An overview of the modernized NSRS

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Outline

- Four new terrestrial reference frames

- One new geopotential datum

- New Types of Coordinates

- OPUS 6

Federal Users of the NSRS

BLUF

Every latitude, longitude and height you have will be <u>incorrect</u> by as much as <u>2 meters </u>in CONUS, and 4 meters in Alaska when the modernized NSRS is released in <u>2025</u>.

New Terrestrial Reference Frames

Replacing NAD 83

The Old:

NAD 83(2011)

NAD 83(PA11)

NAD 83(MA11)

The New:

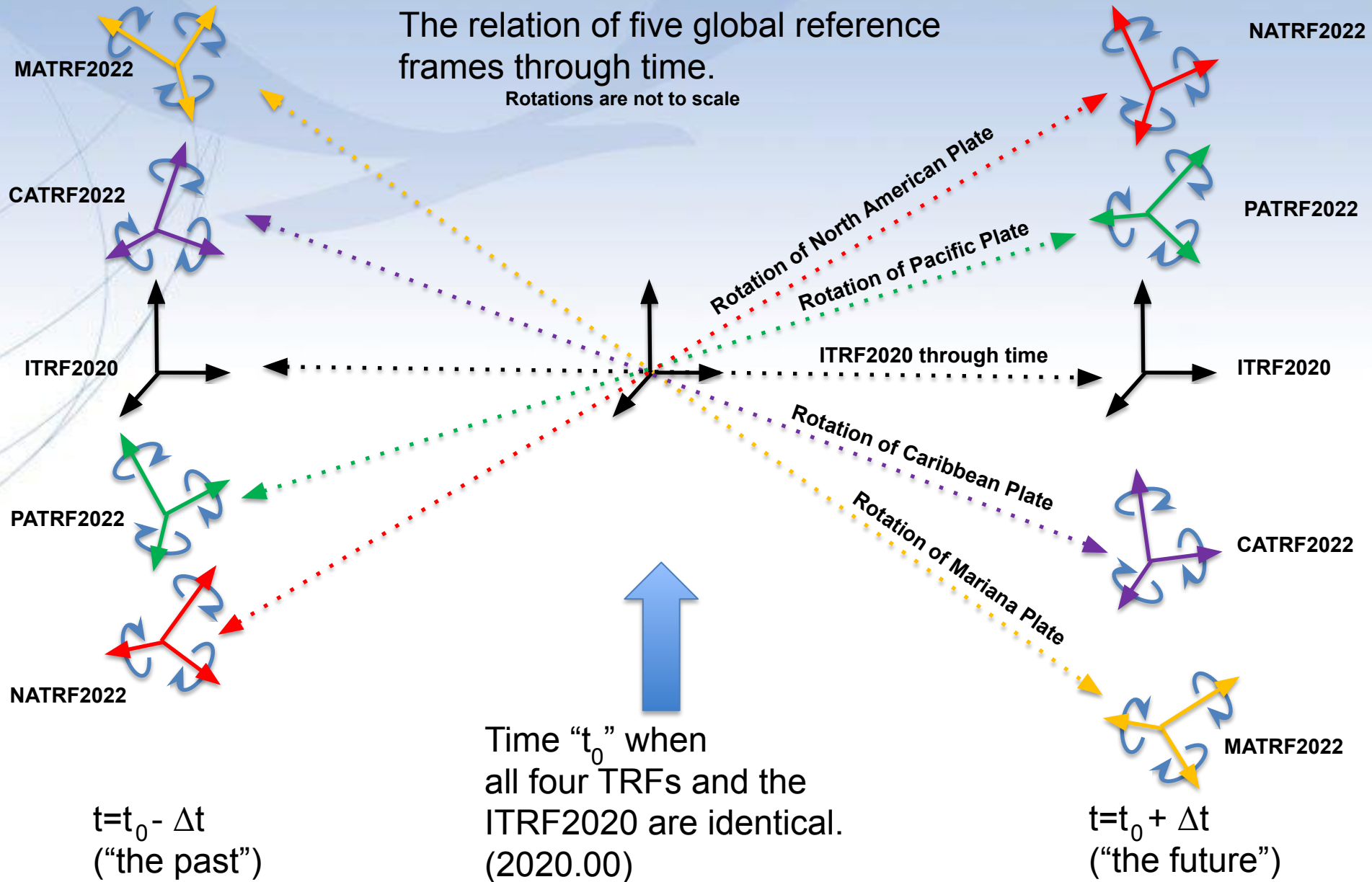The North American Terrestrial Reference Frame of 2022 (NATRF2022)

The Caribbean Terrestrial Reference Frame of 2022 (CATRF2022)

The Pacific Terrestrial Reference Frame of 2022 (PATRF2022)

The Mariana Terrestrial Reference Frame of 2022 (MATRF2022)

Pre-eminence of XYZ

- All geometric computations/adjustments in the Modernized NSRS will be performed first in **ITRF2020 XYZ**

- Everything else is derived from that…
  - $\varphi\lambda h$ in ITRF2020/GRS80
  - $\varphi\lambda h$ in NATRF2022, CATRF2022, MATRF2022, PATRF2022
  - XYZ in NATRF2022, CATRF2022, MATRF2022, PATRF2022
  - SPCS2022 in NATRF2022, CATRF2022, MATRF2022, PATRF2022
  - UTM
  - USNG

The relation of five global reference frames through time.

Rotations are not to scale

MATRF2022

CATRF2022

ITRF2020

PATRF2022

NATRF2022

Rotation of North American Plate

Rotation of Pacific Plate

ITRF2020 through time

Rotation of Caribbean Plate

Rotation of Mariana Plate

NATRF2022

PATRF2022

ITRF2020

CATRF2022

MATRF2022

$t = t_0 - \Delta t$
("the past")

Time "t_0" when
all four TRFs and the
ITRF2020 are identical.
(2020.00)

$t = t_0 + \Delta t$
("the future")

New Geopotential Datum

Replacing NAVD 88

Orthometric Heights

Normal Orthometric Heights

Dynamic Heights Gravity Geoid Undulations Deflections of the Vertical

<u>The Old:</u>

NAVD 88

PRVD 02

VIVD09

ASVD02

NMVD03

GUVD04

IGLD 85

IGSN71

GEOID12B

DEFLEC12B

<u>The New:</u>

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

Will include:
– GEOID2022
– DEFLEC2022
– GRAV2022
– DEM2022
– More

A HUGE component of this effort is <u>GRAV-D</u>:

Gravity for the Redefinition of the American Vertical Datum

New Types of Coordinates

A two-track approach to coordinates

<u>Reference Epoch Coordinates</u>

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

<u>Survey Epoch Coordinates</u>

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

Re-inventing "Bluebooking" or

The Modernized OPUS
AKA
"OPUS 6"

| Static GNSS | RTK/RTN | Classical | Leveling | Rel. Gravity |

RINEX

GDX

GDX

GDX

GDX

- Upload multiple types of data and multiple files into a single survey project
- Process RINEX into a position (like today's OPUS-S)
- Process RINEX into mark-to-mark vectors
- Process Classical into mark-to-mark angles/distances
- Process Leveling into mark-to-mark ortho. differences
- Process Rel. Gravity into mark gravity
- Combine GNSS, RTK/N, Classical in a Geometric Adjustment
- Combine Classical and Leveling in an Orthometric Adj.
- Adjust Relative Gravity for either gravity or vertical gradients in a Gravimetric Adjustment
- Special settings for "Calibration Base Lines"
- Choose your epoch and frame
- All coordinates returned are "OPUS Coordinates"

OPUS 6

- Submit your data to NGS for QA/QC, database loading, and improvement of future passive mark coordinates (RECs and SECs)

Modernizing the NSRS

The "blueprint" documents: Your best source for information

National Geodetic Survey Positioning America for the Future   geodesy.noaa.gov
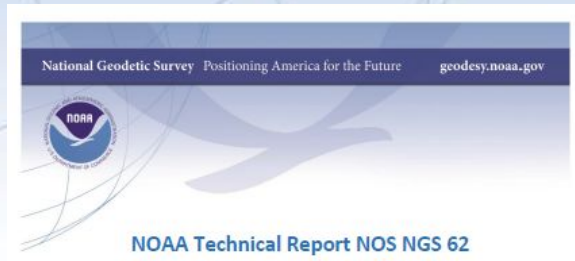
NOAA Technical Report NOS NGS 62

Blueprint for 2022, Part 1: Geometric Coordinates

National Geodetic Survey Positioning America for the Future   geodesy.noaa.gov
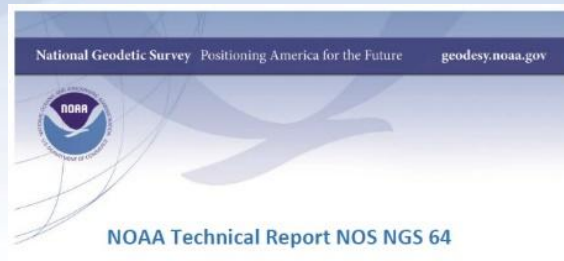
NOAA Technical Report NOS NGS 64

Blueprint for 2022, Part 2: Geopotential Coordinates

National Geodetic Survey Positioning America for the Future   geodesy.noaa.gov
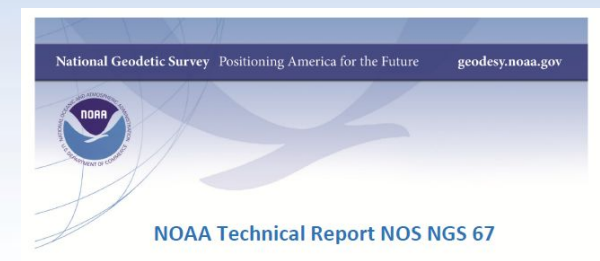
NOAA Technical Report NOS NGS 67

Blueprint for 2022, Part 3:
Working in the Modernized NSRS

All three have been updated and were released in early 2021

Sepbember 18, 2017

National Oceanic and Atmospheric Administration ◦ National Geodetic Survey

Geometric:
Apr 2021
NOAA TR NOS NGS 62

National Oceanic and Atmospheric Administration ◦ National Geodetic Survey

Geopotential:
Feb 2021
NOAA TR NOS NGS 64

National Oceanic and Atmospheric Administration ◦ National Geodetic Survey

Working in the modernized NSRS:
Feb 2021
NOAA TR NOS NGS 67

Thank you!

Questions?