NSRS Modernization Updates from the National Geodetic Survey Part 2

WSLS Surveyors' Institute
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Outline

- NGS Products and Services
- Updates on NSRS Modernization
- New types of coordinates
- New ways of working in the NSRS
- How you can contribute

NGS PRODUCTS AND SERVICES

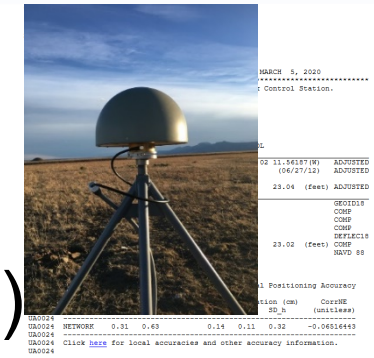
NGS Products and Services help users access the NSRS

What "Access" to the NSRS Means

Until 1980, NGS offered "passive control"

- And one definitive coordinate set for each one
  - 1.6 M marks

More recently, NGS provides data and coordinate functions with NOAA CORS Network (most were not installed by NGS)



```
MARCH  5, 2020
*************************
 Control Station.

02 11.56187(W)   ADJUSTED
     (06/27/12)  ADJUSTED

   23.04  (feet) ADJUSTED

                 GEOID18
                 COMP
                 COMP
                 COMP
                 DEFLEC18
   23.02  (feet) COMP
                 NAVD 88

l Positioning Accuracy

tion (cm)      CorrNE
   SD_h        (unitless)
-------------------------
NETWORK    0.31   0.63      0.14   0.11   0.32     -0.06516443
-------------------------
Click here for local accuracies and other accuracy information.
```

- And one definitive coordinate function for each one
  - And the software (PAGES / OPUS) to differentially position your GPS receiver to each station
    - 2000+ stations currently

What "Access" to the NSRS Will Mean

- Very similar *philosophically*:
  - The NSRS remains "geodetic control" for you to "access"
    - Geospatial information and metadata about various points
    - Passive control will exist…we aren't getting out bulldozers and shovels
      - But gone are the days of getting "the coordinate" on a point from a "datasheet"

What "Access" to the NSRS Will Mean

- Very different *practically*
  - Information: from the **Data Delivery System**
    - Graphics (pictures, graphs, maps)
  - Computations: **OPUS**
    - Do-it-all (mark reporting, positioning, adjustments, etc)
  - Heavy emphasis on using GNSS to get to the NSRS
    - All constellations will be supported
    - Real time helpful CORS information (data availability & quality)
    - Use new GNSS
      - Or, maybe, some "trusted" passive control
      - Otherwise, your preliminary coordinates may say "not NSRS coordinates"

OPUS

The Online Positioning User Service

- NGS will cease the expanding "hyphenated" versions
  - OPUS-Projects, OPUS-S, OPUS-RS, OPUS-Share, etc
- Will replace
  - All internal versions of OPUS
  - All user versions of OPUS
  - All forms of "Bluebooking"
    - Analyzing, adjusting, submitting geodetic survey data to NGS
  - Mark Recovery and Reporting Tool

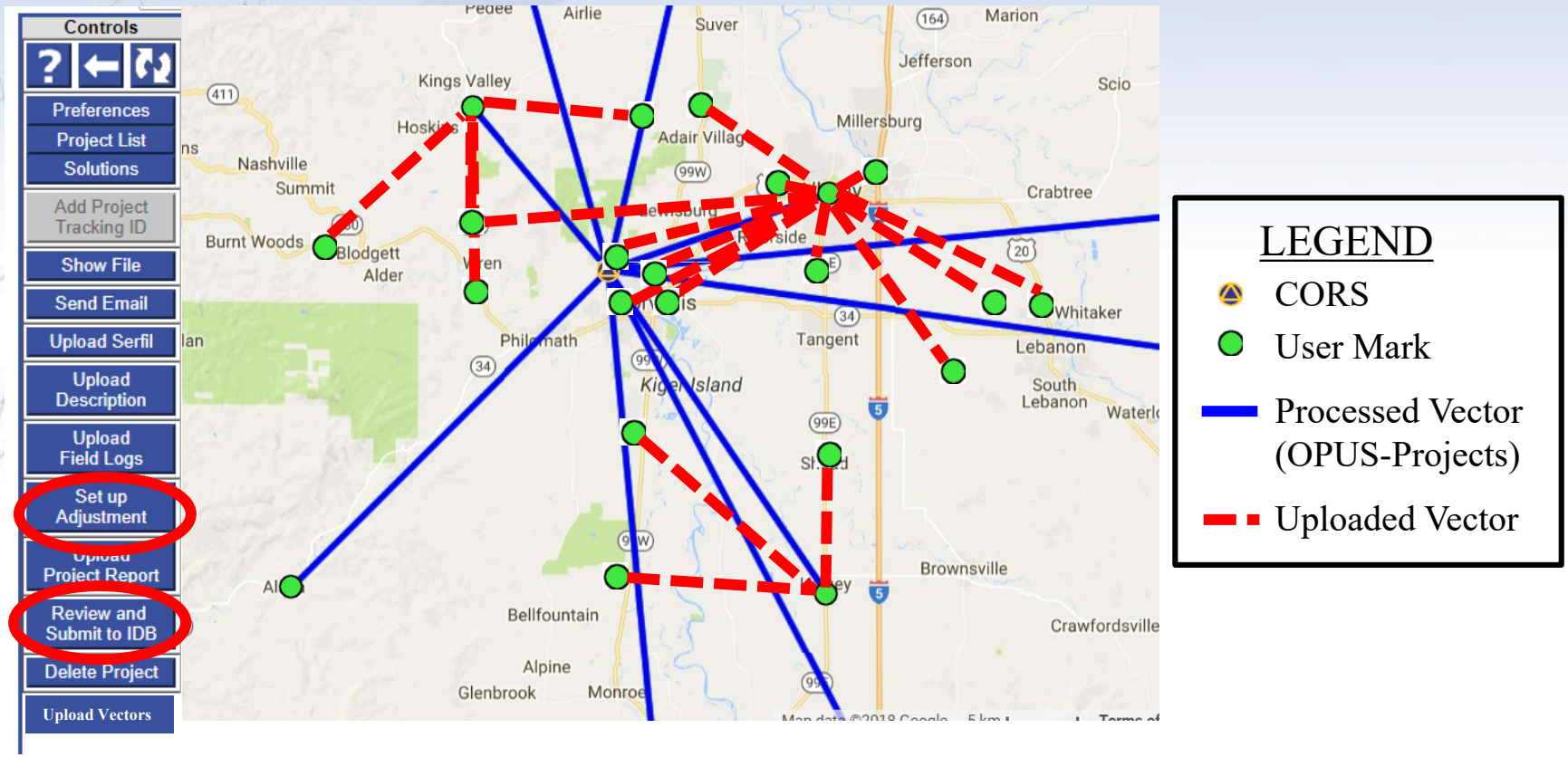
NSRS Coordinates or Not?

- No matter how you use OPUS, a user will always get coordinates with this label:
  - "These are ***OPUS*** coordinates"
- But depending on their choices for "control to use" and "epoch to adjust to", they will get one of these two labels:
  - "These ***are*** tied to the NSRS"
  - "These ***are not*** tied to the NSRS"
- Let's look at why…

GNSS Is Key

- Leveling can (and will) still tell you differential heights
  - But for OPUS to provide you absolute NSRS coordinates, you'll need to "get into the datum"
    - Trusted geodetic control:
      - Primary: New GNSS to get ellipsoid heights
        - » Maybe (still under consideration): "Recently" surveyed passive control
        - » Then GEOID2022 to get orthometric heights
      - Then pick an "appropriate" epoch for your adjustment
      - Now you're "in the datum".

Example: Upload RTN Vectors to OPUS-Projects



Beta OPUS-Projects will accept RTK vectors starting in February 2021!

Leveling: NSRS coordinates or not?

Control used	Epoch of adjustment	Tied to the NSRS?
Passive control from the NSRS DB with RECs at the **most recent** reference epoch and/or SECs whose epoch falls after **the most recent** reference epoch	Any epoch from the most recent reference epoch (e.g. "2020.00") until the midpoint epoch of the leveling campaign	Yes
Passive control from the NSRS DB ***without*** RECs at the **most recent** reference epoch ***and without*** SECs whose epoch falls after **the most recent** reference epoch	Any	No
Passive control where you have surveyed with GNSS using NGS's latest GNSS w/ leveling specifications	Any epoch from the most recent reference epoch (e.g. "2020.00") until the midpoint epoch of the leveling campaign	Yes
Passive control where you have surveyed with GNSS using NGS's latest GNSS w/ leveling specifications	Any epoch before the most recent reference epoch	No
Anything else	Any other epoch	No

Conversion? Transformation?

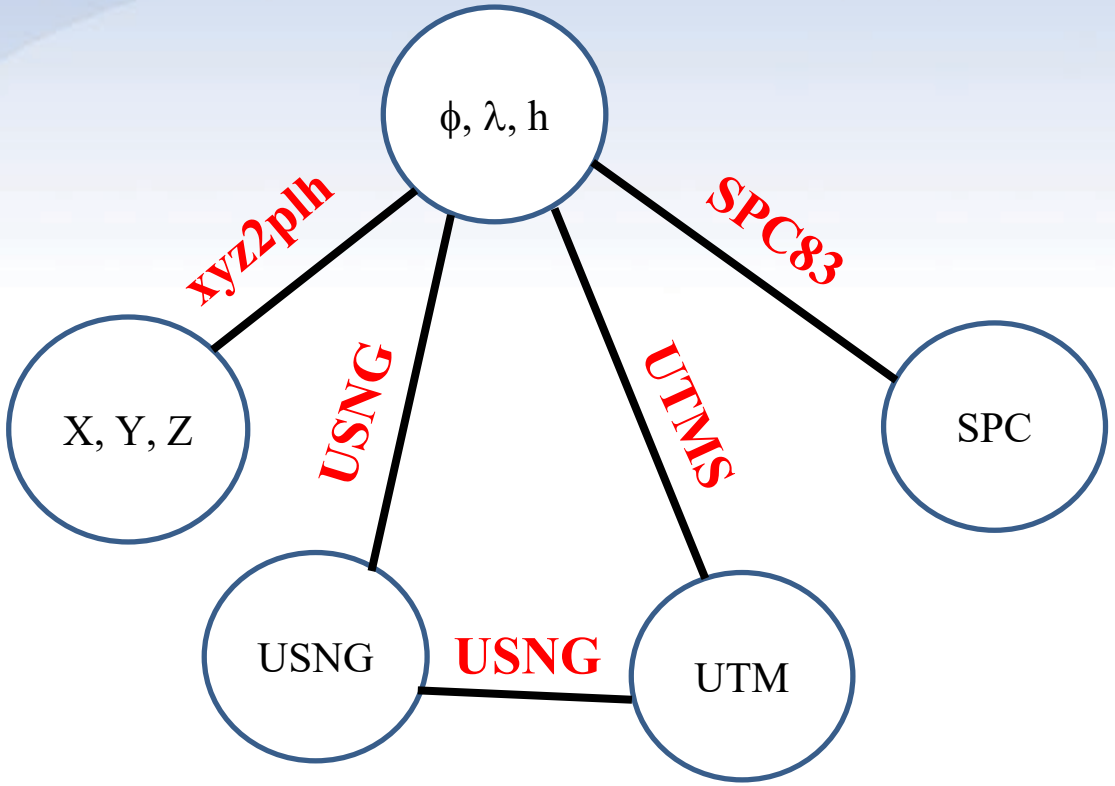
Historically NGS has been inconsistent with these two words. Going forward, we will use them as:

- **Conversion:** Changing the type of coordinate without changing the datum or frame
  - e.g. change NAD 83(1986) latitude and longitude to NAD 83(1986) State Plane Coordinates
- **Transformation:** Changing the datum or frame, without changing the type of coordinate
  - e.g. changing an NAD 27 latitude & longitude to an NAD 83(1986) latitude & longitude

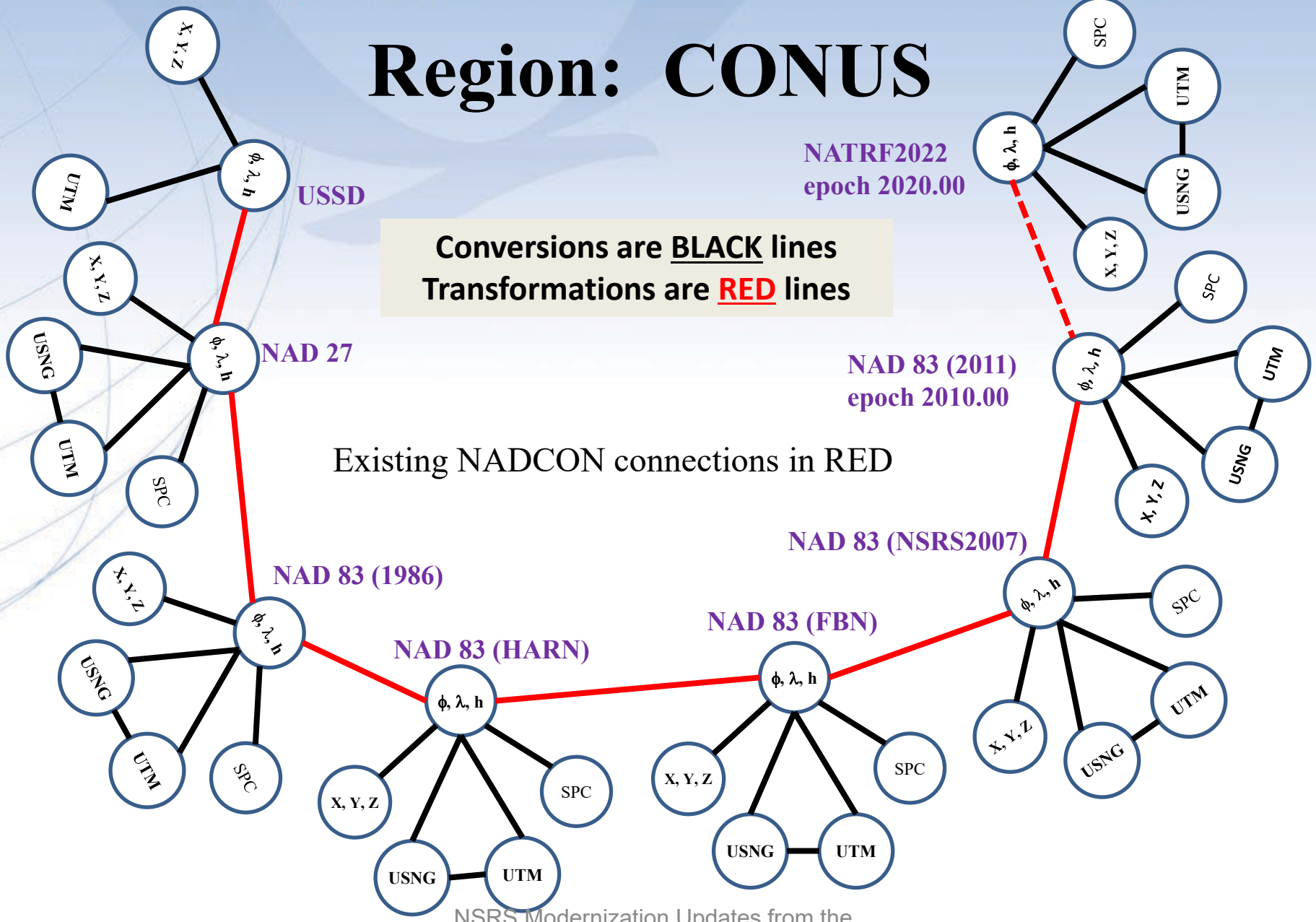
So, for example, "NADCON" which ***transforms*** coordinates between datums really should have been called "NADTRAN." C'est la vie.

Conversions

- **NGS has had many stand-alone computer programs for coordinate conversions.**
- **All of these are now integrated together inside NCAT (NGS Coordinate Conversion and Transformation Tool) – see later slides**
- **No datum changes are shown here**

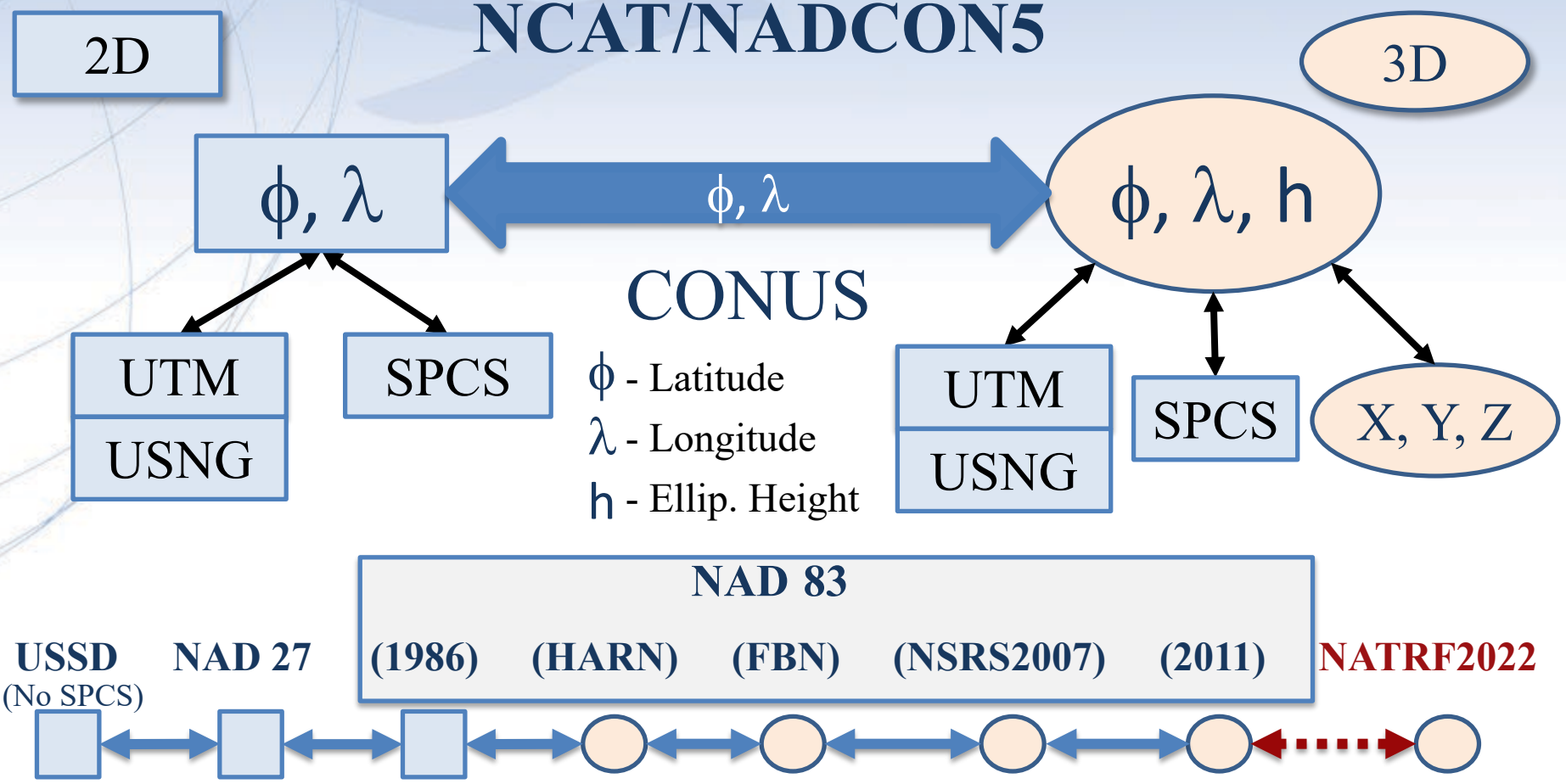


Region: CONUS



Transformations

NCAT/NADCON5



NCAT - with NADCON & VERTCON!

Ways to Use NCAT

- Browser: Interactive, 1 point at a time
- Browser: Upload a file / get a file back (text, xlsx)
- As a Web Service
- Download and run locally
  - Beware: This works, but NCAT is updated frequently, so the copy you have may be outdated, so always download the latest version

NSRS MODERNIZATION EFFORTS

National Spatial Reference System (NSRS)

Geometric Geodesy

- Horizontal Datums/Geometric Reference Frames
- Latitude
- Longitude
- Ellipsoid Height
- State Plane Coordinates

Physical Geodesy

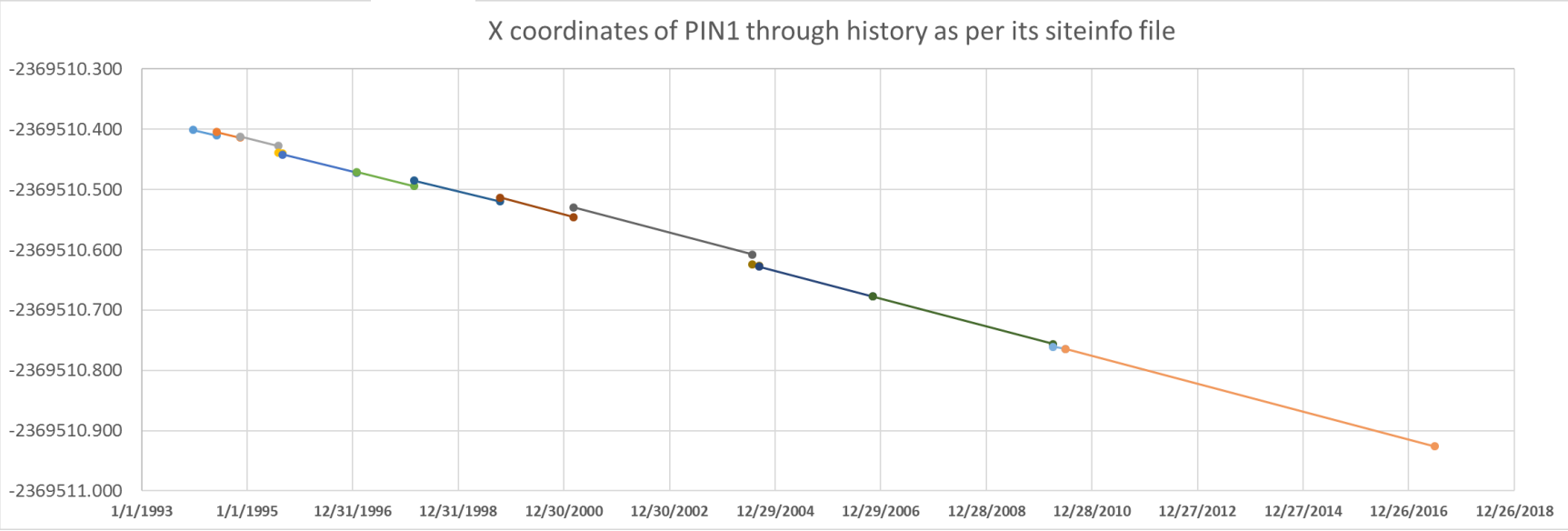
- Geopotential Datums
- Orthometric Height
- Dynamic Height
- Surface Gravity
- Leveling

Main Components: latitude, longitude, height, origin, scale, gravity, and orientation

Modernizing the NCN

- **Coordinate functions** are the way to know where a CORS is at the time you are trying to position yourself relative to that CORS
- They have been **discontinuous**, **piecewise linear** functions since the beginning
- NGS is developing newer, faster ways to update them when any of these occur:
  - An earthquake
  - An obvious drift of the station's daily-computed coordinates away from its own coordinate function
  - An obvious non-linear component to a station's movement

NCN Coordinate Functions



Note each piece is linear, but is offset from its neighboring piece. But at each unique time, there is one and only one "X" coordinate. This makes it a "function" by the strict mathematical definition.

NCN Coordinate Functions

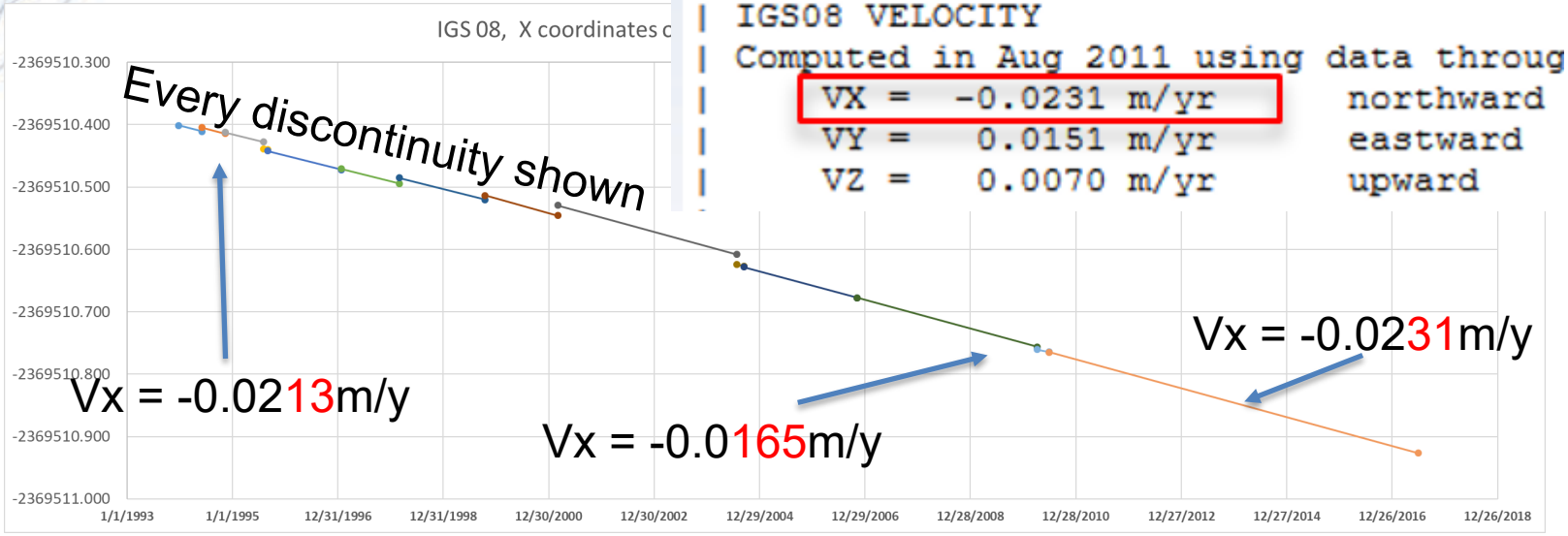
Today:

One coordinate, at one epoch, and one velocity…

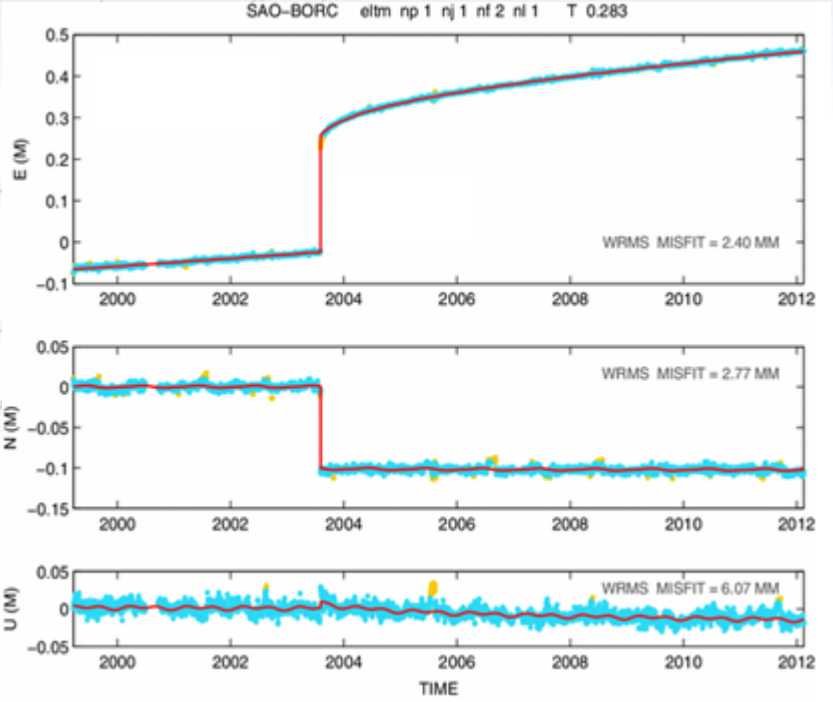
```
        Antenna Reference Point(ARP): PINON 1 PGGA CORS ARP
        ---------------------------------------------------
                          PID = AF9708

IGS08 POSITION (EPOCH 2005.0)
Computed in Aug 2011 using data through gpswk 1631.
    X =  -2369511.285 m      latitude     =  33 36 43.76186 N
    Y =  -4761208.286 m      longitude    = 116 27 29.37473 W
```

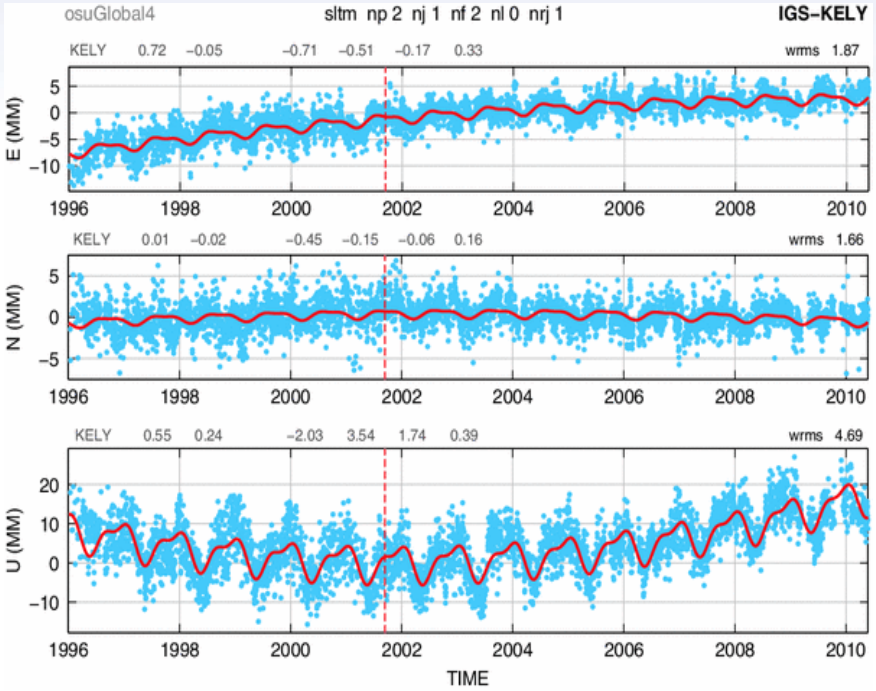
```
IGS08 POSITION (EPOCH 2005.0)
Computed in Aug 2011 using data throug
    X =  -2369511.285 m      latitude
    Y =  -4761208.286 m      longitude
    Z =   3511397.204 m      ellipsoid

IGS08 VELOCITY
Computed in Aug 2011 using data throug
    VX =   -0.0231 m/yr      northward
    VY =    0.0151 m/yr      eastward
    VZ =    0.0070 m/yr      upward
```

Modernized NSRS:



Examples of How Non-Linear CORS Coordinate Functions Might Look





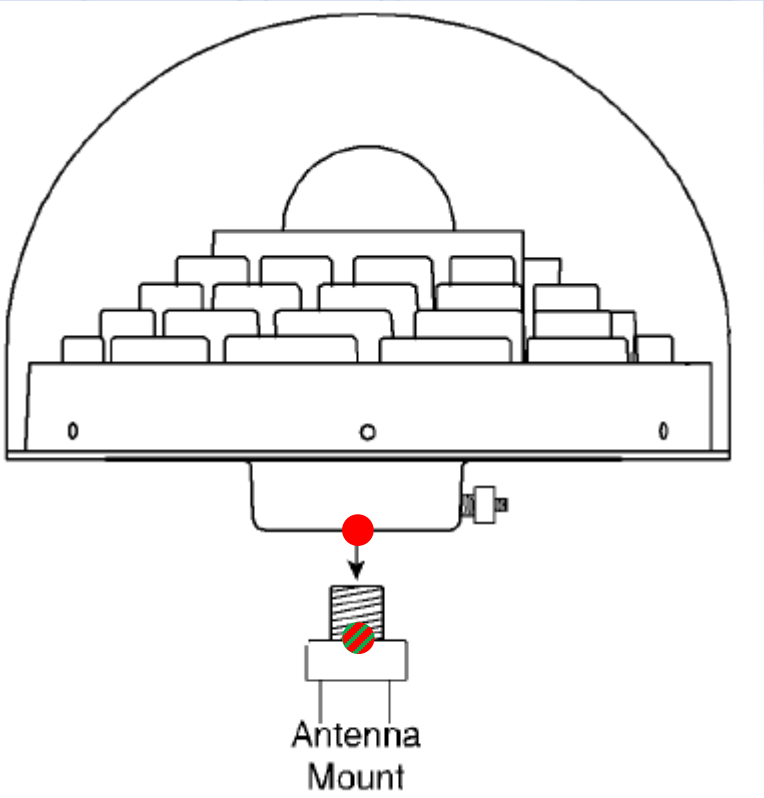
Answers Being Developed…

- The NCN will be the primary access to the modernized NSRS
- This means every historic issue with the NCN to date must be, and *will be*, addressed
- A list of such issues follows

The NCN of the Future Will…

- Have a "CORS grading" system:
  - Quality and availability
  - To encourage use of "best" CORSs
- Address the difference between the one GRP and the many ARPs at each station
  - ARP: Comes and goes with every antenna
  - GRP: Permanent point on the station

The NCN – ARP/GRP issues

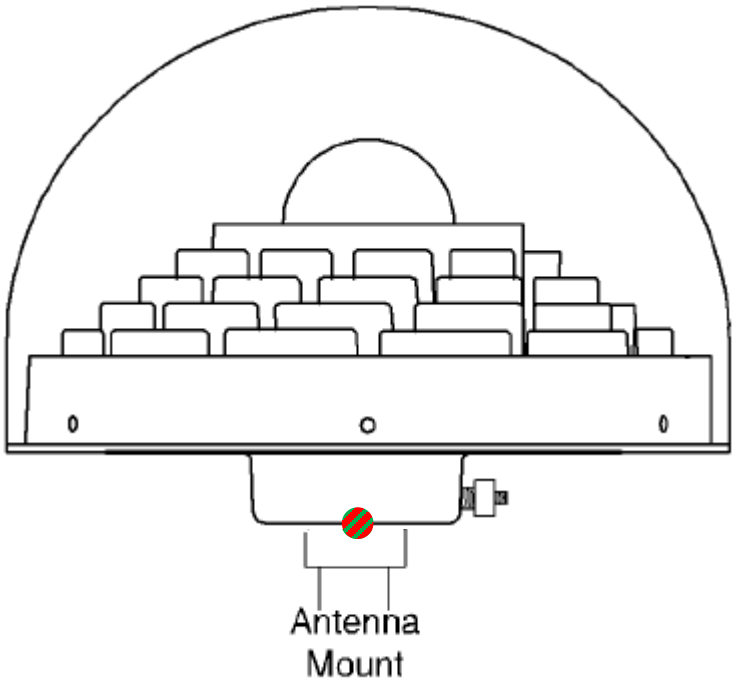


- The ARP is on the lowest non-removable plane of the antenna, usually coinciding with the axis of attachment

- The GRP is:
  - a unique point that is part of a particular station
  - the point to which any coordinate functions of the station refer.
  - identified by the operator of each station
  - (for a CORS) part of the fixed (=non-removable) part of the antenna mount

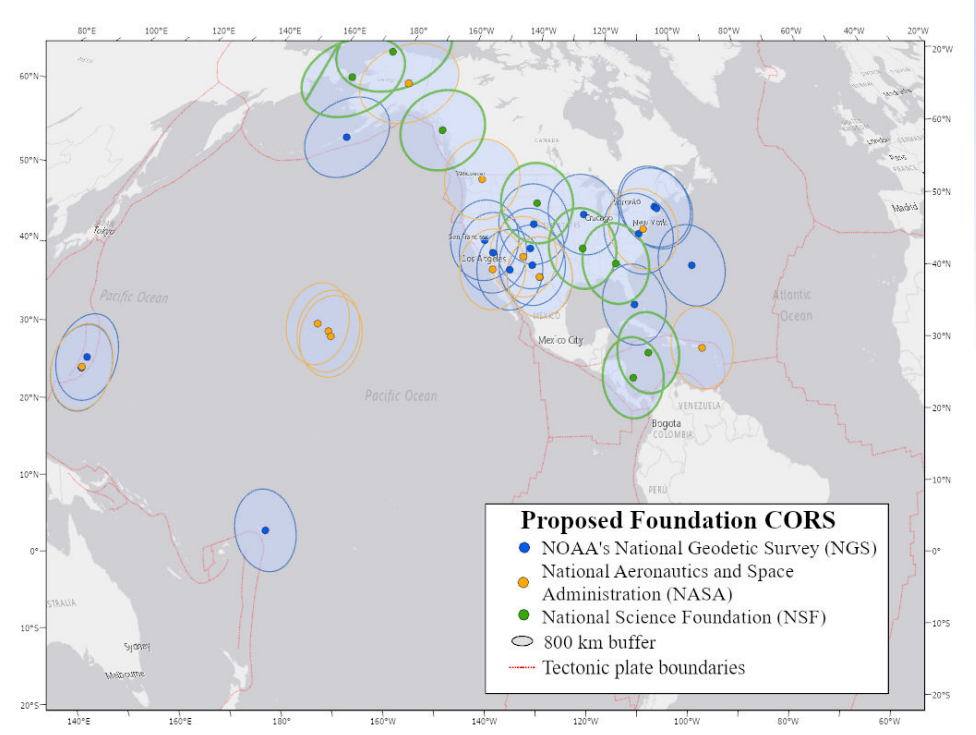
  In this example, we find it convenient to identify the GRP as the point on the axis of attachment which will coincide with the lowest non-removable plane of the antenna when the antenna is mounted.

The NCN – ARP/GRP issues



- When the antenna goes away, so does the ARP
- Leaving the GRP

NOAA Foundation CORS Network



26 in North America
4 in the Pacific
3 in the Caribbean
3 in the Marianas

U.S. Federal Partners	GNSS Site ID	Location	Existing IGS or ITRF Site
National Science Foundation (NSF) Existing Sites Program: Network of the Americas (NOTA)	AB09	Wales, AK	
	AB51	Petersburg, AK	
	ATQK	Atqasuk, AK	
	P043	New Castle, WY	
	P777	Dennard, AR	
	P804	The Rock, GA	
NSF Existing Sites Program: COCONet	CN11	Pedro Cay, Jamaica	
	SAN0	San Andres Island, Colombia	
National Aeronautics and Space Administration (NASA) Existing Sites Program: Global GNSS Network (GGN)	BREW	Brewster, WA	ITRF
	CRO1	St. Croix, VI	ITRF
	FAIR/GCGO	Fairbanks, AK	IGS
	GODE	Greenbelt, MD	IGS/ITRF
	GUAM	Dededo, Guam	IGS
	HAL1	Haleakala, HI	IGS/ITRF
	KOKB	Kauai, HI	IGS/ITRF
	MDO1	McDonald Observatory, TX	ITRF
	MKEA	Mauna Kea, HI	IGS/ITRF
	TBD	TBD California location	TBD
	PIE1	Pie Town, NM	IGS/ITRF
NOAA- National Geodetic Survey (NGS) Existing and New Sites Program: NOAA CORS Network	ASPA	Pago Pago, American Samoa	IGS
	BRSG	St. George, Bermuda	
	CNMR	Saipan, Northern Mariana Islands	IGS
	CORB	Woodford, VA	
	FLF1	Richmond, FL	Proposed IGS/ITRF
	GUUG	Mangilao, Guam	IGS/ITRF
	TMG2	Boulder, CO	Proposed IGS
	WES2	Westford, MA	IGS/ITRF
	Future Station	Apache Point, NM	ITRF
	Future Station	Fort Davis, TX	ITRF
	Future Station	Fort Irwin, CA	ITRF
	Future Station	Hancock, NH	ITRF
	Future Station	Los Alamos, NM	ITRF
	Future Station	Kitt Peak, AZ	ITRF
	Future Station	Owens Valley, CA	ITRF
	Future Station	Cold Bay, AK	ITRF
	Future Station	North Liberty, IA	ITRF

A set of federally-operated, high quality, highly reliable stations with the longevity to guarantee citizens' access to official National Spatial Reference System (NSRS) positions and support international positioning consistency efforts

Three Ongoing Phases of Foundation CORS

Phase 1: Incorporate partner stations

Existing NASA and NSF stations brought into the Foundation CORS network.

[NASA Agreement signed 12/18/2019. Discussions ongoing with NSF.]

Phase 2: Upgrade existing NGS CORSs

Upgrades include fully-GNSS ("All in Sky") capable equipment, RINEX3 support, and submission to IGS.

[RINEX3 creation, ingestion, and QC in development.
5 of 7 NGS Foundation CORS are fully-GNSS enabled]

Phase 3: Construct ~9 new stations

These NGS-owned stations will be co-located at sites with existing space geodetic techniques

Foundation CORS at NGS' Table Mountain Geophysical Observatory in Boulder, CO, installed 2018 (ID: TMG2)

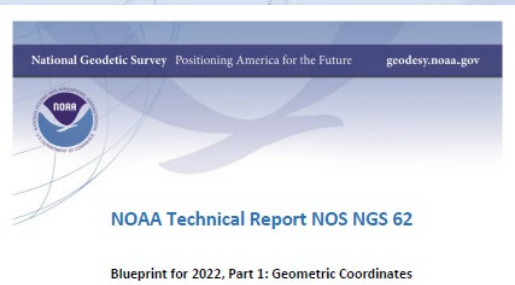
Updates

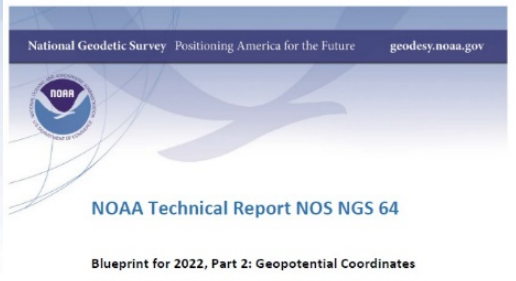
- The Blueprint documents contain some TBDs
  - They will be updated in 2021
- Additional information can be found by:
  - Subscribing to the *NSRS Modernization Newsletter*
  - Subscribing to the NGS Email Newsletters
    - Excellent way to learn when about new TRs and TMs

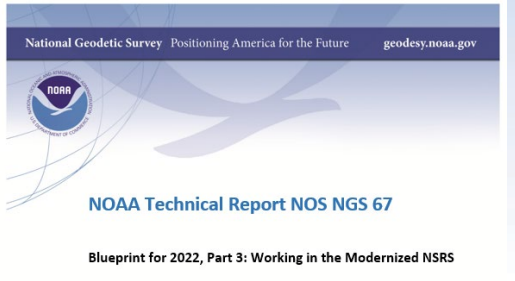
https://www.ngs.noaa.gov/INFO/subscribe

Modernizing the NSRS

The "blueprint" documents: Your best source for information







All three documents are being updated and re-released in 2021!!

Geometric:
Sep 2017
NOAA TR NOS NGS 62
32 pages

Geopotential:
Nov 2017
NOAA TR NOS NGS 64
41 pages

Working in the Modernized NSRS:
April 2019
NOAA TR NOS NGS 67
77 pages

NEW TYPES OF COORDINATES

Embrace Time-Dependencies

- Coordinates Change
  - Even in so-called "plate fixed" frames
- Associate Coordinates with their **Survey Epoch**
  - Active control: daily computed coordinates
    - Fit a simple function to them through time
      - Currently linear. Non-linear in the future.
  - Passive Control: Coordinates only when the point was surveyed

New Types of Coordinates

NGS anticipates that 5 types of coordinates will be used in the NSRS. They are:

- Reported
- OPUS
- Survey Epoch
- Reference Epoch
- Active

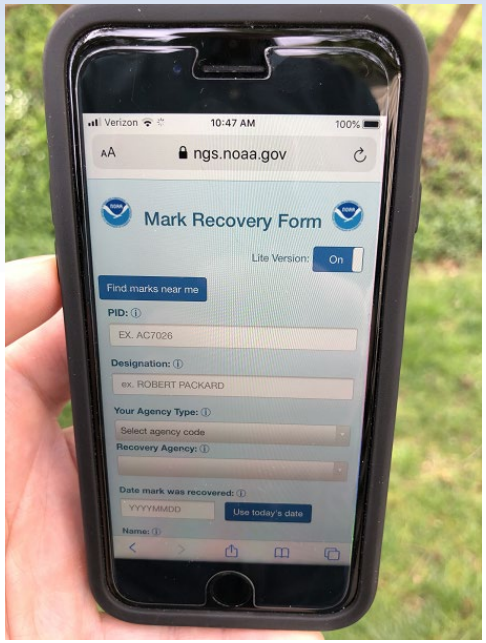
New Types of Coordinates

- ***Reported***
  - *"These are from any source where the coordinate is directly reported to NGS **without the data necessary for NGS to replicate the coordinate**."*
    - Scaled from a map
    - Transformed using NCAT or VDatum
    - Smartphone
    - Reported directly from an RTK rover without data files

Reported Coordinates

Speaking of Smartphones…

NGS has a new mobile-friendly mark recovery webpage. Please try it out!



https://www.ngs.noaa.gov/cgi-bin/mark_recovery_form.prl

Buyer Beware!

- ***Reported*** coordinates might be *very* wrong!
  - Reported in NAD 27 or NAD 83 or WGS 84
    - Systematic Error: 2–100 meters
  - Scaled off of a USGS topographic map
    - Random Error: ± 600 meters
  - Smartphone
    - Random Error: ± 10–50 meters
- NGS ***will show you*** reported coordinates
  - But their function is to get you "in the neighborhood" of a mark, not to use as geodetic control!

New Types of Coordinates

- ***OPUS***
  - *"These are coordinates **at any epoch the user wishes to use** that have been computed by that user in OPUS"*
    - *User-computed* values, such as they might get today from either OPUS-S or OPUS-Projects
    - "OPUS" coordinates are the ***only*** coordinates a user will get directly from OPUS
    - NGS will *not* evaluate your OPUS coordinates!

New Types of Coordinates

- ***OPUS*** coordinates *may* also come with the label "**tied to the NSRS**"
  - **Only** if a user restricts their computations to OPUS-recommended constraints
  - Users who deviate from OPUS-recommended constraints can still perform computations and will get OPUS coordinates, but they will not be "tied to the NSRS", nor have any NSRS label at all.
  - In neither case will OPUS coordinates be considered "***part of the NSRS***" however.
    - That moniker is restricted to NGS-computed coordinates available from the NSRS database, such as **survey epoch coordinates** (SECs), **reference epoch coordinates** (RECs) and **active coordinates** (ACs). See next slides.

New Types of Coordinates

Reference epoch coordinates (RECs)

- *"These are coordinates which have been **estimated by NGS**, from time-dependent age-limited historic survey data, CORS coordinate functions and an intra-frame velocity model, **at an official NSRS reference epoch***
  - NAD 83(2011) epoch 2010.00 (sort of) would've fallen under this category
  - These will be computed by NGS every 5 years
    - On a schedule 2–3 years past the reference epoch
      - » 2020.00 coordinates are computed in CY 2022, etc

New Types of Coordinates

Survey epoch coordinates (SECs)

– *"These are coordinates* **computed by NGS** *using submitted data and metadata, checked and adjusted and* **referenced to distinct epochs through time**.*"*

- These represent the best estimates NGS has of the time-dependent coordinates at any mark
- Adjusting multiple surveys in timespans called "adjustment windows", to a single epoch within that window.
  - Initial plan: 4 weeks for GNSS; 1 year for leveling

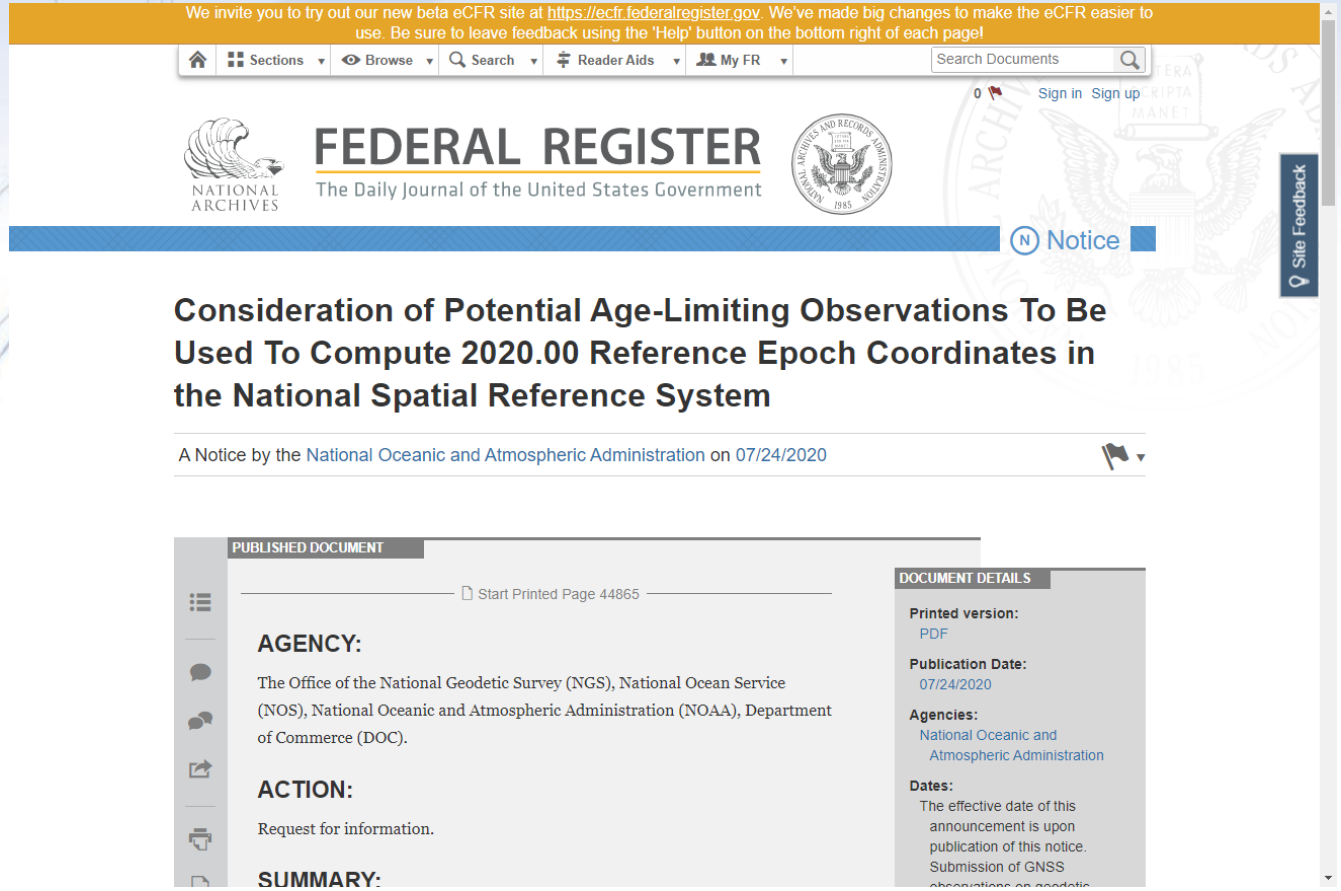
Pros and Cons

	Reference epoch (RECs)	Survey epoch (SECs)
Pros	• Familiarity • Large point count	• Shows, rather than hides, time dependency at marks • Easy to compute in a post-GPS era • Very accurate
Cons	• Hard to compute • Requires an expensive IFVM • Perpetuates old way of using geodetic control • Hides time dependency of marks • Inaccuracies build up based upon the large number of assumptions used	• Lack of familiarity by users • Will require significant effort to compute pre-GPS era absolute values

More on SECs and RECs

- At passive control
- SECs: adjusted to a midpoint epoch near the survey
  - (4 weeks for GNSS; 1 year for leveling; etc)
- RECs: adjusted to a ref. epoch (2020.00, etc.)
- REC adjustments will include:
  - Some *age-limited* span of data
    - If that age-limit were 10 years prior and 2 years post R.E….
      - Then 2020.00 RECs come from data spanning 2010.00 to 2021.99999
    - Exact age-limit won't be known until we start experimenting in 2022 with the 2020.00 REC adjustments

Time limits on reference epoch coordinates



New Types of Coordinates

Active coordinates (ACs)

- *Not discrete, but rather a function through time assigned to some point*
  - At a CORS GRP*, they will be the *coordinate function*
    - Which will be generated by a "fit" to regularly computed coordinates on a TBD basis, perhaps daily, perhaps weekly
      - » These daily or weekly coordinates will not generally be used as geodetic control by themselves

* Recall this is the physical point to which coordinates refer at a station like a CORS

CORS Coordinate Functions… (AKA "Active coordinates")

ftp://www.ngs.noaa.gov/cors/coord/coord_08/pin1_08.coord.txt

```
                          ***IGS 08***
                PINON 1 PGGA (PIN1),  CALIFORNIA

 Created on 31Aug2011 at 09:30:45.

 ------------------------------------------------------------------------
 |
 |         Antenna Reference Point(ARP): PINON 1 PGGA CORS ARP
 |         ---------------------------------------------------
 |                           PID = AF9708
 |
 |
 | IGS08 POSITION (EPOCH 2005.0)
 | Computed in Aug 2011 using data through gpswk 1631.
 |     X =  -2369511.285 m      latitude     =  33 36 43.76186 N
 |     Y =  -4761208.286 m      longitude    = 116 27 29.37473 W
 |     Z =   3511397.204 m      ellipsoid height = 1257.901   m
 |
 | IGS08 VELOCITY
 | Computed in Aug 2011 using data through gpswk 1631.
 |     VX =  -0.0231 m/yr       northward =   0.0076 m/yr
 |     VY =   0.0151 m/yr       eastward  =  -0.0274 m/yr
 |     VZ =   0.0070 m/yr       upward    =   0.0012 m/yr
 |
 |
```

A typical "CORS coordinate file" available from NGS

Just one set of coordinates and ***just one*** set of velocities are given…

…while this is good and useful information, it hides the true nature of the coordinate function.

New Database

- Currently: The NGS Integrated Database (IDB)
  - "Integrated" because it combined the old Horizontal and Vertical databases
- Future: The NSRS Database
  - Time-Dependent, Geospatial

Coordinates

- Five types:
  - **Survey Epoch**: "Time dependent coordinates"
  - **Reference Epoch**: "Estimated at 2020, 2025, 2030, …"
  - **Reported**: Good for finding a point somewhere on Earth.
    - Not to be used as geodetic control
  - **OPUS**: Computed by you, and as accurate or inaccurate as the choices you make
    - Tied to the NSRS if you follow OPUS recommendations
  - **Active**: Continuous functions at a CORS

State Plane Coordinates System of)

- See SPC cedures for details https://ge olicy.shtml
- Wisconsi uested and proposed
  - All zone in 2021
  - Can cha fter official rollout
  - See tom Alan Vonderohe and Dan Rodman

20. Wisconsin's Piece of the State Plane Coordinate System of 2022 (SPCS2022): Practical Aspects of Adoption of New Reference Frames, Datums, and Coordinate Systems

Dan Rodman, PLS, City of Madison Parks Division, Madison, Wis. and Alan Vonderohe, Professor Emeritus of Civil and Environmental Engineering, University of Wisconsin-Madison, Madison, Wis.

2.0 PDHs, Category 1 or 3

Survey requests, proposals, and designs for two 'layers' of map projections to be included in the new State Plane Coordinate System. A statewide single zone, as well as a new set of low-distortion projections (LDPs), similar but not identical to WISCRS, will be described. Practical considerations, from a surveyor's and spatial data manager's perspective, of implementing the new coordinate systems and their underlying new reference frame will be described with examples of potential coordinate differences and alternatives for dealing with them.

Bye, bye, U.S. survey foot…

- In modernized NSRS, NGS will support only one definition of the "foot"
  - Previously called the "international foot"
  - Now, just the "foot"
  - 1 foot = 0.3048 meter (exact)
- *However*
  - Recommend using term "international foot" when there is potential for confusion with other foot
  - NGS will continue to support U.S. survey foot for legacy applications (e.g., SPCS 83 and 27)

HOW YOU CAN CONTRIBUTE

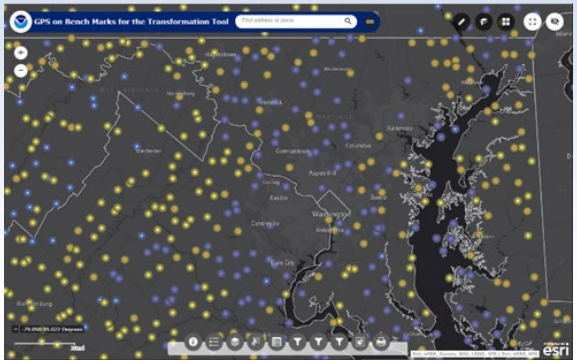
GPS on Bench Marks:

Crowdsourcing Data for Better Models and Tools

NGS provides a prioritized list of marks where new data will most benefit the local accuracy of national scale models and tools such as GEOID18 and the 2022 Transformation Tool

Who: Federal and State government agencies, universities, and private sector firms

What: Mark Recovery Reports & Sharing GPS Observations



Priority Marks Web Map

2022 Transformation Tool Campaign

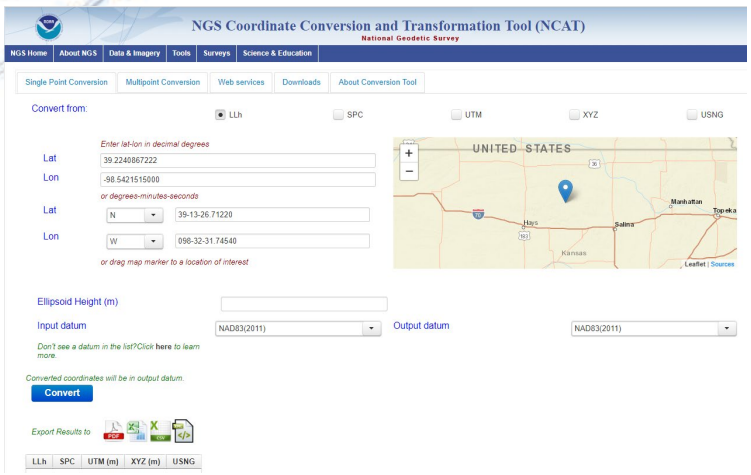
National Coverage @ 10km spacing – ideal resolution for data to develop a national scale transformation tool

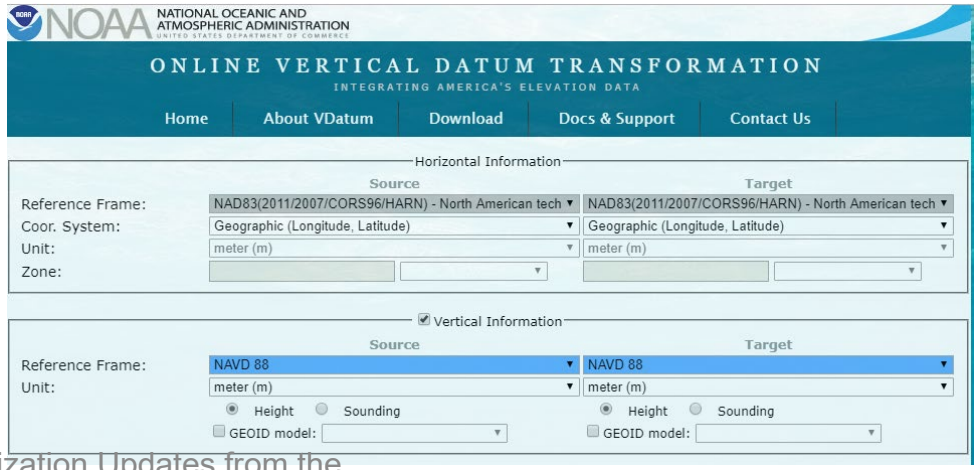
Local Densification @ 2km spacing – Allows partners to collect higher density data and increase local accuracy in areas they work

Transformation Tool Campaign Progress Dashboard

GPSonBM: 2022 Transformation Tool Campaign

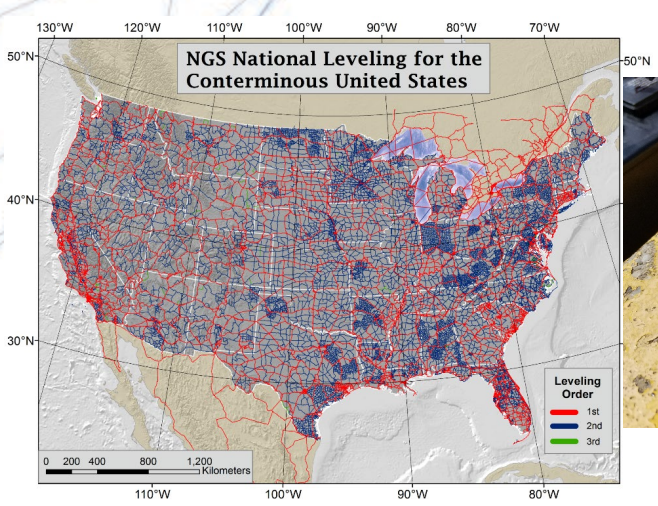
NGS' GPSonBM program is now requesting data to build the models that NCAT and VDatum will use to transform geospatial data from existing datums to the Modernized National Spatial Reference System

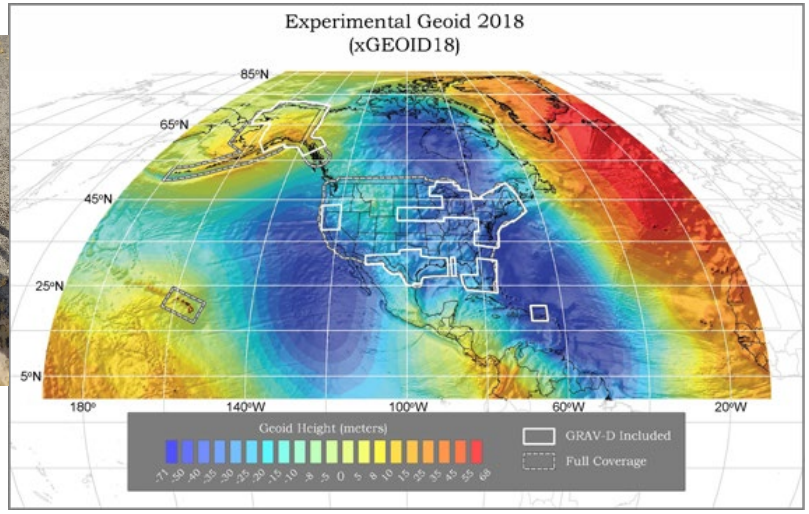




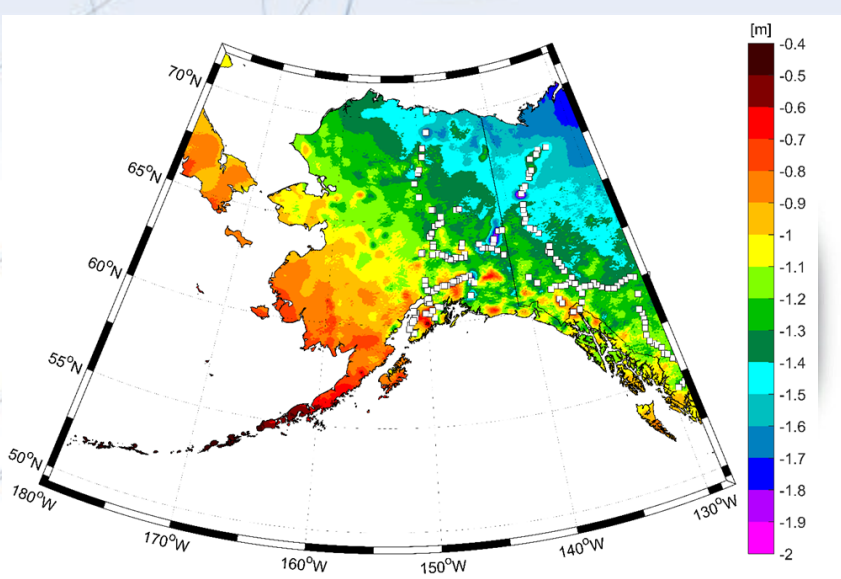
GPSonBM Connects Old & New Datums

Because the relationships between the old and new datums vary by location, the accuracy of the transformations in any particular place is directly related to the density of GPSonBM data available in that area.

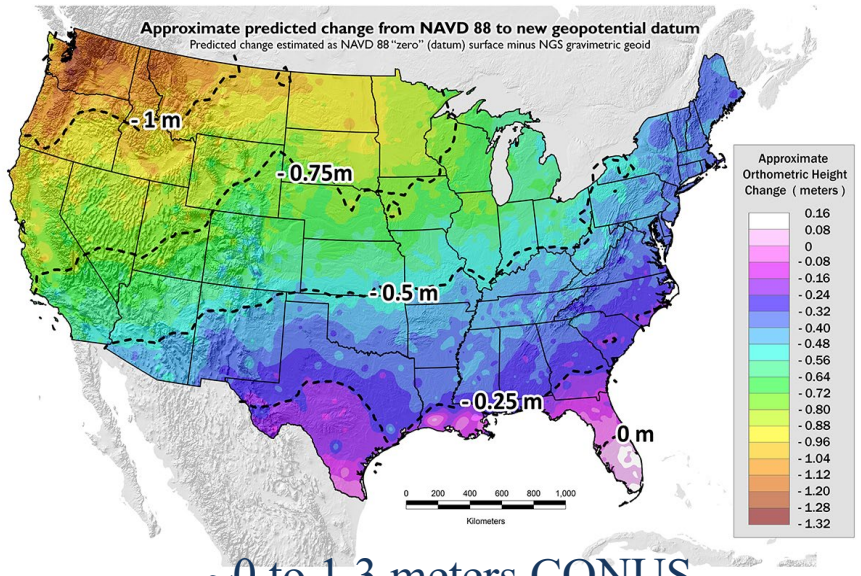




Approximate Predicted differences between Old & New: NAVD 88 minus NAPGD2022



~0.4 to 2 meters in Alaska

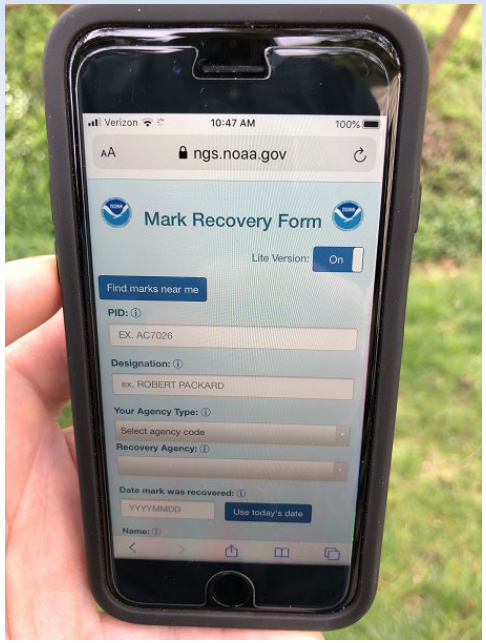


~0 to 1.3 meters CONUS

GPSonBM data collection efforts are focused on the vertical datum transformations to resolve the irregular relationship between the surfaces. Horizontal transformations are smooth and will be done primary with CORS data.

Recover

NGS has a new mobile-friendly mark recovery webpage. Please try it out!



https://www.ngs.noaa.gov/cgi-bin/mark_recovery_form.prl

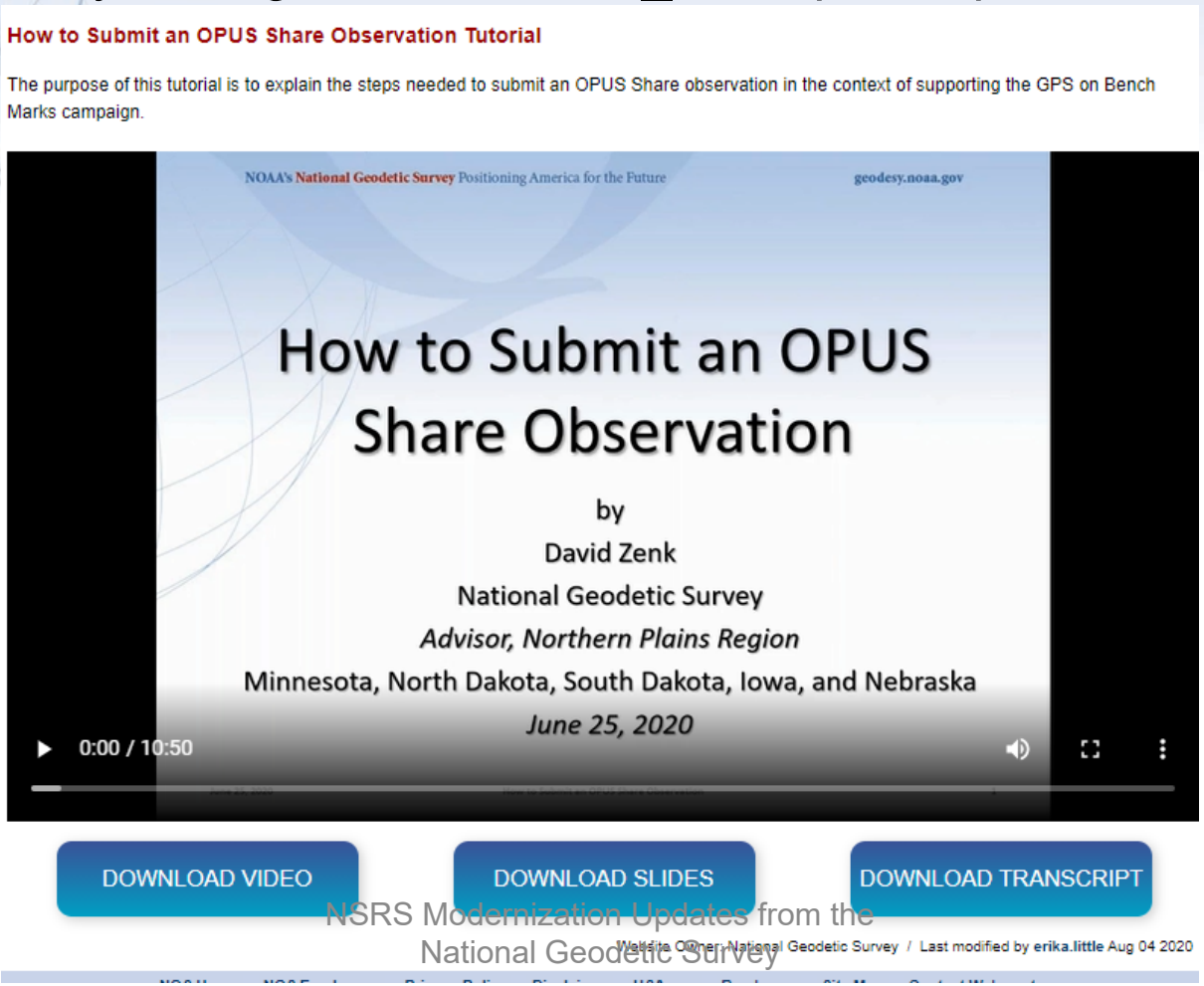
Observe

- 4+ hour static occupation
- **Take photos** of the mark (close up and eye level), take one horizon photo (preferably facing south) and note any changes to the existing mark description.
- Fixed height tripod recommended

Report using OPUS Share

https://www.ngs.noaa.gov/OPUS/

https://geodesy.noaa.gov/corbin/class_description/opus-share-tutorial/



GPS on Bench Marks Deadlines

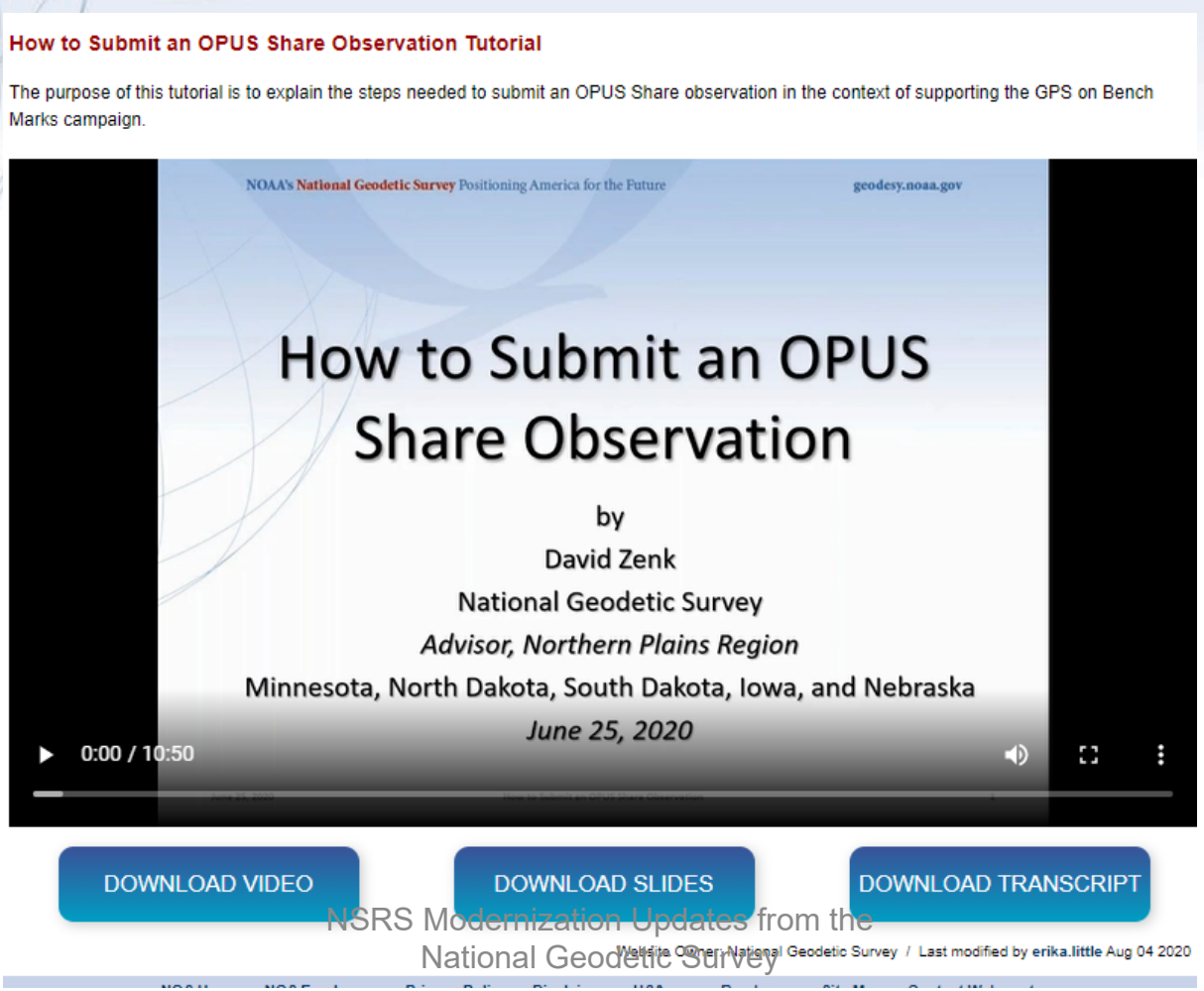
DECEMBER 31, 2021

- Deadline for inclusion in Reference Epoch Coordinate (REC) adjustment

- Deadline for inclusion in the Transformation Tool

New Video Tutorial!

https://geodesy.noaa.gov/corbin/class_description/opus-share-tutorial/



NSRS Modernization: DELAY

- It's official: we are delayed beyond 2022
- On June 23, 2020, this message was rolled out via:
  - NGS Web Page
  - *NSRS Modernization News* Special Issue
  - Granicus Announcement
  - Notifications to NSPS, AAGS, FGDC/FGCS

NSRS Modernization: DELAY

A list of FAQs is available. Some summary highlights:

- **Why are we delayed?**
  - GRAV-D issues (COVID-19, airspace, unforeseen maintenance)
  - Personnel issues (Losses, hiring issues)
- **How long is the delay?**
  - Unknown. Years.
- **Will names change?**
  - No, "GEOID2022", "NATRF2022", etc. will remain the same

NSRS Modernization: DELAY

What now?

- A re-prioritization of all modernization tasks was done
- Efforts on getting tasks completed in a logical order that builds one upon the next
  - To allow us the choice, if we wish, to phase the modernization roll-out:
    - For example, rolling out NATRF2022 before NADCON exists
    - For example, rolling out NATRF2022 before NAPGD2022
  - BUT phased roll-out isn't on the table yet
- No deadlines slip.
  - GPS on BM , SPCS , etc.
  - Steady as she goes…

Summary

- Your NAD 83 coordinates may change by 2–4 meters
- Your orthometric heights may change by up to 2 meters (or more)
- Magnitude of change will vary with location:
  - NAD 83 will change by about 0.5 to 4 meters horizontally
  - Orthometric and NAD 83 ellipsoid heights will change by up to about 2 meters
- And that just gets you to a "reference epoch"
  - Which continues to perpetuate the "one coordinate in perpetuity" myth
  - After that, real motions kick in and become part of the world of geodetic control

Summary

- But it's not all "change"…
  - You will still be able to:
    - Get a position using OPUS
    - Adjust your projects to some reference epoch
    - Look at a mark's "datasheet"
  - Only now, there will be a lot more information and a lot more service provided

Closing

- Surveying will still be surveying
- Just because NGS provides time-dependent information doesn't mean everything you do has to be "time dependent"
  - NGS will provide tools to minimize its impact:
    - Plate fixed frames
    - Reference epoch coordinates

Closing

- But if time-change is important (heights in coastal subsidence zones, anyone?) they are available
  - Survey epoch coordinates will show a mark's coordinate history
    - The IFVM will be broadly useful for showing movement in the horizontal, but significantly less so in the vertical

Online Resources

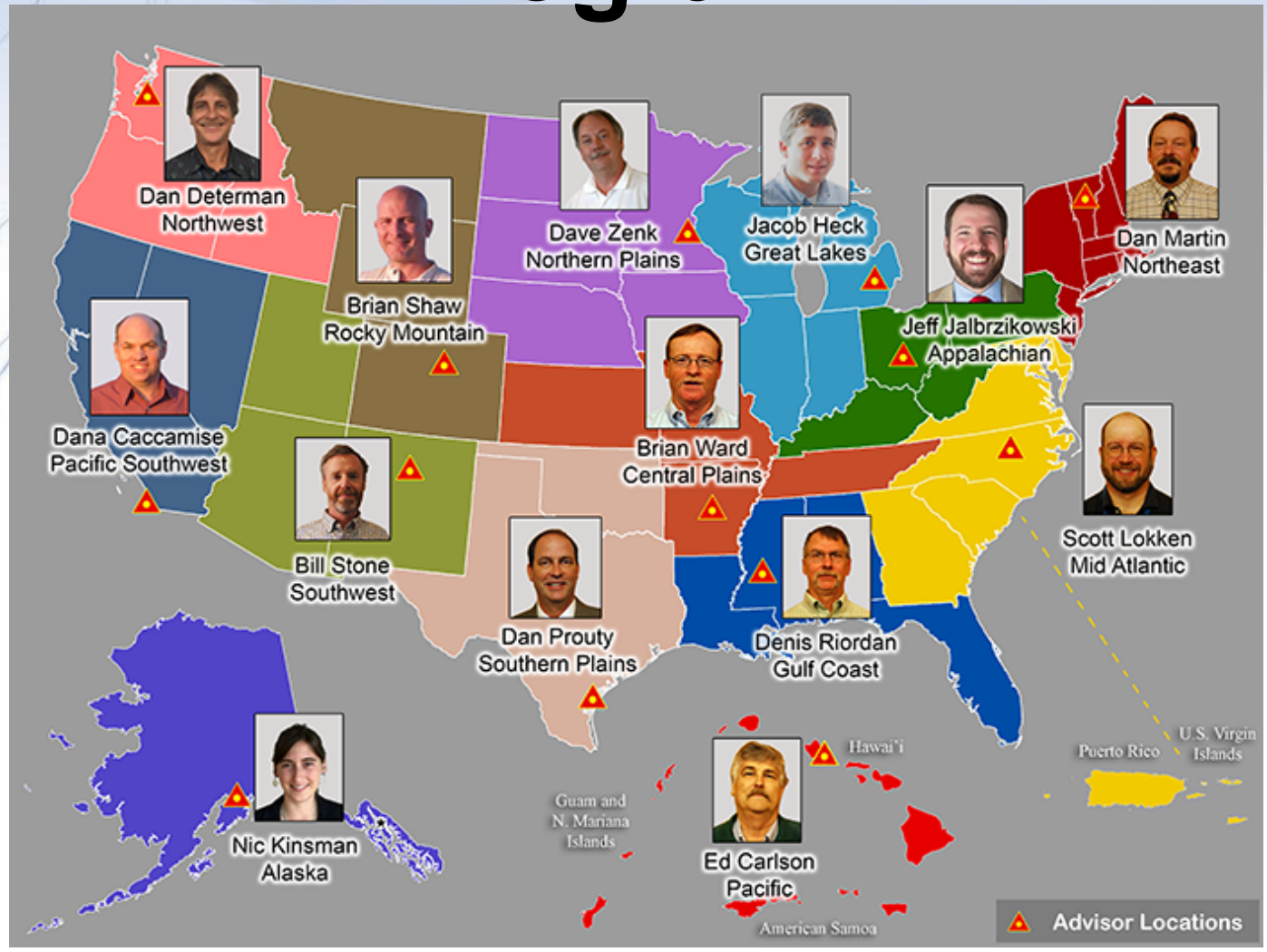
- Monthly webinar series
  - All webinars are recorded and availabl online
- Online lessons
- Video library
- Publication library

https://geodesy.noaa.gov/

How to stay informed

- Questions? ngs.infocenter@noaa.gov
- NGS Regional Advisors:
  - https://geodesy.noaa.gov/ADVISORS/index.shtml
- NSRS Modernization News
  - https://www.ngs.noaa.gov/datums/newdatums/index.shtml
- Webinars:
  - https://www.ngs.noaa.gov/INFO/subscribe.shtml

Regional Geodetic Advisor Program



www.ngs.noaa.gov/ADVISORS/

Thank You!

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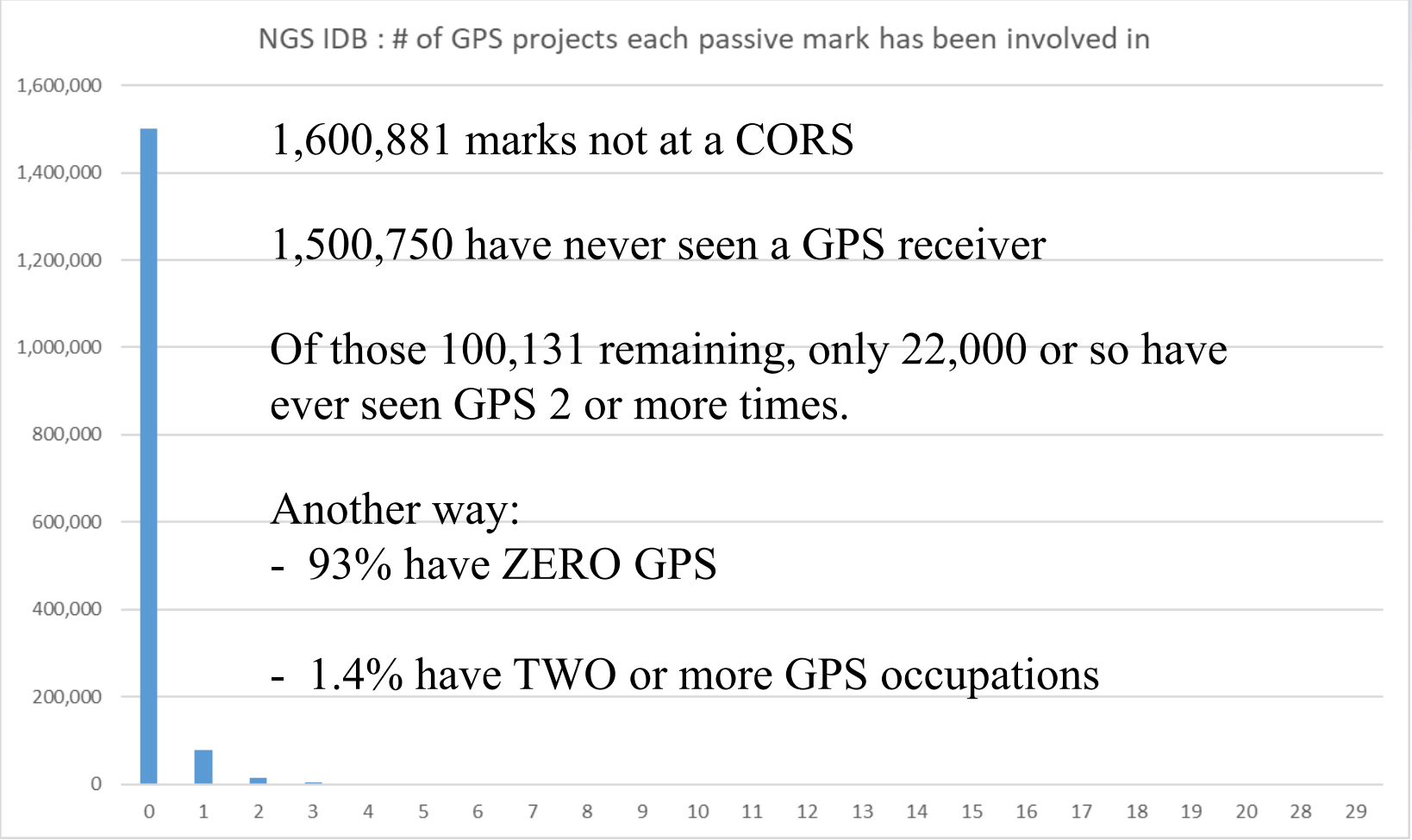
For more information, visit https://geodesy.noaa.gov

Extra Slides

Does anyone *really* re-survey points?



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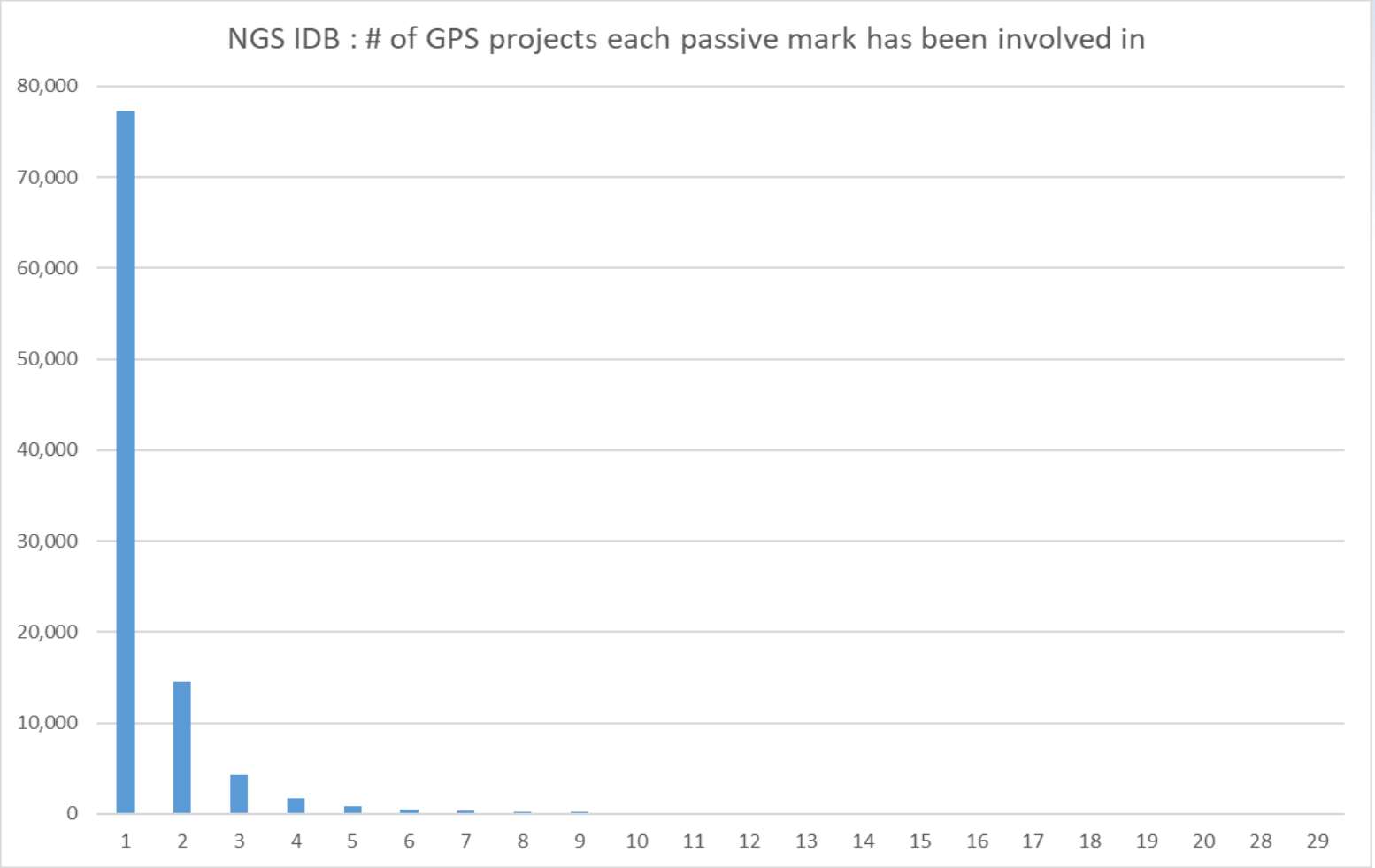

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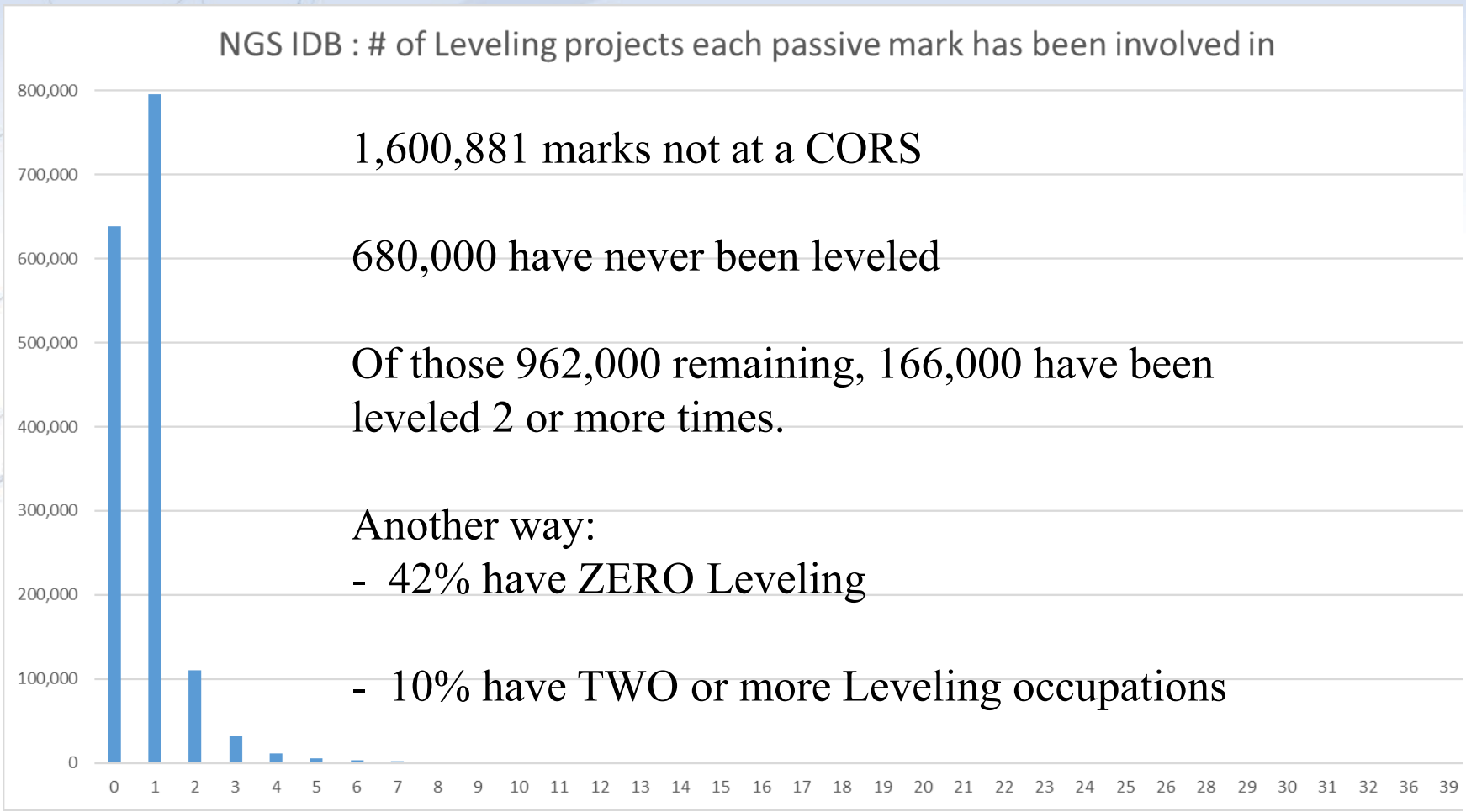

Geoid-Based Vertical Datum

	Passive Control	Geoid-Based / GNSS accessed
Available everywhere?	No	Yes
Safe from being bulldozed?	No	Yes
Accurate to a few cm everywhere?	No	Yes
Differentially accurate to few mm < 50 km?	Yes	No
Differentially accurate to few mm 50-200 km?	Yes	Yes
Differentially accurate to few mm > 200 km?	No	Yes
Change to the way people do business?	No	Yes
Fast?	No	Yes

GPS vs Leveling…