



NSRS Modernization Update

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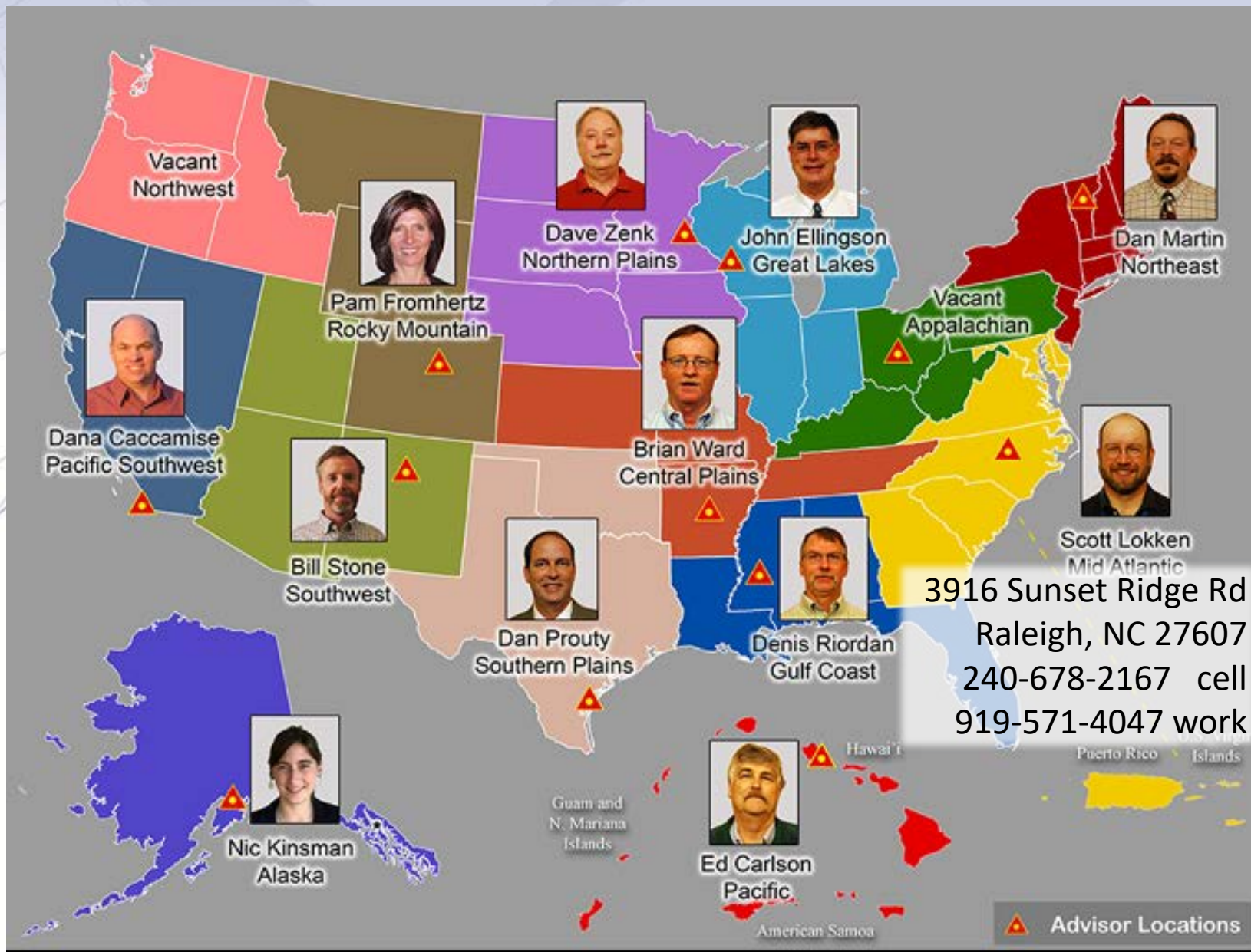
National Geodetic Survey, NOAA

Mid Atlantic Regional Geodetic Advisor

Oct 05, 2017

Maryland Society of Surveyors Fall Conference

NGS Regional Geodetic Advisors



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Session description and objectives

- In 2022, the National Geodetic Survey will be replacing the U.S. horizontal and vertical datums (NAD 83 and NAVD 88). We will discuss the history of these datums, their relationship to other reference frames, the reasons for the change, and how it affects surveyors and their access to these datums.
- Objective...gain a fundamental understanding of:
 - How and why our datums/reference frames have changed over time
 - The need to further modernize the US reference frames
 - How NGS will define new reference frames
 - How users will access the new reference frames

New Datums are Coming in 2022!

- Where are we now?
- Where are we going?

(2022 will be here sooner than we think!)

What is a Datum?

- "A set of constants specifying the coordinate system used for geodetic control, i.e., for calculating the coordinates of points on the Earth."
- "The datum, as defined above, together with the coordinate system and the set of all points and lines whose coordinates, lengths, and directions have been determined by measurement or calculation."

INTRODUCTION: THE NSRS

National Spatial Reference System (NSRS)

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

Consistent National Coordinate System

- Latitude/Northing
- Longitude/Easting
- Height
- Scale
- Gravity
- Orientation

and how these values change with time.



Overview

- The National Spatial Reference System (**NSRS**) is the official coordinate system for all geospatial work done by the civilian federal government.
- Current datums:
 - NAD 83 (latitude, longitude, ellipsoid height)
 - NAVD 88 (orthometric height)
 - IGLD 85 (dynamic heights: predominantly on the Great Lakes)
- These datums are often adopted, even legislated, by states, counties and municipalities.

Why Modernize?

- Older Methodology
 - Terrestrial, pre-space-geodesy, line-of-sight observations
 - Easily destroyed, unmonitored *passive* control marks



Historical datums/Realizations

- NAD27 based on old observations and old datum
- NAD83(86) based on old observations and new datum
- NAD83(91) based on new and old observations and same datum (original HARN)
- NAD83(????) based on better observations and same datum (FBN)
- NAD83(NSRS2007) based on new observations and same datum. Removed regional distortions and made consistent with CORS
- NAD83(2011) based on new observations and same datum. Consistent with new Multi Year CORS solution

Global Positioning System



GPS Block I



GPS Block II

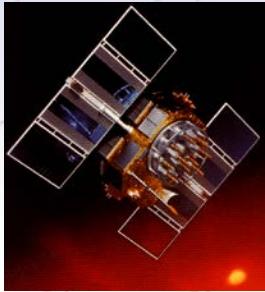


GPS Block III

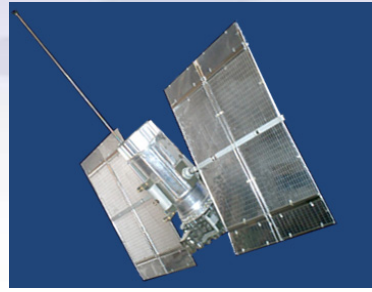
- **February 22, 1978 - 1st NAVSTAR Satellite launched**
- **July 17, 1995 - System Fully Operational**
- **May 1, 2000 - Selective Availability turned off**
- **September 26, 2005 - L2C band added**
- **May 28, 2010 - First L5 Satellite added**
(12 L5 SVs launched to date)
- **Mid 2017 – First Block III scheduled for launch?**
- **2020? - 10-50 cm real-time accuracy! Maybe Sooner!**

NO GROUND CONTROL

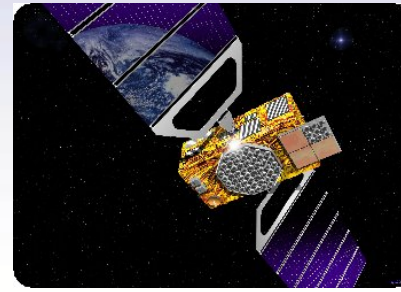
Global Navigation Satellite System



US - GPS



Russia - GLONASS



EU - Galileo



China – BeiDou

Four positioning and navigation systems

- NAVSTAR/GPS – US (Currently 33)
- GLONASS – Russia (Currently 24)
- GALILEO – EU (Currently 18, 30 by 2019)
- BEIDOU/COMPASS – China (30+ by 2020?)

The NSRS has evolved



1 Million
Monuments
(Separate Horizontal
and Vertical Systems) →

70,000
Passive Marks
(3-Dimensional)



Passive
Marks
(Limited
Knowledge of
Stability) →

≈ 2,000 GPS
CORS
(Time Dependent
System Possible;
4-Dimensional)



GPS CORS → GNSS CORS



Historical Vertical Datums

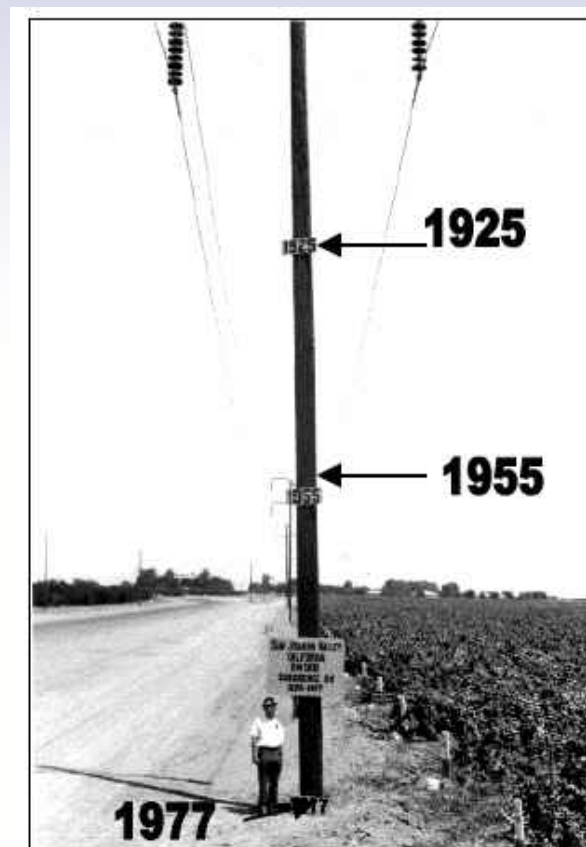
- Sea Level Datum of 1929
- NGVD29 National Geodetic Vertical Datum of 1929
- NAVD88 North American Vertical Datum of 1988
- PRVD02 Puerto Rico Vertical Datum
- ASVD02 American Samoa Vertical Datum
- NMVD03 Northern Marianas Vertical Datum
- VIVD09 Virgin Islands Vertical Datum

When was the passive mark last leveled?



Photo provided by
H. H. Schumann & Associates

Due to land subsidence, the elevation of this spot near Luke Air Force Base in Maricopa County has dropped by more than 18 feet over a 34-year period. Knowledge of subsidence areas is a fundamental requirement for planning infrastructure such as pipelines, canals, and power plants.



Approximate levels of subsidence. The signs show the position of land surface in 1925, 1955, and 1977. Although the rate of subsidence has decreased, the continued pumping of ground water has resulted in additional subsidence in the past 20 years.

Figure 6 Subsidence in California's Central Valley

Why Modernize?

- Evidence of systematic errors
 - Decades of space geodetic observations
 - All of the datums contain *systematic* errors (decimeters to meters)
 - At scales larger than today's accuracy capabilities (centimeters)
 - Origin (center of Earth) offset: 2+ meters
 - Zero elevation surface: 0.5 to 2+ meters

What's Being Replaced?

Horizontal

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

Latitude
Longitude
Ellipsoid Height
State Plane Coordinates

Vertical

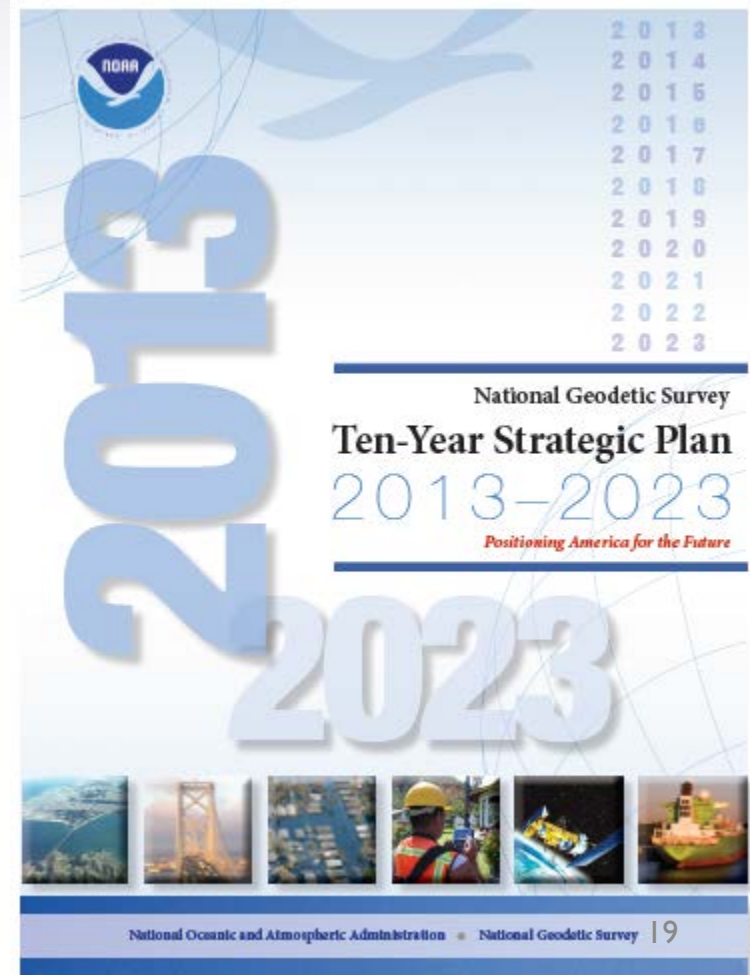
- NAVD 88
- PRVD 02
- VIVD09
- ASVD02
- NMVD03
- GUV D04
- IGLD 85

Heights

The National Geodetic Survey 10 year plan

[http://www.ngs.noaa.gov/web/news/Ten Year Plan 2013-2023.pdf](http://www.ngs.noaa.gov/web/news/Ten_Year_Plan_2013-2023.pdf)

- Official NGS policy as of Jan 31, 2013
 - Updates 2008 plan
 - Modernized and improve NSRS
 - Attention to accuracy
 - Attention to time-changes
 - Improved products and services
 - Fully vetted by NSPS/AAGS
- 2022 Targets:
 - Replace NAD 83 and NAVD 88
 - Cm-accuracy access to all coordinates



NOMENCLATURE AND LEGISLATION

Nomenclature

- A chance to increase accuracy in **naming!**
 - “North American”?
 - Ignores Guam, Hawaii, American Samoa, Northern Mariana Islands
 - Datum vs. Reference Frame?
 - Plate-specific?
 - Vertical vs. Geopotential?
- 6/8/2016: NGS and the Canadian Geodetic Survey (CGS) negotiated a naming proposal
 - Approved by the NGS Executive Steering Committee
 - Approved by the CGS leadership (with minor reservations)
- Early 2017
 - Approved by the Mexico's INEGI

A stylized globe with latitude and longitude lines is on the left side of the slide. A large, light blue eagle logo is positioned in the upper center, with its wings spread. The background is a light blue gradient.

(DRUM ROLL Please)

New Reference Frame Names

NAD 83 becomes:

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

NAVD88 becomes:

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

(Realized by GEOID2022)

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

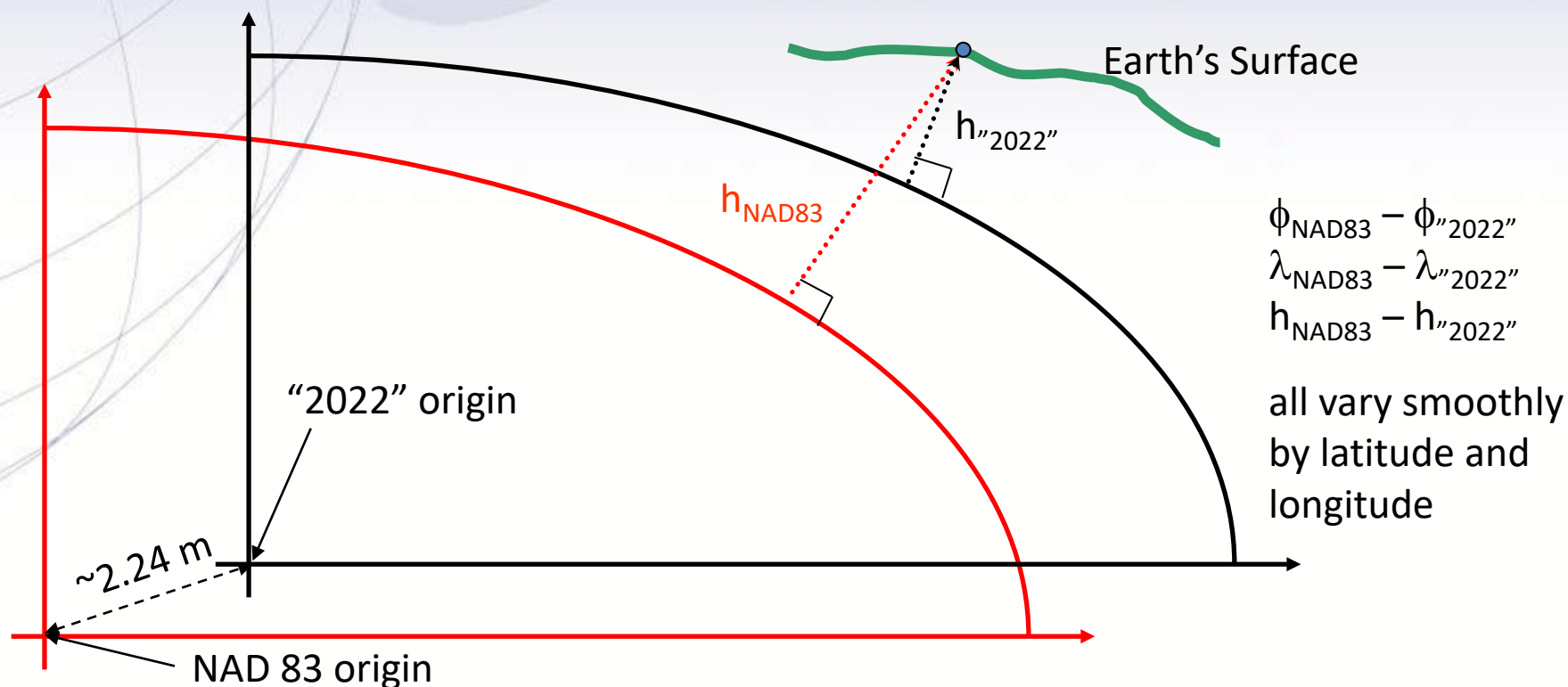
Legislation

- 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

OBJECTIVE 1 OF 5: REPLACE NAD 83

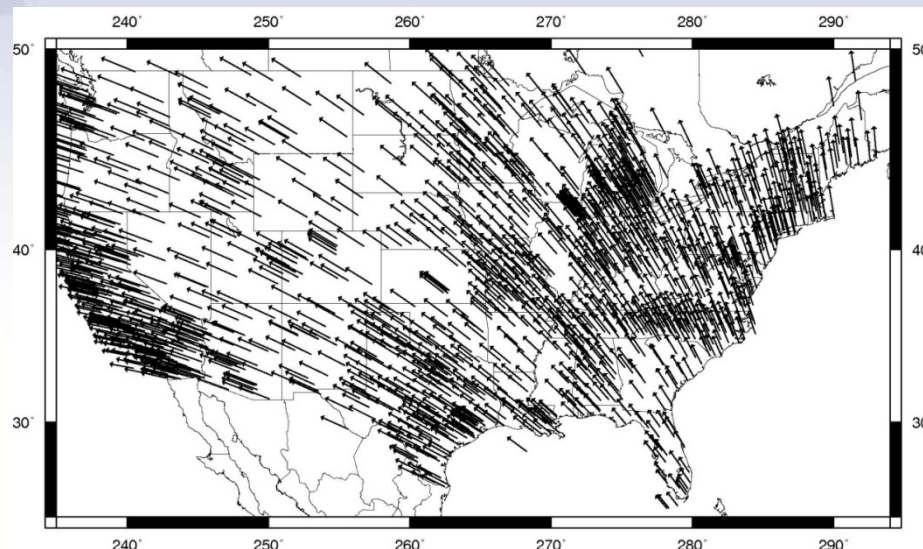
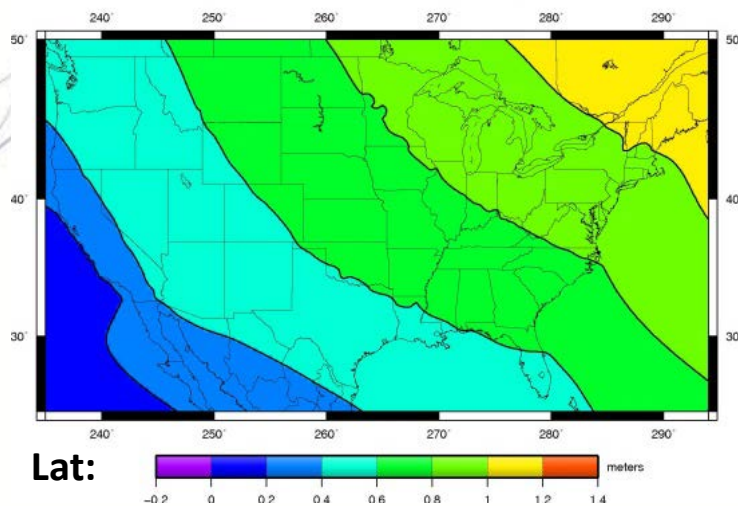
Replace NAD 83

Simplified concept of NAD 83 vs. "2022"

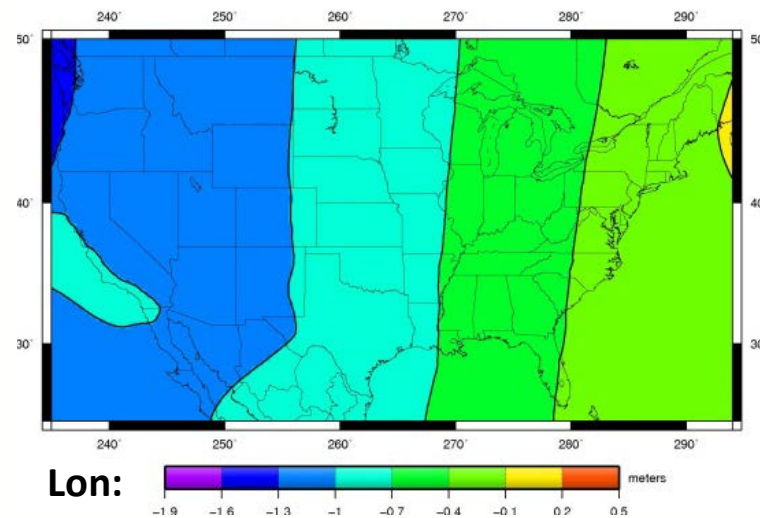


Horizontal Shifts

- Approximate
 - IGS08(GRS-80) minus NAD 83(2011)

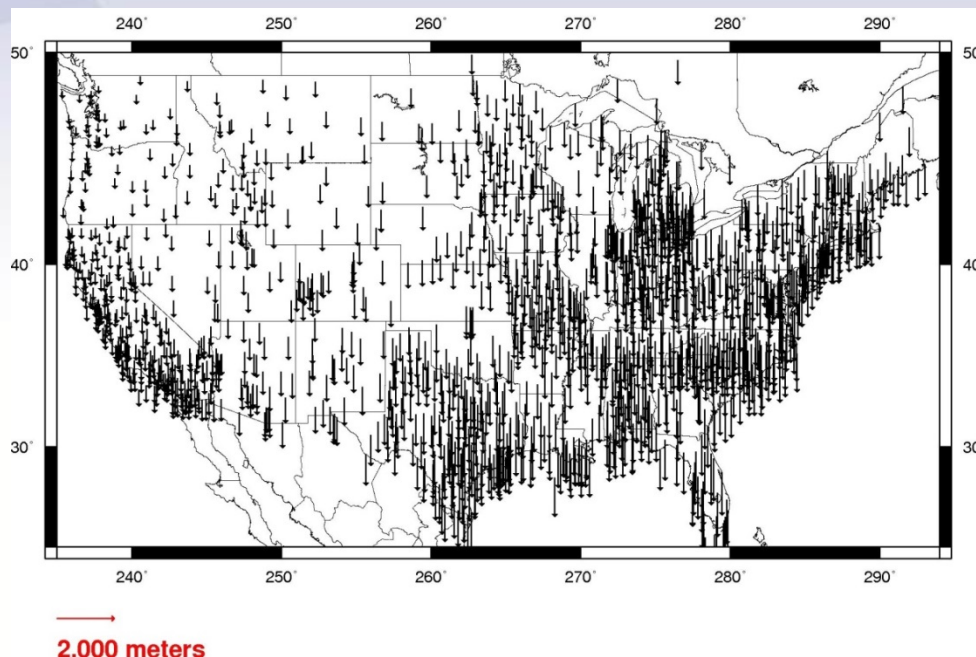
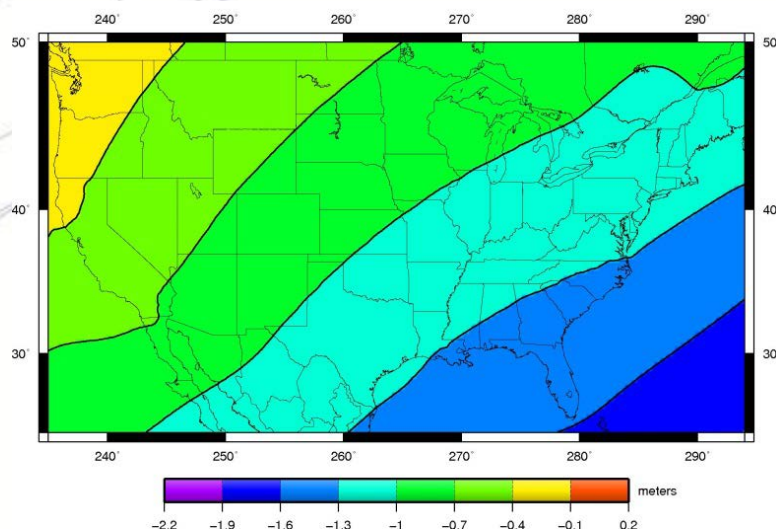


→
2.000 meters



Ellipsoid Height Shifts

- Approximate
 - IGS08(GRS-80) minus NAD 83(2011)



Replace NAD 83

Access and definition



- Primary: CORS
 - Continuous monitoring
 - IGS coordinates
 - Transformable to any national reference frame chosen for 2022
 - OPUS
 - Static Surveys
 - RTK/RTN
 - Validation service
- Secondary: Passive
 - Time-tagged coordinates
 - Will reflect each occupation of the mark
 - Will *generally* not be accepted as “fixed control” in surveys turned in to NGS

More on: ITRF2008, IGS08

ITRF2008

For the geodesy, geophysics and surveying communities, the best International Terrestrial Reference Frame is the “gold standard.”

The global community adopted an updated expression for the reference frame, the ITRF2008.
(actually ITRF2014 published as of Jan2016)

International Earth Rotation and Reference System Service (IERS)

[\(http://www.iers.org\)](http://www.iers.org)

The International Terrestrial Reference System (**ITRS**) constitutes a set of prescriptions and conventions together with the modeling required to define origin, scale, orientation and time evolution

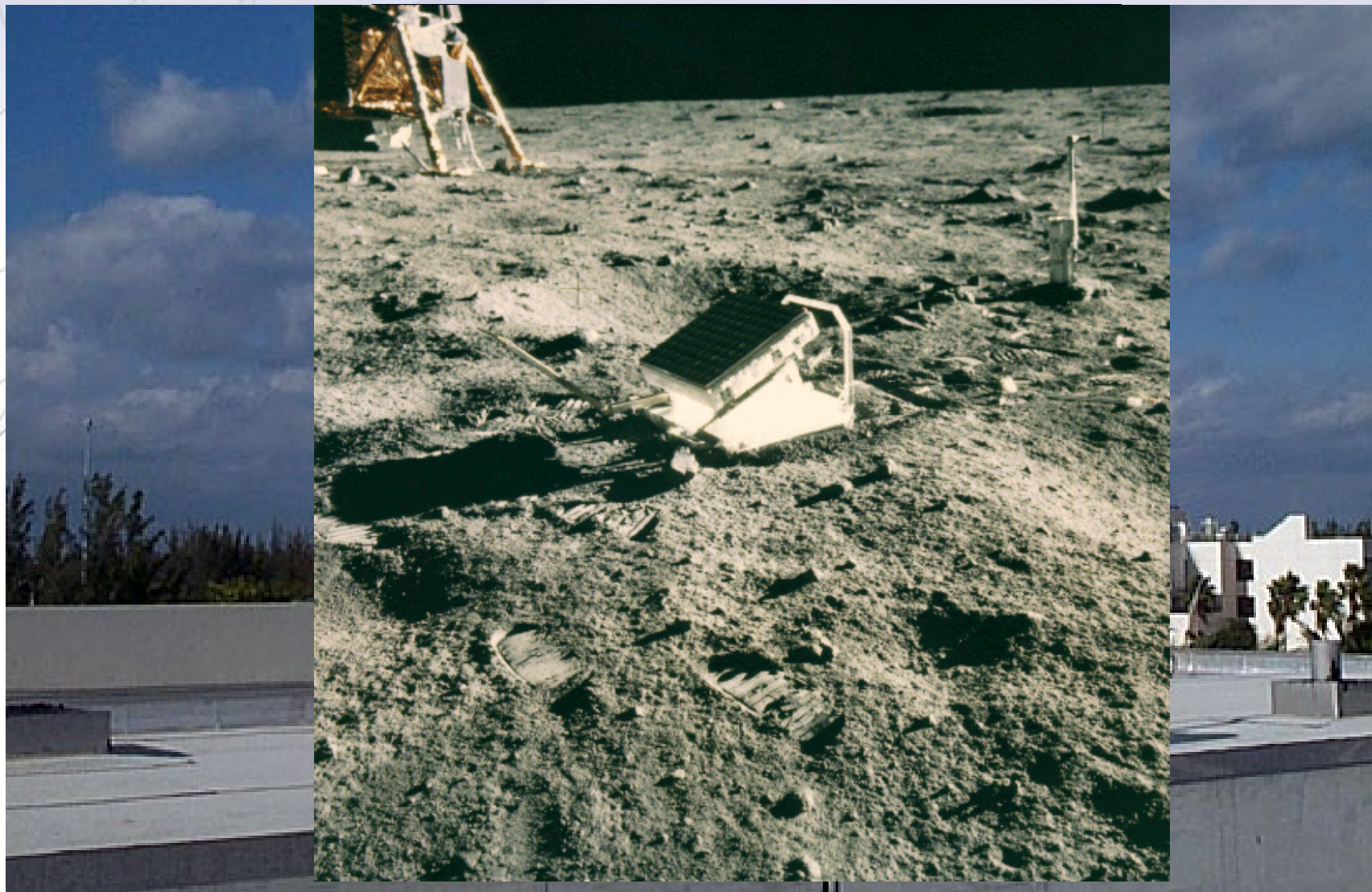
ITRS is realized by the International Terrestrial Reference Frame (**ITRF**) based upon estimated coordinates and velocities of a set of stations observed by:

- Very Long Baseline Interferometry (**VLBI**),
- Satellite Laser Ranging (**SLR**),
- Global Positioning System and GLONASS (**GNSS**), and
- Doppler Orbitography and Radio- positioning Integrated by Satellite (**DORIS**).

**ITRF89, ITRF90, ITRF91, ITRF92, ITRF93, ITRF94, ITRF95, ITRF96, ITRF97,
ITRF2000, ITRF2005, ITRF2008, (ITRF2014)**

International Terrestrial Reference Frame

4 Global Independent Positioning Technologies



The IGS08

(ITRF- but GNSS only)

The IGS has densified reference frame with much larger, global subset of GNSS tracking sites thereby creating a GNSS-only expression of the ITRF2008 called the IGS08. All IGS products have been recreated so as to be consistent with the IGS08 including GNSS ephemerides and antenna models. Information about the IGS08 can be found at the IGS web sites: igsb.jpl.nasa.gov. I would suggest starting with IGSMail-6354, -6355 and -6356, all dated 2011-03-07.

Enough International, Back to the New Datums

Definition of New Frames

“Plate fixed” ... defined at an Epoch.

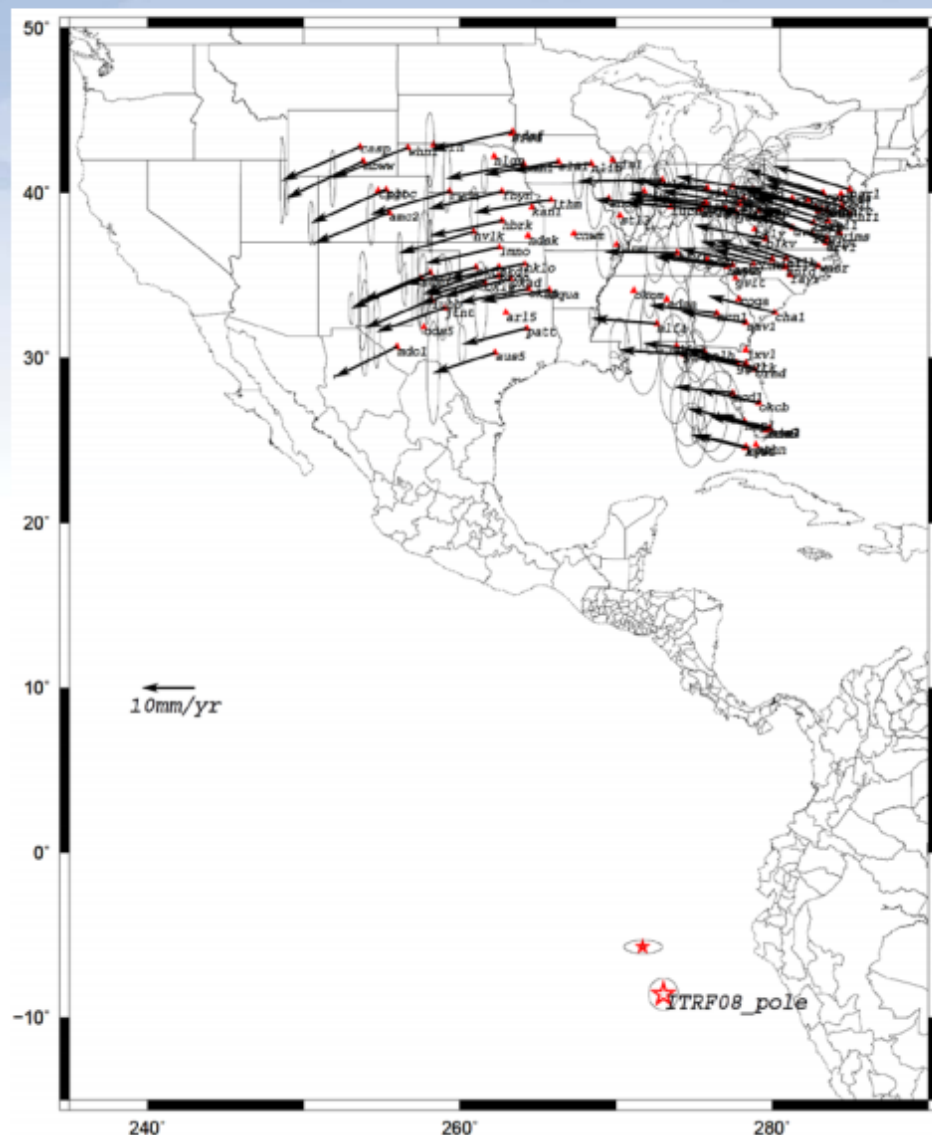
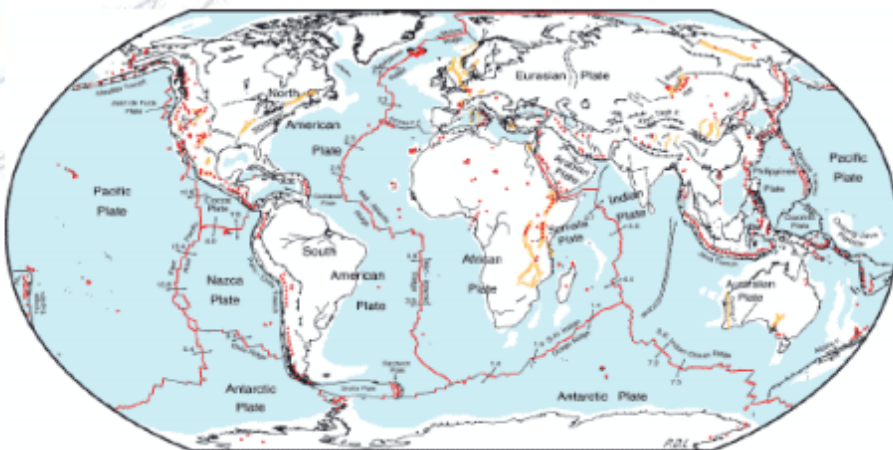
- Euler Pole Plate rotations will tie the new terrestrial reference frames of 2022 to the IGS frame
- Deformational velocities will be modeled separately

Euler Pole

Each reference frame will get:

- Euler Pole Latitude/Longitude
- Rotation rate (radians/year)

Used to compute time-dependent TRF2022 coordinates from time-dependent global (IGS) coordinates



Euler's fixed point theorem states: any motion of a rigid body on the surface of a sphere may be represented as a rotation about an appropriately chosen rotation pole ("Euler Pole")

Time Dependencies

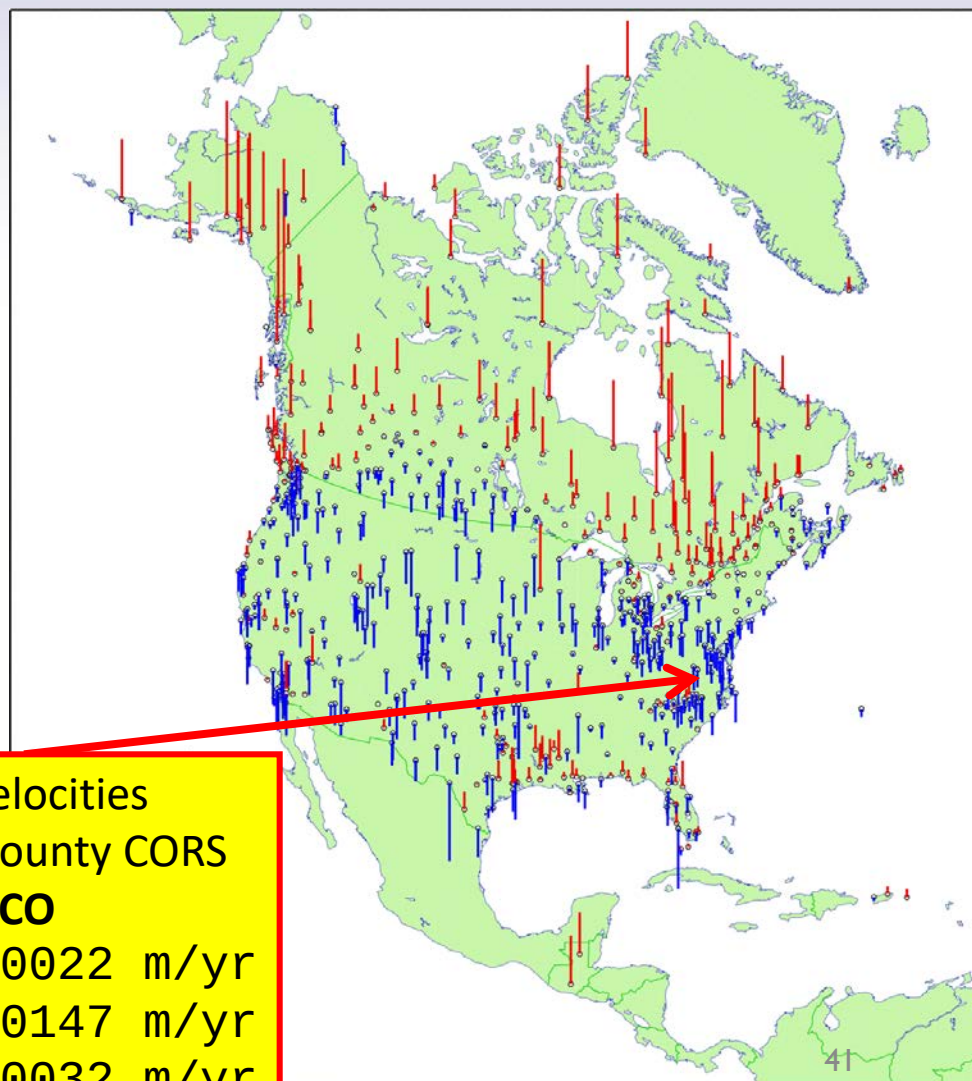
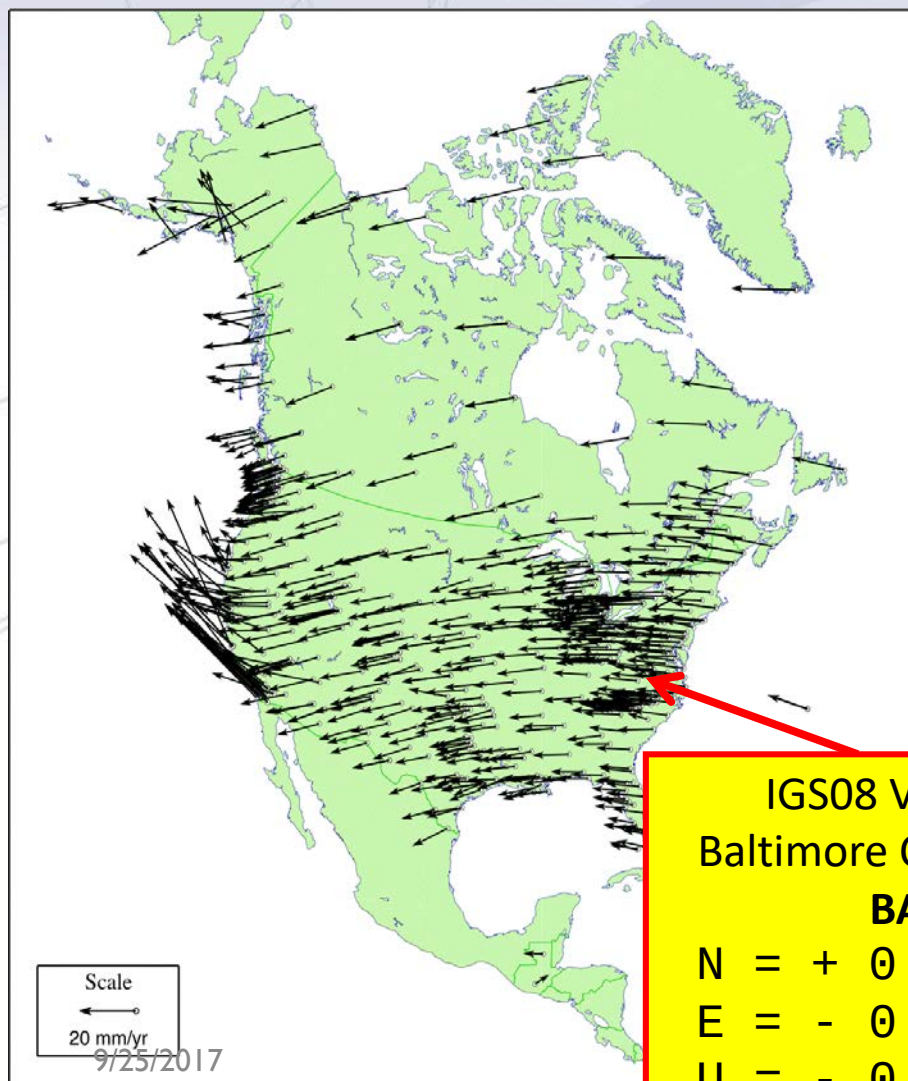
Track CORS and always know where you are

- Surveying to CORS positions at survey epoch
 - If we track CORS, we can do this easily
- Plate rotations
 - Easily removed for a “good east of the Rockies” solution
(Euler Pole Rotation for each plate’s reference frame)
 - Latitude/Longitude only
- Residual deformations
 - Can be modeled many ways and provided for cross-epoch checking between surveys
(Inter-frame velocities models)

IGS Plate Velocities

Horizontal

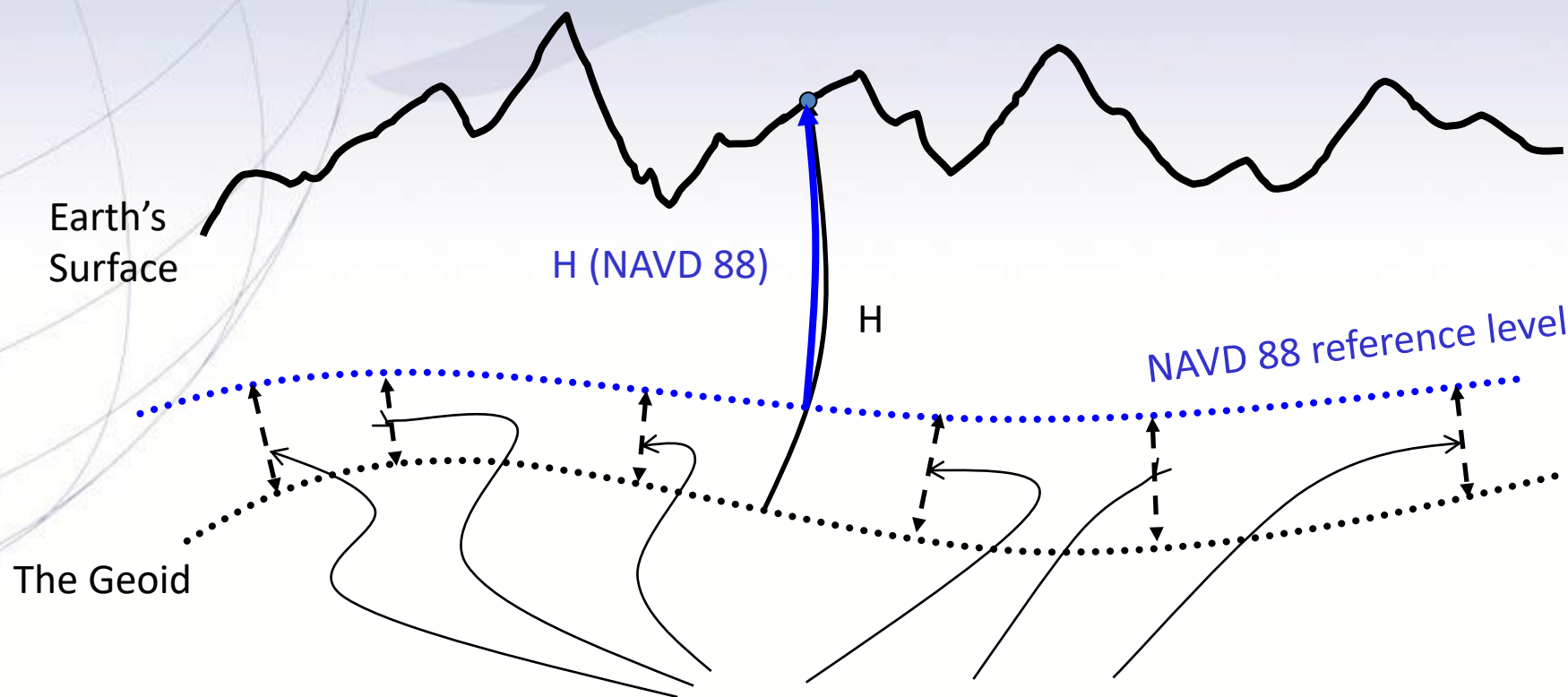
Vertical



IGS08 Velocities
Baltimore County CORS
BACO
N = + 0.0022 m/yr
E = - 0.0147 m/yr
U = - 0.0032 m/yr

OBJECTIVE 2 OF 5: REPLACE NAVD 88

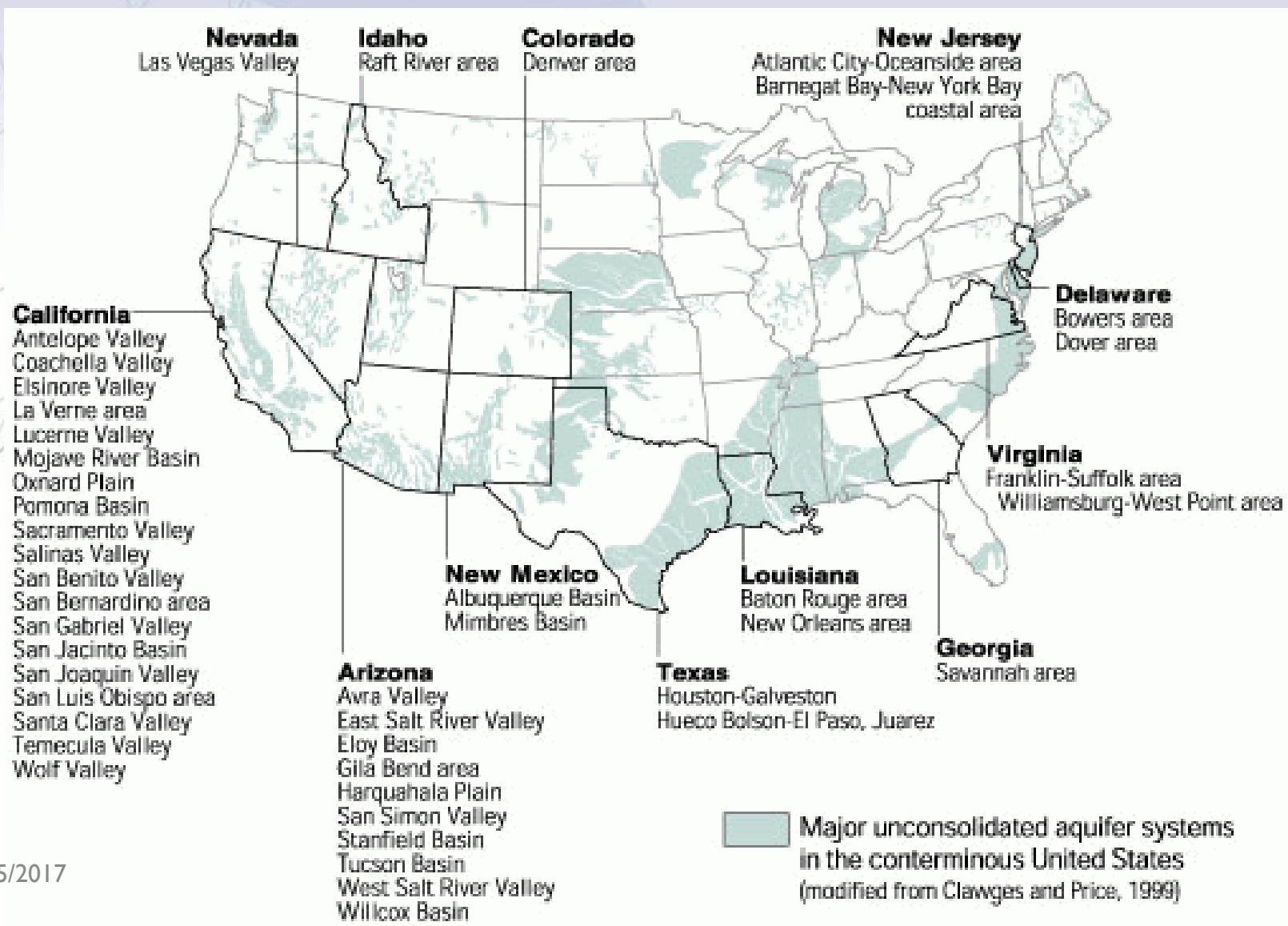
Replace NAVD 88



Errors in NAVD 88: ~50 cm average, 100 cm CONUS tilt, 1-2 meters average in Alaska, NO tracking

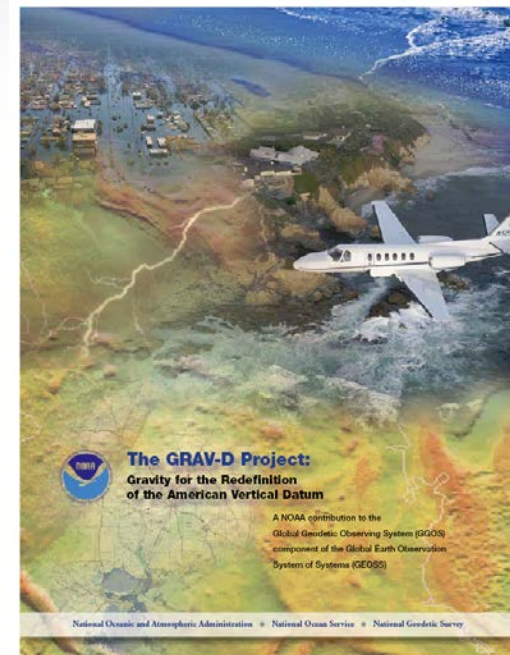
Subsidence areas of the U.S.

Source: U.S. Geological Survey



Replace NAVD 88

- Changing from a leveling-based to a geoid/GNSS-based vertical datum
- Biggest requirement: An updated, accurate, nationwide gravity survey
 - Airborne
 - GRAV-D!
 - **G**ravity for the **R**edefinition of the **A**merican **V**ertical **D**atum



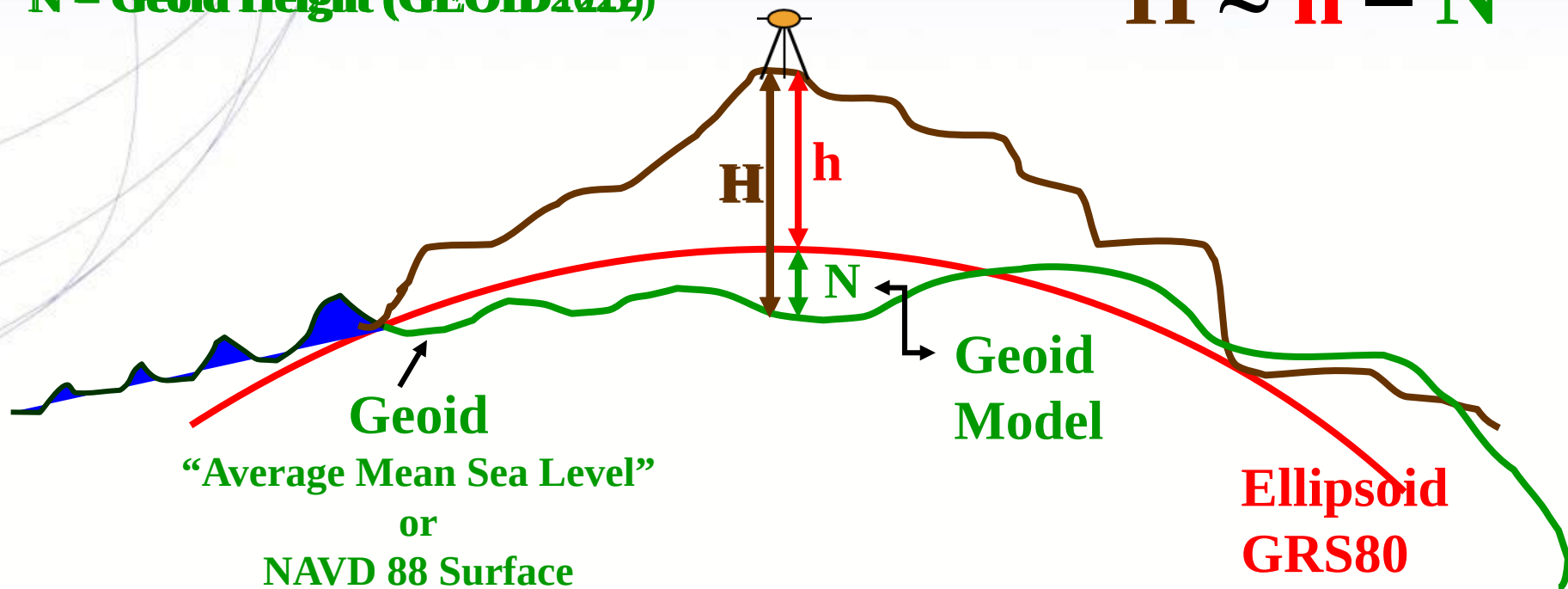
ELLIPSOID – GEOID RELATIONSHIP

H = Geopotential Height (NAVD 88)

h = Ellipsoid Height (NAD 83 (2011))

N = Geoid Height (GEOID2022)

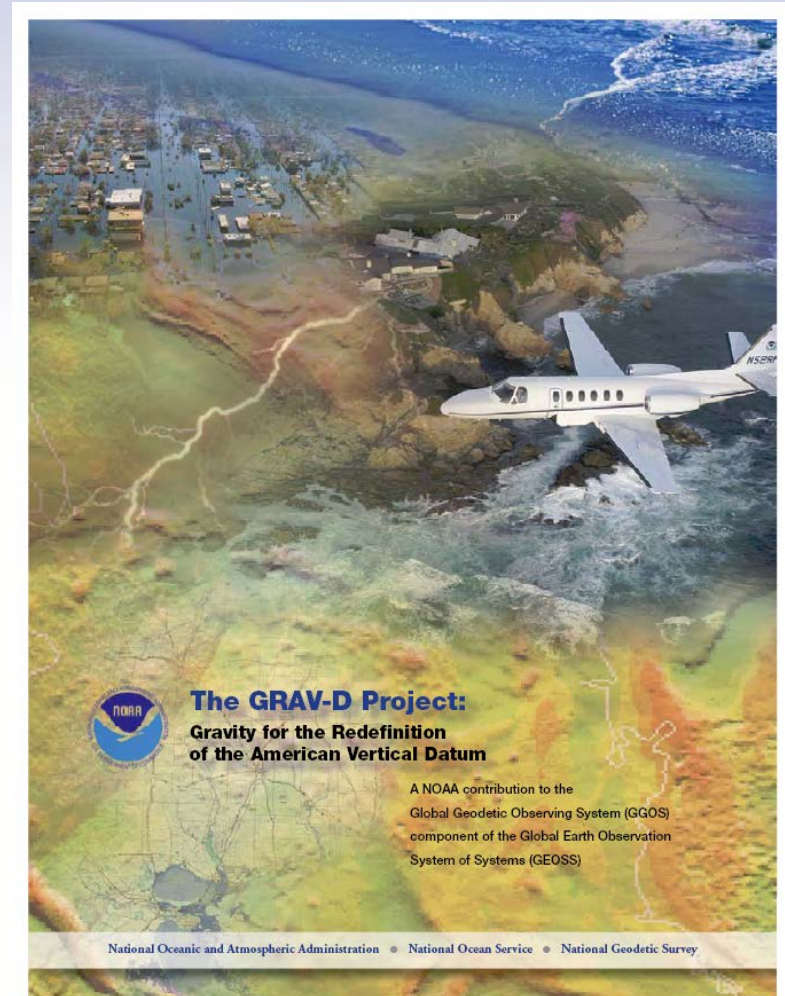
$$H = h - N$$
$$H \approx h - N$$



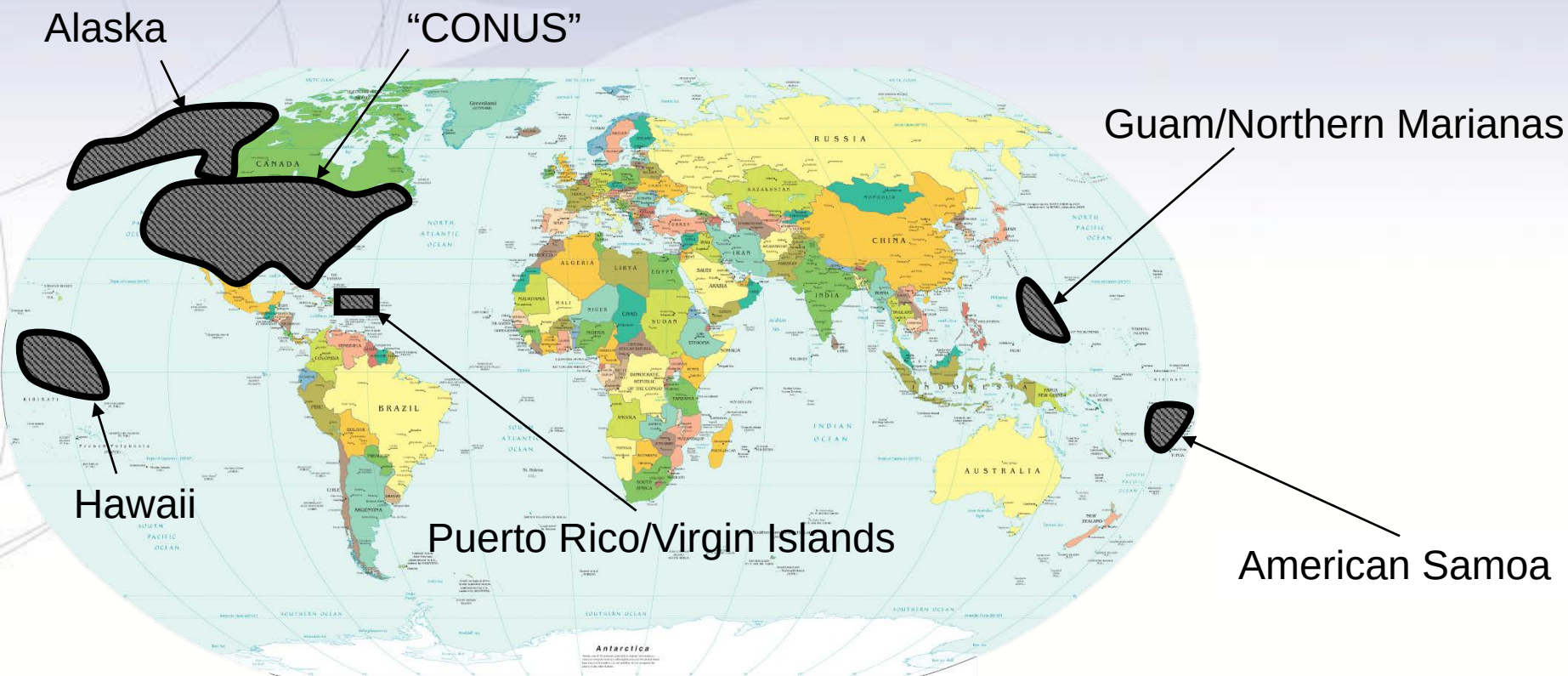
Transition to the Future – GRAV-D

Gravity for the Redefinition of the American Vertical Datum

- Official NGS policy as of Nov 14, 2007
 - \$38.5M over 10 years
- Airborne Gravity Snapshot
- Absolute Gravity Tracking
- Re-define the Vertical Datum of the USA by 2022



GRAV-D Coverage



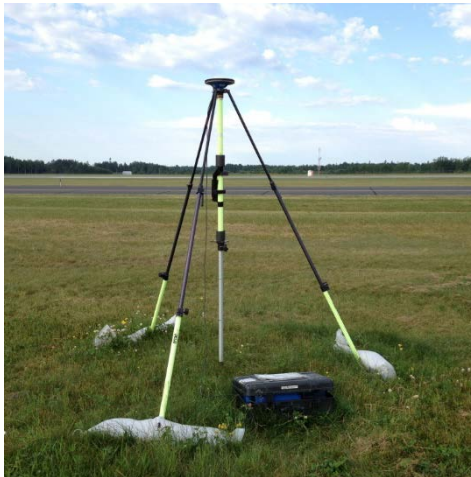
GRAVITY AND GPS BASE STATIONS



Parking spot ID



Micro-G A10 Absolute Gravity measurement



GPS Base Stations



Vertical gravity gradient

GRAV-D AIRCRAFT INSTRUMENTATION



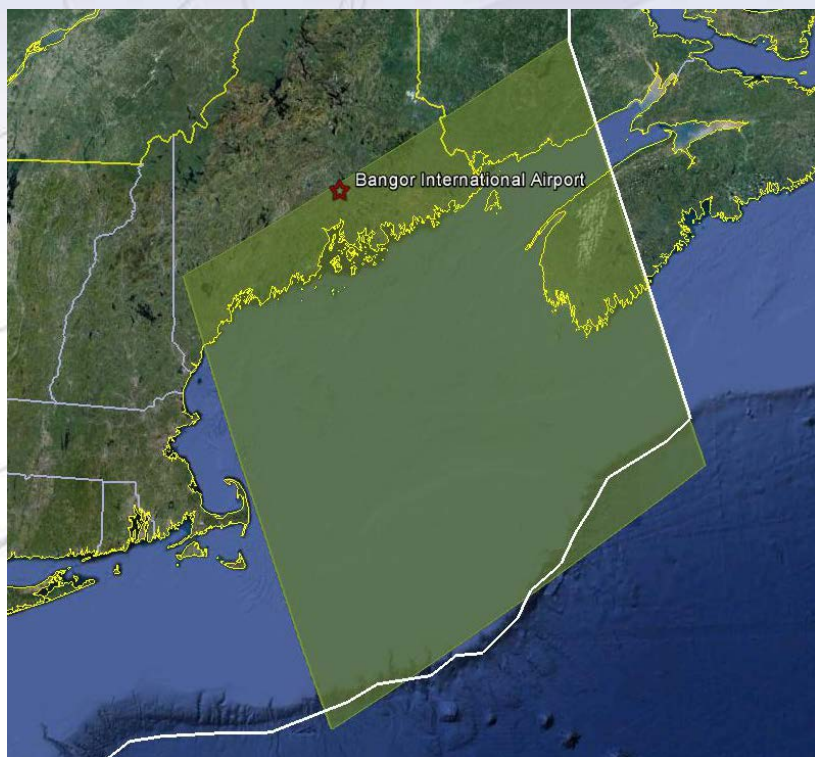
**Micro-g LaCoste
TAGS Gravimeter**



**NovAtel SPAN-SE
w/ Honeywell μ IRS IMU**

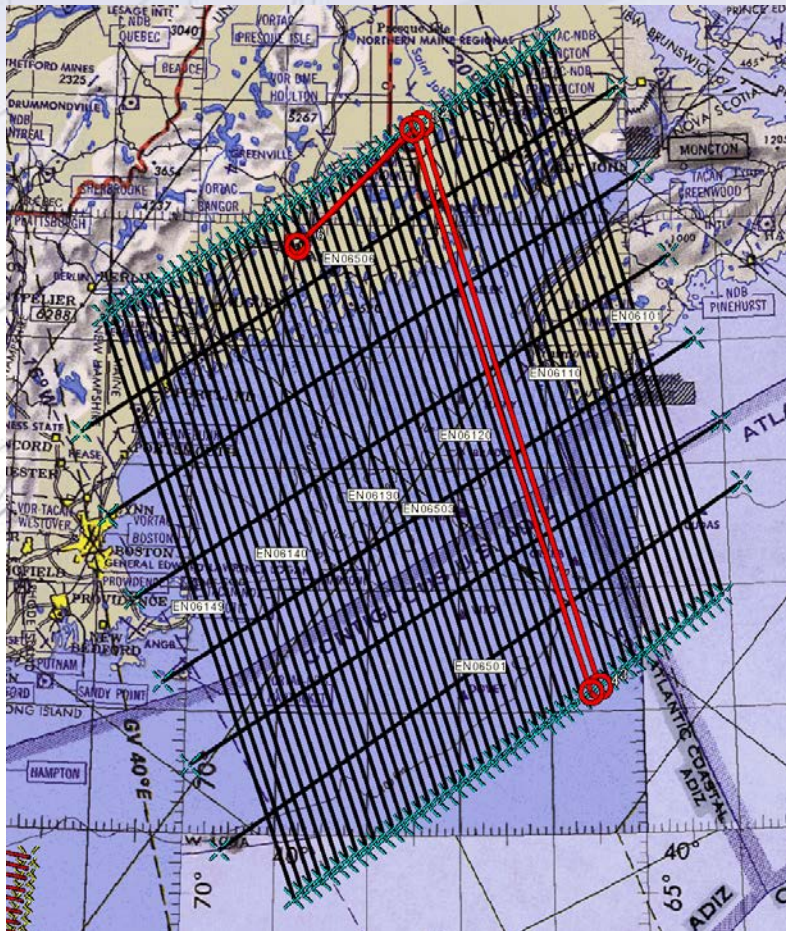
- **Both instruments include GNSS receivers**
- **SPAN system allows for tightly coupled GPS/IMU solutions**

SURVEY AND BLOCK PLANS

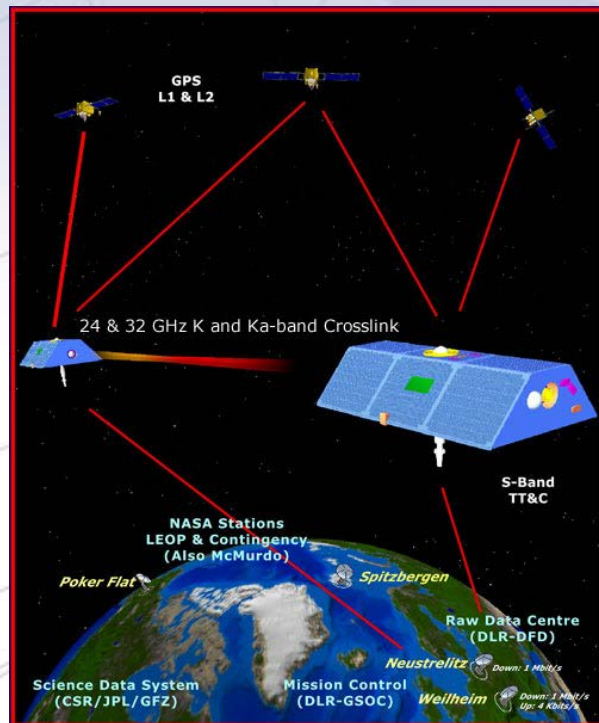


- **Layout rectangular survey 400 x 500 km**
- **Extends beyond the shelf break**
- **Block size will reflect the endurance of the aircraft**

- **Data lines spaced 10 km apart**
- **Cross lines spaced 60-80 km apart**
- **Flight altitude 20,000 ft**
- **Nominal speed 220-250 kts**



Space-Base Gravity Observations

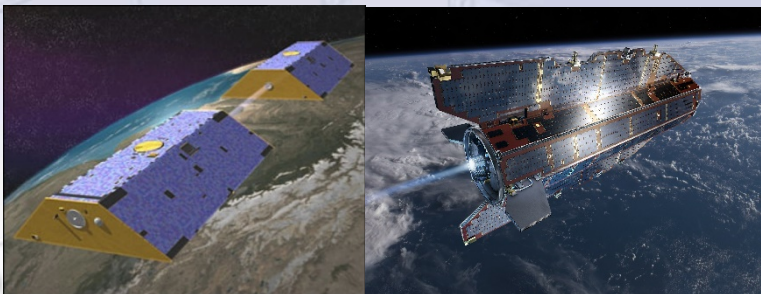


Gravity Recovery And Climate Experiment (GRACE) Launched - 2002

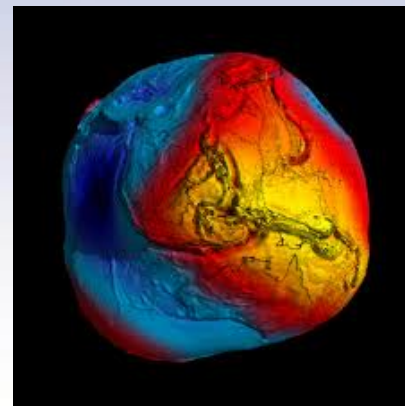
Gravity field and steady state Ocean Circulation Explorer (GOCE)
Launched – 2009
Re-entered November, 2013



Building a model of the Earth's Gravity Field



**Long Wavelengths:
(≥ 400 km)**

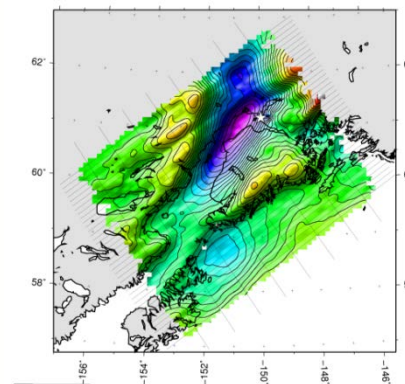


GRACE & GOCE Satellites

+

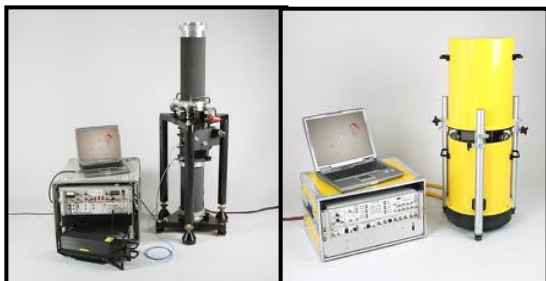


**Intermediate Wavelengths
(500 km to 20 km)**

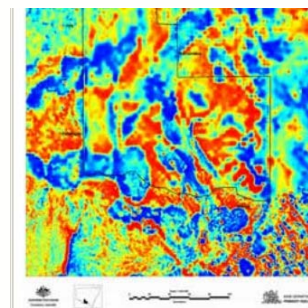


Airborne Measurement

+



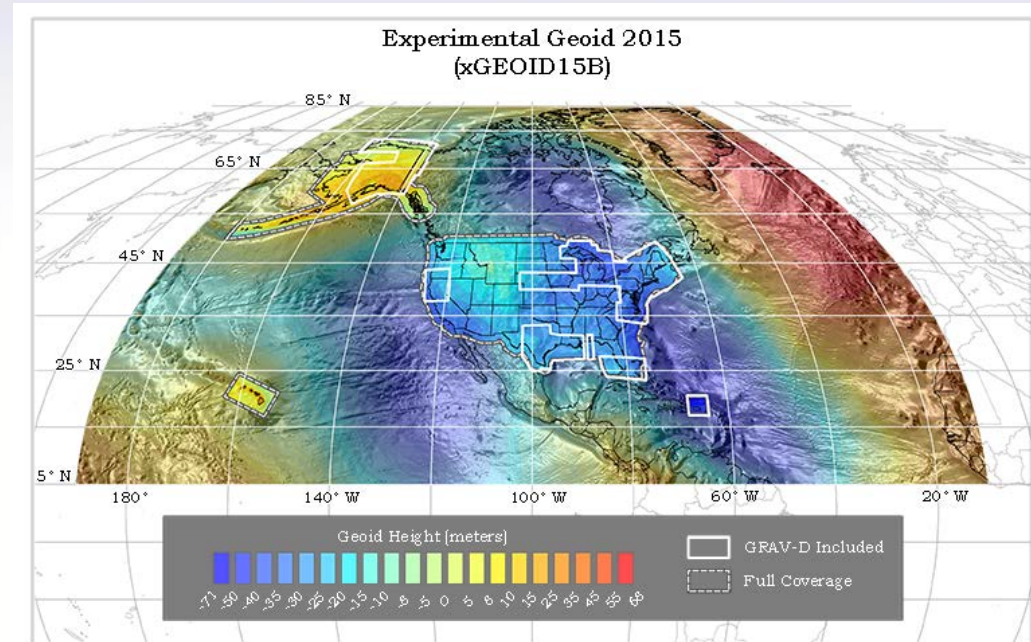
**Short Wavelengths
(< 200 km)**



Surface Measurement

EXPERIMENTAL GEOIDS

- The gravity data from satellites, airborne, corrected surface data, and terrain predictions will be blended into a gravity field
- Methods for blending will be tested to prepare for 2022
- Available on the Website

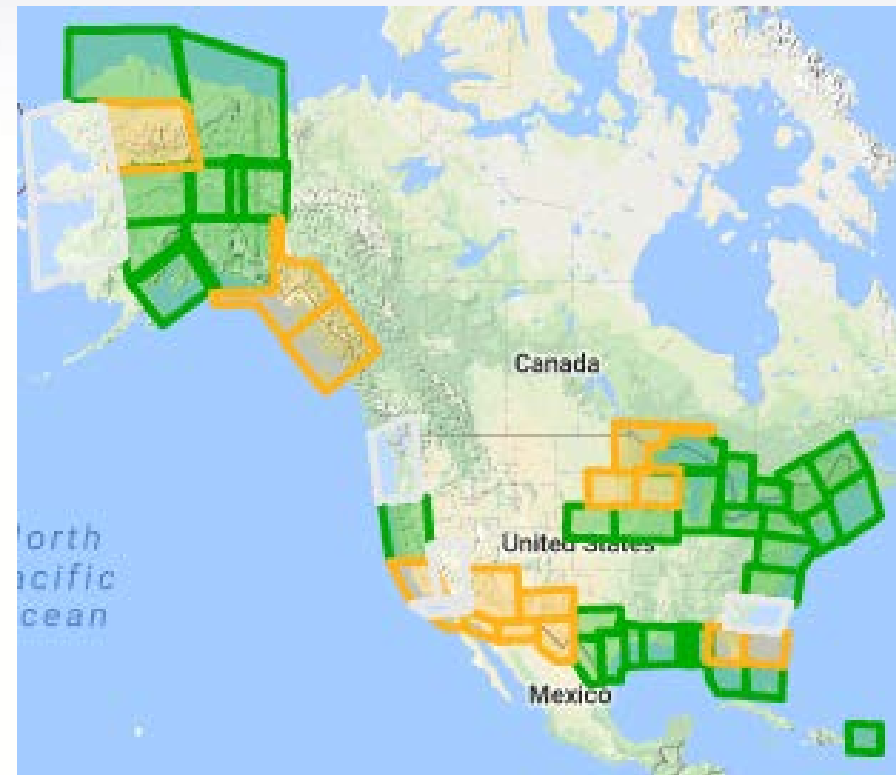


<http://beta.ngs.noaa.gov/GEOID/xGEOID/>

GRAV-D Status

100% by 2022

- 50% mark hit in FY2016
 - FY2017 target: 62%
- Two planes at a time
 - Occasionally three
- Mix of government and private industry collection

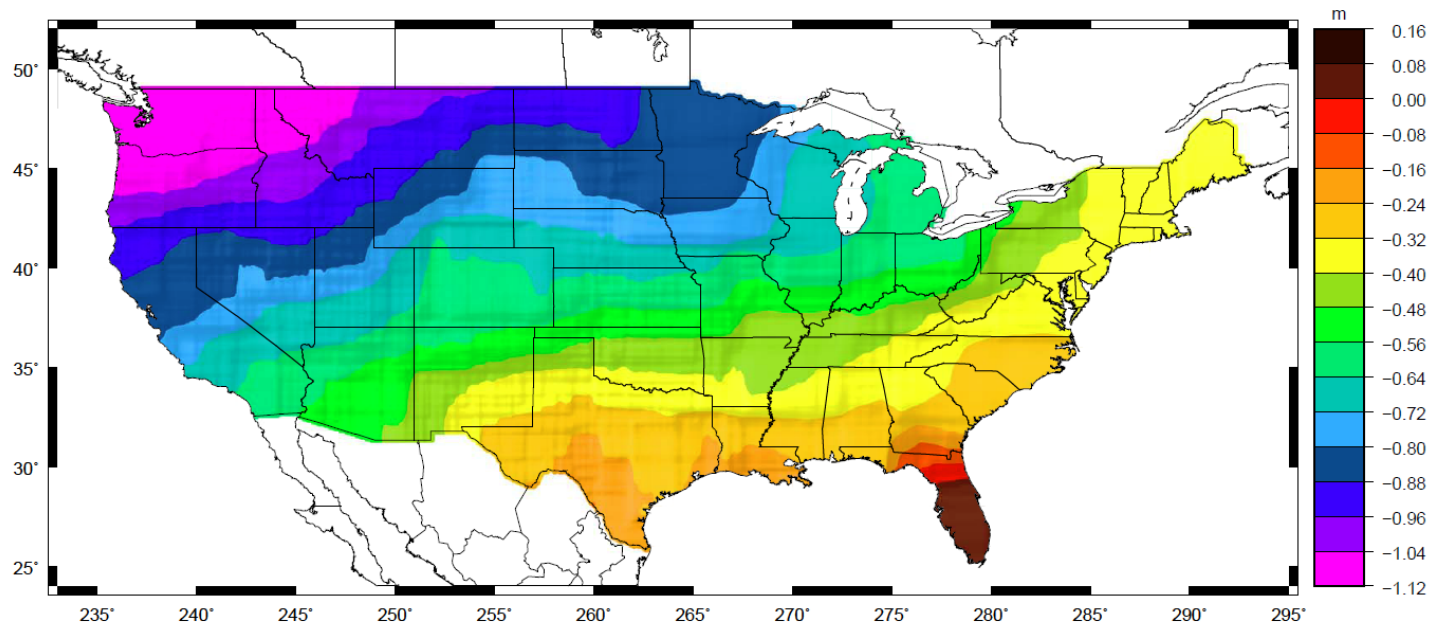


Green: Available data and metadata
Blue: Data being processed
Orange: Data collection underway
White: Planned for data collection

Orthometric Heights

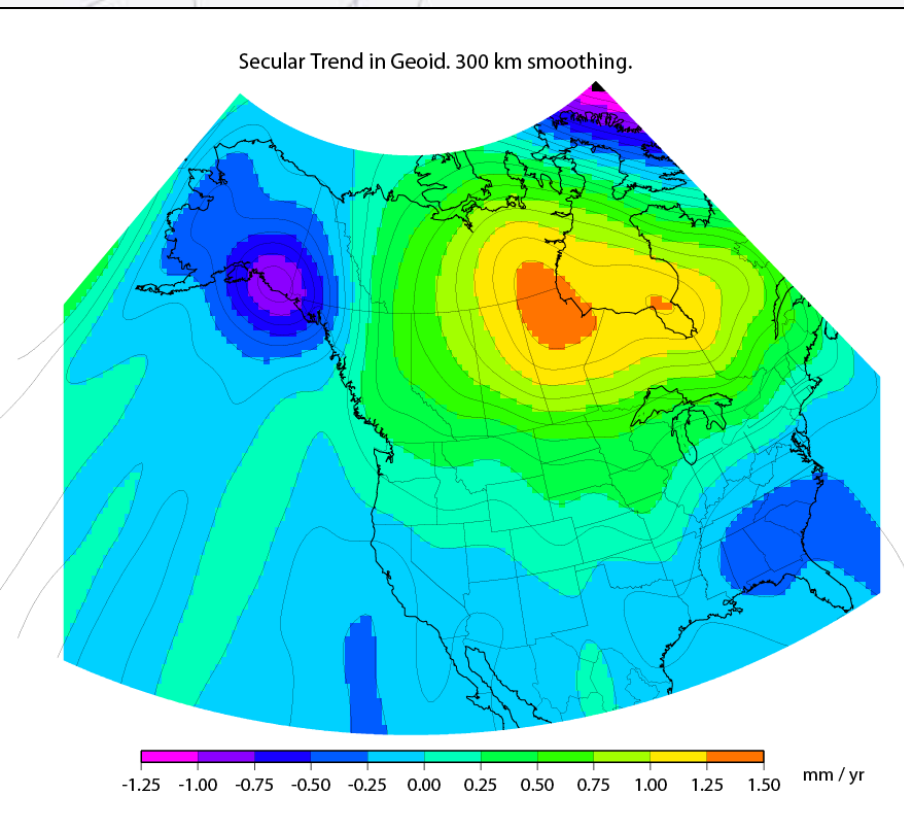
Approximate EXPECTED SHIFTS

- Approximate level of geoid mismatch known to exist in the NAVD 88 zero surface
- Does not include local subsidence issues



Time Dependencies

Geoid changes cause height changes

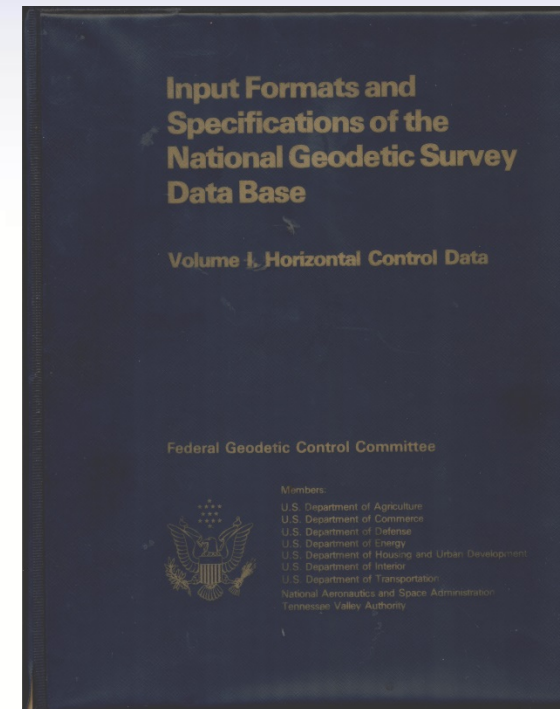


- The zero elevation surface will change with time
- Heights will be time tagged to respect:
 - Geoid change
 - Subsidence

OBJECTIVE 3 OF 5: RE-INVENT BLUEBOOKING

Bluebooking

- Refers to the blue cover of Input Formats and Specifications of the National Geodetic Survey Data Base
 - The requirements for turning in a geodetic survey to NGS
 - Very DOS/FORTRAN heavy
 - Horizontal (angles, distances) vertical (leveling) and gravity
 - GPS surveys were force-fitted into the horizontal rules
- Reputation: “Cumbersome”
 - To be fair: All industry standards are cumbersome – it prevents chaos

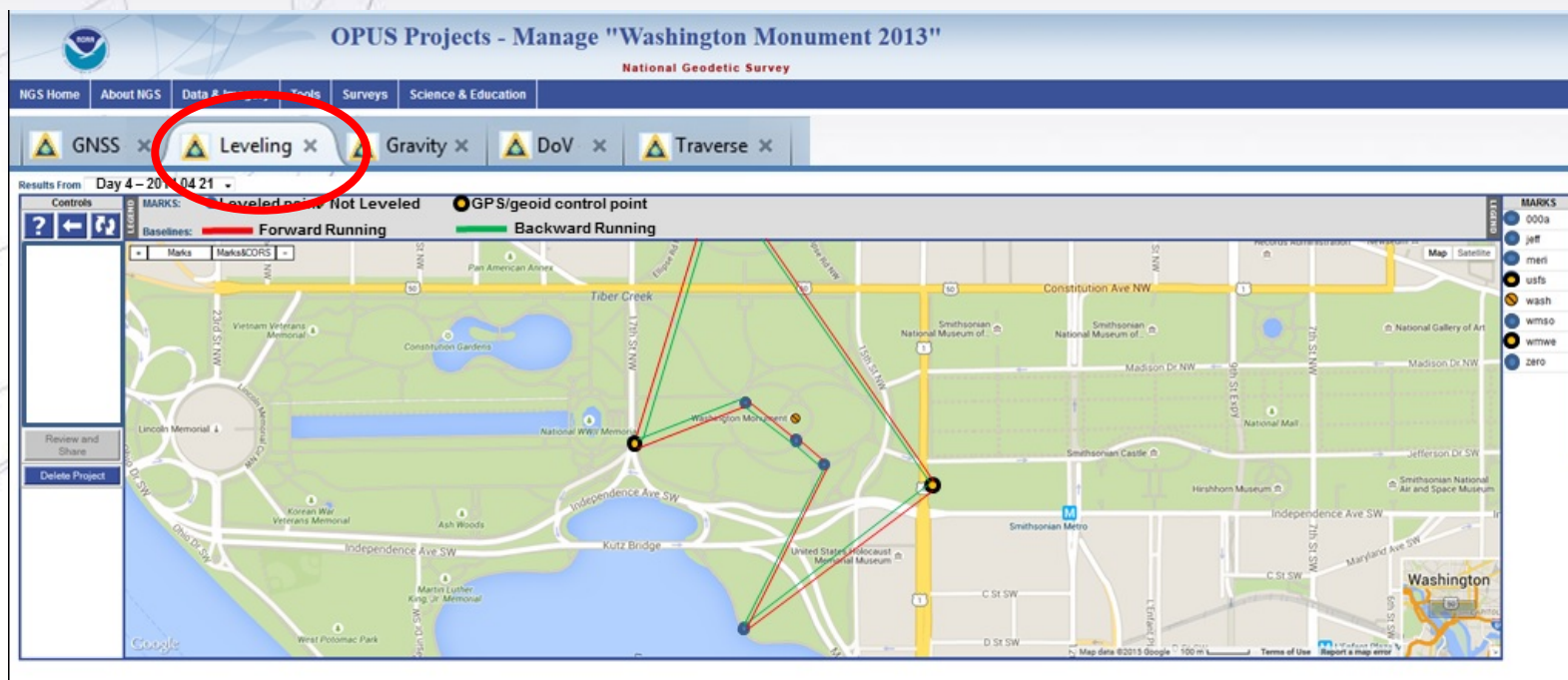


Or “bluebooking for the 21st century”

An integrated OPUS-Projects might allow for easier processing and especially cross-processing

OPUS-Projects

Or “bluebooking for the 21st century”



New Database

Replacing the NGS IDB

- **NGS IDB**

- “Integrated Database”
- Current official repository of some (most?) NSRS data
- “Integrated”...2 old DBs:
 - Horizontal / Vertical
- Built for
 - Passive control
 - No time dependencies
 - Line of sight techniques
 - Points

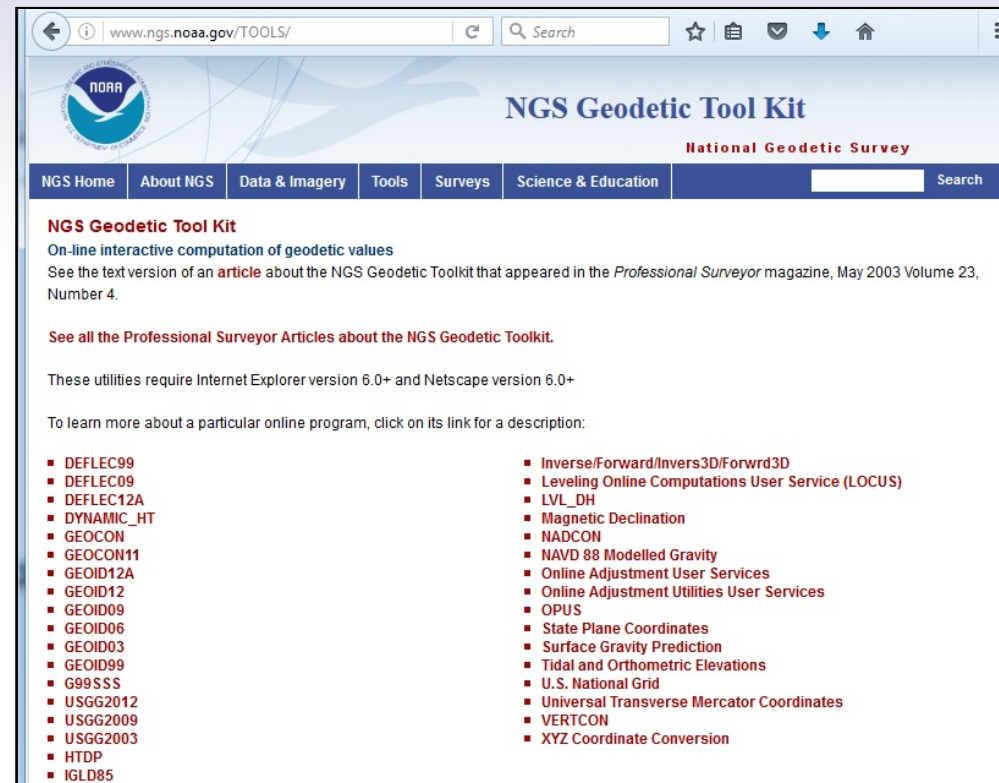
- **NSRS DB**

- Being built (target: 2020)
- “Spatial” database
- Time tags for everything
- Open design for any type of data
- Things that couldn't go into the IDB, but can go in the NSRS DB:
 - Lines of airborne gravity
 - LIDAR clouds
 - CORS
 - Superconducting Gravimeter data
 - Etc.

OBJECTIVE 4 OF 5: IMPROVE THE TOOLKIT

NGS Toolkit

- A set of (mostly FORTRAN-based) geodetic tools
- Little integration
- Many with no online capability
- No web services



New Toolkit

<http://beta.ngs.noaa.gov/gtkweb/>

The screenshot shows the NOAA BETA Coordinate Conversion Tool interface. At the top, there's a header with the NOAA logo, the word "BETA" in large red letters, and the text "This is a BETA Release Site". Below this is a navigation bar with links: "NGS Home", "About NGS", "Data & Imagery", "Tools", "Surveys", "Science & Education", and "National Geodetic Survey". Below the navigation bar, there are four tabs: "Single Point Conversion", "Multipoint Conversion", "Web services", and "Downloads". The "Single Point Conversion" tab is selected. Below the tabs, there's a "Convert from:" section with radio buttons for "LLH", "SPC", "UTM", "XYZ", and "USNG". The "LLH" radio button is selected. Below this, there are input fields for "Lat" and "Lon" in decimal degrees, and "Lat" and "Lon" in degrees-minutes-seconds. The "Lat" decimal field contains "39.3398291238" and the "Lon" decimal field contains "-76.6442206641". The "Lat" DMS field contains "N" and "39-20-23.38485", and the "Lon" DMS field contains "W" and "076-38-39.19439". Below these fields, there's a text input for "Ellipsoid Height(m)" with the value "15,000". To the right of the input fields is a map showing the location of Baltimore, Maryland. Below the map, there's a section for "Converted coordinates will be in output datum" with "Input datum" set to "NAD83(1986)" and "Output datum" set to "NAD83(2011)". At the bottom left, there is a blue "Convert" button.

BETA
This is a BETA Release Site

Coordinate Conversion Tool
National Geodetic Survey

NGS Home About NGS Data & Imagery Tools Surveys Science & Education

Single Point Conversion Multipoint Conversion Web services Downloads About Conversion Tool

Convert from: ☒ LLH ☐ SPC ☐ UTM ☐ XYZ ☐ USNG

Enter lat-lon in decimal degrees

Lat

Lon

or degrees-minutes-seconds

Lat

Lon

or drag map marker to a location of interest

Ellipsoid Height(m)

Converted coordinates will be in output datum

Input datum Output datum

Convert

- Datum transformations
- Convert to/from latitude and longitude
 - State Plane Coordinates
 - UTM
 - US National Grid
- Upload file of points
- Web service
- Download and run offline

NADCON 5

- Replacing NADCON 4.2 and GEOCON 2.0
- Support for nearly all horizontal datums since 1897
 - Exceptions: Regional Alaska
- No “state by state” grids
- Fixing all existing bugs
- Web service
- Consistent
- Documented
- Rigorous location-dependent error estimates
- **Ready to support 2022**

Toolkit Future

The entire NGS Toolkit will be integrated eventually

- VERTCON 3.0
- HTDP
- VDatum
- All other tools

OBJECTIVE 5 OF 5: BETTER SURVEYING

Better Surveying

Overview

- A focus on updating technology and field procedures
- Field research
- New manuals

NOAA Technical Memorandum NOS NGS-58

GUIDELINES FOR ESTABLISHING GPS-DERIVED ELLIPSOID HEIGHTS
(STANDARDS: 2 CM AND 5 CM)
VERSION 4.3

David B. Zilkoski
Joseph D. D'Onofrio
Stephen J. Frakes

Silver Spring, MD

November 1997

1997

NOAA Manual NOS NGS 3



Geodetic Leveling

National Geodetic Survey
Rockville, Md.
August 1981
Reprinted June 2001



1981

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Survey

NOAA Technical Memorandum NOS NGS 59

Guidelines for Establishing GPS-Derived Orthometric Heights

David B. Zilkoski
Edward E. Carlson
Curtis L. Smith

National Geodetic Survey
1315 East-West Highway
Silver Spring, Maryland 20910
(301) 713-3191

26 March 2008

2008

SUMMARY

Summary

NSRS Modernization

- More than just replacing NAD 83 and NAVD 88
- Affects most tools, products and services of NGS
- Dozens of interdependent, multi-year projects ongoing
- Expect rollouts and announcements throughout the next 6 years!

To Learn More

Visit the New Datums web page



The screenshot shows the NOAA National Geodetic Survey 'New Datums' web page. At the top left is the NOAA logo. The main heading is 'New Datums' with the subtitle 'National Geodetic Survey'. Below this is a navigation bar with links: NGS Home, About NGS, Data & Imagery, Tools, Surveys, Science & Education, and a search box. The date 'September 28, 2016' is displayed on the right. On the left side, there is a globe graphic and a 'New Datums Quick Links' section with links to Home, What to expect, Get prepared, Track our progress, Related projects, Watch videos, Learn more, New Datums FAQ, Contact Us, and Sign up for list-serve. Below this is an 'Events' section listing the 2017 Summit and 2015 Summit. The main content area features the heading 'Replacing NAVD 88 and NAD 83' and a paragraph explaining that these datums will be replaced in 2022 and that related projects are being undertaken to ensure a smooth transition. It encourages users to read the 'NGS Ten-Year Plan' for more information. Below this text are six buttons arranged in two columns: 'What to Expect', 'Get Prepared', 'Related Projects', 'Track Our Progress', 'Watch Our Videos', and 'Learn More'. On the right side, there are two promotional banners: 'FAQs frequently asked questions' and 'NGS 2017 Geospatial Summit April 24-25'. At the bottom right is a banner for 'Geodetic Datums' with the text 'See our videos!' and a play button icon. The footer of the page includes the URL 'geodesy.noaa.gov/datums/newdatums/index.shtml'.

NOAA

New Datums

National Geodetic Survey

NGS Home About NGS Data & Imagery Tools Surveys Science & Education Search

September 28, 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

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

Events

- 2017 Summit
- 2015 Summit

FAQs

frequently asked questions

NGS 2017 Geospatial Summit

April 24-25

Geodetic Datums

See our videos!

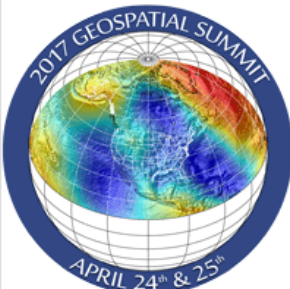
To Learn More Geospatial Summit



National Geodetic Survey

Positioning America for the Future

[NGS Home](#) | [About NGS](#) | [Data & Imagery](#) | [Tools](#) | [Surveys](#) | [Science & Education](#) | [Search](#)



2017 Geospatial Summit



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

The 2017 Geospatial Summit provided 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 provided an opportunity for NGS to share updates and discuss the progress of projects related to NSRS Modernization. NGS also heard feedback and collected requirements from its stakeholders across the federal, public and private sectors. This event continued 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](#).

2017 Summit Home
[Presentations](#)
[Summit Documents](#)
[2017 Summit Report](#)
[FAQs](#)

Related Links
[NGS 10-year plan](#)
[2015 Summit Report](#)
[2010 Summit Proceedings](#)
[New Datums Web page](#)

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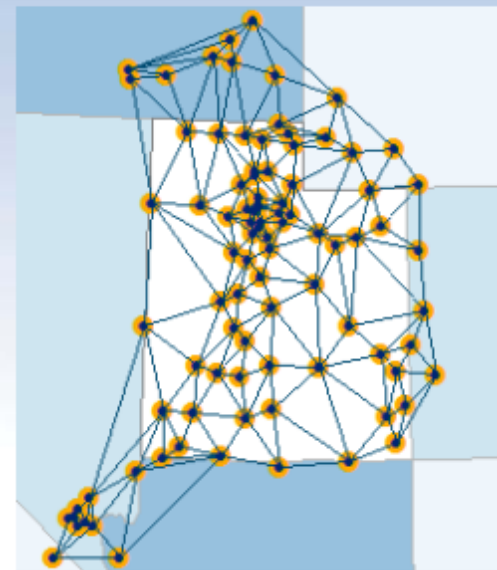
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Details: Blueprint documents

- Blueprint for 2022, Part 1: Geometric Coordinates
 - A.K.A. **NOAA Technical Report NOS NGS 62** (April 2017 release)
 - Time-dependency
 - Four terrestrial reference frames
 - Intra-frame velocity models
- Blueprint for 2022, Part 2: Geopotential Coordinates
 - A.K.A. **NOAA Technical Report NOS NGS 64** (September 2017 release)
 - Time-dependency
 - One geopotential datum
 - Interrelated global geopotential model, regional geoid grids, regional DoV grids, regional surface gravity grids

How to Plan for 2022

- **Move to NAD 83(2011) epoch 2010.00**
 - via surveys (or *possibly* via NADCON)
- **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 & NAD83(2011) ties**
 - improve next geoid model & relationship with new datum
- **METADATA!!!!**



- Where are we now?
- Where are we going?

(2022 is already almost an hour closer!)

QUESTIONS?