The Current State of Great Lakes Water Levels

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ELPC
May 9, 2022

Outline


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USGS

GLPF

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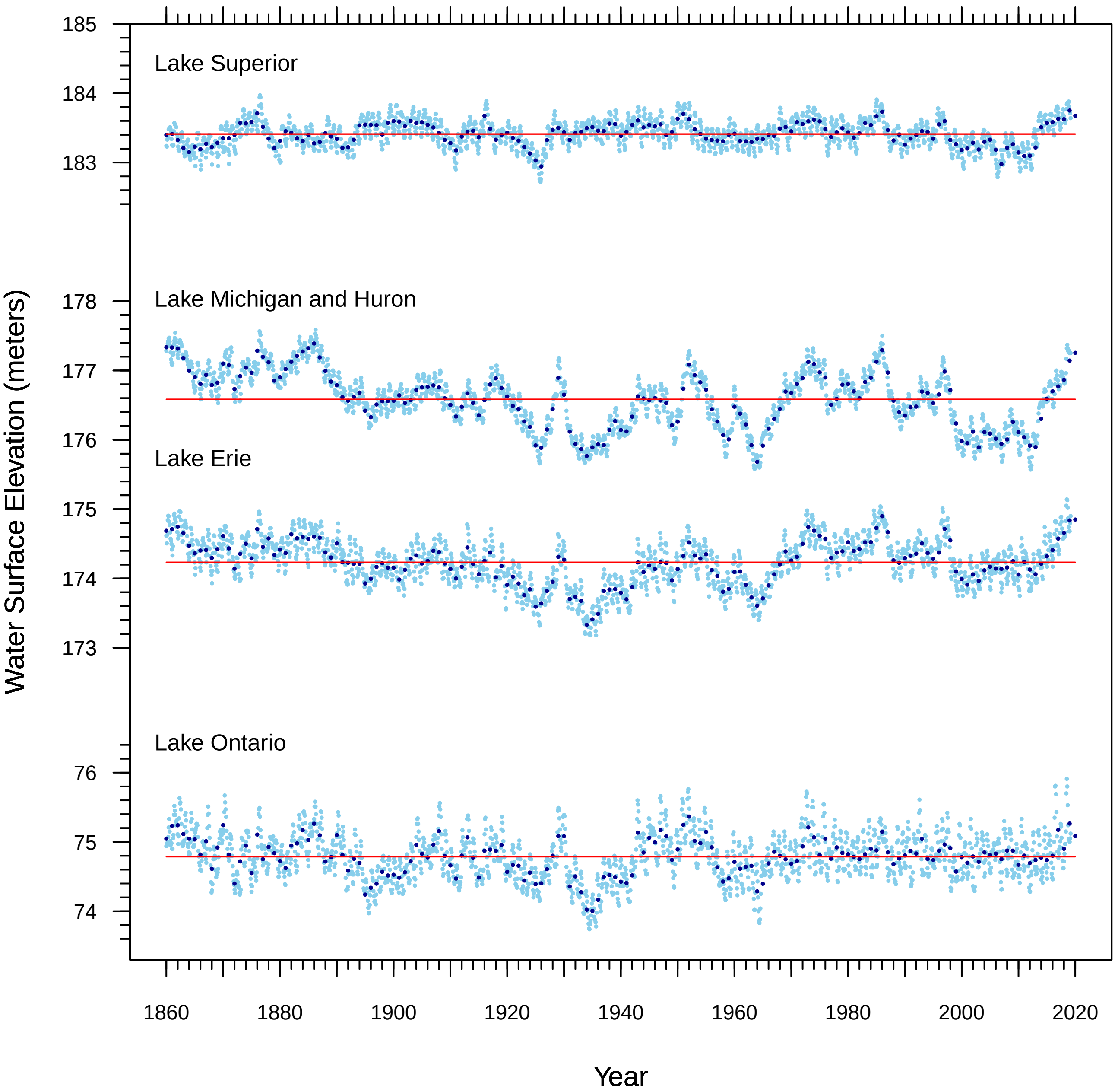
Michigan Department of Transportation

UNIVERSITY OF
MICHIGAN

GREAT LAKES
ST. LAWRENCE
GOVERNORS
& PREMIERS

Outline

1. Introduction
2. A look back at May 2021
3. May 2022 water level status
4. Future water levels


Lake Superior
Lake Michigan and Huron
Lake Erie
Lake Ontario
185
184
183
178
177
176
175
174
173
76
75
74
Water Surface Elevation (meters)
1860
1880
1900
1920
1940
1960
1980
2000
2020
Year

SEARCH The New York Times

CANADA

Montreal Flooding Displaces Thousands

By CRAIG S. SMITH MAY 6, 2017

Jean-François Perrault, left, and Julie Theriault moved mattresses from a home in Gatineau, Quebec. Chris Wattie/Reuters

(Antonio Perez / Chicago Tribune)

Groundwater running out in northeastern Illinois

FEB 25, 2021

Outline

The Great Lakes Dashboard

5/9/2022, 10:00:30 AM

Variable | By Basin | Metric | <<

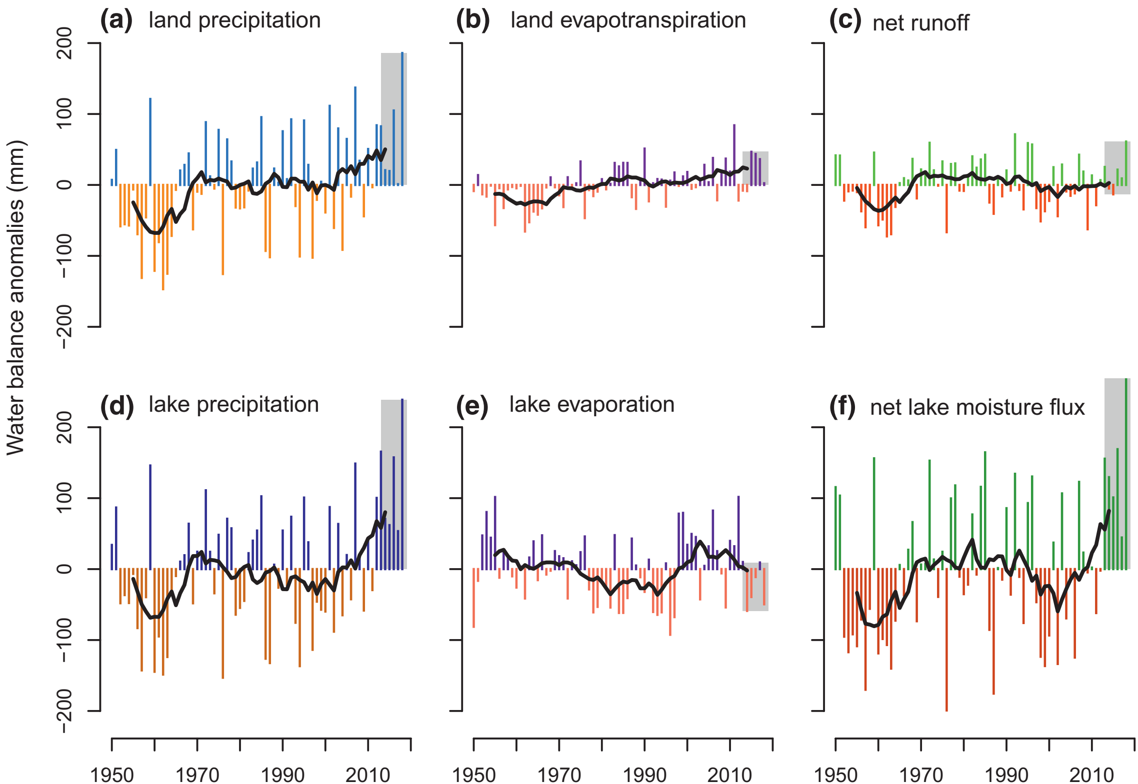
☑ Superior ☑ Michigan-Huron ☐ St. Clair ☐ Erie ☐ Ontario | Water Levels

The Great Lakes Dashboard

5/9/2022, 10:00:30 AM

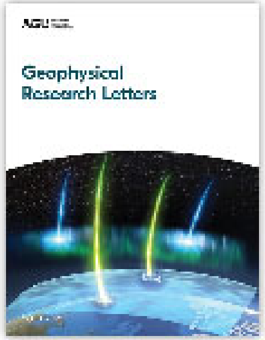
Variable | By Basin | Metric | <<

☑ Superior ☑ Michigan-Huron ☐ St. Clair ☐ Erie ☐ Ontario | Water Levels



(a) land precipitation
(b) land evapotranspiration
(c) net runoff
(d) lake precipitation
(e) lake evaporation
(f) net lake moisture flux
Water balance anomalies (mm)
200
100
0
−100
−200
1950
1970
1990
2010

Geophysical Research Letters



Research Letter

A tug-of-war within the hydrologic cycle of a continental freshwater basin

A. D. Gronewold, H. X. Do, Y. Mei, C. A. Stow

First published: 04 January 2021 | https://doi.org/10.1029/2020GL090374

Outline

The Great Lakes Dashboard

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☑ Superior ☑ Michigan-Huron ☐ St. Clair ☐ Erie ☐ Ontario | Water Levels

The Great Lakes Dashboard

5/9/2022, 10:00:30 AM

GLERL CIGLR Great Lakes RESTORATION Great Lakes Commission des Grands Lacs

Variable | By Basin | Metric | <<

☑ Superior ☑ Michigan-Huron ☐ St. Clair ☐ Erie ☐ Ontario | Water Levels

The Great Lakes Dashboard

5/9/2022, 10:00:30 AM

Variable | By Basin

Metric | <<

☑ Superior ☑ Michigan-Huron ☐ St. Clair ☐ Erie ☐ Ontario | Water Levels

The Great Lakes Dashboard

5/9/2022, 10:00:30 AM

Variable | By Basin | Metric | <<

☑ Superior ☑ Michigan-Huron ☐ St. Clair ☐ Erie ☐ Ontario | Water Levels

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Water Level Forecasting (multi-decadal)

Lakes Michigan-Huron and Erie

Generated by the Great Lakes Dashboard: http://www.glerl.noaa.gov/data/gldb

Frontiers in Water

ORIGINAL RESEARCH
published: 13 April 2022
doi: 10.3389/frwa.2022.805143

Check for updates

Changes in Large Lake Water Level Dynamics in Response to Climate Change

*Alexander VanDeWeghe[1], Victor Lin[2], Jennani Jayaram[3] and Andrew D. Gronewold[1,4]**

[1] Department of Civil and Environmental Engineering, College of Engineering, University of Michigan, Ann Arbor, MI, United States, [2] Department of Electrical Engineering and Computer Science, College of Engineering, University of Michigan, Ann Arbor, MI, United States, [3] Department of Mathematics, College of Literature, Science, and the Arts, Ann Arbor, MI, United States, [4] School for Environment and Sustainability, University of Michigan, Ann Arbor, MI, United States

"2100? IT DOESN'T KEEP ME UP AT NIGHT!"

Lessons for the Next Generation of Climate Assessments

BY LEE TRYHORN AND ART DEGAETANO

Climate change is underway and the impacts are being felt. Assessments of climate change impacts, adaptation, and vulnerability (collectively termed "climate assessments") are being undertaken to inform decision making in this environment of uncertainty (Carter et al. 2007). The urgent need for climate information for management and adaptation decisions has led to an increase in the number of climate assessments being performed across the United States (National Assessment Synthesis Team 2001; New England Regional Assessment Group 2001; Frumhoff et al. 2007; Titus et al. 2009; Jacobson et al. 2009; Moser et al. 2009; Karl et al. 2009; NYSERDA ClimAID Team 2010). Assessment methodologies have gradually evolved and increased in number (Carter et al. 2007), and this trend is likely to continue. In recent years, climate assessments have been progressively propelled from exclusively research-oriented summaries or activities toward analytical frameworks that are designed for practical decision making (Carter et al. 2007). The latest climate assessments (the "new generation") are often required to formulate comprehensive adaptation alternatives or, at the very least, recommendations that will guide the choice of alternatives. This transition is occurring with mixed success, as the aims of research and decision analysis differ somewhat in their treatment of uncertainty (Dessai and Hulme 2004; Rayner et al. 2005). Research seeks to understand and minimize uncertainty, whereas decision analysis aims to manage uncertainty in order to prioritize and carry out actions (Carter et al. 2007).

Despite the increase in assessments that deal with adaptation alternatives, and the increasing recognition that climate impacts and adaptation are unique issues in each community (Miles et al. 2006; Lynch and Brunner 2007; Christoplos et al. 2009; Brunner and Lynch 2010a,b), there has continued to be a lack of practical advice for adaptation decision making at the local level (Arnell 2010). This is particularly true when considering smaller, less urbanized communities. There are a number of examples of larger well-resourced communities taking adaptation action (Lowe et al. 2009; NYC Climate Change Adaptation Task Force), but at smaller scales communities that are proactive with adaptation are a rarity. The attitude is captured by the quote used for the title of this essay from a water supply plant manager when asked about future planning efforts.

The focus of this essay is therefore ways in which assessments can make themselves more socially relevant (i.e., better link climate science to real-world problems being faced by communities) and successfully meet the new demands that are being asked of them. This essay draws on experiences from the 2010 Integrated Assessment for Effective Climate Change

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CORRESPONDING AUTHOR: Dr. Lee Tryhorn, 1112 Bradfield Hall, Cornell University, Ithaca, NY 14853
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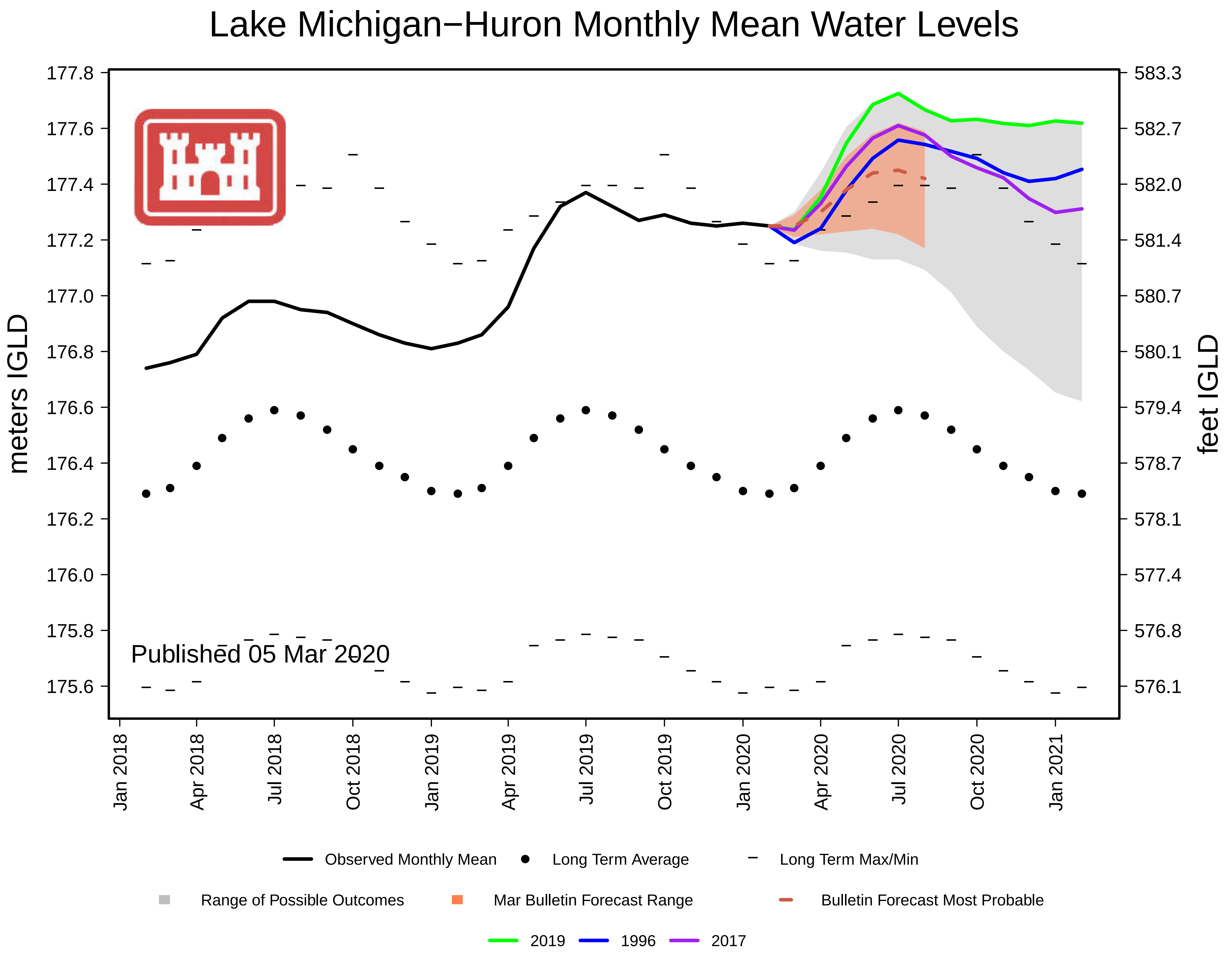
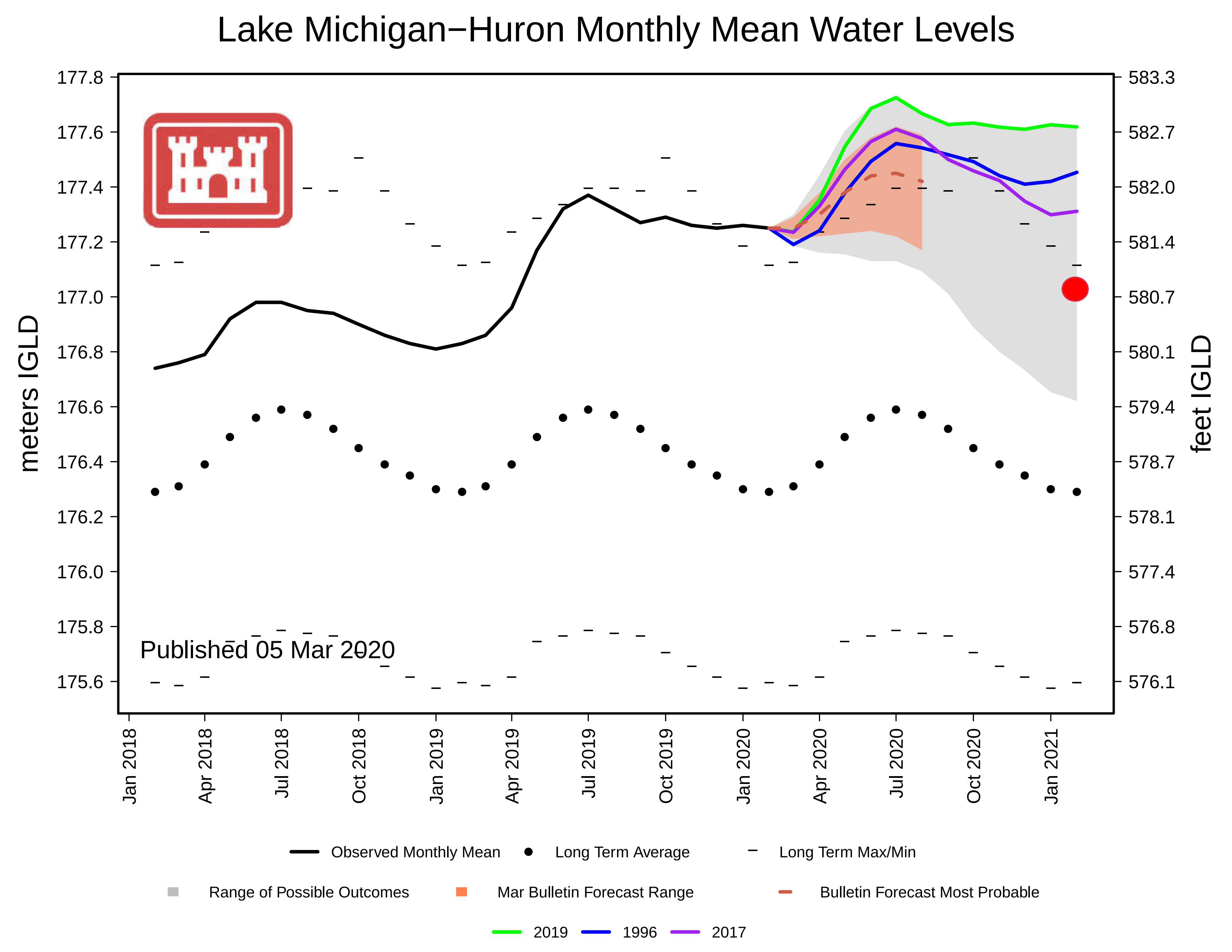
DOI:10.1175/2010BAMS3104.1

In final form 18 November 2010



Lake Michigan−Huron Monthly Mean Water Levels
meters IGLD
feet IGLD
177.8
177.6
177.4
177.2
177.0
176.8
176.6
176.4
176.2
176.0
175.8
175.6
583.3
582.7
582.0
581.4
580.7
580.1
579.4
578.7
578.1
577.4
576.8
576.1
Jan 2018
Apr 2018
Jul 2018
Oct 2018
Jan 2019
Apr 2019
Jul 2019
Oct 2019
Jan 2020
Apr 2020
Jul 2020
Oct 2020
Jan 2021
Published 05 Mar 2020
Observed Monthly Mean
Long Term Average
Long Term Max/Min
Range of Possible Outcomes
Mar Bulletin Forecast Range
Bulletin Forecast Most Probable
2019
1996
2017



Lake Michigan−Huron Monthly Mean Water Levels
meters IGLD
feet IGLD
177.8
177.6
177.4
177.2
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176.8
176.6
176.4
176.2
176.0
175.8
175.6
583.3
582.7
582.0
581.4
580.7
580.1
579.4
578.7
578.1
577.4
576.8
576.1
Jan 2018
Apr 2018
Jul 2018
Oct 2018
Jan 2019
Apr 2019
Jul 2019
Oct 2019
Jan 2020
Apr 2020
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Observed Monthly Mean
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Mar Bulletin Forecast Range
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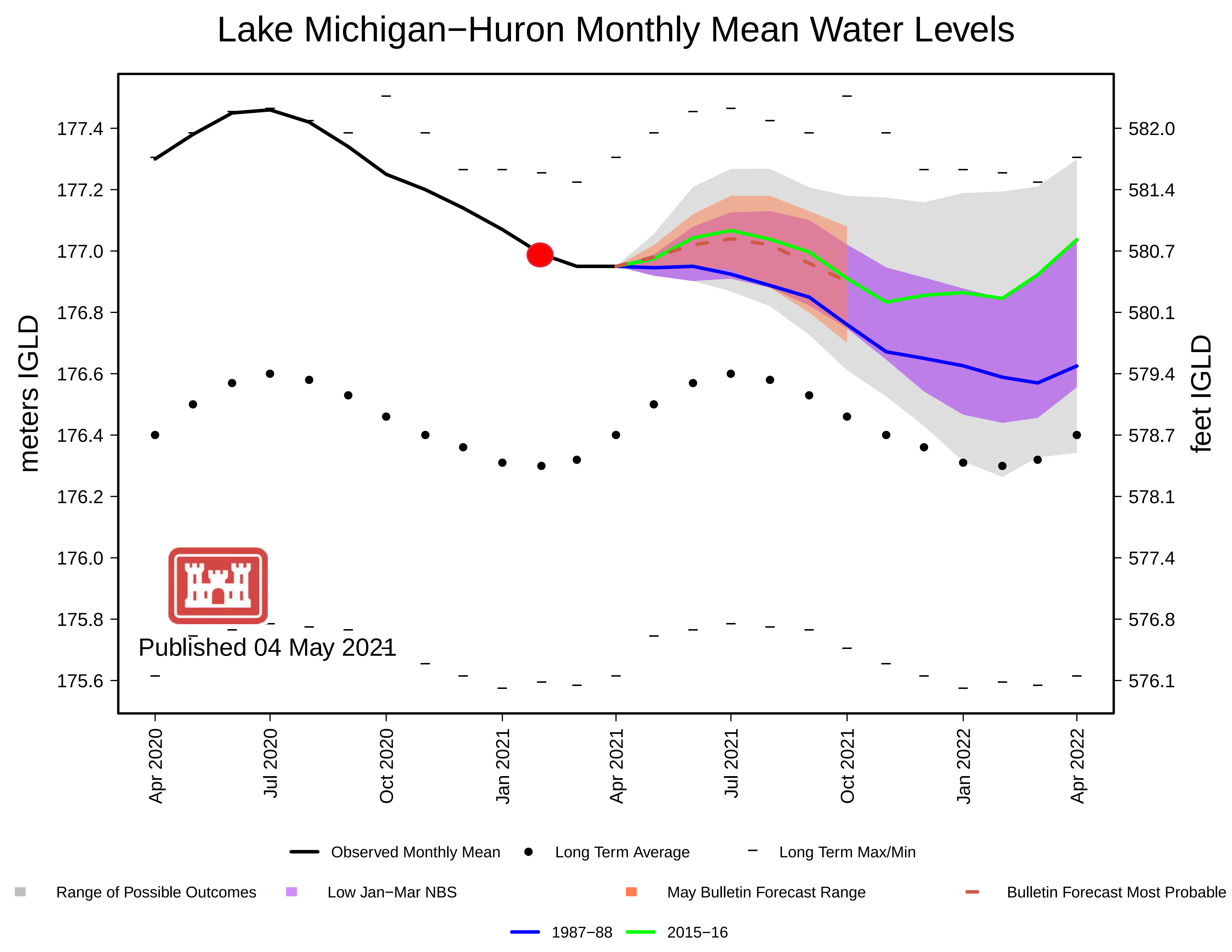
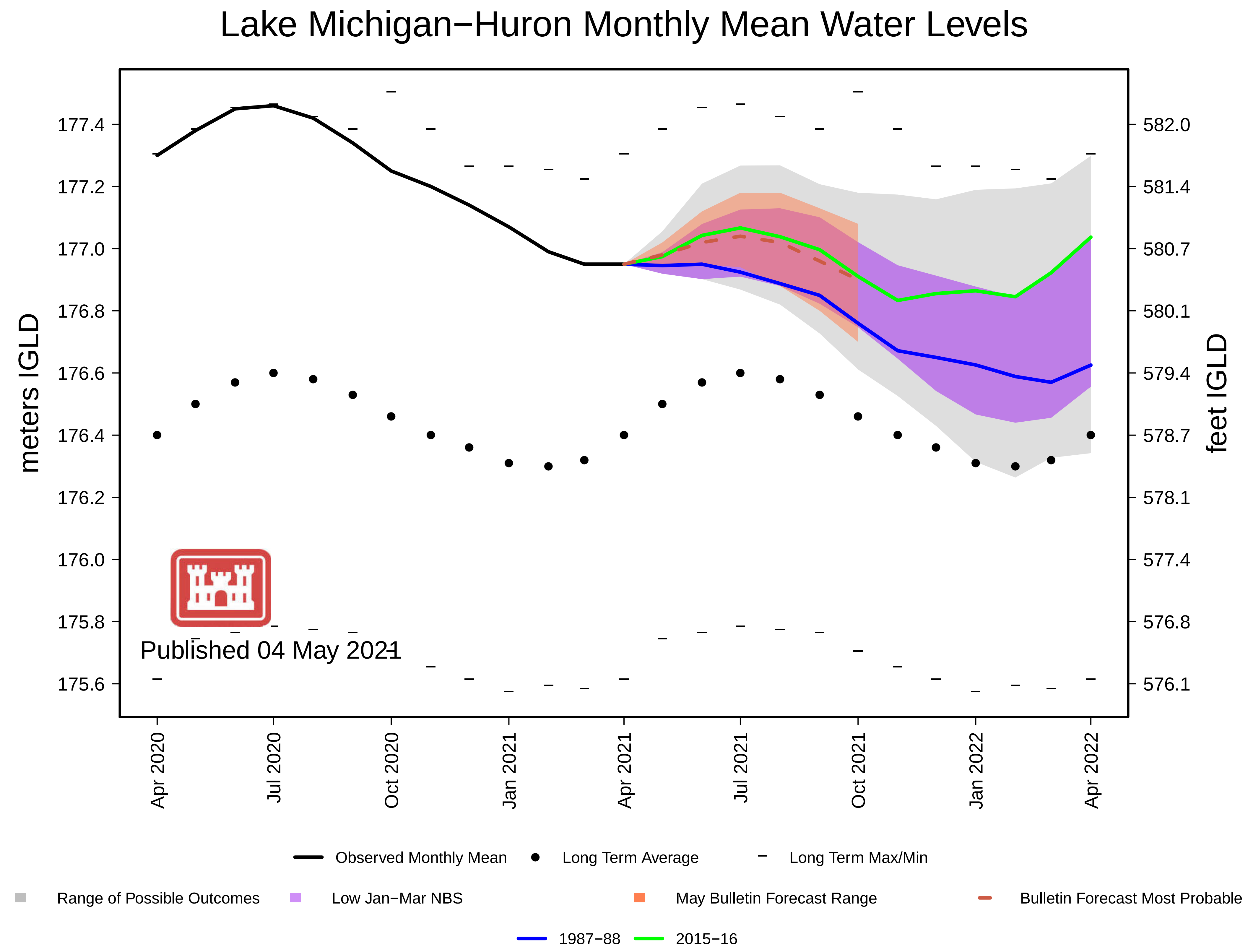
2019
1996
2017



Lake Michigan−Huron Monthly Mean Water Levels
meters IGLD
feet IGLD
177.4
177.2
177.0
176.8
176.6
176.4
176.2
176.0
175.8
175.6
582.0
581.4
580.7
580.1
579.4
578.7
578.1
577.4
576.8
576.1
Apr 2020
Jul 2020
Oct 2020
Jan 2021
Apr 2021
Jul 2021
Oct 2021
Jan 2022
Apr 2022
Published 04 May 2021
Observed Monthly Mean
Long Term Average
Long Term Max/Min
Range of Possible Outcomes
Low Jan−Mar NBS
May Bulletin Forecast Range
Bulletin Forecast Most Probable
1987−88
2015−16



Lake Michigan−Huron Monthly Mean Water Levels
meters IGLD
feet IGLD
177.4
177.2
177.0
176.8
176.6
176.4
176.2
176.0
175.8
175.6
582.0
581.4
580.7
580.1
579.4
578.7
578.1
577.4
576.8
576.1
Apr 2020
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Range of Possible Outcomes
Low Jan−Mar NBS
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Bulletin Forecast Most Probable
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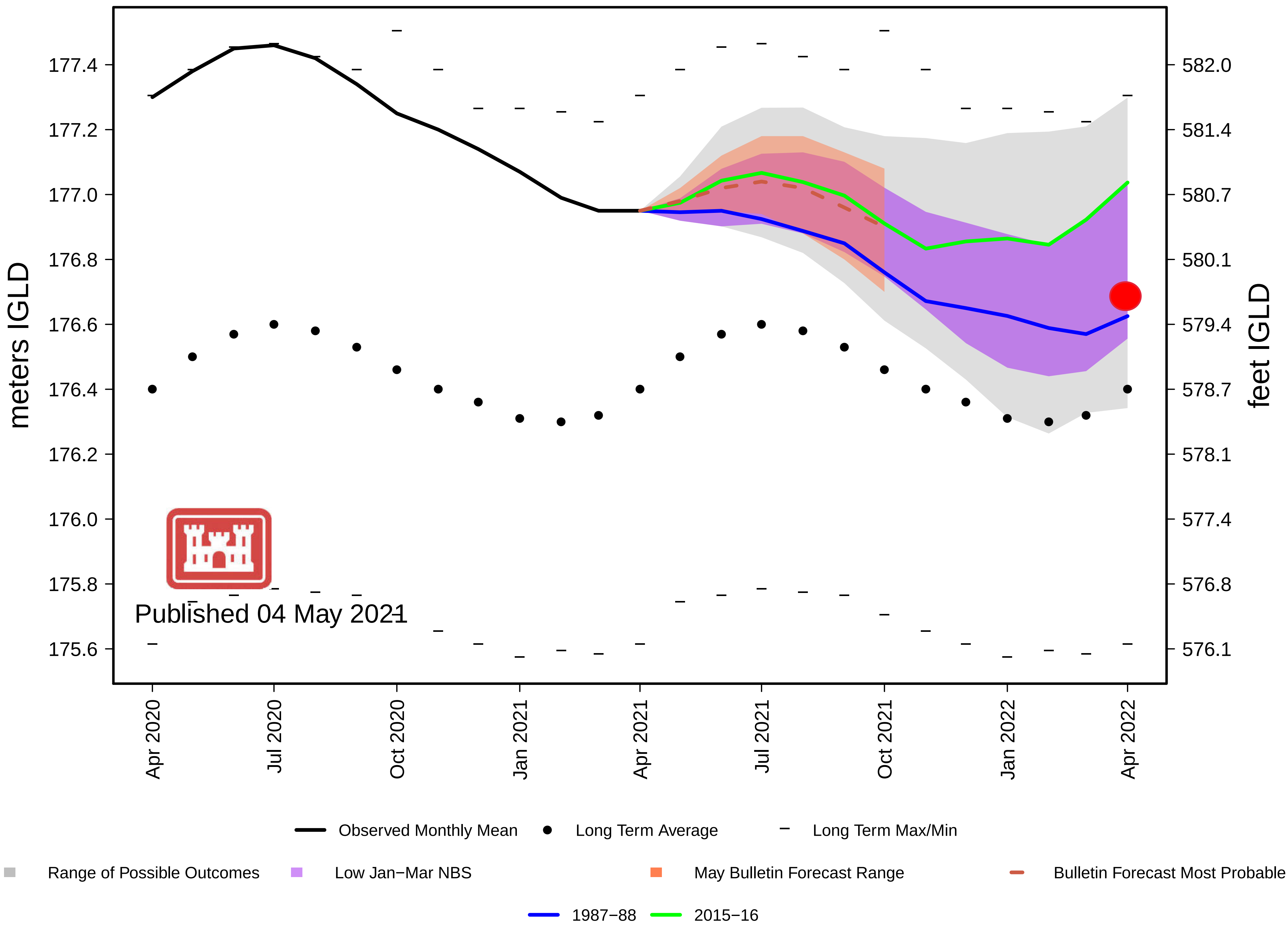
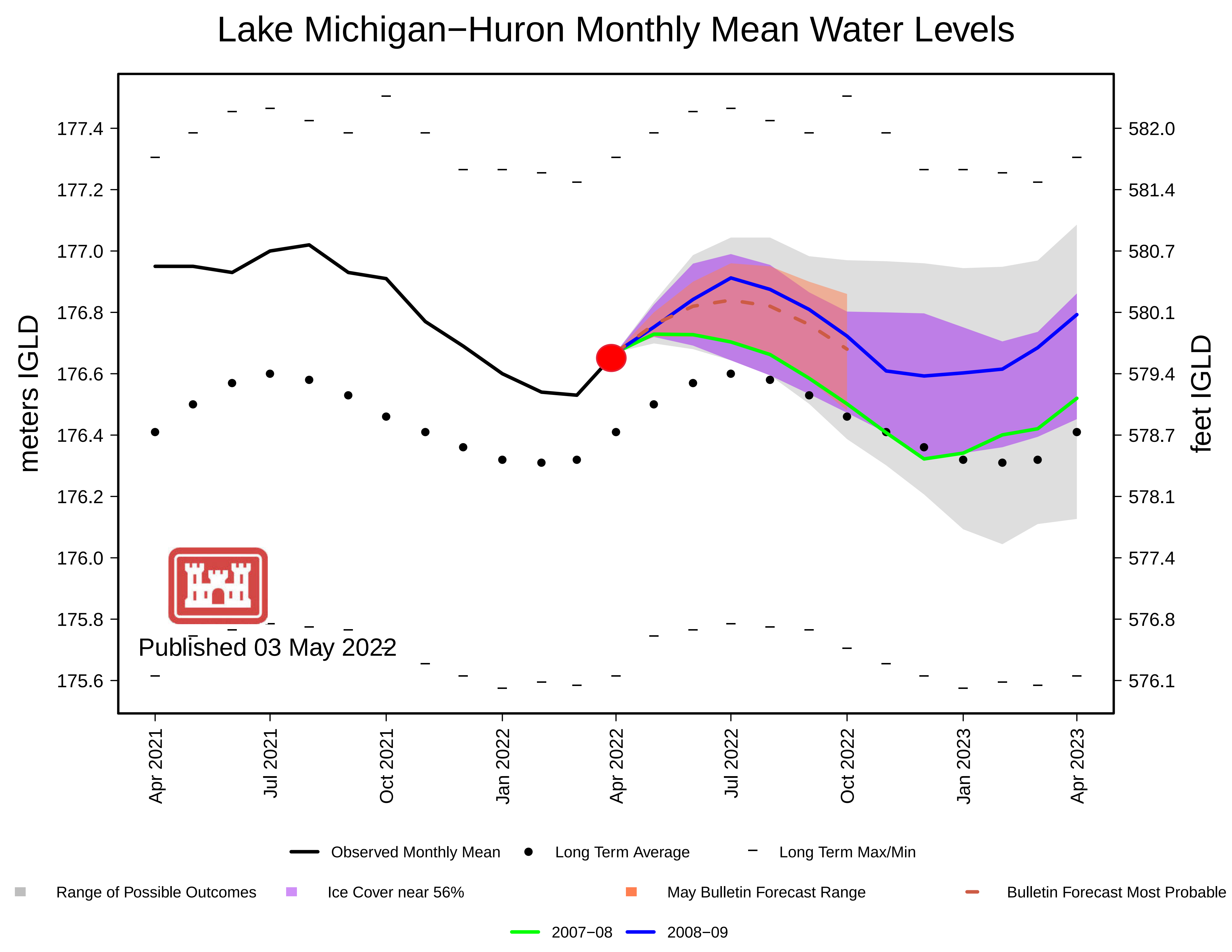
Lake Michigan−Huron Monthly Mean Water Levels





Lake Michigan−Huron Monthly Mean Water Levels
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176.8
176.6
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176.0
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581.4
580.7
580.1
579.4
578.7
578.1
577.4
576.8
576.1
Apr 2021
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Oct 2021
Jan 2022
Apr 2022
Jul 2022
Oct 2022
Jan 2023
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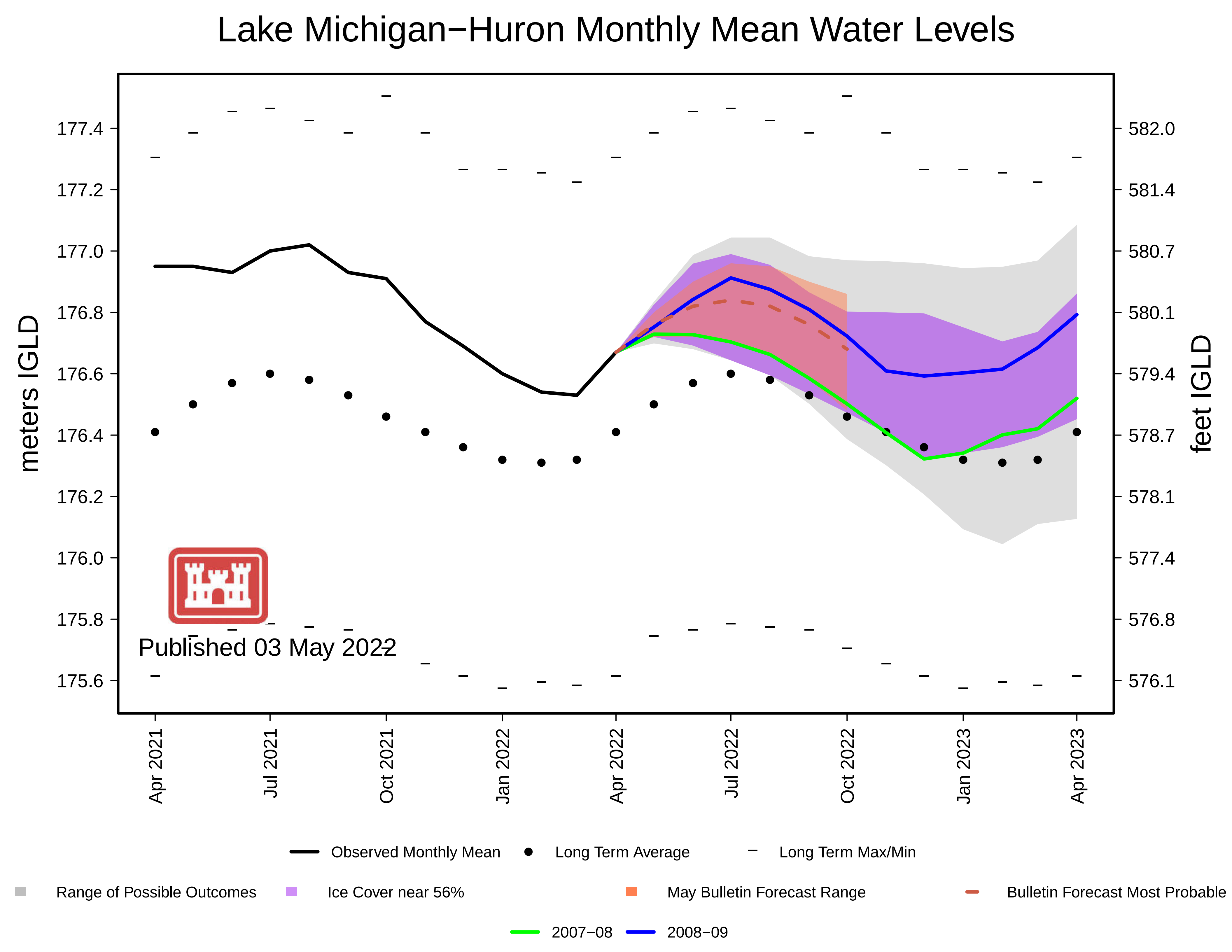
Observed Monthly Mean
Long Term Average
Long Term Max/Min
Range of Possible Outcomes
Ice Cover near 56%
May Bulletin Forecast Range
Bulletin Forecast Most Probable
2007−08
2008−09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Ice Cover near 56%
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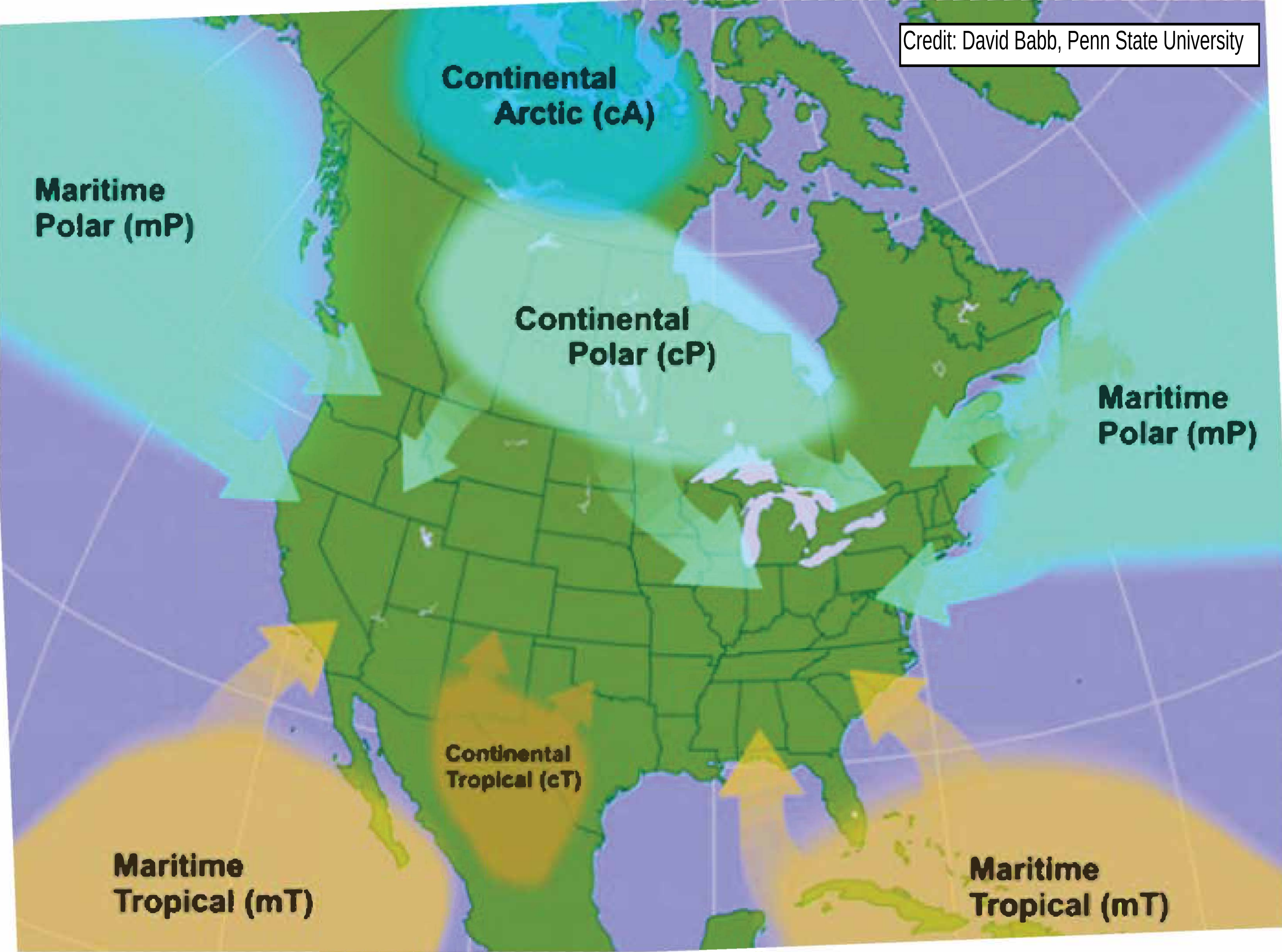
Credit: David Babb, Penn State University
Continental
Arctic (cA)
Maritime
Polar (mP)
Continental
Polar (cP)
Maritime
Polar (mP)
Continental
Tropical (cT)
Maritime
Tropical (mT)
Maritime
Tropical (mT)

Acknowledgements

- Libby Prakel, Jill Geiger, Howard Learner
- NOAA, ECCC, CHS, IJC, USACE, USGS

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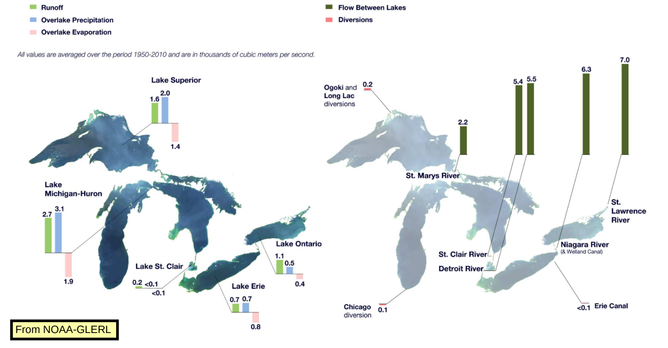
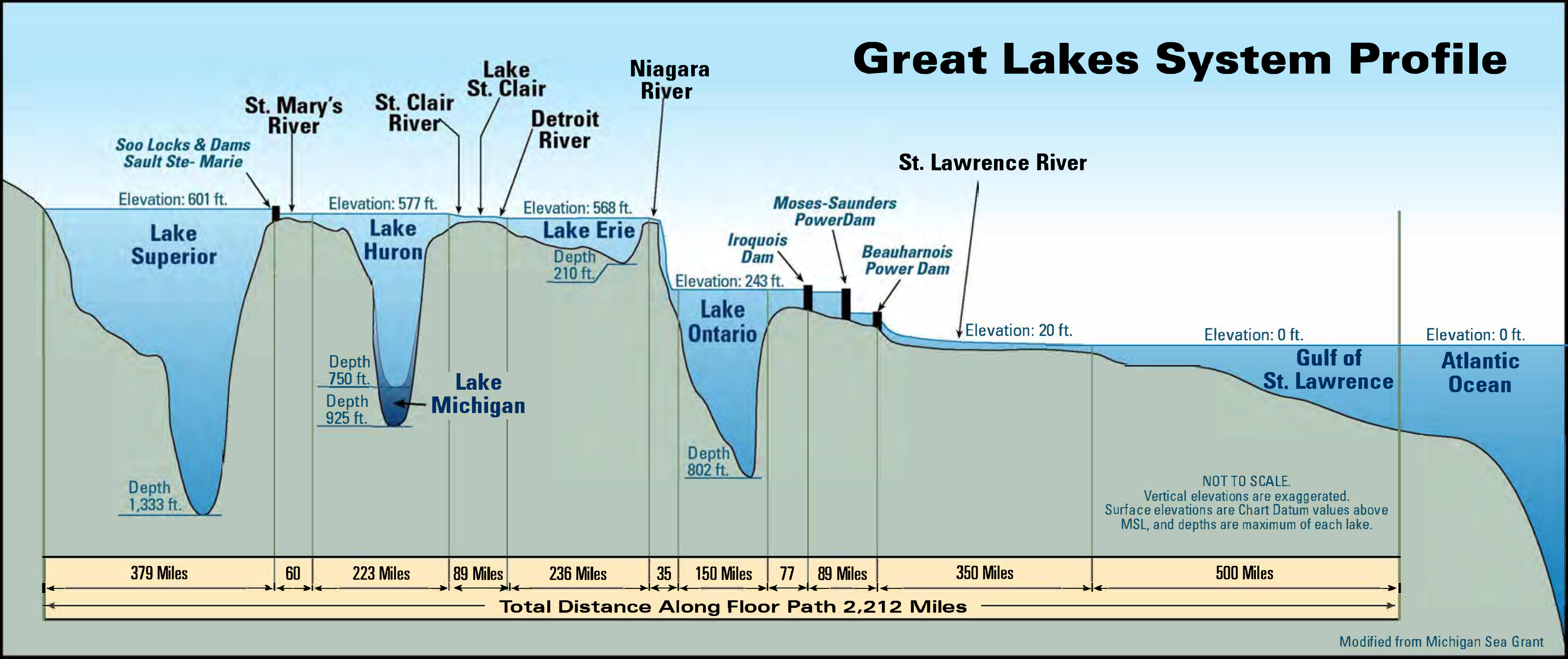
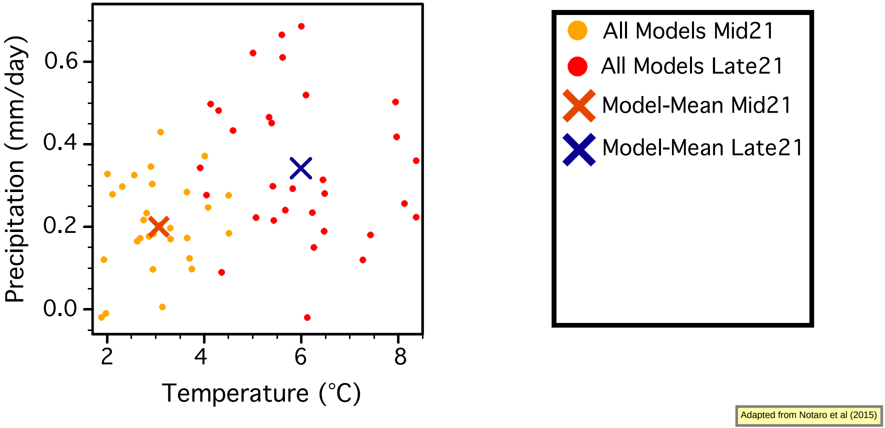
EXTRA SLIDES



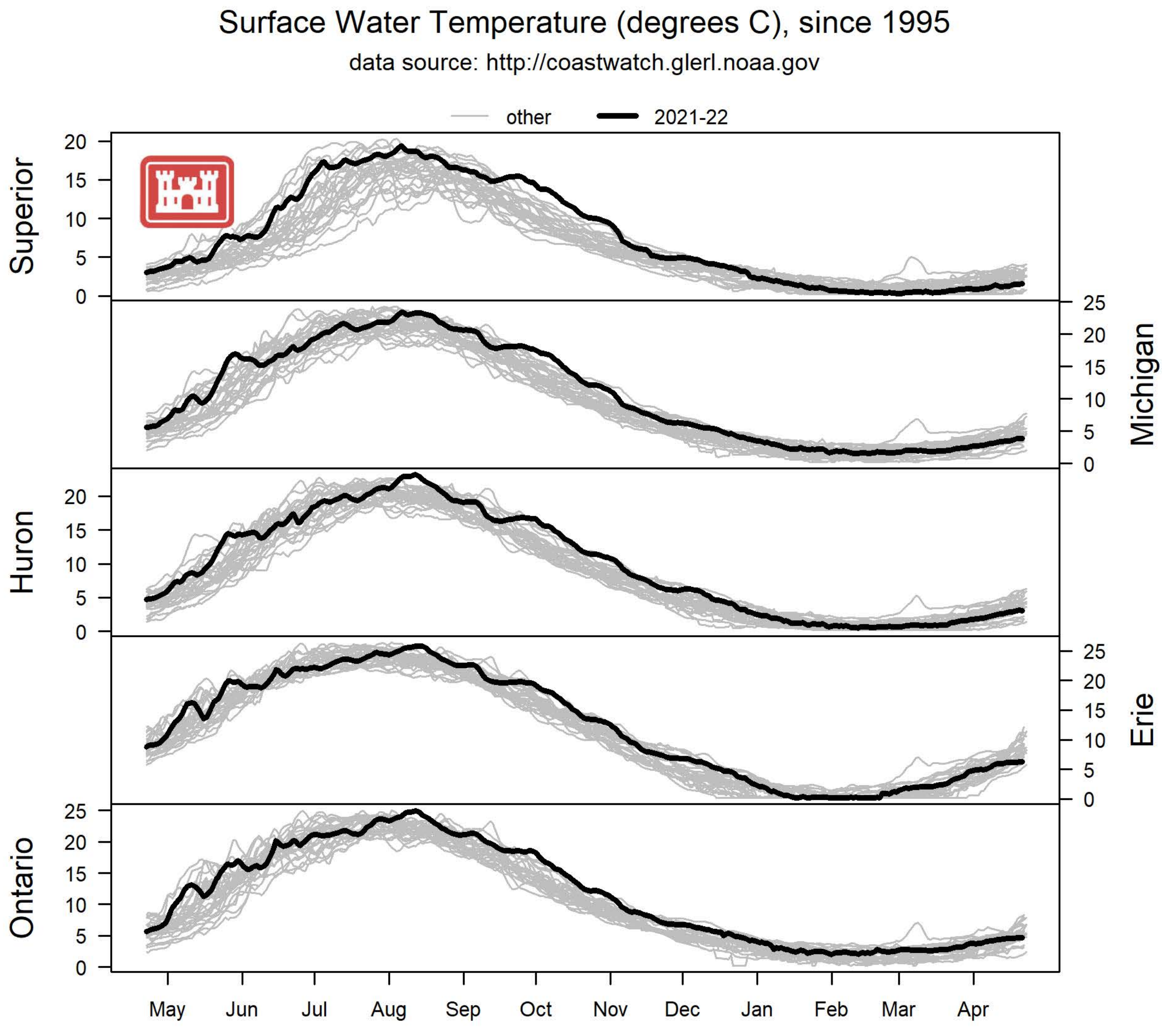
Runoff
Overlake Precipitation
Overlake Evaporation
Flow Between Lakes
Diversions
All values are averaged over the period 1950-2010 and are in thousands of cubic meters per second.
Lake Superior
1.6
2.0
1.4
Lake Michigan-Huron
2.7
3.1
1.9
Lake St. Clair
0.2
<0.1
<0.1
Lake Erie
0.7
0.7
0.8
Lake Ontario
1.1
0.5
0.4
Ogoki and Long Lac diversions
0.2
2.2
St. Marys River
5.4
5.5
St. Clair River
Detroit River
6.3
Niagara River
(& Welland Canal)
7.0
St. Lawrence River
Chicago diversion
0.1
<0.1
Erie Canal
From NOAA-GLERL



Great Lakes System Profile
Soo Locks & Dams
Sault Ste- Marie
St. Mary's River
St. Clair River
Lake St. Clair
Detroit River
Niagara River
St. Lawrence River
Moses-Saunders PowerDam
Iroquois Dam
Beauharnois Power Dam
Elevation: 601 ft.
Lake Superior
Elevation: 577 ft.
Lake Huron
Elevation: 568 ft.
Lake Erie
Depth 210 ft.
Elevation: 243 ft.
Lake Ontario
Elevation: 20 ft.
Elevation: 0 ft.
Gulf of St. Lawrence
Elevation: 0 ft.
Atlantic Ocean
Depth 750 ft.
Depth 925 ft.
Lake Michigan
Depth 802 ft.
Depth 1,333 ft.
NOT TO SCALE.
Vertical elevations are exaggerated.
Surface elevations are Chart Datum values above MSL, and depths are maximum of each lake.
379 Miles
60
223 Miles
89 Miles
236 Miles
35
150 Miles
77
89 Miles
350 Miles
500 Miles
Total Distance Along Floor Path 2,212 Miles
Modified from Michigan Sea Grant



0.6
0.4
0.2
0.0
Precipitation (mm/day)
2
4
6
8
Temperature (°C)
All Models Mid21
All Models Late21
Model-Mean Mid21
Model-Mean Late21
Adapted from Notaro et al (2015)


Surface Water Temperature (degrees C), since 1995
data source: http://coastwatch.glerl.noaa.gov
other
2021-22
Superior
Michigan
Huron
Erie
Ontario
0
5
10
15
20
25
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr

Natural Hazards (2019) 98:119–135
https://doi.org/10.1007/s11069-018-3429-2

ORIGINAL PAPER

A review of cyclone track shifts over the Great Lakes of North America: implications for storm surges

Tew-Fik Mahdi[1] · Gaurav Jain[2] · Shay Patel[3] · Aman Kaur Sidhu[4]

Received: 1 June 2018 / Accepted: 7 August 2018 / Published online: 20 August 2018

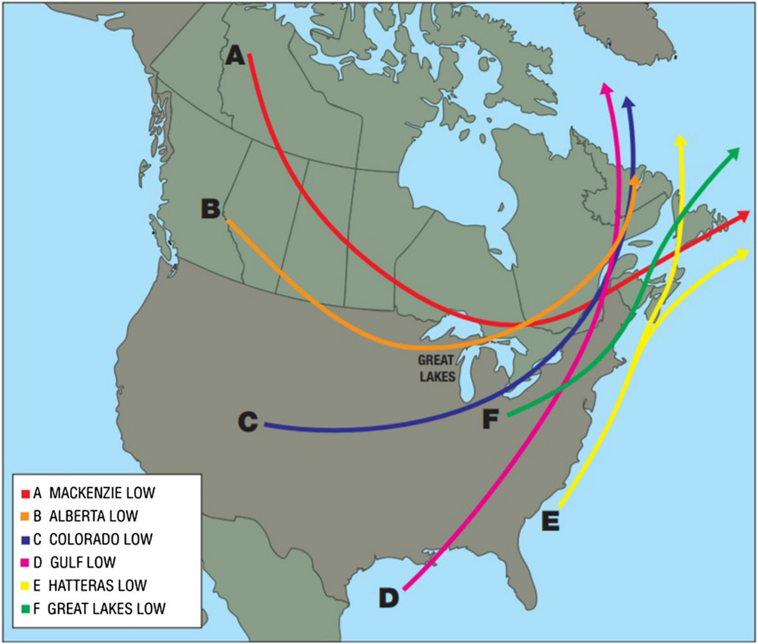


Fig. 2 Cyclone tracks during winter in North America. (Reproduced with permission from NAV Canada 2017)