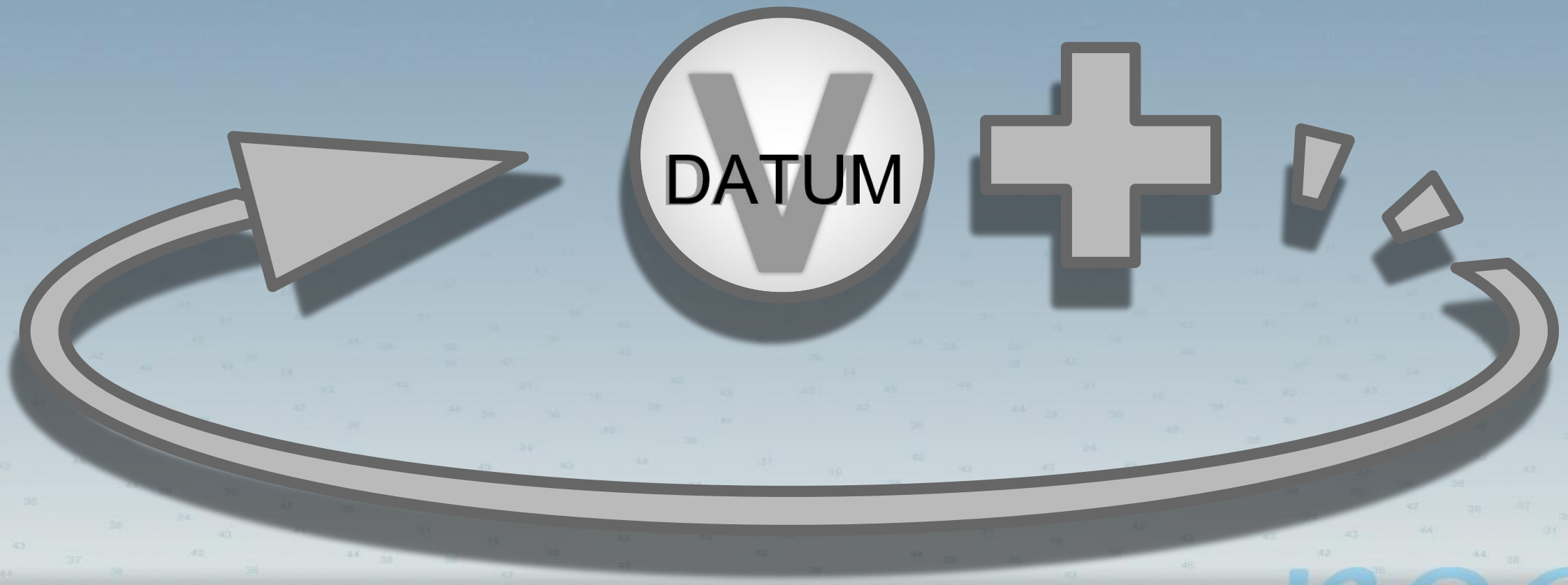
VDatum long-term research (VDatum+)

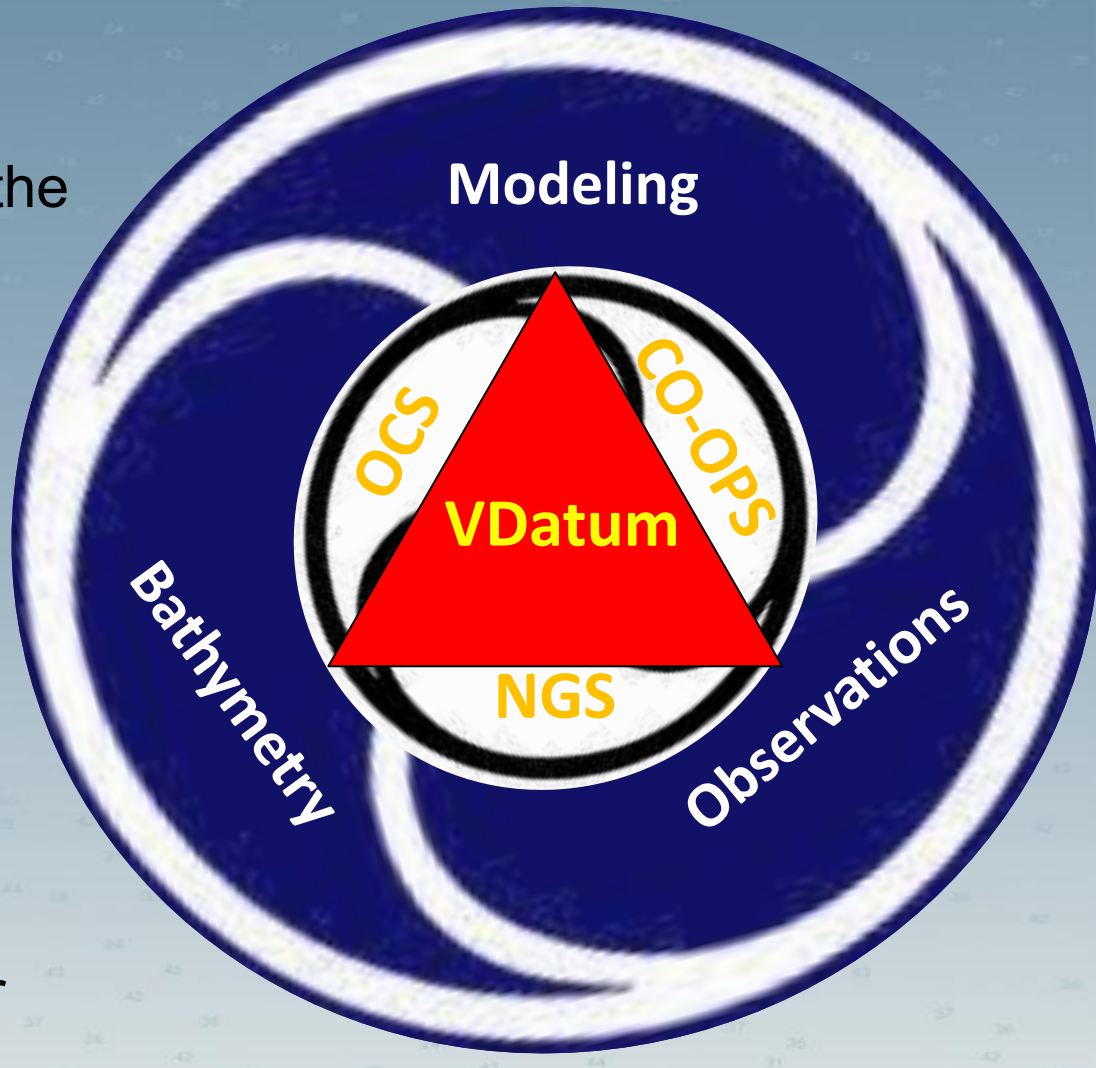
Shachak Pe'eri (NOAA/NOS/NGS)



Gap Analysis

Desired goal

- Providing accurate vertical transformations for all of the US and its territories.
- Incorporate the new modernized NSRS layers
- The service and downloadable tool should work efficiently to serve the all the end user communities.



Current Status

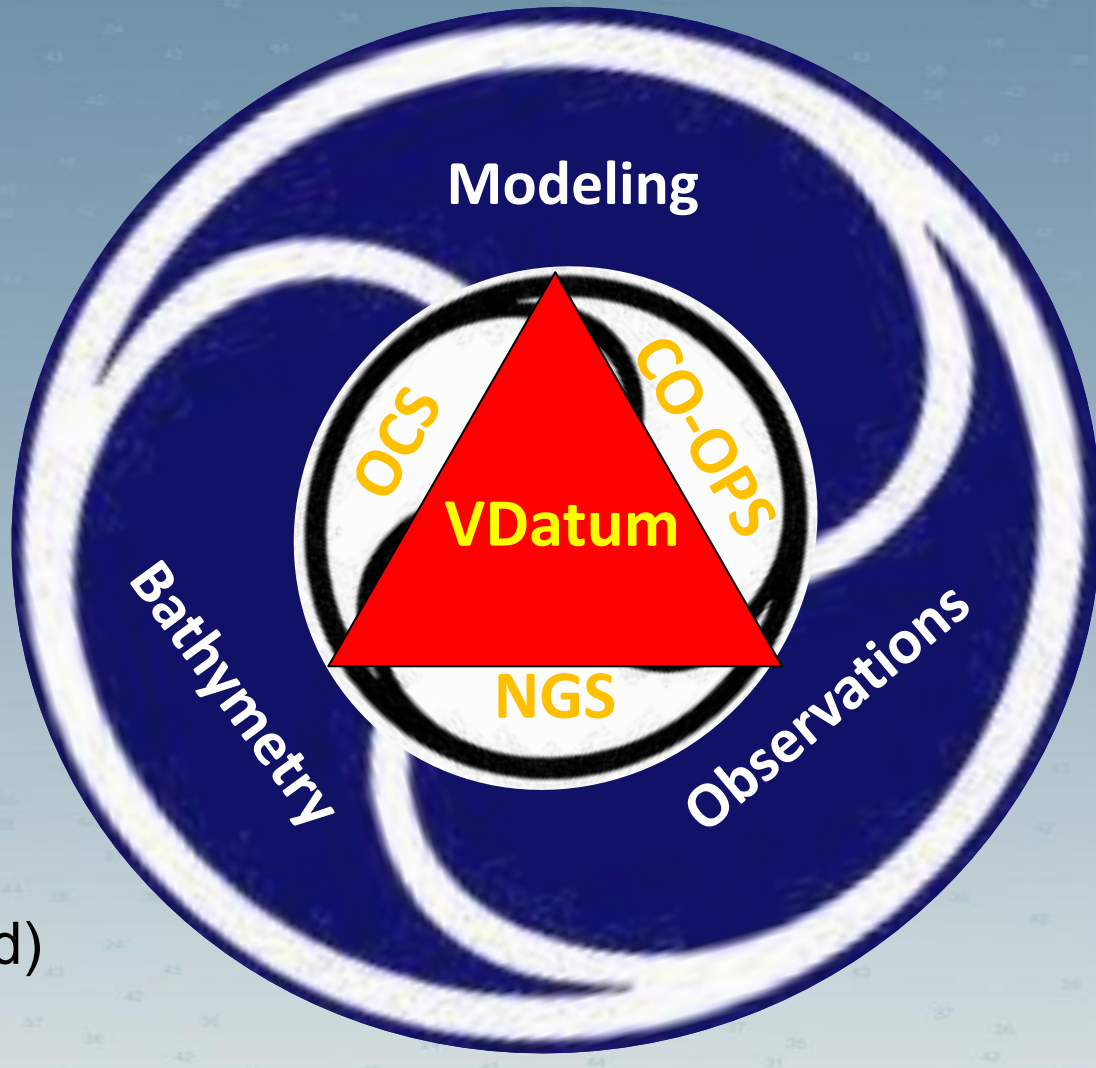
- Limited coverage - there is a 5-year implementation plan.
- The grids and executables require a large computer space to download.

FY24 was a good year for Geodesy, Hydrography and Oceanography

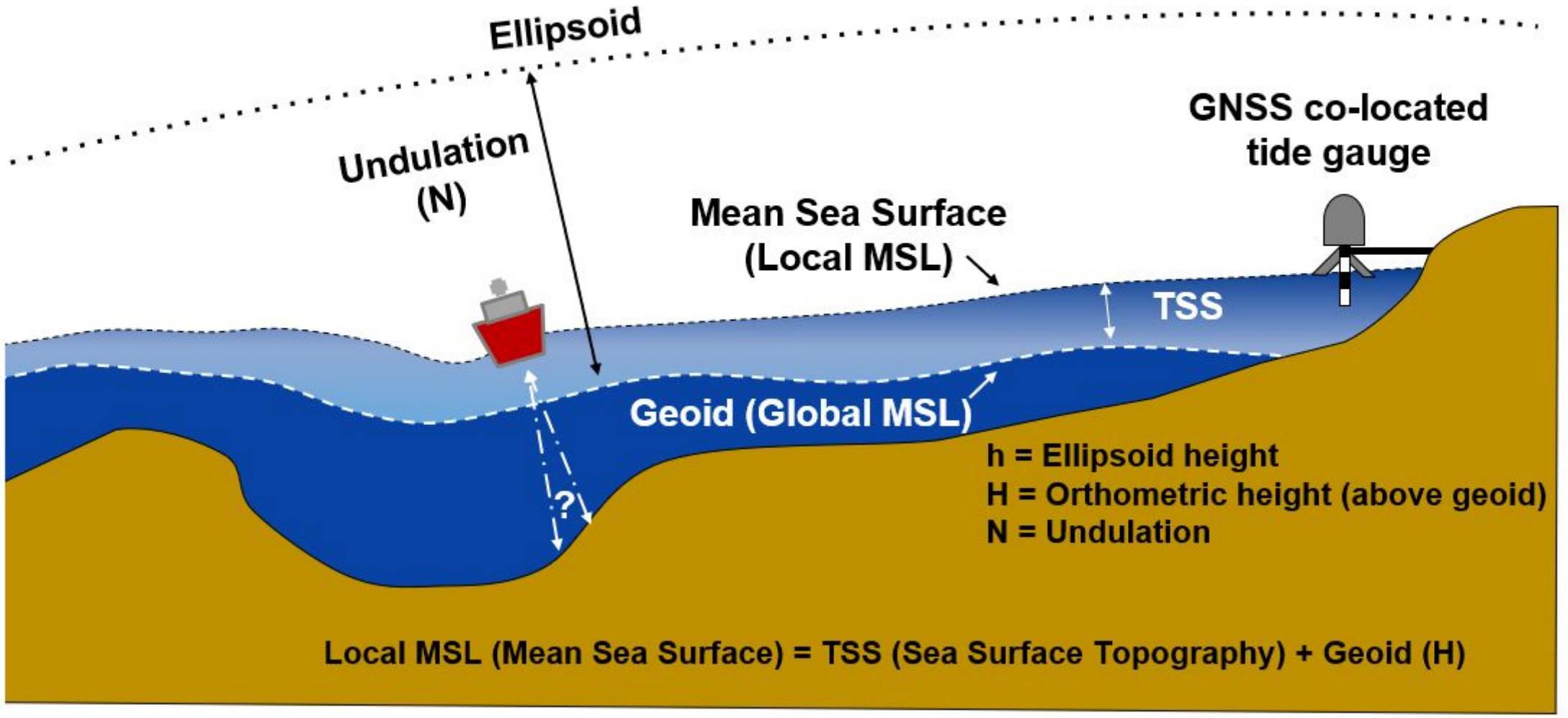
Geospatial modeling
- Release of GEOID2022
- publication of the Euler Pole Parameters
- IFDM work

Circulation modeling
- Global STOFS-2D model (coarse-scale resolution)
- Regional models (high-scale ground resolution)

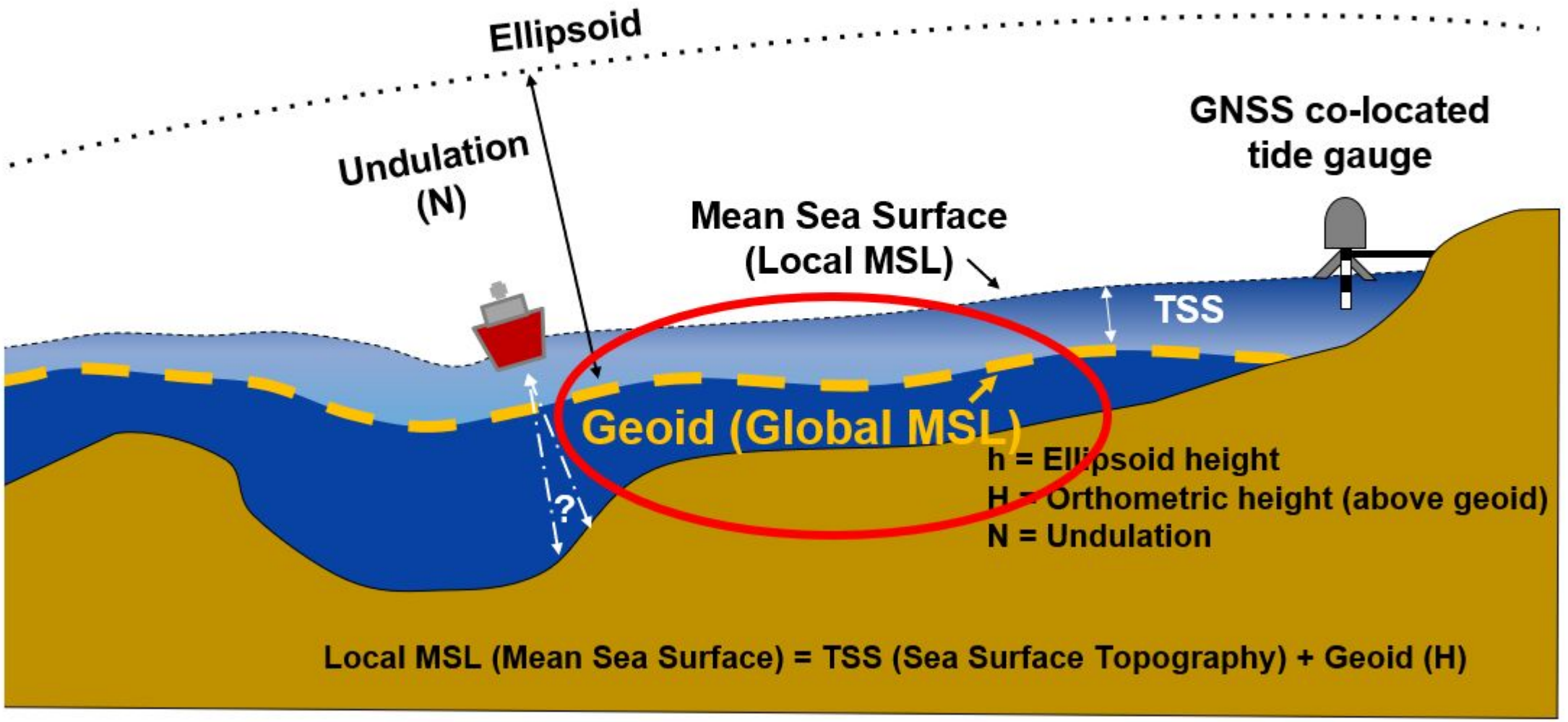
Complete list
- NOAA's Water Level Obs.
- USACE (New Orleans, New York and New England)
- USGS (Maine, Connecticut, and Florida)
- IOC (Pacific Ocean)



Height relationships



Height relationships



A new geospatial infrastructure

North American – Pacific Geopotential Datum of 2022 (NAPGD2022)

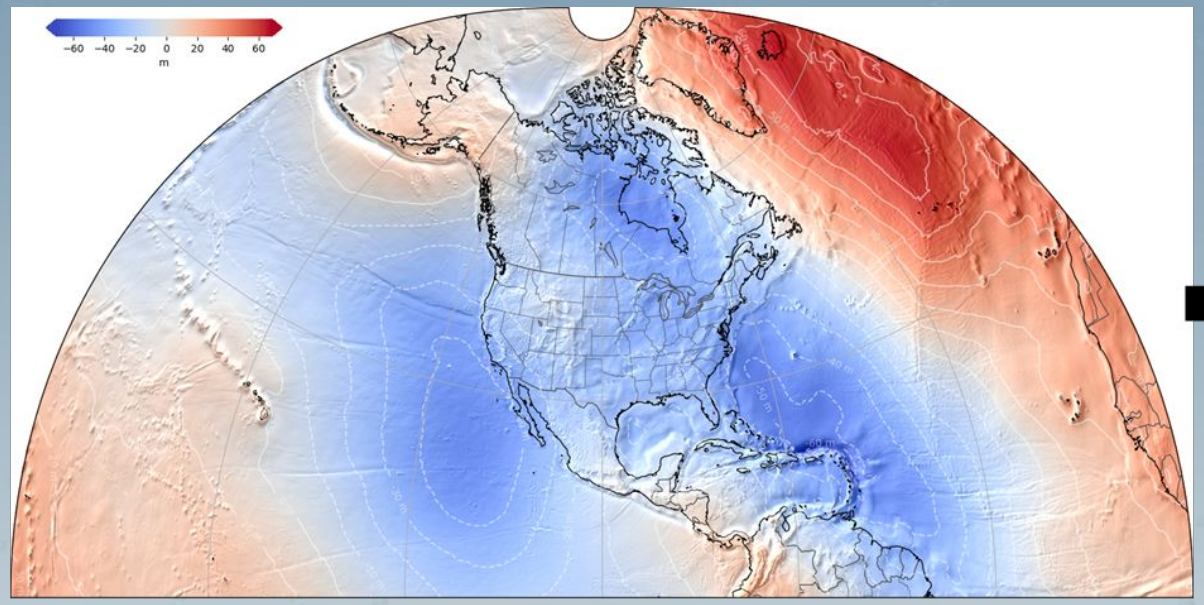
Overview

- 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.
- Enable better alignment of NOAA data to support a Climate Ready Nation
- Provide more Equitable Access across ¼ of the Earth

Image modified from Disney's Lion King

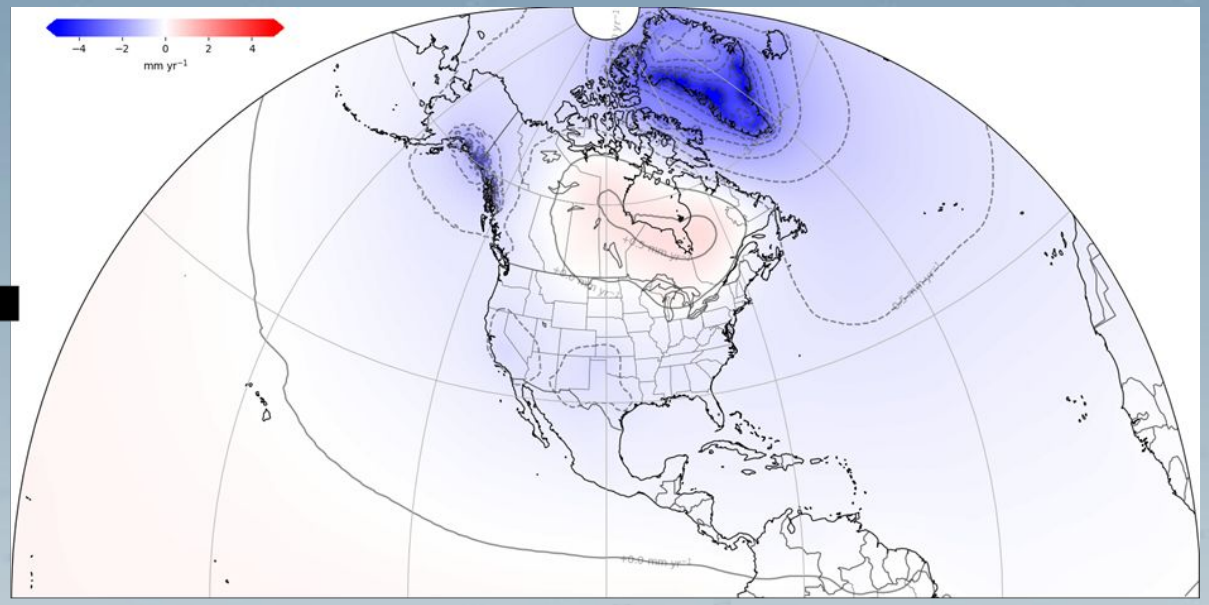
GEOID2022 Update

(Final product is expected to be available by mid-October)



GEOID2022: Static Component

+

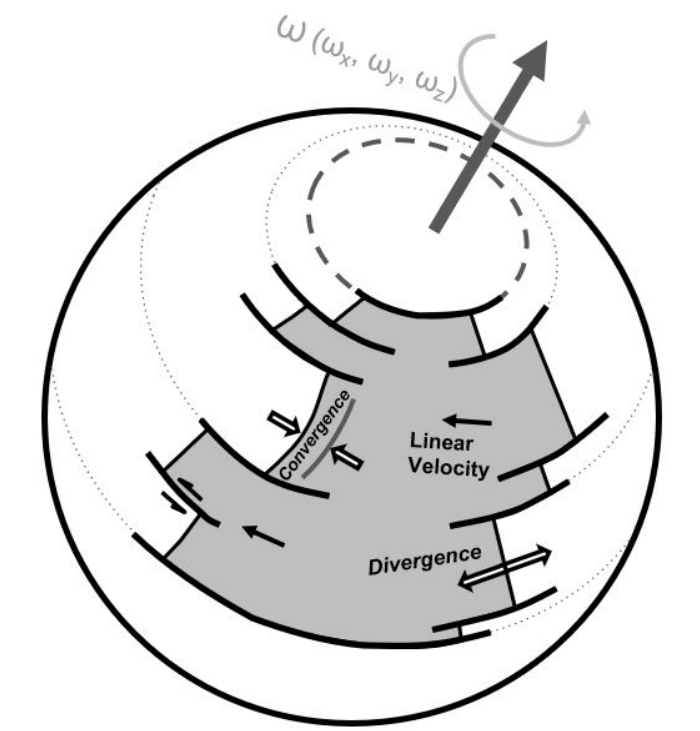


Dynamic Component

¼ Earth's Surface

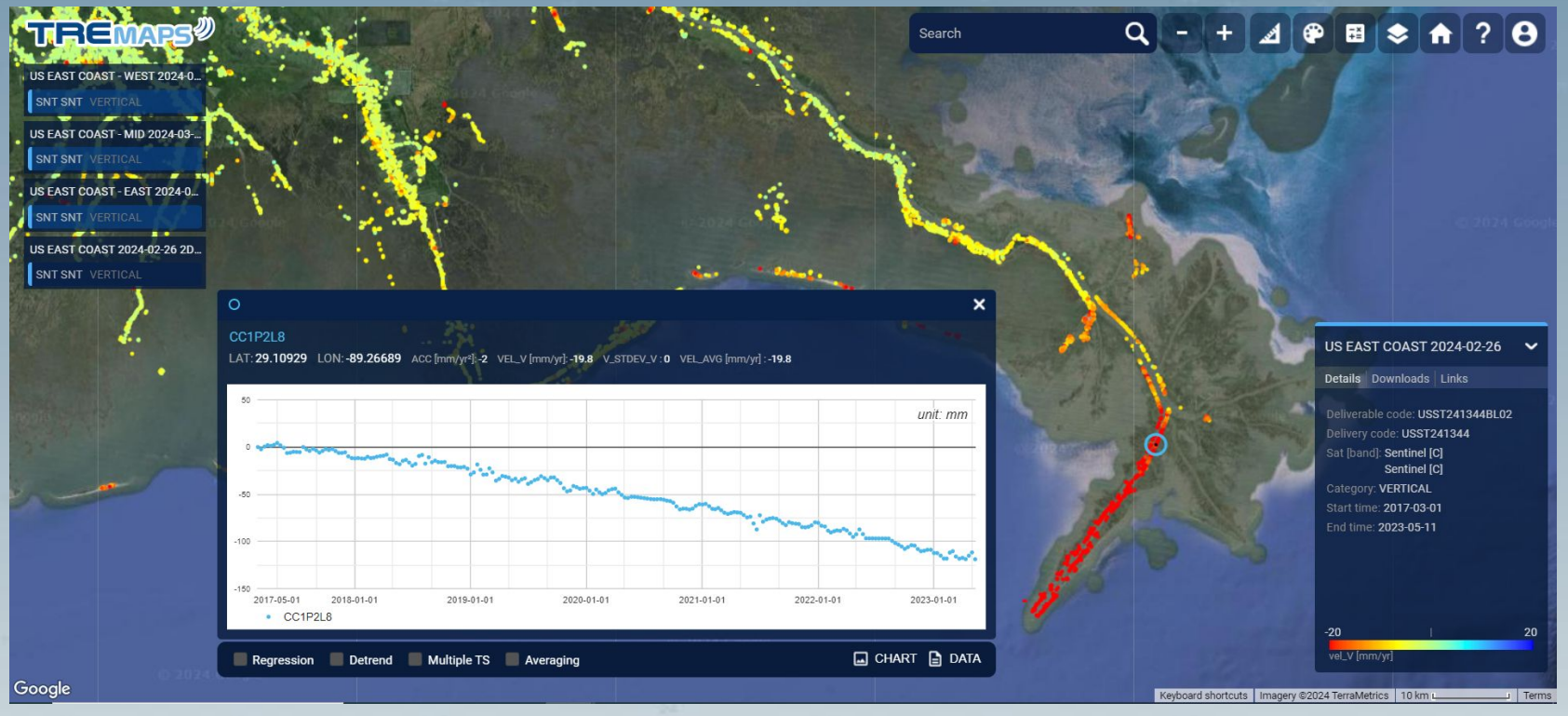
NSRS modernization: Geospatial infrastructure

Euler Pole model

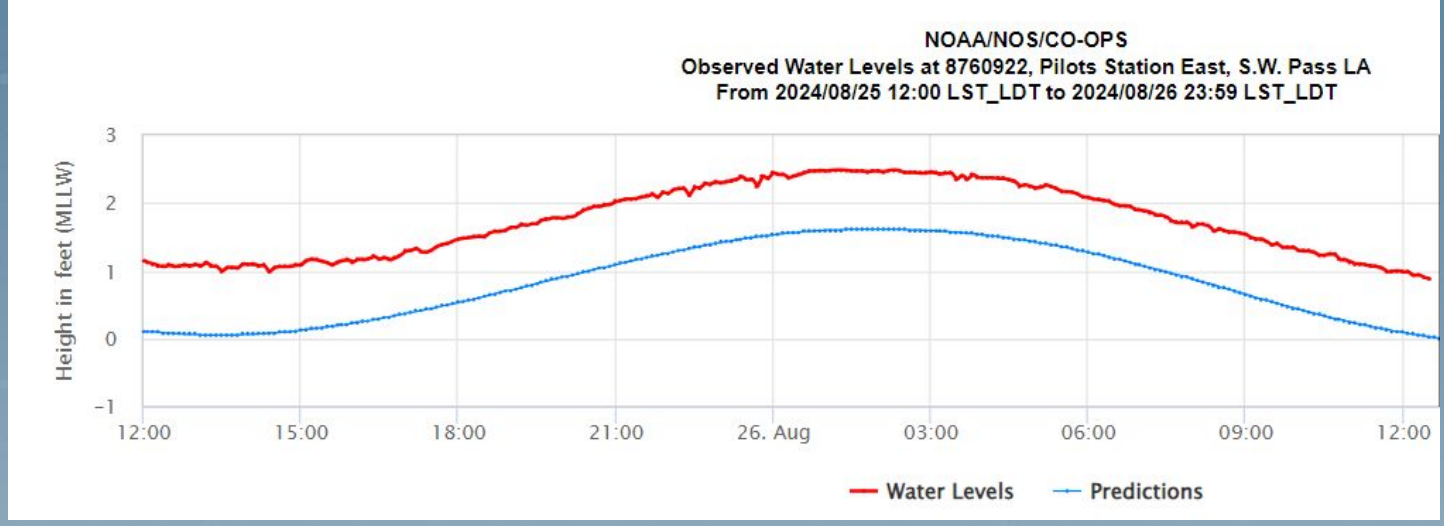


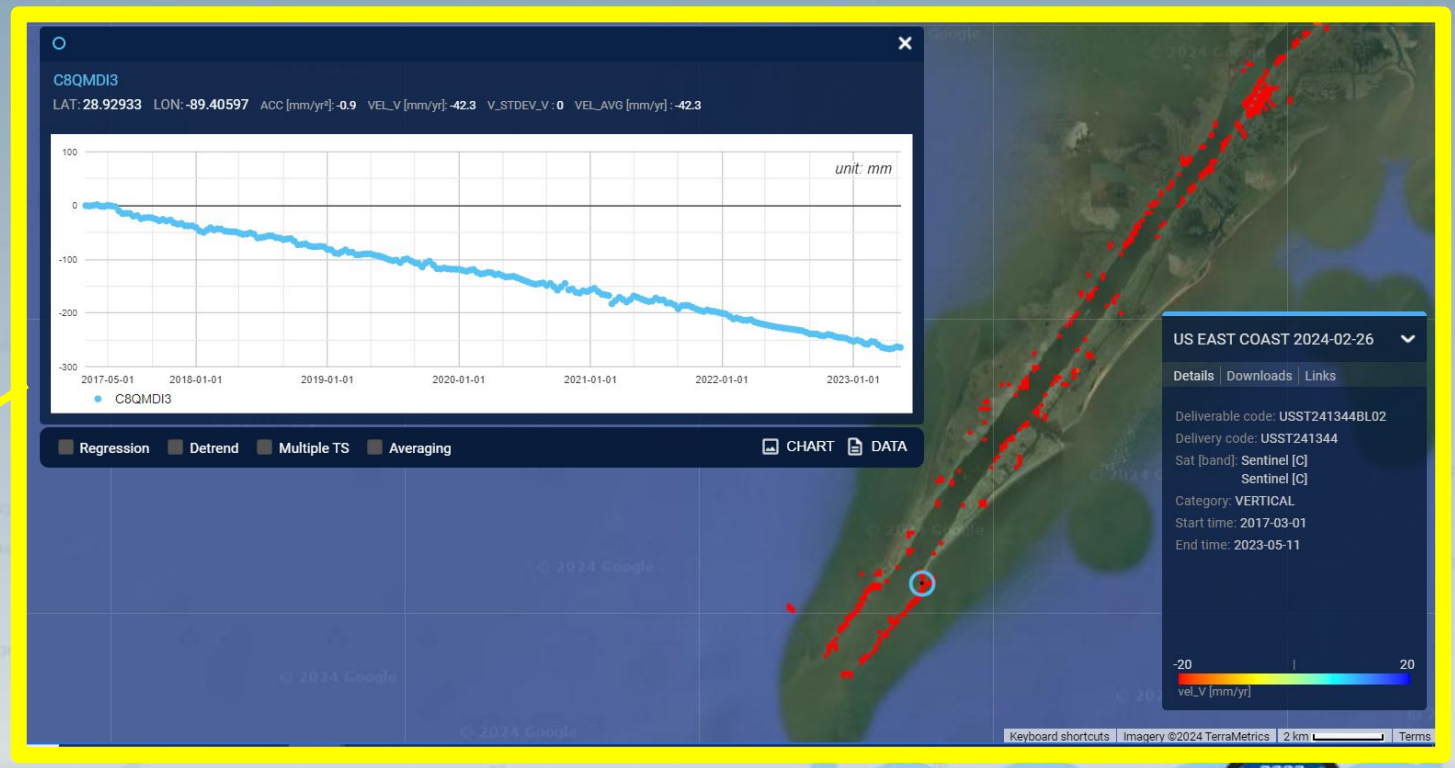
Rigid plate (frame) motion using GNSS observations

Deformation model

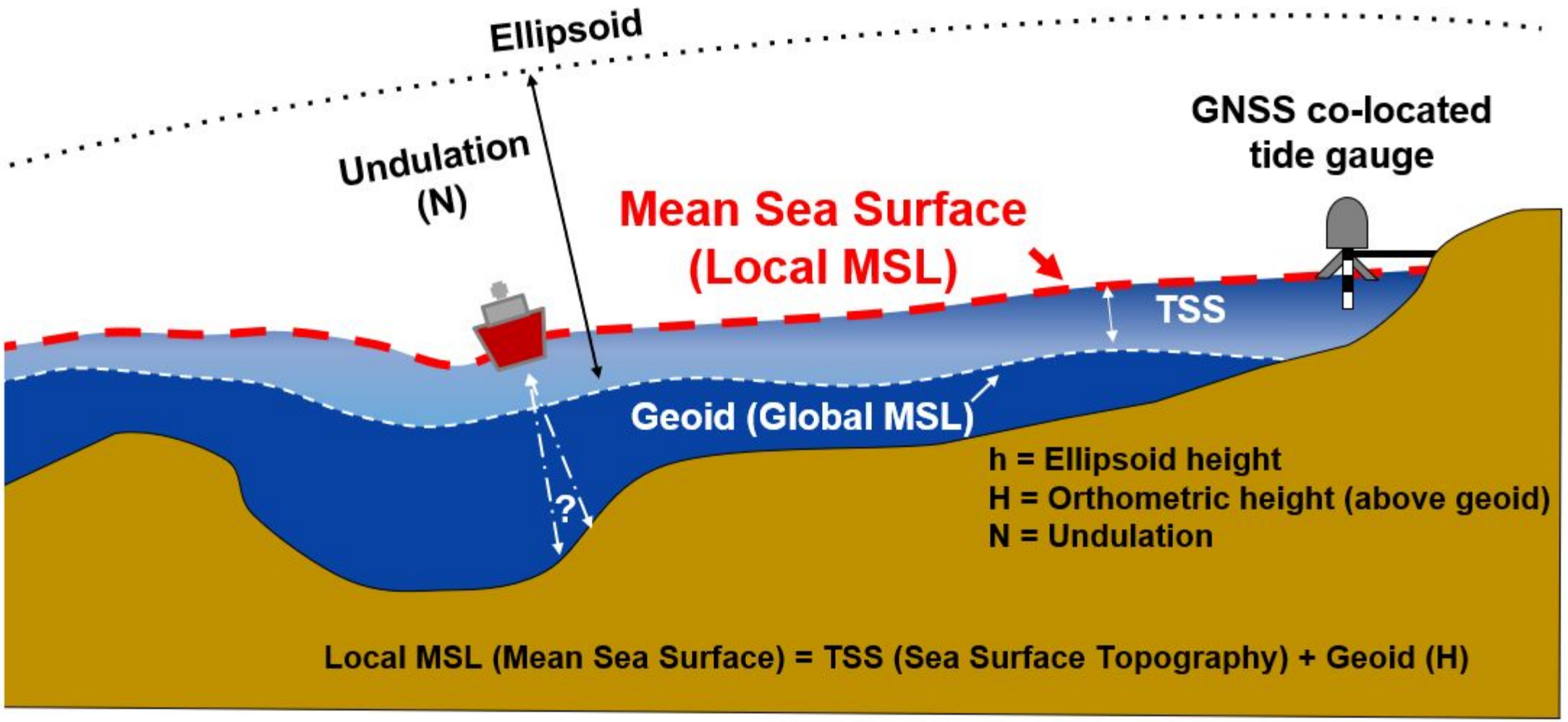


Vertical land motion using InSAR imagery

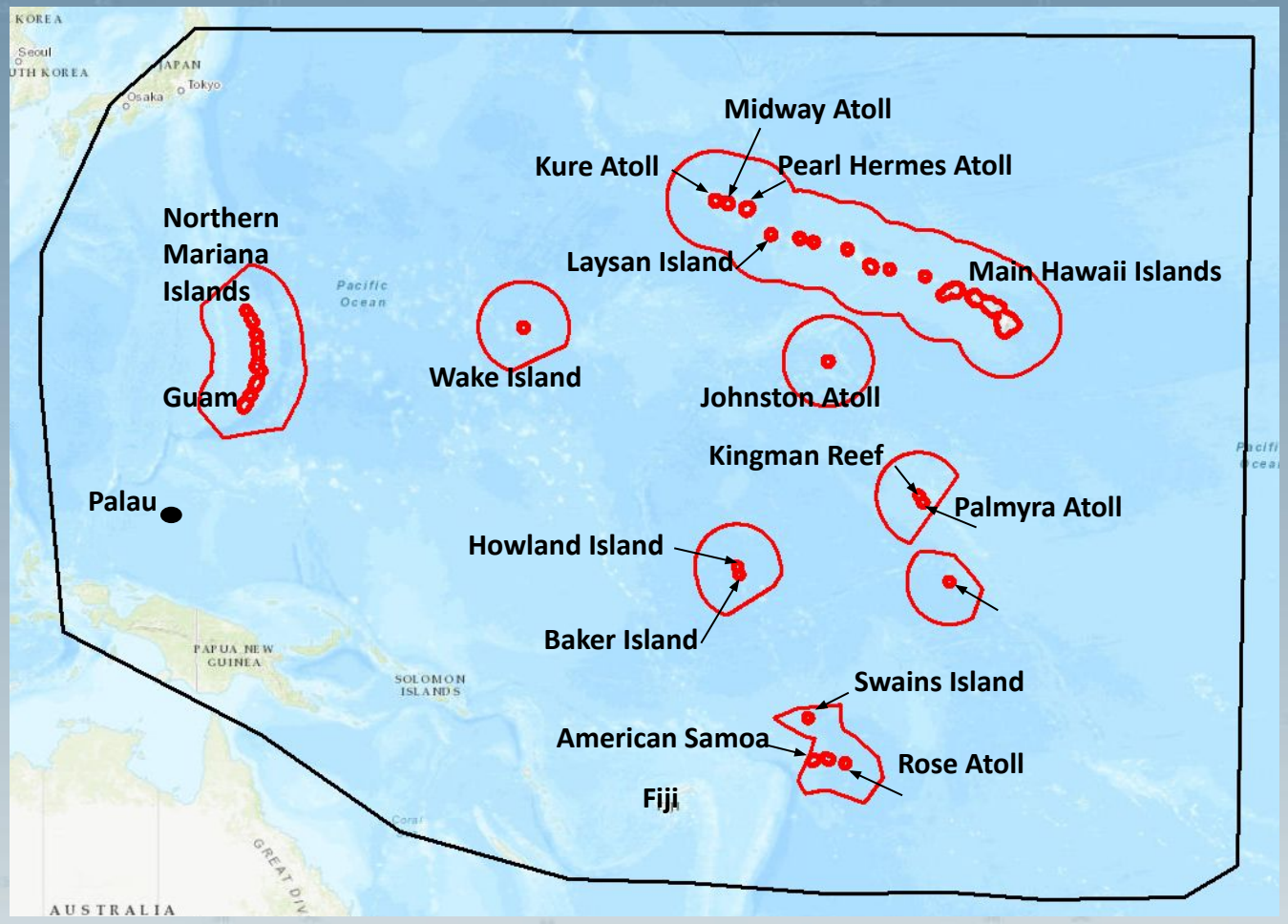

NOAA/NOS/CO-OPS
Observed Water Levels at 8760922, Pilots Station East, S.W. Pass LA
From 2024/08/25 12:00 LST_LDT to 2024/08/26 23:59 LST_LDT
Height in feet (MLLW)
3
2
1
0
-1
12:00
15:00
18:00
21:00
26. Aug
03:00
06:00
09:00
12:00
Water Levels
Predictions


C8QMDI3
LAT: 28.92933 LON: -89.40597 ACC [mm/yr²]: -0.9 VEL_V [mm/yr]: -42.3 V_STDEV_V : 0 VEL_AVG [mm/yr] : -42.3
unit: mm
100
0
-100
-200
-300
2017-05-01
2018-01-01
2019-01-01
2020-01-01
2021-01-01
2022-01-01
2023-01-01
C8QMDI3
Regression
Detrend
Multiple TS
Averaging
CHART
DATA
US EAST COAST 2024-02-26
Details
Downloads
Links
Deliverable code: USST241344BL02
Delivery code: USST241344
Sat [band]: Sentinel [C]
Sentinel [C]
Category: VERTICAL
Start time: 2017-03-01
End time: 2023-05-11
-20
20
vel_V [mm/yr]
Keyboard shortcuts
Imagery ©2024 TerraMetrics
2 km
Terms

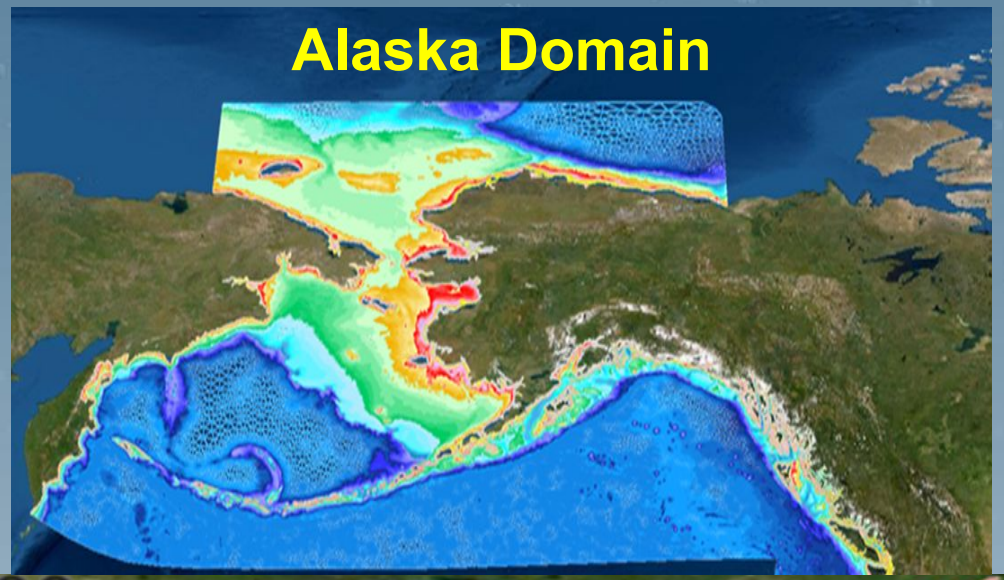
Height relationships

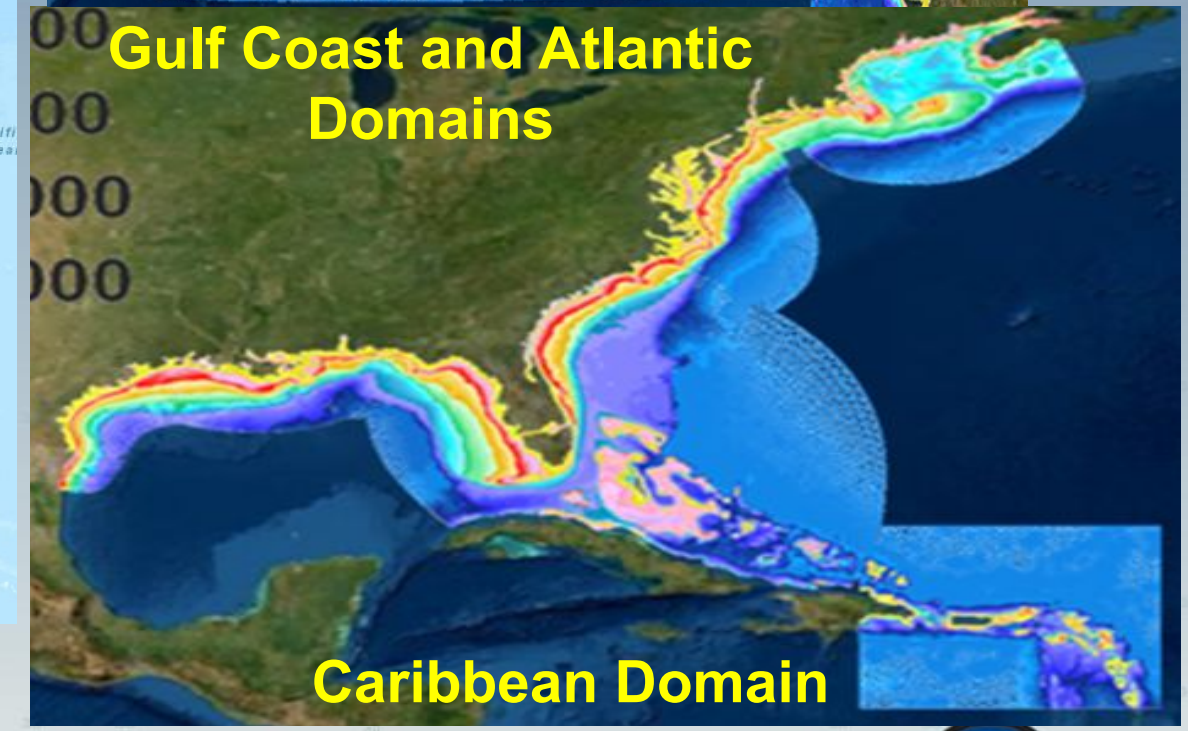


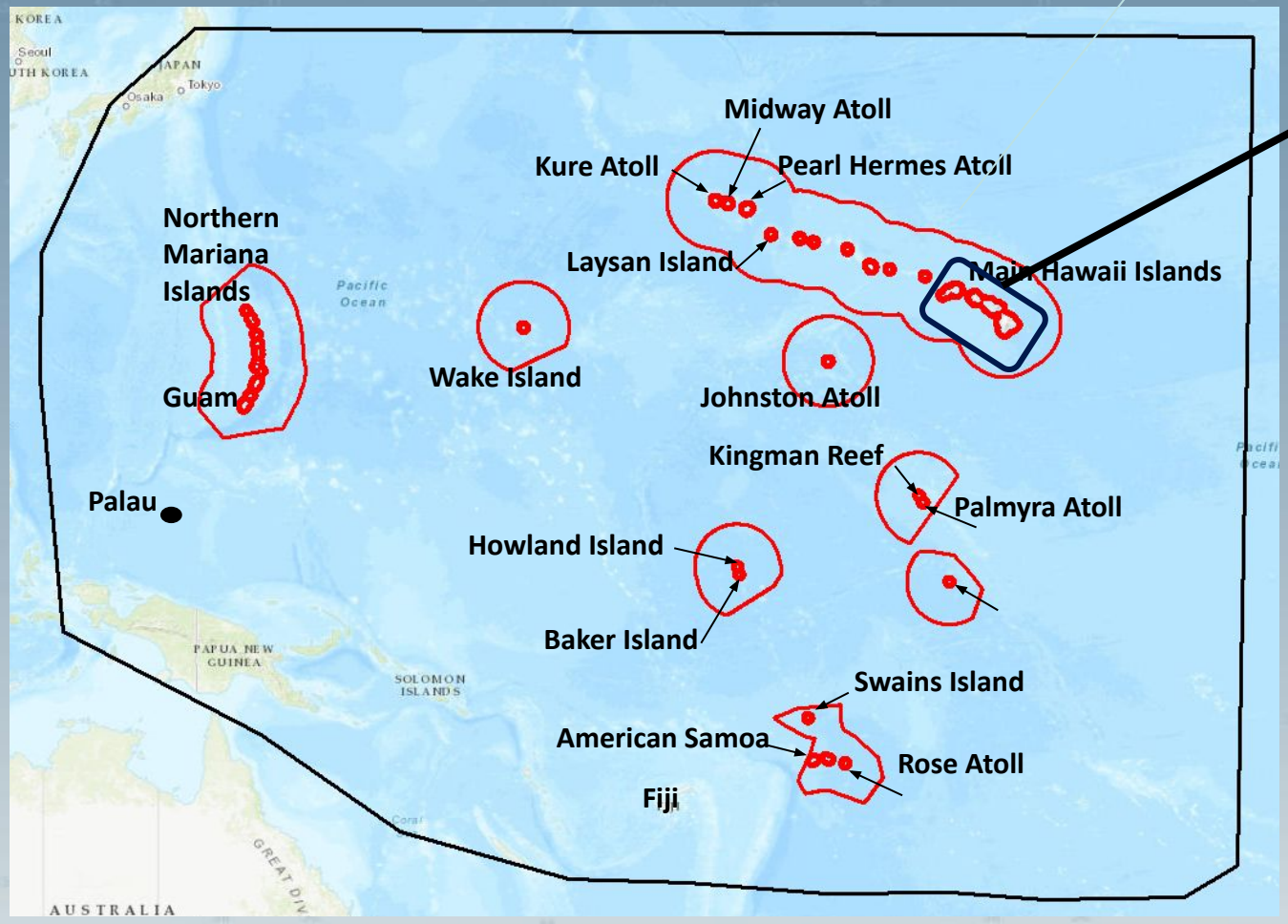
Implementation plan (2025-2028)

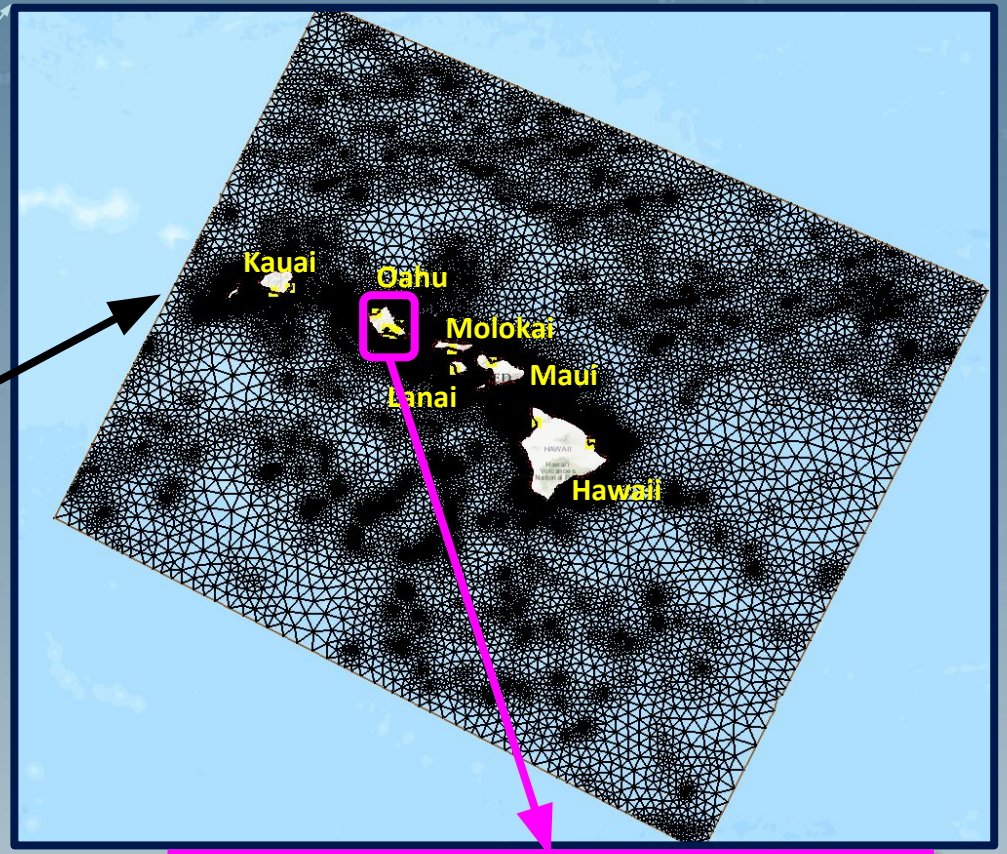


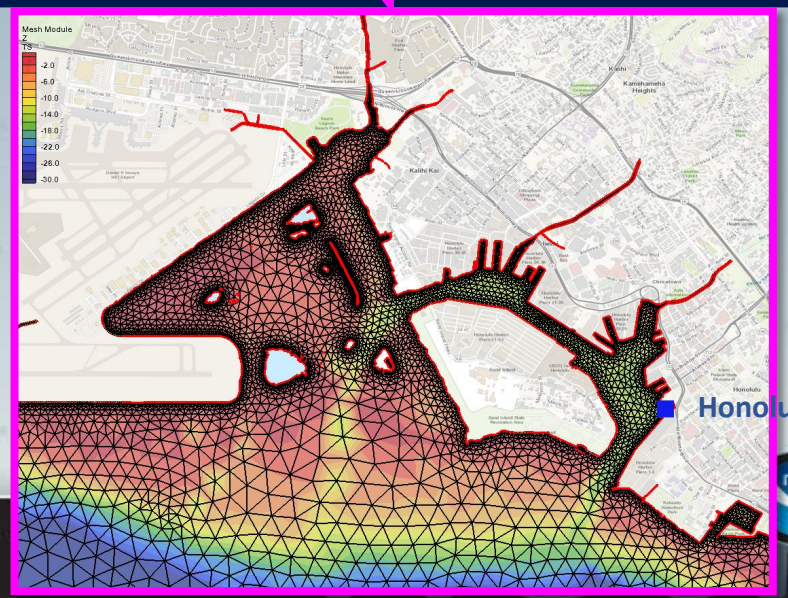
Pacific Domain



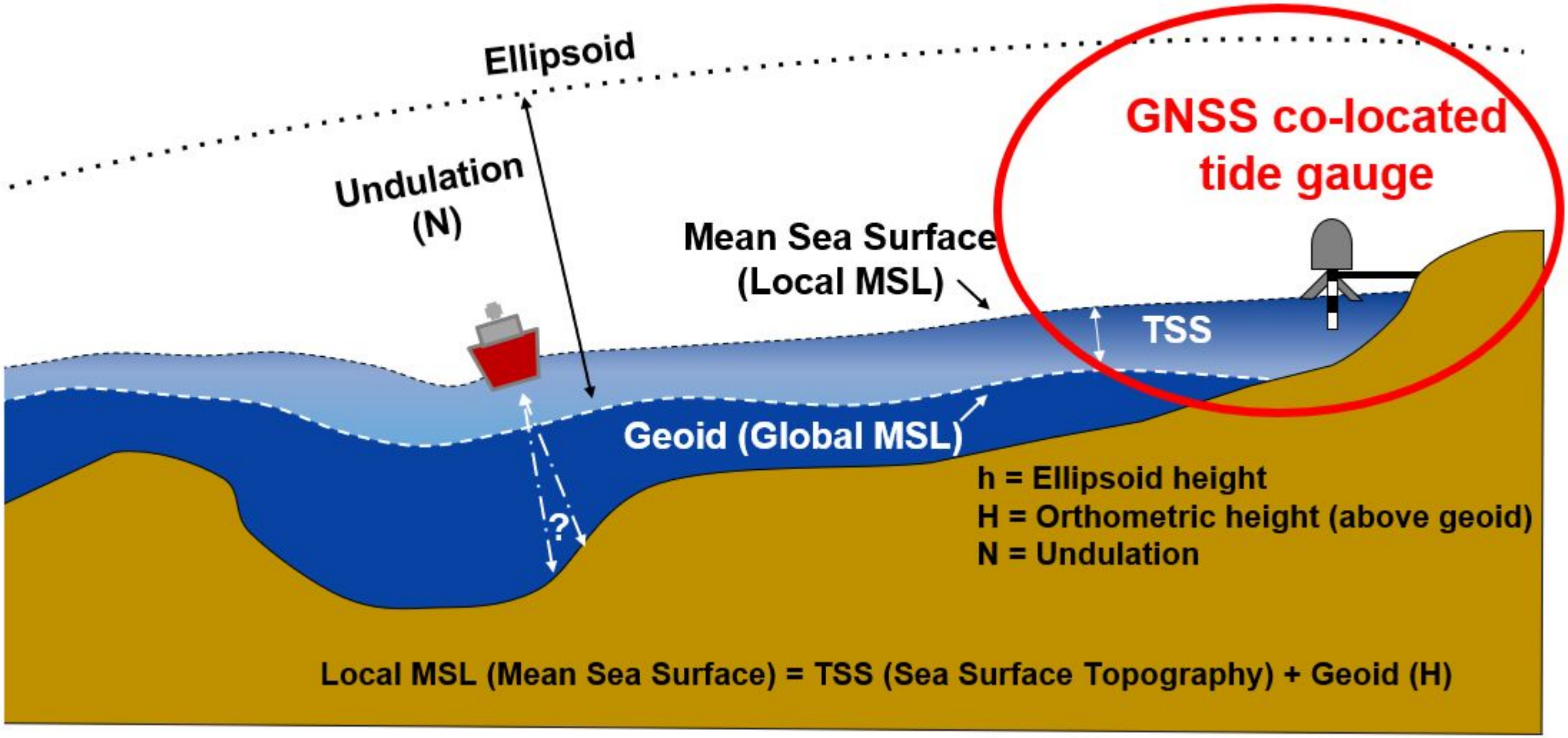


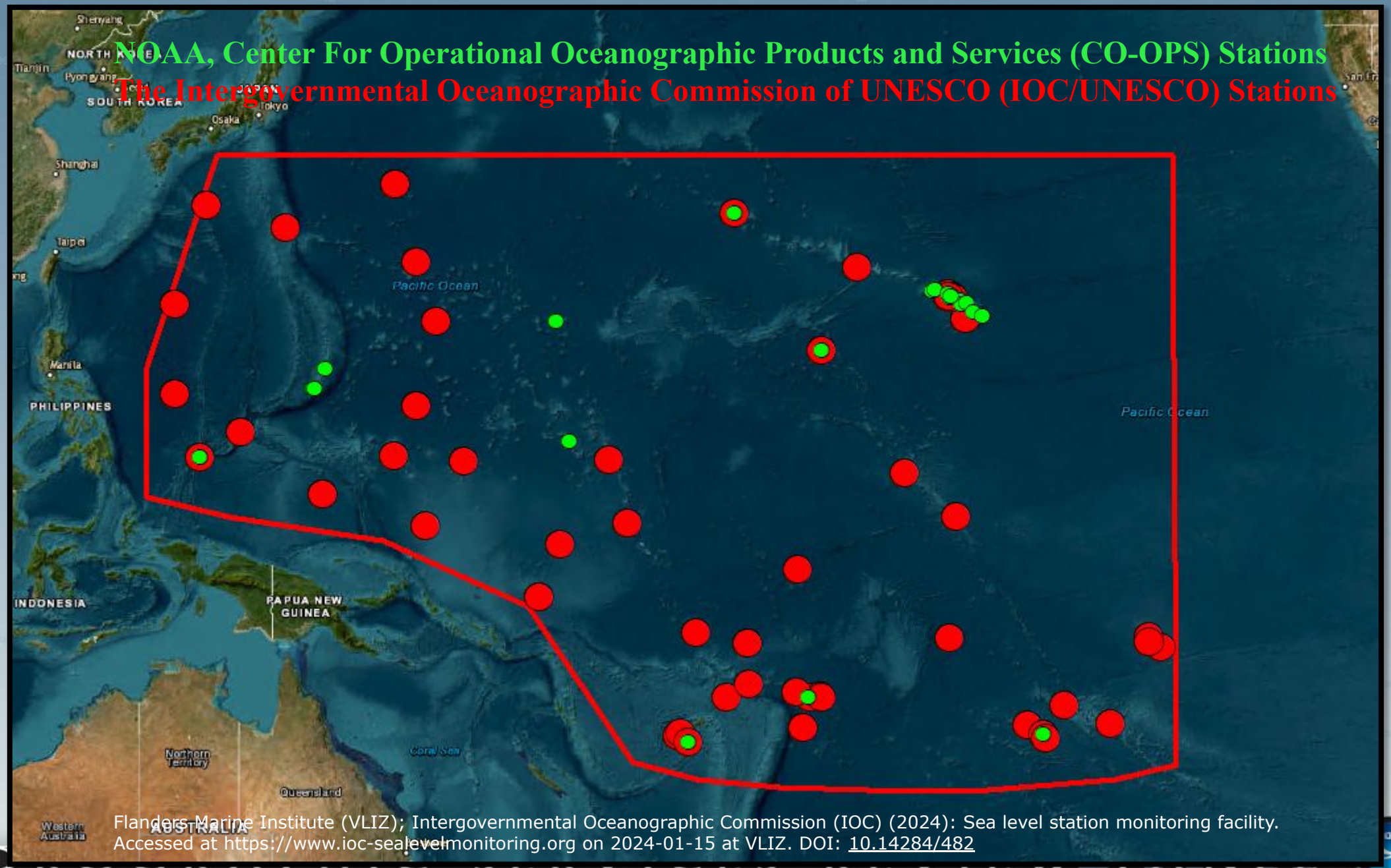

KOREA
Seoul
JAPAN
Tokyo
Osaka
Midway Atoll
Kure Atoll
Pearl Hermes Atoll
Northern Mariana Islands
Laysan Island
Main Hawaii Islands
Pacific Ocean
Wake Island
Guam
Johnston Atoll
Kingman Reef
Palmyra Atoll
Palau
Howland Island
Baker Island
PAPUA NEW GUINEA
SOLOMON ISLANDS
Swains Island
American Samoa
Rose Atoll
Fiji
AUSTRALIA


Kauai
Oahu
Molokai
Maui
Lanai
Hawaii


Honolulu Station

Height relationships





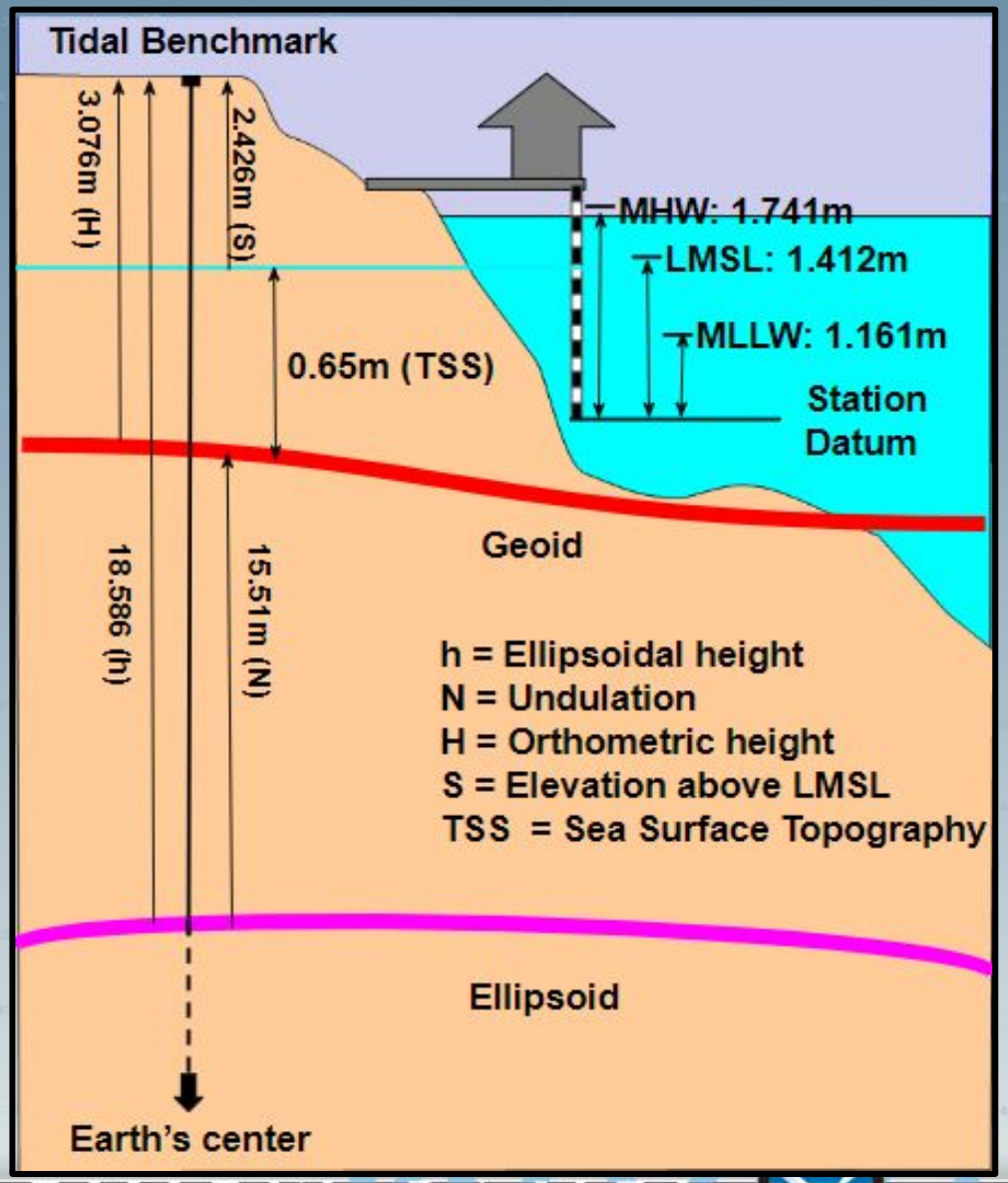
Flanders Marine Institute (VLIZ); Intergovernmental Oceanographic Commission (IOC) (2024): Sea level station monitoring facility. Accessed at https://www.ioc-sealevelmonitoring.org on 2024-01-15 at VLIZ. DOI: 10.14284/482

Referencing the circulation models to Tidal Datum

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**

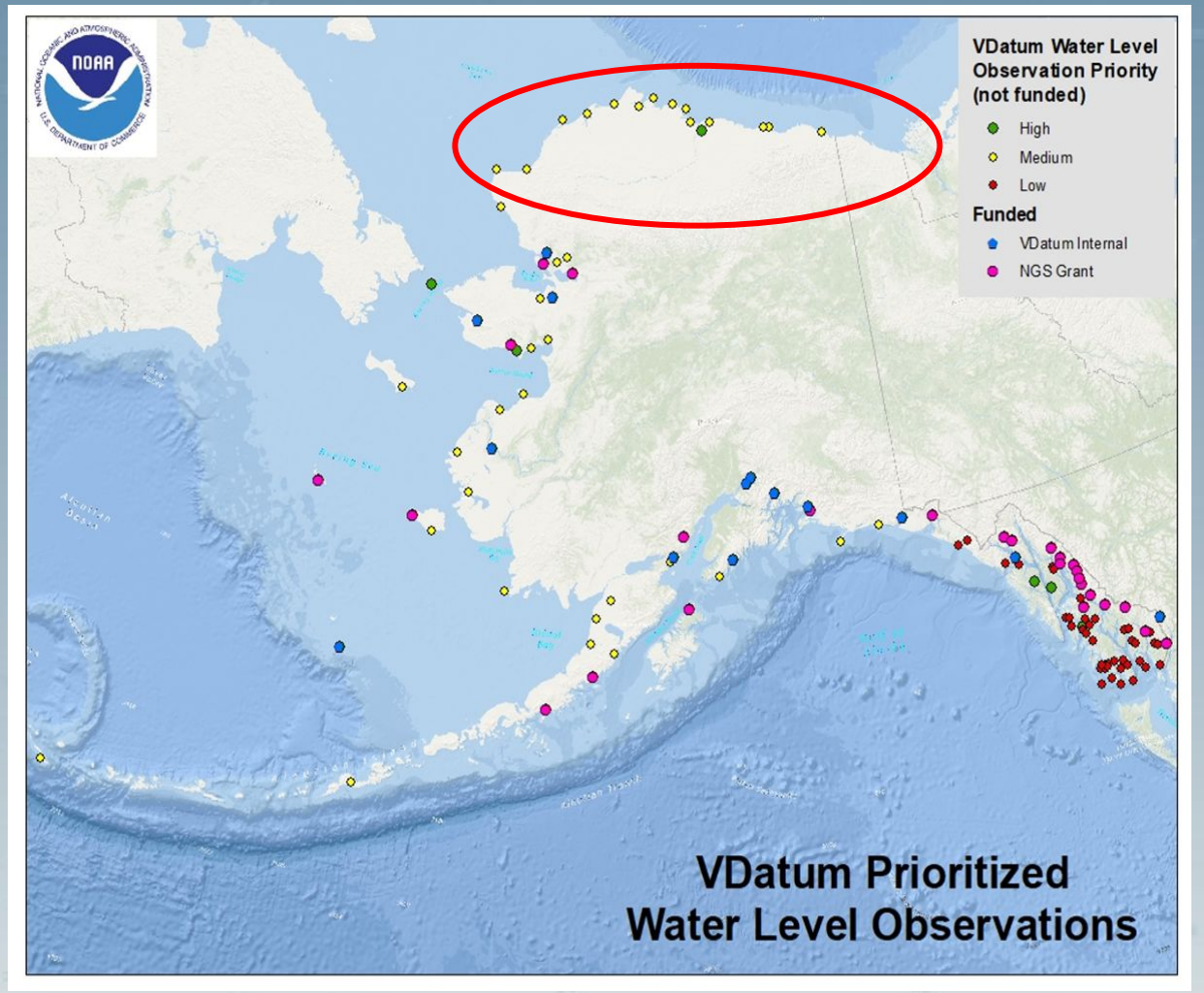


Opportunities - Tide stations

The State of Alaska has received from NOAA a $5M grant is for installing +30 tide station to allow more accurate calculations using height relationship for Alaska.

Location for these 30-day water level observations have been already prioritized and scheduled for the next four years (2024-2028).

Another group in NOAA (OCM via IOOS/AOOS) is planning to provide an additional ~$1.5M to support the VDatum project



Internal Data Delivery agreement for Tier B

Background: VDatum effort is following the CO-OPS Tiered Data Policy (2015) that requires requiring water level data to be up 10 cm uncertainty (Tier A). According to the current policy, water level observations with an uncertainty ranging from **11 to 30 cm (Tier B)** data cannot be used in applications such as VDatum. However, given the constraints and needs of the Alaska project, a waiver is necessary to proceed effectively, and accept dataset that are collected using a buoy platform (i.e., GNSS Tide Buoys).

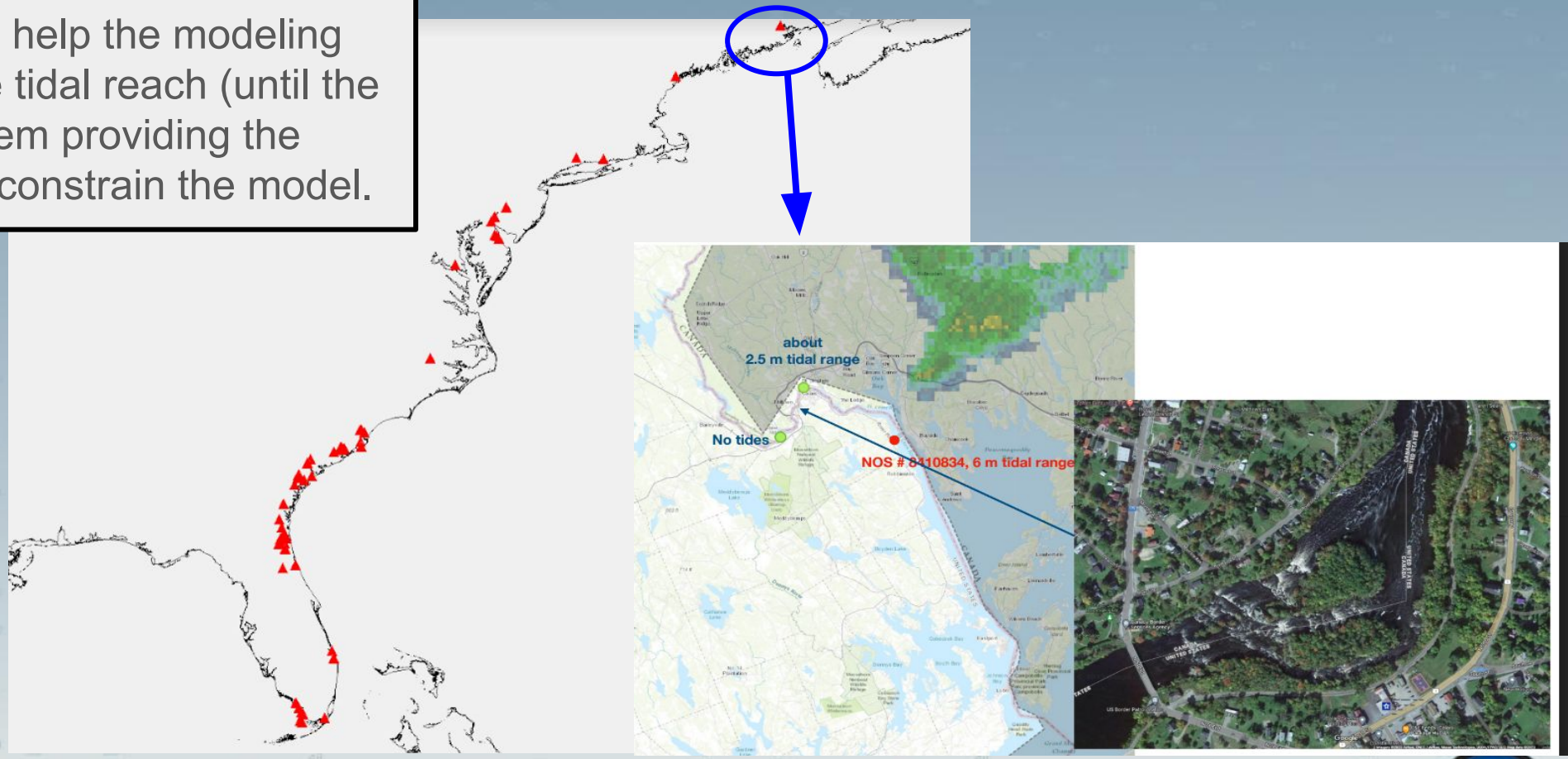
Justification for Waiver (thinking bigger):

- Geographical Necessity: In Alaska, many locations where data are needed are remote, cost-prohibitive, and environmentally challenging, making GNSS tide buoys the only feasible option.
- Operational Efficiency: Utilizing GNSS tide buoys allows for the collection of short-term (minimum 30-day observations) water level data efficiently and cost-effectively.
- Data Quality and Coverage: Including Tier B data from GNSS tide buoys will enhance the overall data density and improve the accuracy of the marine grids produced by VDatum models. This approach ensures better coverage and more reliable data for coastal and ocean modeling.

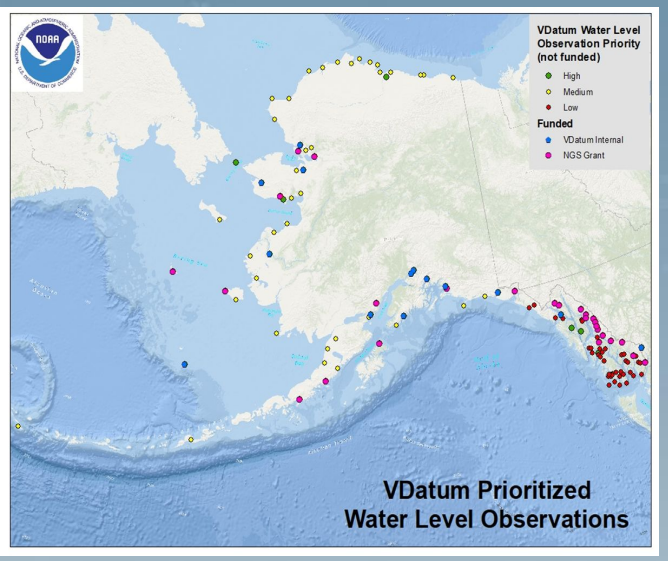
Updating surveys and aligning sister agency efforts

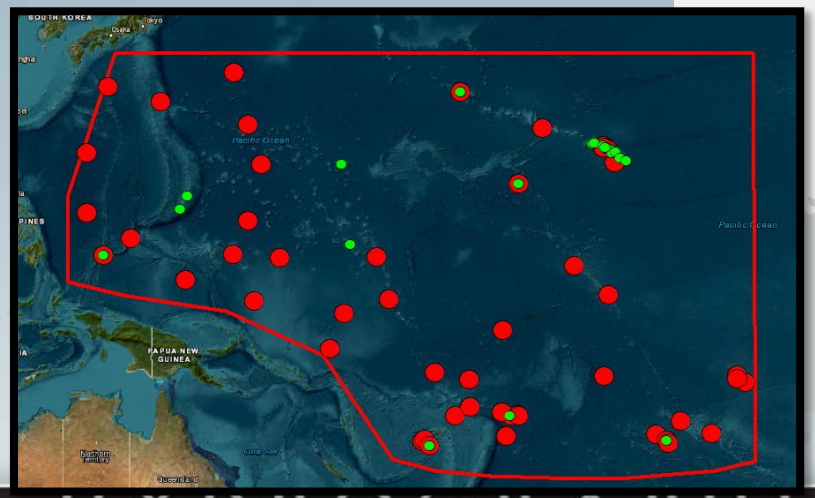
USGS Tide stations - St. Croix, Maine

The two USGS gages help the modeling team to determine the tidal reach (until the rapids), and one of them providing the observational data to constrain the model.



Updating surveys and aligning sister agency efforts (FY24)





Maine
St. Croix (USGS)
Falmouth (USGS)

Connecticut
Essex (USGS)
Stevenson (USGS)

Louisiana
Baton Rouge (USGS/USACE)
Donaldsonville (USGS/USACE)
New Orleans (USGS/USACE)
Alliance (USGS/USACE)
Pointe a la Hache (USGS/USACE)
Empire (USGS/USACE)
Venice (USGS/USACE)

Florida
Jacksonville (USGS/USACE)
Key West - Working (USGS)

N

River Gage Status
Gages with Data Collected
Gages with No Data Collected

0 75 150 300 Miles

Gap Analysis

Desired goal

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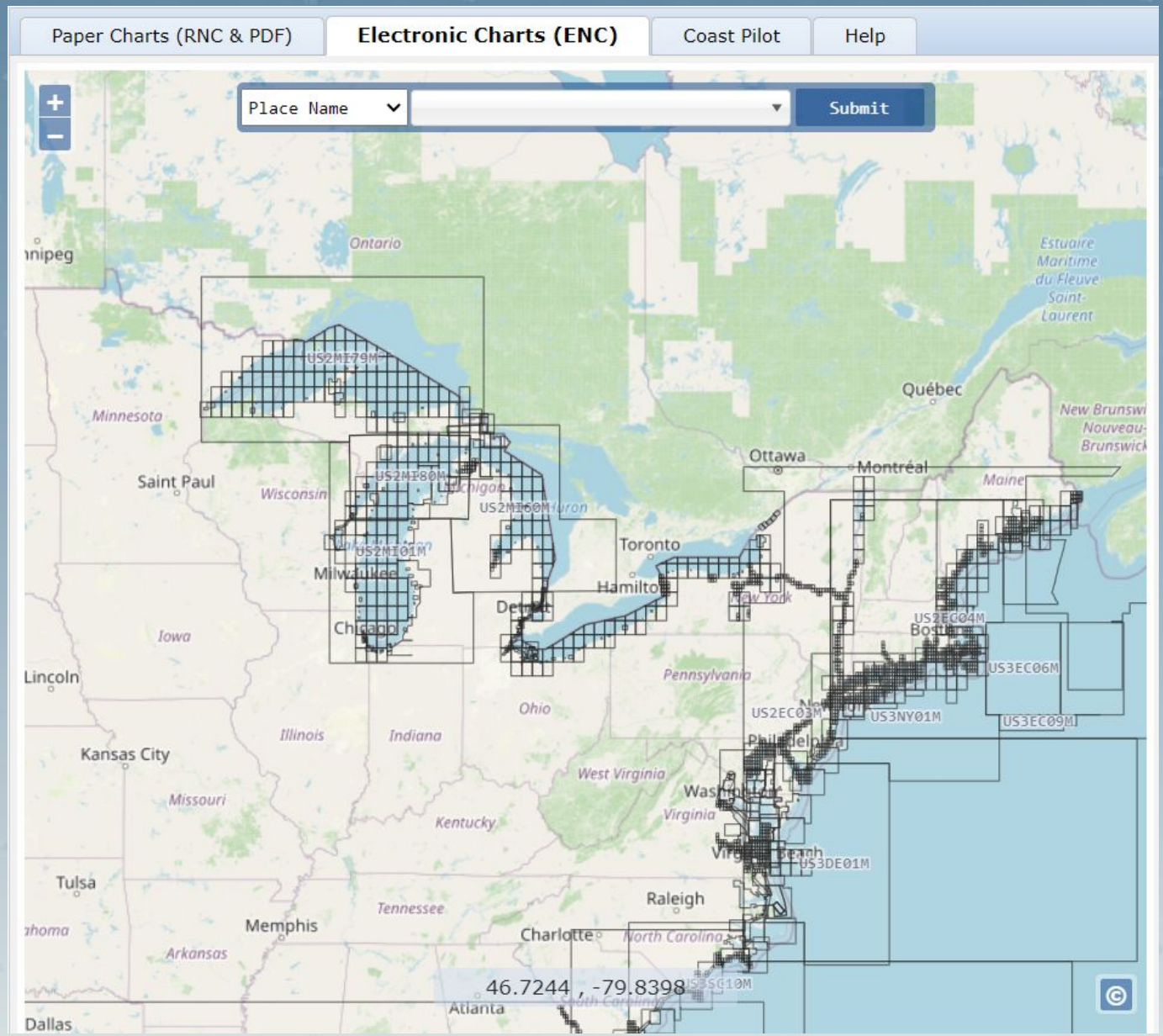


Challenges

Complete costal coverage

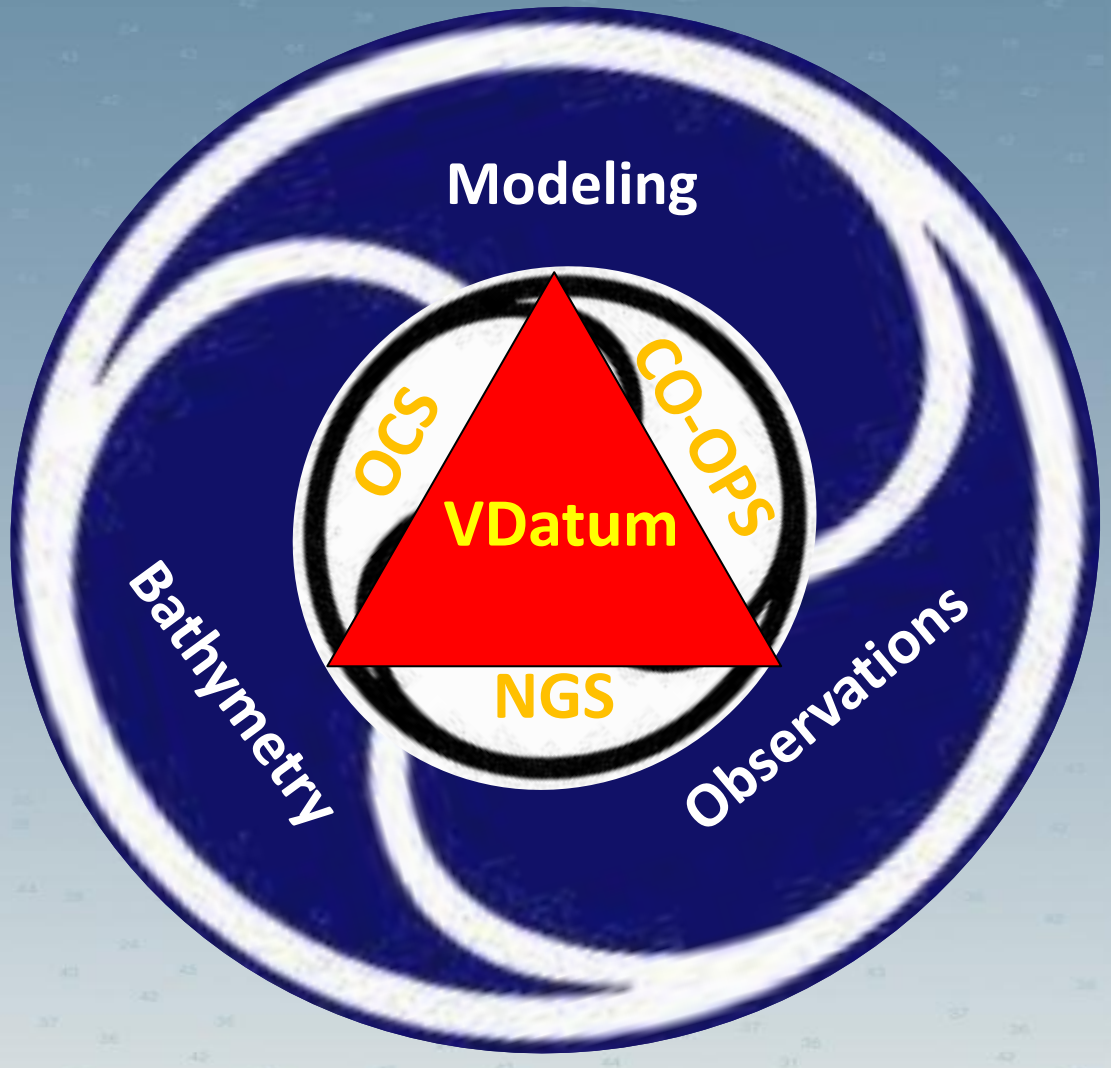
- Coastal modeling
- National Bathymetry Model
- Benchmark observations

Gravity modeling

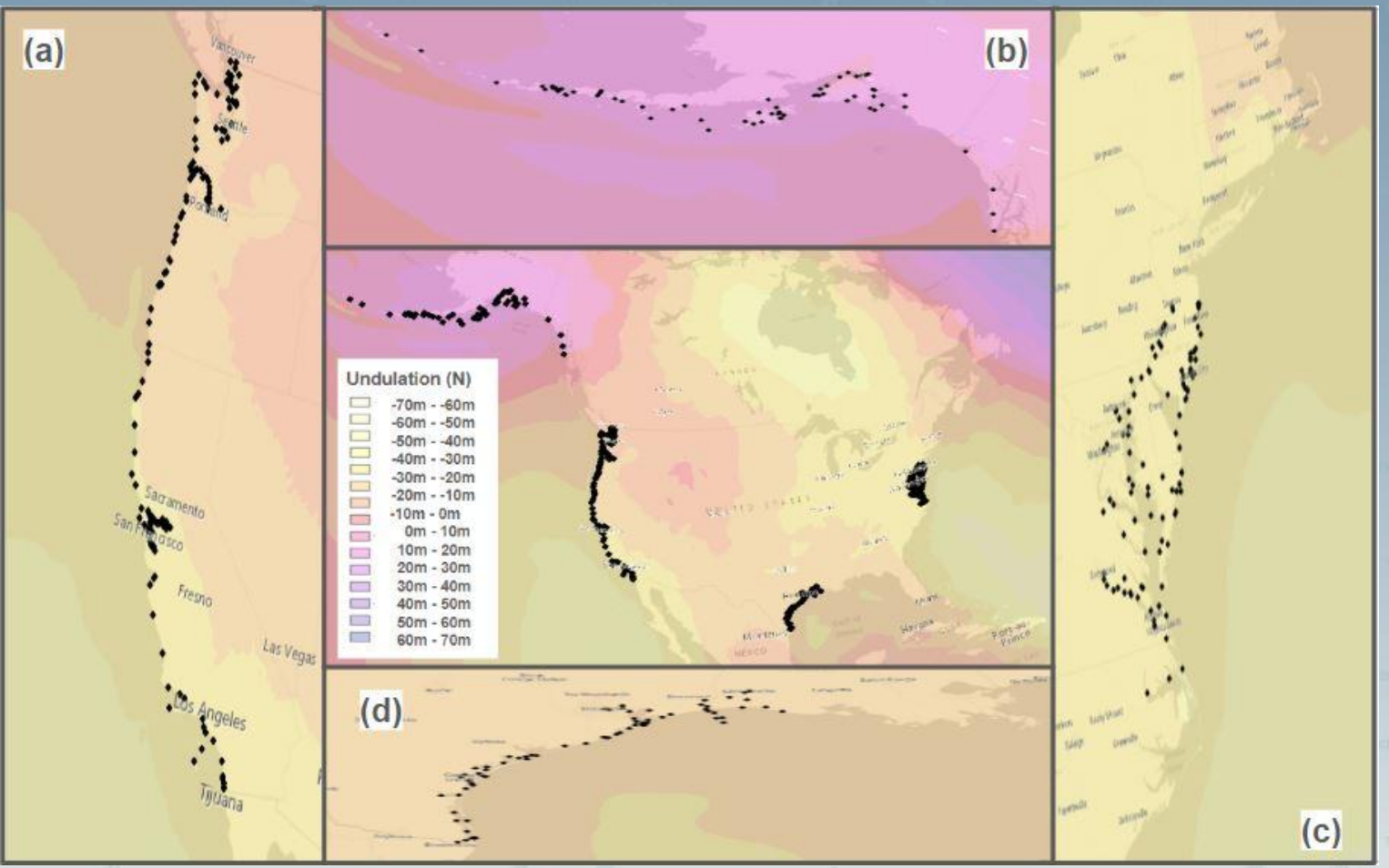
- Astro-geodetic observations

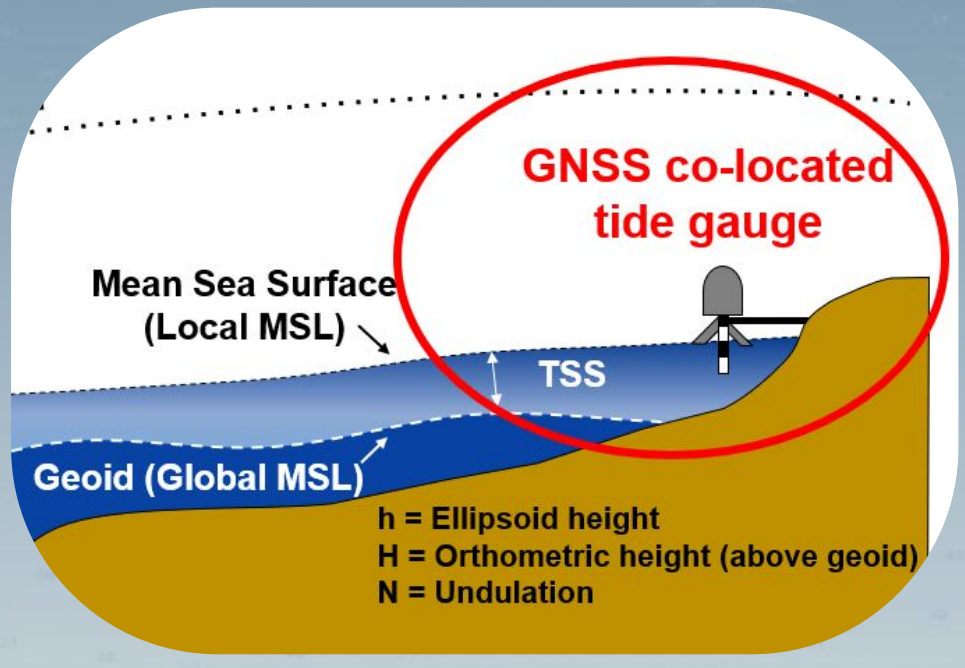
Geometric (deformation) model

- Euler Pole Motion
- Vertical Land Motion modeling
-



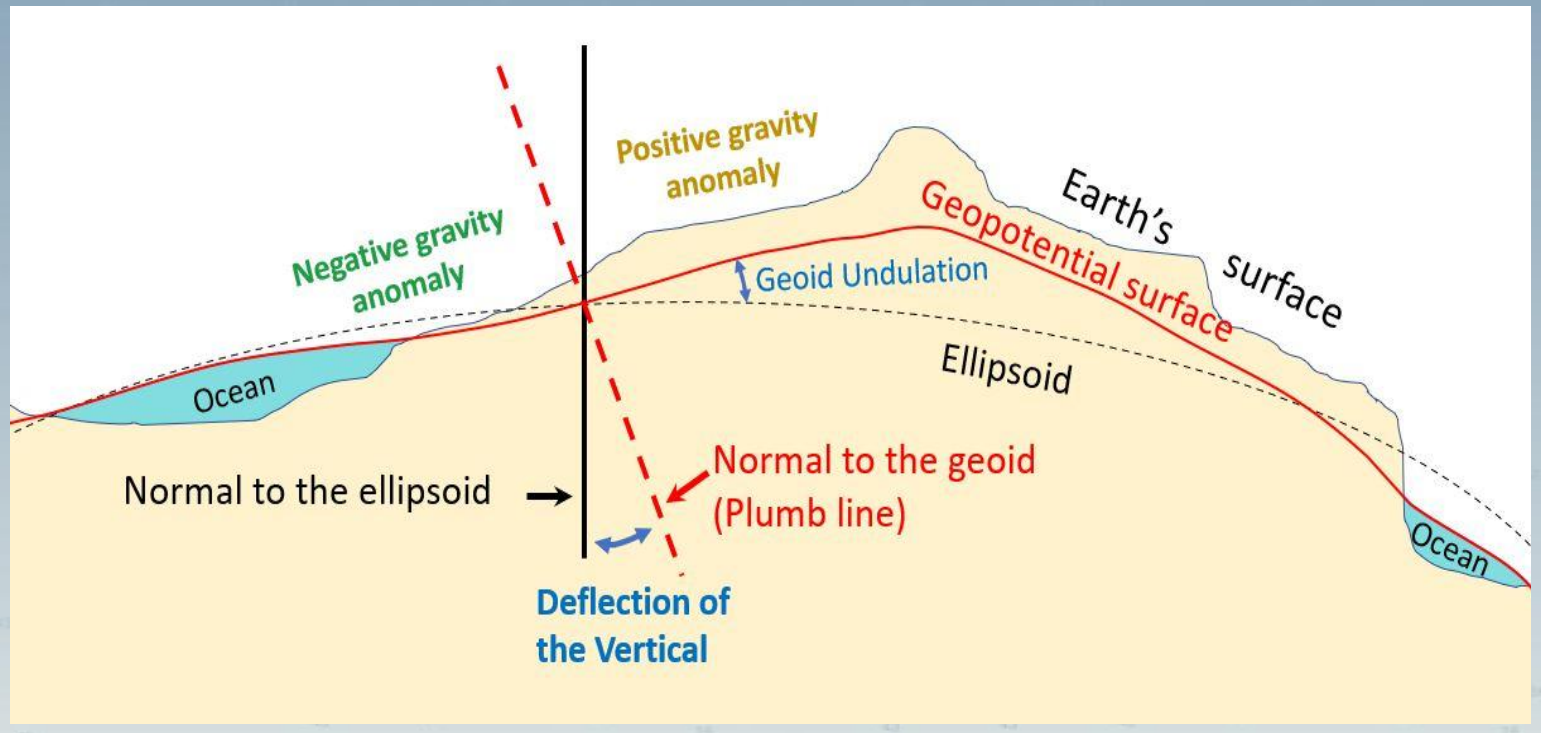
Height relationships: Referencing the tidal datum

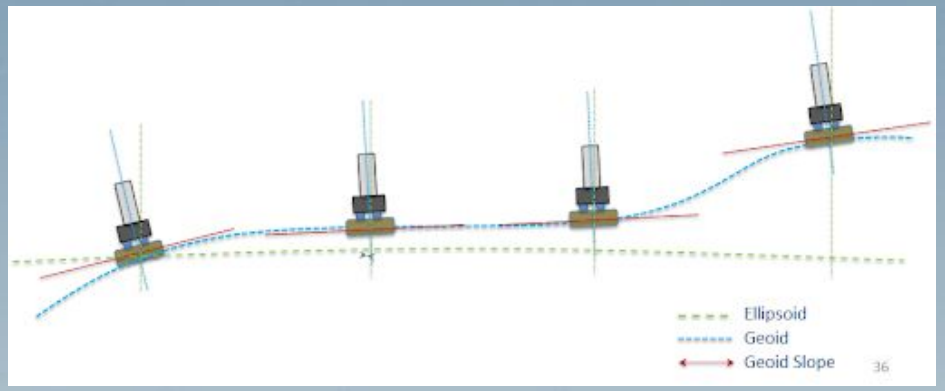




Height relationships: Deflections of the Vertical

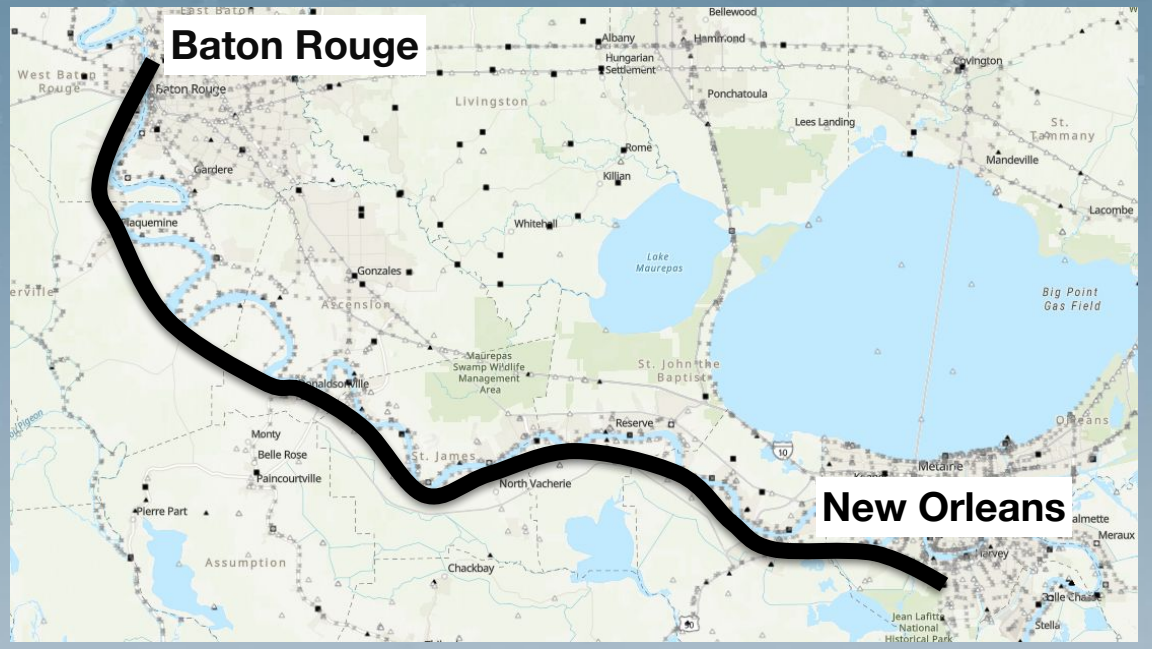
- Deflections of the vertical effectively measure the slope of the geoid.
- Integrating geoid slopes along a profile reveal undulation in the geoid directly
- These can be measured astronomically

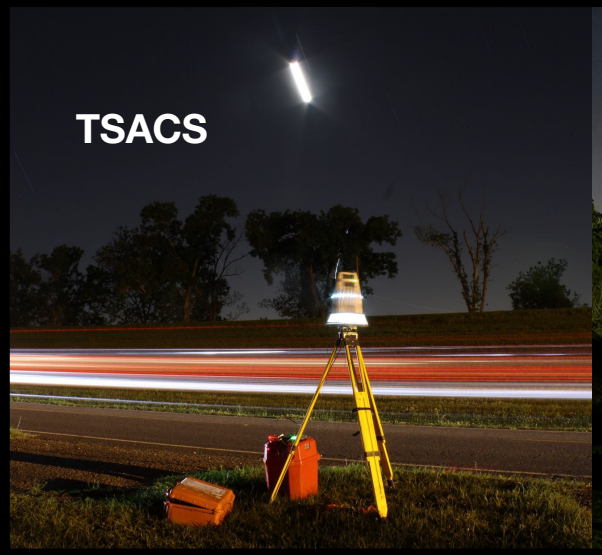


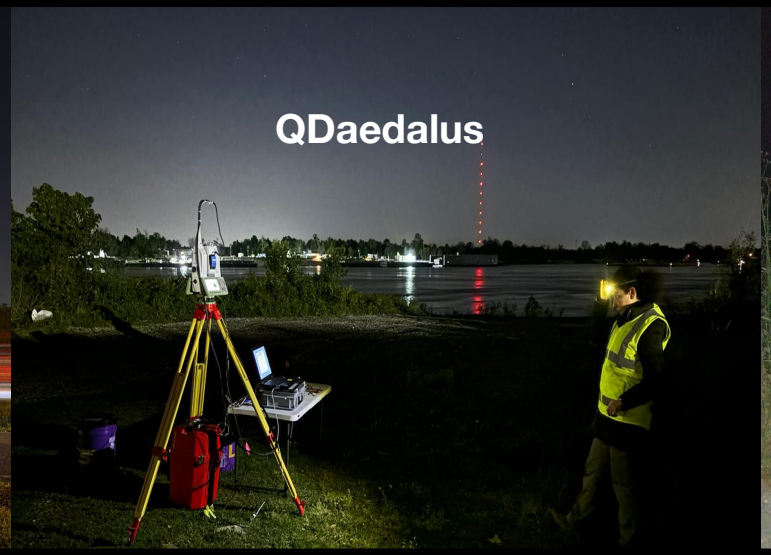


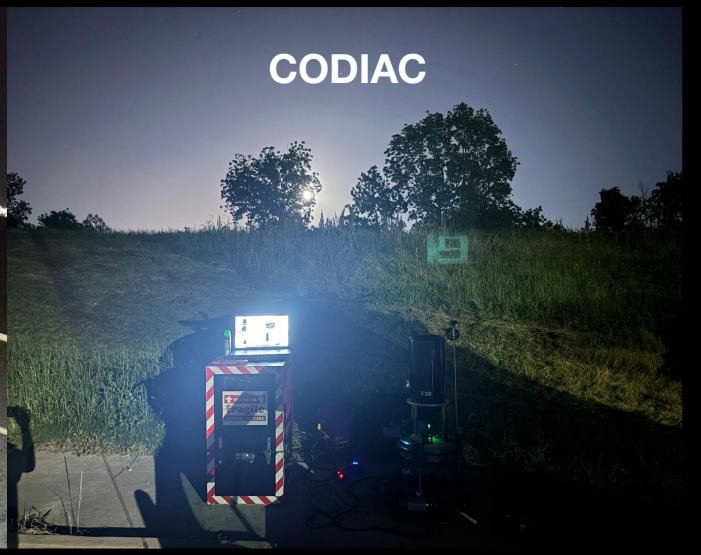
Louisiana Astrogeodetic Survey

- April 2024, ~150 km profile between New Orleans and Baton Rouge
- Participants
  - PI: Muge Albayrak (Oregon State)
  - CODIAC, QDAEDALUS (SwissTopo)
  - VESTA, GNSS, and relative gravity (LSU C4G)
  - TSACS (NGS)



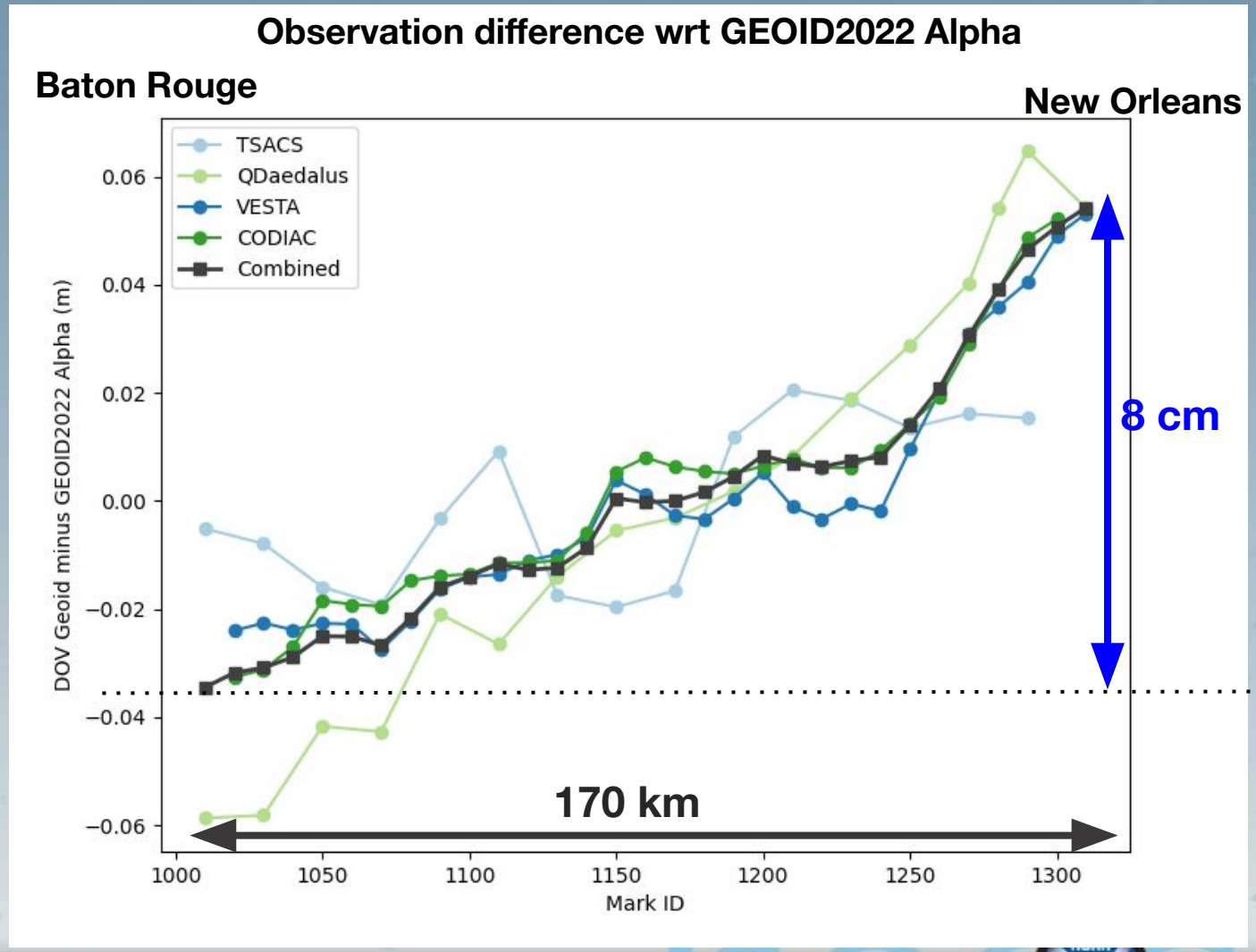




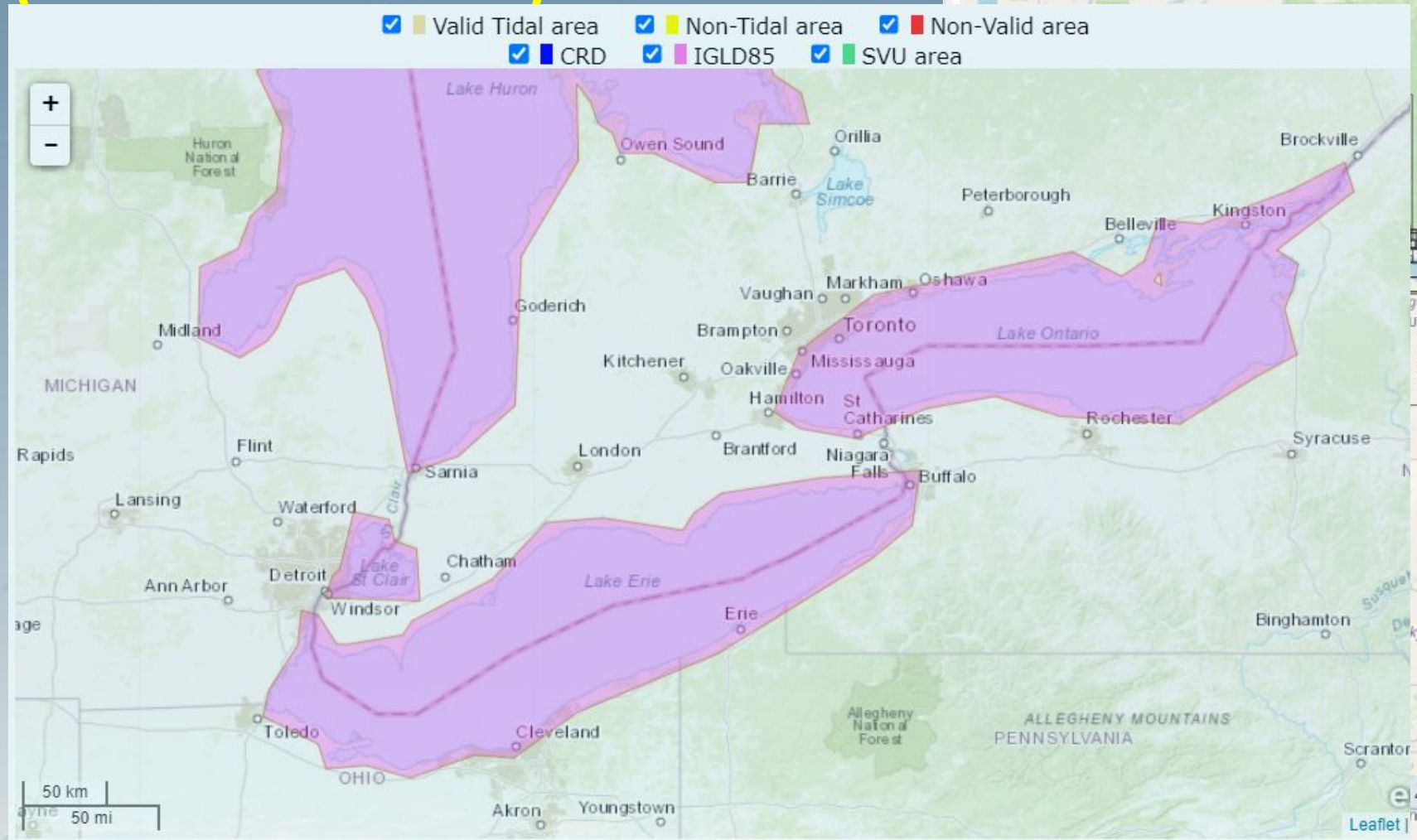


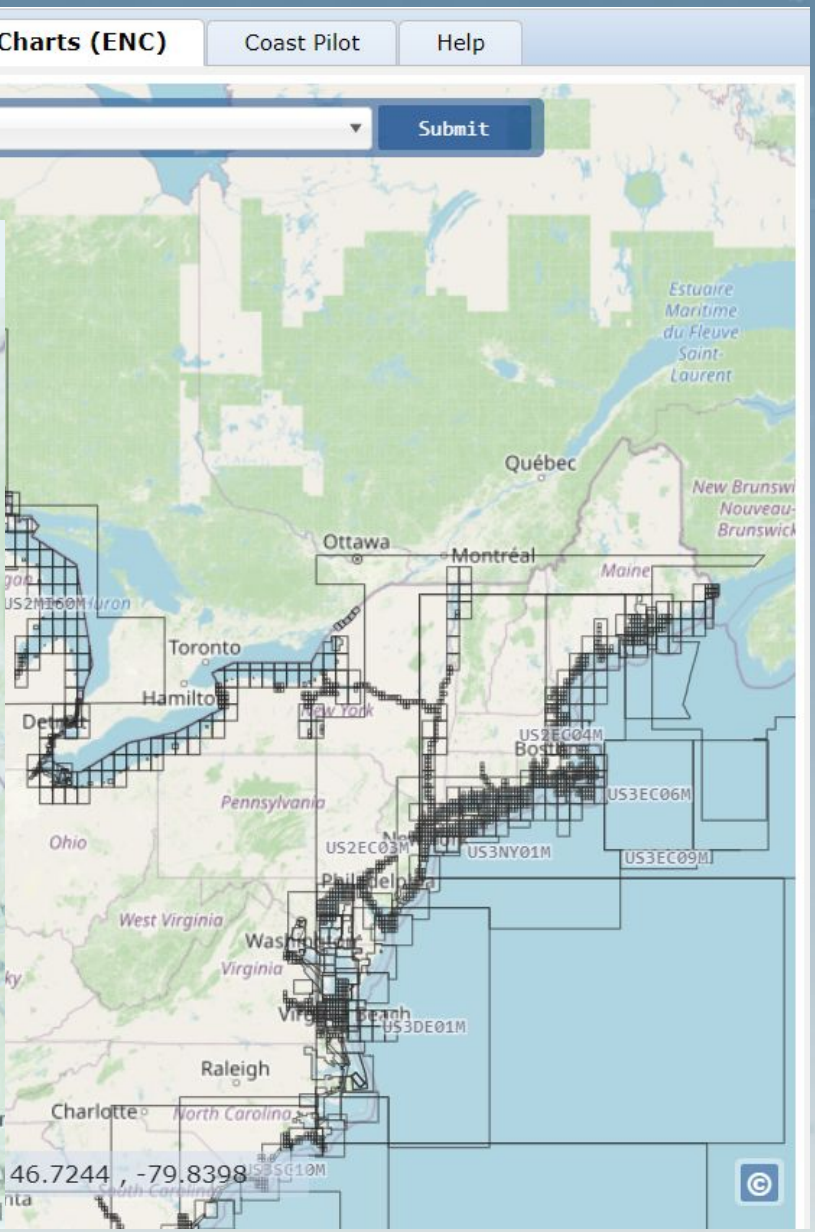
Louisiana Astrogeodetic Survey

- Preliminary results using deflection of the vertical observe that Baton Rouge geopotential surface is 8 cm higher than New Orleans than previously thought
- RMS of measure measurements are 2 cm.
- Results are preliminary, but indicate the strength of astronomical methods for establishing heights

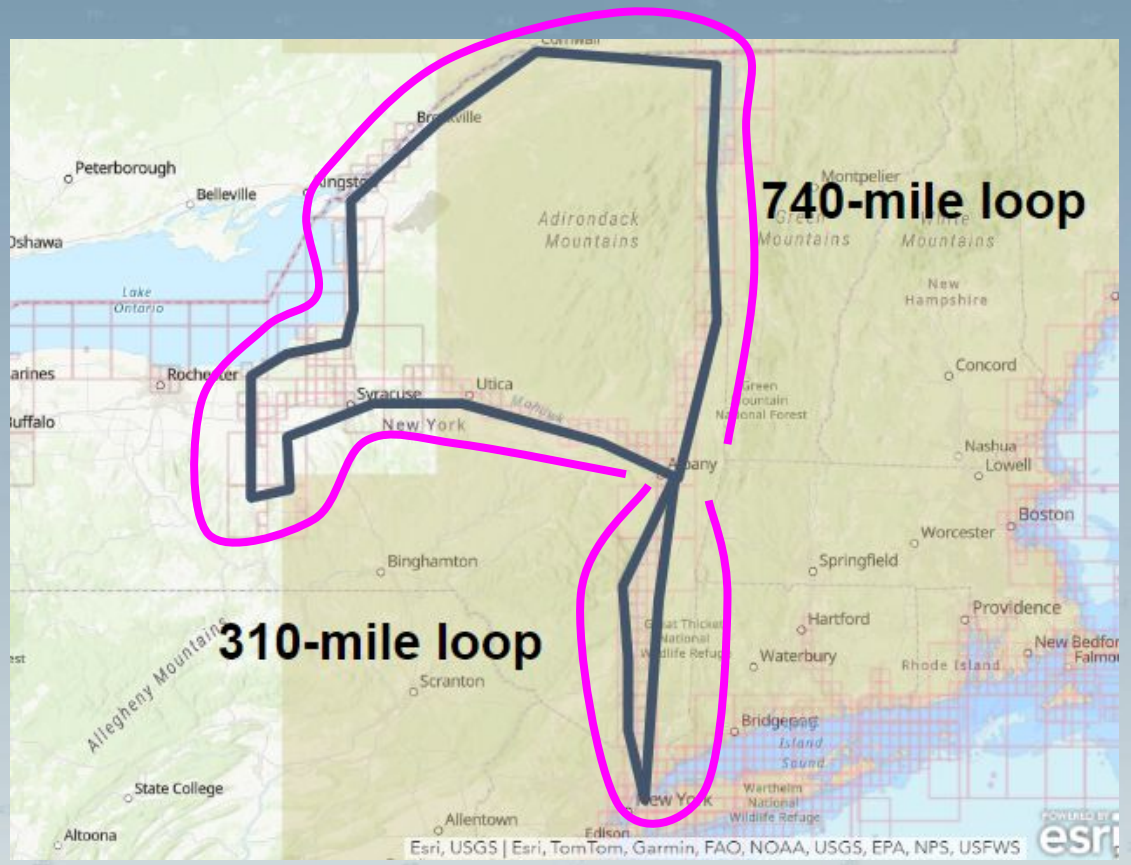


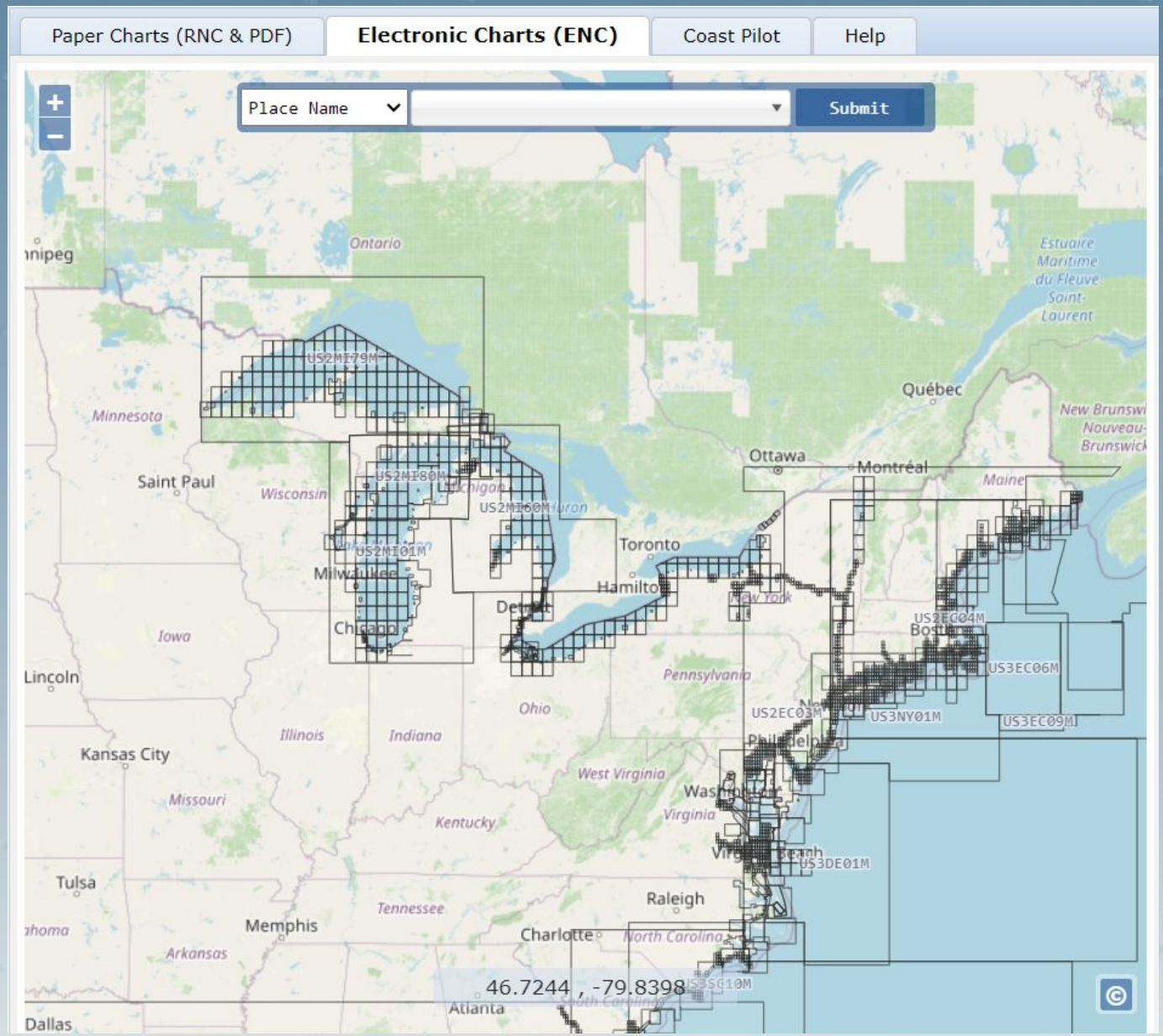
Potential approach (Current Status)



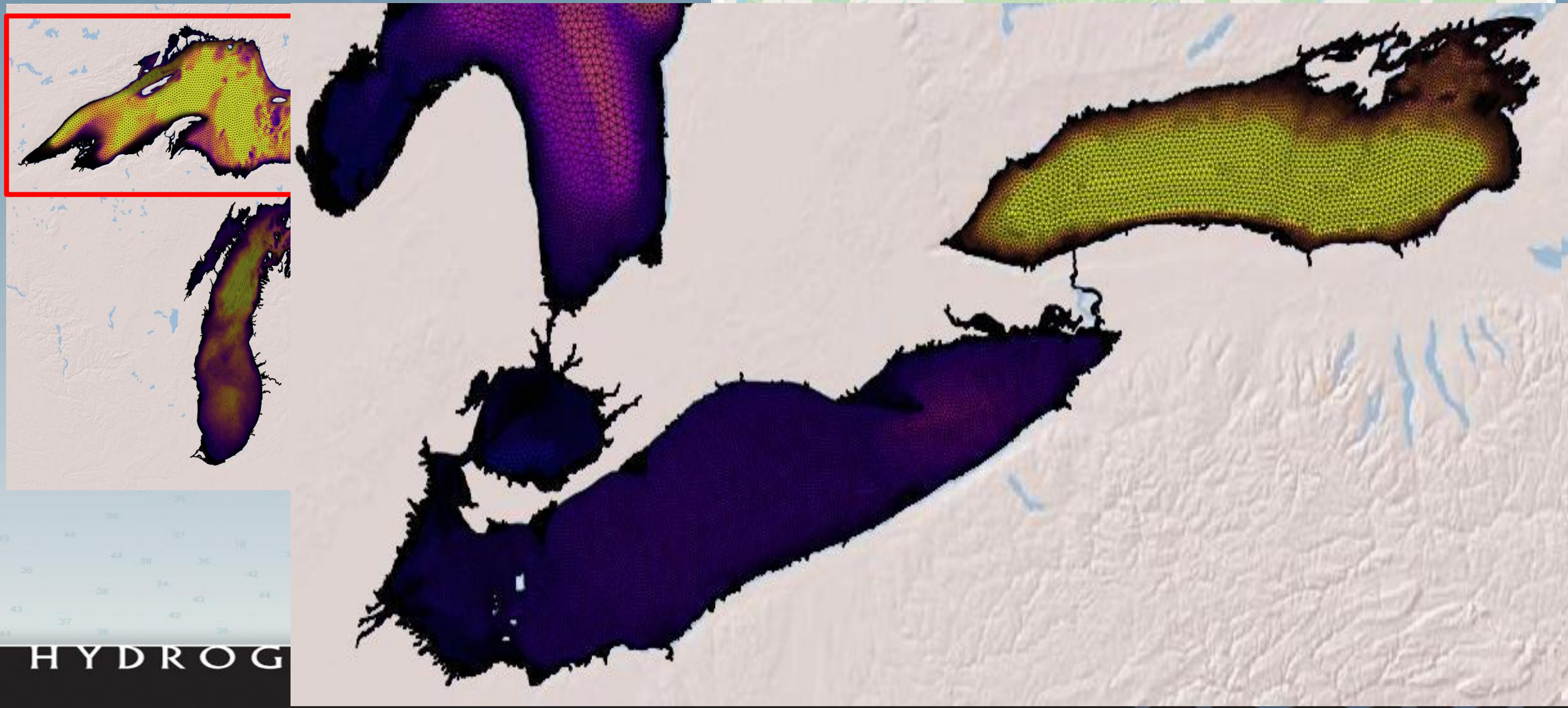


Potential approach (Deflection of the Vertical)





Potential approach (Mesh for modeling)



It takes a village to raise a child - Thank you!

VDatum Team
Mike Aslaksen (NGS)
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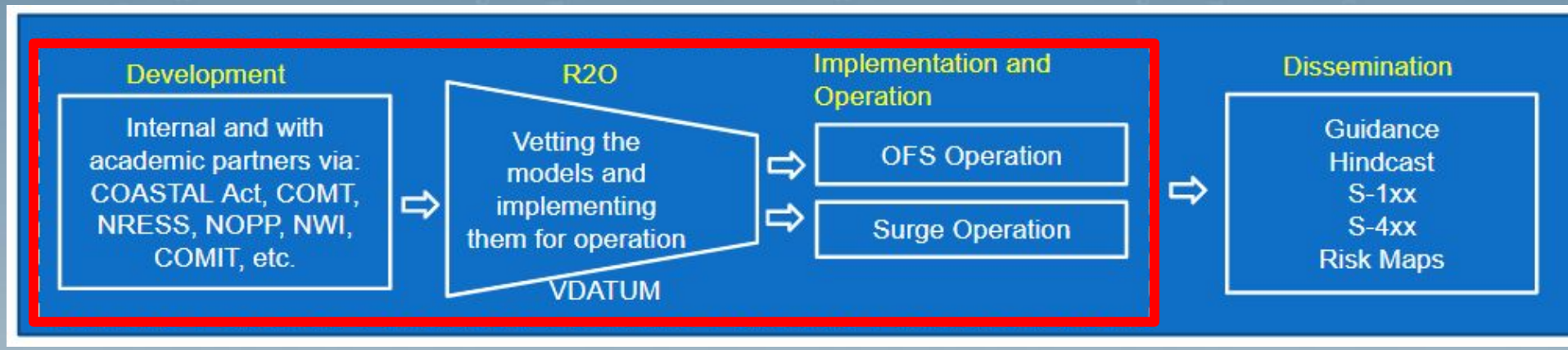
Pat Burke (CO-OPS)
Michael Dennis (NGS)
Tingzhe (Tom) Si (NGS)
Belinda Nava (NGS)
Ben Gavin (NGS)
Philip Marshal (NGS)
Doug Graham (NGS)
Inseong Jeong (NGS)
Lei Shi (OCS)
Ryan Hippenstiel (NGS)
Phil Marshall (NGS)
Ed Myers (OCS)
Liujuan (Rachel) Tang (OCS)
Mojgan Rostaminia (OCS)



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Ryan Hardy (NGS)
Xiaopeng Li (NGS)
Jordan Krcmaric (NGS)

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Scott Mowrey Teng (CO-OPS)
Louis Licate (CO-OPS)
Robert Heitsenrether (CO-OPS)

Surge Team
Saeed Moghimi (OCS)
Soroosh Mani (OCS)
Bahram Khazai (OCS)

…And many colleagues in other NOAA program offices and in academia

Engagement with Federal, State, and local communities

USACE

DoT

NGA

NASA

USAF

Navy

USCG/FEMA

USGS