



Overview of New Datums

NOAA's National Geodetic Survey

NGS's Mission and Role

- **NGS Mission:** “To define, maintain, and provide access to the National Spatial Reference System to meet our nation’s economic, social, and environmental needs”
- **OMB Circular A-16 (revised)** names DOC and NOAA as “lead agency” for Geodetic Control:
 - “All NSDI framework data and users' applications data require geodetic control to accurately register spatial data.”
 - “The National Spatial Reference System is the fundamental geodetic control for the United States.”
- **Coast and Geodetic Survey Act** (Public Law 80-373) gives DOC the right to (among numerous other things) “... conduct ... geodetic control surveys ... ”

<http://uscode.house.gov/download/pls/33C17.txt>

NGS's Mission and Role

- NGS has defined the datums of the NSRS as NAD 83 and NAVD 88 (plus others)
- FGCS requires that all civilian federal surveying and mapping use NAD 83 and/or NAVD 88 (plus others)
- “To the extent practicable, legally allowable, and feasible, require that all Federal agencies using or producing (vertical height / coordinate) information undertake an orderly transition to (NAVD 88/NAD 83)”
 - 1989 FGCC Federal Register Notice (54 FR 25318)
 - 1993 FGCS Federal Register Notice (Vol. 58, No. 120)
- These regulations do not apply to DoD nor to state and local surveying, but these groups often do adopt NAD 83 / NAVD 88

New Datums are Coming in 2022!

- Both a new geometric and a new geopotential (vertical) datum will be released in 2022.
- The realization of the new datums will be through GNSS receivers.
- NGS will provide the tools to easily transform between the new and old datums.



New Geometric Datum

- Cartesian coordinate system
- Designed to be Earth Centered, Earth Fixed (ECEF)
- Positions represented as an X,Y,Z set with (0,0,0) located at the origin of the coordinate system – center of the Earth
- Allow for individual plate motions
- Coordinates will have velocity components

- WGS 84 and IGS08 are ECEF systems
- NAD 83 is a plate-fixed system – North American plate
- 3-4 foot magnitude difference between NAD 83 and WGS 84 / IGS

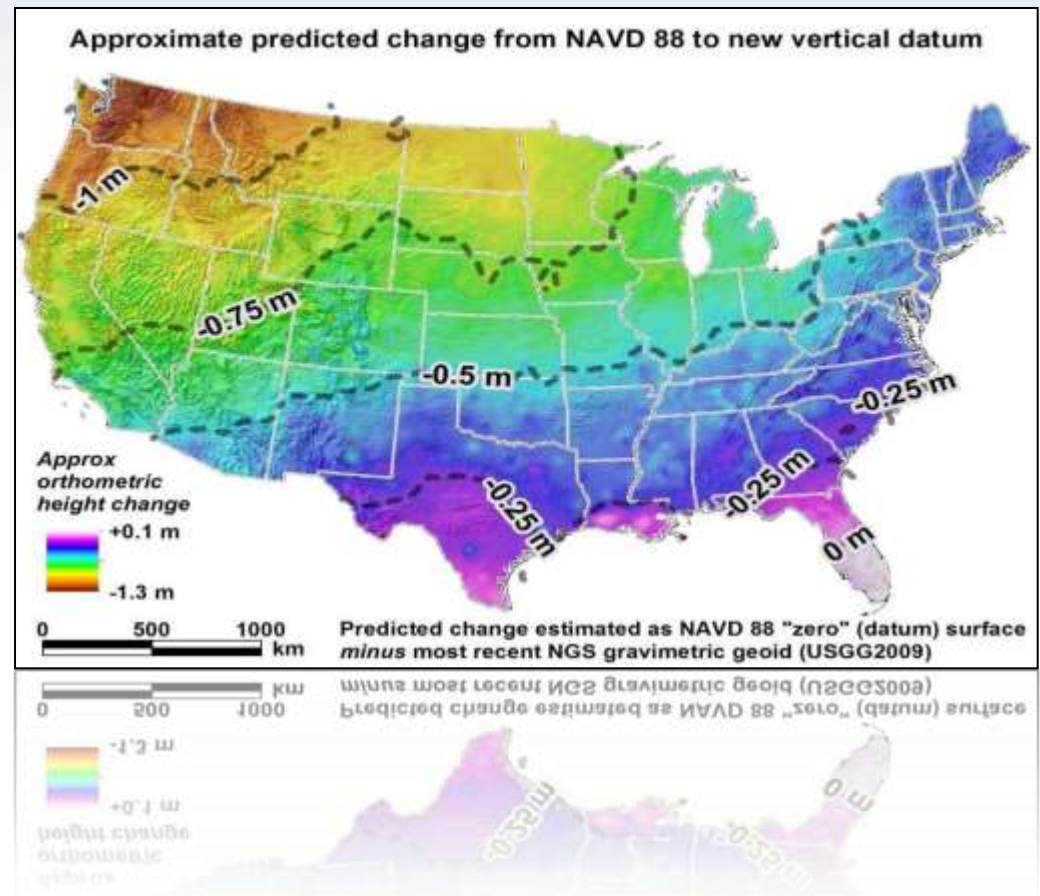
- Define new SPC system?

New Geopotential Datum

- The current North American Vertical Datum of 1988 (NAVD 88)
 - is a minimally constrained adjustment of a massive leveling campaign performed in the 1980's
 - NAVD 88 is internally consistent but has a significant mismatch with MSL
- The new datum will be accessed via GNSS technology versus benchmarks
- New vertical datum to be released in 2022 will be based upon a gravimetric geoid
- Airborne gravity data collected by the Gravity for the Redefinition of the American Vertical Datum (GRAV-D) project will allow for blending of data from satellite, altimetric, and surface sources
- The datum will be updated to reflect temporal change

How will the new datums affect you?

- The new geometric datum will change latitude, longitude, and ellipsoid height by between 1 and 2 meters.
- The new vertical (geopotential) datum will change heights on average 50 cm (20"), with a 1 meter (39") tilt towards the Pacific Northwest.



Questions: Themes

The questions provided to NGS fall into 3 major categories:

- Datum adoption
 - Speed, legal issues, impacts, transformations
- Datasheets
- State Plane Coordinates

Old vs New Datums

- 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
- GUVD04
- IGLD 85

Heights

Old vs New Datums

- The old way

- The new way

Text based datasheets

```
NAD 83(2011) POSITION- 40 03 10.11448(N) 082 58 34.91800(W) ADJUSTED
NAD 83(2011) ELLIP HT- 239.400 (meters) (06/27/12) ADJUSTED
NAD 83(2011) EPOCH - 2010.00
NAVD 88 ORTHO HEIGHT - 273.3 (meters) 897. (feet) GPS OBS
```

Observed changes viewed as “corrections” not “movement”

SUPERSEDED SURVEY CONTROL

```
NAD 83(2007)- 40 03 10.11456(N) 082 58 34.91884(W) AD(2002.00) 0
ELLIP H (02/10/07) 239.418 (m) GP(2002.00)
ELLIP H (03/08/05) 239.413 (m) GP( ) 4 2
NAD 83(1995)- 40 03 10.11462(N) 082 58 34.91855(W) AD( ) B
ELLIP H (08/20/96) 239.417 (m) GP( ) 4 2
NAD 83(1986)- 40 03 10.12158(N) 082 58 34.92303(W) AD( ) 1
NAD 27 - 40 03 09.89400(N) 082 58 35.26500(W) AD( ) 1
NGVD 29 (09/26/89) 273.5 (m) RAPSU86 model used GPS OBS
```

Fragile, unchecked passive control



February 3, 2015

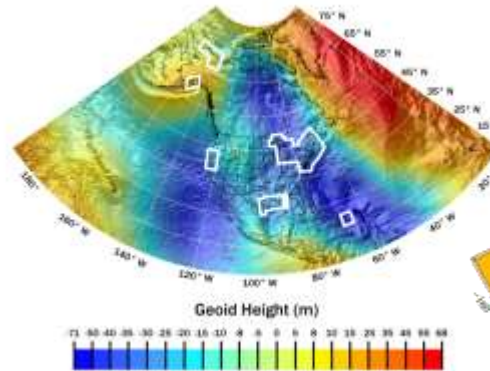
Modern datasheets



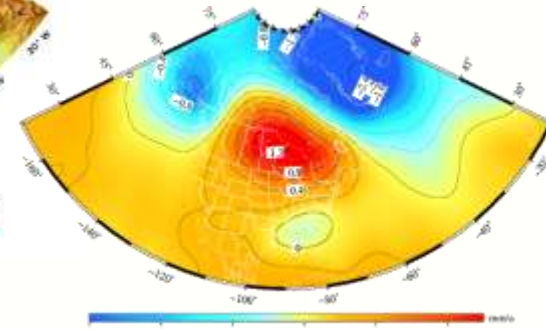
CORS



RTN



Geoid



Temporal Geoid Change

Why isn't NAVD 88 good enough anymore?

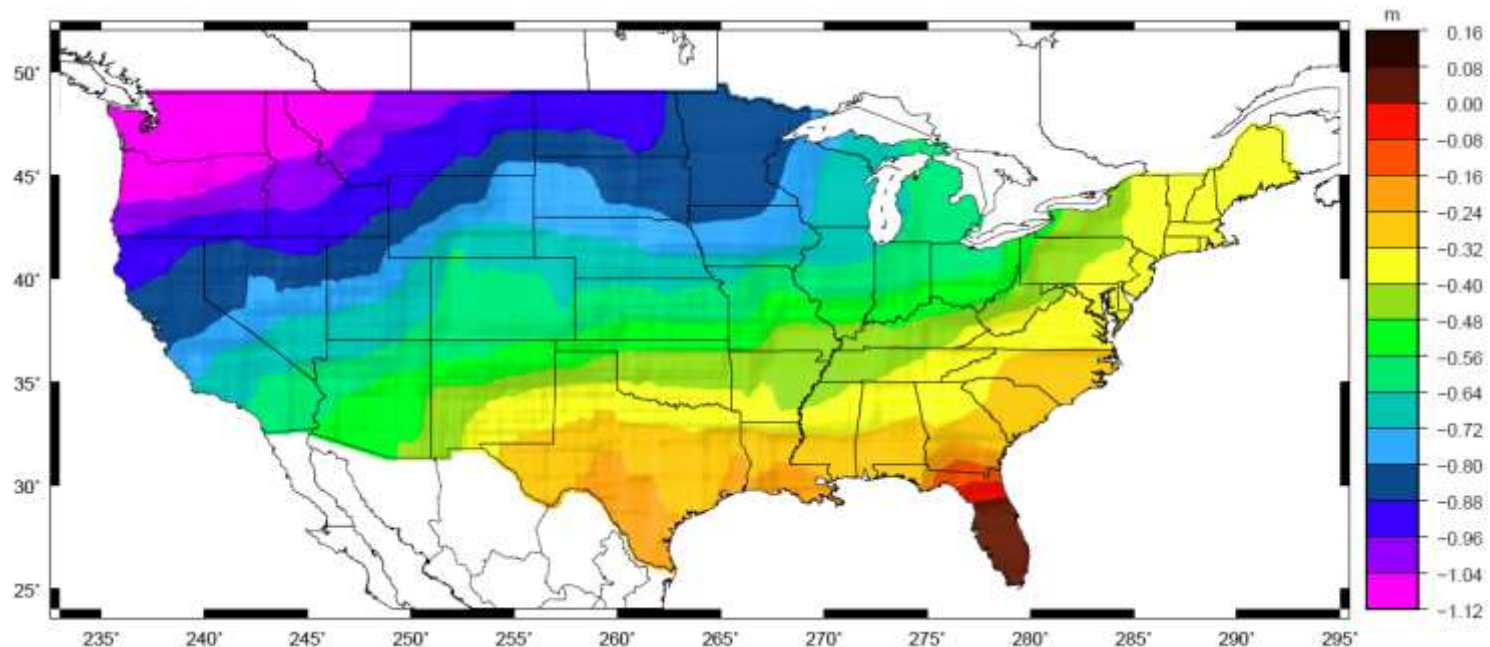
NAVD 88 suffers from use of bench marks that:

- Almost never re-checked for movement
- Unknown numbers disappear every year
- No funding for replacement
- Not necessarily in convenient places
- Don't exist in most of Alaska
- Weren't adopted in Canada
- Were determined by leveling from a single point, allowing cross-country error build up



Why isn't NAVD 88 good enough anymore?

- **Approximate level of geoid mismatch known to exist in the NAVD 88 zero surface:**

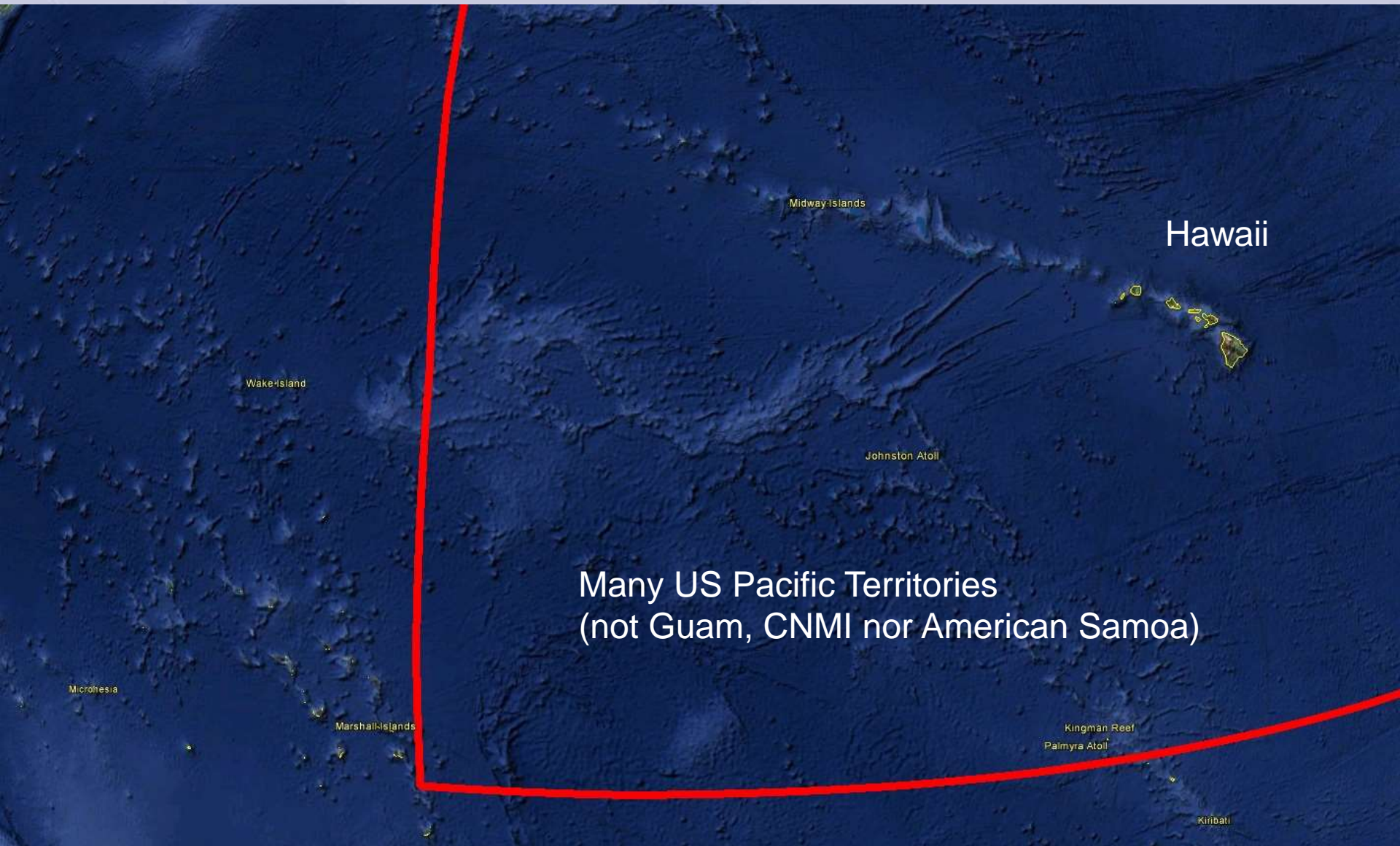


Terminology

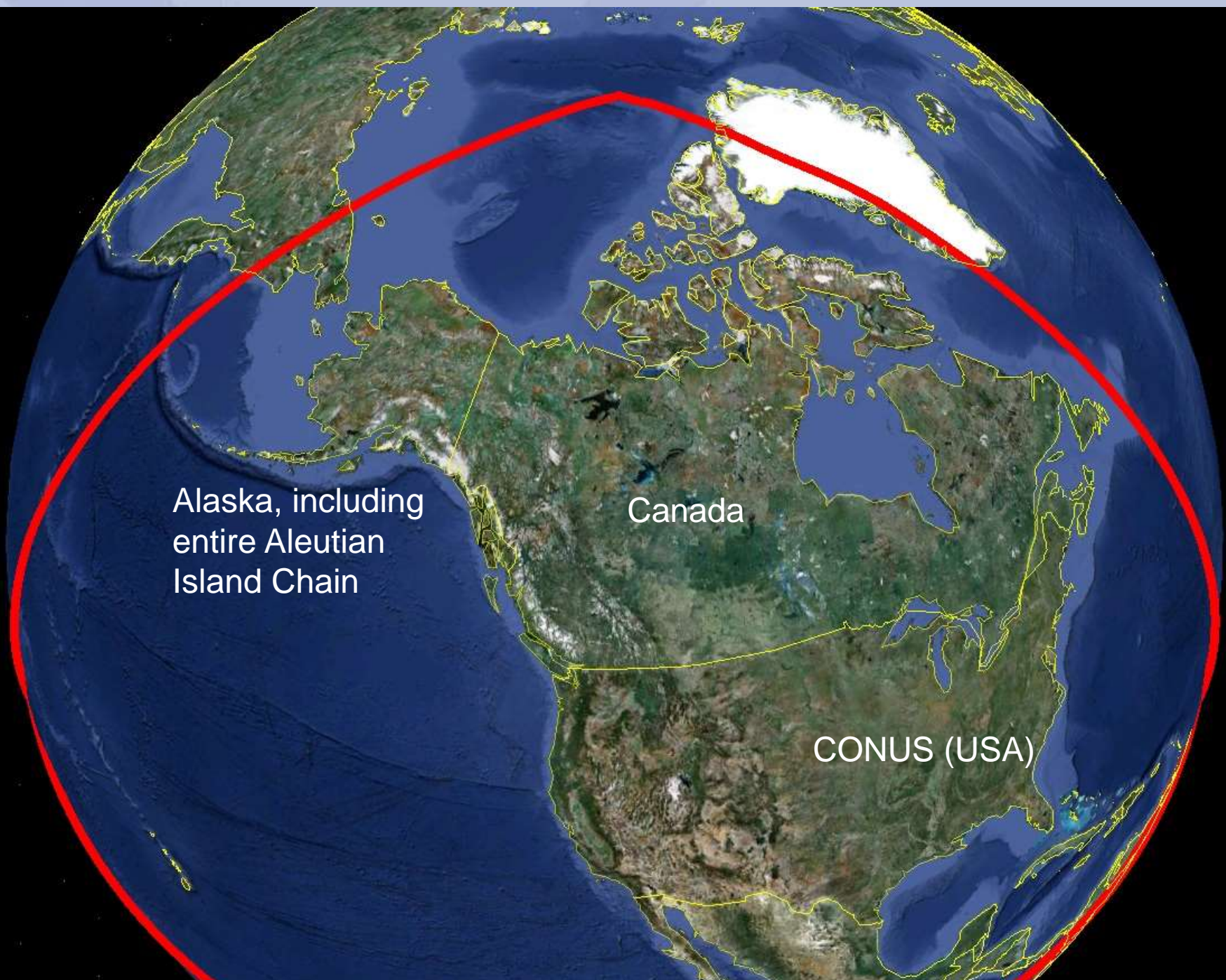
- ~~Horizontal Datum~~
 - Geometric Reference Frame
 - Geocentric X, Y, Z
 - Latitude, Longitude, Ellipsoid Height
- ~~Vertical Datum~~
 - Geopotential Reference Frame
 - Geoid undulation
 - Orthometric height
 - Gravity
 - Deflection of the Vertical



Approximate extent of 2022 geoid model used for the “North American” part of the new geopotential reference frame.



Many US Pacific Territories
(not Guam, CNMI nor American Samoa)



Alaska, including
entire Aleutian
Island Chain

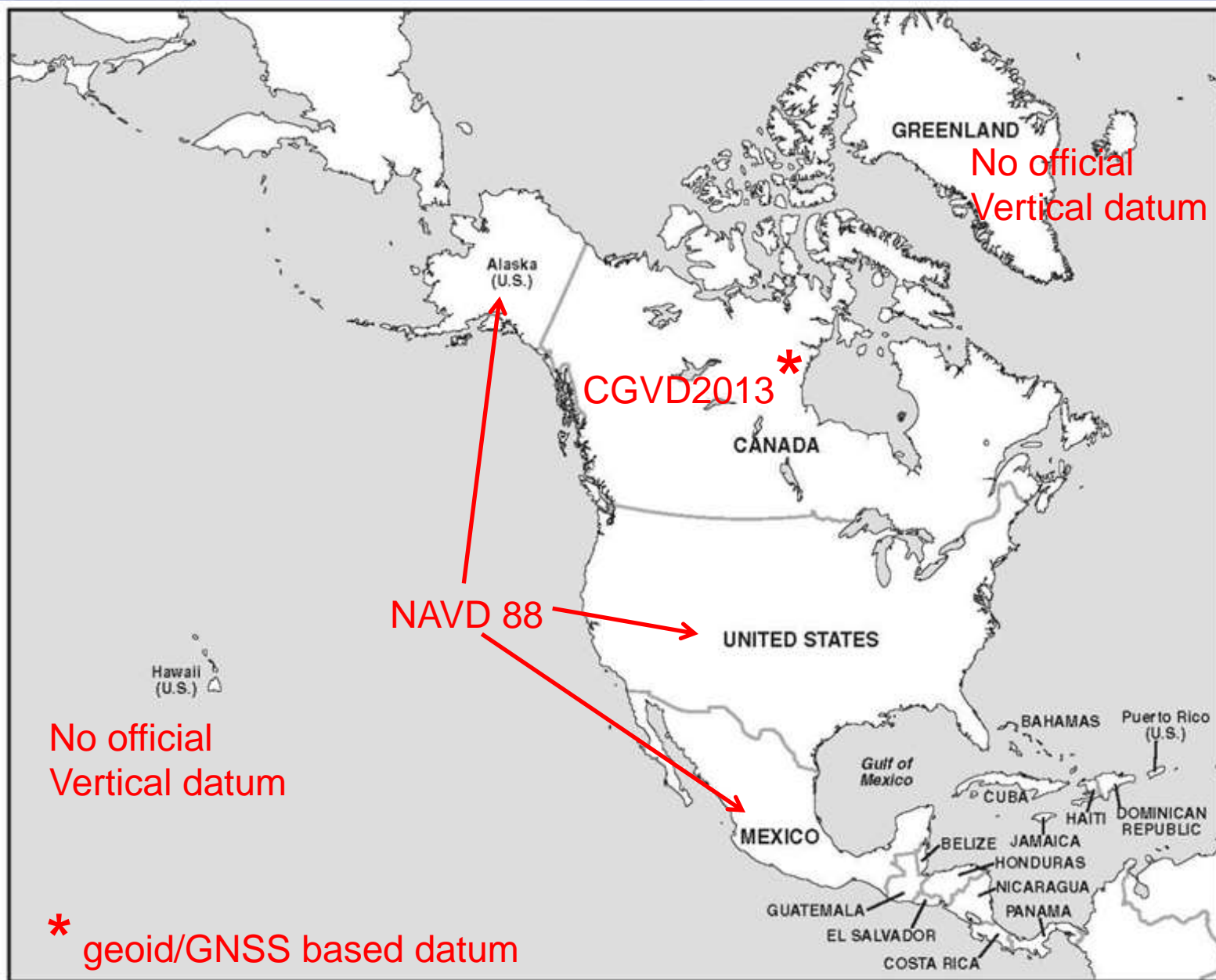
Canada

CONUS (USA)

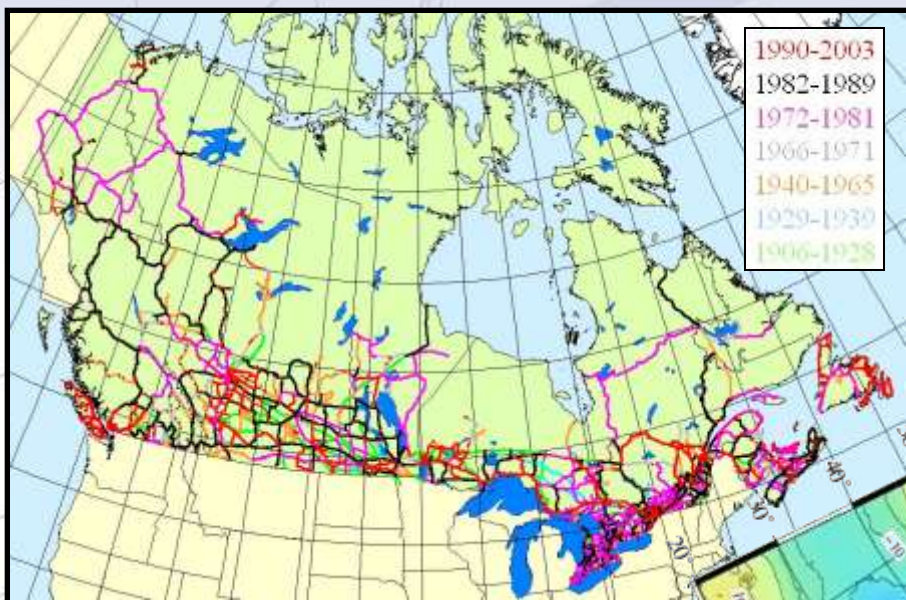




Google earth

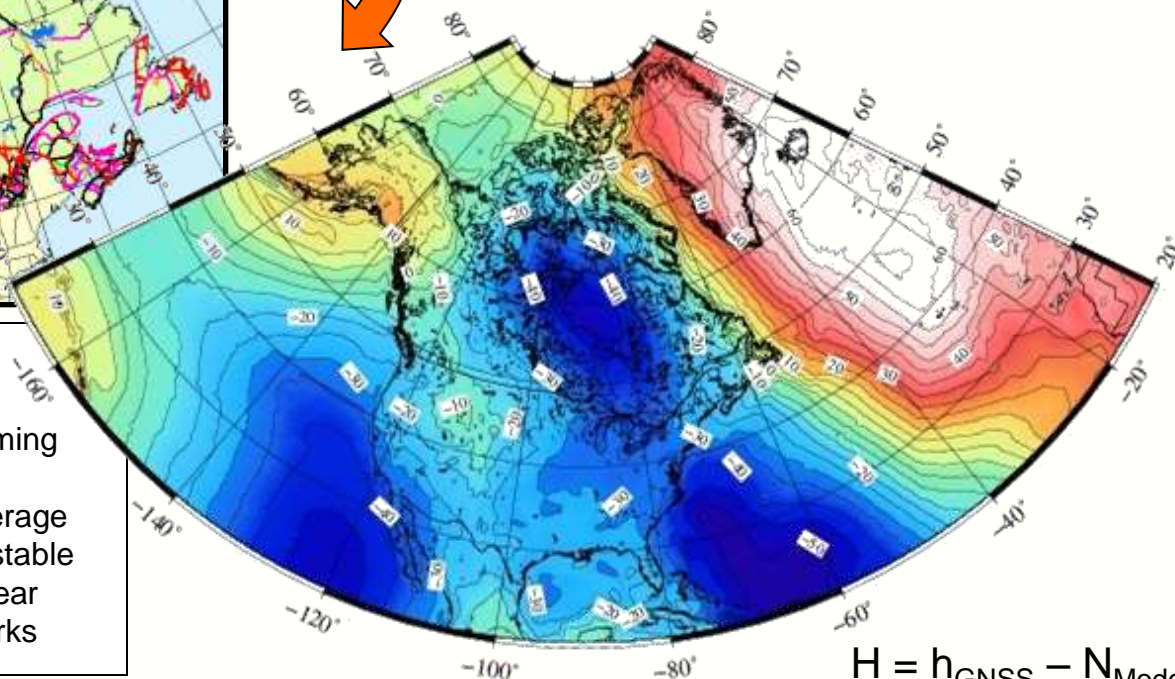


Canada Height Modernization - 2013



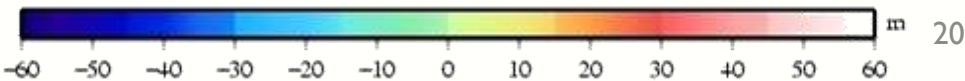
The geoid model:

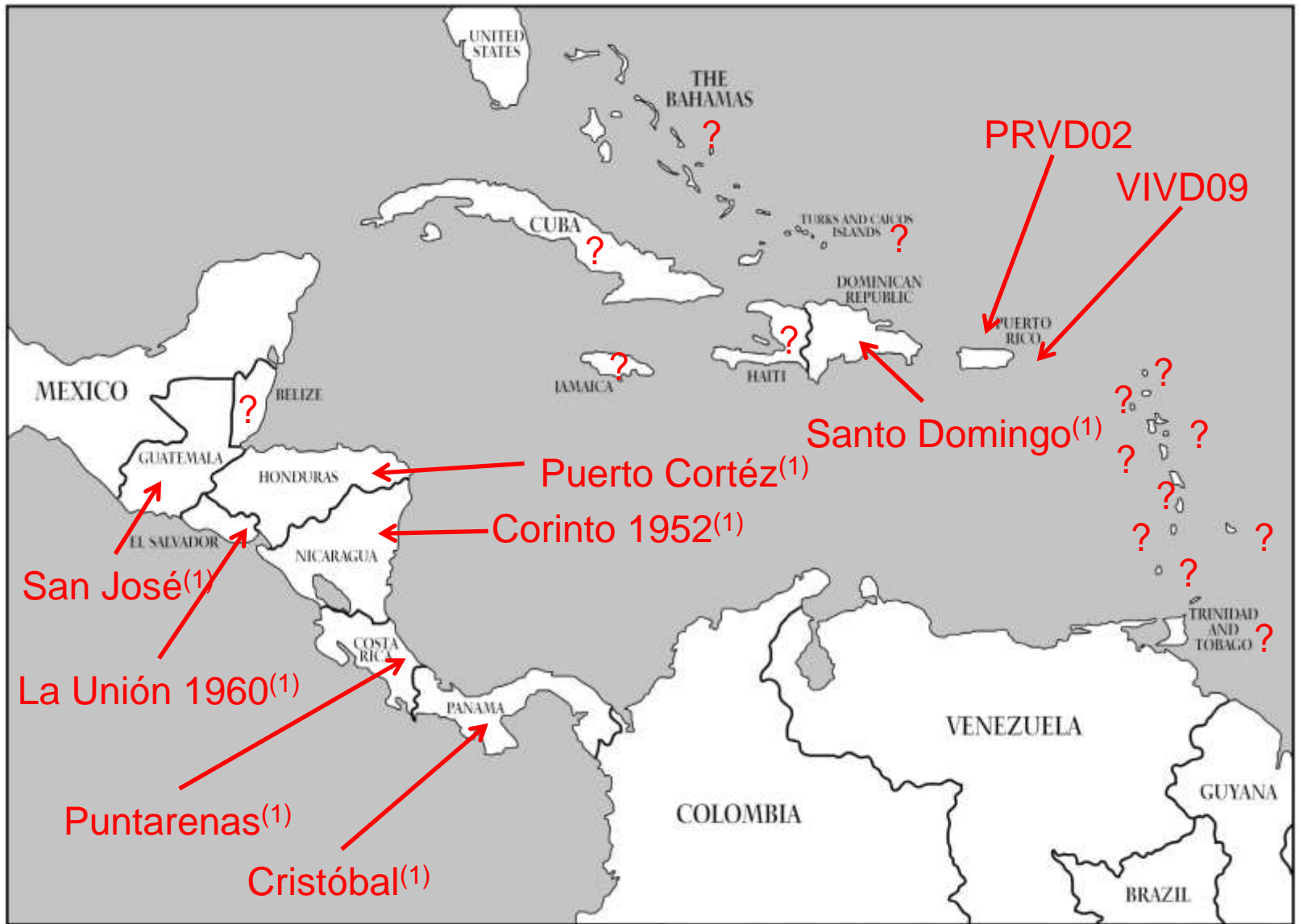
1. Entire coverage of the Canadian territory (land, lakes and oceans)
2. Compatible with space-based positioning (e.g., GNSS, altimetry)
3. Less expensive for maintenance
4. Fairly stable reference surface



Levelling Networks:

- | | |
|--|---------------------|
| 1. Established over the last 100 years | 1. Time consuming |
| 2. 120,000 km of levelling lines | 2. Expensive |
| 3. Some 80,000 benchmarks | 3. Limited coverage |
| | 4. BMs are unstable |
| | 5. BMs disappear |
| | 6. Local networks |





(1) Información cortesía de David Avalos

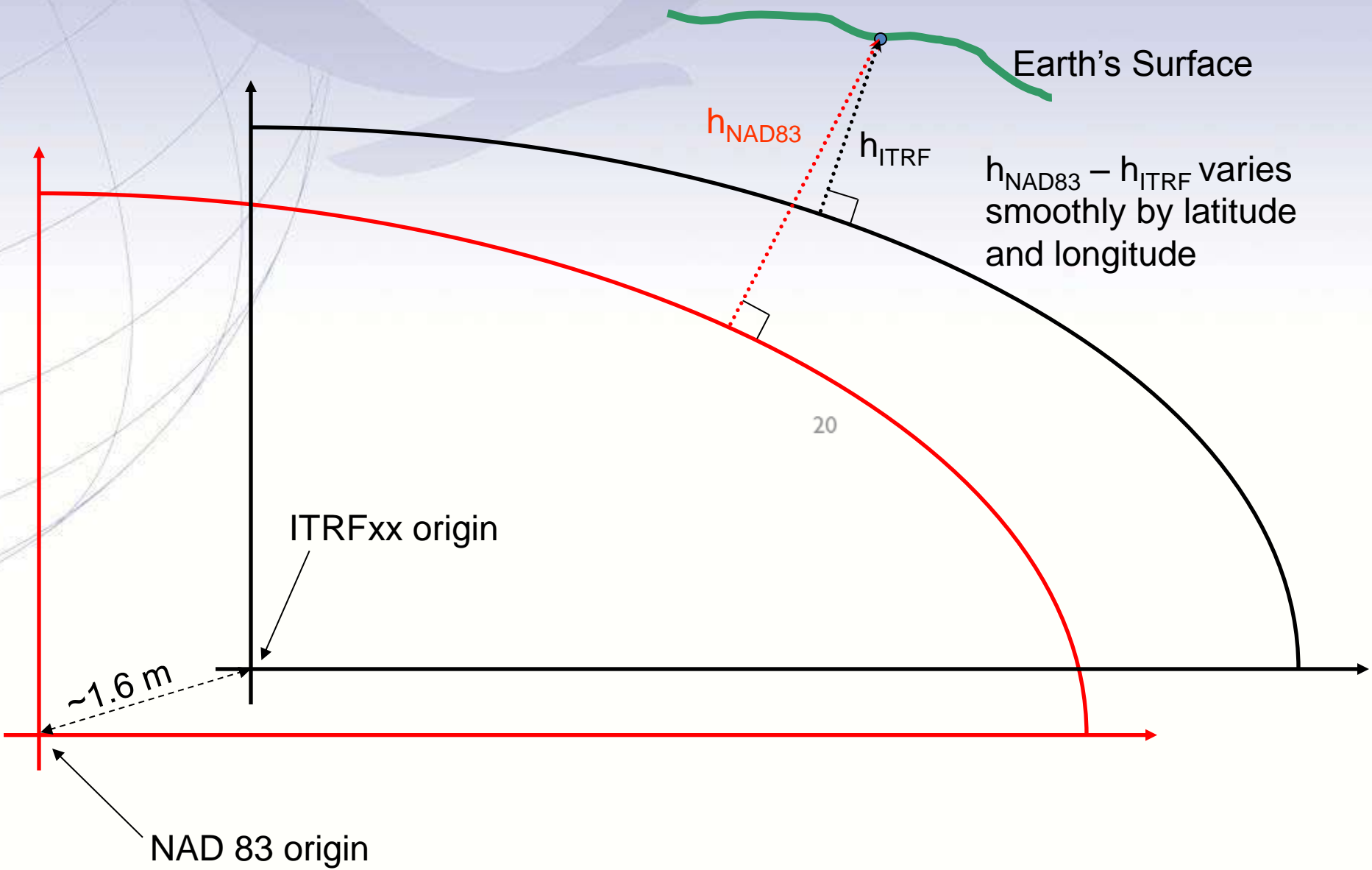
Old vs New Datums

- Step 1: Do the best scientific positioning work we can in ITRF
 - Before any discussion of “plate fixed” or “map projections”
 - NGS’s core goal must be the *scientific integrity of positions*
 - **New database**
 - **Replacement of static vector-based GNSS processing**

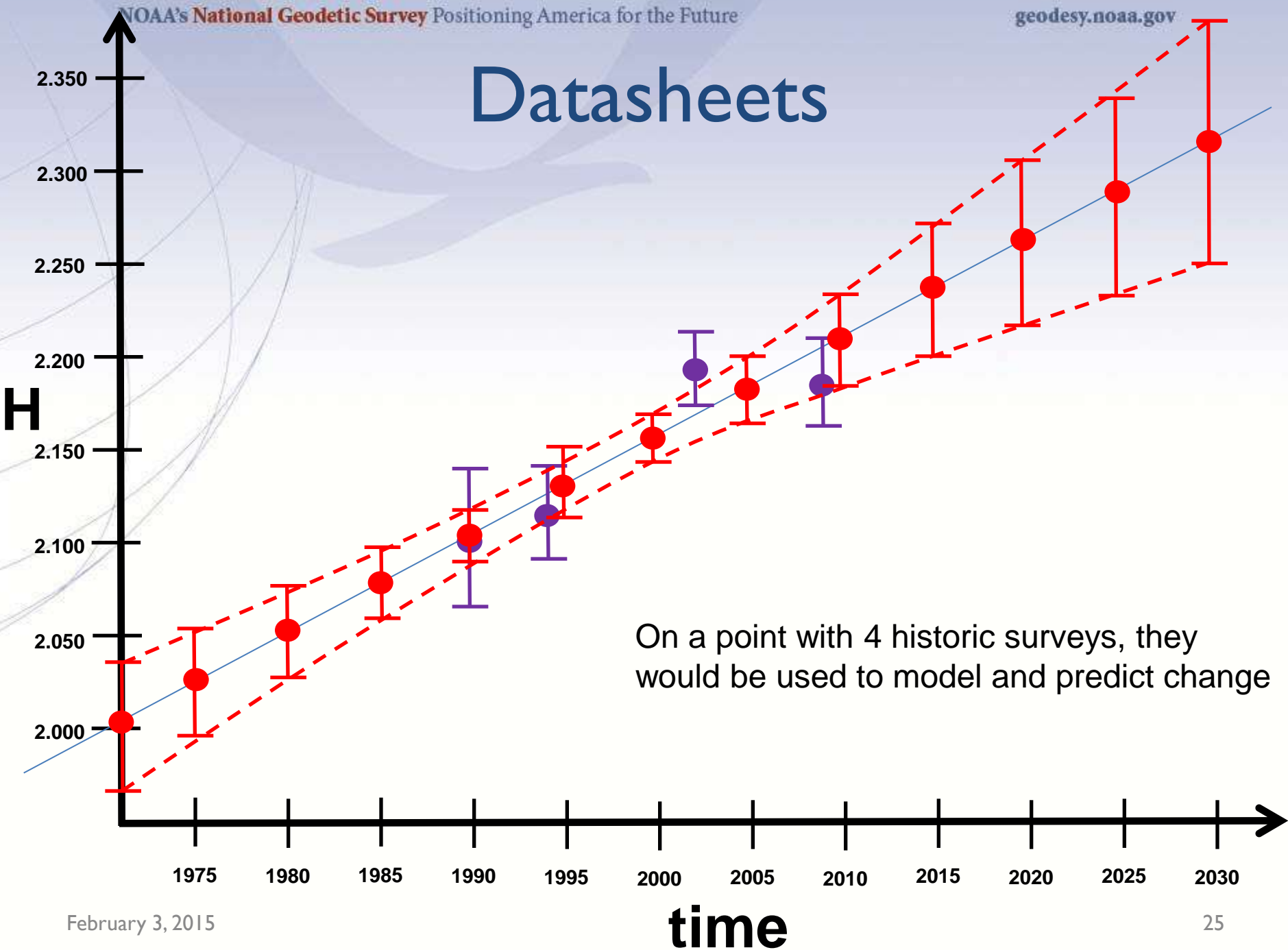
Old vs New Datums

- Step 2: Consider the question of “plate fixed”:
 - Why do users want this?
 - Fixed latitude and longitude?
 - Nothing is “fixed” though
 - Plate is not just rotating; more than 1 plate
 - Who wins? Who defines “fixed”? Must all points maintain zero change?
 - Model and remove all real motion? (aka “HTDP”)
 - If not removing *all* motion, why remove *any* motion?
 - » ITRF minus plate rotation vs just ITRF

Simplified Concept of NAD 83 vs. ITRF



Datasheets



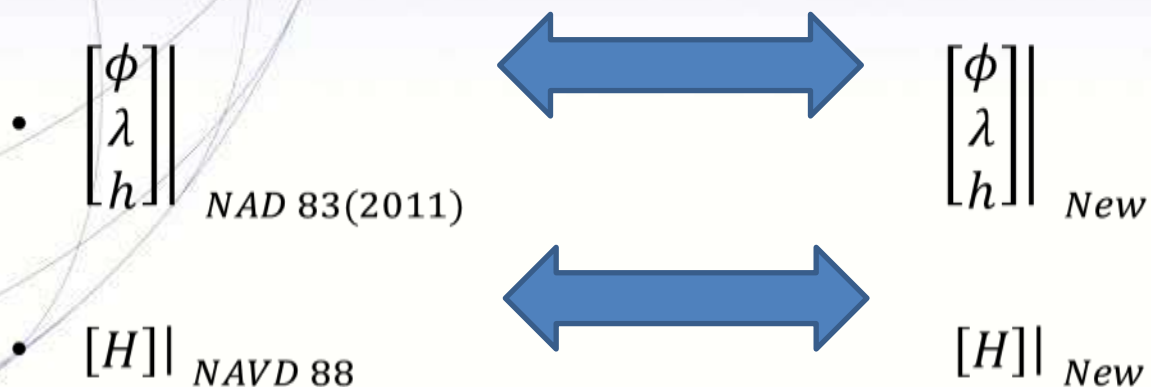
State Plane Coordinates

- Barring user-requested changes, NGS may use existing SPC projections, boundaries and equations, but with new false northings & eastings (to distinguish from NAD 27 and NAD 83)
- User-provided plug-ins (pre-written code) for SPC or other projections may be possible

Tools for Transitioning

Tools: Transformational

- NADCON and VERTCON will be expanded to provide coarse mapping grade transformations:



Adoption and Outreach

Adoption: Legal / Feds

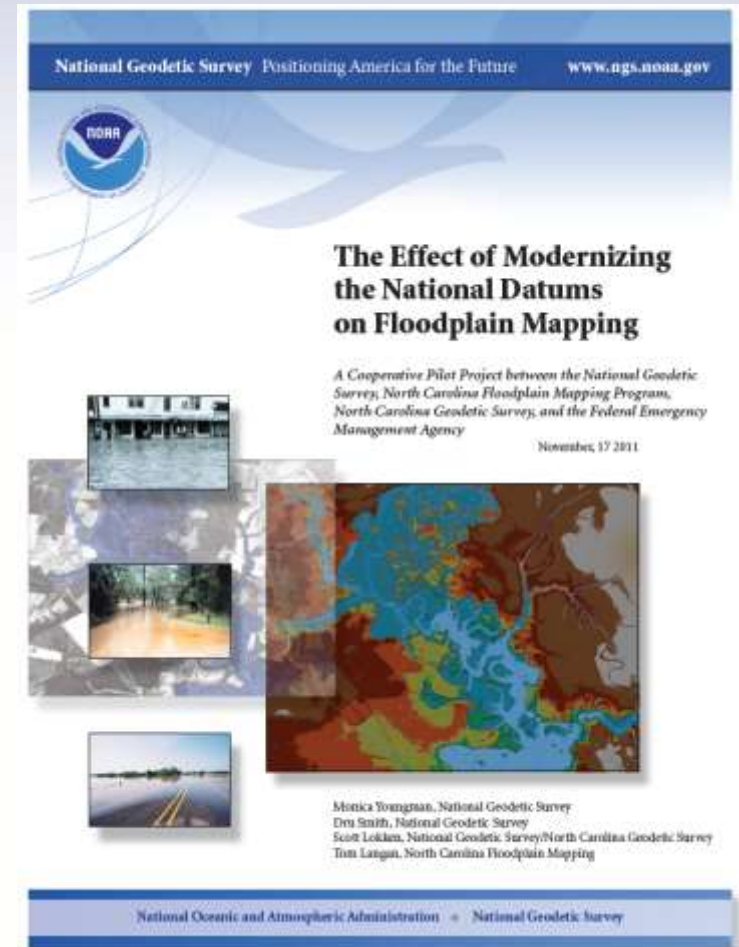
- The datums will be official once the FGCS approves them
- OMB A-16 then requires all federal, civil agencies to transition to the new datums
- Other groups may adopt at their own speed and need

Adoption: Legal / States

- NGS historically provided template acts for each state to help adopt changes
 - NAD 83
 - SPCS
- Has one major drawback: “NAD 83” is now *by-name* mandated in over 40 states.
- Would this be useful again?
 - **Only if “the latest coordinates of the NSRS as defined by the NGS” is the language used**
 - Avoids name-specific issues in the future

Outreach

- FEMA Pilot Project
 - NGS, NCGS and FEMA partnered in 2011
 - Goal: Evaluate how the NSRS is used at FEMA and how changes will affect FEMA workflow




Outreach

- Federal Geospatial Summits
 - 2010: 200 attendees
 - <http://geodesy.noaa.gov/2010Summit/>
 - “White paper” described why the datums are changing
 - Significant end-user feedback collected
 - Next summit: April 2015

2015 Geospatial Summit

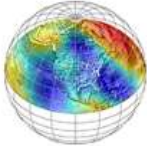
- April 13-14, 2015, in the Washington, DC Area
- As part of a broader “conference of conferences” with National Society of Professional Surveyors and Management Association for Private Photogrammetric Surveyors (MAPPS)
- Follows the successful 2010 Geospatial Summit. More info at the 2015 Geospatial Summit website.



2015 Geospatial Summit

National Geodetic Survey

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2015 Summit Home

Draft Agendas:

- Monday
- Tuesday
- HTMOD

Related Links

- NGS 10-year plan
- 2010 Summit Proceedings
- New Datums (white paper)
- New Datums web page

2015 Geospatial Summit

NOAA's National Geodetic Survey (NGS) will host the **2015 Geospatial Summit on Improvements to the National Spatial Reference System** in conjunction with the National Society of Professional Surveyors in April 2015 at the Hilton Crystal City hotel in Arlington, VA.

Join us to find out more about the planned retirement of the North American Datum of 1983 (NAD 83) and the North American Vertical Datum of 1988 (NAVD 88), how this will impact your mapping work, and what tools are planned to ease the transition to new, more accurate datums.

This summit continues a forum begun in May 2010, in Silver Spring, Maryland. ([2010 Proceedings available online](#))

This event will be part of a larger conference organized by the National Society of Professional Surveyors (NSPS) and in partnership with the Management Association for Private Photogrammetric Surveyors (MAPPS). There will be no cost for NGS sessions, but registration is required and space is limited. General conference information and registration will be available through the NSPS/MAPPS conference website.

Link will be posted when conference website is live.

For more information on NGS sessions, please contact us [here](#).

EVENTS:

Monday, April 13, 2015
 Time: 12 PM - 5 PM
 Location: Hilton Crystal City, Arlington, VA
This half day event will feature presentations from NGS.
[Draft Agenda](#)

Tuesday, April 14, 2012
 Time: 8 AM - 12 PM
 Location: Hilton Crystal City, Arlington, VA
This half day event will feature presentations from NGS on steps to implementation and then presentations from sectors on potential impacts and challenges.
[Draft Agenda](#)

<http://www.geodesy.noaa.gov/2015GeospatialSummit/>

Summary: Priorities

NGS Priorities, in order:

1. Define datums on solid scientific footing
2. Provide tools for transitioning
3. Work within FGCS to ensure OMB A-16 compliance
4. Work with additional groups to aid in adoption

Questions



Thank you!