

2023 SCAUG

# EXISTING & UPCOMING HORIZONTAL VERTICAL DATUMS

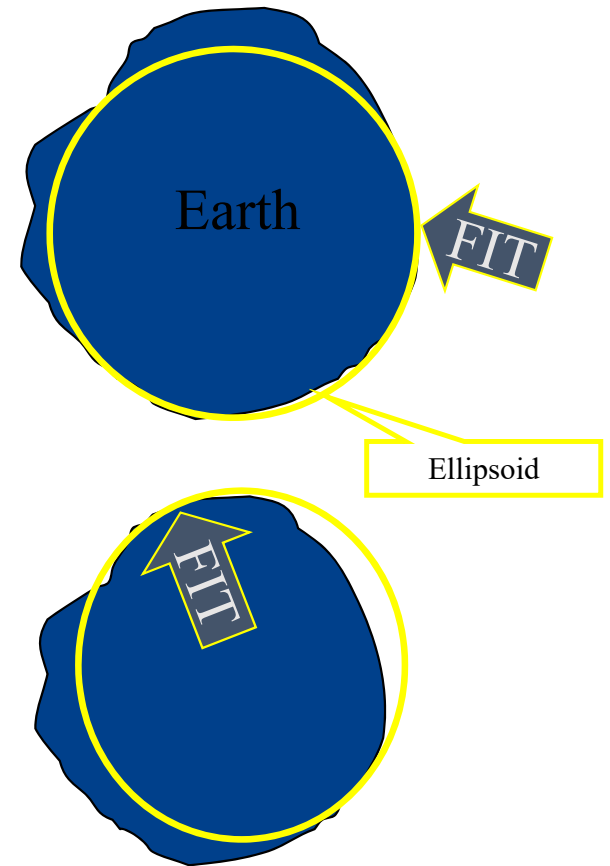
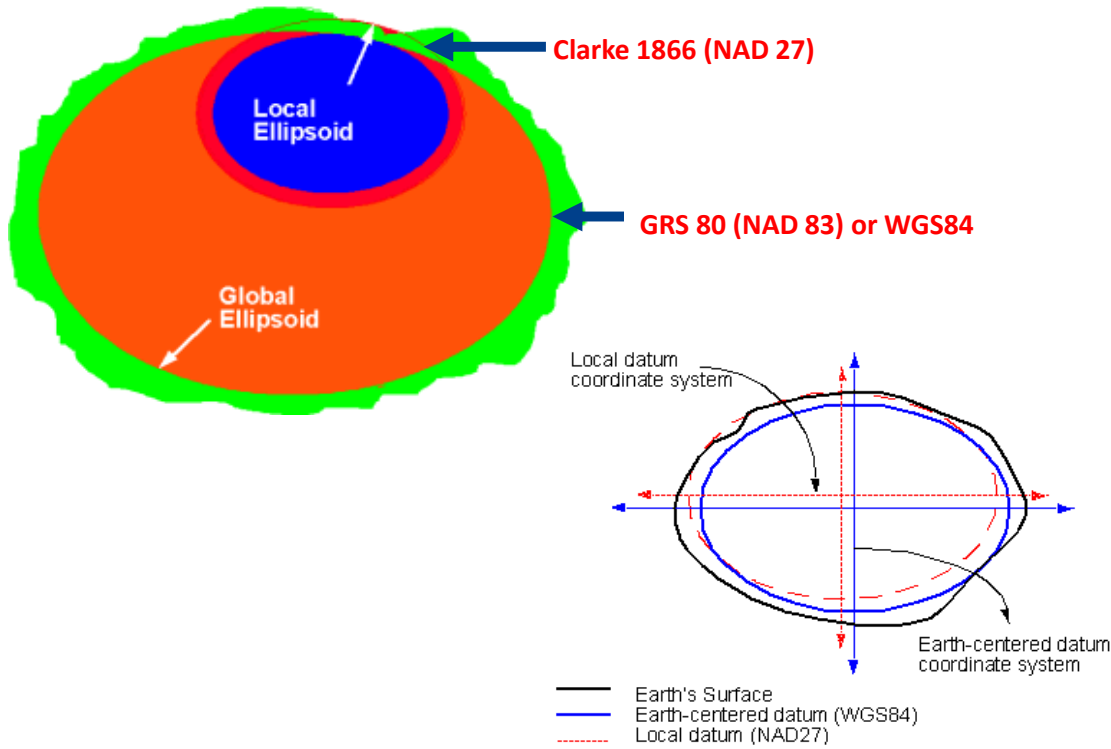
APRIL 20, 2023



# EXISTING HORIZONTAL DATUMS

# SECTION | EXISTING HORIZONTAL DATUMS

## Local and Global Ellipsoid



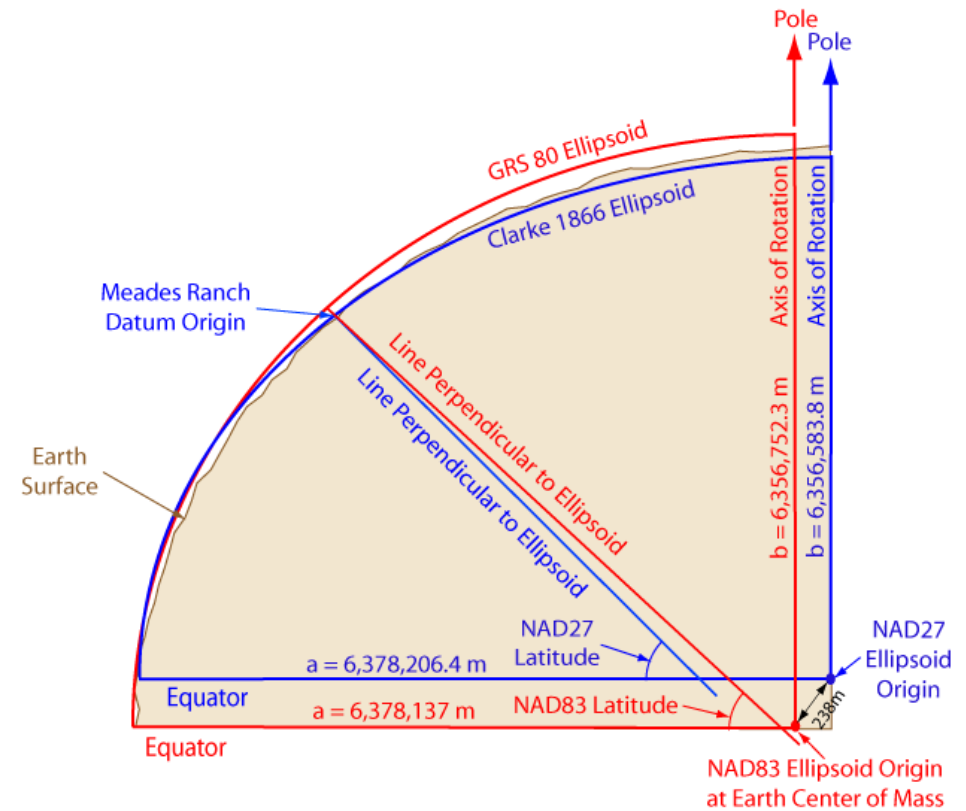


## SECTION | EXISTING HORIZONTAL DATUMS

### MAJOR DIFFERENCES

#### NAD 27 vs NAD 83

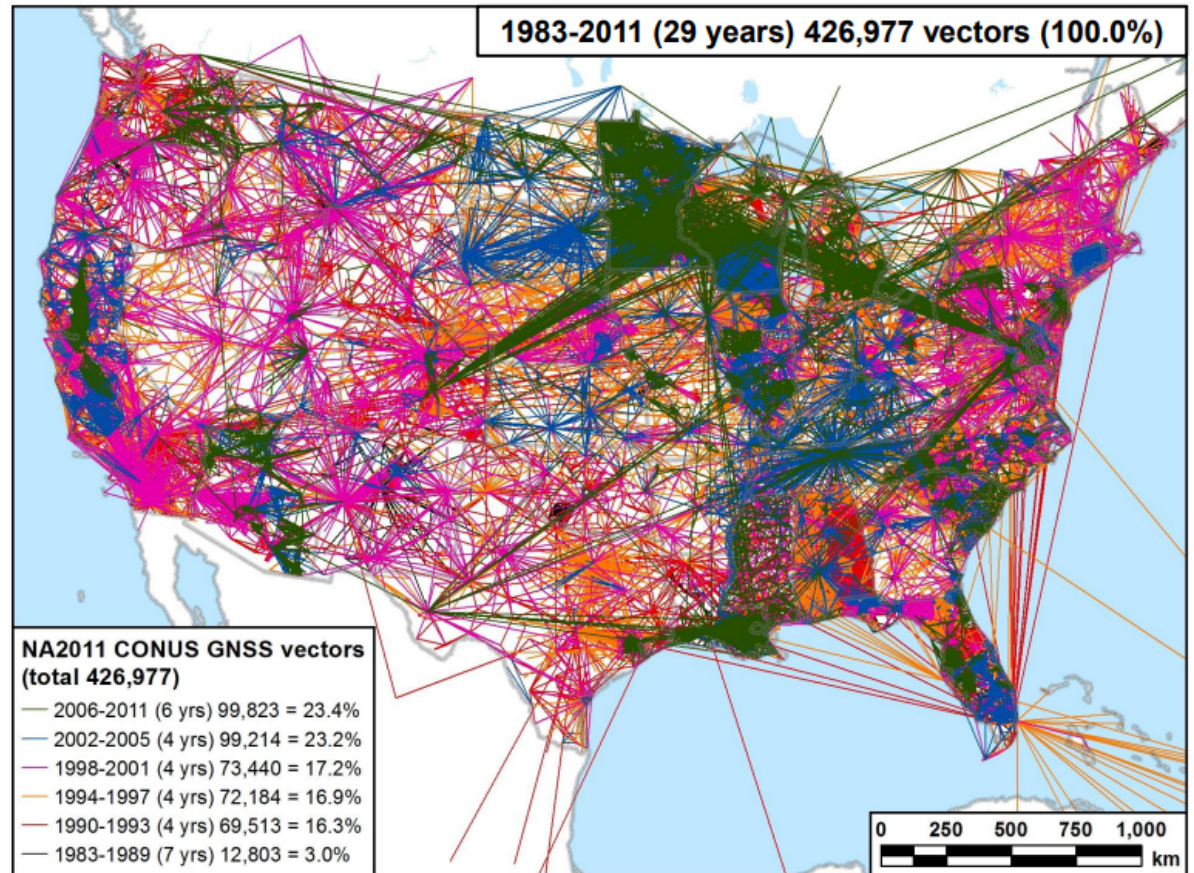
- Clark 1866 vs GRS80
- Local vs Geocentric Ellipsoid
- Single point vs No Datum Point
- Density of Network/Adjustment
- NAD 83 removed significant local distortions



## SECTION | EXISTING HORIZONTAL DATUMS

### NAD 83 ADJUSTMENTS

- NAD 83 (1986)
- NAD 83 (HARN 1997)
- NAD 83 (FBN)
- NAD 83 (NSRS 2007)
- NAD 83 (2011) epoch#2010.00







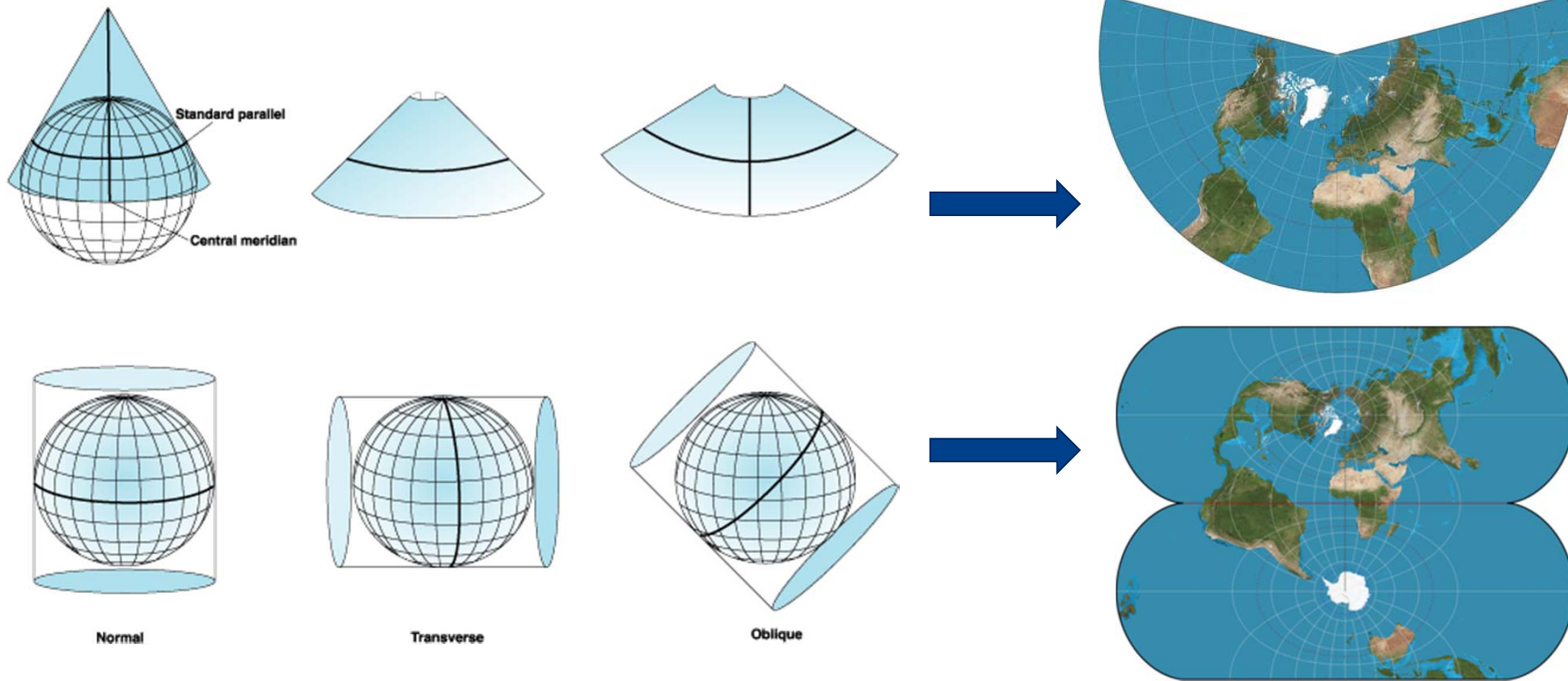
# EXISTING PROJECTIONS



## SECTION | EXISTING PROJECTIONS

### ■ PROJECTED COORDINATE SYSTEMS

- So how do we get from our Geographic Coordinates to a **Lambert Conic** or **Transverse Mercator** Projected Coordinate System?



## SECTION | EXISTING PROJECTIONS

### STATE PLANE COORDINATE SYSTEMS

■ State Plane zones are identified by the Federal Information Processing System (FIPS) Codes

■ [NGS NCAT TOOL](#)







# EXISTING VERTICAL DATUMS

# SECTION | EXISTING VERTICAL DATUMS

## GEOID

### Gravitational Models

- Geoid 18
- Geoid 12B / 12A / 12
- Geoid 09 / 06/ 03/ 99/ 96

## ORTHOMETRIC HEIGHT

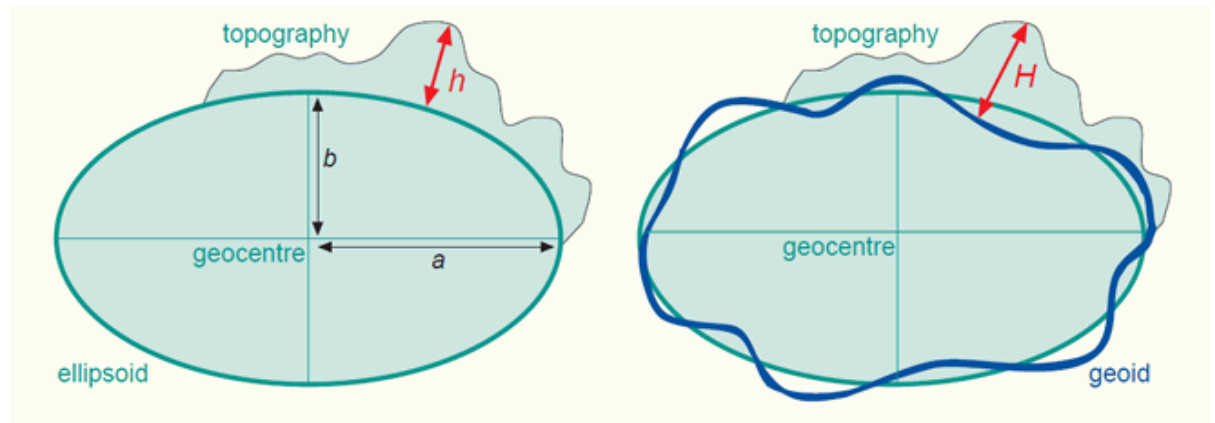
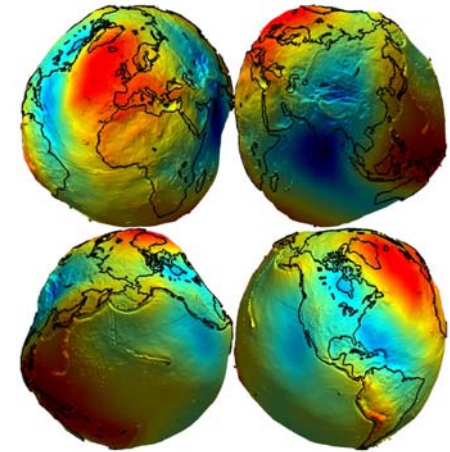
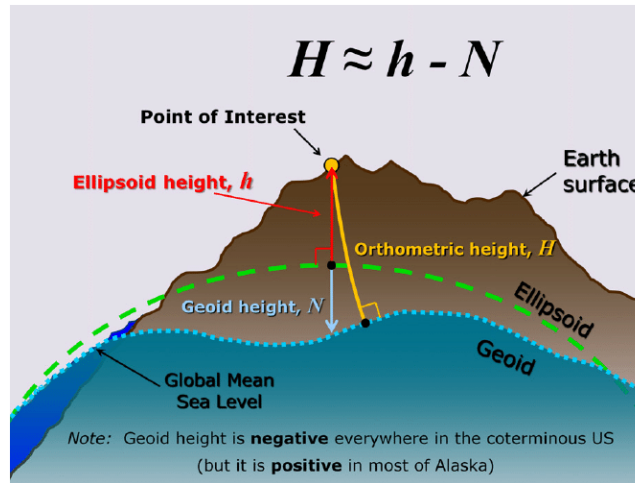
$$H = h - N$$

H: Orthometric Height

h: Ellipsoidal height (GPS)

N: Geoid

### GEOID INTERACTIVE COMPUTATIONS



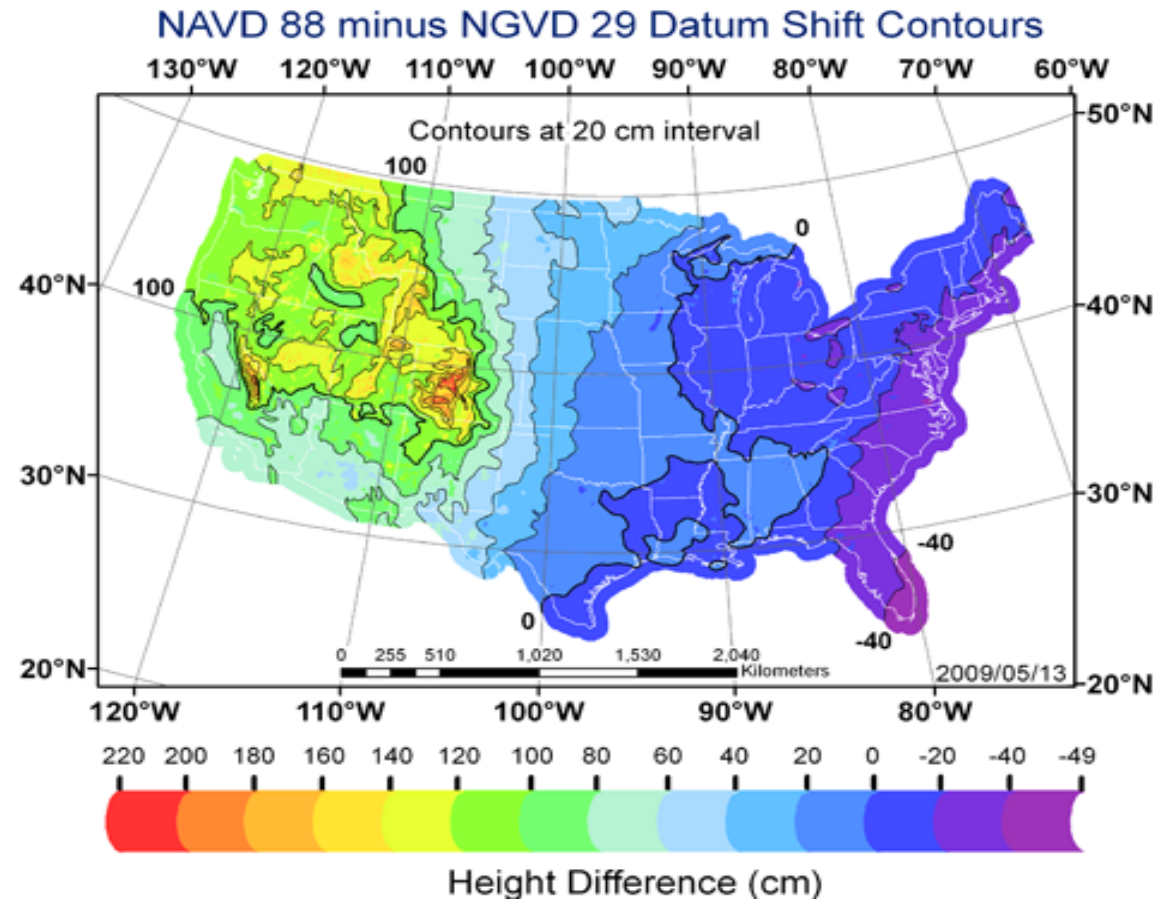


## SECTION | EXISTING VERTICAL DATUMS

### NATIONAL DATUMS

#### Differences (NGVD29 vs NAVD88)

- 26 MSLs vs 1 MSL
- 100K vs 450K (US) benchmarks
- 100K Kms vs 1M Kms levelling
- Ortho vs Geopotential corrections
- Various vs 18.6 year Tidal Epoch

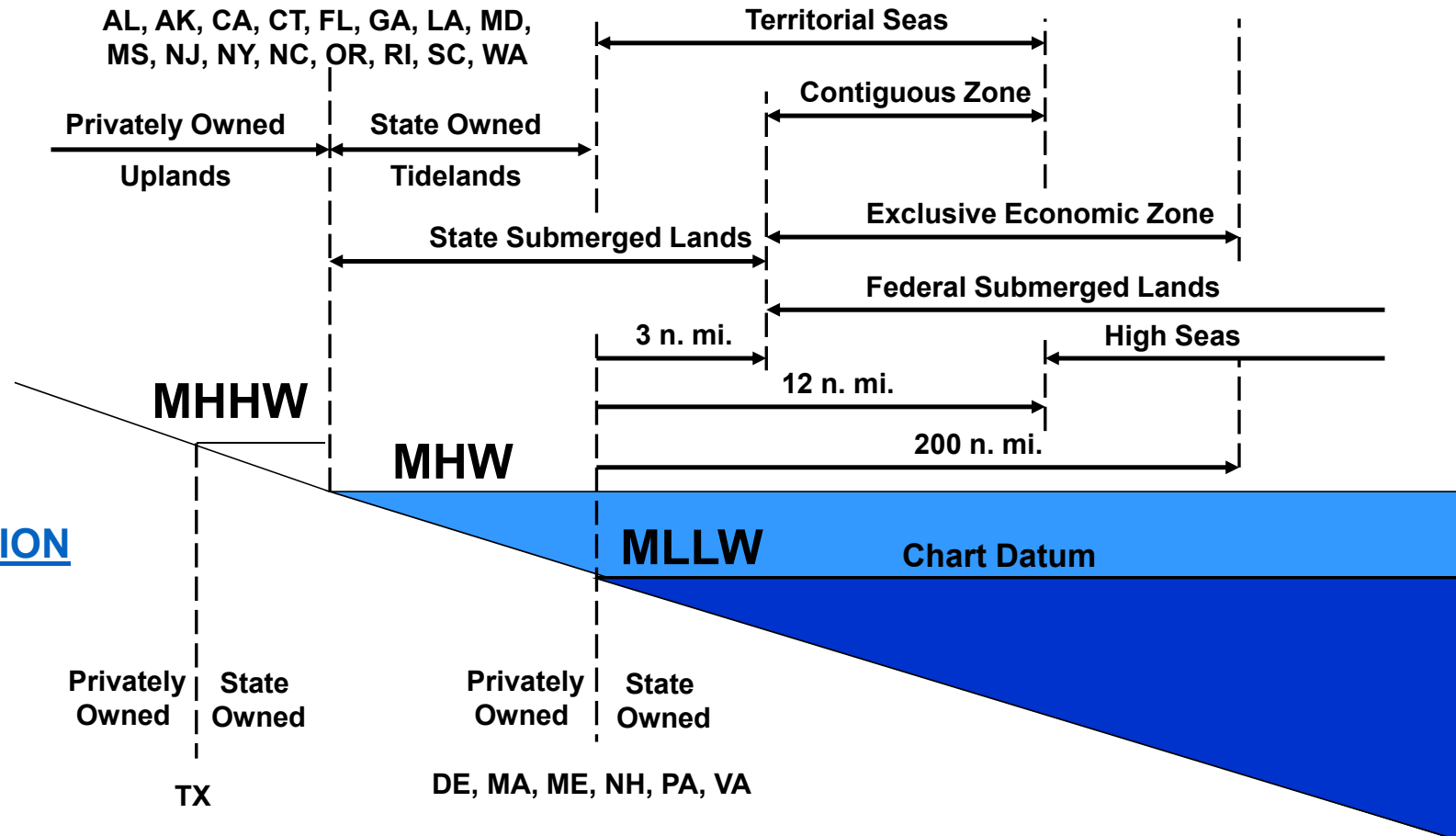


# SECTION | EXISTING VERTICAL DATUMS

## LOCAL DATUMS

### Local/Regional

- Assumed
- City/County







# NEW HORIZONTAL & VERTICAL DATUMS



# SECTION | NEW HORIZONTAL & VERTICAL DATUMS

## NEW HORIZONTAL DATUMS

### National

- 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)

## NEW VERTICAL DATUM

### National

- North American-Pacific Geopotential Datum of 2022 (NAPGD2022)
  - Vertical Datum
  - Will be referenced to GEOID2022

The screenshot shows a NOAA website page with the following content:

- Header:** National Geodetic Survey Positioning America for the Future geodesy.noaa.gov
- Logo:** NOAA logo on the left.
- Section Header:** New Datums Are Coming!
- Main Text:**

**NOAA is Replacing NAD 83 and NAVD 88.** NOAA's National Geodetic Survey (NGS) will be replacing the datums of the National Spatial Reference System (NSRS), including the **North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88)**. NGS will provide the tools to easily transform between the new and old datums. Read the NGS Ten-Year Plan and visit the **New Datums Web page** on our site to learn more.

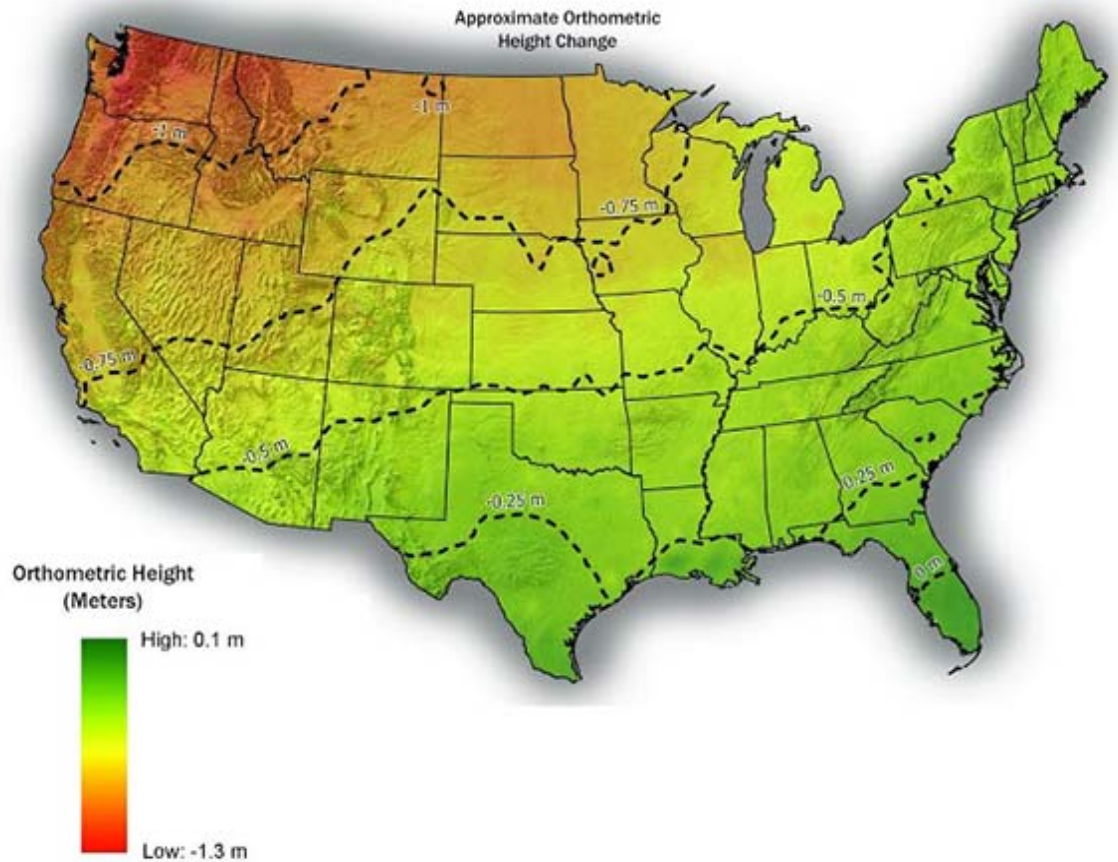
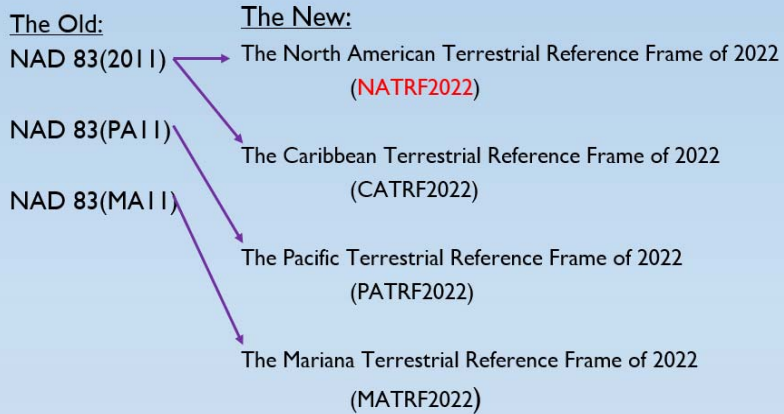
**Benefits**  
The new reference frames (geometric and geopotential) will rely primarily on **Global Navigation Satellite Systems (GNSS)**, such as the Global Positioning System (GPS), as well as on a gravimetric geoid model resulting from NGS' **Gravity for the Redefinition of the American Vertical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

The target accuracy of differential orthometric heights (heights relative to sea level) in the geopotential reference frame will be 2 centimeters over any distance, where possible.

**What You Can Expect**  
The magnitude of change with the new datums will vary depending on the datum you are using and your geographic location. The new geometric datum will change latitude, longitude, and ellipsoid height between 1 and 4 meters. In the conterminous United States (CONUS), the new vertical datum will change heights on average 50 centimeters, with approximately a 1-meter tilt towards the Pacific Northwest.
- How You Can Prepare:**
  - Learn if **legislation** or other formal documents referencing NAD 83 and NAVD 88 need to be changed in your state.
  - **Transform existing data** to the latest NSRS datums and realizations; i.e. NAD 83 (2011), GEOID18, and NAVD 88.
  - **Obtain precise ellipsoidal heights** on NAVD 88 bench marks, and visit the GPS on Bench Marks Web page to learn more.
  - **Require and provide complete metadata** on all mapping contracts. See our website for more details.
- Image:** A globe showing a color-coded geoid model with latitude and longitude lines.
- Caption:** *The new datums will extend across CONUS and U.S. territories. The terrestrial reference frames replacing NAD 83 will be consistent with geocentric global reference frames defining latitude and longitude. The geopotential datum replacing NAVD 88 will be based on a gravimetric geoid model, enhanced by data from NGS' Gravity for the Redefinition of the American Vertical Datum (GRAV-D) Project.*
- Footer:** National Oceanic and Atmospheric Administration • National Geodetic Survey



# SECTION | NEW HORIZONTAL & VERTICAL DATUMS



# SECTION | NEW HORIZONTAL & VERTICAL DATUMS

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

1 ft = 0.3048006096... m

1 ft = 0.3048 m *exactly*

differ by  
2 parts per million  
(ppm) or 0.01 ft/mile

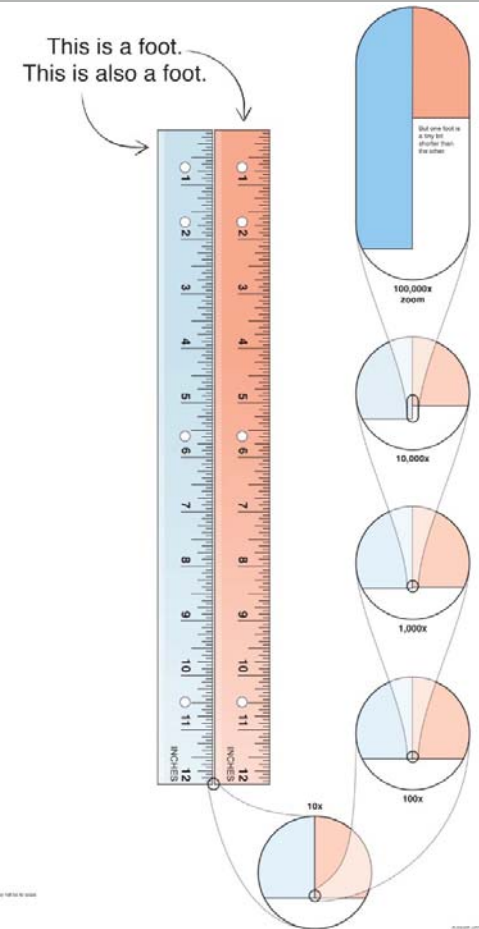
*A real problem with real costs*

<https://www.nytimes.com/2020/08/18/science/foot-surveying-metrology-dennis.html>

U.S. survey foot from 1893

international foot from  
1959

differ by about one hundredth of a foot (0.12672 inches) per mile **that's two feet for every million feet**



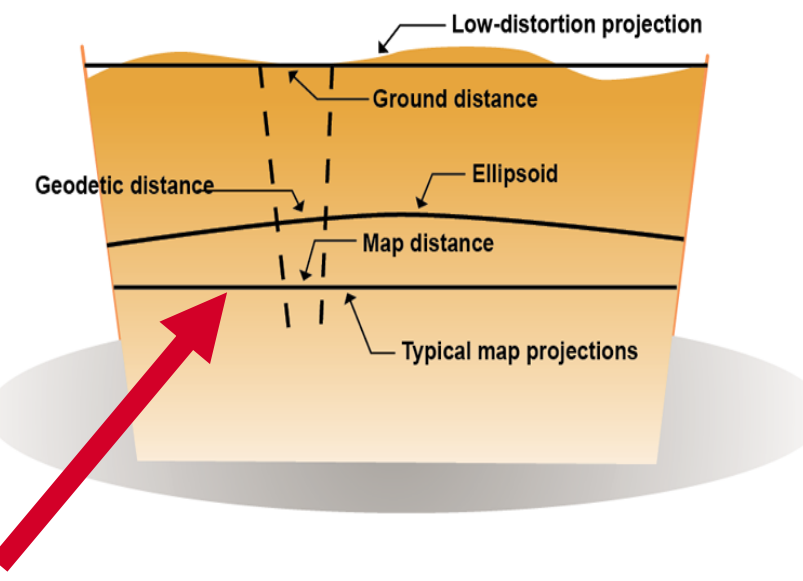
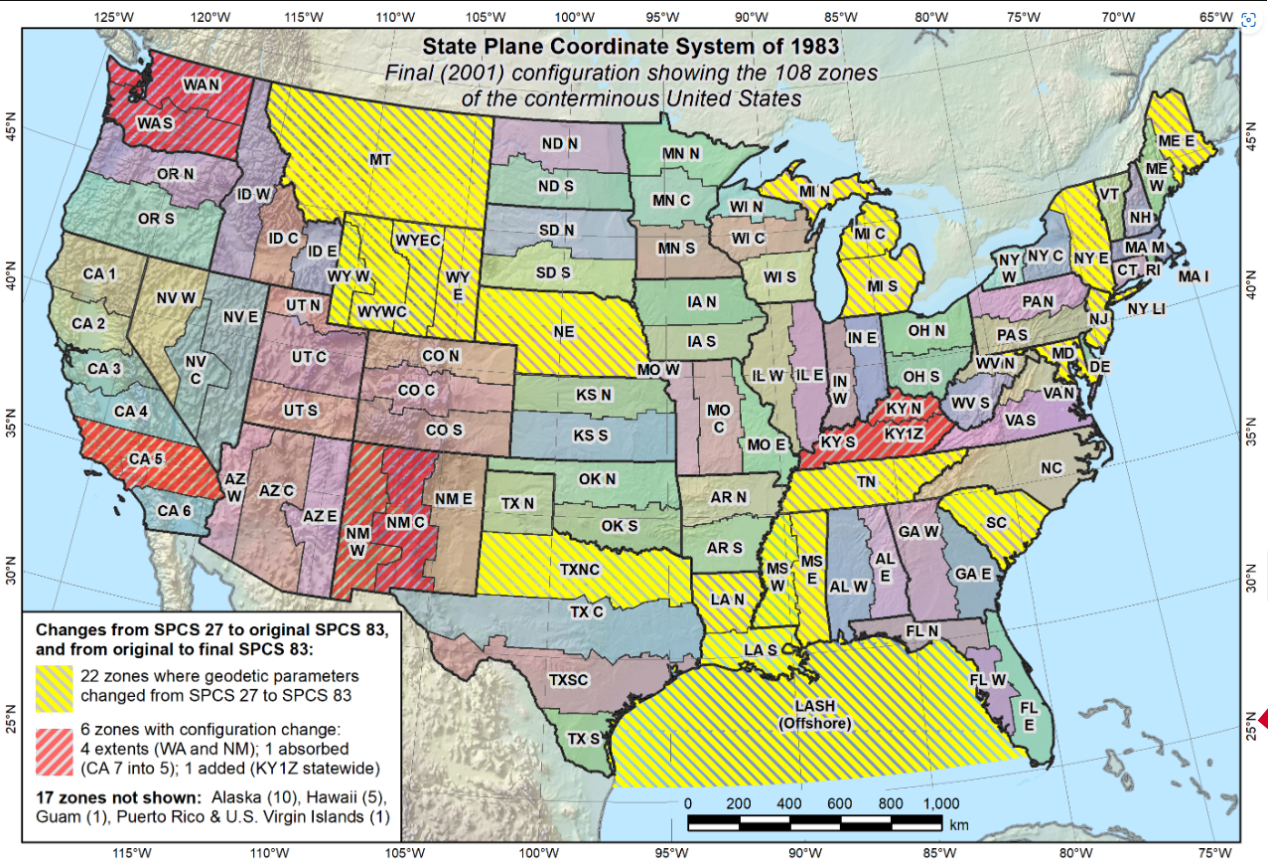




# LOW DISTORTION PROJECTIONS (LDPS)



# SECTION | LDPS



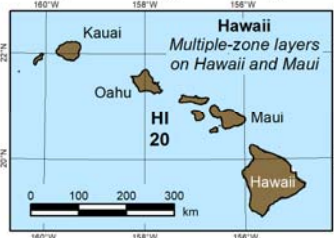
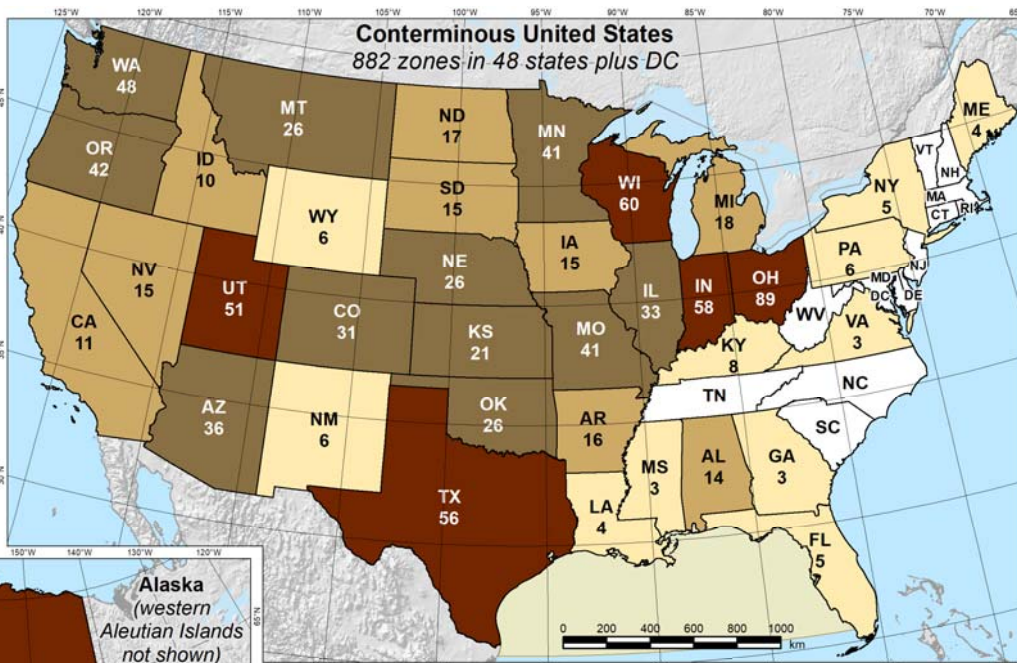
# SECTION | LDPS

## State Plane Coordinate System of 2022 (CONUS, Alaska, and Hawaii)

Three island zones not shown:  
Puerto Rico and U.S. Virgin Islands

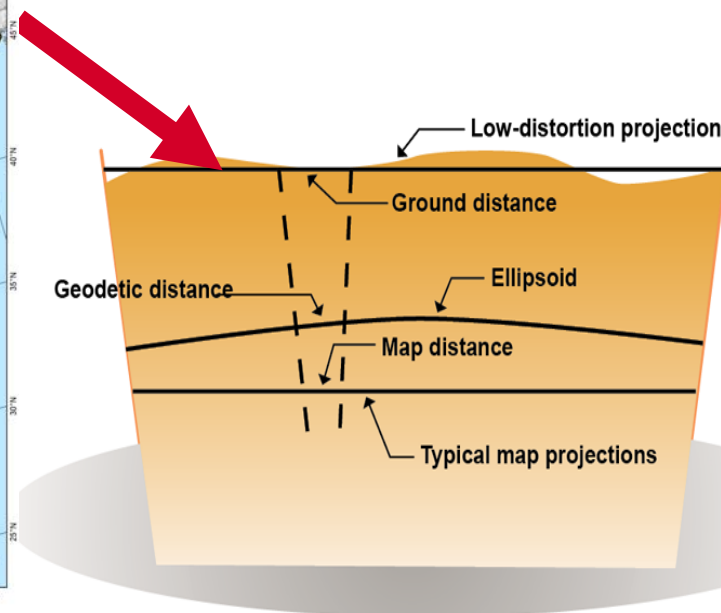
American Samoa

Guam and Commonwealth of the Northern Mariana Islands



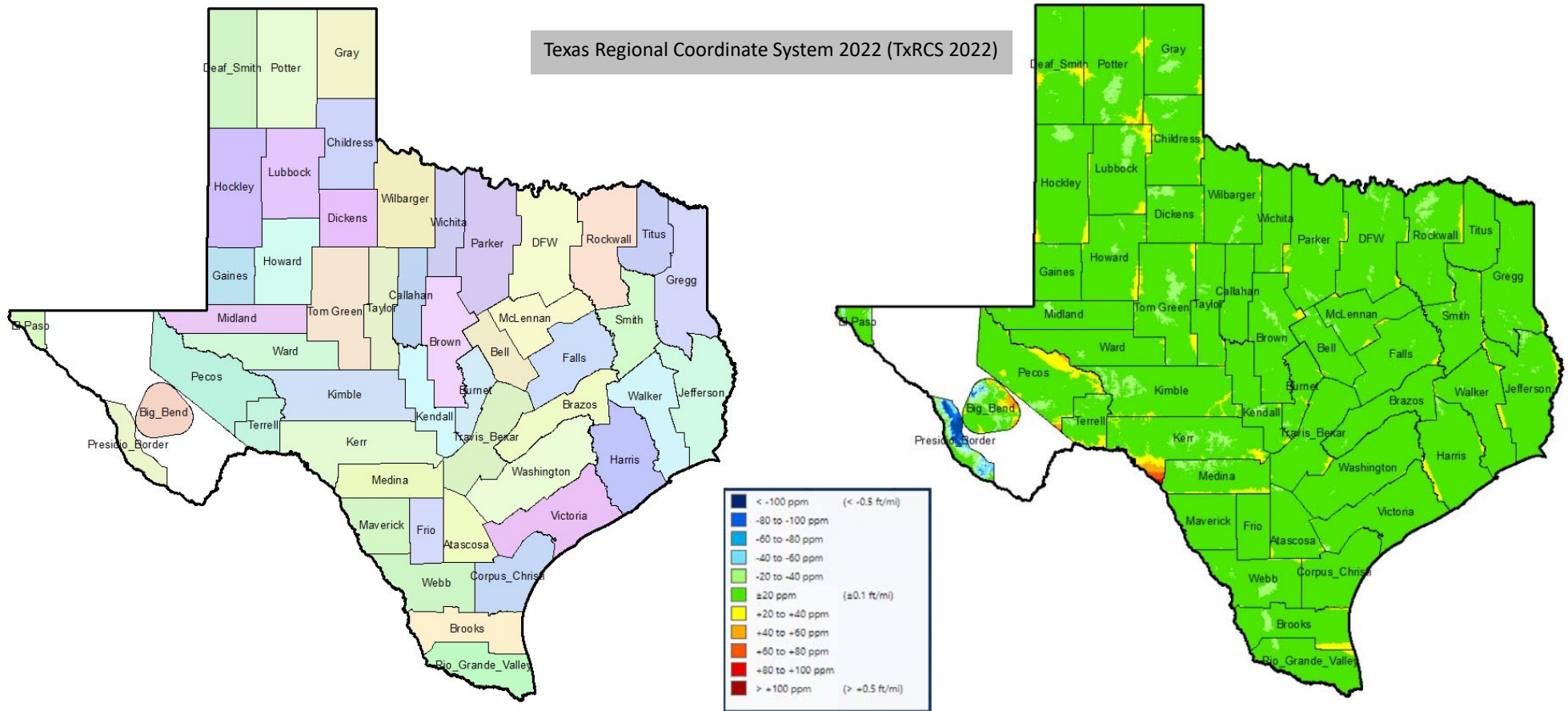
**Number of zones per state**  
Total = 955 (as of 6/11/2020)

- 1 zone (16 states)
- 3 - 8 zones (11 states)
- 10 - 18 zones (9 states)
- 20 - 48 zones (12 states)
- 50 - 89 zones (6 states)



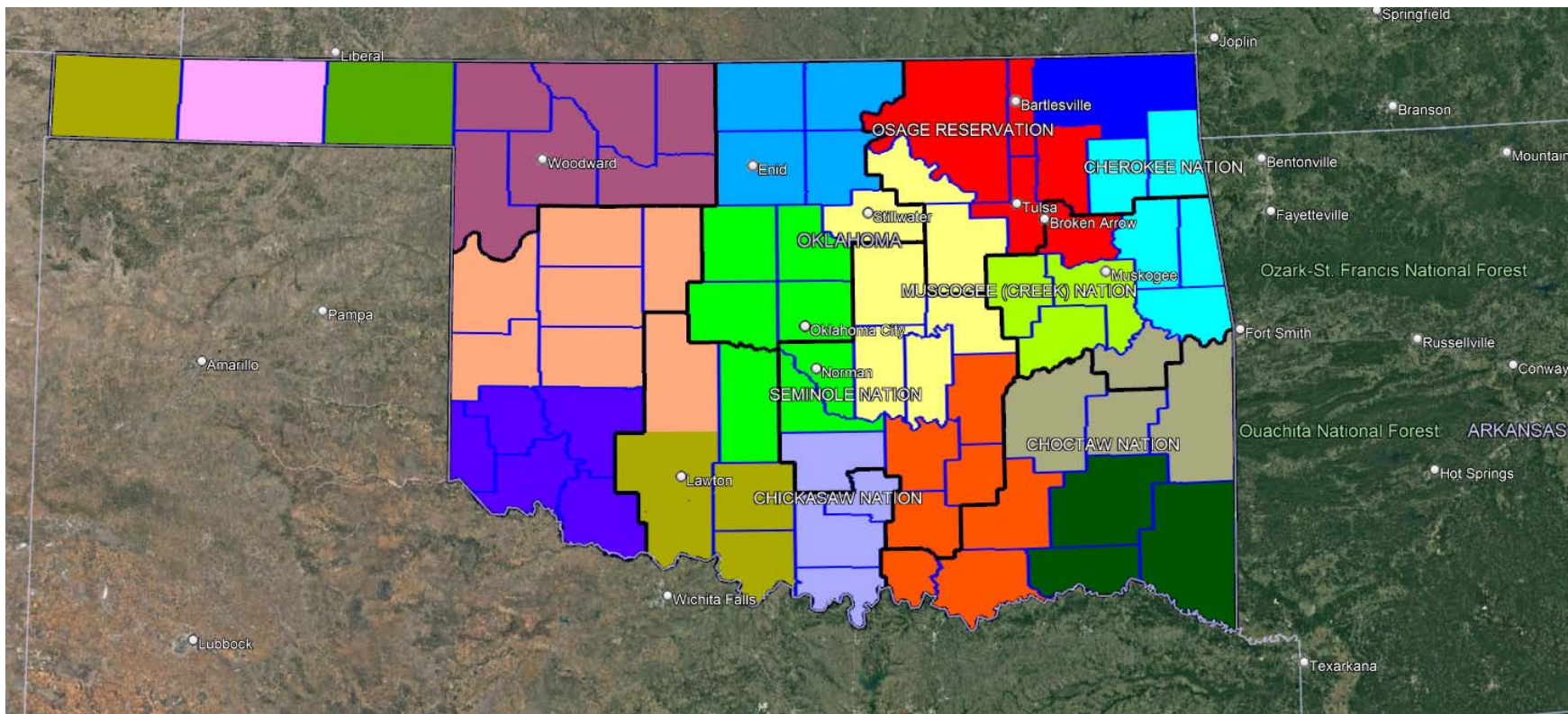


# SECTION | LDPS



# SECTION | LDPS

Oklahoma LDPS







# Q & A SAMPLE CASES AFTER 2025

## SECTION | Q & A SAMPLE CASES AFTER 2025

---

### Q&A

- [Will Project Scale Factors be minimized after 2025?](#)
- [Are we going to manage more County based LDPs after 2025?](#)
- [Will there be a level of confusion with International Feet after 2025?](#)
- [How can we prevent this level of confusion?](#)
- [Should we expect RTN GPS Base Stations and Software updates?](#)
- [Will we be able to solely rely on Transformation tools after 2025?](#)





## CLOSING | HEADLINE

---



# QUESTIONS?

Contact:

**Vas Kalogirou**, RPLS, PLS, PS, PSM, LS  
VP, Survey Practice Leader

Email Address: [vkalogirou@halff.com](mailto:vkalogirou@halff.com)

Phone: (214) 532-2308