

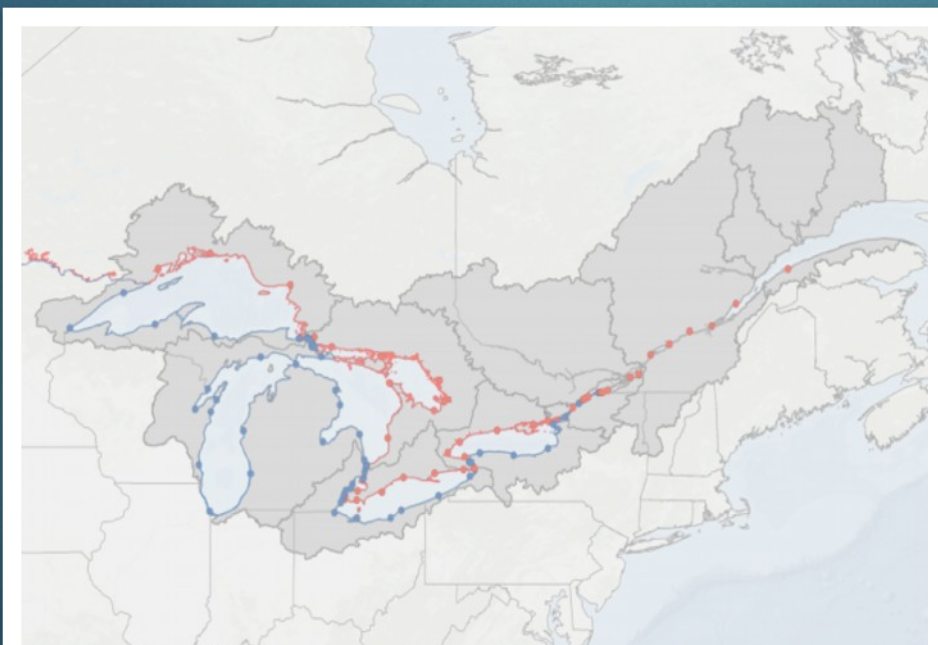


Presented on behalf of the Vertical Control – Water Levels Subcommittee
Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data



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An Updated International Great Lakes Datum (IGLD): What Does This Mean For Your Field Of Practice And Local Community



Lakebed 2030 Conference
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1:45 - 2:15 PM

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in support of NOAA CO-OPS



Speaker Introduction



Nicole Kruz

Communications & Outreach Specialist
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Contracted to:
NOAA CO-OPS,
Oceanographic Division,
Stakeholder Services Branch

Located in:
Silver Spring, MD (Metropolitan DC)
From Michigan



PPT Contents

- ☐ What is IGLD?
- ☐ Who uses datums?
- ☐ Why a new IGLD?
- ☐ Attributes defining the IGLD
- ☐ What is the update's scope?
- ☐ What does the update include?
- ☐ What impacts are expected?
- ☐ Planned outreach and more information
- ☐ Questions



Coordinating Committee

Coordinating Committee on Great Lakes Basic Hydraulic and Hydrologic Data

- ☐ responsible for the coordination of the collection, compilation, use, and dissemination of data related to hydraulics, hydrology, and vertical control for the Great Lakes – St. Lawrence River System

Member Agencies

- ☐ Canadian
 - ☐ Canadian Hydrographic Service
 - ☐ Canadian Geodetic Survey
 - ☐ Environment and Climate Change Canada
- ☐ US
 - ☐ US Army Corps of Engineers
 - ☐ National Oceanic and Atmospheric Administration
 - ☐ US Geological Survey



What is IGLD?

IGLD = International Great Lakes Datum

A common height reference system (i.e. vertical datum). Used to measure and relate water levels to each other.

The official vertical datum for water level measurements and navigation products in the Great Lakes, connecting channels and the St. Lawrence River.

Required for the unified, internationally coordinated collection, compilation, and use of data related to hydraulics, hydrology and water level management.



IGLD Significance

- ❑ **Great Lakes-St. Lawrence River resources are utilized jointly by US & Canada**
 - This requires a common datum and water level gauge network for measuring water levels, depths, volumes and flows
- ❑ **IGLD and water level gauge infrastructure are key components for:**
 - Transportation networks
 - Power generation – both hydroelectric and nuclear
 - Domestic and industrial water use and regulation
 - Monitoring of the largest freshwater ecosystem in the world
- ❑ **Harmonious use of these waters requires international coordination**
 - Coordinating Committee on Great Lakes Basic Hydraulic & Hydrologic Data (CC)
 - International Joint Commission



Who Uses Datums?

- ❑ **Hydraulics engineers**
 - To determine how deeply to dredge navigable channels and waterways
- ❑ **Lock and hydroelectric dam operators**
 - To monitor/regulate water levels referenced to datums
- ❑ **Hydrographers**
 - To generate nautical charts
- ❑ **Mariners**
 - To navigate waterways using nautical charts generated from datums
- ❑ **Ecologists**
 - To determine inundation for marsh restoration projects
- ❑ **Surveyors**
 - To map coastlines & determine marine boundaries

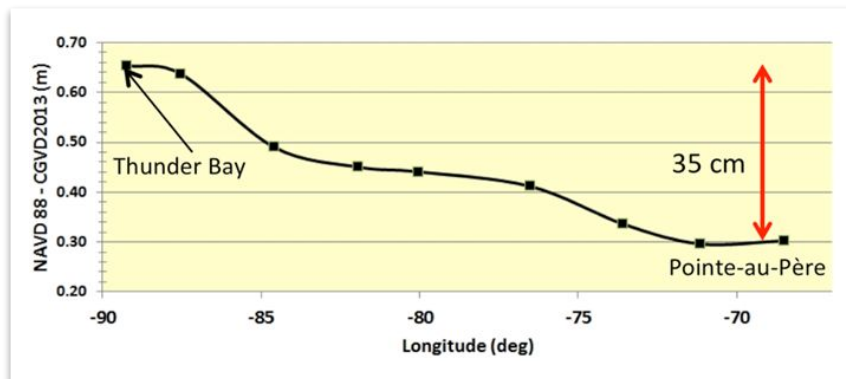




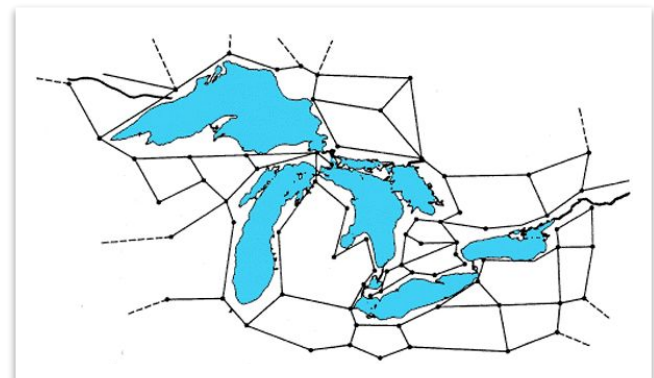
Why A New IGLD?

Two Primary Reasons

- ❑ **IGLD needs to be periodically updated due to ongoing vertical land motion**
 - This motion is known as Glacial Isostatic Adjustment (GIA)
- ❑ **IGLD (1985) is also contaminated by systematic errors in leveling**



Graph showing the range of leveling errors present in IGLD (1985)



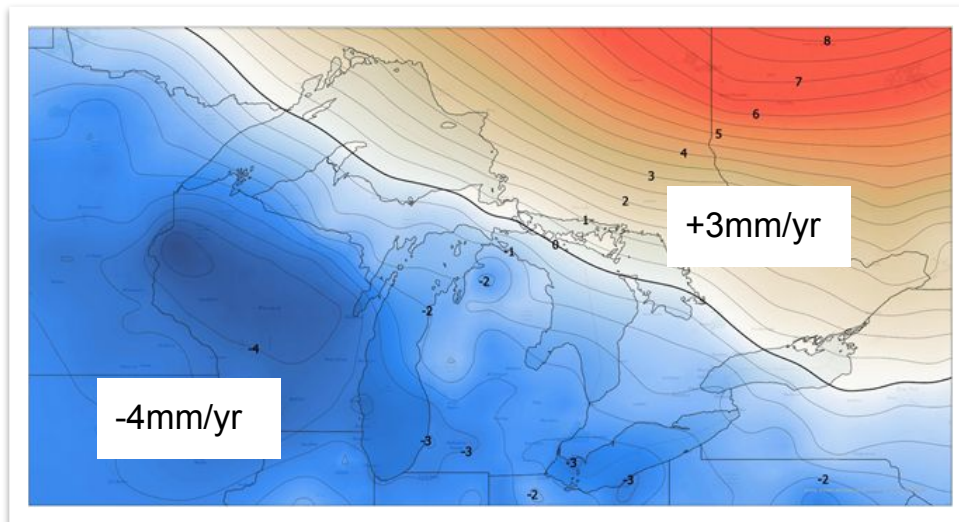
Map depicting the network of leveling loops present in the Great Lakes



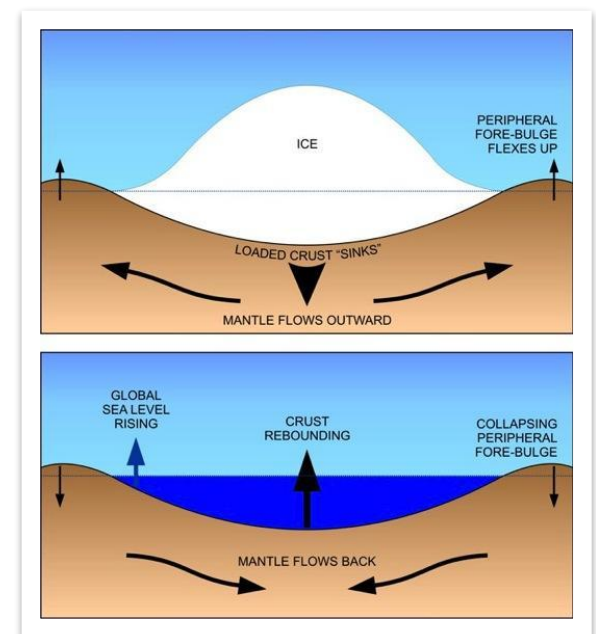
Land Movement

(Glacial Isostatic Adjustment)

- ❑ Uplifting in north, subsiding in south
- ❑ Overall tilting ~ 7 mm/year (21 cm over 30 year)
- ❑ Need to update IGLD every 25-30 year (*overdue*)



Regional map depicting Glacial Isostatic Adjustment from GPS measurements
M. Craymer and C. Wisotzkey, 2021

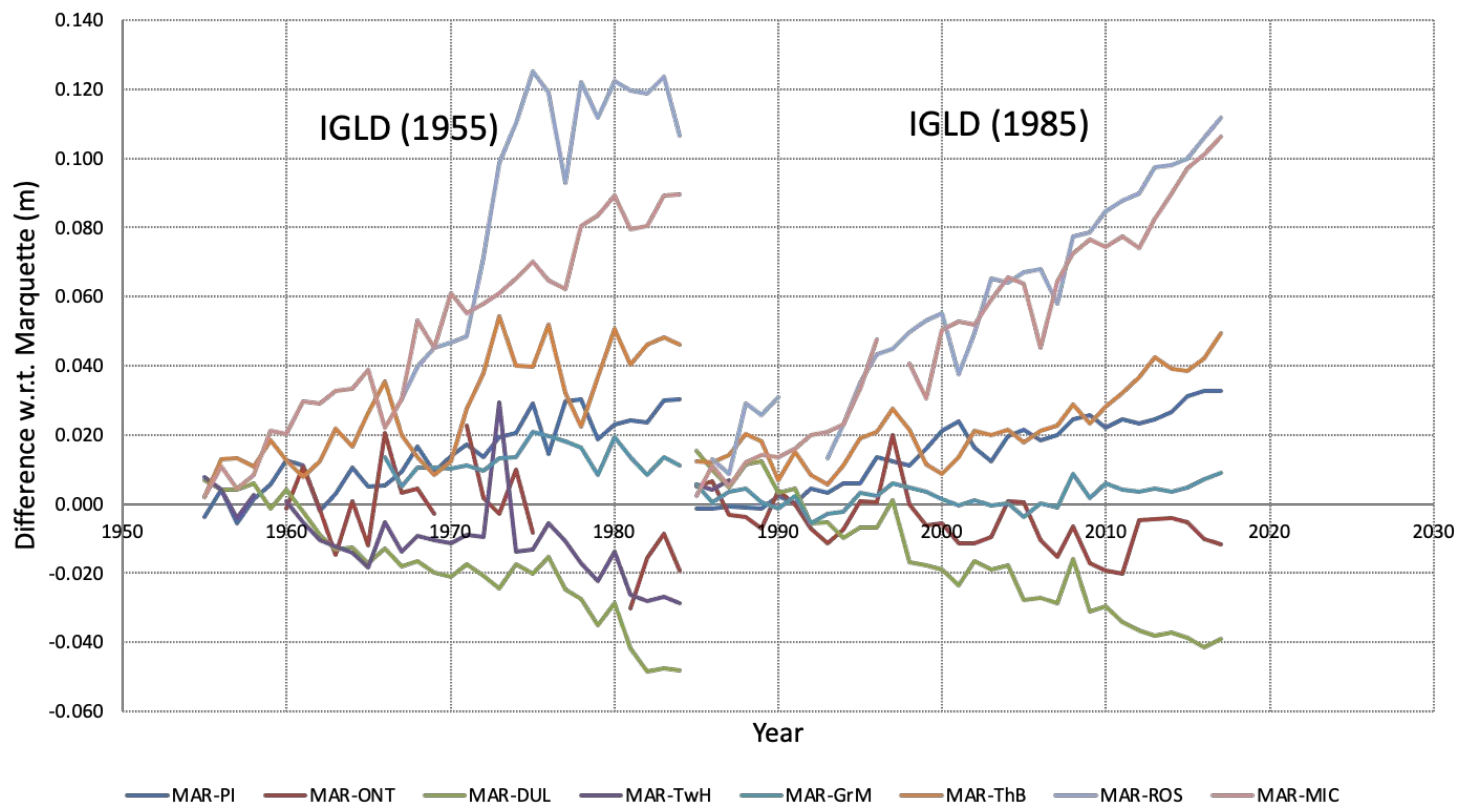


Process of glacial isostatic adjustment.
Top: heavy ice loads on the Earth's surface.
Bottom: Once ice is removed, some areas rebound, while others collapse. Henton et al., 2006.



GIA Effects on Water Levels

Yearly Average Difference in Lake Superior Water Levels – Marquette vs Other Gauges





History & Update Schedule

How often is IGLD update?

- ❑ Every 25-30 years to account for GIA (*overdue*)

Previous realizations of IGLD

- ❑ Leveling-based datums
 - IGLD (1955): original/first
 - IGLD (1985): current, based on NAVD88/Dynamic Heights

New Realization of IGLD

- ❑ IGLD (2020)
- ❑ IGLD (2020) will be based on the new North American Pacific Geopotential Datum (NAPGD2022)
- ❑ Geoid-based datum
- ❑ IGLD is expected to be released shortly after NAPGD2022



Attributes Defining IGLD

Reference Zero

- ☐ References to which heights are referred
- ☐ Usually set at Mean Sea Level (MSL)
- ☐ There are different realizations of MSL for IGLD:
 - IGLD (1955) used MSL at Pointe-au-Père, QC
 - IGLD (1985) used MSL at Pointe-au-Père & Rimouski (5 km away)
- ☐ IGLD (2020) will have same reference zero as the new NAPGD2022 and the Canadian Vertical Datum of 2013
- ☐ Will be 31 cm above that of IGLD (1985)

Reference Surface

- ☐ Equipotential surface to which MSL heights are referenced
- ☐ Extends the reference zero inland
- ☐ Defined by geodetic leveling in IGLD (1955) and (1985)
- ☐ IGLD (2020) will be defined by the new, more accurate NAPGD2022 geoid



Attributes Continued

Dynamic Heights

- ❑ Based on geopotential difference between a point and the reference geopotential surface
- ❑ Constant along an equipotential surface (e.g. lake)
- ❑ Required for water management and power generation

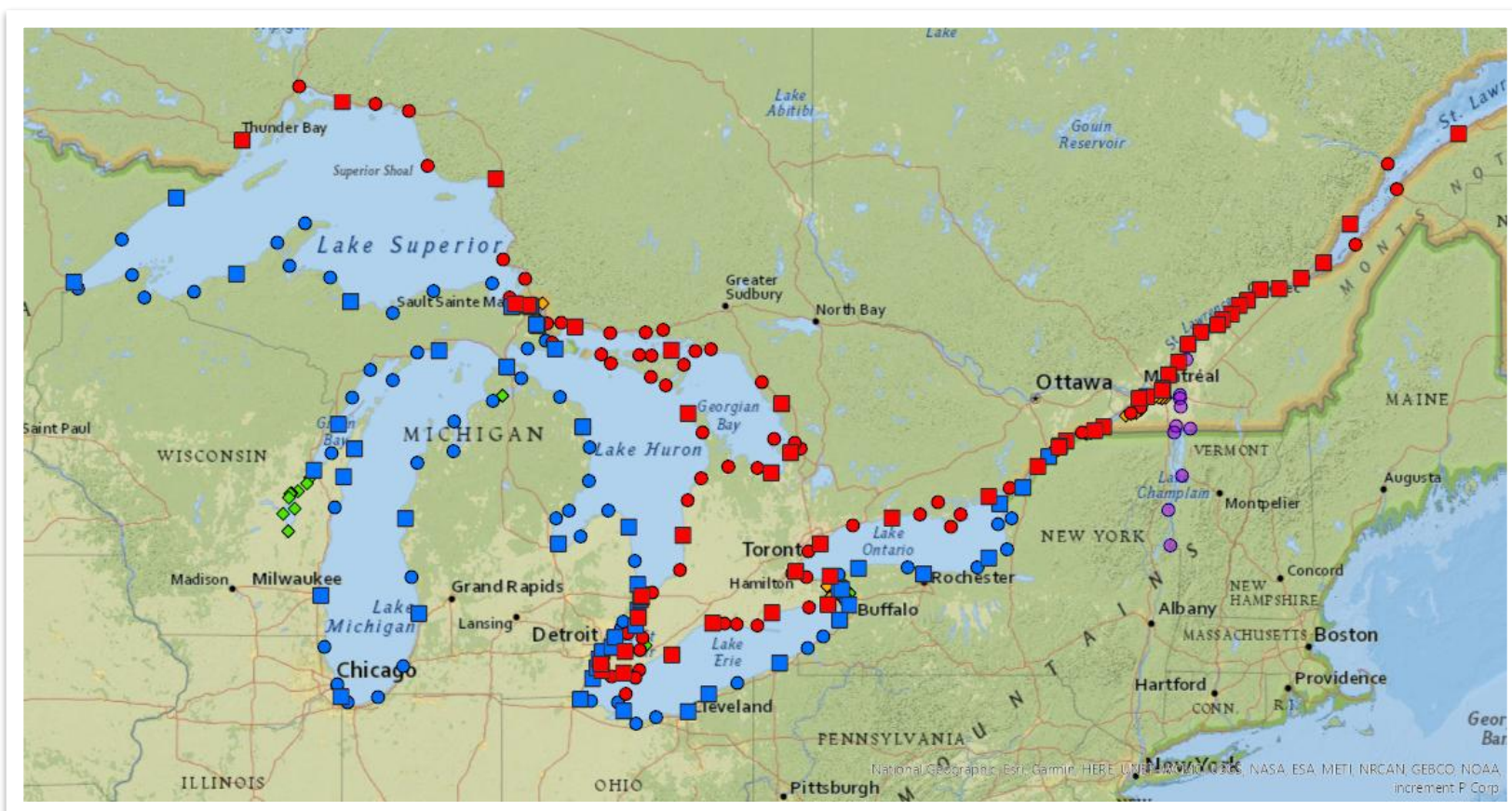
Reference Epoch

- ❑ A point in time to which data is referenced (i.e. collection period for data)
- ❑ Represents the mean water level defined over a 7-year period
- ❑ Used to evaluate lake topography
- ❑ IGLD (2020) will use the reference epoch 2017-2023. Central epoch is 2020



Update Scope

Location of Great Lakes Stations / Gauges



Water level stations in the Great Lakes region. Square symbols indicate permanent stations and circle symbols indicate seasonal stations. Other symbols indicate Seaway, USACE, USGS, ECCC, NYPA, and OPG stations. Source: [IGLD Update Station Map](#)



Station / Gauge Types

Permanent Stations

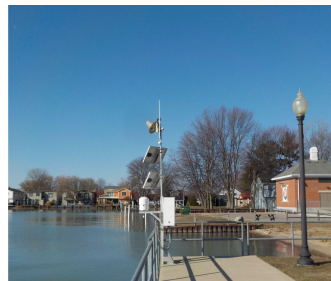
- ☐ Housed in brick structures with solid foundations and heat lamps
- ☐ Most have been around for decades
- ☐ Collect data year round and transmits this data every 6 or 3 minutes
- ☐ Sensors used: encoder, pressure gauges
- ☐ 58 in Canada / 53 in US, some with GNSS



Permanent Station: Toronto, ON (left), Encoder sensor (right)

Seasonal Stations

- ☐ Lack dedicated structure, most are affixed to existing infrastructure
- ☐ Collects data only during summer
- ☐ First used in IGLD (1955) but not in IGLD (1985), reintroduced in IGLD (2020)
- ☐ Sensors used: microwave radar
- ☐ 66 in Canada / 54 in US



Seasonal Stations: New Baltimore, MI (left). Killarney, ON (right)



Timeline of Activities

Activity	Date
Complete bi-national plan for IGLD (2020) and present to the Coordinating Committee for approval	2018
Choose and adopt a W_0 as the new IGLD reference zero	2015
Identify potential partners/users who can help develop and implement IGLD (2020)	2016-2023
Digitize and archive old leveling information, as required	2016-2023
Perform annual maintenance and leveling ties at permanent water level gauges	2016-2024
Perform analysis of permanent gauging requirements and prioritize new proposed gauges	Completed US / 2023 CHS
Adjust and publish 2015 GPS campaign survey results	2017
Complete preparing methodologies for determining heights using GNSS surveys and local leveling at tie gauges	2017-2018
Review historic water level data for re-evaluation of Low Water Datum (LWD)	2017-2018
Reanalyze/compare GPS campaign surveys from '97, '05, '10, '15 to estimate preliminary movement	2017-2018
Perform analysis of seasonal gauging requirements and prioritize locations	Completed
Continue annual installations of seasonal water level gauges with GPS and leveling ties	2017-2023
Perform 20201 GNSS campaign survey in Great Lakes – St. Lawrence River system	Summer 2022
Adopt North American geoid model for IGLD (2020)	2025
Create crustal movement models using GPS campaigns and CORS/CACS data	2023
Complete seasonal water level gauging	2023
Determine hydraulic correctors (lake topography)	2024
Determine new Low Water Datum on lakes and rivers with respect to IGLD (2020)	2025
Determine/publish transformations between IGLD (2020) and other datums, including IGLD (1985)	2024
Perform 2025 GNSS Campaign, validate IGLD (2020) heights and crustal movement model	2025
Publish new IGLD (2020)	2025
Publish final IGLD (2020) report	2026



Activity Highlights

- ☐ Develop Update Plan **COMPLETE** (*available on the Coordinating Committee website*)
- ☐ Adopt Reference Zero **COMPLETE**
- ☐ Collect data, achieved through the following: **UNDERWAY**
 - Installation of seasonal gauges (*each year from 2017-2023 between June to September*)
 - Completion of GNSS survey & collection of Global Navigation Satellite Positioning Data at 200+ locations
- ☐ Create crustal movement models using GNSS data **PLANNED**
- ☐ Determine lake topography **PLANNED**
- ☐ Determine new Low Water Datum on lakes and rivers with respect to IGLD (2020) **PLANNED**
- ☐ Determine/publish transformations between IGLD (2020) and other datums (e.g. IGLD (1985)) **PLANNED**
- ☐ Perform 2025 GNSS Campaign, validate IGLD (2020) heights and crustal movement model **PLANNED**



Updating Other Gauges

- ❑ **Many other “entity” gauging stations used for water management operations, such as:**
 - International Gauging Stations (IGS) & Binational Interest Gauging Stations (BIGS) for water outflow regulation (regulation)
 - Seaway gauges for lock operations, dredging, navigation, and regulation
 - US Army Corps of Engineers gauges used for dredging operations
 - Power entity gauges for power generation operations and regulation
 - ECCC and USGS inland river and canal gauges
 - Municipal gauges

- ❑ **These gauges need to be updated to IGLD (2020)**
 - Need to use GNSS to get heights in IGLD (2020)
 - Many of these gauges will be included in the water level analysis and 2022 GNSS survey campaign



Transforming Between Datums

- ❑ **Many products use previous IGLD datums and will need to be updated to the new datum**
- ❑ **It is not possible to regenerate all products in the new datum**
- ❑ **Transformation models and tools will be needed**
 - Need heights at common points in old and new datums
 - May require digitizing heights in older datums
 - Tools must be capable of transforming thousands of data points
- ❑ **Accuracy of transformations depends on:**
 - Homogeneous spatial coverage of stations common with older datums
 - Including as many such stations as possible in 2022 GNSS campaign



Expected Impacts

Examples include:

- ❑ Economic viability and safety of commercial and recreational navigation
 - Chart depth references and under keel clearance
 - Low Water Datum: the elevation for water depths on nautical charts
 - Dredging in ports, harbors, navigation channels
- ❑ Water level regulation (hydropower), planning, and forecasting
- ❑ Coastal zone management and planning, including flood & erosion prediction and response, and coastal structure design, construction & maintenance
- ❑ Coastal habitat restoration under the Great Lakes Restoration Initiative (GLRI)



Outreach & Communications

- Member agencies of the Coordinating will need to inform and educate stakeholders about the IGLD (2020) update and its anticipated impacts
- To achieve this, an Outreach Working Group has developed an outreach plan that outlines a process to identify:
 - Stakeholders
 - Communications channels,
 - Media strategy,
 - Outreach product development,
 - Tracking and evaluation metrics



Cover page

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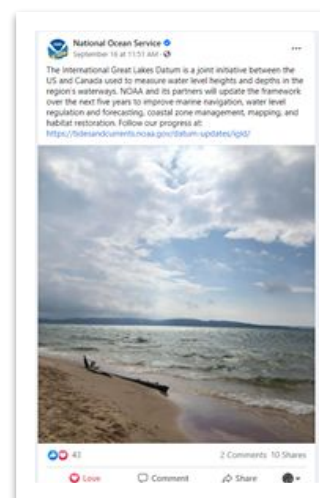
Outreach & Communications

Recent/Past Media

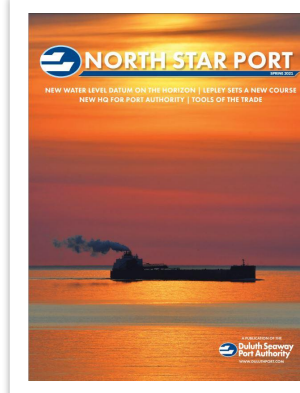
- **Webinars:** US Army Corps of Engineers, National Geodetic Survey, IJC engineers
- **News article:** Freight Waves “On the Level: How Water Data Updates Help Maritime Shippers”
- **Podcast:** Interlochen Public Radio: Points North: Rising Waters
- **Social Media:** Great Lakes Environmental Research Laboratory Facebook post
- **Websites:** NOAA’s CO-OPS datums update webpage, Coordinating Committee updated IGLD (2020) webpage

Future/Targeted Outreach

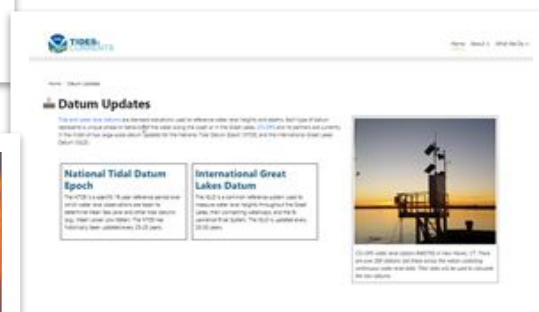
- **Webinars:** targeted user groups
- **Conference presentations:** Canadian Hydrographic Conference (2022)
- **Blog:** GLOS semi-annual publication
- **Factsheets:** IGLD, Low Water Datum
- **Board Meetings:** IJC Commissioners



Facebook post



Local radio podcast (Traverse City, MI)



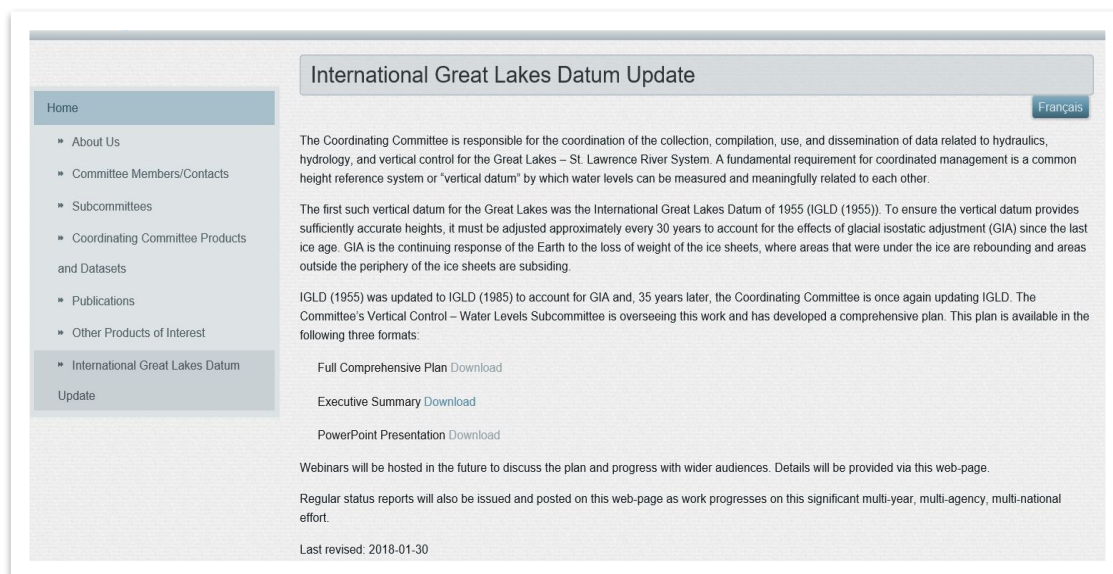
New NOAA CO-OPS website

Port Authority article (Duluth, MN)



More Information

Coordinating Committee Website



<http://www.greatlakescc.org>

Email Contacts

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Questions?

