Geodetic control using circulation modeling

HSRP Update

Shachak Pe'eri and Stephen White
(NOAA/NOS/NGS)

Safe, Efficient Navigation

Schematic illustration of S-1XX and S-4XX layers (IHO.int)

It takes a village to raise a child

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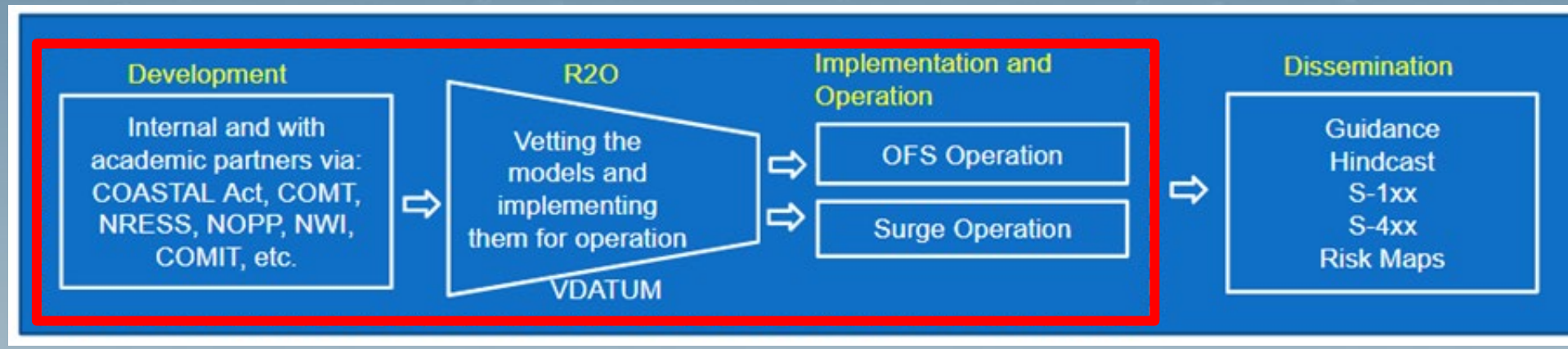

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2024 - The year of Geodetic Research

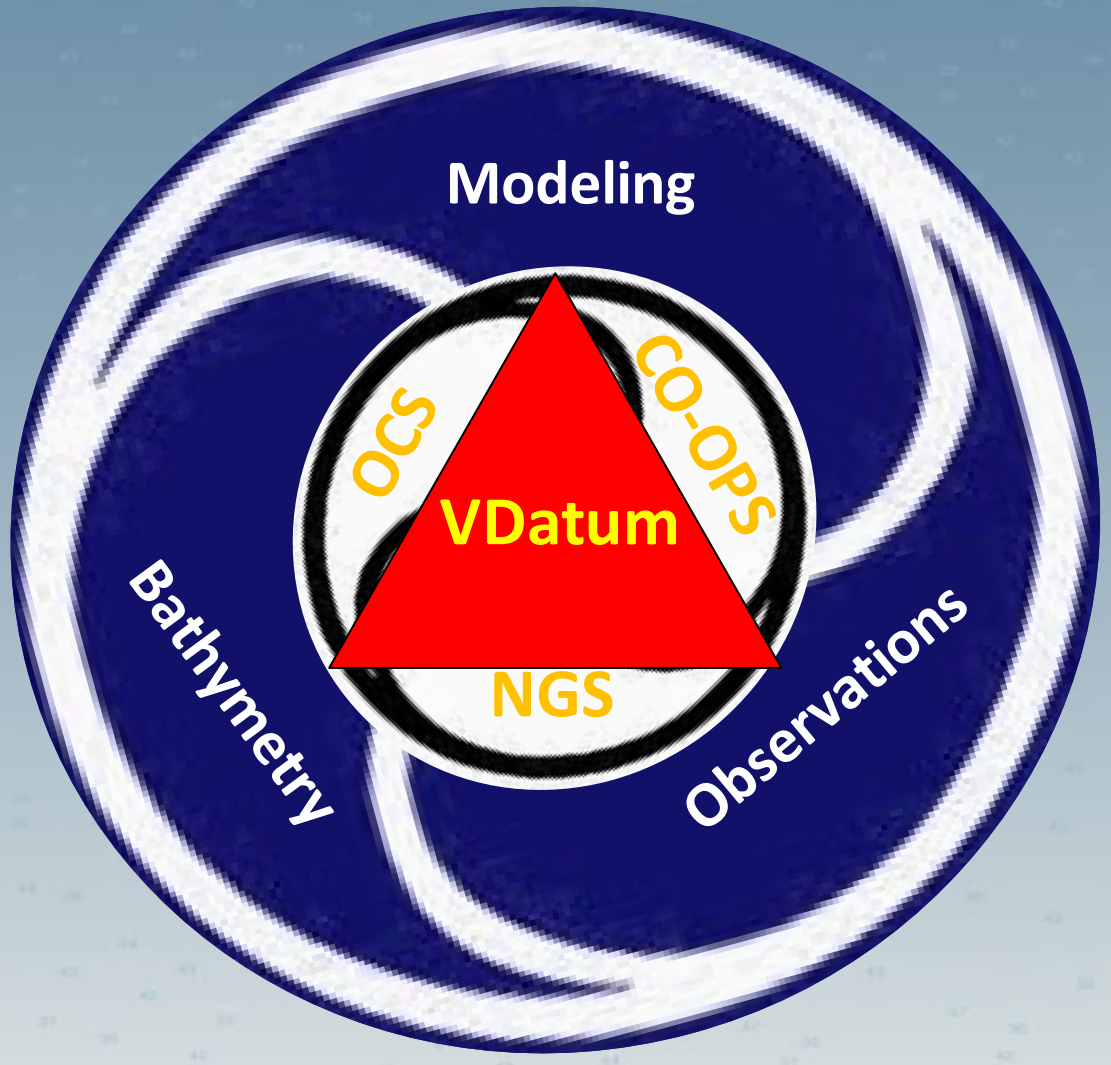
NSRS Modernization
- Plate-fixed terrestrial reference systems
- Geopotential model

Marine and riverine geodesy
- GNSS co-location
- GNSS-R
- Datum Unification

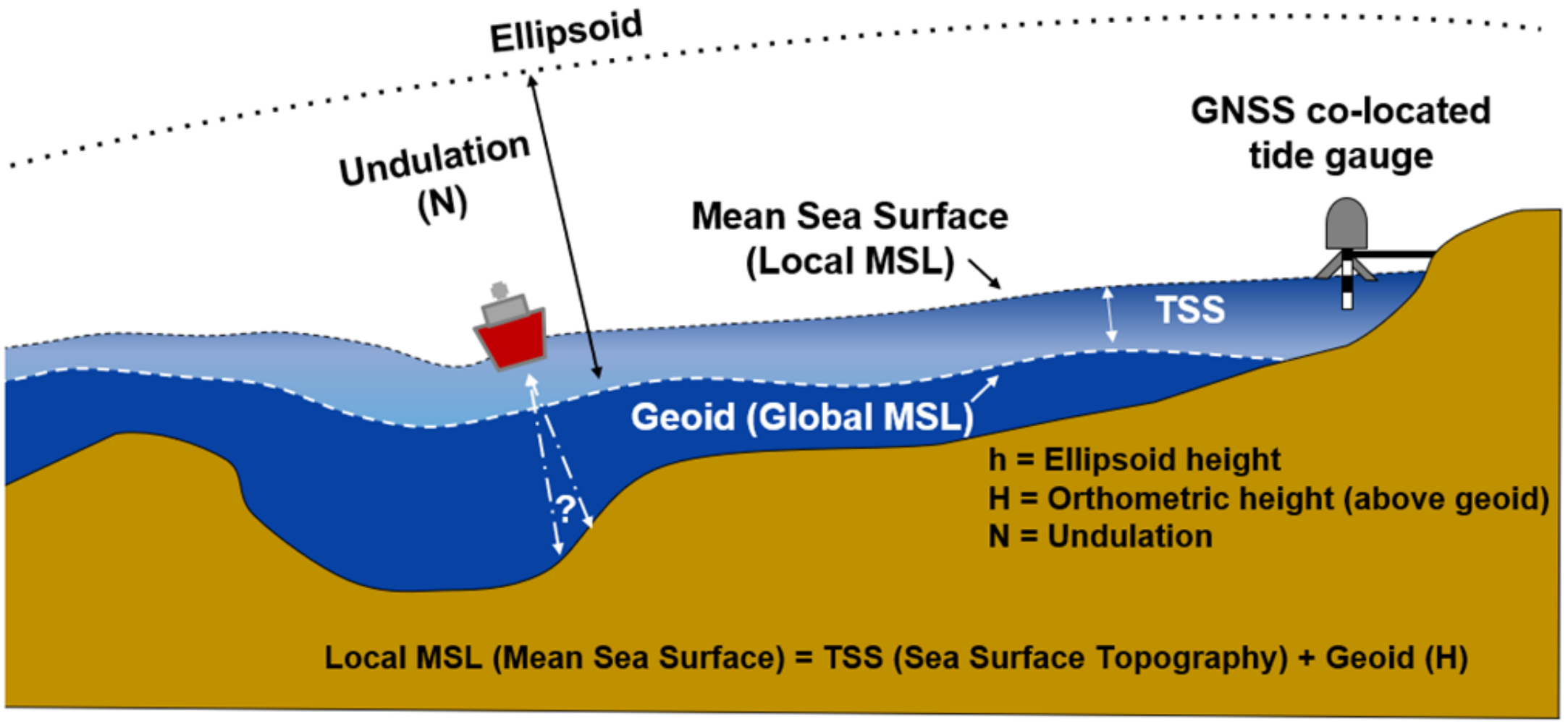
Space Geodesy
- Satellite Altimetry
- GNSS ION/MET

National deformation model
- Vertical Land Motion modeling

NOAA Service Flag



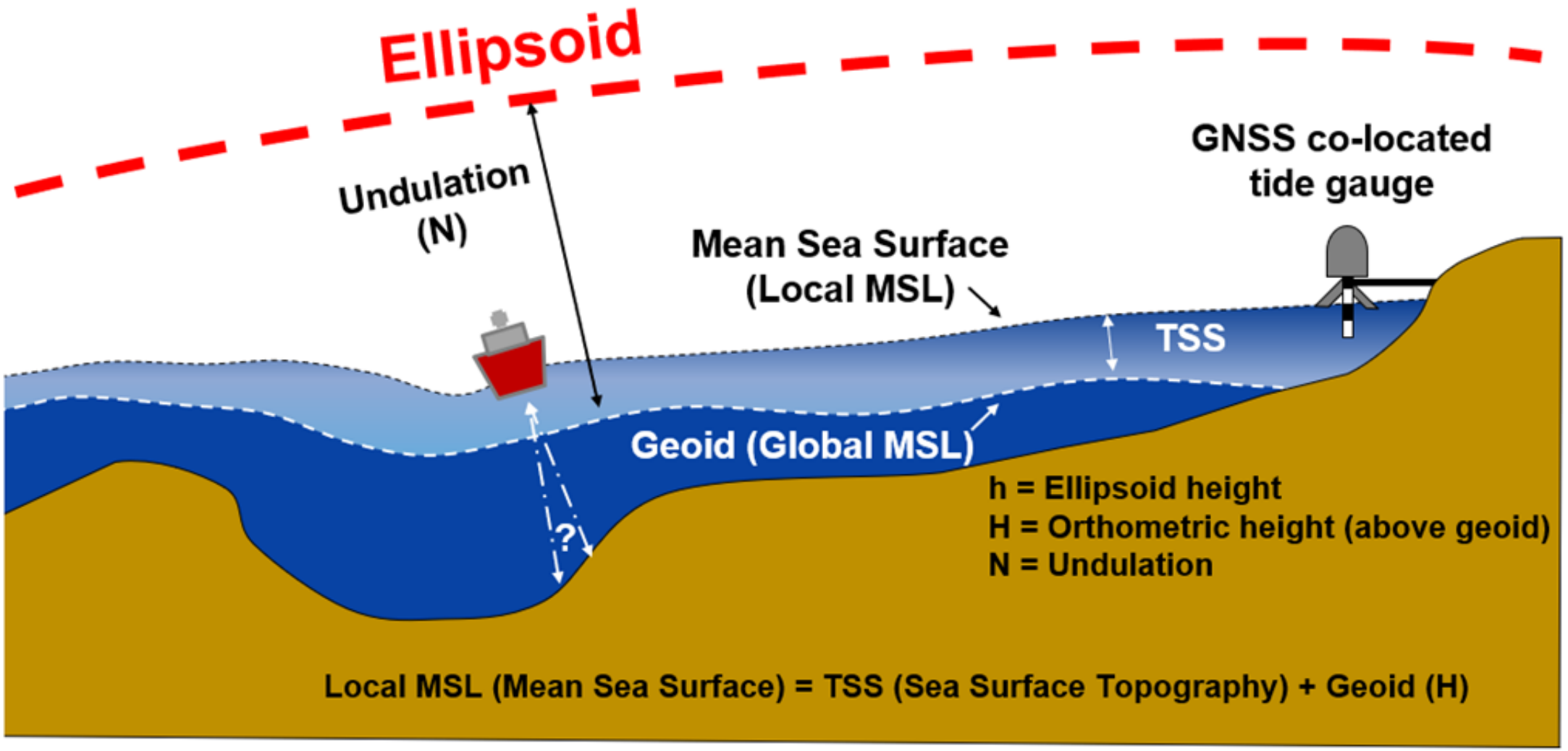
Height relationships



Important note!

All elevation data should be processed to the same horizontal and vertical reference system

Height relationships



NSRS Modernization - Geometric

End users will have tools and service to calculate three-dimensional positioning from 4 plate-fixed reference frames that cover the U.S. and its most populated territories (i.e., the ability to determine latitude, longitude and height coordinates relative to an ellipsoid model of Earth)

The new reference system will be linked to a global dynamic reference system (i.e., ITRF).

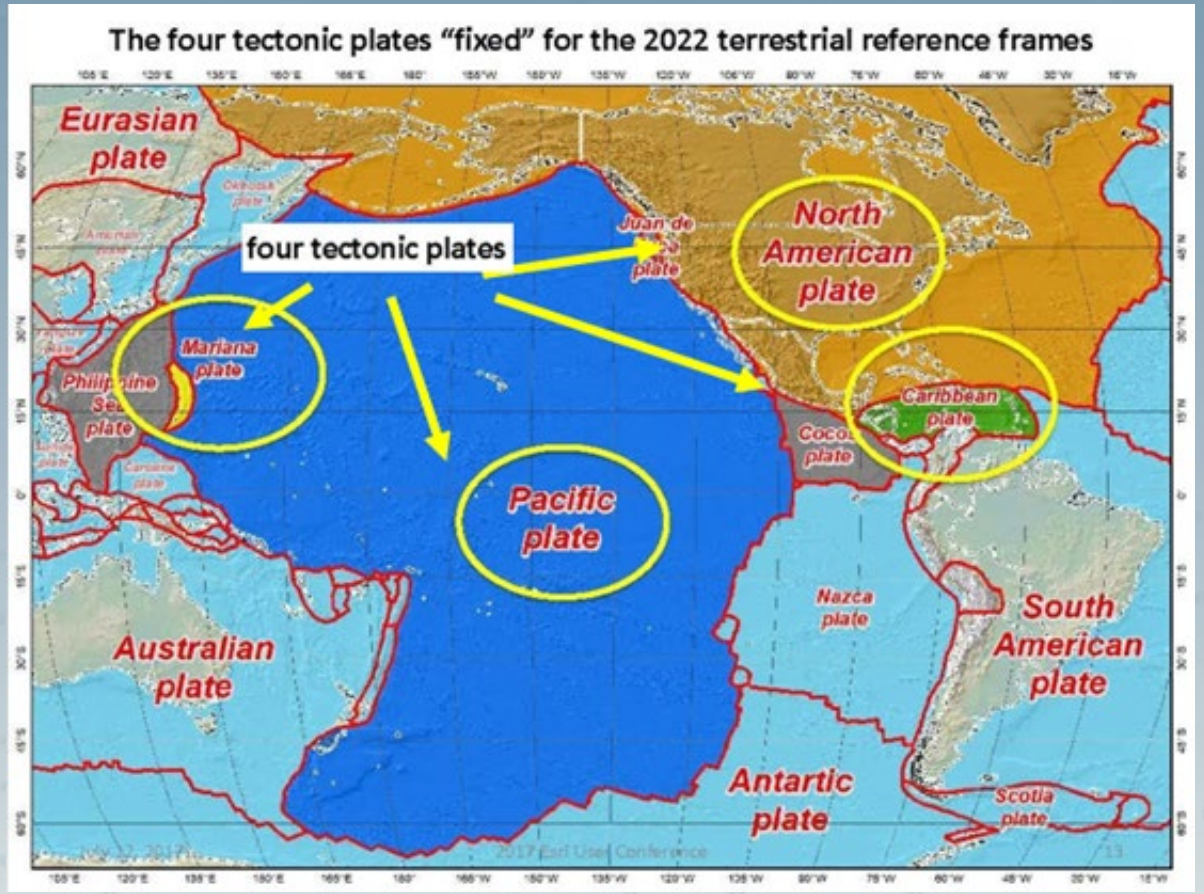
The old

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

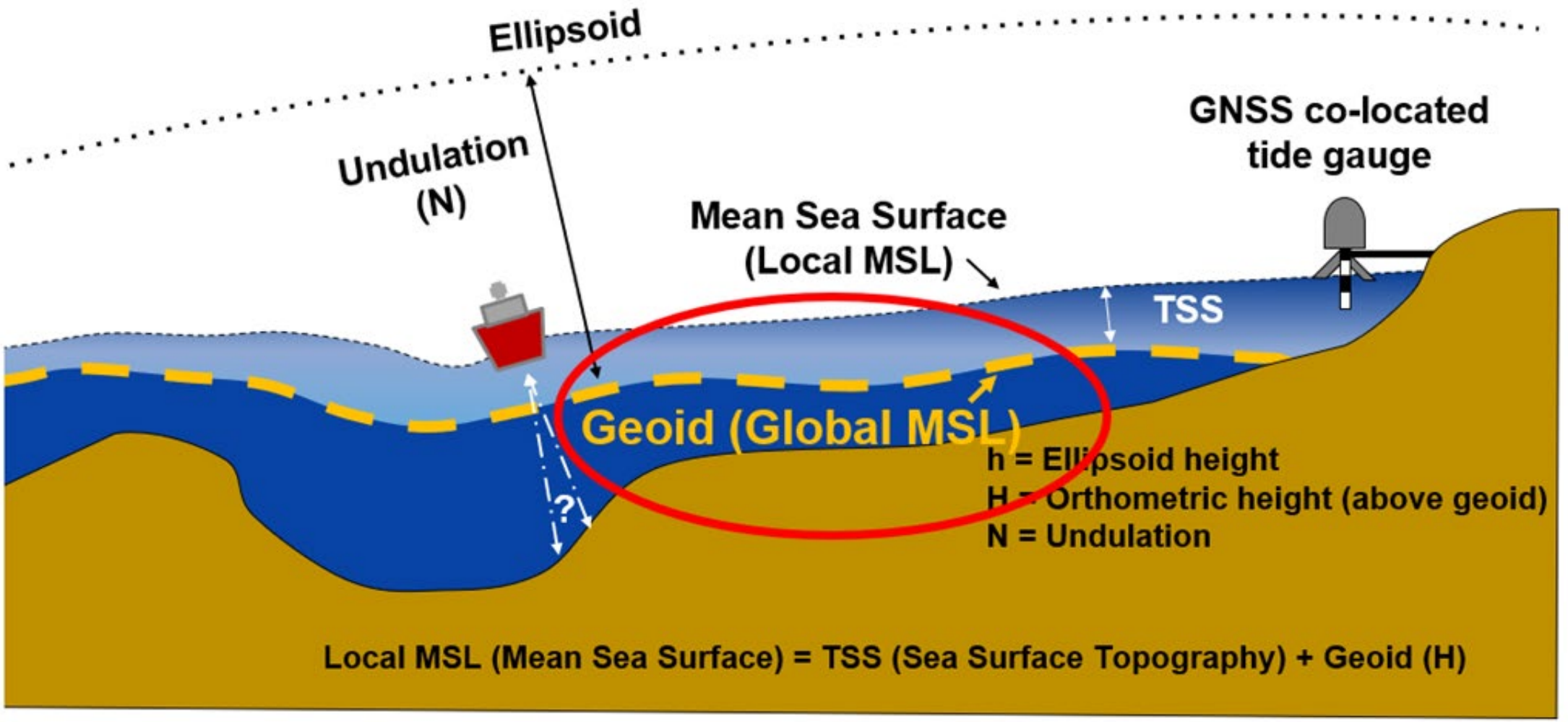
➡

The new

- NATRF
- CATRF
- PATRF
- MATRF

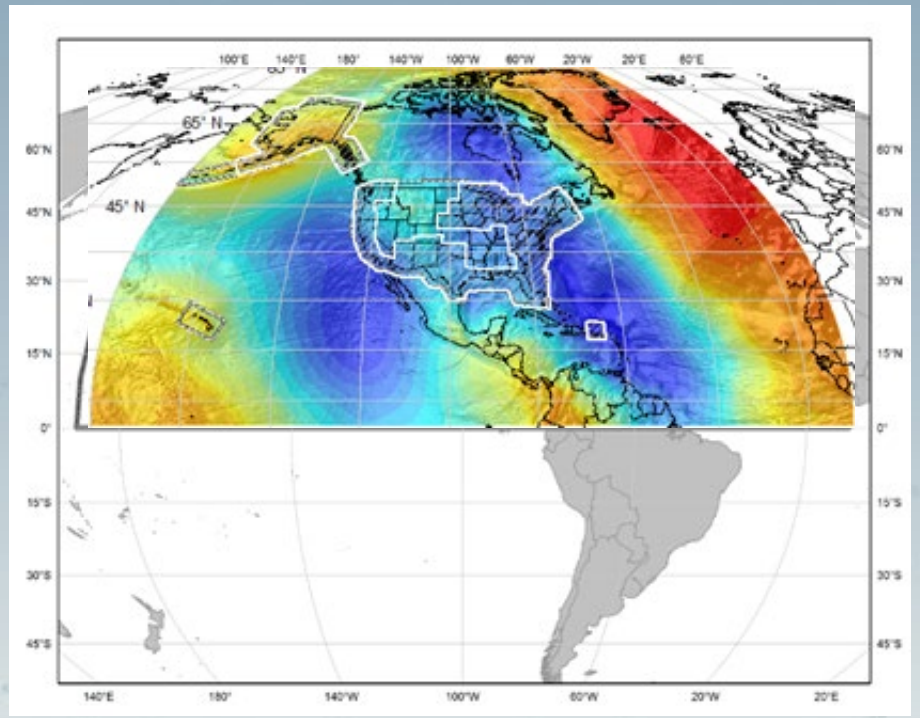


Height relationships

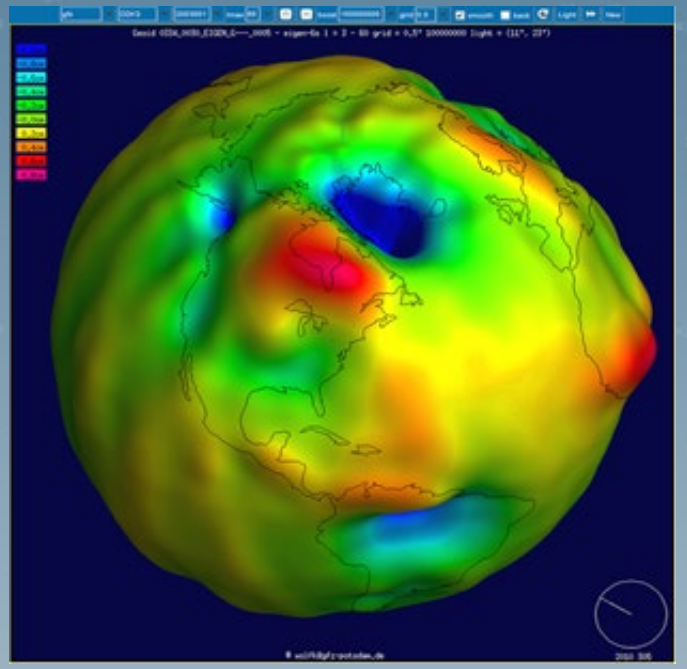


North American – Pacific Geopotential Datum of 2022 (NAPGD2022)

A new geopotential datum using a vertical reference system calculated from gravity observations. **The geopotential surface does not take into account oceanographic processes, such as tides and currents**.



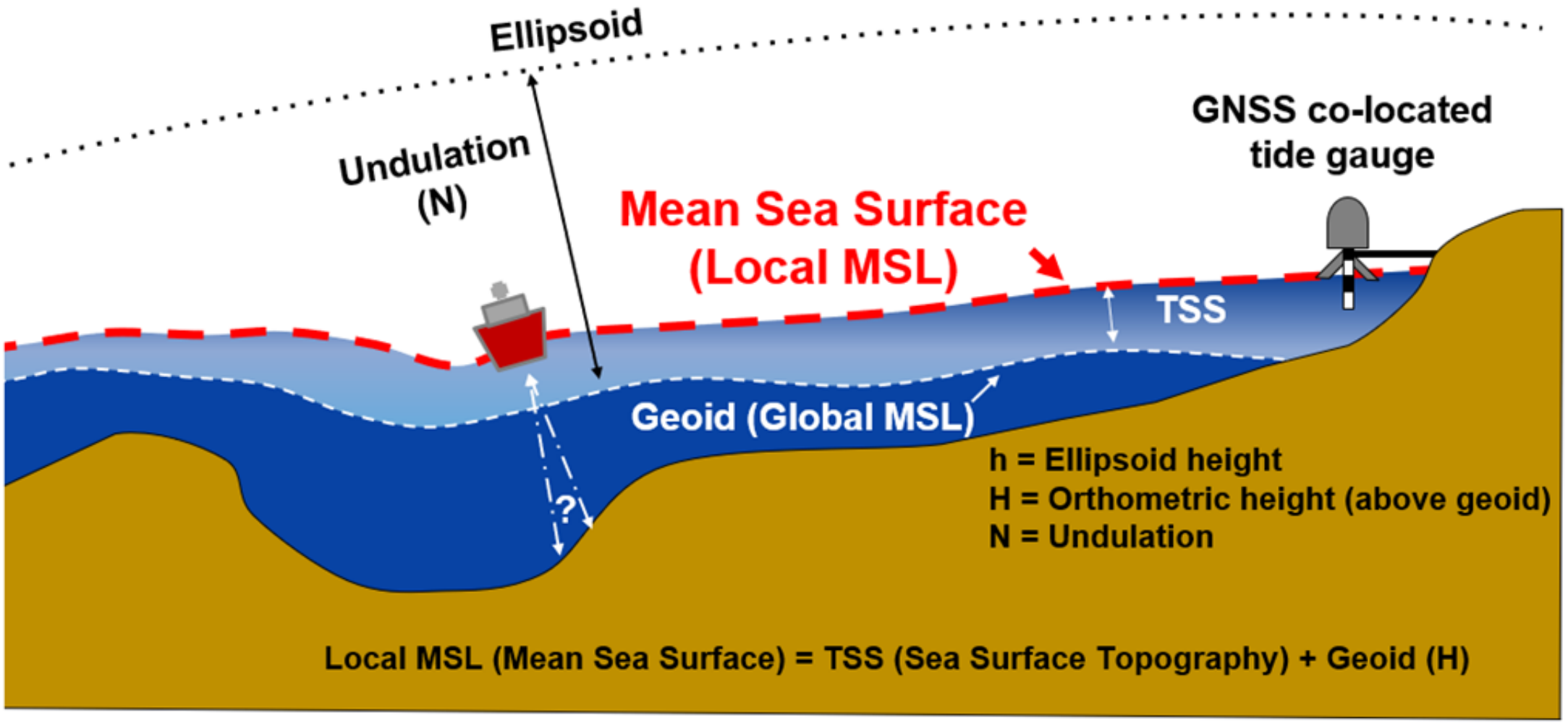
"North American region"
- ¼ of the Earth



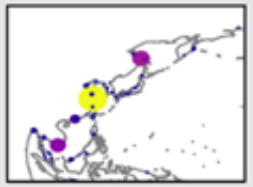
GGM derived from EIGEN-6c2 model Provided on ICGEM website

This geopotential is of particular importance at the coast where it is necessary to ensure that **geophysical and oceanographic observations**, **and resulting coastal models**, can be consistently aligned with terrestrial applications.

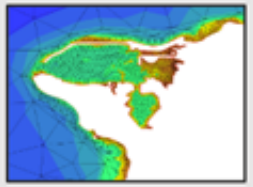
Height relationships



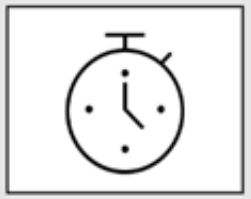
Regional coverage at high resolution (ADCIRC/SCHISM models)



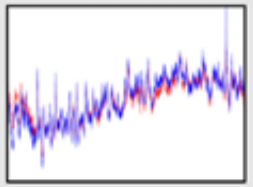
Implementation



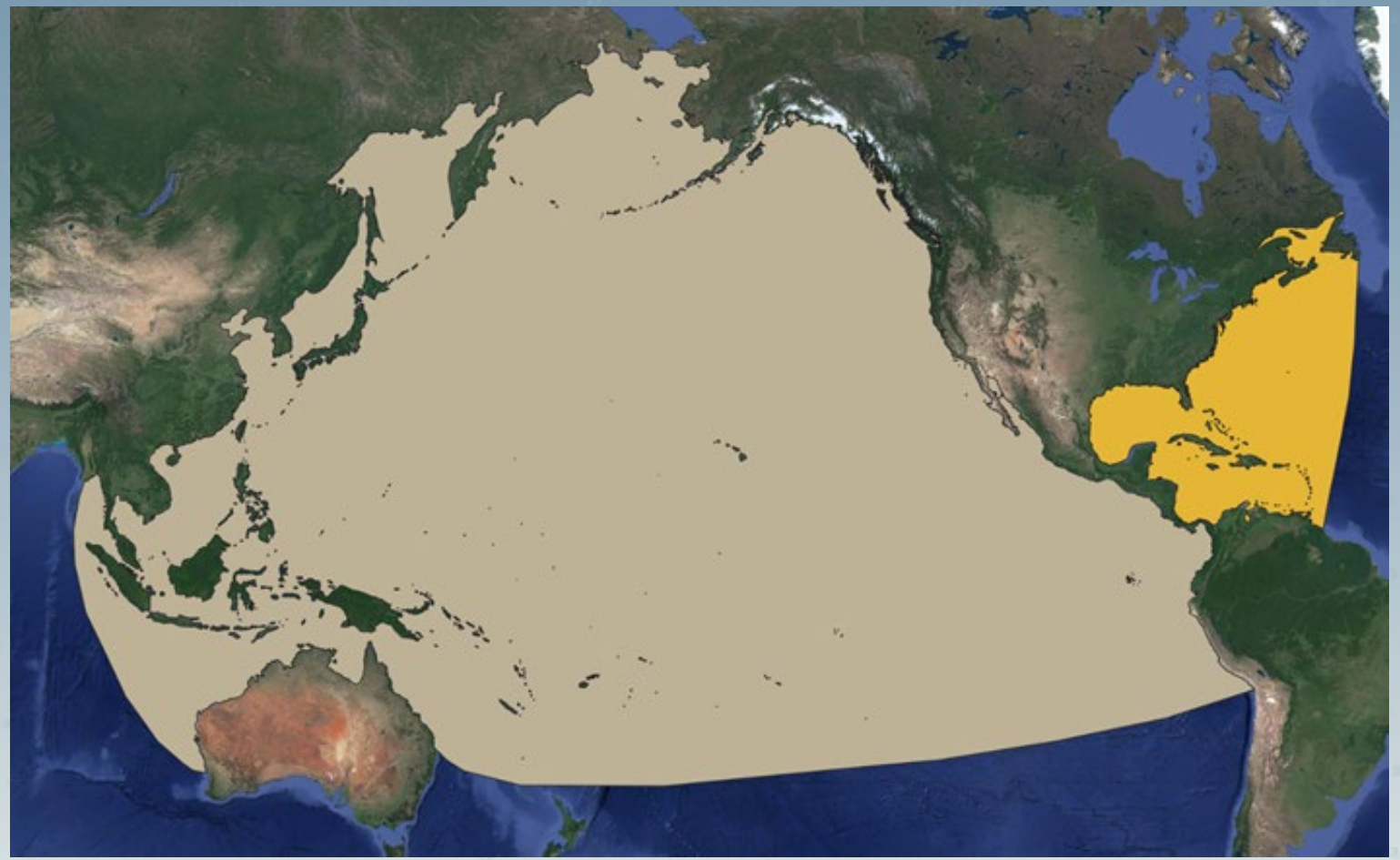
High resolution



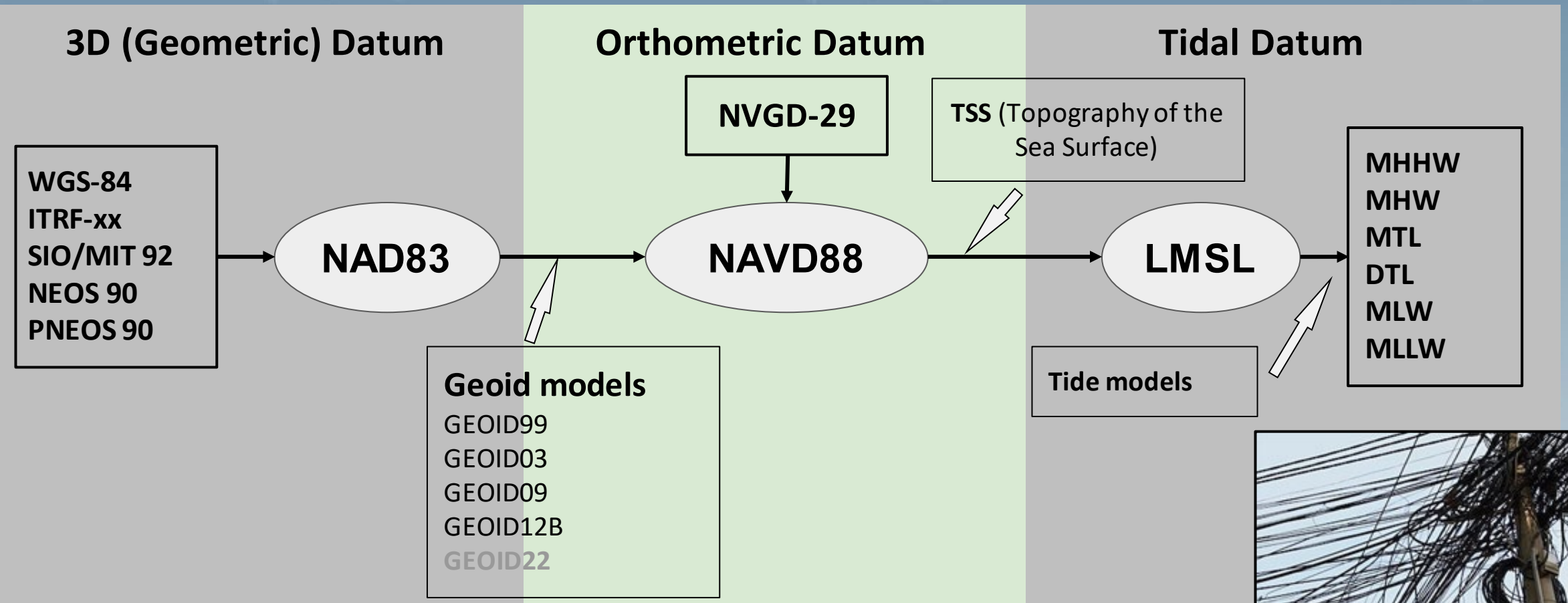
Computational efficiency



Water levels



Welcome to the multiverse of reference systems: VDatum!



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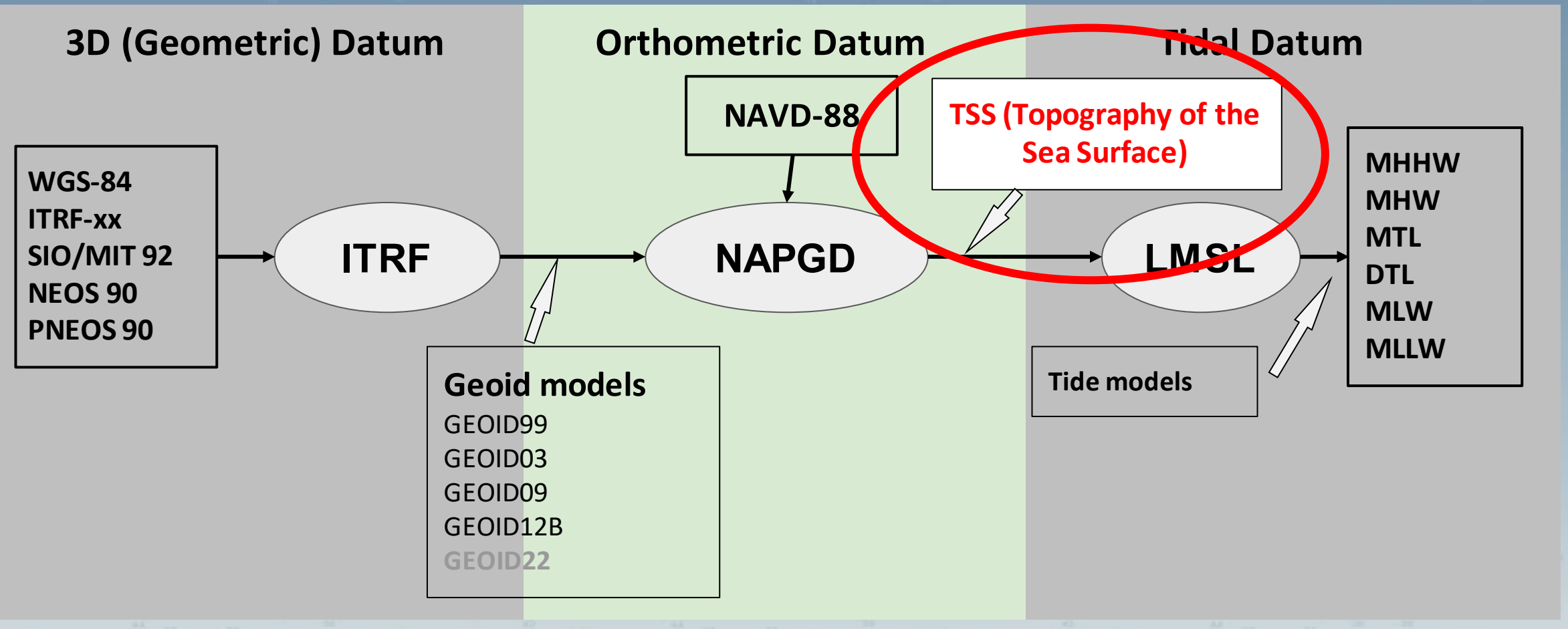
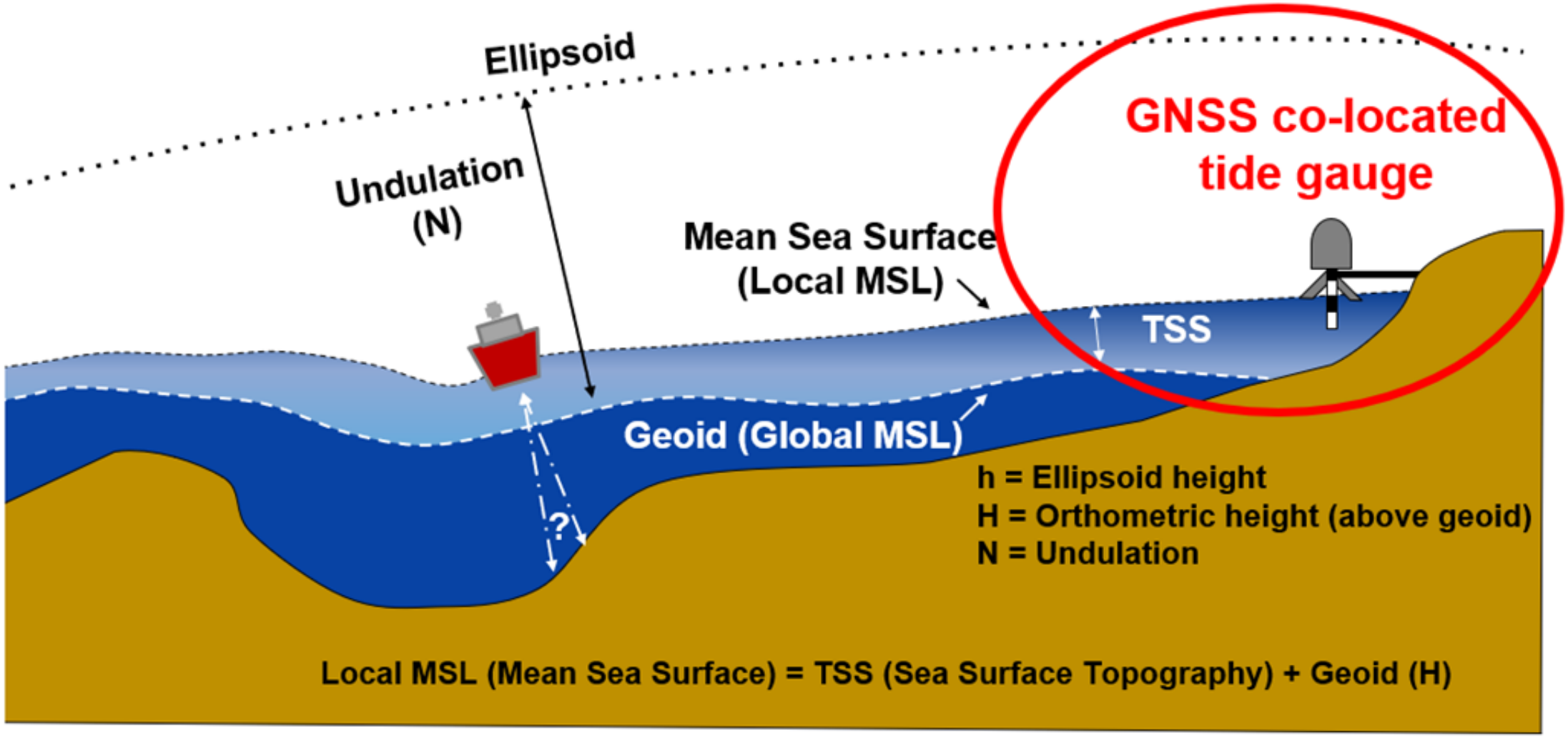


Height relationships

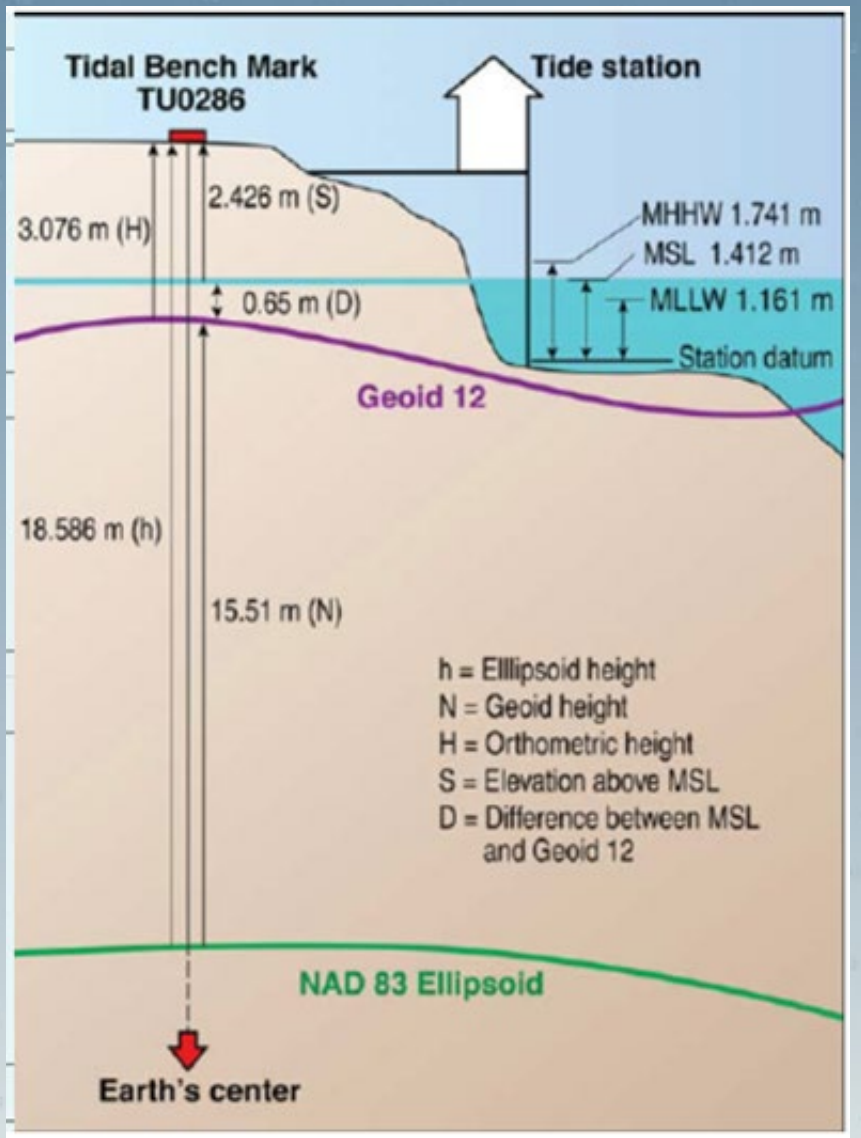


Referencing the circulation models to Tidal Datum

Will additional observations improve the TSS products and the VDatum results overall?

Using a co-located GNSS water level observation it is possible to reference the water level information directly to the ellipsoid with knowing the deformation model (e.g., tidal loading) of the benchmark. As such, three key component are needed to evaluate the total propagated uncertainty (TPU) of the observation:

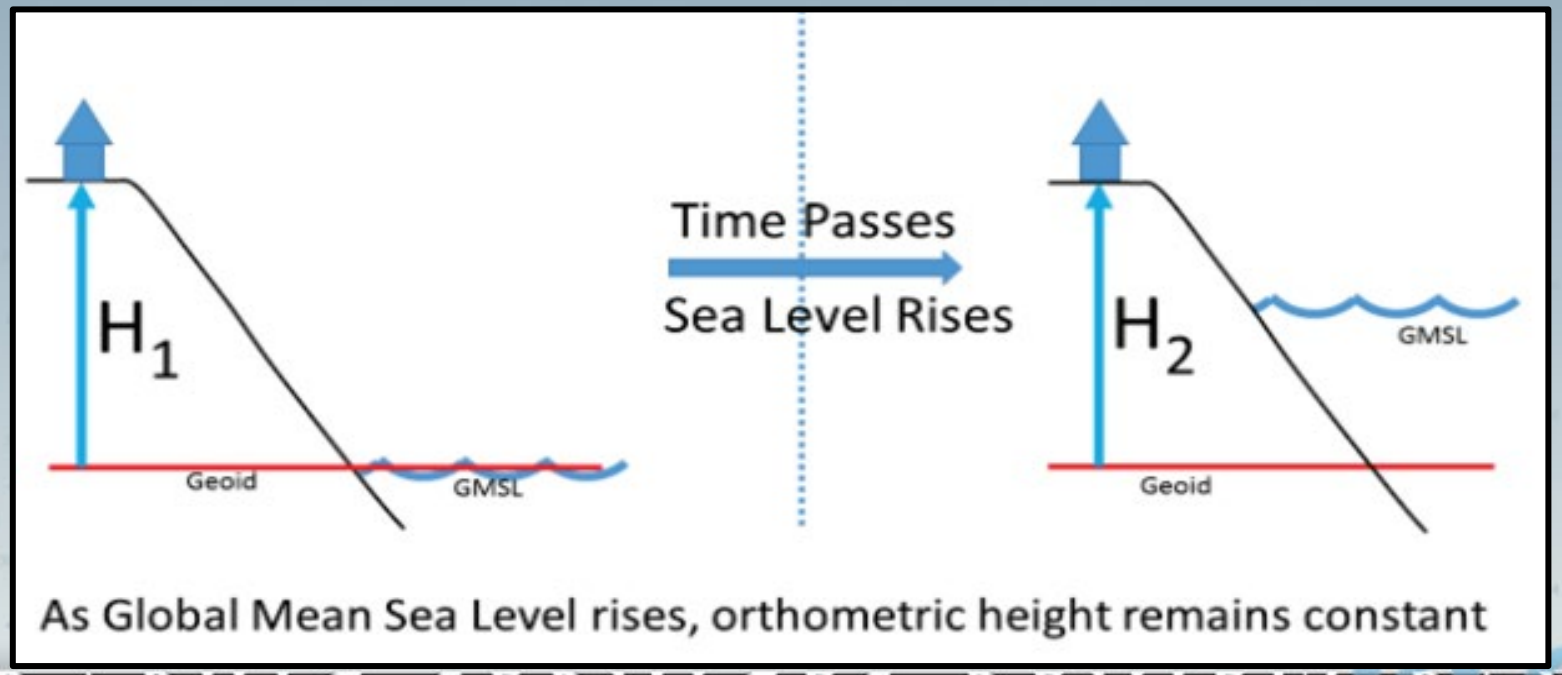
- **Accuracy of the sensor**
- **Geodetic control**
- **Length of observation**



Referencing the circulation models to Tidal Datum

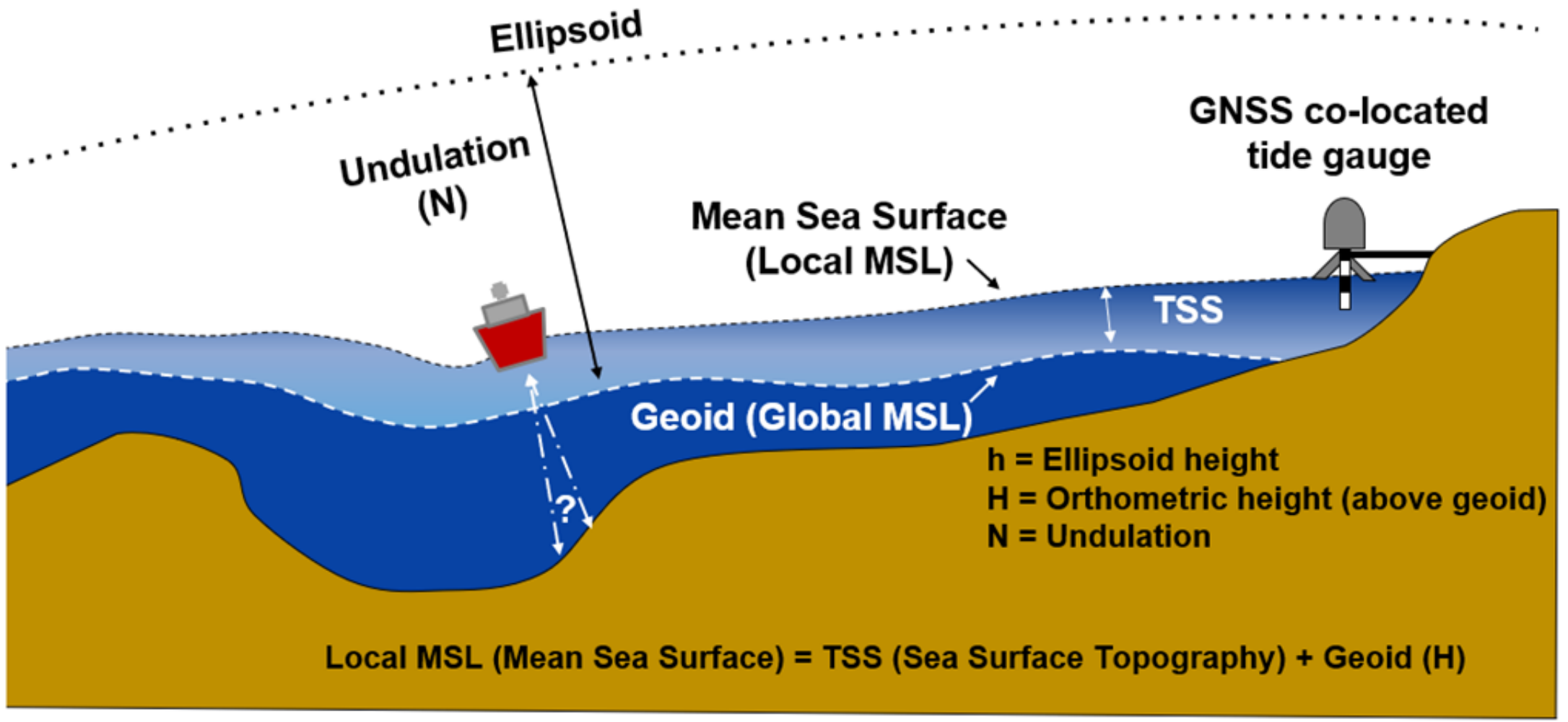
NGS determined that the best value for the shape of the Earth using comparisons at tide gauges around North America. This decision will tie more closely to the mission of the **National Ocean Service** inside of NOAA and provide enhancements to products, such as **VDatum** and the **Sea Level Rise viewer**.

It will also better serve the American public by making a more explicit link between the ocean surface and places on land in the form of relative sea level.

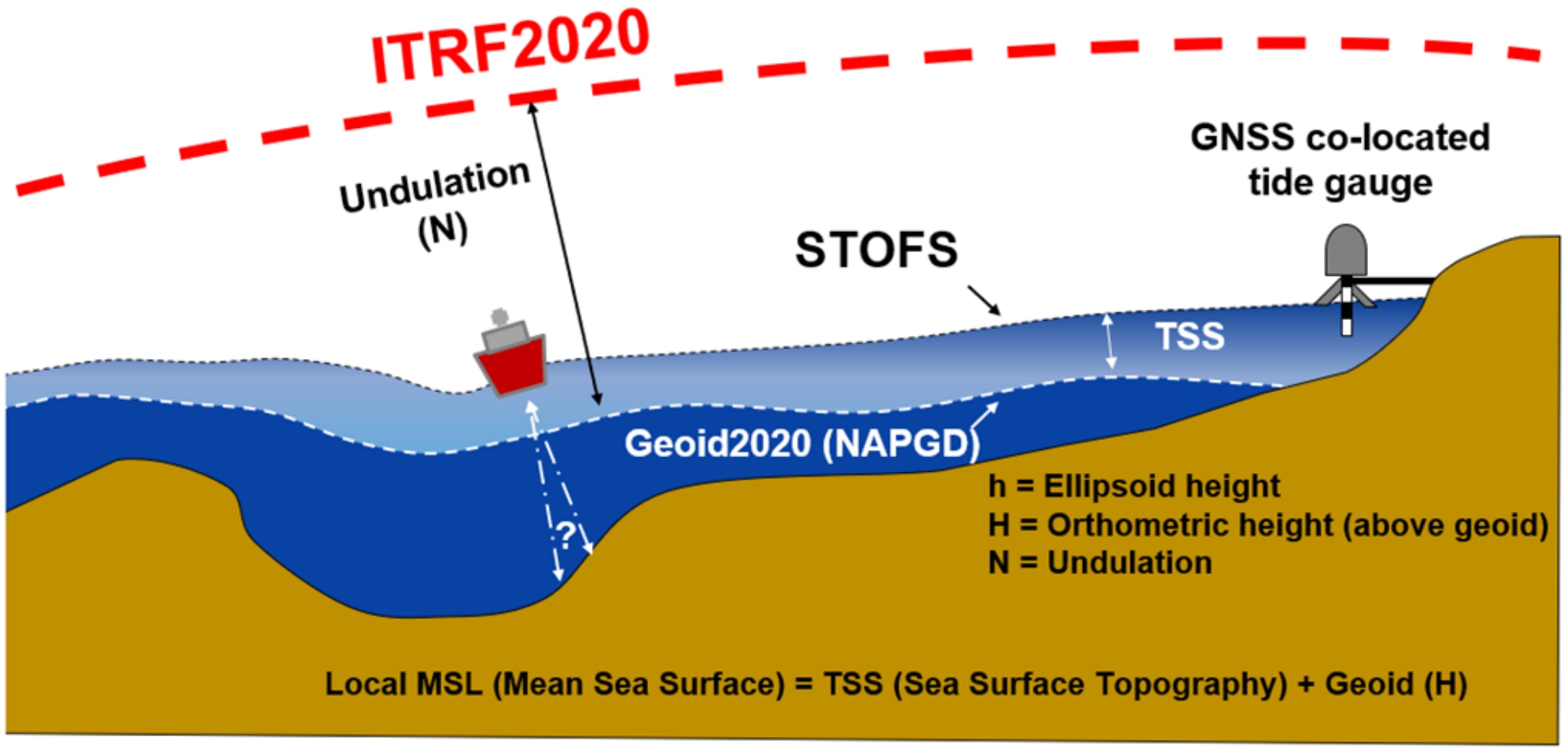


As Global Mean Sea Level rises, orthometric height remains constant

Height relationships



Height relationships

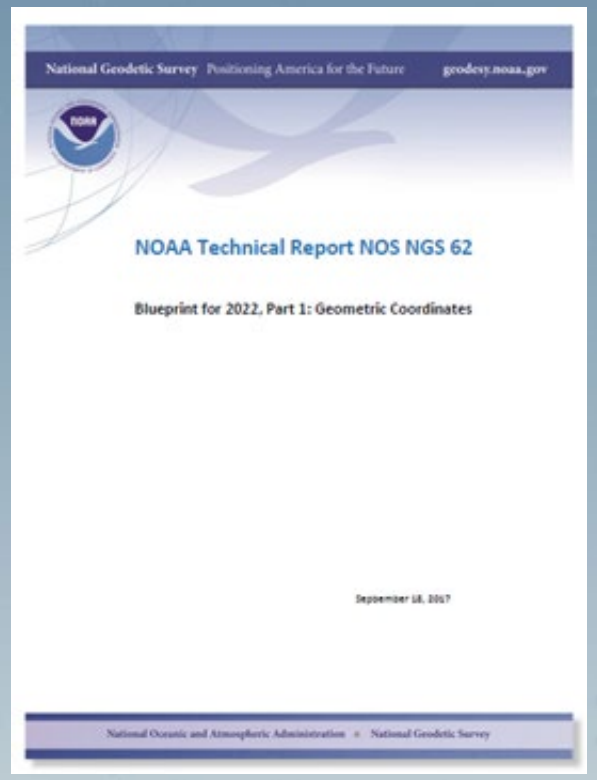


VDatum 5.0

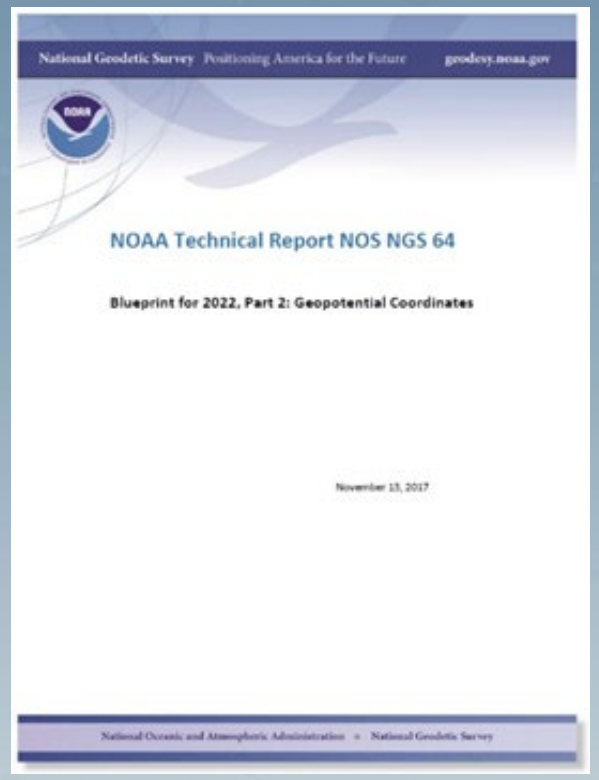
- More coverage using the global circulation models
- Incorporating the NSRS.
- Interoperability with older versions
- Referencing all sources to the ellipsoid height

Thank you

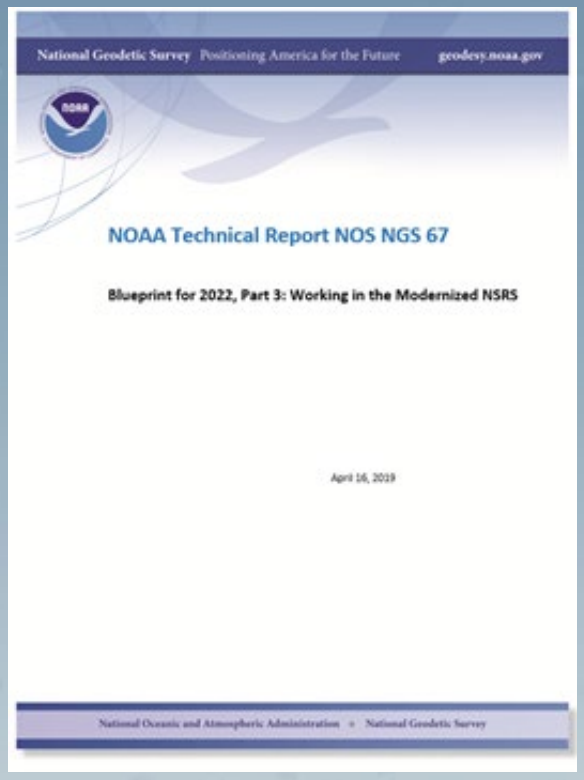
The “blueprint” documents: Your best source for information



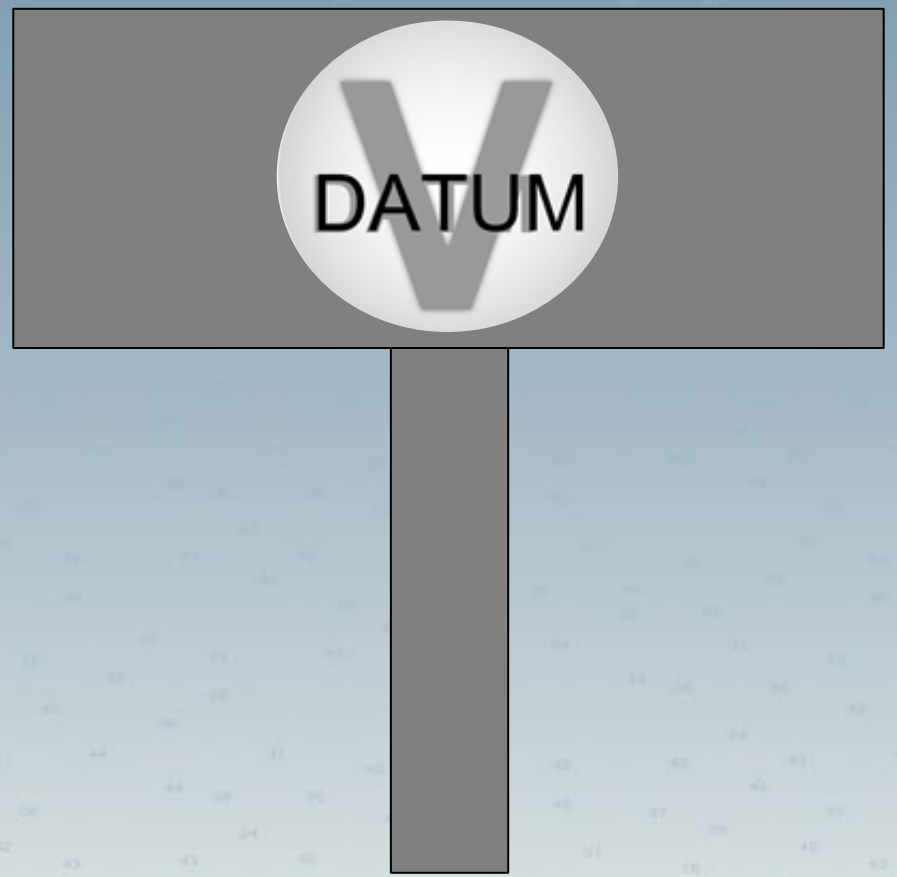
Geometric:
Sep 2017
NOAA TR NOS NGS 62
32 pages



Geopotential:
Nov 2017
NOAA TR NOS NGS 64
41 pages



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


V
DATUM