



Determining Heights in the New IGLD (2020)

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On Behalf of the Vertical Control – Water Levels Subcommittee
Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data

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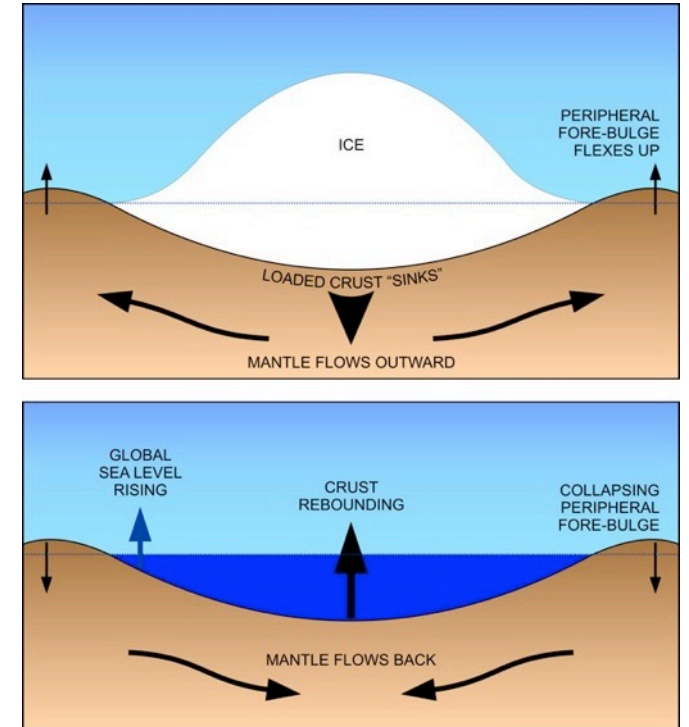
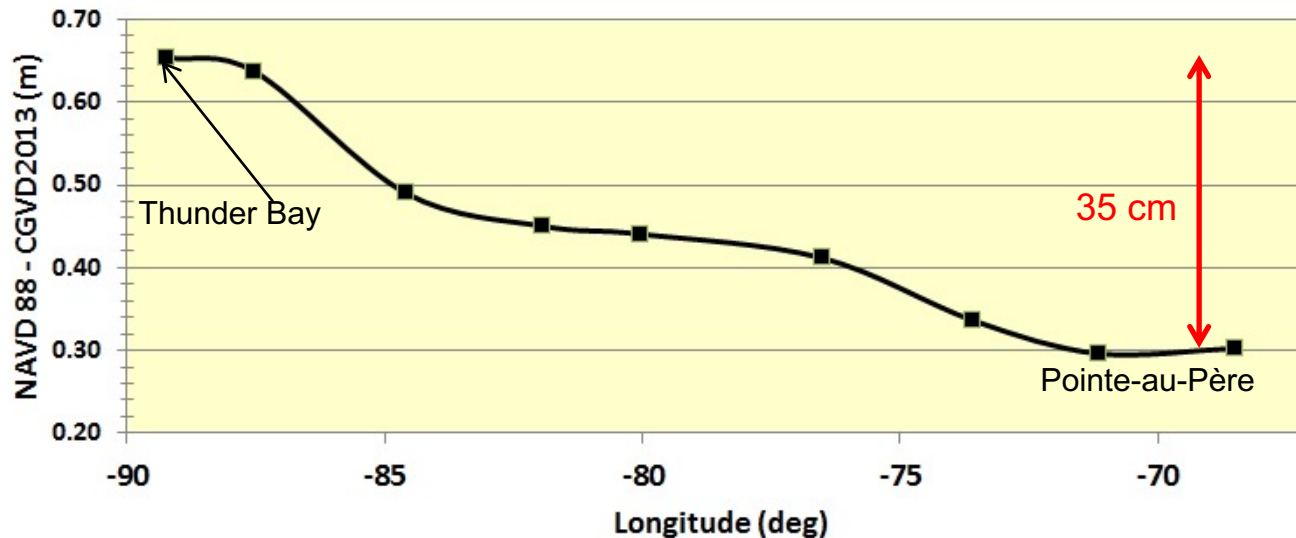


The International Great Lakes Datum

- Official vertical datum used for water level measurements and navigation charts throughout the Great Lakes, their connecting channels and the upper St. Lawrence River
- Defined & maintained by the Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data (CC), a binational committee with representatives from the Governments of Canada and the United States
- Two realizations of IGLD
 - IGLD (1955)
 - IGLD (1985) – current realization based on the NAVD88 datum
 - Both based on expensive, time consuming levelling from MSL at Pointe-au-Père, QC

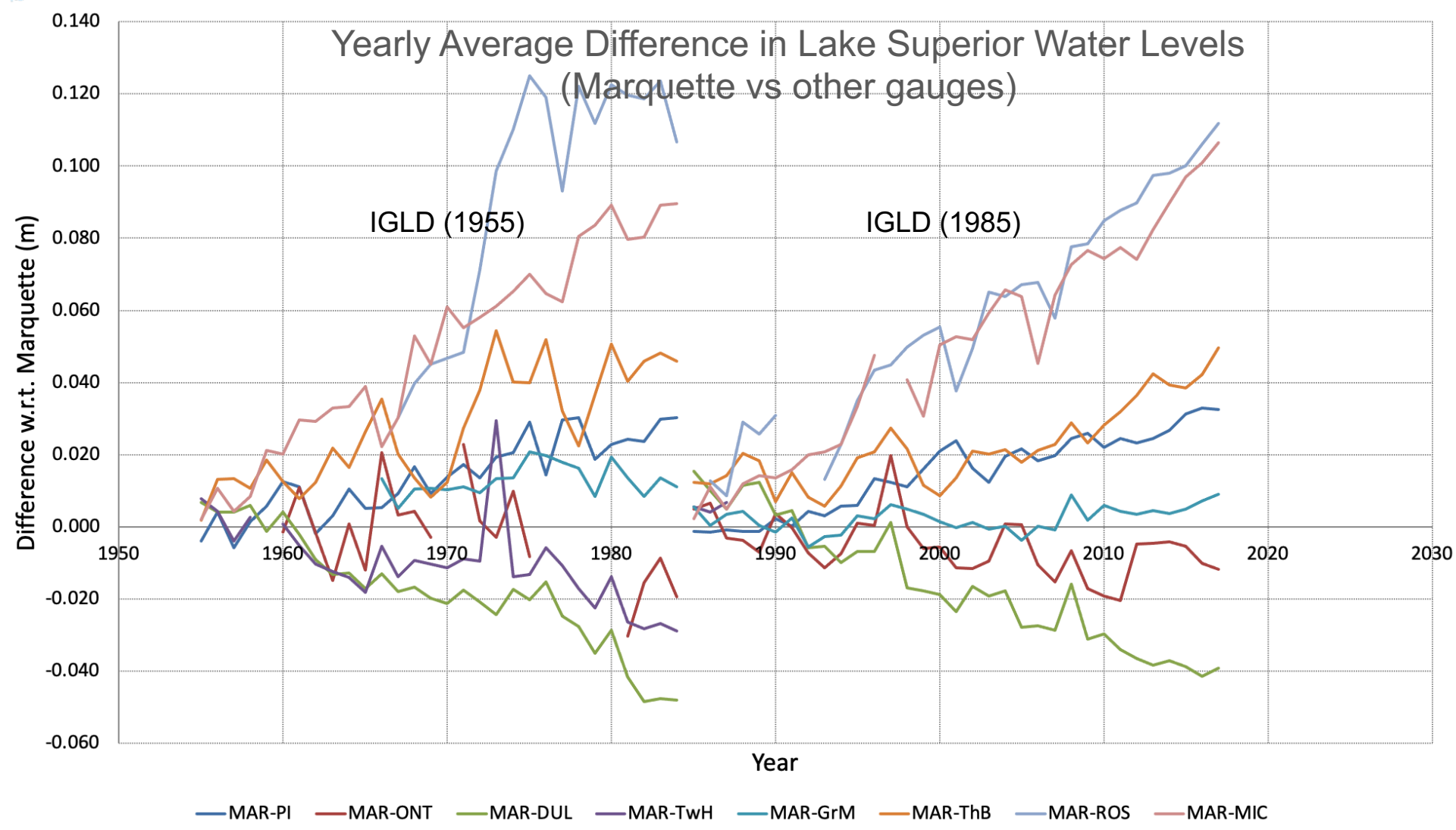
Need to Update IGLD (1985)

- Effects of glacial isostatic adjustment (GIA)
 - ~7mm/yr tilting of Great Lakes Basin (~21cm in 30 yr)
 - Need to update the IGLD datum every 25-30 years
- Systematic error in NAVD88 levelling
 - ~35 cm accumulation of error





GIA Effect on Water Levels Measurements



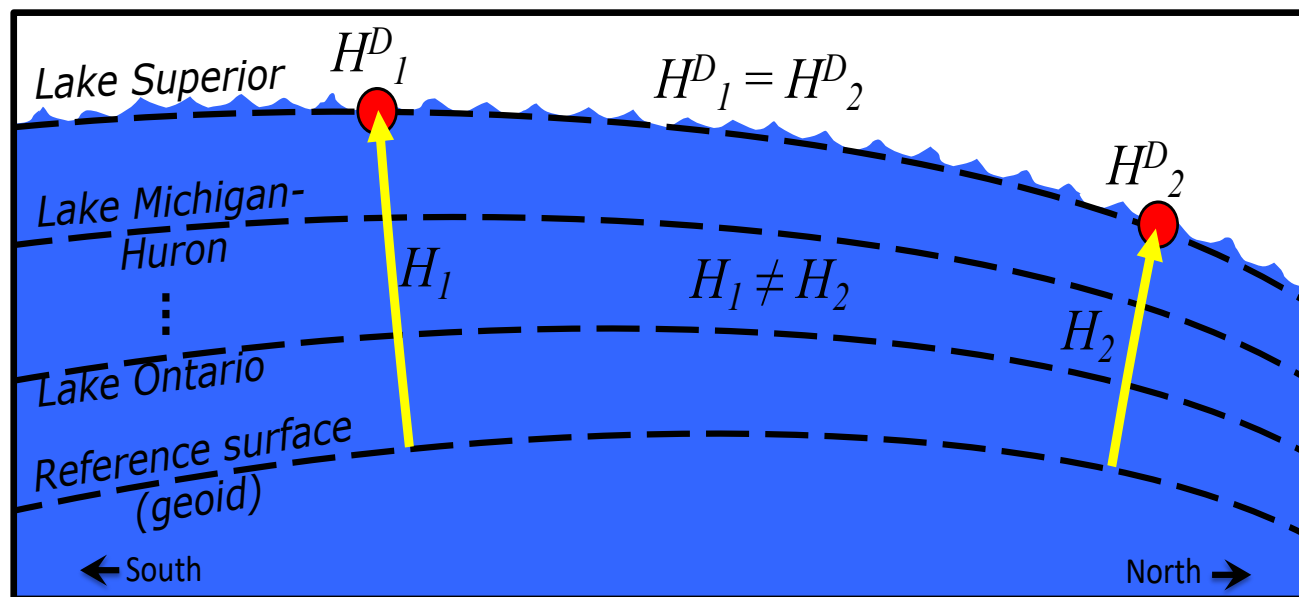


Definition of IGLD (2020)

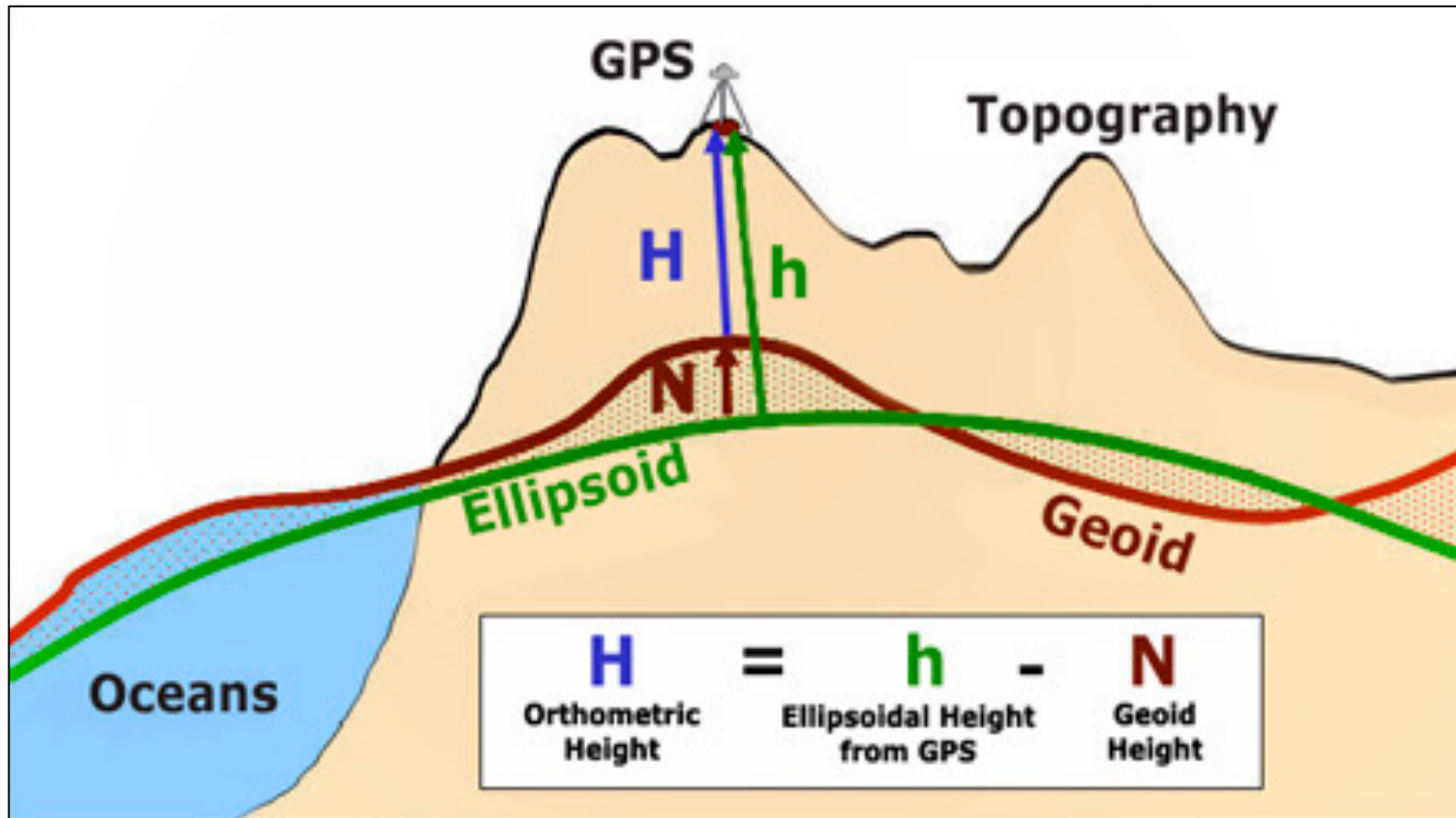
- Reference zero
 - Geopotential value (W_0) of MSL around the coasts of North America
 - Same definition as for CGVD2013 and forthcoming NAPGD2022
 - **31 cm above MSL for IGLD (1985)**
- Reference surface
 - Equipotential surface to which heights are referenced
 - Extension of reference zero inland
 - IGLD (2020) using the same geoid model as NAPGD2022
 - Unlike levelling, geoid model is defined everywhere
 - Geoid model will be compatible with CGVD2013
- Reference epoch for heights: 2020.0
 - Central epoch of 7 year water level observation period

Dynamic Heights

- Orthometric heights (H)
 - Physical distance above reference surface (geoid)
 - Not constant along an equipotential surface such as a lake
- Dynamic heights (H^D)
 - Geopotential numbers scaled by constant value of Normal gravity at 45° latitude
 - Constant along an equipotential surface (lake)
 - Enables the measurement of hydraulic head for water level management
 - Used by all IGLD realizations



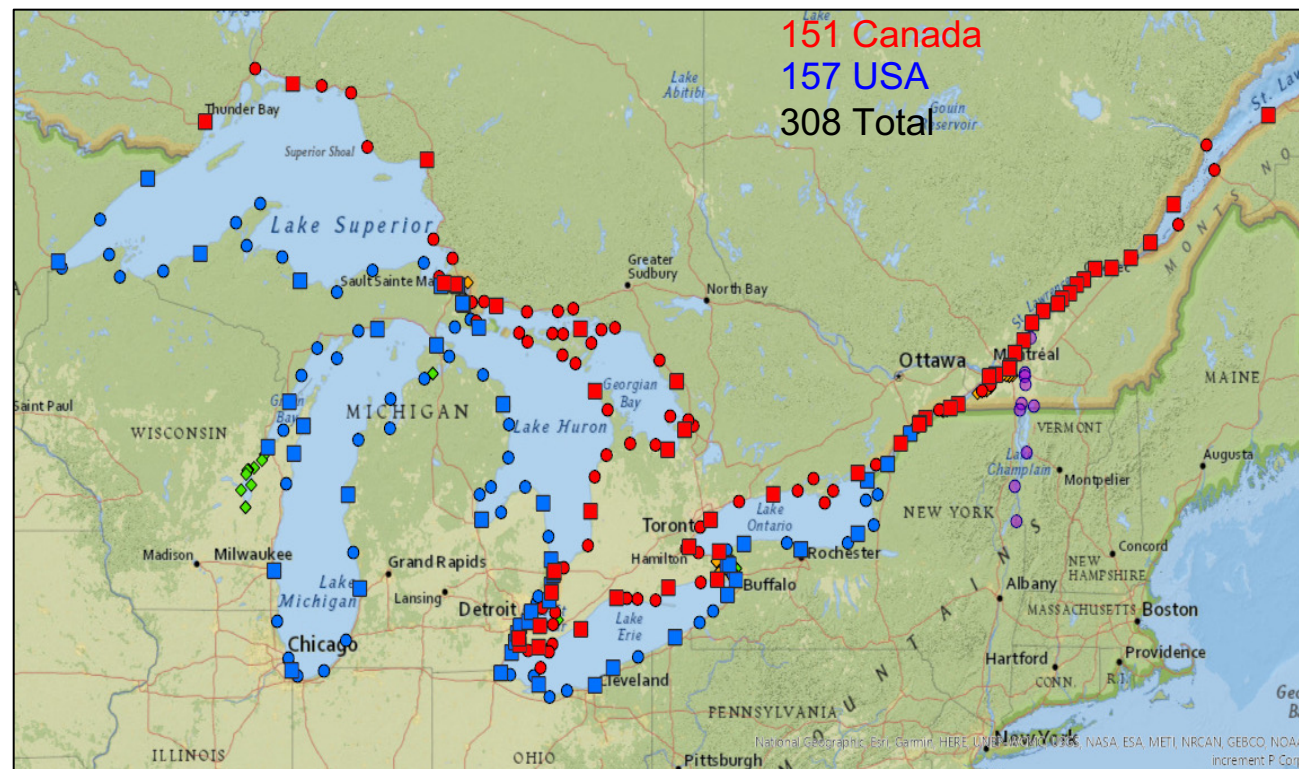
IGLD (2020) Heights from GNSS



- IGLD (2020) heights determined via GNSS
 - Accurate & efficient
- h & N to be referenced to the same NATRF2022 reference ellipsoid
- Dynamic heights are derived from H using a gravity model

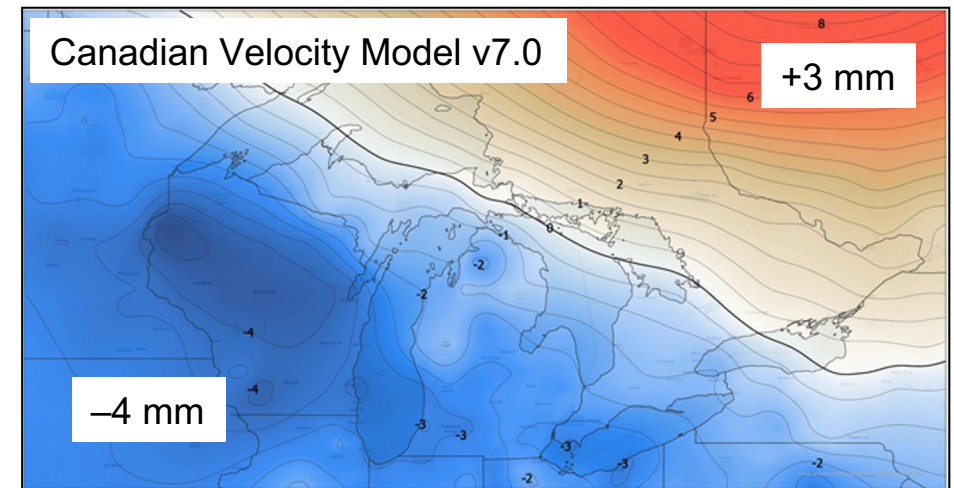
Updating Heights to IGLD (2020)

- GNSS provides the most accurate way to tie to the IGLD (2020) datum
- Planning a high accuracy GNSS survey at Great Lakes water level gauges
 - Schedule for later this summer
 - Occupying 300+ GL gauges
 - Coordinated effort among multiple U.S. and Canadian agencies
 - Led by the geodetic agencies



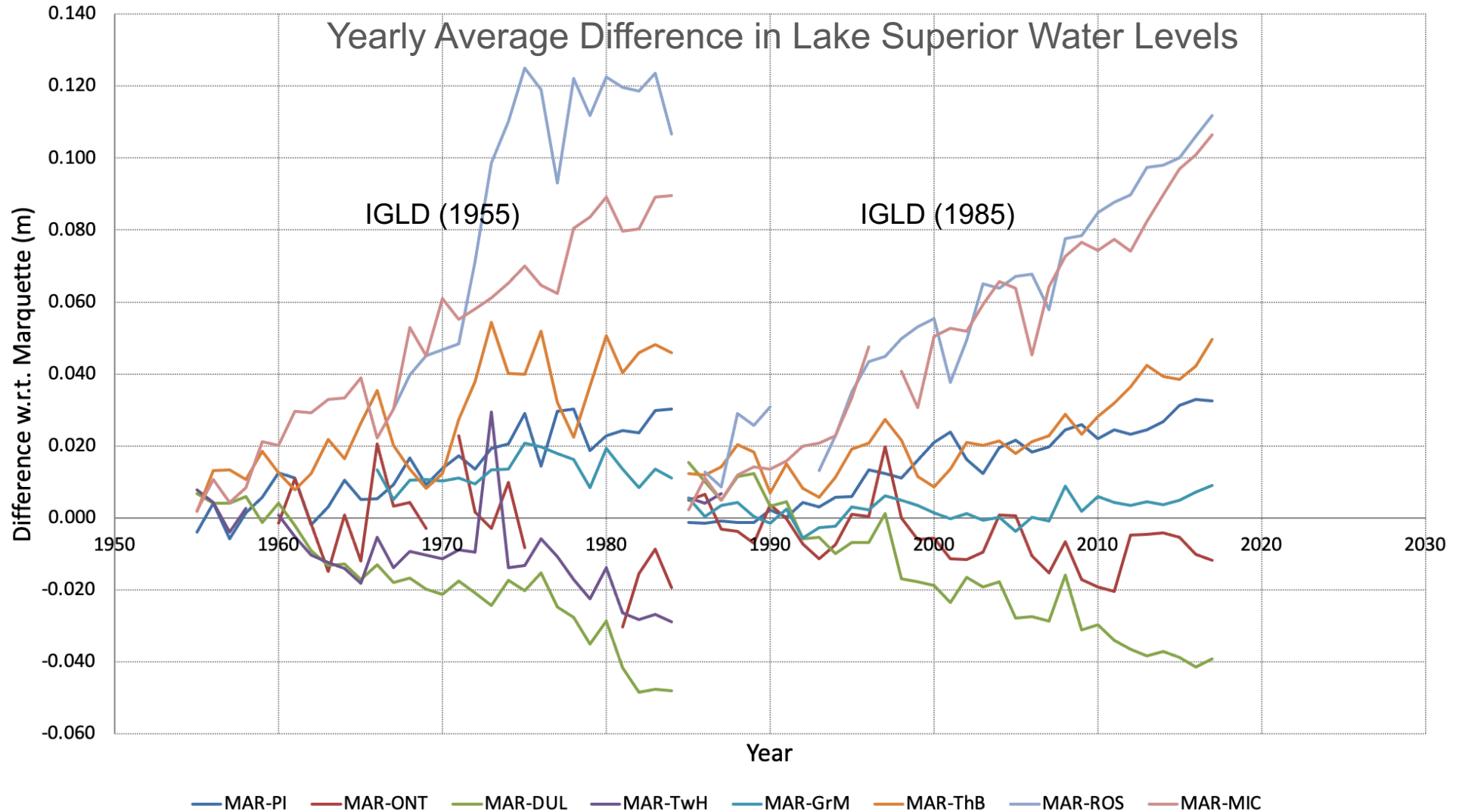
Dynamic Nature of IGLD (2020)

- IGLD (2020) & NAPGD2022 are dynamic datums
- Heights are changing due to regional & local crustal motions
- A **velocity model** will be used to propagate heights between epochs
 - Estimated from a long time series of CACS & CORS positions
 - Implemented as an interpolation grid
 - Can be used to account for crustal motion by propagating heights to a common reference epoch
 - Model will be provided by CGS & NGS
 - Expected to be also incorporated into commercial software





Water Levels Measurements





Transformations & Tools

- Transformations
 - Can be used to convert large amounts of data to IGLD (2020)
 - Transformations will be determined using the 2022 GNSS survey campaign
 - Will have limited accuracy due to uncertainties & biases in old IGLD heights
- Other Tools
 - GNSS processing services (CSRS-PPP & OPUS)
 - Velocity model (TRX & HTDP)
- Commercial software
 - Working with developers to ensure their users have these tools
 - Planning a binational workshop with developers this fall
- Guidelines
 - Will be provided for determining heights in IGLD (2020)
 - Similar procedures as for working in CGVD2013 & NAD3(CSRS)



For More Information

IGLD datums

- Website: <https://GreatLakesCC.org/>
- Email: info@GreatLakesCC.org

New NAPGD2022 & NATRF2022 datums

- <https://geodesy.noaa.gov/datums/newdatums/>

National Geodetic Survey Positioning America for the Future geodesy.noaa.gov

New Datums Are Coming!

NOAA is Replacing NAD 83 and NAVD 88. NOAA's National Geodetic Survey (NGS) will be replacing the datums of the National Spatial Reference System (NSRS), including the **North American Datum of 1983 (NAD 83)** and the **North American Vertical Datum of 1988 (NAVD 88)**. NGS will provide the tools to easily transform between the new and old datums. Read the NGS Ten-Year Plan and visit the **New Datums Web page** on our site to learn more.

How You Can Prepare

- Learn if **legislation** or other formal documents referencing NAD 83 and NAVD 88 need to be changed in your state.
- **Transform existing data** to the latest NSRS datums and realizations, i.e. NAD 83 (2011), GEOID12B, and NAVD 88.
- **Obtain precise ellipsoidal heights** on NAVD 88 bench marks, and visit the GPS on Bench Marks Web page to learn more.
- Require and provide **complete metadata** on all mapping contracts. See our website for more details.

Benefits

The new reference frames (geometric and geopotential) will rely primarily on **Global Navigation Satellite Systems (GNSS)**, such as the Global Positioning System (GPS), as well as on a gravimetric geoid model resulting from NGS' **Gravity for the Redefinition of the American Vertical Datum (GRAV-D)** Project.

The target accuracy of differential orthometric heights (heights relative to sea level) in the geopotential reference frame will be 2 centimeters over any distance, where possible.

What You Can Expect

The magnitude of change with the new datums will vary depending on the datum you are using and your geographic location. The new geometric datum will change latitude, longitude, and ellipsoid height between 1 and 2 meters. In the conterminous United States (CONUS), the new vertical datum will change heights on average 50 centimeters, with approximately a 1-meter tilt towards the Pacific Northwest.

The new datums will extend across CONUS and U.S. territories. The geometric datum replacing NAD 83 will be consistent with geocentric global reference frames defining latitude and longitude. The geopotential datum replacing NAVD 88 will be based on a gravimetric geoid model, enhanced by data from NGS' Gravity for the Redefinition of the American Vertical Datum (GRAV-D) Project.

New Datums

National Oceanic and Atmospheric Administration • National Geodetic Survey