The modernized NSRS: Coming in 2025

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Outline

- Brief overview
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  - New Types of Coordinates
  - OPUS 6
- Recent progress
- Re-prioritization: a "data first" approach
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- Sneak peak

Brief overview:
4 New Reference Frames &
1 New Geopotential Datum

Replacing NAD 83

The Old:

NAD 83(2011)

NAD 83(PA11)

NAD 83(MA11)

The New:

The North American Terrestrial Reference Frame of 2022 (NATRF2022)

The Caribbean Terrestrial Reference Frame of 2022 (CATRF2022)

The Pacific Terrestrial Reference Frame of 2022 (PATRF2022)

The Mariana Terrestrial Reference Frame of 2022 (MATRF2022)

Replacing NAVD 88

	The Old:	The New:
Orthometric Heights	NAVD 88	The North American-Pacific ***Geopotential Datum*** of 2022 (NAPGD2022)
Normal Orthometric Heights	PRVD 02	
	VIVD09	
	ASVD02	Will include:
	NMVD03	– GEOID2022
	GUVD04	– DEFLEC2022
		– GRAV2022
		– DEM2022
		– More
Dynamic Heights	IGLD 85	
Gravity	IGSN71	
Geoid Undulations	GEOID12B	
Deflections of the Vertical	DEFLEC12B	

A HUGE component of this effort is GRAV-D:

Gravity for the Redefinition of the American Vertical Datum

New types of Coordinates

Reference Epoch Coordinates

- An estimated "snapshot" of entire network
- Every 5 or 10 years
- Similar to NAD 83(2011) epoch 2010.00

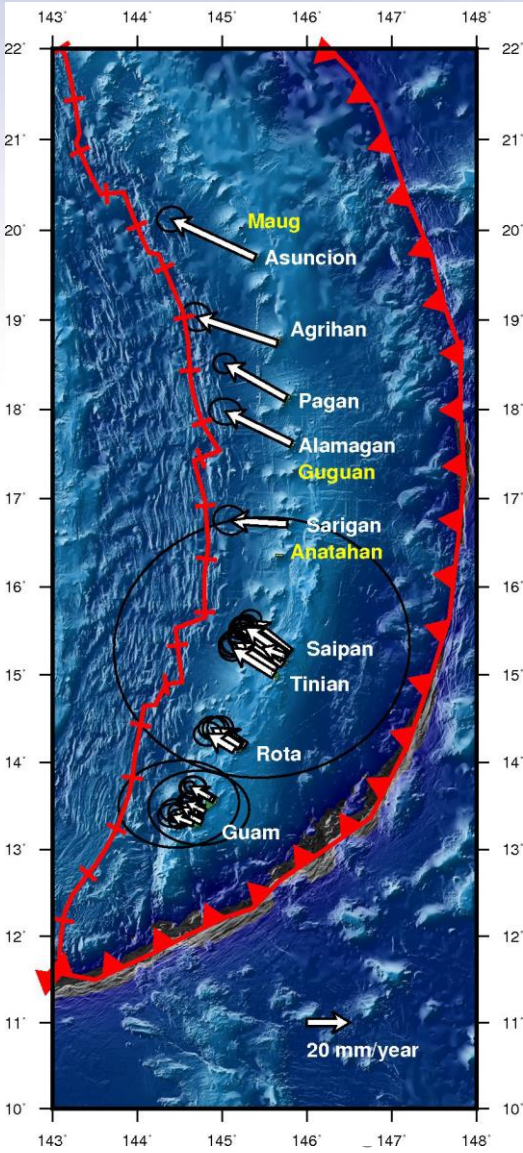
Survey Epoch Coordinates

- Time-dependent!
- Reflects coordinates at time of observation
- Multiple SECs can show changes over time

Recent Progress

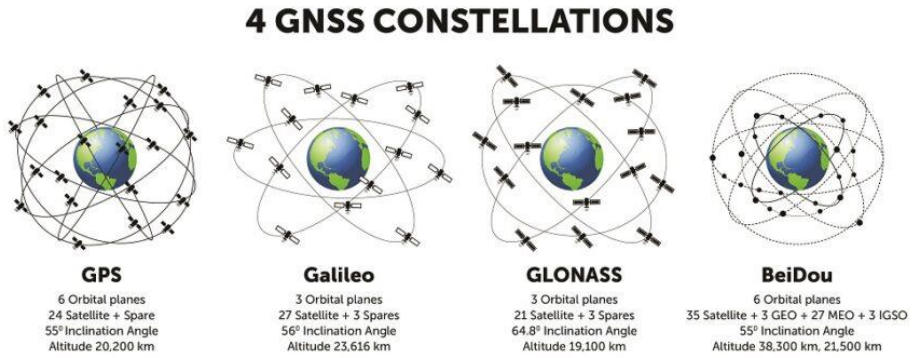
A rotation model for the Mariana Plate

- A rotation model for the Mariana plate released
  - Uses all available active & passive control data
  - Relative to ITRF2014
    - Will need to be updated to ITRF2020 to **define MATRF2022**
  - NOAA Technical Report NOS NGS 74

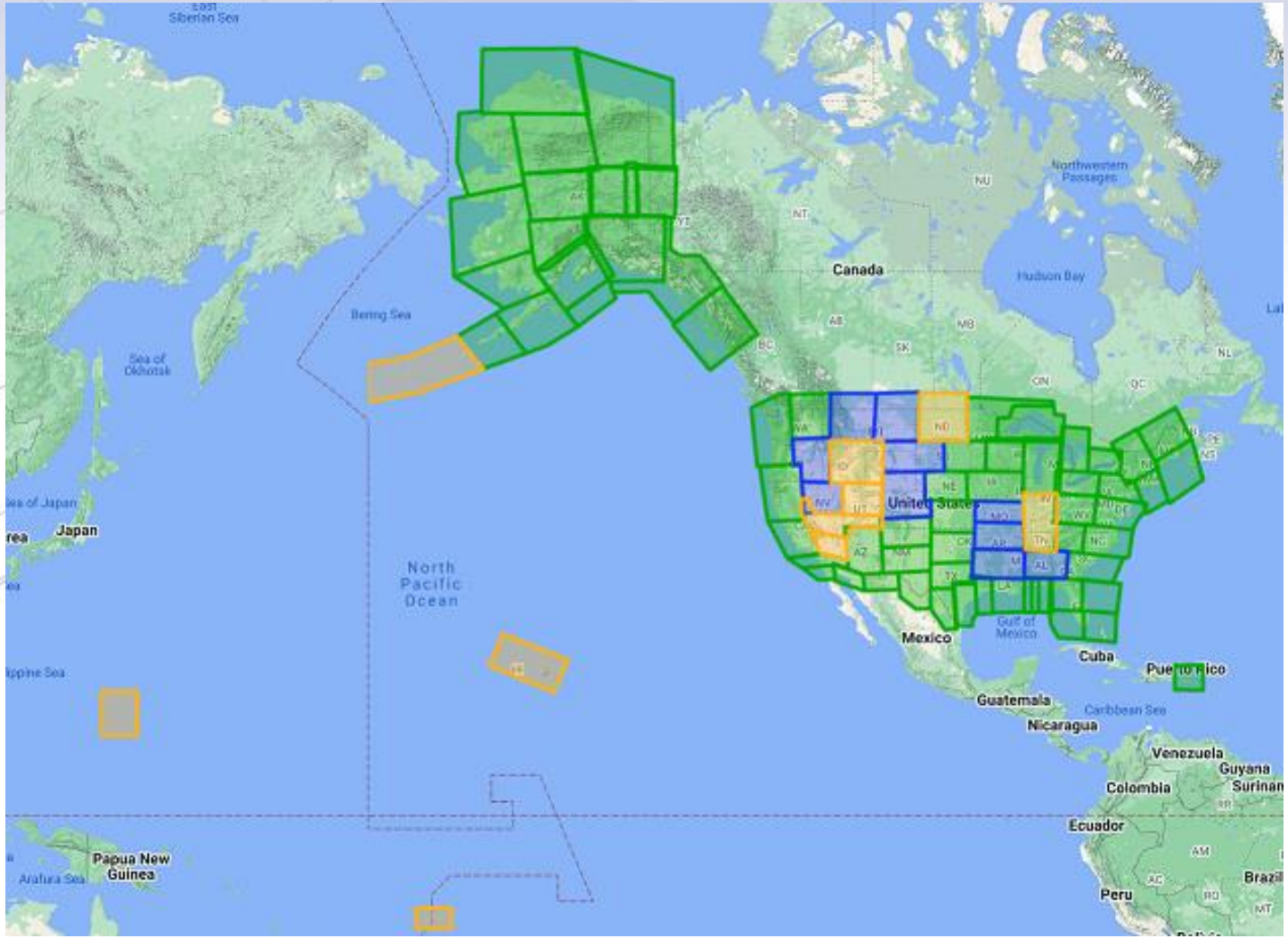


M-PAGES for multi-GNSS

- M-PAGES can now process data from all existing constellations
  - Still under development
  - Has been integrated into OPUS-S for testing



GRAV-D

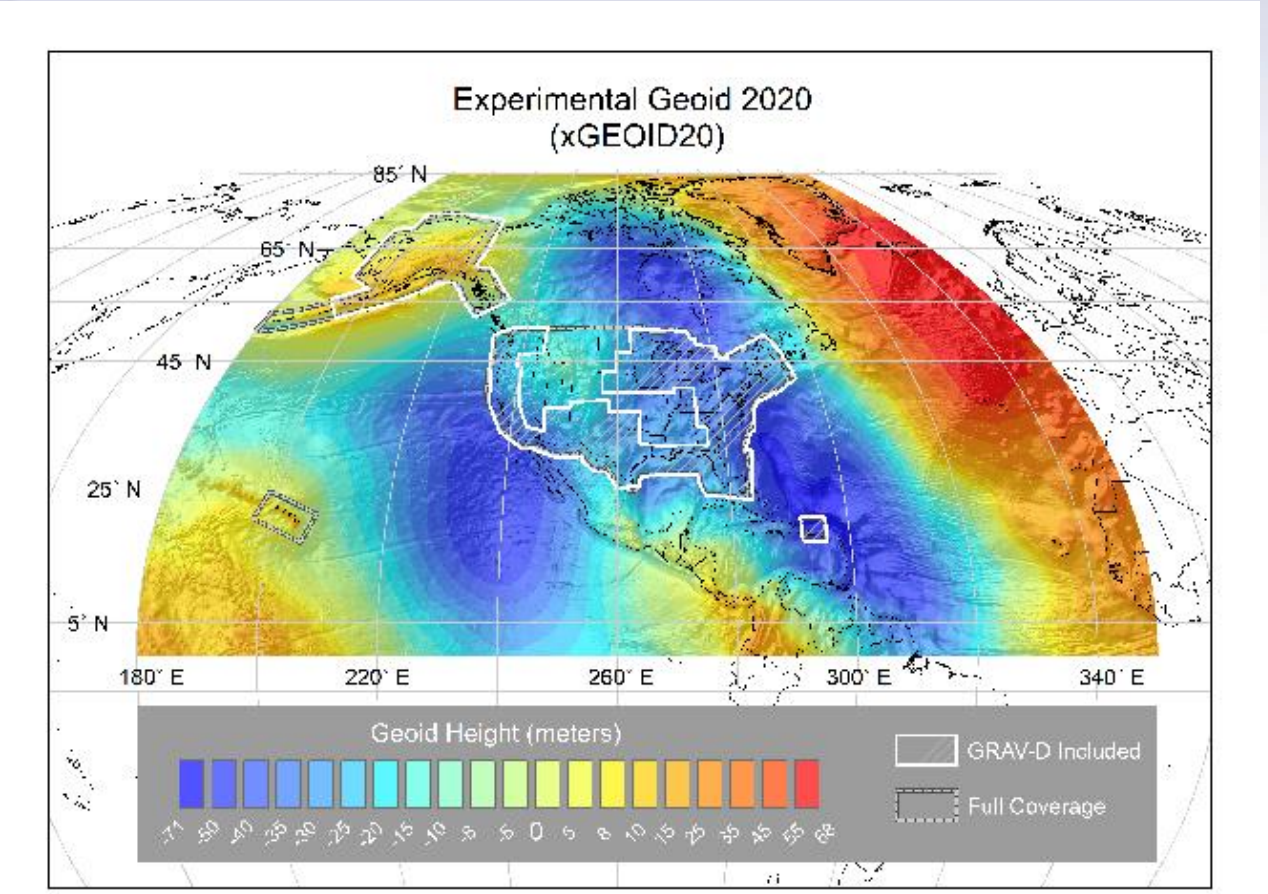


- Flying since 2007
- 96.8% complete
- No blocks have zero data
- 100% by end of 2023

- Available data and metadata
- Data being processed
- Data collection underway
- Planned for data collection

Geoid modeling

- NGS, Canada and Mexico released the first ever joint geoid model between our countries
  - xGEOID20
  - The final GEOID2022 model will also be a joint model



OPUS

- NGS's flagship GNSS product
- GVX (GNSS Vector Exchange) 1.0 format released
  - Being adopted by industry
    - Scheduled to be **replaced by GDX in early 2023**
- OPUS-Projects 5.1.2 current official version
  - Will be moved soon to https://www.ngs.noaa.gov/OPUS-Projects/OpusProjects.shtml
  - Works with the current NSRS
  - Supports upload of GNSS vectors in GVX format

Science

- Nine science papers in the last 2 years
  - More coming this year
  - https://geodesy.noaa.gov/library/

Least-squares adjustments

- NGS has decided to replace all LSA software with a single suite
- LASER (replaces ADJUST, et al.)
  - **L**east squares **A**djustments: **S**tatistics, **E**stimates and **R**esiduals
  - Replicated the 2011 national adjustment in 2 hours on a modern laptop
  - Without "Helmert Blocking"
  - Currently supports geometic (GNSS, classical) and orthometric (leveling) adjustments
- Coming soon:
  - Relative gravity, CBLs

Re-prioritization: a "data first" approach

Re-prioritization

- There are 33 active projects within NGS explicitly dedicated to NSRS modernization
  - In an agency of ~200 people….resources are spread *thin*
- Meanwhile the current NSRS slowly deteriorates
  - Marks subside without checking
  - CORSs drift away from their published coordinate functions
  - The passive control network deviates from active control

Re-prioritization

- NGS has recently decided to release all of the modernized NSRS ***data*** before we have fully completed all support ***tools***

- ***If we do not take this approach, we are not likely to see the modernized NSRS defined and released until 2030***

Data

- Upon release, the modernized NSRS will consist of this *data*:
  - The NOAA CORS Network (NCN) operating on **ITRF2020**
  - **NATRF2022, PATRF2022, MATRF2022, CATRF2022** defined relative to ITRF2020
  - **NAPGD2022**, including:
    - GM2022, GEOID2022, DEFLEC2022, GRAV2022
  - Geometric (XYZ / $\phi\lambda$h) and orthometric (H) **reference epoch coordinates** (RECs) at 2020.00 at those passive control with the observations to support such coordinates
  - Geometric (XYZ / $\phi\lambda$h) and orthometric (H) **survey epoch coordinates** (SECs) at survey epochs between about 1994 and 2020 at those passive control with the observations to support such coordinates
  - **State Plane Coordinates** of 2022 (SPCS2022), plus UTM and USNG
  - **NADCON**
    - Connecting NAD 83(2011/MA11/PA11) epoch 2010.00 to N/P/M/CATRF2022 epoch 2020.00
  - **VERTCON**
    - Connecting NAVD 88, PRVD02, ASVD02, NMVD03, GUVD04 and VIVD09 to NAPGD2022 epoch 2020.00

Tools

- At a minimum, NGS is targeting these tools upon release:
  - A **Data Delivery System** capable of yielding:
    - RECs on some kind of datasheet
    - Information on CORSs
- A downloadable version of LASER
- **A browser-based online multi-GNSS service:**
  - Like OPUS-S
  - Like OPUS-Projects 5.x
- **NCAT** and **Vdatum** capable of invoking **NADCON**, **VERTCON** and **SPCS2022**

What will come after

- Work will continue to and through the rollout of the modernized NSRS. Tools released after the initial release of the modernized NSRS include:
  - Integrating leveling, classical data and gravity into OPUS
  - Full integration of all old tools into NCAT and Vdatum
  - SECs for pre-1994 (AKA "pre-NCN") years, plus SECs for post-2020

Timeline

Timeline

- Resources are being diverted from tool building to the assurance of quality ***data*** first and foremost
- As such, based on this new approach, NGS anticipates the release of all data, and limited tools, by the **middle of 2025**.
- Work on additional tools will continue in the out-years

Sneak Peak

What's on deck?

NOW: Use OPUS-Projects 5.1.2 on beta.ngs.noaa.gov to mix static GNSS with RTK/RTN

Early 2023: Check out multi-GNSS with M-PAGES in OPUS-S

Early 2023: Look for GDX to replace GVX

Early 2023: The first ("alpha") set of RECs in N/P/C/MATRF2022 on 100,000+ marks

Early 2023: The release of the State Plane Coordinate System of 2022

End of 2023: ITRF2020 coordinate functions on all NOAA CORS Network stations

End of 2023: First ("alpha") release of GEOID2022

Mid 2024-Mid 2025: One year roll-out of products, "domino style", on the beta website

Mid 2025: Official announcement of the modernized NSRS

Thank you!

Questions?