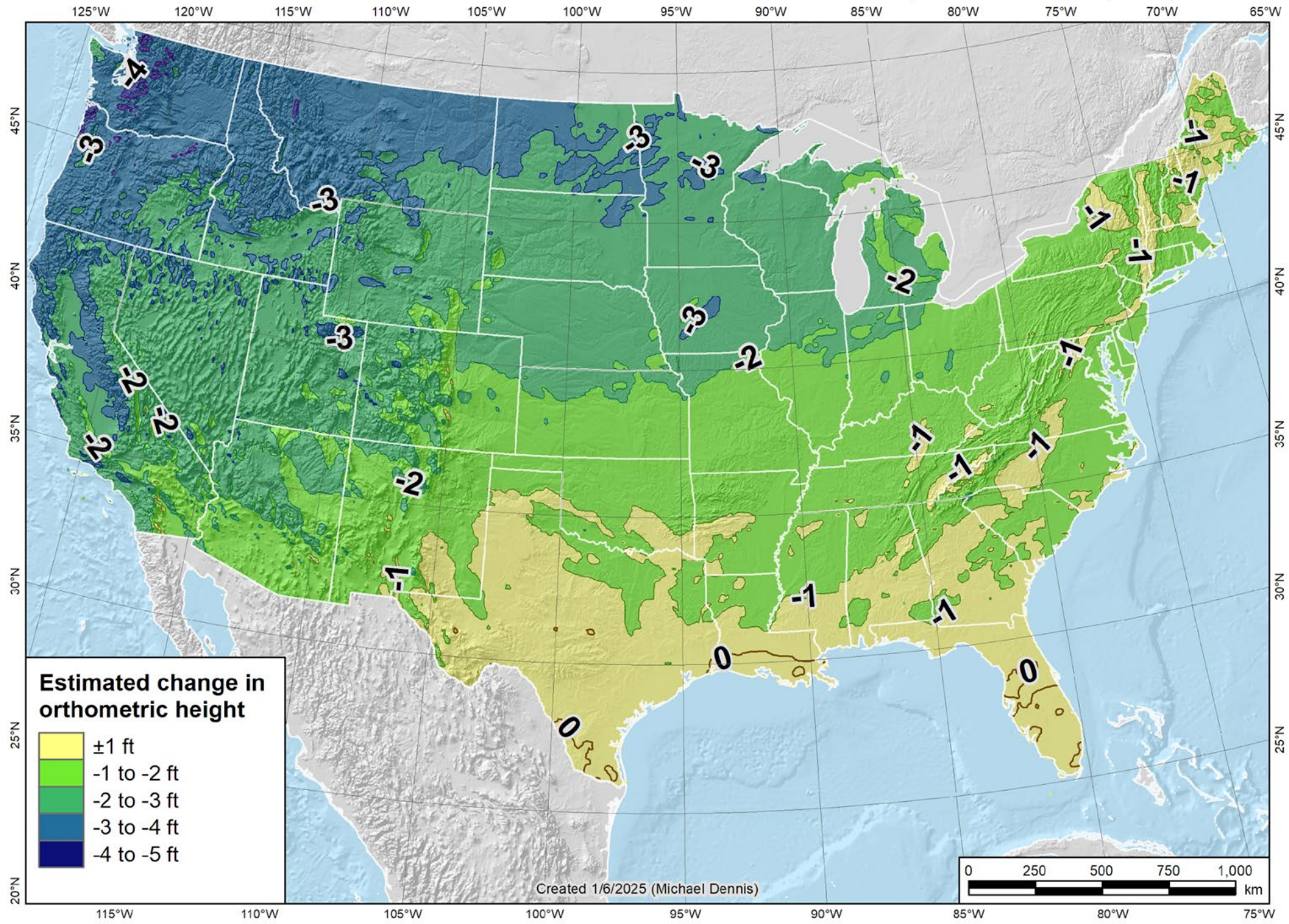
Modernized NSRS accounts for temporal changes...

...so you don't have to!



Estimated horizontal shifts (CONUS):

NAD 83 epoch 2010.0 to NATRF2022 epoch 2020.0 (feet)

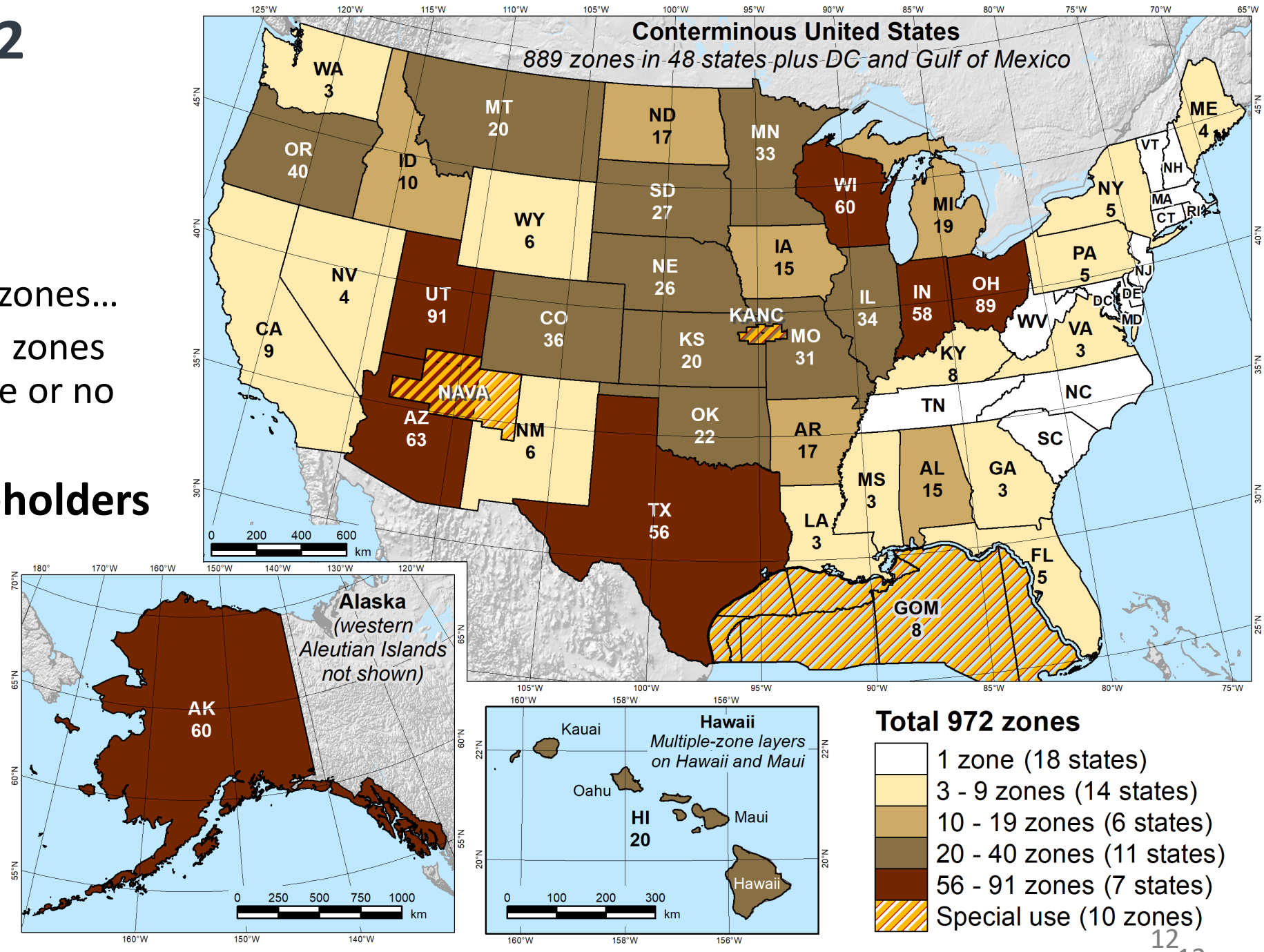


Estimated orthometric height shifts

(CONUS):
NAVD 88 to NAPGD2022 epoch 2020.0 (feet)

Number of SPCS2022 zones *(preliminary)*

- **Designs by NGS**
  - 153 zones
  - Includes 54 statewide zones…
  - …and 10 “special use” zones (in more than one state or no state at all)
- **Designs by state stakeholders**
  - 819 zones in 28 states
- **Total = 972 zones** for 56 states and territories
- ***Compare to 125 zones in existing State Plane (SPCS 83)***



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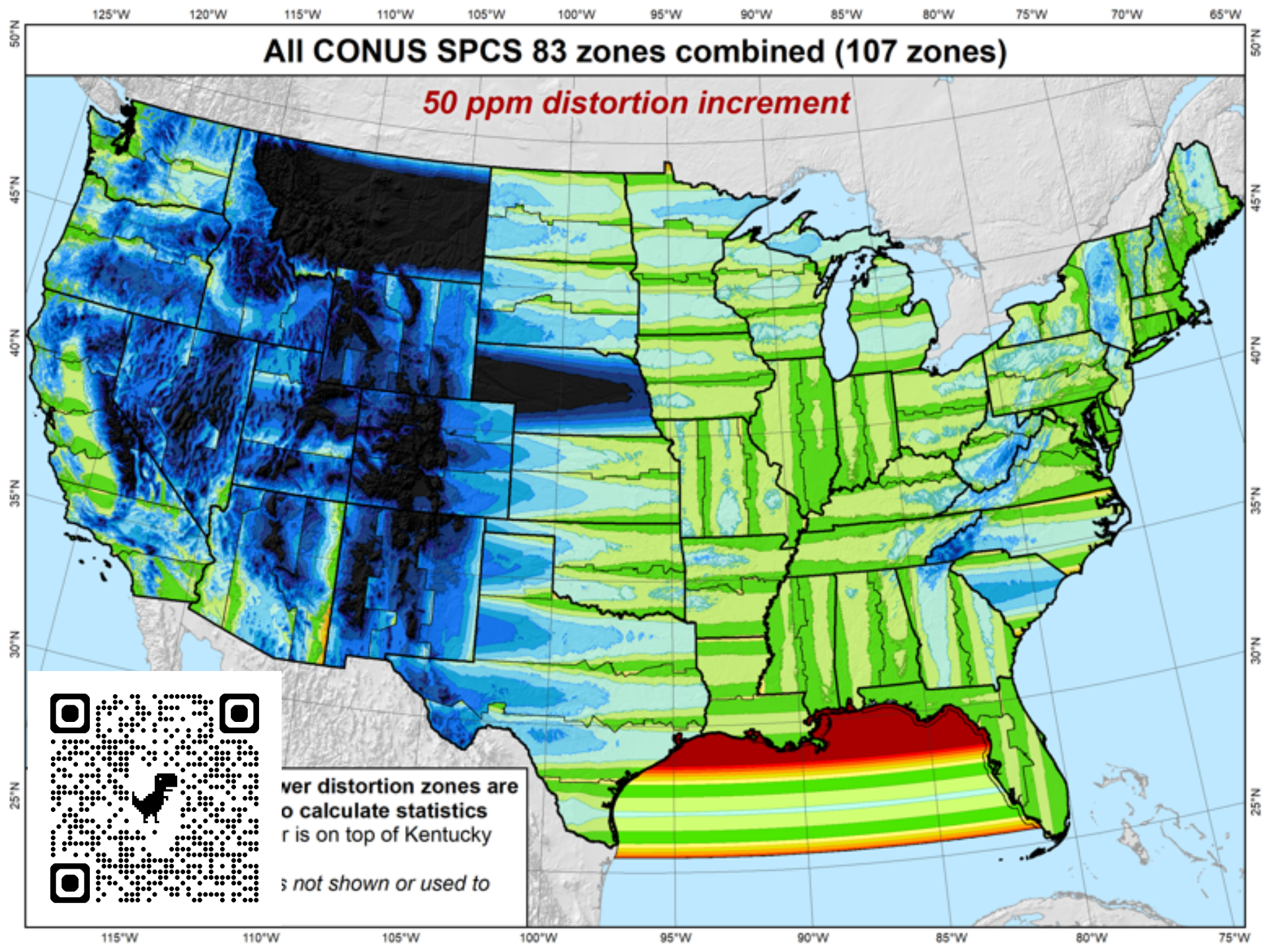


SPCS 83 linear distortion *(existing)*

Green is ±50 ppm (±0.26 ft/mile)

Distortion performance:
±159 ppm

Performance percentages:
90% population
85% cities & towns
59% total area

Mean weighted by population: **-75 ppm**

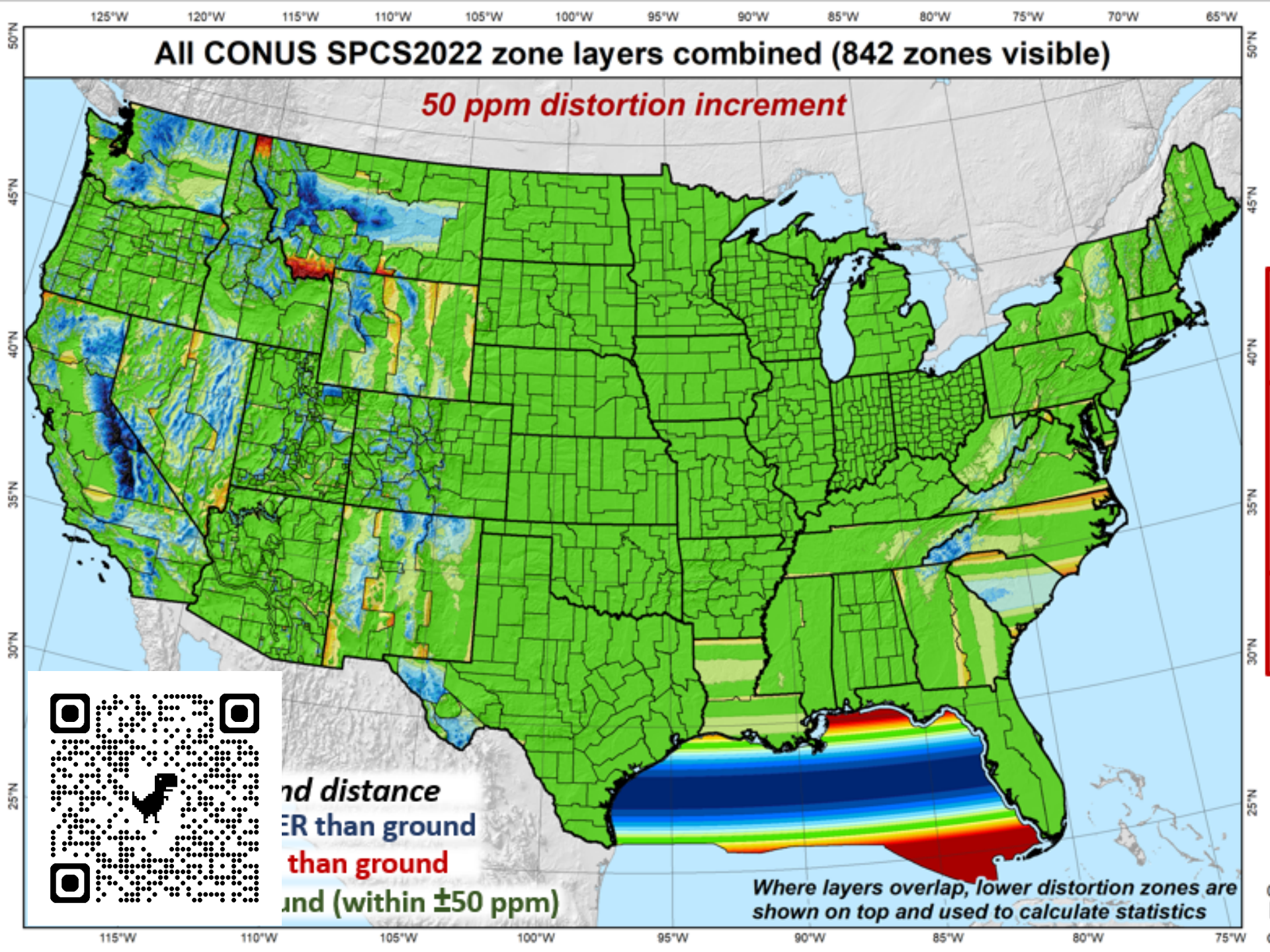
Linear distortion at topographic surface (parts per million, ppm)

< -400	to -200	to +150
to -400	to -150	to +200
to -350	to -100	to +250
to -300	±50	to +300
to -250	to +100	> +300

0 200 400 600 800 km

Created 6/24/2023 (Michael Dennis)

NOAA's National Geodetic Survey



SPCS2022 linear distortion *(preliminary)*

Green is ±50 ppm (±0.26 ft/mile)

Distortion performance:
±46 ppm

Performance percentages:
90% population
87% cities & towns
70% total area

Mean weighted by population: **-3 ppm**

Linear distortion at topographic surface (parts per million, ppm)

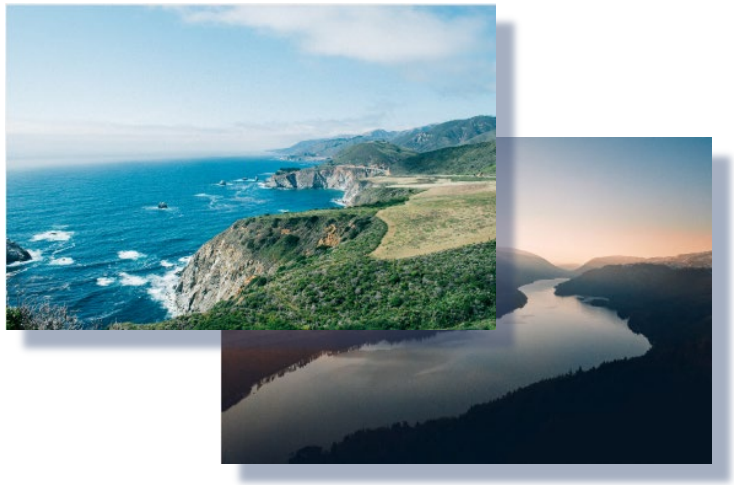
< -400	to -200	to +150
to -400	to -150	to +200
to -350	to -100	to +250
to -300	±50	to +300
to -250	to +100	> +300

0 200 400 600 800 km

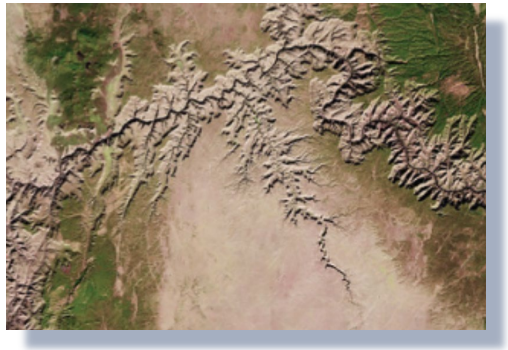
Created 12/06/2024 (Michael Dennis)

NOAA's National Geodetic Survey

What types of data are affected?

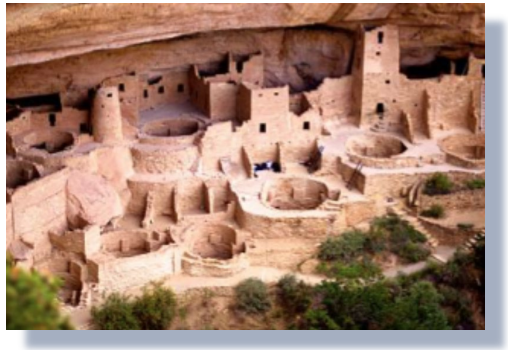


Water – Inland & Oceans and Coasts



Geology

Soils



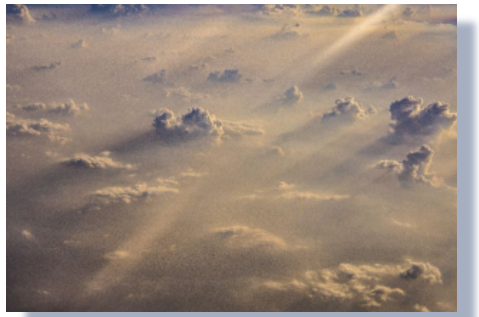
Cultural Resources

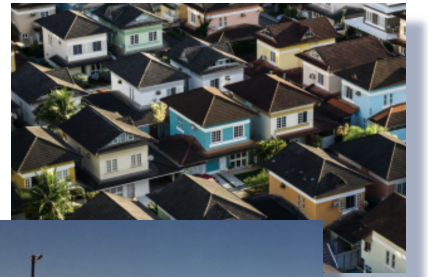
Address

Biodiversity and Ecosystems

Land Use-Land Cover

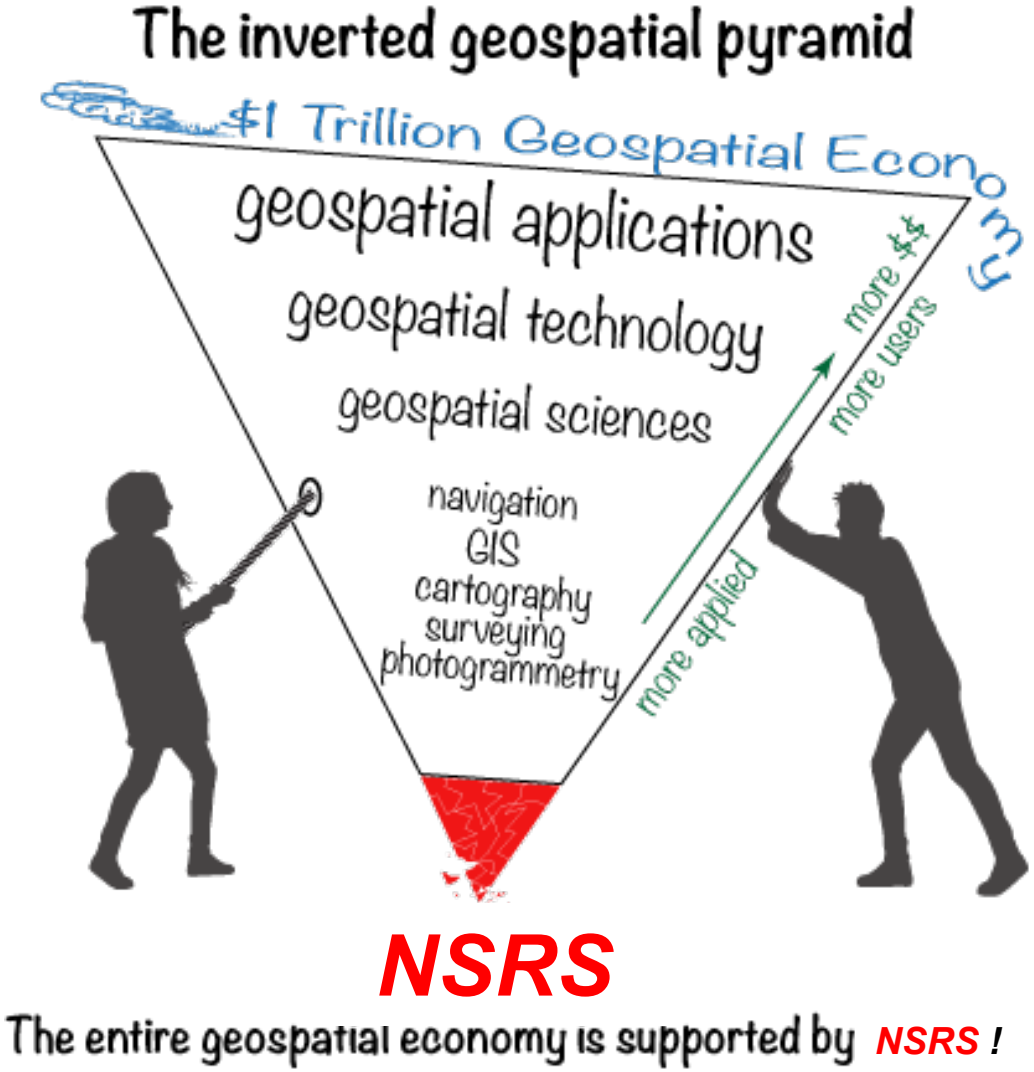
Climate and Weather





Real Property and Utilities

The Foundation Risk

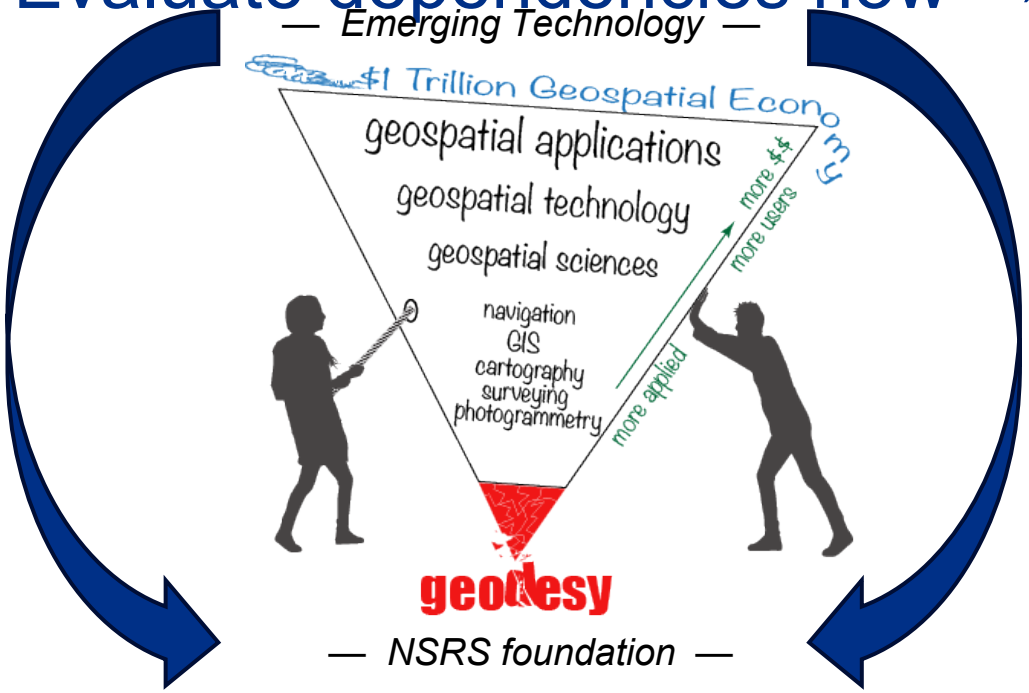


Risks

- Risk models are only as strong as their foundation
- National Spatial Reference System (NSRS) = the nation's common reference for position, height, and time
- Without alignment → fragmented models, misleading decisions

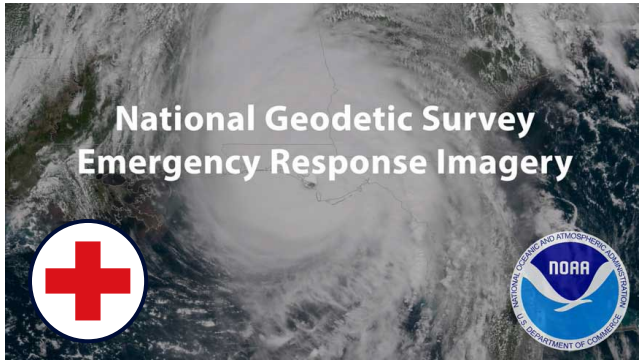
Future-Proofing Risk Workflows

- Digital twins, AI/ML, Digital Project Delivery **only work if data is aligned**
- Modernized NSRS → time-dependent, gravity-based, accessible online
- **Call to action:** Evaluate dependencies now → make workflows **future-proof**



Real-World Risk Examples

- **Floodplain & storm surge mapping** → tied to vertical datum
- **Transportation resilience** → monitoring bridge/road subsidence
- **Shoreline change** → tracking coastal hazards and community exposure
- **Emergency response** → precise location data saves lives



Data Readiness: The software you use will be affected

Trimble

QGIS

BLUE MARBLE GEOGRAPHICS

PostGIS Spatial PostgreSQL

AUTODESK

HEXAGON

esri

PROJ

ORACLE SPATIAL

Field Software

Geospatial Software

Transformation Software

Spatial Database Management Systems

Benefits of adopting the Modernized NSRS

Provides greater **accuracy** and **precision**

Supports the **F.A.I.R.** principle for spatial data

- Findable. Accessible. Interoperable. Reusable.

Helps quantify spatial improvement

"Future proofs" data and workflows

Enables better coordination between federal agencies and external parties

Modernizing now prevents more costly adoption later

- Planning and being proactive will make for a smoother transition
- Coordinating adoption with other agencies facilitates data sharing and collaboration

NSRS Modernization is nearly done!

Preliminary release in phases

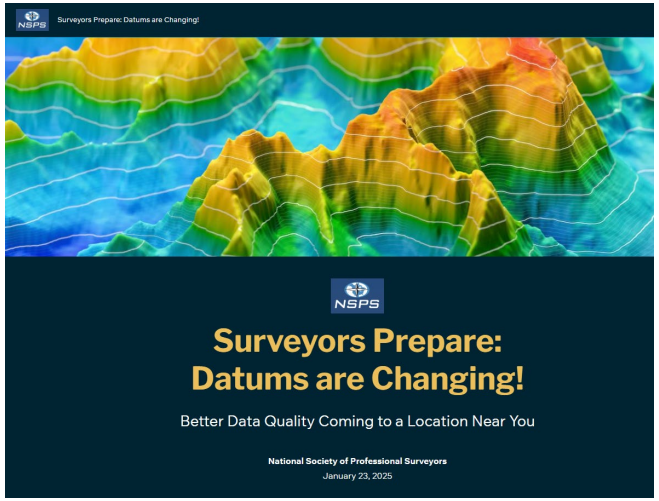
- Initial release beta ***AVAILABLE NOW***, (released in Year 2025)
- Final beta release in calendar year 2026
- ***These releases are for testing and evaluation only***

NGS Will replace current datums at least 6-months after final beta release

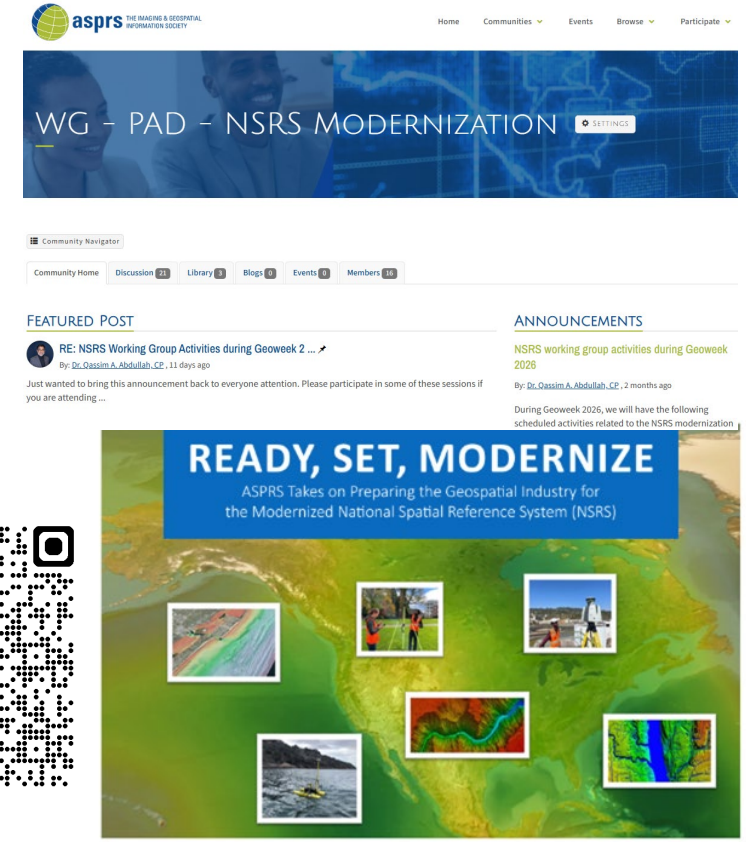
Yes! NGS will continue supporting the current NSRS through the rollout and testing of the modernized NSRS

Partners as Force Multipliers

National Society of Professional Surveyors (NSPS)

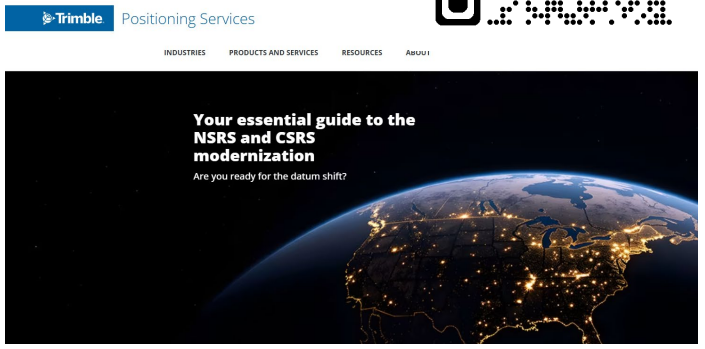


American Society of Photogrammetry and Remote Sensing (ASPRS)



Esri

Trimble



Prepare Now: The R U Ready Package

NSPS Version for Surveying Community

Package Contents:

- Initial outreach tools (Email & Leadership Memo)
- Technical readiness resources (Self-Assessment Checklist & Survey)
- Briefing materials for agency coordination (Presentation Template)

"**Proactive self-assessment is essential**…. You know your workflow and data and the external data you depend on best."

Next steps for Modernization

Evaluate operational needs and avoid unnecessary changes

- Organizational impact and staff readiness
- Program and regional support
- Interagency collaboration
- Leadership and communication
- Include plans to accommodate greater accuracy in the future

Lower-accuracy datasets may require no change at all (e.g., 10 ft)

NSRS modernization is more than a technical update

- An opportunity to enhance your agency's geospatial capabilities for the future

What does NGS need to help YOU?

- To clearly communicate what is needed with one voice

What would it cost our agency if we waited too long to prepare?

Find out more...

geodesy.noaa.gov

NGS.Feedback@noaa.gov

Thank You!