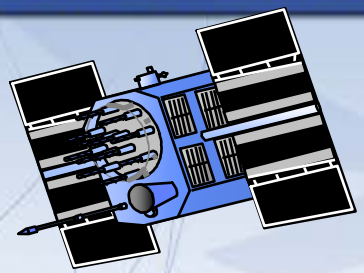


National Geodetic Survey – Preparing for Tomorrow

William (Bill) Stone
Southwest Region (AZ, NM, UT) Geodetic Advisor

william.stone@noaa.gov

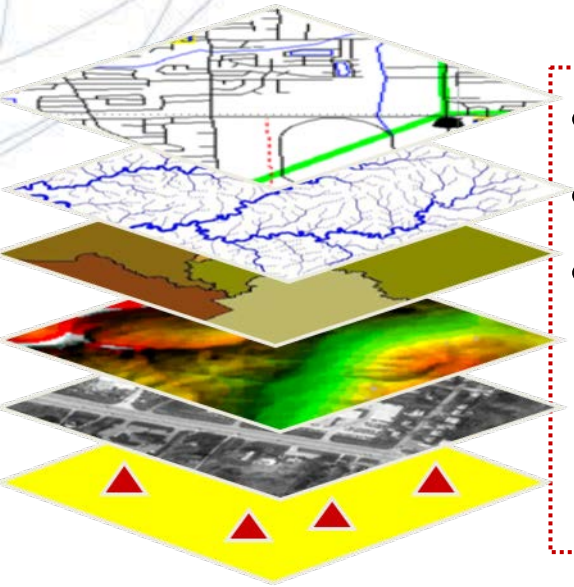
NOAA's National Geodetic Survey
geodesy.noaa.gov

February 24, 2017
St. George

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Geodetic Survey

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

National Spatial Reference System



- **Latitude**
- **Longitude**
- **Height**
- Gravity
- Orientation
- Scale

& their time variations

(& National Shoreline, etc.)

- North American Datum 1983 (NAD83)
- North American Vertical Datum 1988 (NAVD88)


SOME
SOME GIVE ALL


NEVADA
UTAH
ARIZONA
Arizona - Nevada - Utah
Monument
2016

USER: william.stone@noaa.gov DATE: February 24, 2017
RINEX FILE: 3cor054u.17o TIME: 05:29:02 UTC

SOFTWARE: page5 1209.04 master52.pl 160321 START: 2017/02/23 20:52:00
EPHEMERIS: igu19374.eph [ultra-rapid] STOP: 2017/02/23 23:59:00
NAV FILE: brdc0540.17n OBS USED: 7658 / 8153 : 94%
ANT NAME: CHCX90D-OPUS NONE # FIXED AMB: 43 / 45 : 96%
ARP HEIGHT: 0.180 OVERALL RMS: 0.014(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000)		IGS08 (EPOCH:2017.1478)	
X:	-2078663.057(m) 0.010(m)	-2078663.936(m)	0.010(m)
Y:	-4657799.043(m) 0.014(m)	-4657797.727(m)	0.014(m)
Z:	3817863.470(m) 0.003(m)	3817863.352(m)	0.003(m)

LAT:	37 0 0.69689	0.005(m)	37 0 0.71029	0.005(m)
E LON:	245 56 59.81599	0.015(m)	245 56 59.76184	0.015(m)
W LON:	114 3 0.18401	0.015(m)	114 3 0.23816	0.015(m)
EL HGT:	752.973(m)	0.009(m)	752.229(m)	0.009(m)
ORTHO HGT:	778.810(m)	0.021(m) [NAVD88 (Computed using GEOID12B)]		

	UTM COORDINATES UTM (Zone 12)	STATE PLANE COORDINATES SPC (0203 AZ W)
Northing (Y) [meters]	4099243.864	665555.848
Easting (X) [meters]	228583.492	186653.763
Convergence [degrees]	-1.83669558	-0.18057714
Point Scale	1.00050761	0.99994212
Combined Factor	1.00038940	0.99982398

US NATIONAL GRID DESIGNATOR: 12STF2858399243(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN8733	AZDS DOLAN SPRINGS CORS ARP	N353159.266	W1142133.190	165161.0
DM7868	AZGV GOLDEN VALLEY CORS ARP	N351515.731	W1141515.311	194606.3
AI8805	FRED FREDONIA CORS ARP	N365917.978	W1122957.135	138082.8

NEAREST NGS PUBLISHED CONTROL POINT

HP0314 BOUNDARY INITIAL MON AZ NV UT N370000.687 W1140300.182 0.3

This position and the above vector components were computed without any knowledge by the National Geodetic Survey regarding the equipment or field operating procedures used.

8002 Did you observe at BOUNDARY INITIAL MON AZ NV UT ? https://geodesy.noaa.gov/cgi-bin/ds_mark.prl?PidBox=HP0314

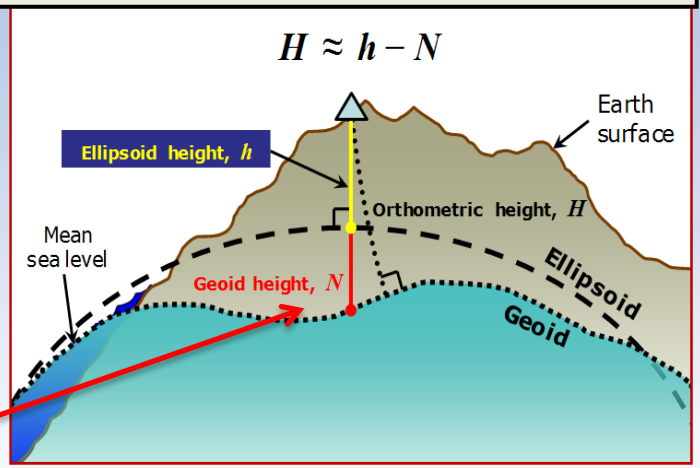
8002 To help maintain the NSRS database, please consider sharing either your

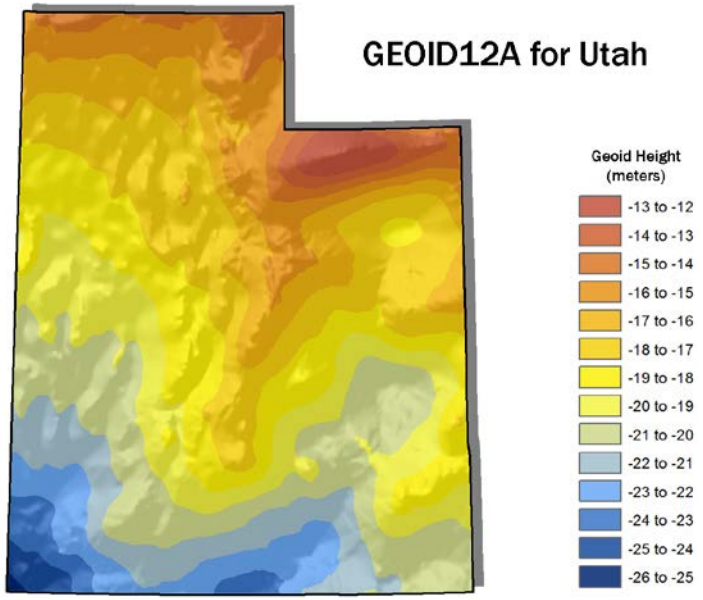
8002 -- data & recovery notes (see https://geodesy.noaa.gov/marks/sharing/)

8002 -- recovery notes only (see https://geodesy.noaa.gov/marks/recovery/)

NAD 83(2011) epoch 2010.00

```
HT_MOD      -  This is a Height Modernization Survey Station.
DESIGNATION -  HURRICANE PBO MONUMENT
PID         -  DK9770
STATE/COUNTY-  UT/WASHINGTON
COUNTRY     -  US
USGS QUAD   -  ST GEORGE (1986)

                        *CURRENT SURVEY CONTROL
______________________________________________________________________________
NAD 83(2011) POSITION- 37 03 49.92237(N) 113 34 28.98433(W)   ADJUSTED
NAD 83(2011) ELLIP HT-   925.195 (meters)        (06/27/12)   ADJUSTED
NAD 83(2011) EPOCH    -  2010.00
NAVD 88 ORTHO HEIGHT -   949.80  (meters)     3116.1   (feet) GPS OBS
______________________________________________________________________________
NAVD 88 orthometric height was determined with geoid model    GEOID09
GEOID HEIGHT    -        -24.60  (meters)                     GEOID09
GEOID HEIGHT    -        -24.61  (meters)                     GEOID12A
NAD 83(2011) X  - -2,038,302.930 (meters)                     COMP
NAD 83(2011) Y  - -4,671,108.286 (meters)                     COMP
NAD 83(2011) Z  -  3,823,609.037 (meters)                     COMP
LAPLACE CORR    -          3.32  (seconds)                    DEFLEC12A

Network accuracy estimates per FGDC Geospatial Positioning Accuracy
Standards:
       FGDC (95% conf, cm)     Standard deviation (cm)     CorrNE
          Horiz  Ellip           SD_N   SD_E   SD_h      (unitless)
-------------------------------------------------------------------
NETWORK    0.83   2.14           0.38   0.28   1.09      0.12820431
-------------------------------------------------------------------
Click here for local accuracies and other accuracy information.


.The horizontal coordinates were established by GPS observations
.and adjusted by the National Geodetic Survey in June 2012.

.NAD 83(2011) refers to NAD 83 coordinates where the reference
.frame has been affixed to the stable North American tectonic plate. See
.NA2011 for more information.

.The horizontal coordinates are valid at the epoch date displayed above
.which is a decimal equivalence of Year/Month/Day.

.The orthometric height was determined by GPS observations and a
.high-resolution geoid model using precise GPS observation and
.processing techniques.
```





National Geodetic Survey Data Explorer

National Geodetic Survey

View Map | View List

Help

Map Layers

Horizontal

- ☆ CORS
- ▲ GPS Sites
- △ Classical Horizontal

Vertical

- ● Vertical Control
- ○ Approximate Heights

Find Marks | Clear Marks

Location radius 5 Miles

Mark Center

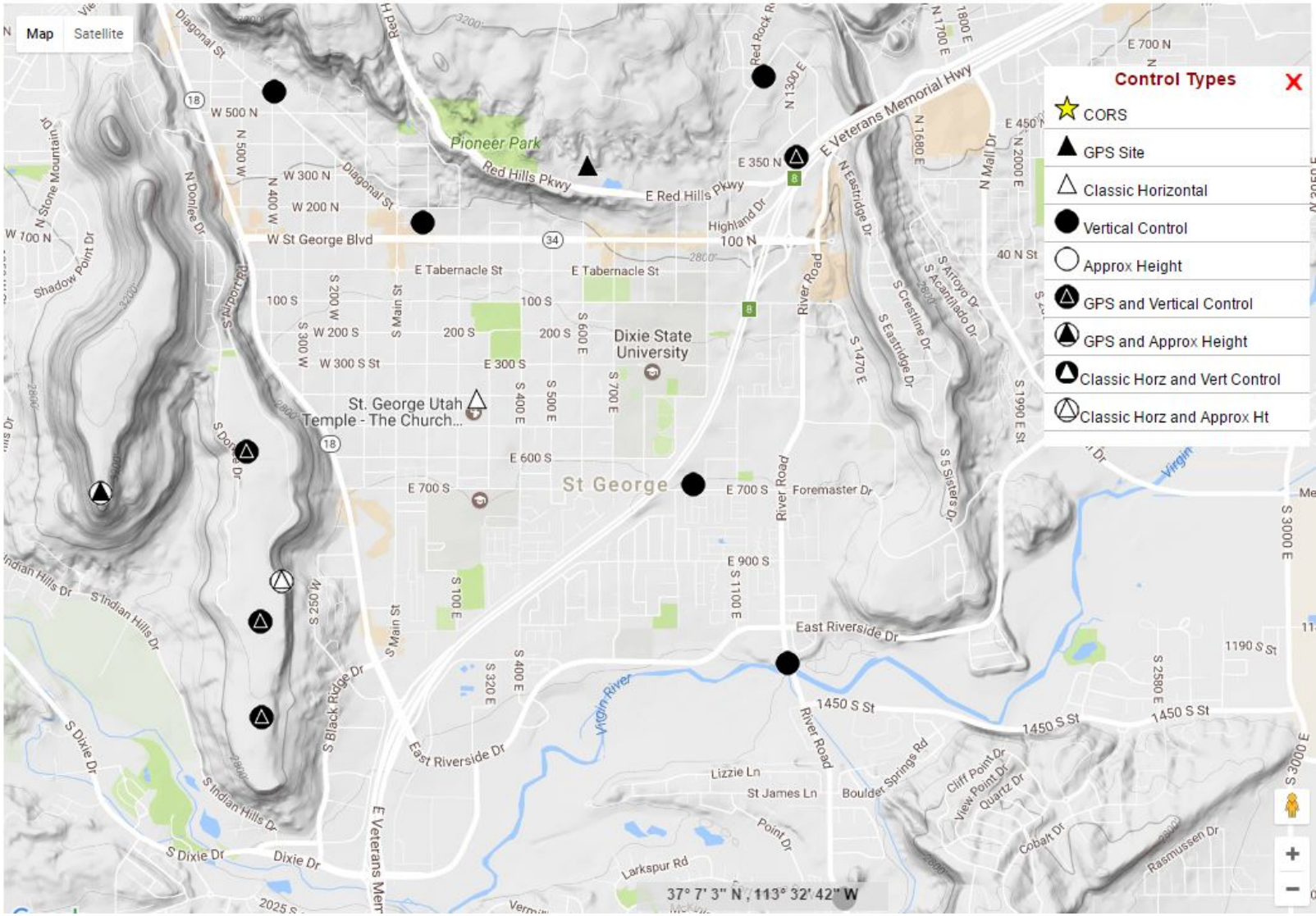
Go To Location

PID : DK9770

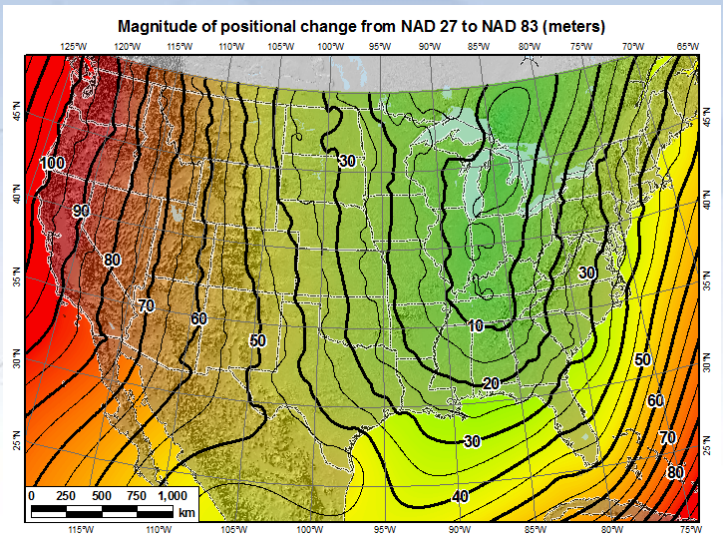
Name : HURRICANE PBO MONUMENT
Elev Source : GPS OBS
Elev Order : None
Pos Source : ADJUSTED
Pos Order : None
Ortho Ht : 949.80
Ellip Ht : 925.195

Datasheet

Show/Hide Legend



A (very) Brief History of U.S. Horizontal / Geometric Datums



U.S. Standard Datum

NAD27

NAD83 (1986)

NAD83 (HARN /199X)

NAD83 (2007)

NAD83 (2011)

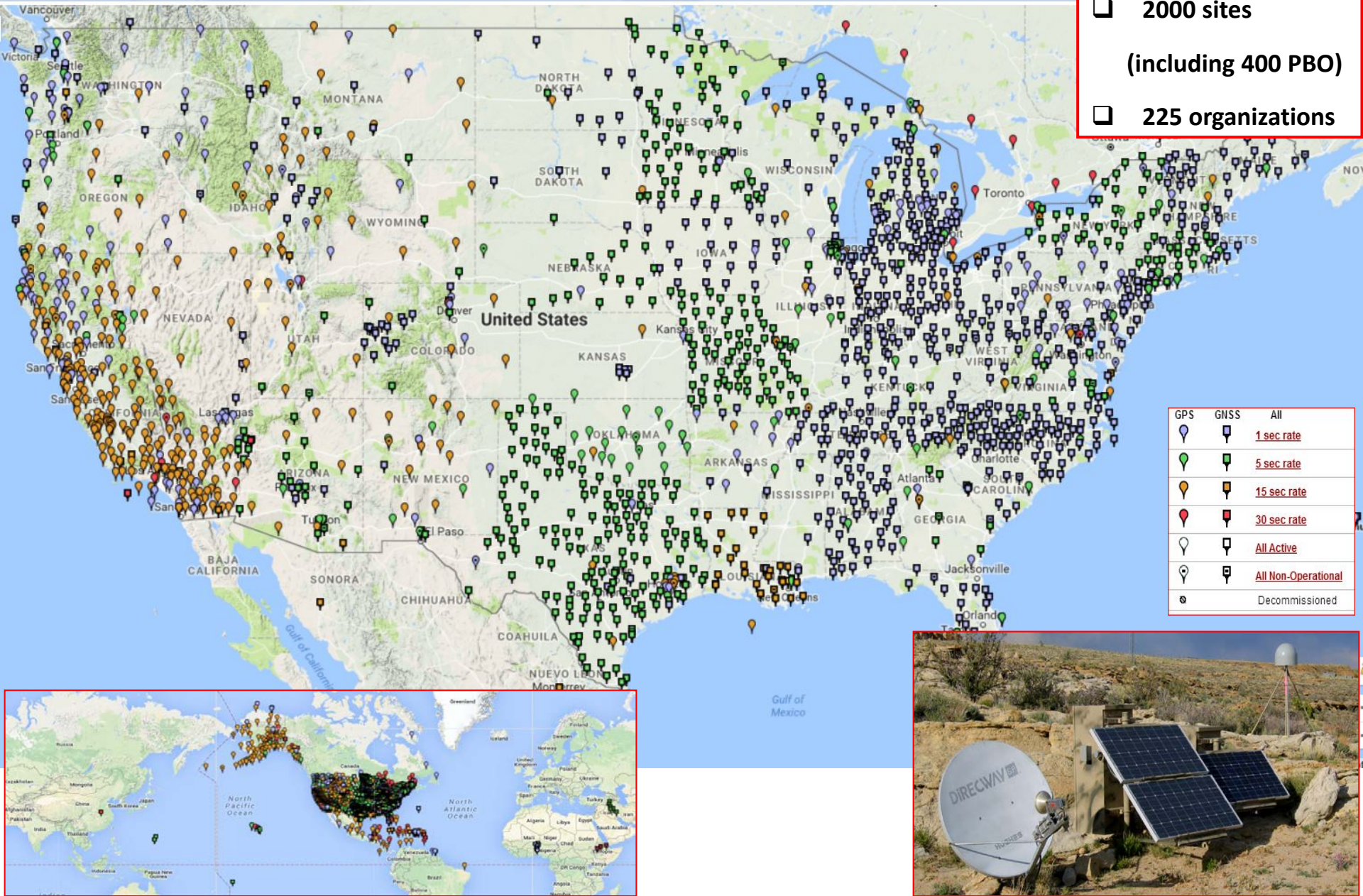
...

time

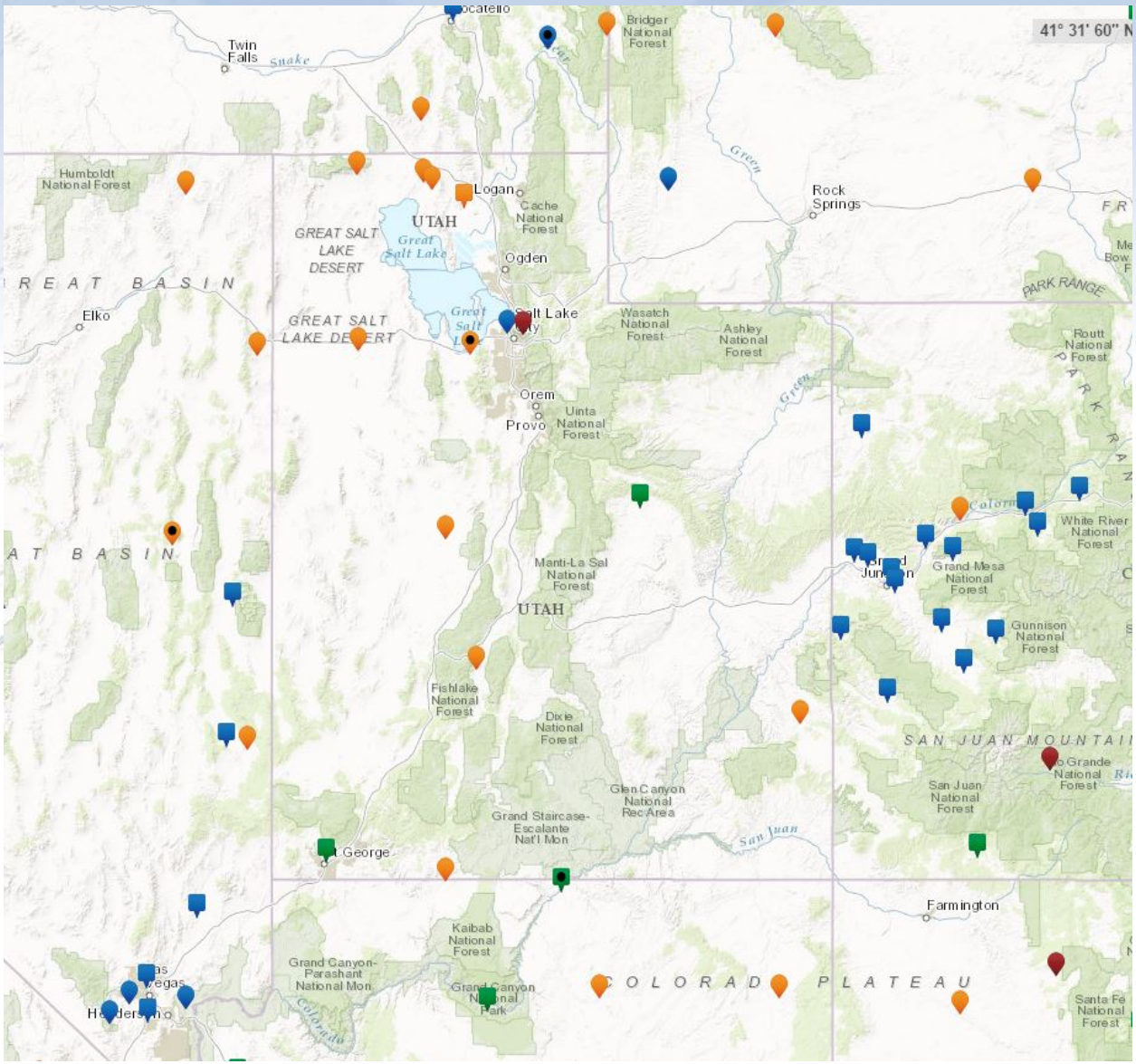
shift: < 10 m | tens of meters | few 0.1m | few 0.01m | few 0.01m

Continuously Operating Reference Station (CORS) Network

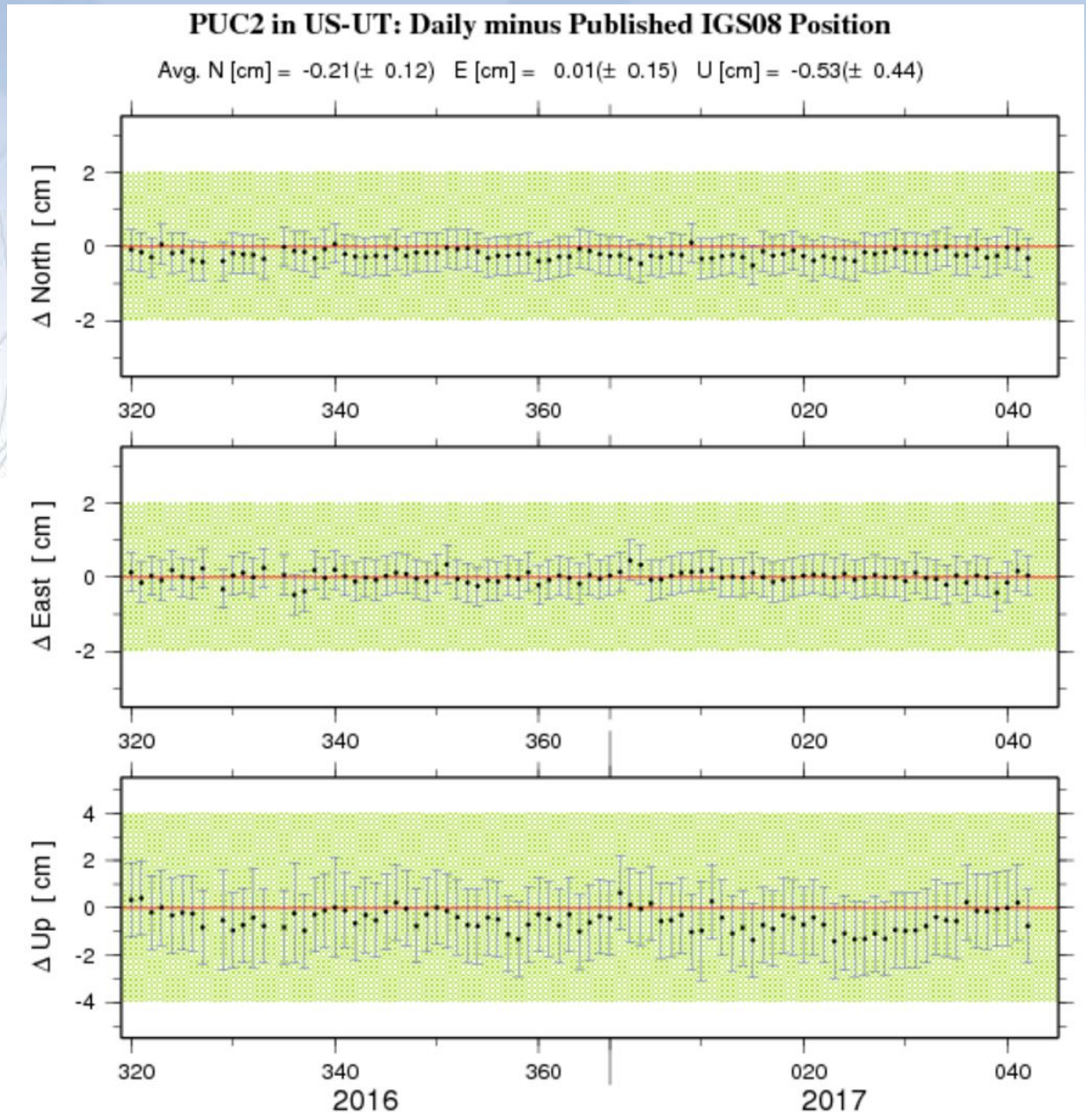
- 2000 sites (including 400 PBO)
- 225 organizations

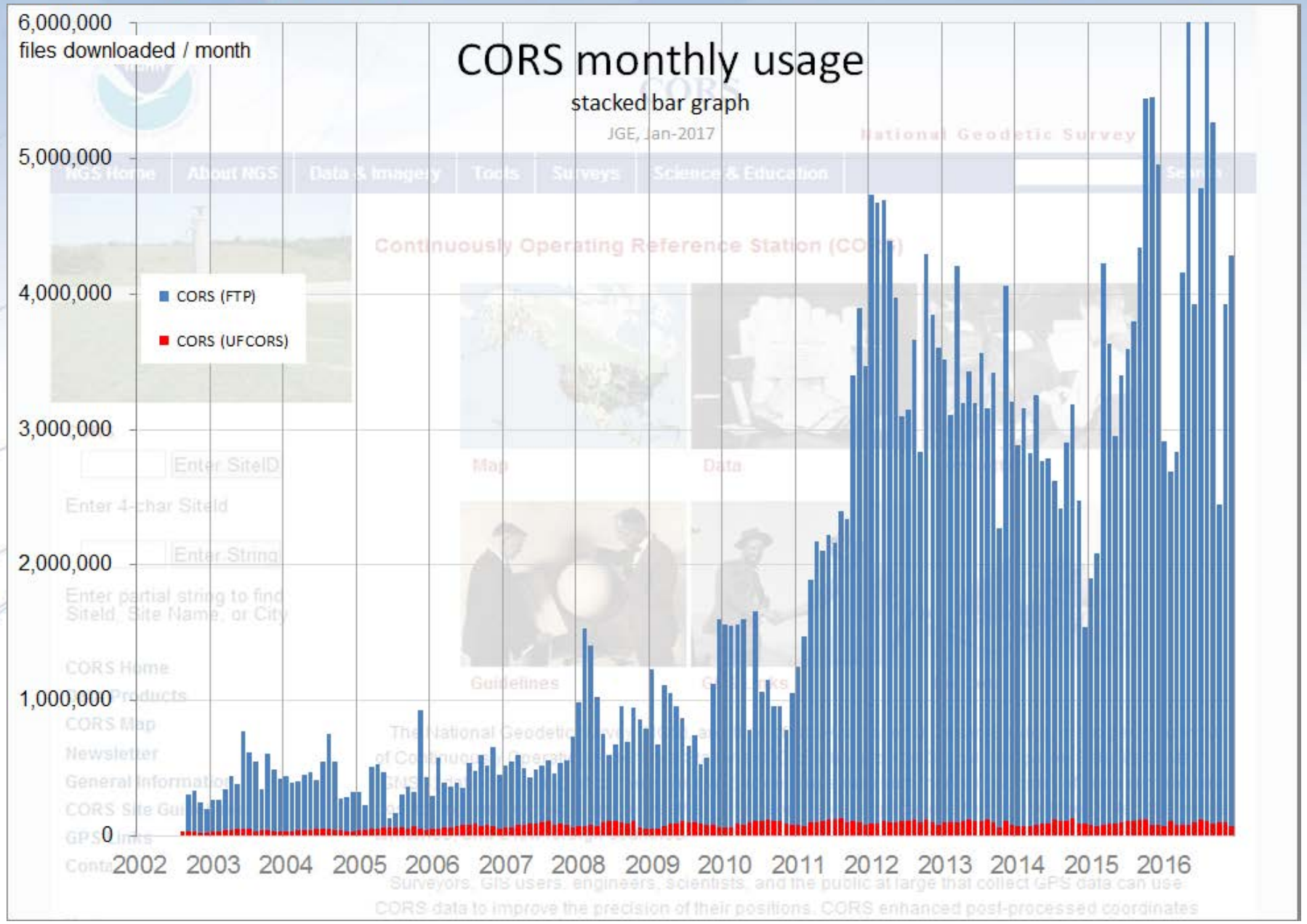


Continuously Operating Reference Station (CORS) Network



GPS	GNSS	Plot
		1 sec rate
		5 sec rate
		15 sec rate
		30 sec rate
		All Operational
		Non-Operational
		Decommissioned


PUC2 in US-UT: Daily minus Published IGS08 Position
Avg. N [cm] = -0.21(± 0.12) E [cm] = 0.01(± 0.15) U [cm] = -0.53(± 0.44)
Δ North [cm]
Δ East [cm]
Δ Up [cm]
320
340
360
020
040
2016
2017


CORS monthly usage
stacked bar graph
JGE, Jan-2017
6,000,000
files downloaded / month
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
CORS (FTP)
CORS (UFCORS)
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

International Terrestrial Reference Frame ITRF

International Terrestrial Reference Frame (ITRF)

4 Global Independent Positioning Technologies

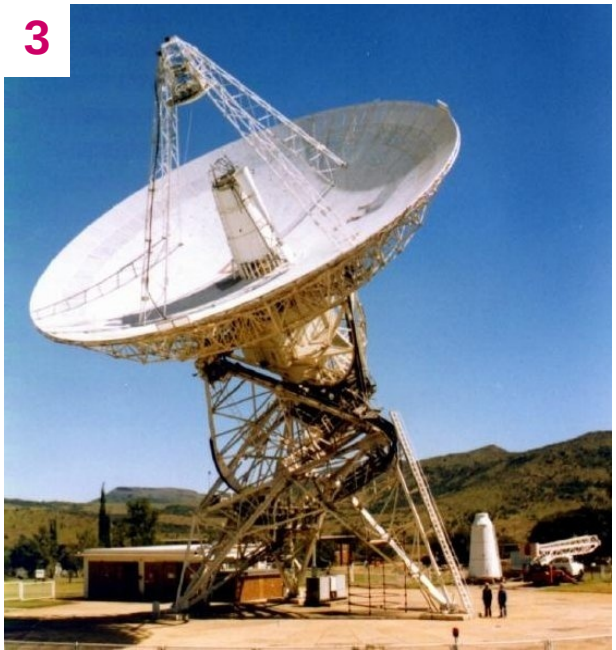
- 1. Global Navigation Satellite Systems (GNSS)
- 2. Satellite Laser Ranging (SLR)
- 3. Very Long Baseline Interferometry (VLBI)
- 4. Doppler Orbitography & Radiopositioning Integrated by Satellite (DORIS)

4

1

2

3

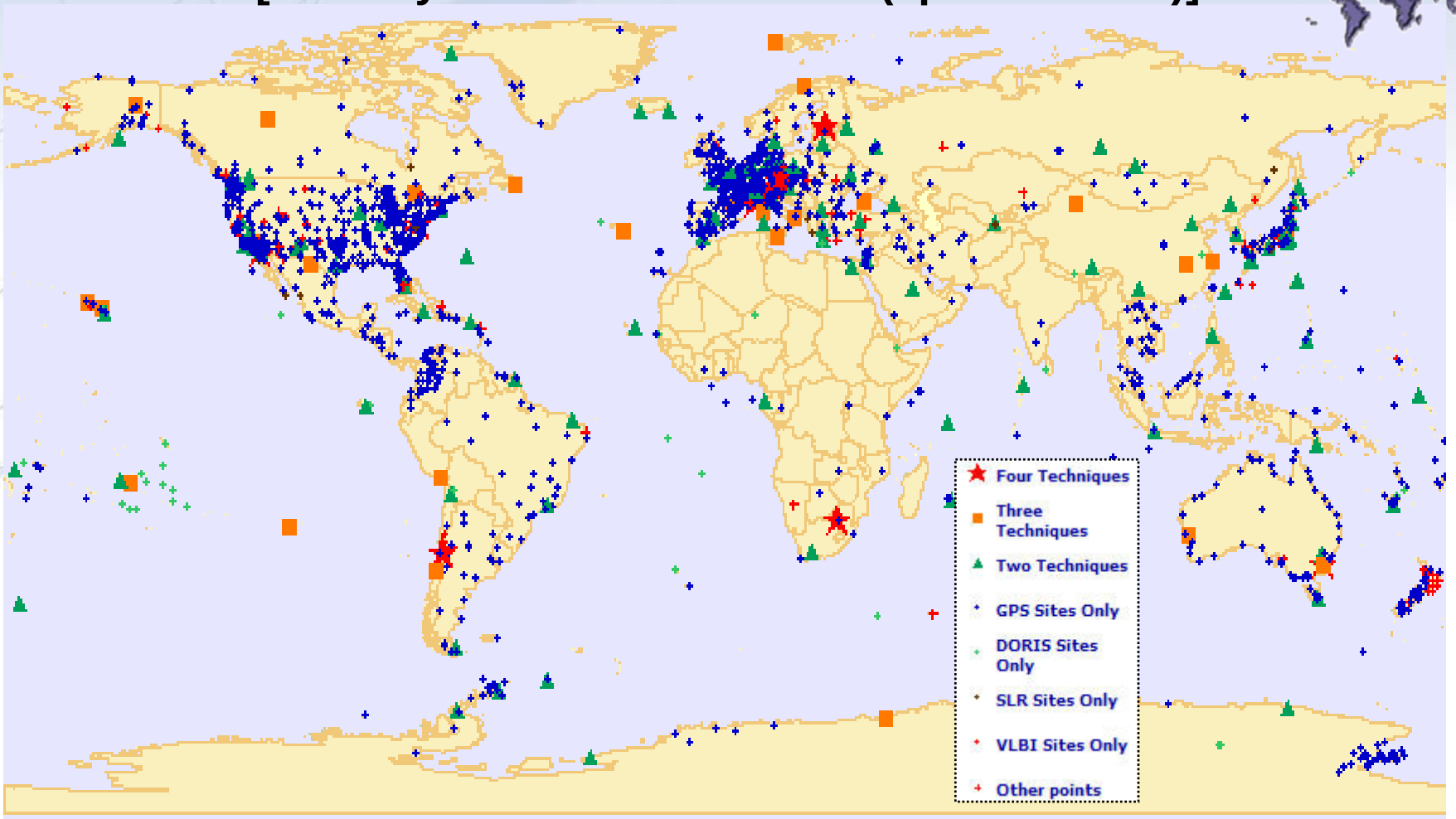


International Terrestrial Reference Frame (ITRF)

space-based techniques: VLBI, DORIS, SLR, GNSS

current version @ NGS: ITRF 2008 (epoch 2005.0)

[recently released: ITRF 2014 (epoch 2010.0)]



International Earth Rotation and Reference System Service (IERS)

(http://www.iers.org)

CORS Coordinates

```
        Antenna Reference Point(ARP): CARBON COUNTY UT CORS ARP
        ------------------------------------------------------
                            PID = DP9024
```

IGS08 epoch 2005.0 = International GNSS Service 2008 (@ January 1, 2005) (GPS-only realization of ITRF2008)

IGS08 Position >>

```
IGS08 POSITION (EPOCH 2005.0)
Computed in Sep 2015 using 12 days of data.
    X =  -1745062.460 m     latitude    =  39 35 38.11967 N
    Y =  -4603213.161 m     longitude   = 110 45 41.57151 W
    Z =   4044436.503 m     ellipsoid height = 1713.494   m
```

IGS08 Velocity >>

```
IGS08 VELOCITY
Predicted with HTDP_3.2.3 Sep 2015.
    VX =  -0.0151 m/yr      northward =  -0.0071 m/yr
    VY =   0.0009 m/yr      eastward  =  -0.0144 m/yr
    VZ =  -0.0055 m/yr      upward    =  -0.0000 m/yr
```

NAD83 Position >>

```
NAD_83 (2011) POSITION (EPOCH 2010.0)
Transformed from IGS08 (epoch 2005.0) position in Sep 2015.
    X =  -1745061.768 m     latitude    =  39 35 38.10058 N
    Y =  -4603214.452 m     longitude   = 110 45 41.52524 W
    Z =   4044436.534 m     ellipsoid height = 1714.255   m
```

NAD83 Velocity >>

```
NAD_83 (2011) VELOCITY
Transformed from IGS08 velocity in Sep 2015.
    VX =   0.0019 m/yr      northward =   0.0018 m/yr
    VY =   0.0016 m/yr      eastward  =   0.0012 m/yr
    VZ =   0.0006 m/yr      upward    =  -0.0013 m/yr
```

NAD83 (2011) epoch 2010.00 = North American Datum 1983 (2011) (@ January 1, 2010)

Current 14-Parameter Transformation – IGS08 >> NAD83(2011)

IGS08 --> NAD 83 (2011)

[12 common points]

$t_0 = 1997.0$

$T_x(t_0) = 0.99343$ m; $T_y(t_0) = -1.90331$m; $T_z(t_0) = -0.52655$ m

$\varepsilon_x(t_0) = 25.91467$ mas; $\varepsilon_y(t_0) = 9.42645$ mas; $\varepsilon_z(t_0) = 11.59935$ mas

$s(t_0) = 1.71504 \cdot 10^{-9}$ (unitless)

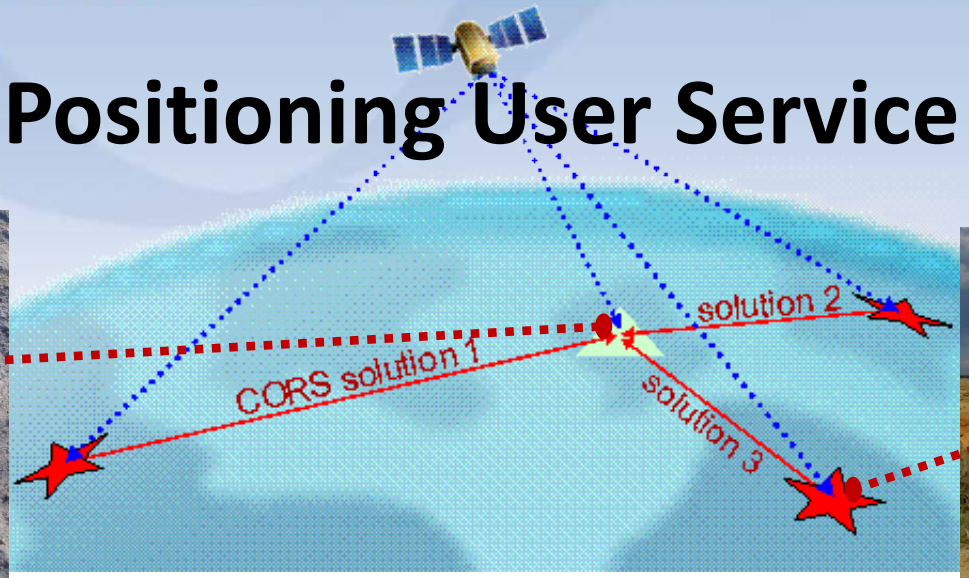
$\dot{T}_x = 0.00079$ m · year^{-1}; $\dot{T}_y = -0.00060$ m · year^{-1}; $\dot{T}_z = -0.00134$ m · year^{-1}

$\dot{\varepsilon}_x = 0.06667$ mas · year^{-1}; $\dot{\varepsilon}_y = -0.75744$ mas · year^{-1}; $\dot{\varepsilon}_z = -0.05133$ mas · year^{-1}

$\dot{s} = -0.10201 \cdot 10^{-9}$ year^{-1}

http://geodesy.noaa.gov/CORS/coords.shtml

Online Positioning User Service (OPUS)



- upload L1/L2 GPS data >>> solution via email in minutes
  - OPUS-RS (Rapid Static) ----15 min to 2 hr (per CORS)
  - OPUS-S (Static) ---- 2 to 48 hr (anywhere)
  - OPUS-DB (Database) --- sharing of results
  - OPUS-Projects --- network of multi-stations/occupations

Fast, easy, consistent access to NSRS

You are invited! ….

- OPUS-Projects Workshop
  - May 8-9, 2017
  - Park City, UT
  - at UT Geographic Information Council (UGIC) Annual Conference (May 8-12, 2017)

UGIC
UTAH GEOGRAPHIC INFORMATION COUNCIL

OPUS IGS14 Announcement

frame change to IGS14 begins with orbits

Orbits have been upgraded by IGS to their new IGS14 reference frame (**29 Jan 2017**.)
As other sources remain in IGS08 for now, we expect no significant impact to OPUS users.
A fully IGS14-based OPUS should be available in beta later this year.

Final
: The final combinations are available at 12 days latency.

Rapid
: The Rapid product is available with approximately 17 hours latency.

UltraRapid
: The UltraRapid combinations are released four times each day (at 0300, 0900, 1500, and 2100 UT) and contain 48 hours worth of orbits; the first half computed from observations and the second half predicted orbit. The files are named according to the midpoint time in the file: 00, 06, 12, and 18 UT.

OPUS – Share (aka OPUS-DB)

❑ Sharing Criteria:

- NGS-calibrated antenna
- > 4 hour data span
- > 70% observations used
- > 70% fixed ambiguities
- < 0.04m H peak-to-peak
- < 0.08m V peak-to-peak

❑ Uses:

- GPS on BMs
- PLSS / GCDB
- Data archive
- Data sharing

Shared Solution

PID: GT0228
Designation: F 72
Stamping: F 72 1928
Stability: Most reliable; expected to hold position well
Setting: In rock outcrop or ledge
Mark Condition: G
Description: The station is located 6.2 miles along the Mount Whitney Trail from the trailhead at the Whitney Portal, west of Lone Pine. It is located at Trail Camp, about 250 feet south of the south shore of a lake and about 50 feet south of the trail, opposite a 10-feet-tall boulder that sits directly along the north side of the trail. The station is a USCGS bench mark disk set flush in the top of a granite outcrop measuring about 75 feet by 25 feet and standing about 10 feet above the level of the trail.
Observed: 2010-08-17T16:53:00Z
See Also 1928
Source: OPUS - page5 1209.04

Close-up View

REF_FRAME:	EPOCH:	SOURCE:	UNITS:	SET PROFILE	DETAILS
NAD_83(2011)	2010.0000	NAVD88 (Computed using GEOID12A)	m		

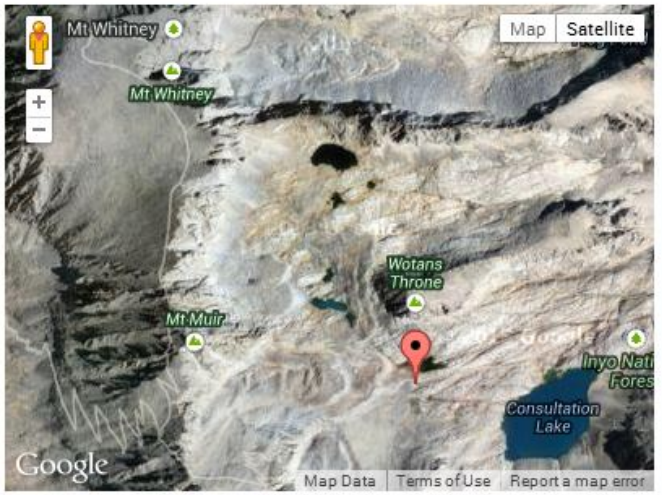
LAT:	36° 33' 46.36644" ± 0.006 m	
LON:	-118° 16' 46.29502" ± 0.003 m	
ELL HT:	3645.963 ± 0.013 m	
X:	-2431390.178 ± 0.006 m	
Y:	-4519449.679 ± 0.013 m	
Z:	3780713.238 ± 0.002 m	
ORTHO HT:	3671.261 ± 0.031 m	

	UTM 11	SPC 404(CA 4)
NORTHING:	4047144.640m	636673.937m
EASTING:	385501.607m	2064491.407m
CONVERGENCE:	-0.76230261°	0.42982529°
POINT SCALE:	0.99976152	0.99994136
COMBINED FACTOR:	0.99918979	0.99936952

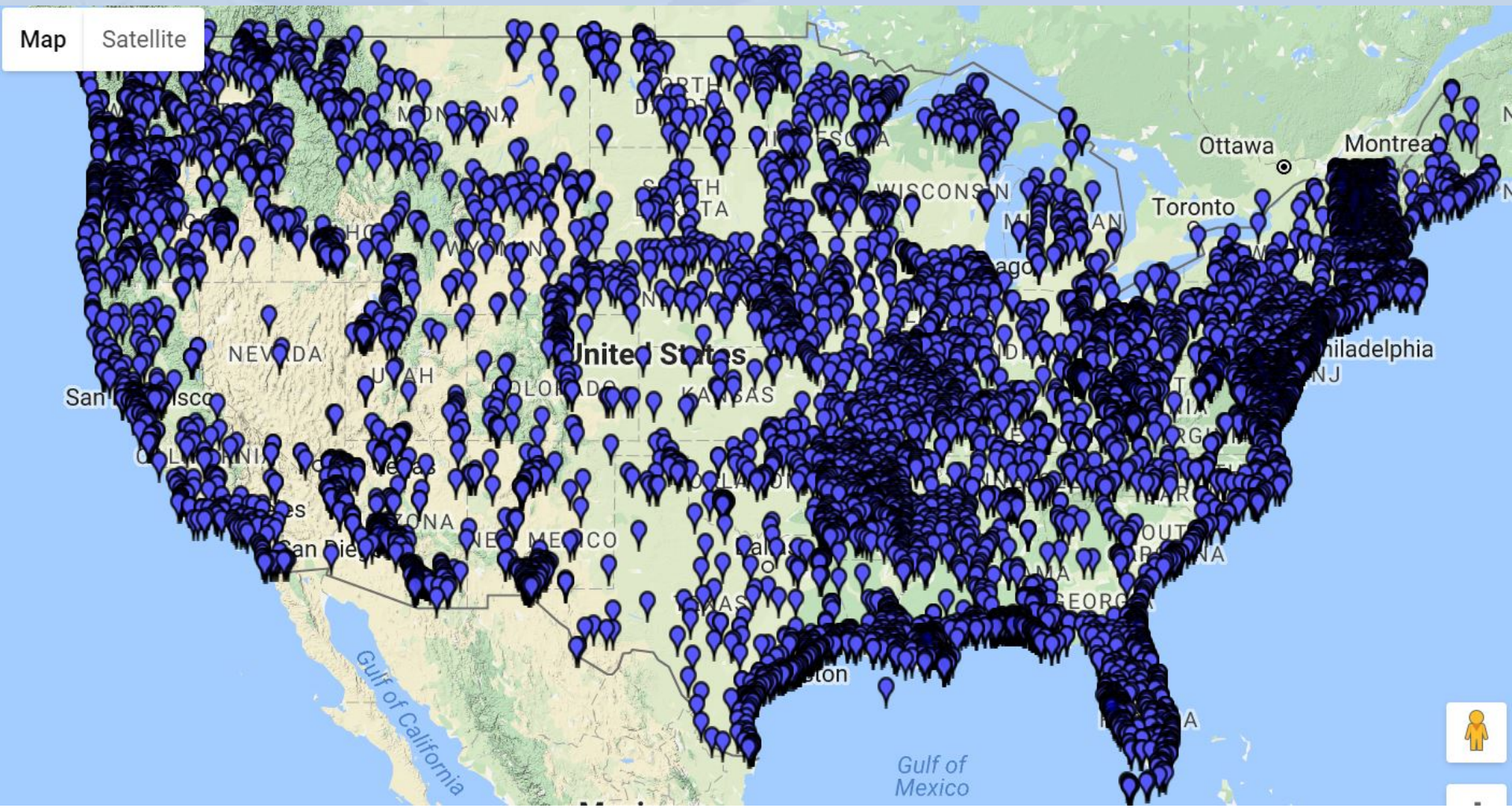
CONTRIBUTED BY

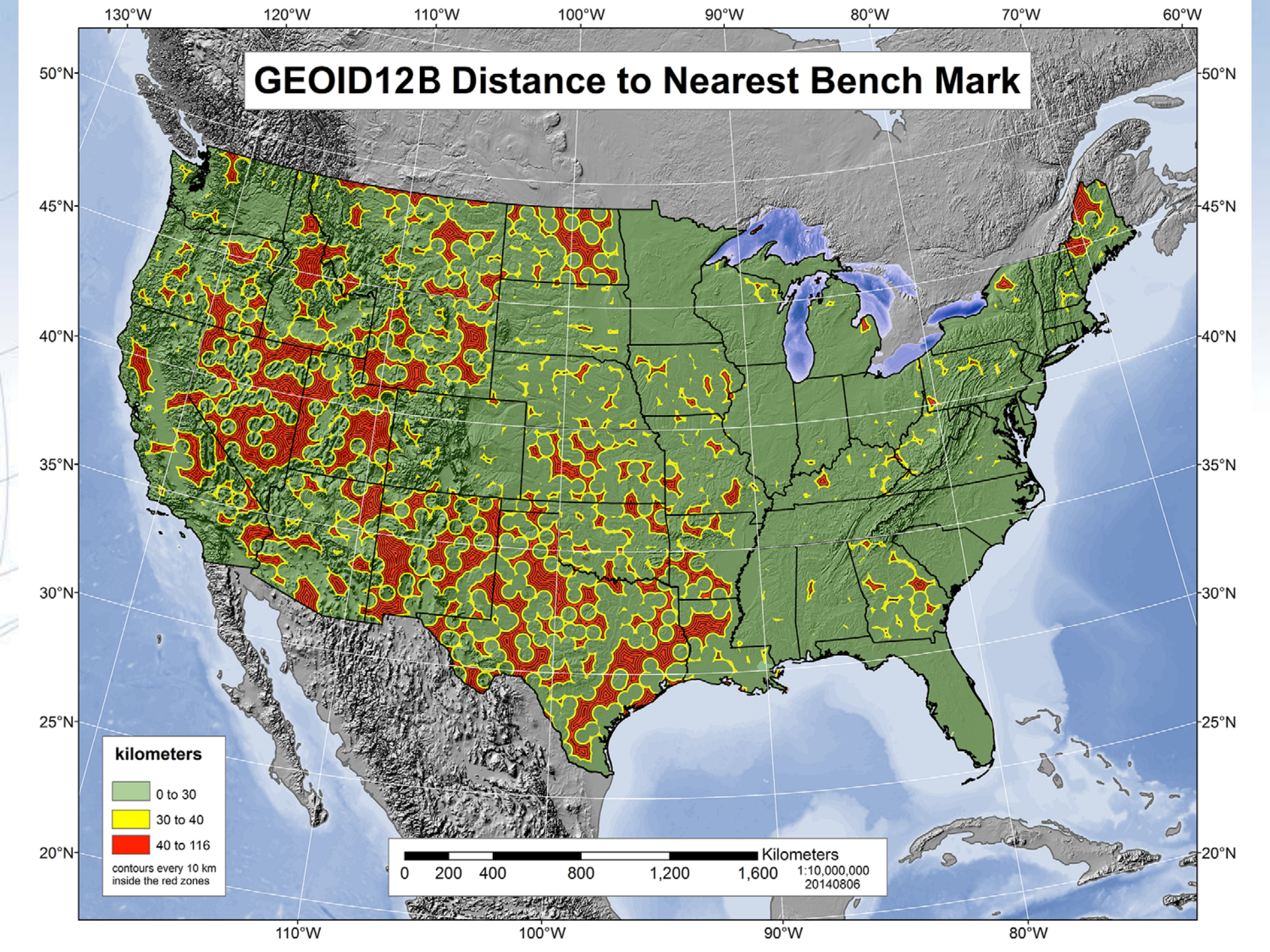
william.stone
National Geodetic Survey


Horizon View



Shared OPUS Solutions

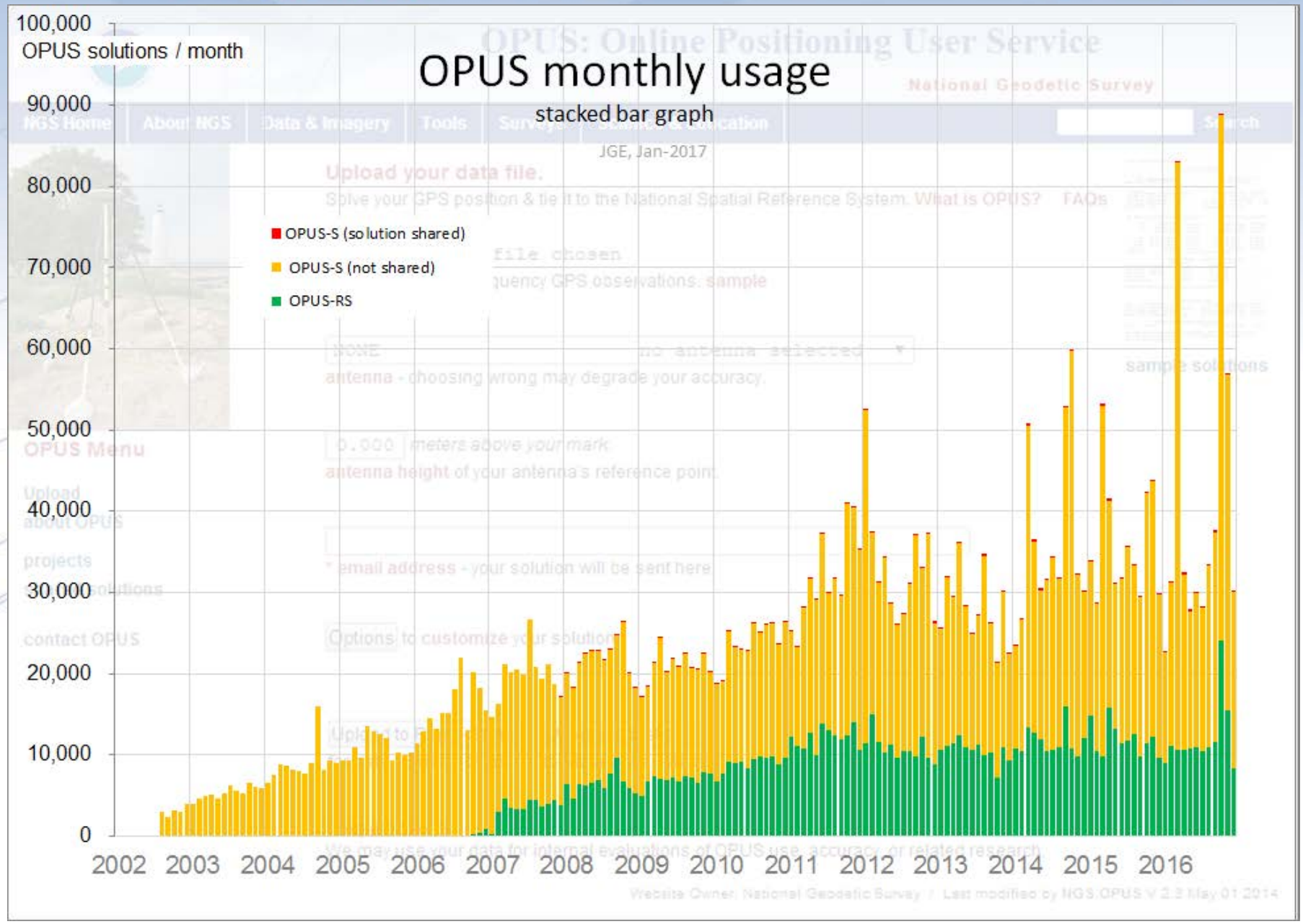



GEOID12B Distance to Nearest Bench Mark
130°W
120°W
110°W
100°W
90°W
80°W
70°W
60°W
50°N
45°N
40°N
35°N
30°N
25°N
20°N
kilometers
0 to 30
30 to 40
40 to 116
contours every 10 km
inside the red zones
Kilometers
0 200 400 800 1,200 1,600
1:10,000,000
20140806

OPUS monthly usage

stacked bar graph

JGE, Jan-2017



National Geodetic Survey ***Ten-Year Strategic Plan***

- By 2022, reduce all definitional & access-related errors in geometric reference frame to 1 cm when using 15 min of GNSS data

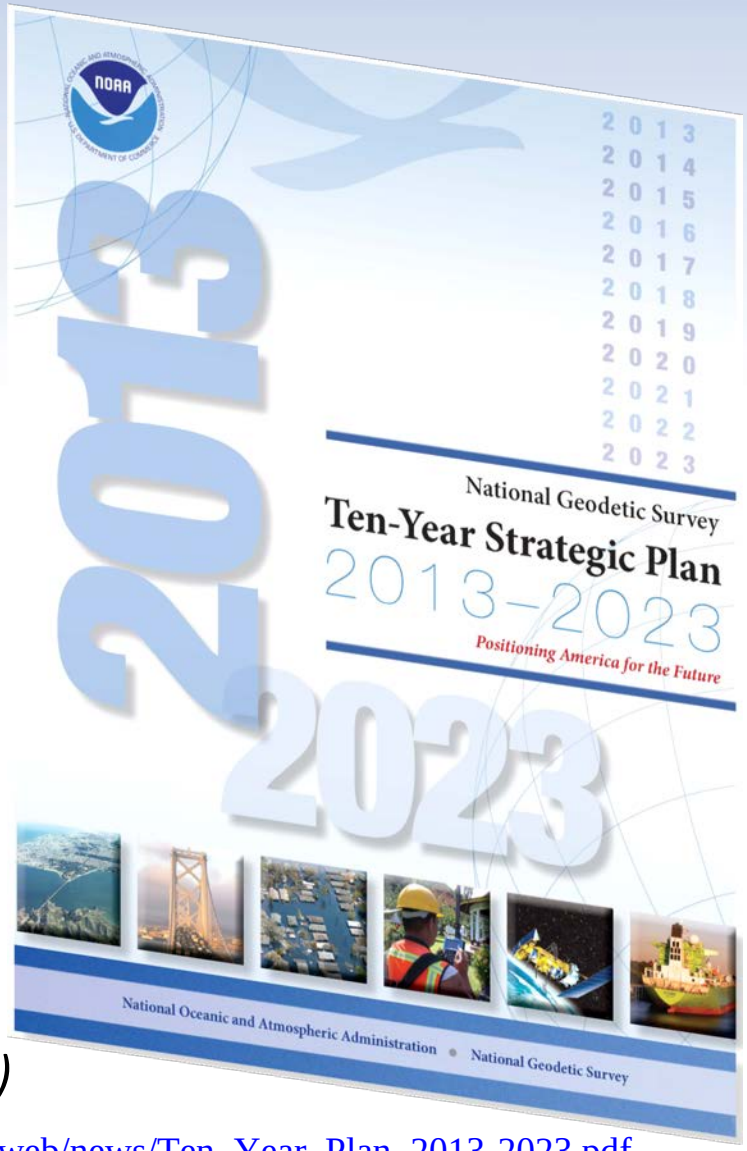
  "**Replace NAD83**"

(NAD83 = North American Datum 1983)

- By 2022, reduce all definitional & access-related errors in orthometric heights in geopotential reference frame to 2 cm when using 15 min of GNSS data

  "**Replace NAVD88**"

(NAVD88 = North American Vertical Datum 1988)



http://www.geodesy.noaa.gov/web/news/Ten_Year_Plan_2013-2023.pdf

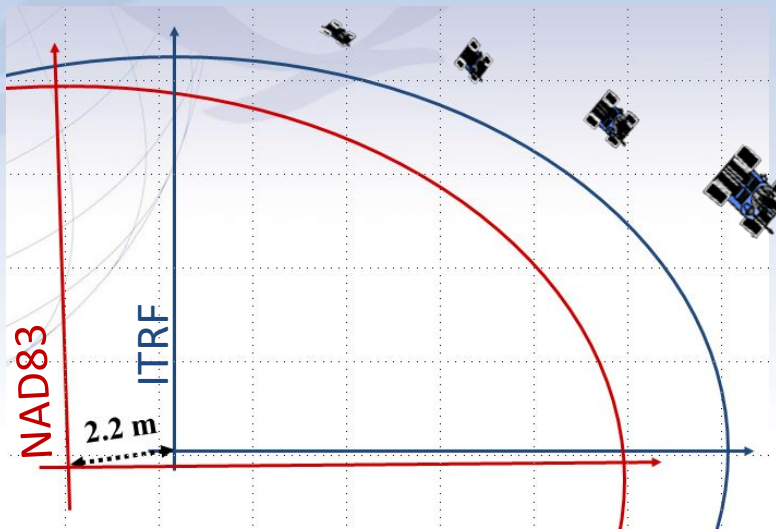
NAD83 Shortcomings

- **2.2 m offset –**

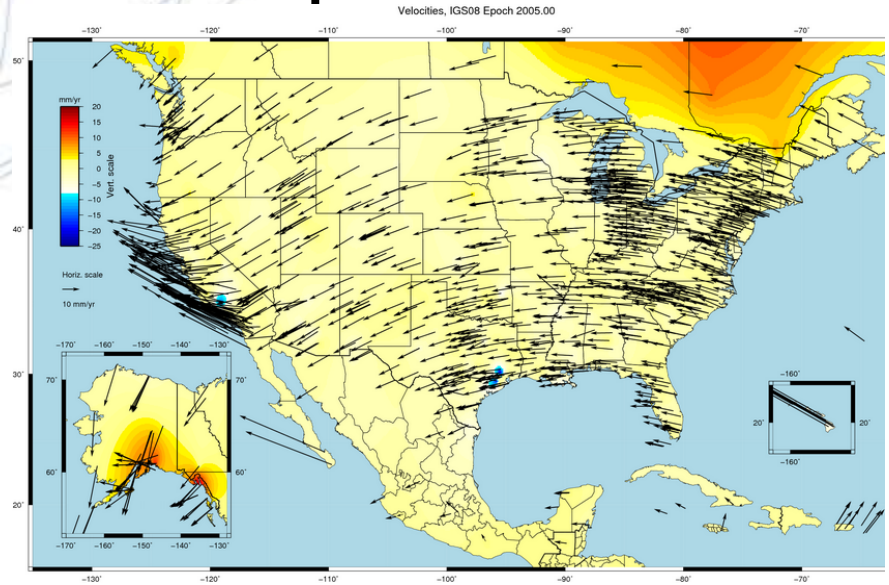
  NAD83 vs.

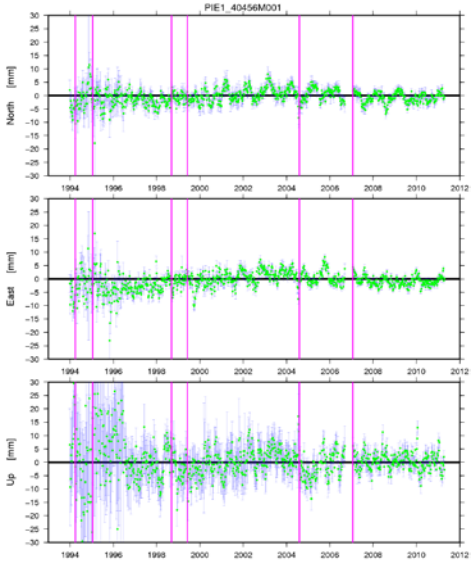
  International Terrestrial Reference Frame (ITRF)

  (and WGS84)



- **CORS & passive network "disconnect"**





VS.

Future Geometric (3-D) Reference Frame

- **replace NAD83 with new geometric reference frame – by 2022**
- **CORS-based, accessed via GNSS observations**
- **coordinates & velocities in ITRF & new US reference frame**
- **passive control tied to new reference frame (not a component)**
- **transformation tools will relate NAD83 to new US reference frame**

  (HTDP / NADCON / GEOCON …)

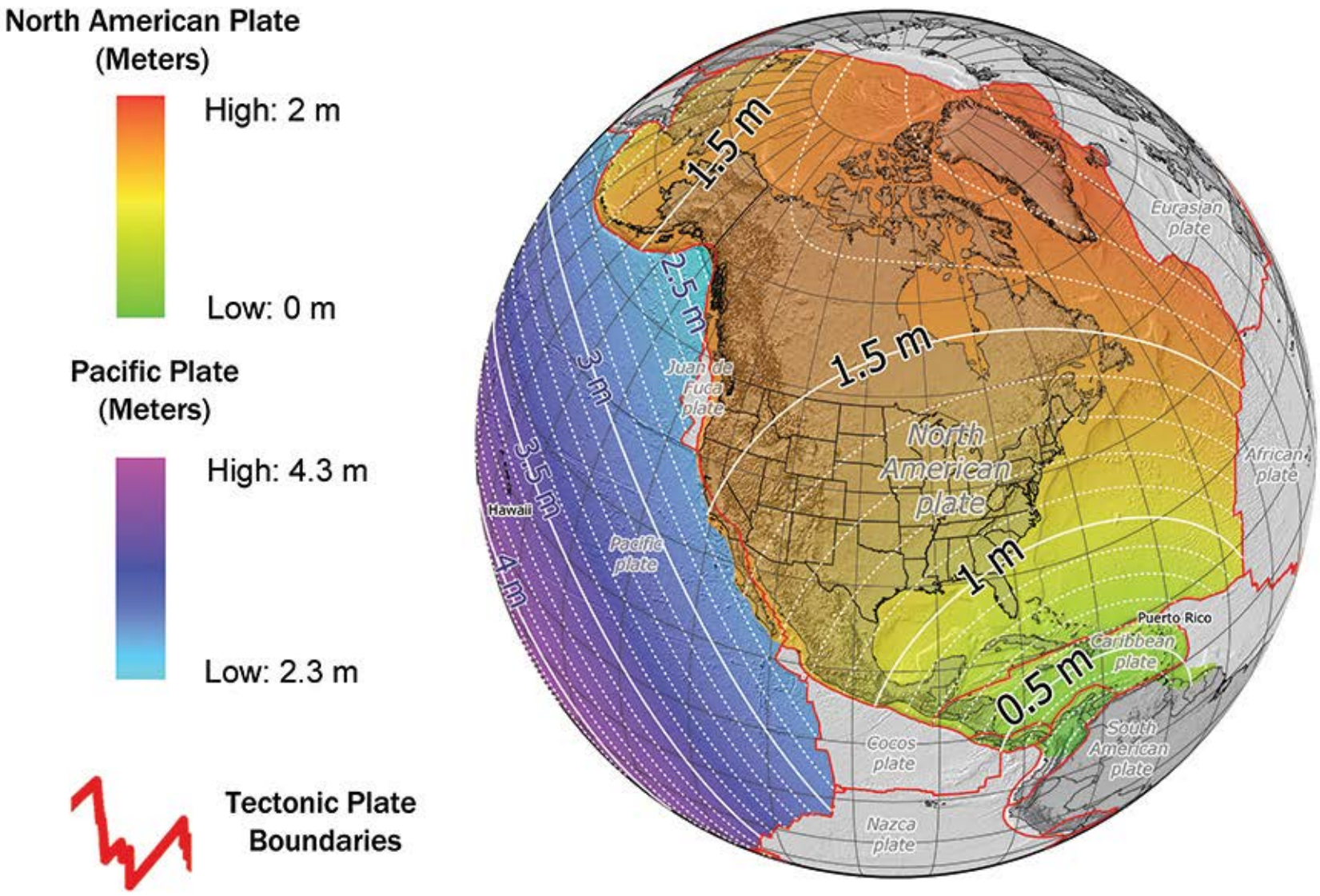
And it shall be called…

North American Terrestrial Reference Frame of 2022 (NATRF2022)

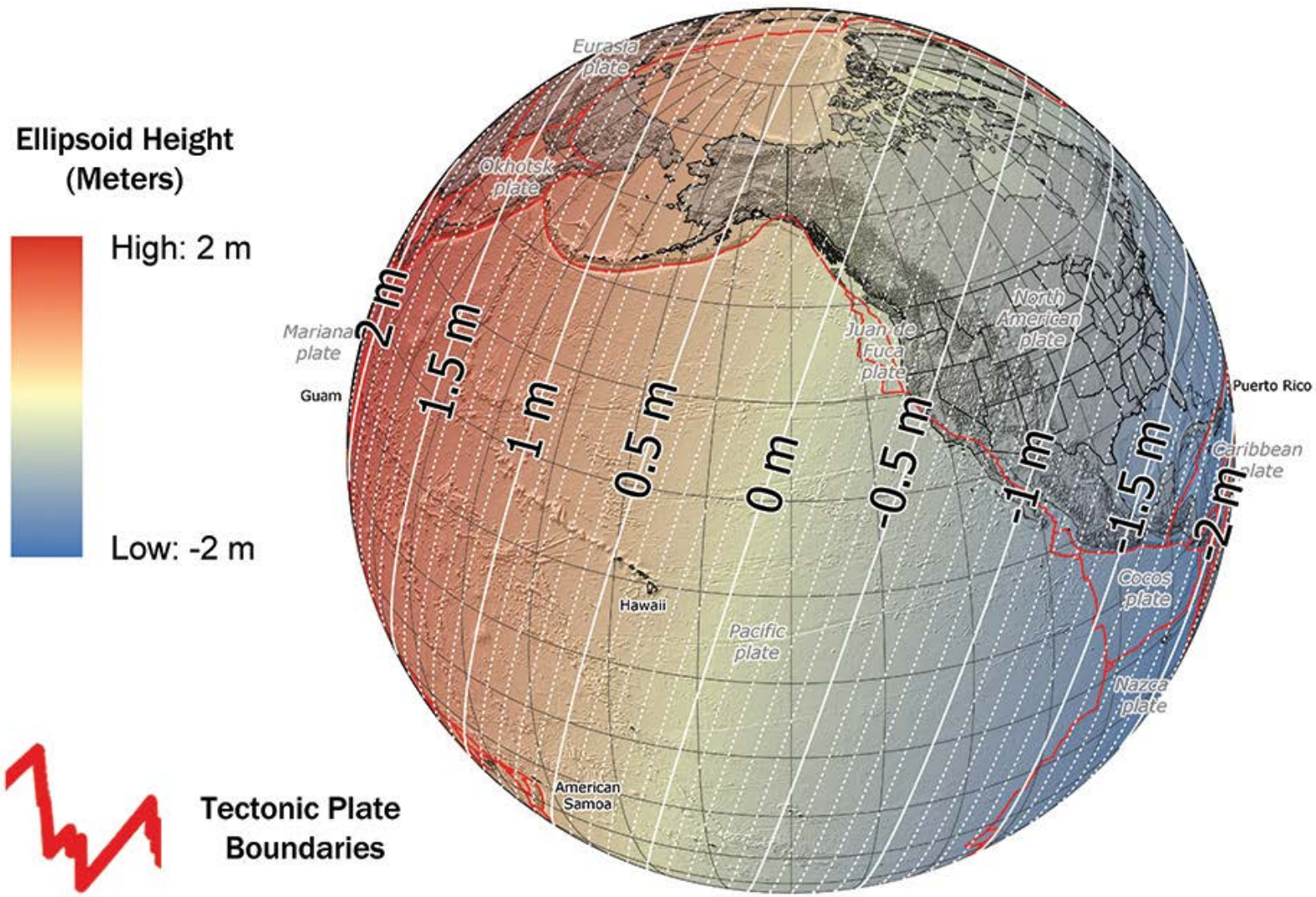
(& Pacific/Mariana/Caribbean Terrestrial Reference Frame of 2022)

- 4 plate-fixed frames
- identical to the IGSXX reference frame at a TBD epoch
- over time, will relate to IGS frame via Euler Pole Rotation
- all CORS velocities deviating from rigid-plate rotation will be captured in 3-D velocity model

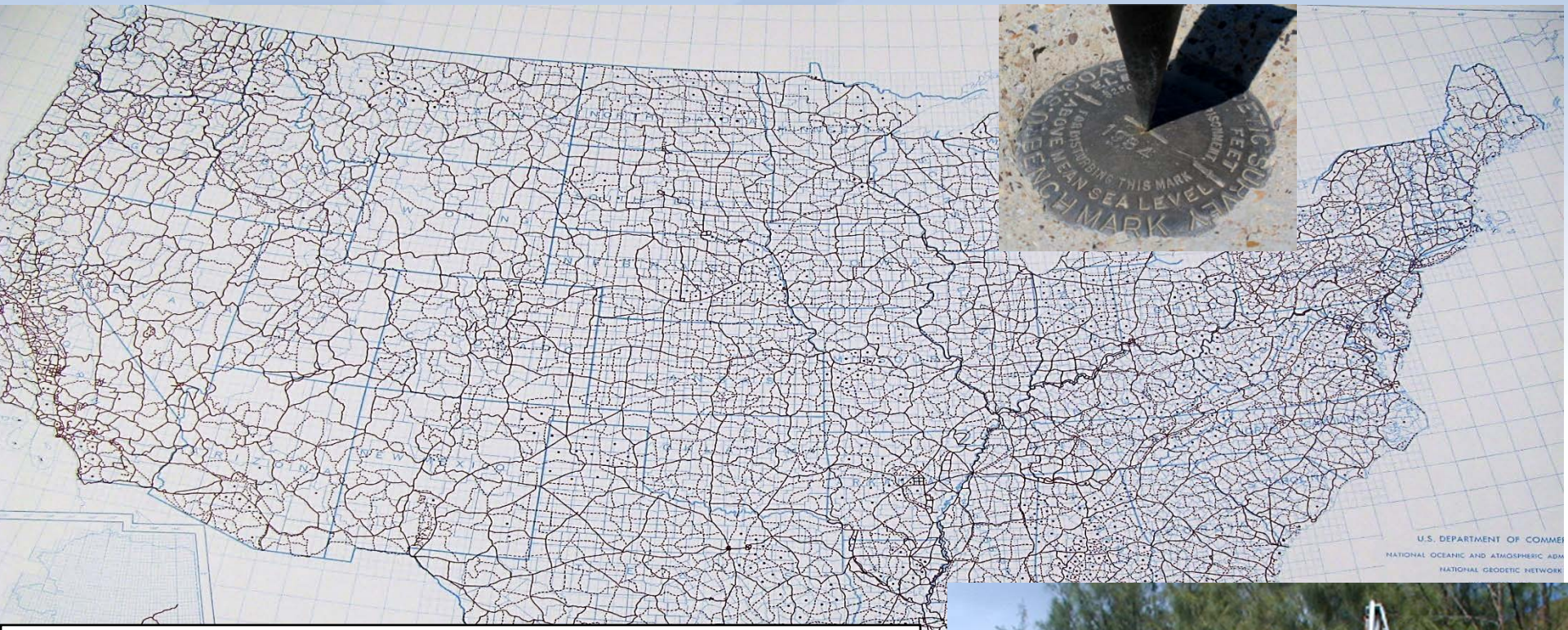
Approximate Horizontal Change North American Plate

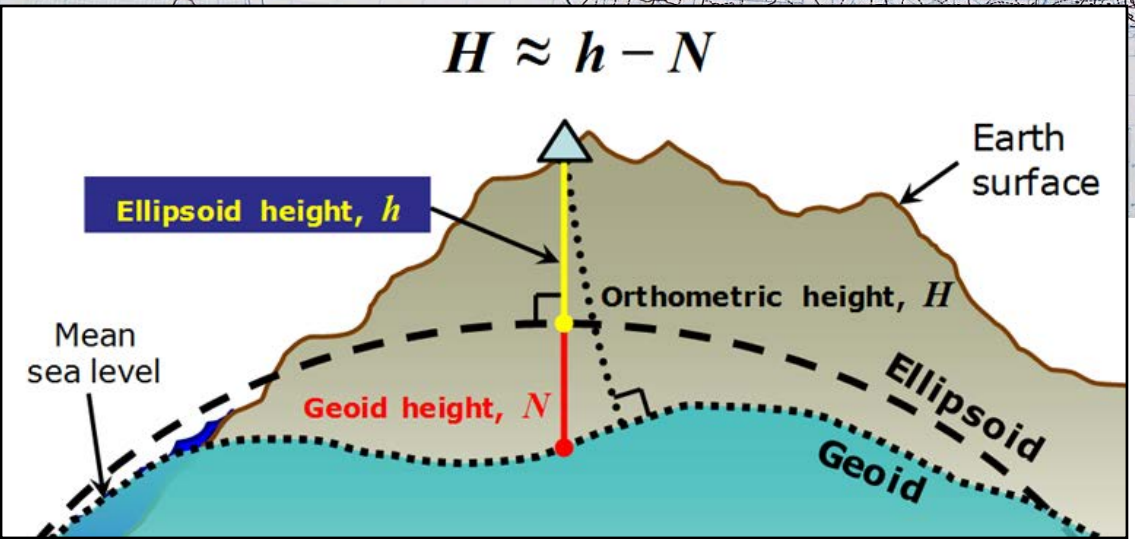


Approximate Ellipsoid Height Change



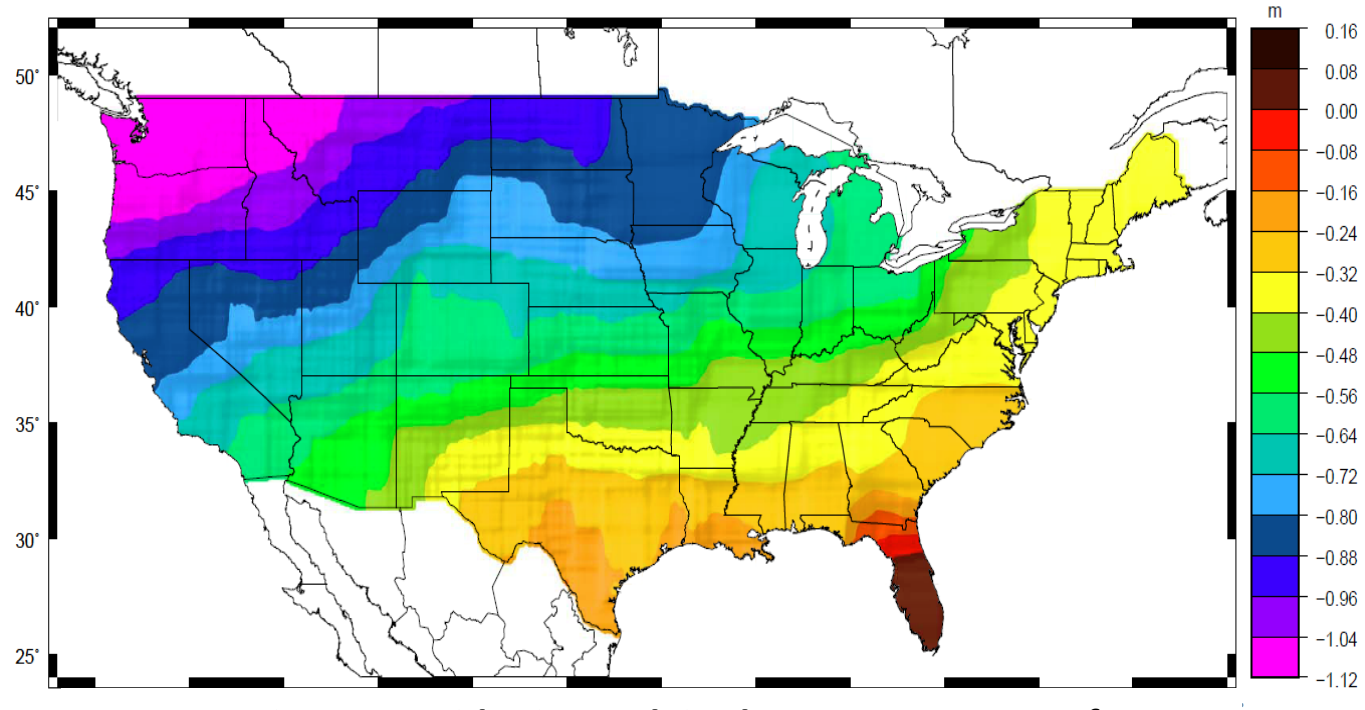
NORTH AMERICAL VERTICAL DATUM 1988 (NAVD88)





North American Vertical Datum 1988 (NAVD88) Shortcomings

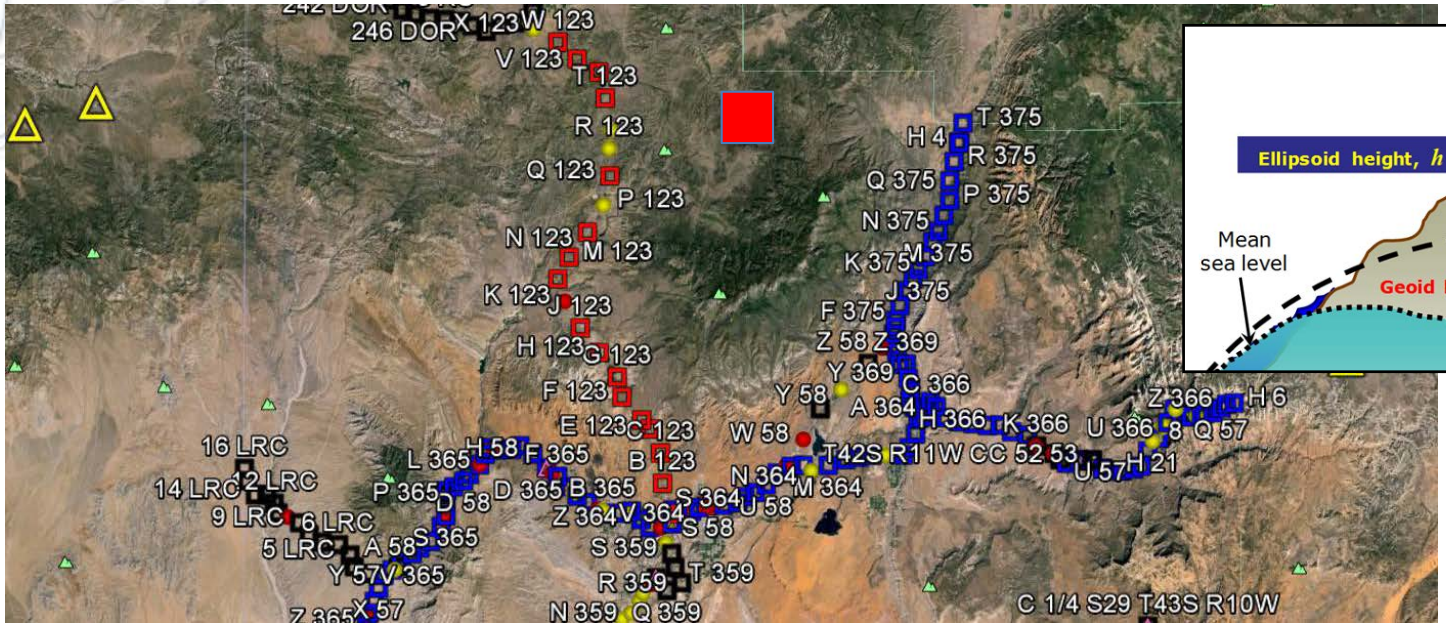
- Cross-country errors (1-m tilt)
- 0.5 m bias in reference surface vs. global mean sea level
- Subsidence, uplift, freeze/thaw invalidate BM elevations
- LIMITED AVAILABILITY / ACCESS

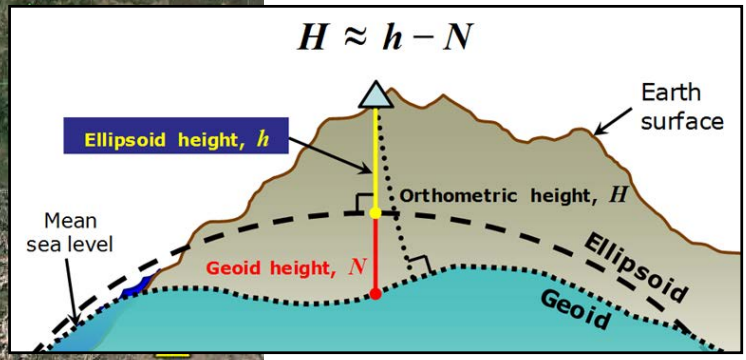


Approximate Geoid Mismatch in the NAVD88 H=0 surface

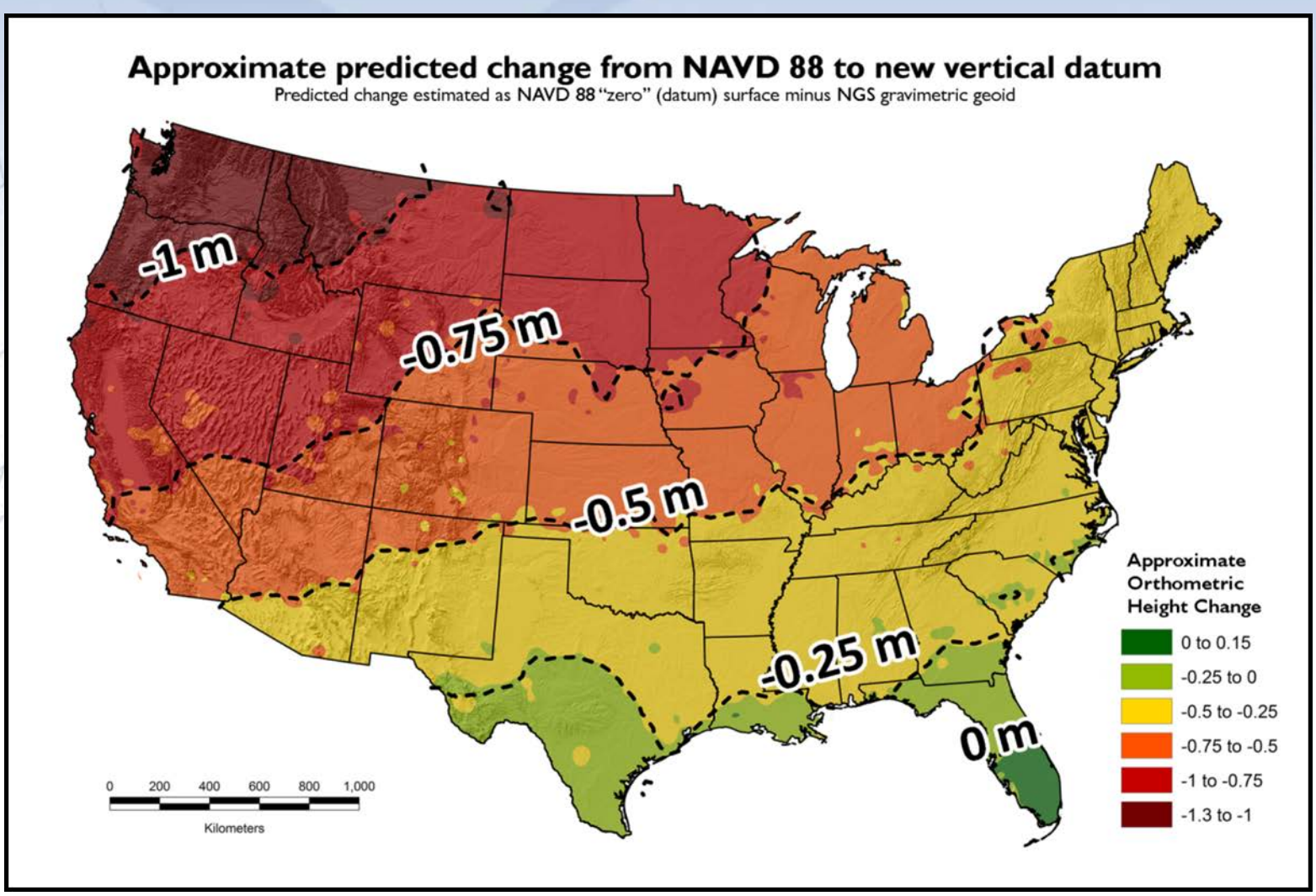
Future Geopotential (Vertical) Datum

- **replace NAVD88 – by 2022**
- **accessed by GNSS & gravimetric geoid**
- **monitor time-varying nature of gravity field**
- **most accurate continental gravimetric geoid model ever built: 1 cm**





Future Geopotential (Vertical) Datum



And they shall be called…

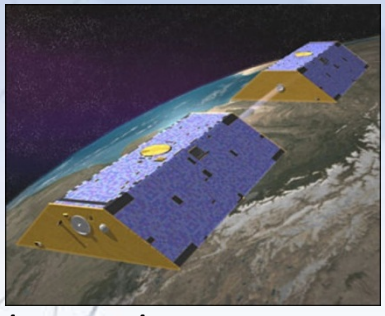
North American-Pacific Geopotential Datum of 2022 (NAPGD2022)

&

GEOID2022

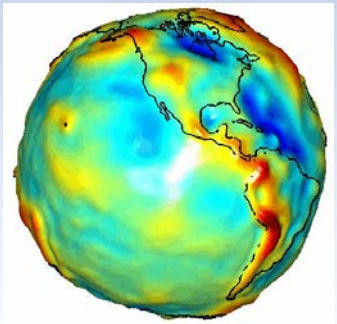
- NAPGD2022 will contain information for:
  - Orthometric heights
  - Geoid undulations
  - Gravity anomalies
  - Deflections of the vertical
  - & other gravity field information
- GEOID2022 will be time-dependent

Building a Gravity Field



GRACE/GOCE/Satellite Altimetry

Long Wavelengths
(≥ 250 km)



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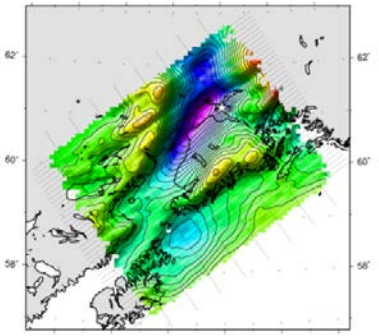
Airborne Measurement

Intermediate Wavelengths
(300 km to 20 km)



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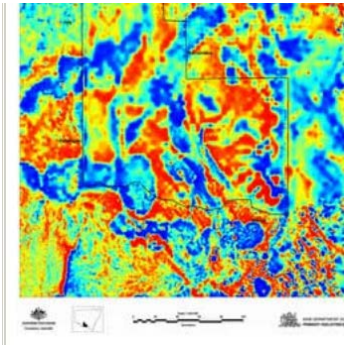
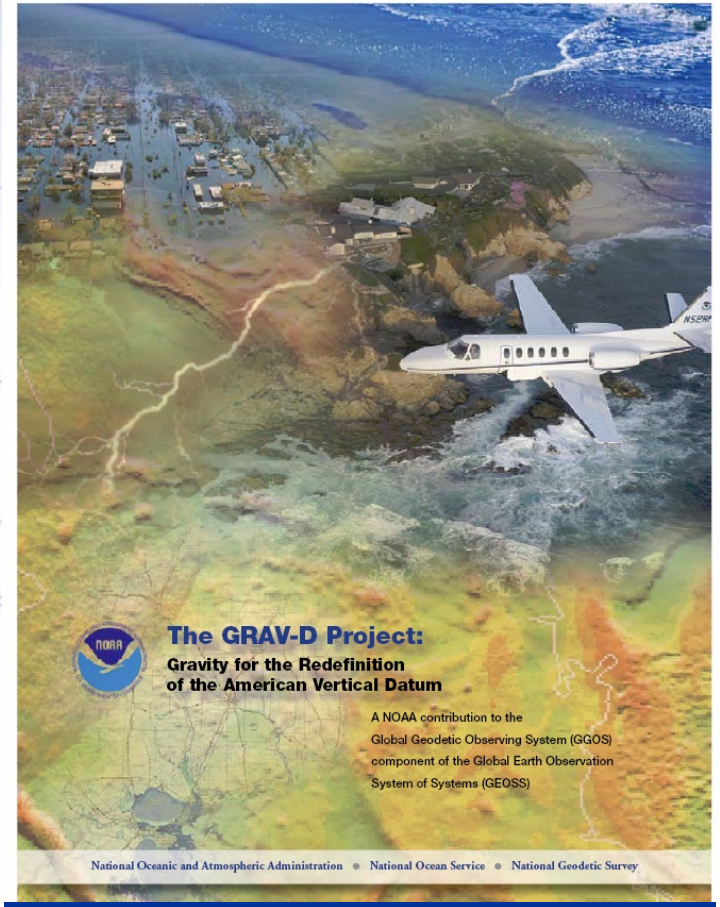
Surface Measurement and
Predicted Gravity from Topography

Short Wavelengths
(< 100 km)



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



Gravity *and* ***Heights*** *are inseparably connected*

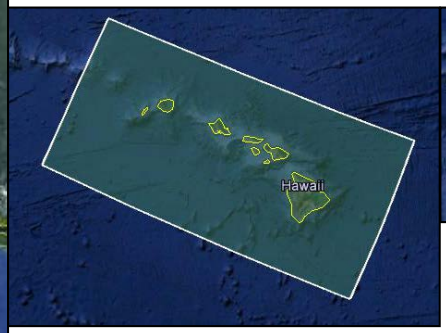
- Replace the national vertical datum (NAVD88) by 2022 with a ***1 cm accurate gravimetric geoid***
- Orthometric heights accessed via GNSS ***accurate to 2 cm***
- Thrusts of project:
  - Airborne gravity survey of entire country and its holdings
  - Long-term geoid change monitoring
  - Partnership surveys

GRAV-D Status (58%)

- 10 km data lines
- 70 km cross lines
- 20,000 ft altitude
- 230 kt flight speed

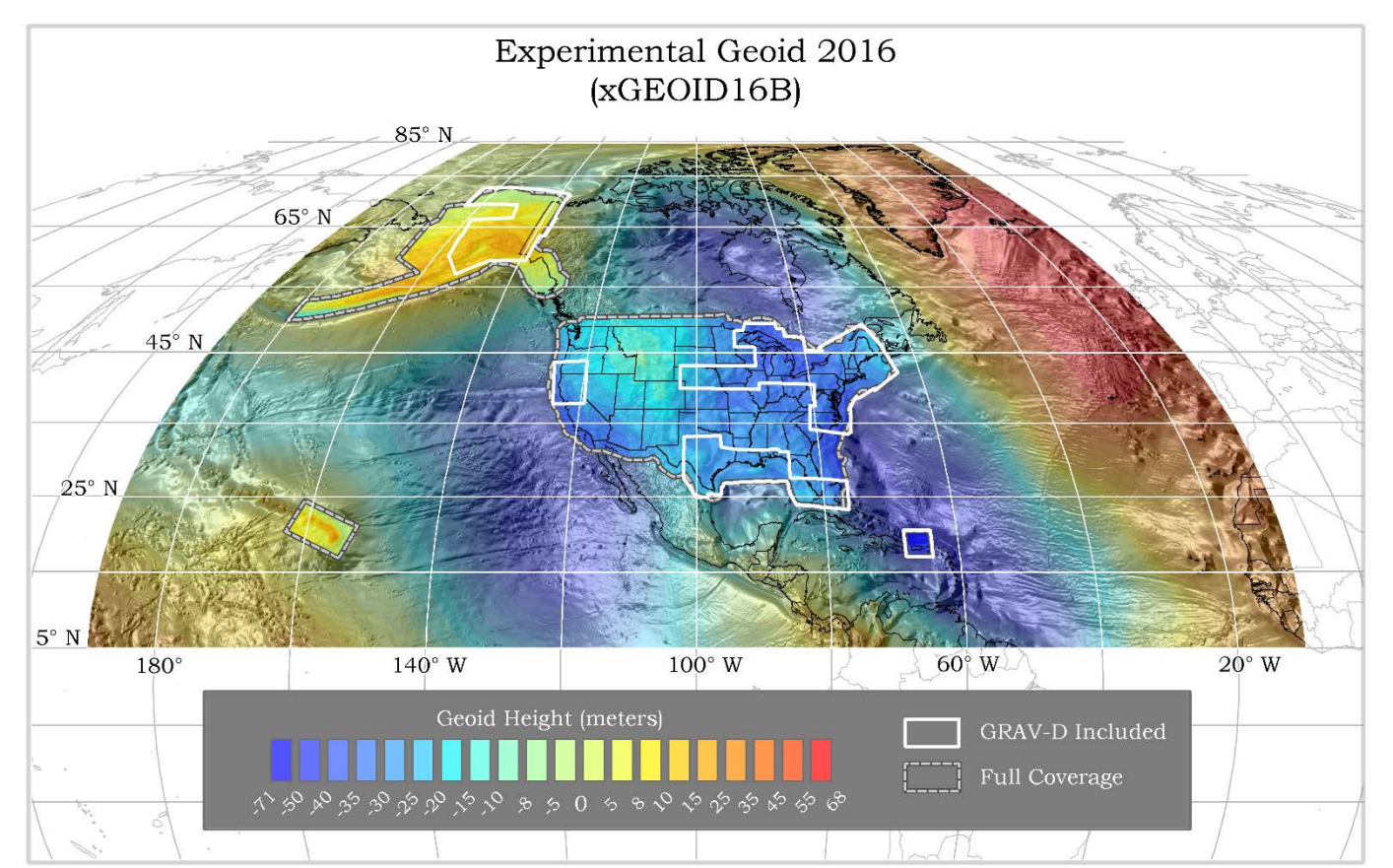
GRAV-D Data Collection Scope

- Entire U.S. and territories
  - Area: 15.6 million sq km
  - Initial target area for 2022
  - ~200 km buffer around territory or shelf break



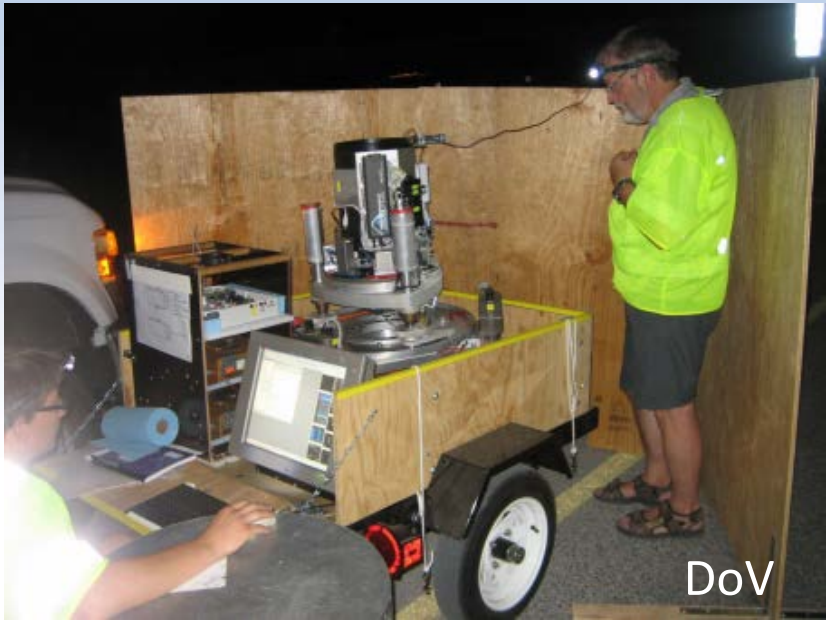
Extent of 2022 gravimetric geoid model used for new geopotential reference frame

Experimental Geoid 2016 xGEOID16B



https://beta.ngs.noaa.gov/GEOID/xGEOID16/

Geoid Slope Validation Surveys – 2011 & 2014



Geoid Slope Validation Survey: 3 phases to validate accuracy of the gravimetric geoid model

Phase 1- GSVS11

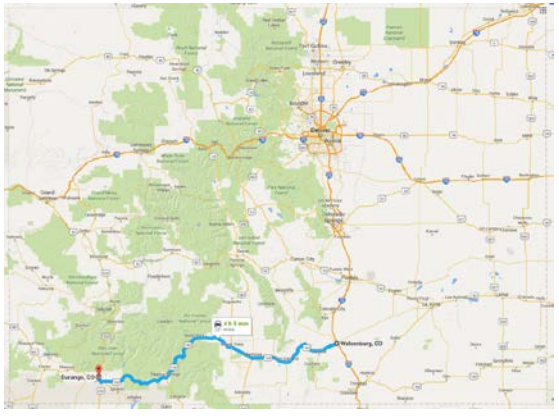
- 2011; Low/Flat/Simple: **Texas**

Phase 2- GSVS14

- 2014; High/Flat/Complicated: **Iowa**

Phase 3 – GSVS17

- 2017; High/Rugged: **Colorado** (10,860ft)



How to Plan for 2022

- **Move to NAD 83(2011) epoch 2010.00**
  - via surveys (or *possibly* via NADCON/GEOCON)
- **Move to NAVD 88**
  - via surveys (or *possibly* via VERTCON)
- **Move from reliance on passive marks to GNSS infrastructure**
  - utilize CORS, OPUS, real-time networks, etc.
- **Use OPUS-Share/Database for GPSBMs**
  - improve next geoid model & relationship with new datum
- **METADATA!!!!**

Legislation

- When NAD 83 replaced NAD 27, the Federal NSRS users were required to switch to NAD 83
- Through the 1980s and 1990s NGS worked with the *states* to update their laws
  - To encourage use of the new system beyond the feds
- 48 states now have laws that refer to NAD 83 *by name*
  - A name which will be *retired* in 2022

Legislation

- In 2016, NSPS, AAGS, and NGS formed a committee to address this issue
  - The NSPS/AAGS/NGS Advisory Committee on National Spatial Reference System Legislation
- New Legislative Template completed June 2016
  - Generic terminology: "NSRS or its successor," etc.
  - NSPS will work with the states to adopt the new template between 2017 and 2022

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.

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.

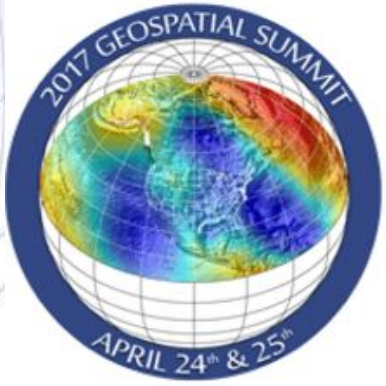
NSPS/AAGS/NGS Advisory Committee on National Spatial Reference System Legislation

J.B. Byrd	NSPS	jbyrd@jmpa.us
Dave Doyle	NSPS	base9geodesy@gmail.com

NGS Geospatial Summit
Silver Spring, MD (and via web) -- April 24-25, 2017

National Geodetic Survey

Positioning America for the Future



2017 Summit Home
Register
Logistics
Agenda
FAQs

Related Links
NGS 10-year plan
2015 Summit Proceedings
2010 Summit Proceedings
New Datums Web page

2017 Geospatial Summit

Registration Now Open

On April 24-25, 2017 we will host the 2017 Geospatial Summit at the Silver Spring Civic Building at 1 Veterans Pl, Silver Spring, MD 20910.

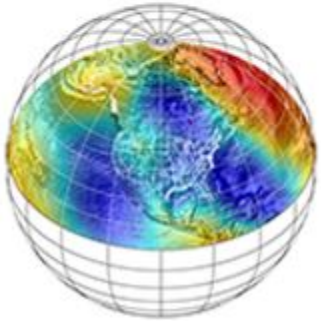
The 2017 Geospatial Summit will provide updated information about the planned modernization of the National Spatial Reference System (NSRS). Specifically, NGS plans to replace the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88) in 2022.

The Summit will provide an opportunity for NGS to share updates and discuss the progress of projects related to NSRS Modernization. NGS also looks forward to hearing feedback and collecting requirements from its stakeholders across the federal, public and private sectors. This event will help continue discussions from previous Geospatial Summits held in 2010 and 2015.

Additional information about the 2017 Geospatial Summit will be posted online. If you have questions or comments, contact us.

New Datums

National Geodetic Survey



New Datums Quick Links

Home
What to expect
Get prepared
Track our progress
Related projects
Watch videos
Learn more
New Datums FAQ
Contact Us
Sign up for list-serve

September 20, 2016

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
Related Projects | Track Our Progress
Watch Our Videos | Learn More

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 defining new horizontal and vertical datums.

FAQs frequently asked questions

Issue 6, January 2017

NSRS Modernization News

For all issues of **NSRS Modernization News**, visit:
geodesy.noaa.gov/datums/newdatums/TrackOurProgress.shtml

Decision Points

The National Geodetic Survey (NGS), through a series of both internal debates and external discussions with the Canadian Geodetic Survey, has finalized certain key decisions in the replacement of the three NAD 83 reference frames, and in the replacement of the various vertical datums of the NSRS. These decisions cover both the science and nomenclature of the changes coming in 2022.

Four Terrestrial Reference Frames

Replacing the three existing NAD 83 reference frames will be four plate-fixed *terrestrial reference frames.* The tectonic plate for each frame may be inferred from their names, which are:

North American Terrestrial Reference Frame of 2022 (NATRF2022)

Pacific Terrestrial Reference Frame of 2022 (PTRF2022)

Mariana Terrestrial Reference Frame of 2022 (MTRF2022)

Caribbean Terrestrial Reference Frame of 2022 (CTRF2022)

Relationship to the IGS Frame

Each of the above four frames will be identical to the latest IGS reference frame (as available in 2022) at an epoch to be determined. Away from that epoch, the four frames will relate to the IGS frame through the definition of an Euler Pole rotation specific to that plate. All Continuously Operating Reference Stations (CORS) velocities which deviate from the rotation of a rigid plate will be captured in a residual 3-D velocity model.

Heights and Other Physical Coordinates

A *geopotential datum* will be created which will contain all of the necessary information to provide mutually consistent orthometric heights, geoid undulations, gravity anomalies, deflections of the vertical, and all other geodetic coordinates related to the gravity field. This geopotential datum will be called:

North American-Pacific Geopotential Datum of 2022 (NAPGD2022)

Geoid Model

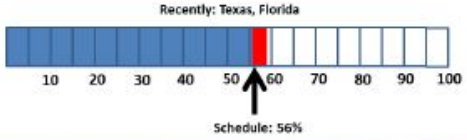
Within NAPGD2022, a variety of products will exist. The most prominent of these products will be a ***time-dependent model of the geoid,*** provided in three regions (the first covering the entirety of North and Central America, Hawaii, Alaska, Greenland, and the Caribbean; the second covering American Samoa; and the third covering Guam and the Commonwealth of the Mariana Islands). The name of this model will be:

GEOID2022

Further Information

A comprehensive white paper, outlining the technical details of the above decisions, is currently being drafted in NGS and we plan for it to be ready by the upcoming 2017 Geospatial Summit. In addition, details may be released on the NGS website and through our email listserv.

GRAV-D progress last quarter: up 3.0% to 58.4%
Ahead of Schedule!



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- Regional Advisors
- Contact Us

NGS Subscription Services

NGS News - Receive emails about the latest NGS News. These notices will highlight:

- the release of new products
- updates to existing services
- progress reports for major projects
- information about upcoming NGS-sponsored events
- upcoming job opportunities at NGS

Sign up to receive these announcements automatically.

NGS Webinar Series - Each month, a speaker will give a presentation on various topics related to NGS programs, projects, products and services to educate constituents about NGS activities.

Sign up to receive a monthly notice describing the upcoming presentation.

NGS Training - Receive emails about online and classroom-based training opportunities when new classes are available.

Sign up to receive these announcements.

NGS Video Library

National Geodetic Survey

Educational Videos Quick Links

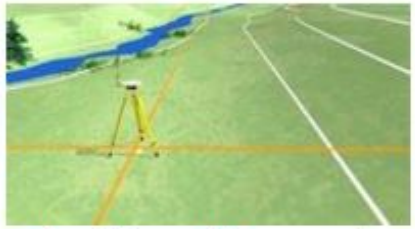
- Corbin Training Center
- Online Lessons
- Geospatial COMET MetED Resources
- National Ocean Service Lesson Plan Libary
- Other Videos +

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

Attend a Monthly Webinar

NGS Webinar Series

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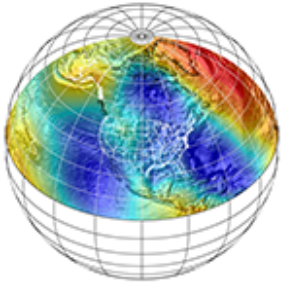


Webinar Series Quick Links

- Overview
- Upcoming Webinars
- Recorded Webinars
- Frequently Asked Questions (FAQ)

Contact information

- Email us
- Sign-up for webinar announcements
- Sign-up for list-serve

Geodetic Datums

Overview

Each month, a speaker will give a presentation on various topics related to NGS programs, projects, products and services to educate constituents about NGS activities.

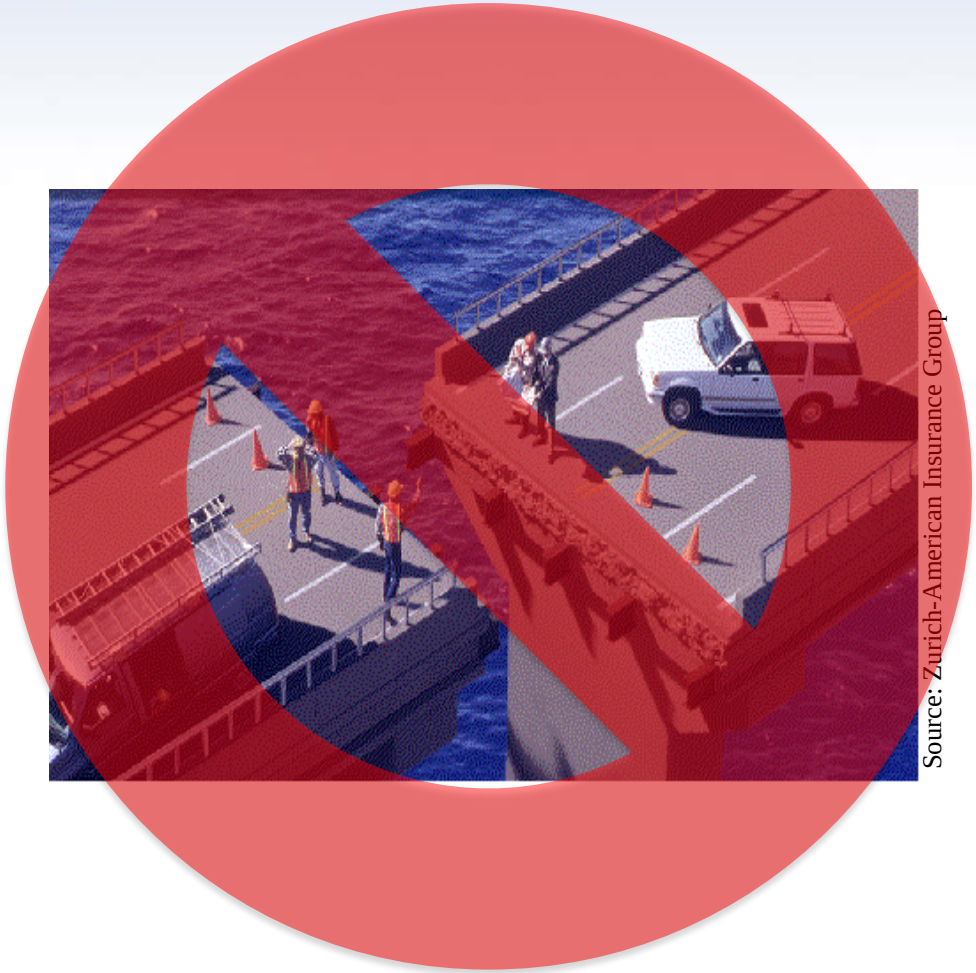
Webinars are held on the second Thursday of every month, from 2:00-3:00 p.m. East Coast time. You can register for any presentation on the **"Upcoming Webinars" page**, and you can **sign-up to receive a monthly notice** describing the upcoming presentation.

This webinar series is a continuation of **monthly presentations sponsored by the National Height Modernization Program**, and you can download previous presentations from the Program's online meeting archive.

Many additional NGS resources are available online, including:

- **Continuously Operating Reference Station (CORS) weekly newsletter archive**
- **Ecosystem and Climate Operations newsletter archive**
- **Educational videos**
- **Height Modernization monthly meeting archive**
- **Online Learning Resources** (e.g. recorded webinars and online training modules)
- **Presentation library**

Accurate positioning begins with *accurate* coordinates



Source: Zurich-American Insurance Group