



# Reference Frames and Datums: Improvements Planned for the Pacific

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HSRP Modeling Session 04 March 2021

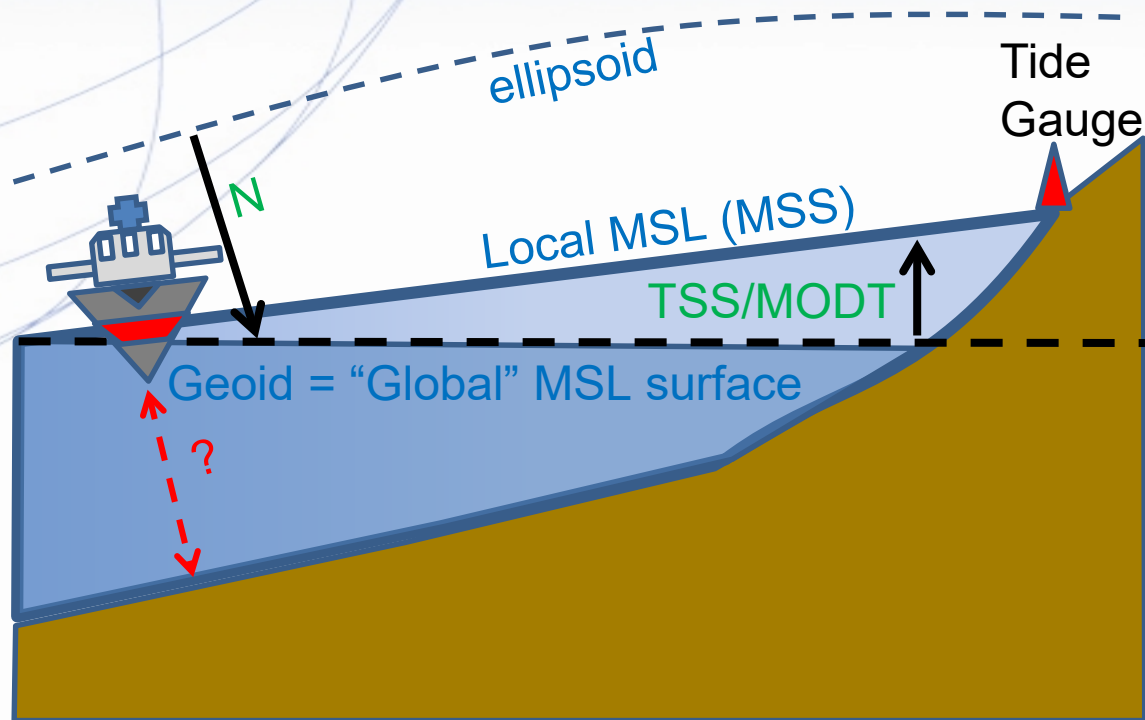
# Outline

- Height relationships
- GGRF and ITRS and WGS84
- NSRS 2022
- Western Pacific
- Summary

# Height Relationships

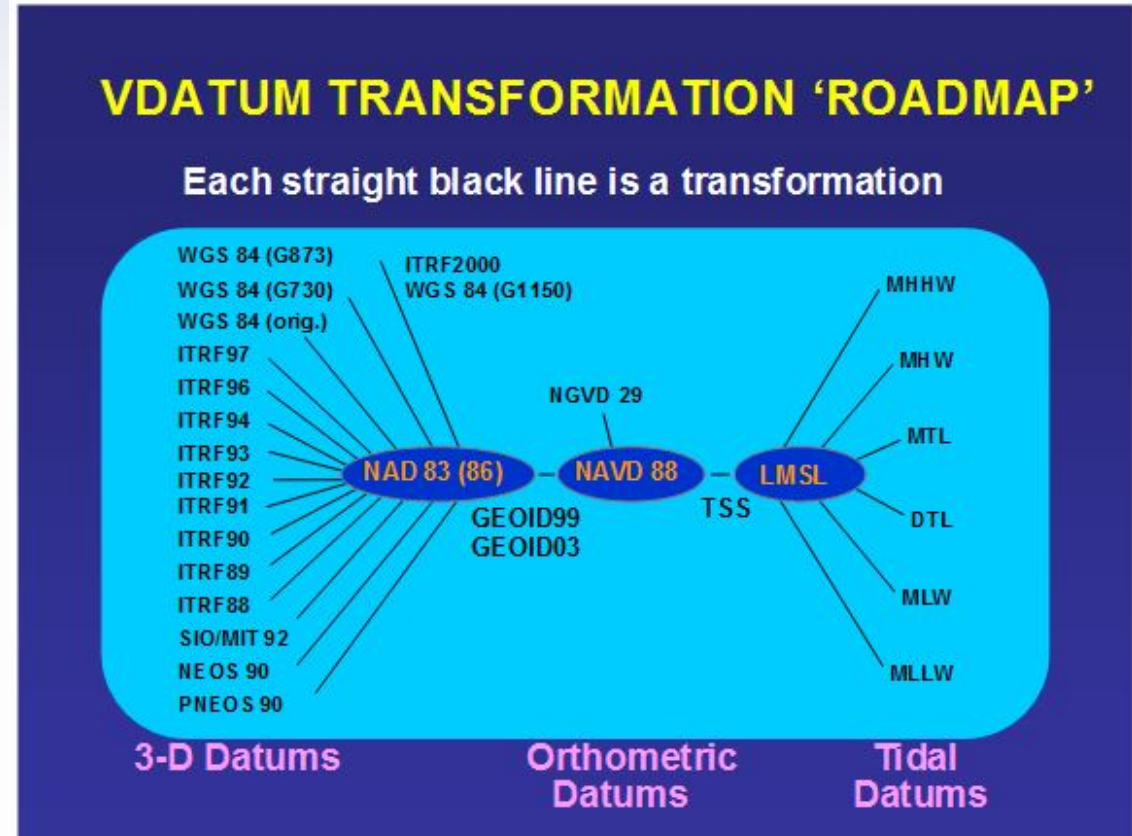
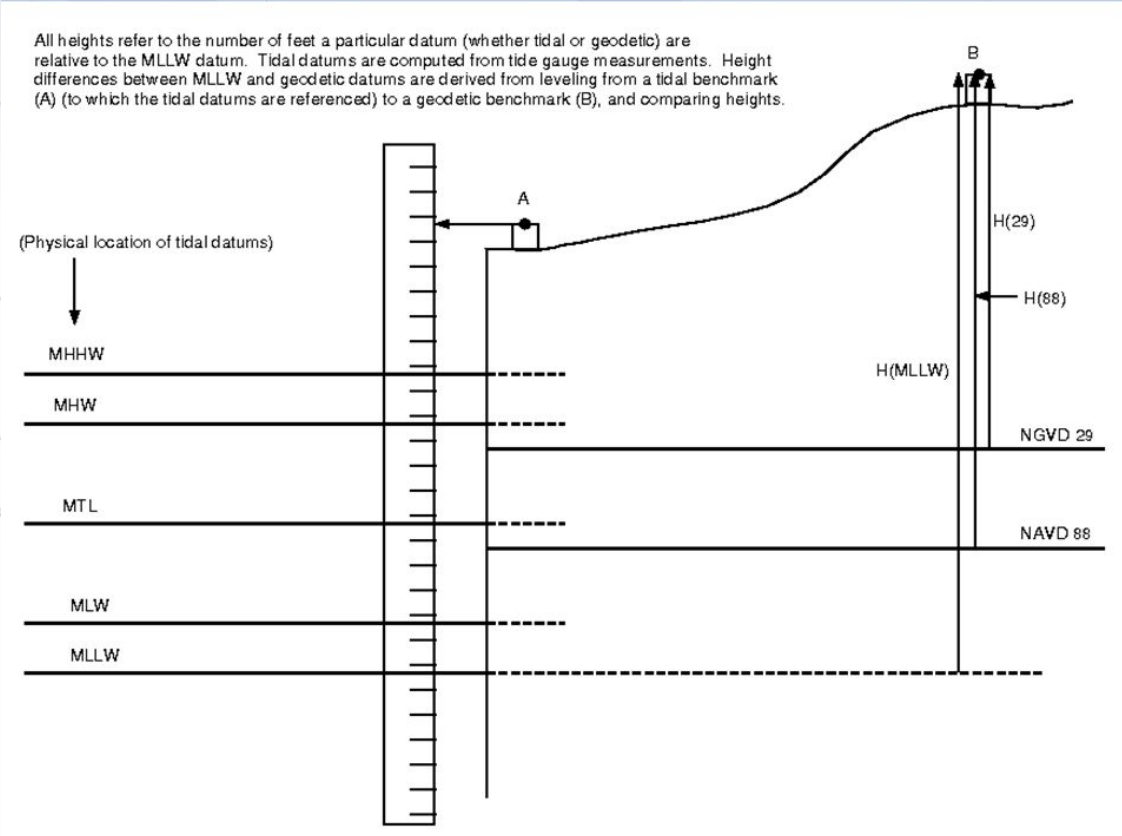
$$h = H + N \quad \text{or} \quad H = h - N$$

$$\text{Geoid} + \text{TSS} = \text{LMSL}$$

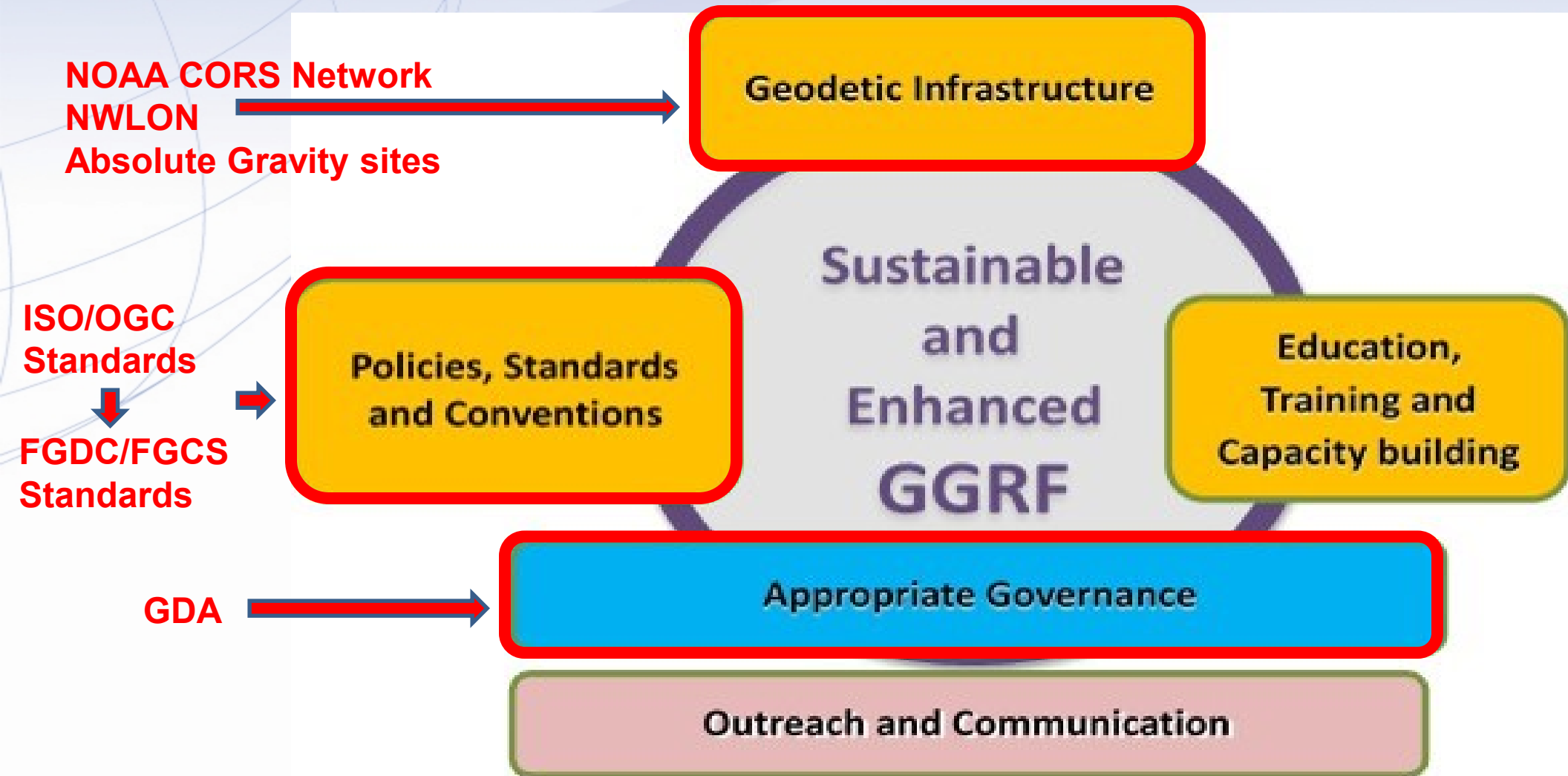


- **h: ellipsoid height**
  - Above/below ellipsoid surface/datum
- **H: orthometric heights**
  - Above geopotential datum (geoid)
  - Geoid  $\approx$  Global MSL (MSL)
- **N: geoid height**
  - Height from ellipsoid to geoid
- **Local Mean Sea Level (LMSL)**
  - Mean Sea Surface
- **Topography of the Sea Surface (TSS)**
  - Height from MSL(geoid) to LMSL(MSS)

# Input for VDatum



# Global Geodetic Reference Frame Roadmap



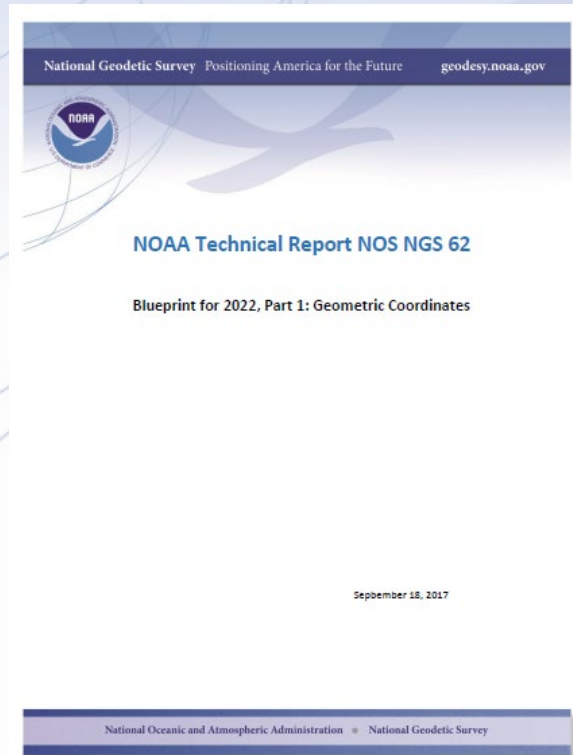
# WGS84 versus ITRS

Realization	Epoch, $t_D$	Implementation date		Nominally Aligned to	Accuracy (m)
		Broadcast orbits	Precise ephemeris		
WGS84	1984.0	1987	1 Jan 1987 (1987.00)	BTS 1984	1-2
WGS84 (G730)	1994.0	29 Jun 1994 (1994.49)	2 Jan 1994 (1994.00)	ITRF91	0.10
WGS84 (G873)	1997.0	20 Jan 1997 (1997.05)	29 Sep 1996 (1996.74)	ITRF94	0.05
WGS84 (G1150)	2001.0	20 Jan 2002 (2002.05)	20 Jan 2002 (2002.05)	ITRF2000	0.01
WGS84 (G1674)	2005.0	8 Feb 2012 (2012.10)	7 May 2012 (2012.35)	ITRF2008	< 0.01
WGS84 (G1762)	2005.0	16 Oct 2013 (2013.79)	16 Oct 2013 (2013.79)	ITRF2008	< 0.01

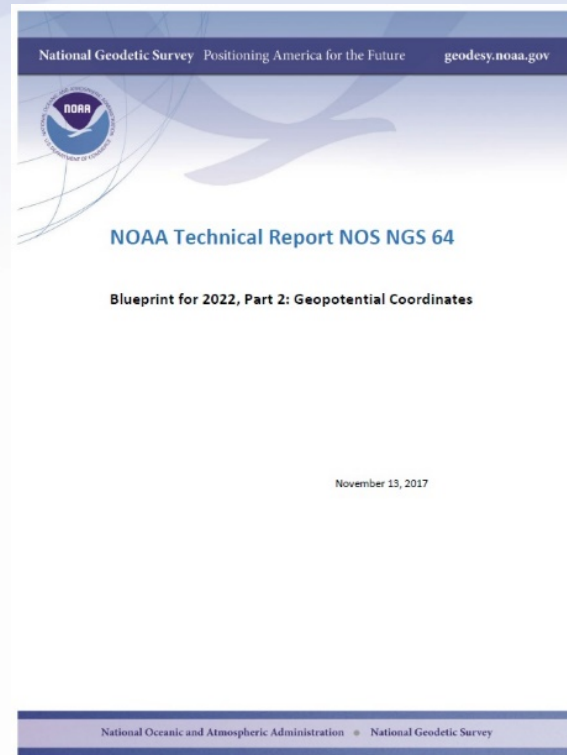
*Kelly and Dennis, 2021 in preparation (in review)*

# Modernizing the NSRS

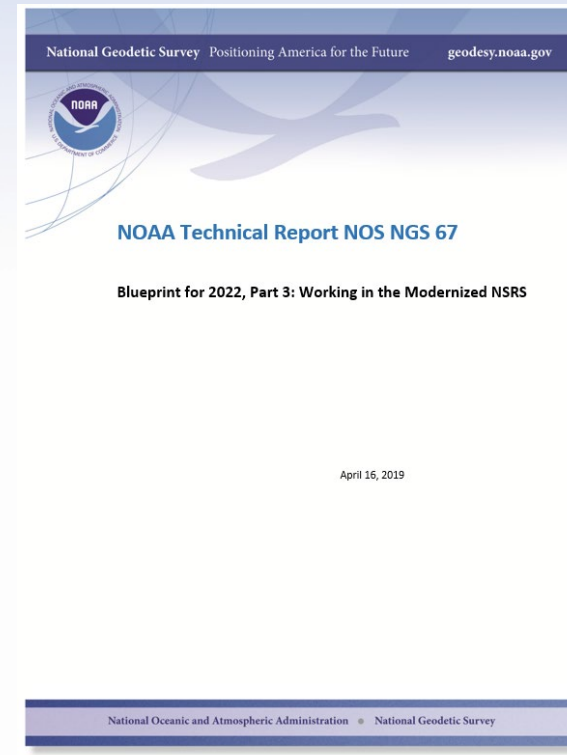
The “blueprint” documents: Your best source for information



**Geometric:**  
Sep 2017  
**NOAA TR NOS NGS 62**  
32 pages

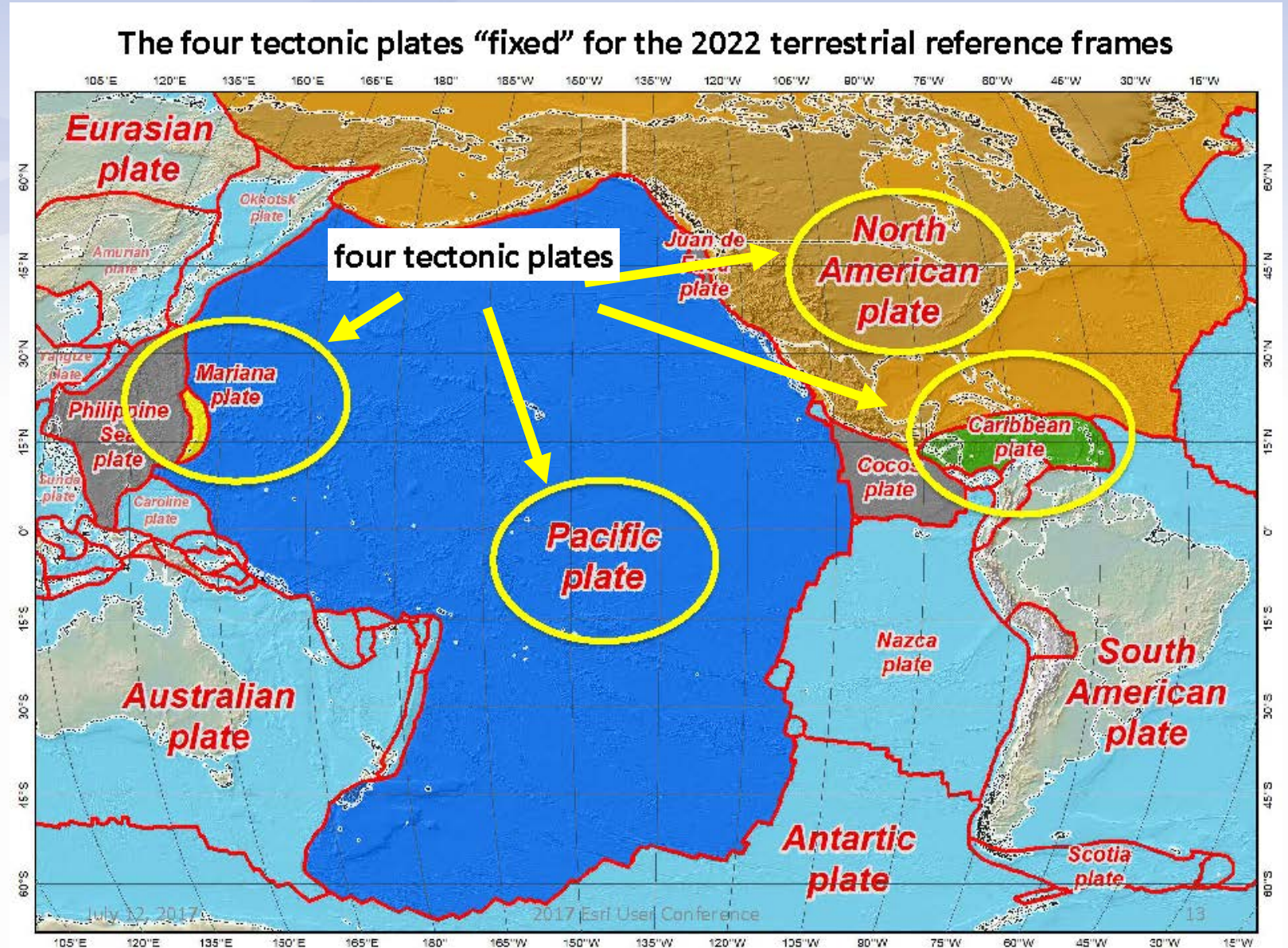


**Geopotential:**  
Nov 2017  
**NOAA TR NOS NGS 64**  
41 pages



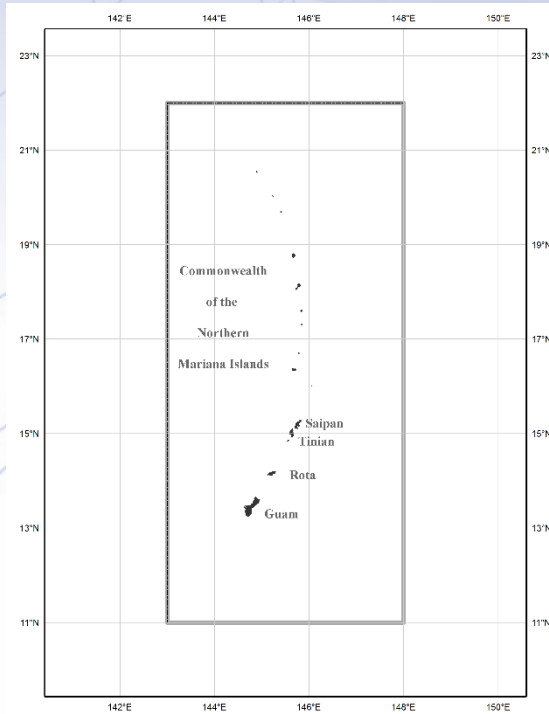
**Working in the  
modernized NSRS:**  
April 2019  
**NOAA TR NOS NGS 67**  
77 pages

- The old
  - NAD 83 (2011)
  - NAD 83 (PA11)
  - NAD 83 (MA11)
- The new
  - NATRF
  - CATRF
  - **PATRF**
  - **MATRF**



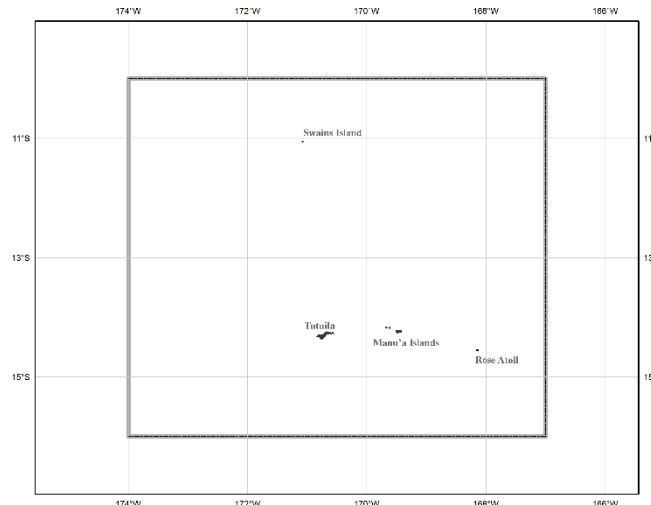


# NAPGD2022 - The three gridded regions

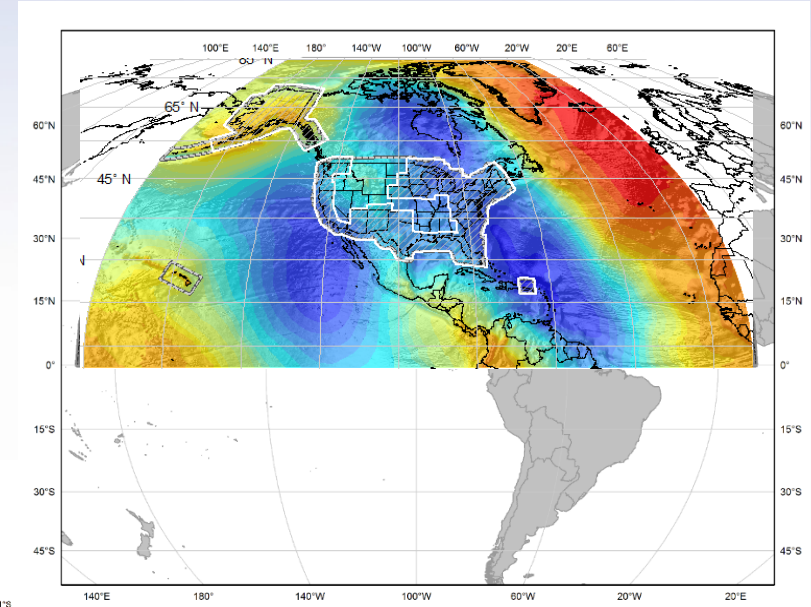


“Guam/CNMI region”

Project Area



“American Samoa region”



“North American region”  
1/4 of the Earth

# Western Pacific Geodesy

## Needs

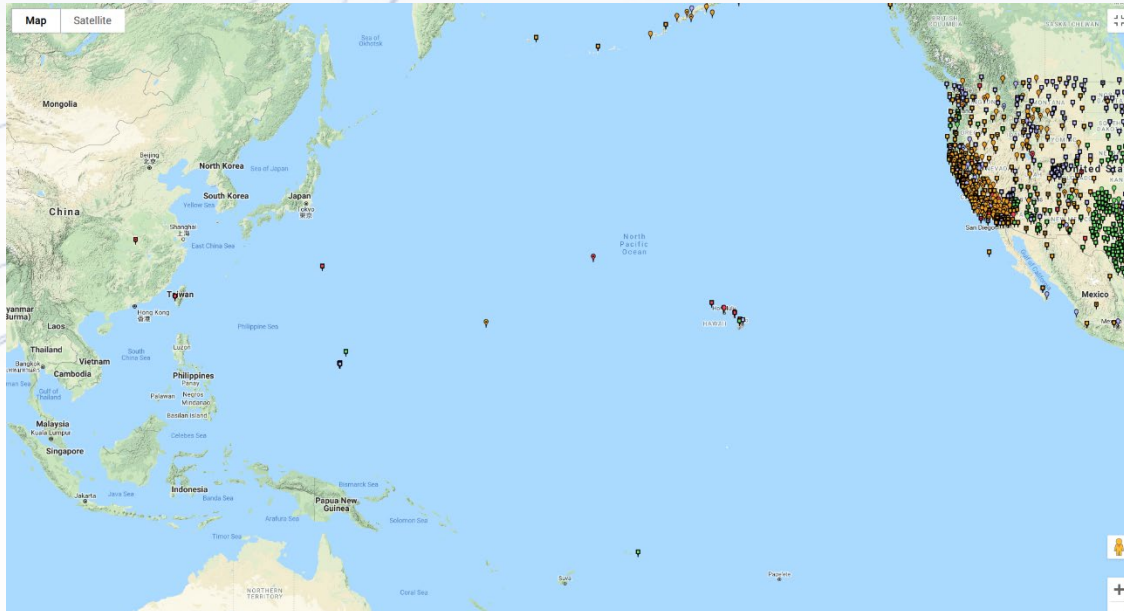
- Geometric Reference Frame
- GNSS access to the Frame
- Geoid model ( $h \Rightarrow H$ ) GGM vs. regional
- Terrestrial & altimetric gravity data
- Tide gauges/TSS (MSL  $\Rightarrow$  LMSL)

## Possibilities

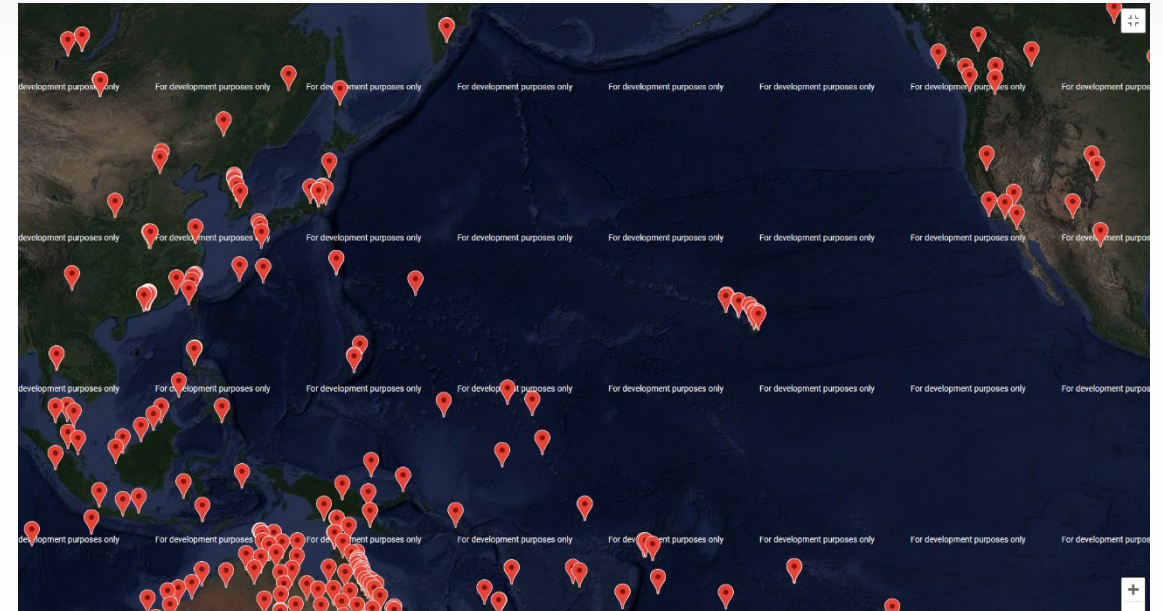
- [ITRF2014](#)/*ITRF2020/PATRF/MATRF*
- [NCN/APREF](#)
- [ICGEM/ISG](#)/**EGM2008**/*EGM2020*
- NGA/[BGI](#)/PGSC
- *Academia*/PGSC/[PSMSL](#)

# GNSS Access

## NOAA CORS Network

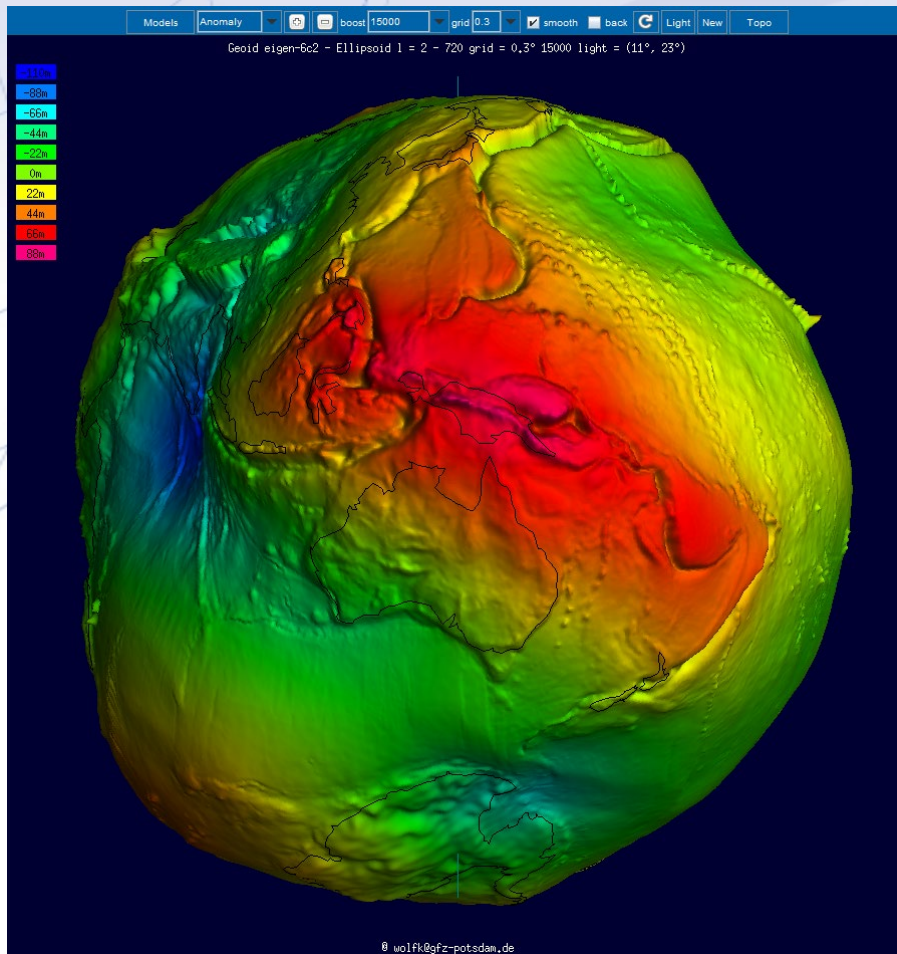


## Asia-Pacific Reference Frame (APREF)



Stations in APREF are being added to the NCN to boost coverage and access in the West Pacific

# Geoid Models



GGM derived from EIGEN-6c2 model  
Provided on [ICGEM](http://www.igem.org) website

- Global Gravity Models at ICGEM
  - Generally 5' resolution or worse
  - 10-20 km resolution – omission error
  - Commission errors more significant
- Regional geoid models
  - Developed using GGM
  - R-C-R
  - Need additional terrestrial gravity
  - Altimetric anomalies
  - Still requires gravity data on islands

# Pacific Geospatial and Surveying Council

## PGSC Core Members

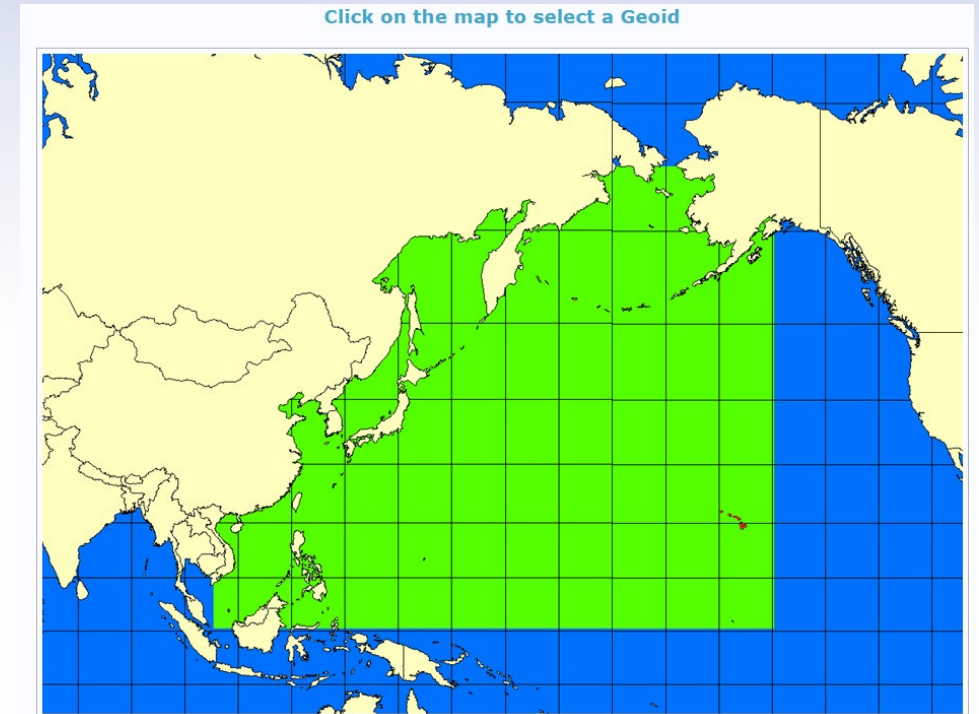
- Core members are national *geospatial*, *hydrographic* and *surveying* authorities of Pacific Island countries and territories
- Maintain GNSS receivers in region
- Ties: GA, LINZ, NGS, UN-GGIM, FIG, IAG
- Possibilities of having local gravity data, tide information, leveling
- Vision: *Sustainable development in the Pacific enabled by world-class geospatial information and surveying services.*



Cook Islands, Federated States of Micronesia, Fiji, Kiribati, Nauru, Niue, Republic of the Marshall Islands, Papua New Guinea, Palau, Samoa, Solomon Islands, Tonga, Tuvalu, Vanuatu

# Summary

- VDatum requires considerable data/care
- GGRF requires all Nations to adopt ITRS
- WGS-84 is not sufficient for positioning
- For the West Pacific
  - ITRF2014 is available
  - NCN access limited but improving
  - NAPGD2022 will not cover region
  - EGM's available but insufficient by themselves
  - Require regional geoid (R-C-R)
  - Altimetric anomalies available
  - Still lacking terrestrial gravity, TSS, tide gauge data
- PGSC may be able to help with data gaps
  - These are the Nations in the project area



## QUESTIONS?

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