



Presented at the FIG Working Week 2023,
28 May - 1 June 2023 in Orlando, Florida, USA

FIG WORKING WEEK 2023

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Protecting
Our World,
Conquering
New Frontiers

The 2022 GNSS Survey for a New International Great Lakes Datum

Overcoming Challenges with International Planning and Digital Tools

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International Cooperation

- Surveyors from the US and Canada collaborated in support of the International Great Lakes Datum (IGLD)
- The survey collected over 19,000 hours of GNSS over the span of 6 weeks each



Background

- The Great Lakes region is one of the largest freshwater resources on Earth
- It is affected by crustal motion largely due to glacial isostatic adjustment (GIA)
- The IGLD accounts for such changes to provide a consistent water level datum
- IGLD is updated every 25-30 years and a new update is currently underway



GNSS surveys

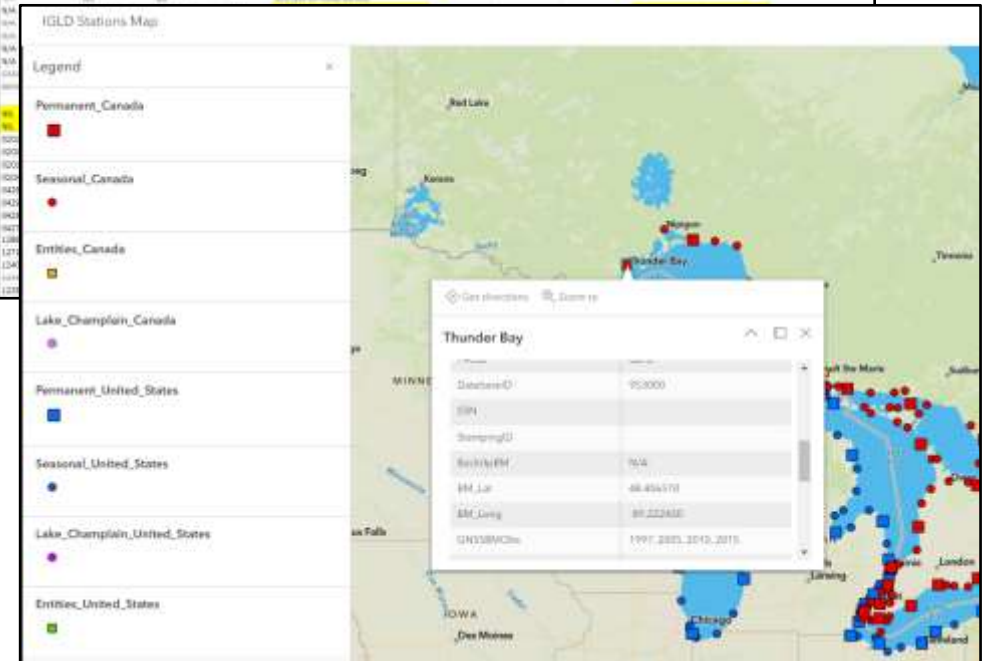
- GNSS data on ground marks is combined with geodetic leveling data to the water level stations to create datum products
- Previous GNSS surveys were completed in 1997, 2005, 2010, and 2015
- The 2022 survey was the largest, observing at permanent and seasonal water level stations - 365 bench marks



Planning

- Geodetic and water level partners from both nations planned the work
- Stations and marks to survey were agreed upon
- Visualization through web mapping improved planning efforts

Station ID	Station Name	Country	Water Body	Station Type	Station ID	Station Name	Country	Water Body	Station Type	Station ID	Station Name	Country	Water Body	Station Type
511	Chicago Lock	United States	Chicago River	Chicago Lock	511	Chicago Lock	United States	Chicago River	Chicago Lock	511	Chicago Lock	United States	Chicago River	Chicago Lock
520	Chicago Lock	United States	Chicago River	Chicago Lock	520	Chicago Lock	United States	Chicago River	Chicago Lock	520	Chicago Lock	United States	Chicago River	Chicago Lock
530	Chicago Lock	United States	Chicago River	Chicago Lock	530	Chicago Lock	United States	Chicago River	Chicago Lock	530	Chicago Lock	United States	Chicago River	Chicago Lock
540	Chicago Lock	United States	Chicago River	Chicago Lock	540	Chicago Lock	United States	Chicago River	Chicago Lock	540	Chicago Lock	United States	Chicago River	Chicago Lock
550	Chicago Lock	United States	Chicago River	Chicago Lock	550	Chicago Lock	United States	Chicago River	Chicago Lock	550	Chicago Lock	United States	Chicago River	Chicago Lock



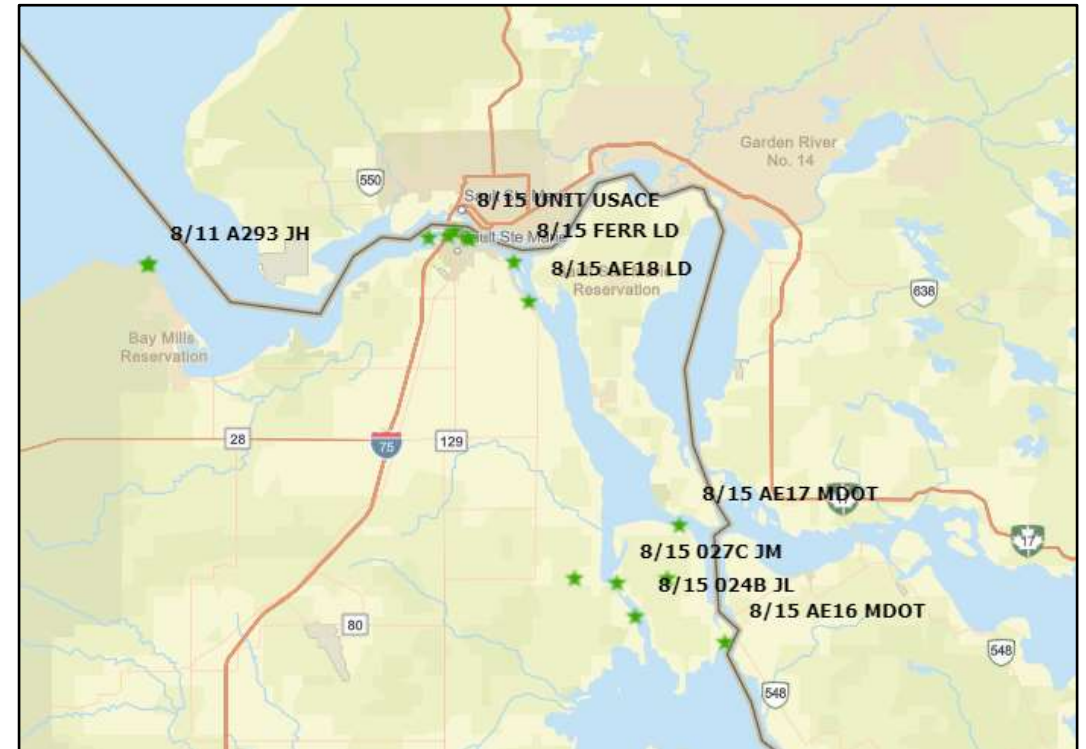
Planning

- Binational specifications were written to improve field protocols and account for equipment differences
- Details on duration, rate of collection, metadata, quality of equipment were established
- Desired accuracy was a minimum of 2 cm at each benchmark



Planning

- Two 24-hour static GNSS observations were to be collected on each mark
- US and Canada surveyors developed a schedule to maintain pace with each other
- Consistent conditions and "cross-lake" observations were important



Execution

- Multiple partners assisted with mark reconnaissance and observation
- Survey was completed on schedule with limited disruptions
- Successful planning and preparations led to efficient adjustments

Canadian Partners	United States Partners
NRCan - Canadian Geodetic Survey (CGS)	NOAA – National Geodetic Survey (NGS)
DFO - Canadian Hydrographic Service (CHS)	NOAA – Center for Oceanic and Operation Products (CO-OPS)
ECCC - National Hydrological Service (NHS)	US Army Corp of Engineers (USACE)
Ontario Power Generation (OPG)	Michigan Department of Transportation (MDOT)
Saint Lawrence Seaway Management Corporation (SLSMC)	New York Power Authority (NYPA)
Hydro Québec (HQ)	Great Lakes St. Lawrence Seaway Development Corporation (SLSDC)
	Wisconsin Department of Transportation (WisDOT)
	Darin J. Henkel, PLS


Execution

- Both US and Canada implemented protocols for communication and data storage
- Established start/stop times worked well for traversing between points and transferring data
- Early QA/QC was performed to ensure data quality

Shared with me > IGLD (2020) Observations > US Observations

Name ↑

- 00FR_DQ7277_905 2000 F RESET
- 2LMN_DE7816_831 1062 LMN
- 2RAL_OG0217_906 3012 RAIL
- 007J_XXXXXX_906 3007
- 009G_XXXXXX_906 3009
- 010A_BBHK02_909 9010
- 010G_BBDV74_908 7010
- 011B_BBGK51_907 5011
- 012B_BBHJ42_905 2012



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Solution Quality Indicators

MARKS	ANTENNA	HEIGHT (m)	EPH TYPE	OBS (%)	FIXED (%)	RMS (m)	LAT (m)	Lon (m)	HGT (m)
010a	TRM115000.00	NONE	1.499 rapid	94.3	99.0	0.011	0.000	0.000	0.001
013a	TRM115000.10	NONE	2.000 rapid	95.1	97.6	0.012	0.000	0.000	0.001
013c	TRM115000.10	NONE	2.000 rapid	93.9	96.2	0.014	0.000	0.000	0.001
018k	TRM115000.00	NONE	1.998 rapid	92.9	94.2	0.013	0.000	0.000	0.001
018l	TRM115000.00	NONE	2.001 rapid	95.1	98.2	0.011	0.000	0.000	0.001
020c	TRM115000.00	NONE	1.999 rapid	94.4	83.6	0.014	0.000	0.000	0.001

Results

- Over 19,000 hours of static GNSS data collected by ~25 observers
- Metadata including photos, equipment, mark information, weather, and obstructions delivered
- Sub-cm repeatability exceeded goals
- Full data processing and adjustment is underway





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Thank you!

**For more information about the
IGLD update, visit:**

<https://GreatLakesCC.org>



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