*Slide deck updated on November, 24, 2015

Great Lakes Water Levels: an inter-agency briefing

November 19, 2015

Panelists:

- Drew Gronewold, hydrologist, NOAA Great Lakes Environmental Research Laboratory
- Matthew Rosencrans, head of forecast operations, NOAA National Weather Service Climate Prediction Center
- Jim Noel, hydrologist, NOAA National Weather Service Ohio River Forecast Center
- Keith Kompoltowicz, chief, Watershed Hydrology Branch, U.S. Army Corp of Engineers Detroit District
- Stephen Gill, senior scientist, NOAA National Ocean Service Center for Operational Oceanographic Products and Services

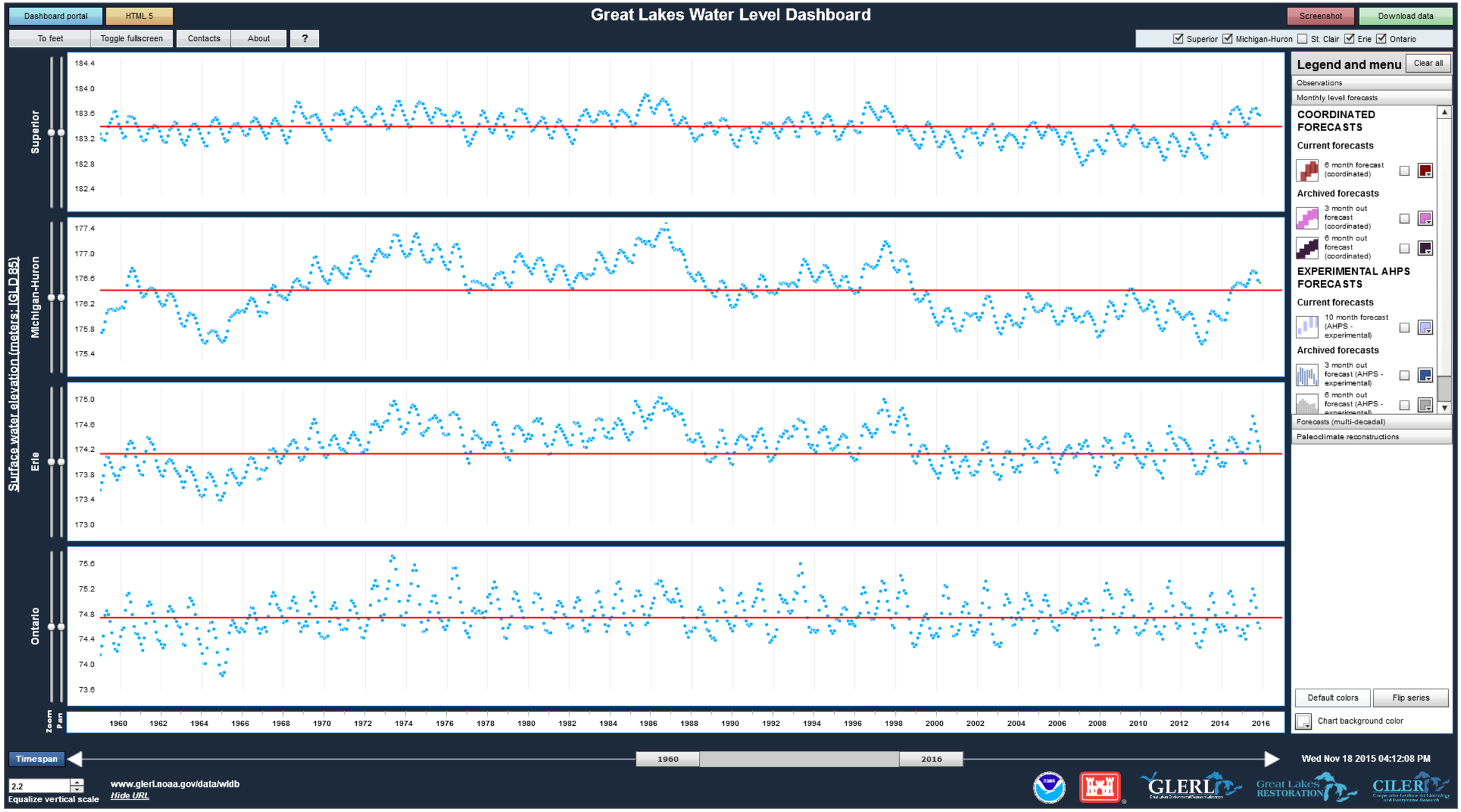
Outline

Name	Country	Surface area (km^2)	Surface area (mi^2)	Volume (km^3)	Volume (mi^3)
Michigan–Huron	U.S. and Canada	117,702	45,445	8,458	2,029
Superior	U.S. and Canada	82,414	31,820	12,100	2,900
Victoria	Multiple	69,485	26,828	2,750	660
Tanganyika	Multiple	32,893	12,700	18,900	4,500
Baikal	Russia	31,500	12,200	23,600	5,700
Great Bear Lake	Canada	31,080	12,000	2,236	536
Malawi	Multiple	30,044	11,600	8,400	2,000
Great Slave Lake	Canada	28,930	11,170	2,090	500
Erie	U.S. and Canada	25,719	9,930	489	117
Winnipeg	Canada	23,553	9,094	283	68
Ontario	U.S. and Canada	19,477	7,520	1,639	393

Table: Surface area and volume of the earth's largest fresh surface water bodies (ranked by surface area).

From: Gronewold, Fortin, Lofgren, Clites, Stow, and Quinn (2013). *Climatic Change*.

Outline


Dashboard portal
HTML 5
Great Lakes Water Level Dashboard
Screenshot
Download data
To feet
Toggle fullscreen
Contacts
About
?
Superior
Michigan-Huron
St. Clair
Erie
Ontario
Surface water elevation (meters; IGLD 85)
Superior
Michigan-Huron
Erie
Ontario
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Legend and menu
Clear all
Observations
Monthly level forecasts
COORDINATED FORECASTS
Current forecasts
6 month forecast (coordinated)
Archived forecasts
3 month out forecast (coordinated)
6 month out forecast (coordinated)
EXPERIMENTAL AHPS FORECASTS
Current forecasts
10 month forecast (AHPS - experimental)
Archived forecasts
3 month out forecast (AHPS - experimental)
6 month out forecast (AHPS - experimental)
Forecasts (multi-decadal)
Paleoclimate reconstructions
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Chart background color
Timespan
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Record-Setting Water Level Rise in the Great Lakes

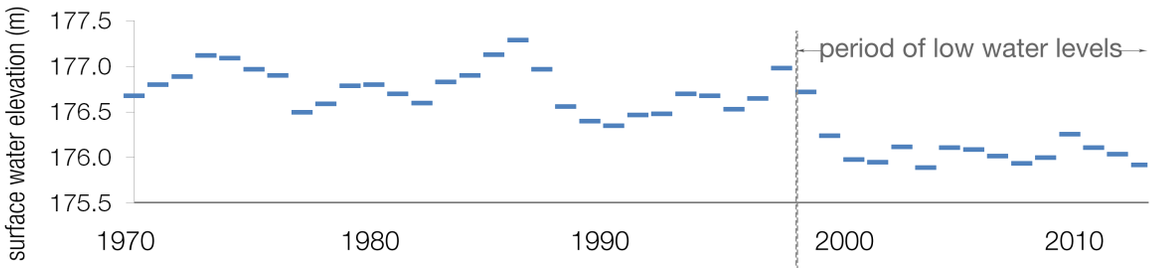
Water levels on Lake Michigan-Huron just had their greatest two-year increase in recorded history after a 14-year period of persistent below-average conditions.

Low Point(s): 1998 - 2012

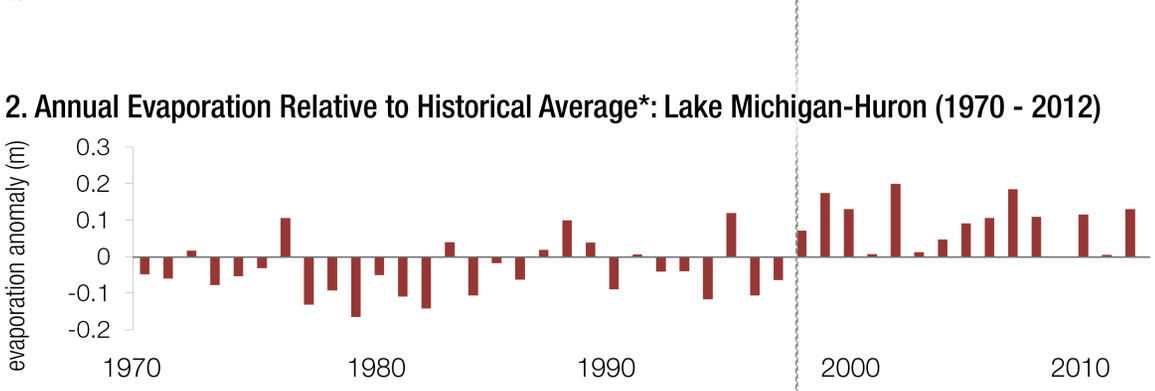
Why were **water levels so low** in the first place? The Great Lakes have a massive **surface area** and are impacted by **evaporation.**

The period of low water levels for Lake Michigan-Huron (Graph 1) corresponds to a period of above-average evaporation (Graph 2), starting in 1998.

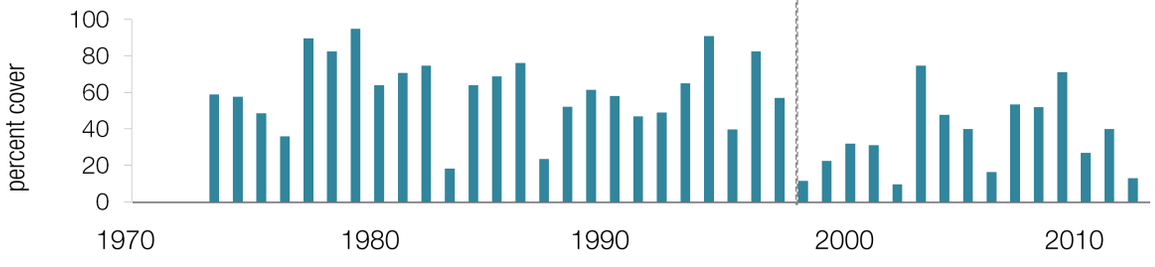
1. Annual Average Water Levels: Lake Michigan-Huron (1970 - 2012)



2. Annual Evaporation Relative to Historical Average*: Lake Michigan-Huron (1970 - 2012)



3. Annual Maximum Ice Cover: All Great Lakes (1973 - 2012)



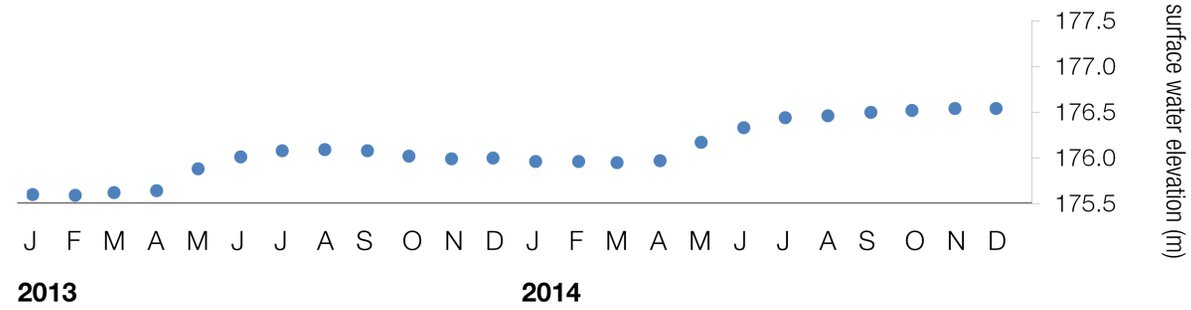
Why was evaporation so high? One reason is that **ice cover** was relatively low for many years in that period (Graph 3). The more ice cover on the lakes, the less time the water has to heat up throughout the summer and leading into fall, which is when most evaporation occurs. Higher ice cover one winter could therefore translate to less evaporation the next fall.

**Historical averages were calculated using a 1918 - 2012 period of record.*

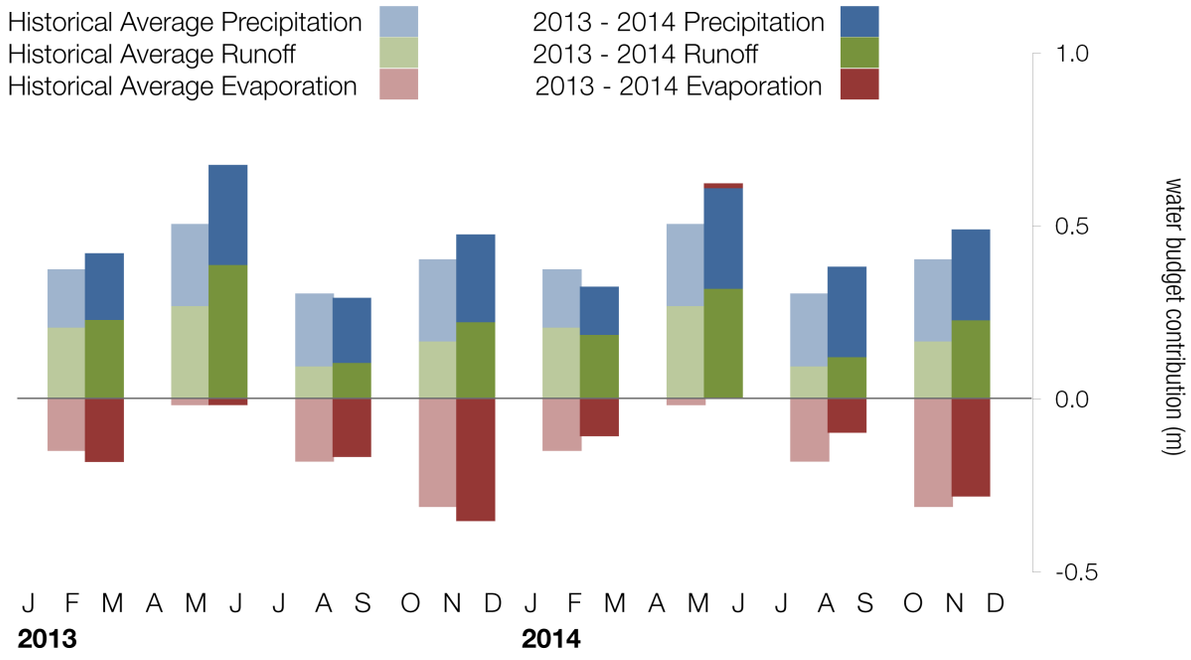
Resurgence: 2013 - 2014

Water levels have made a dramatic comeback in recent years, rising **0.96 meters** from January 2013 to December 2014 (Graph 4). Since inflow and outflow are fairly constant, **the main drivers of lake levels are precipitation, evaporation, and runoff**. The fast changes were driven by **heavy precipitation/runoff** and **a cold winter** that **limited evaporation** in 2014.

4. Monthly Average Water Levels: Lake Michigan-Huron (2013 - 2014)



5. Quarterly Modeled Water Budget: Lake Michigan-Huron (2013-2014)

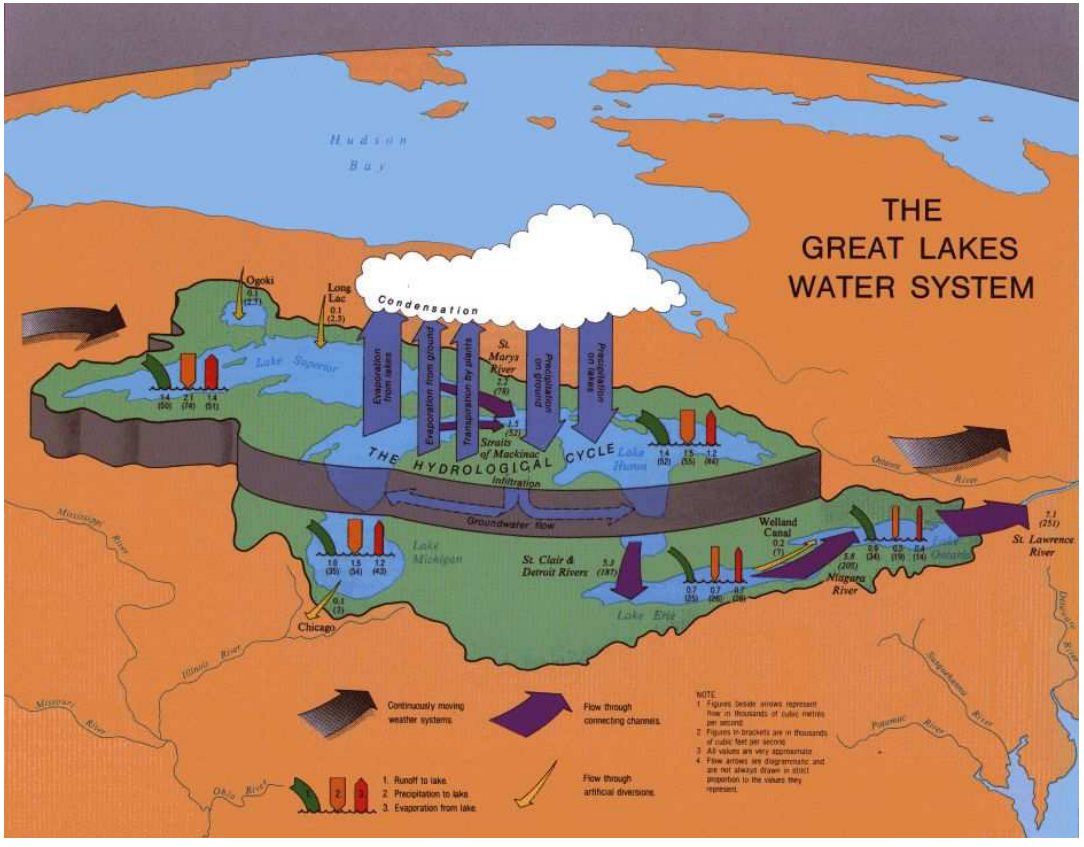


Graph 5 breaks 2013 and 2014 into 3-month periods, and for each period, compares values of precipitation, runoff, and evaporation for Lake Michigan-Huron with the historical average*. Historical and 2013-2014 values were modeled by GLERL scientists. Comparing Graphs 4 and 5 helps explain why the lakes rose as quickly as they did.

Sources: Gronewold et al. 2015 (DOI:10.1029/2015EO026023), Hunter et al. 2015 (DOI:10.1016/j.jglr.2014.4.12.006), Wang et al. 2012 (DOI:10.1175/2011JCLI4066.1).

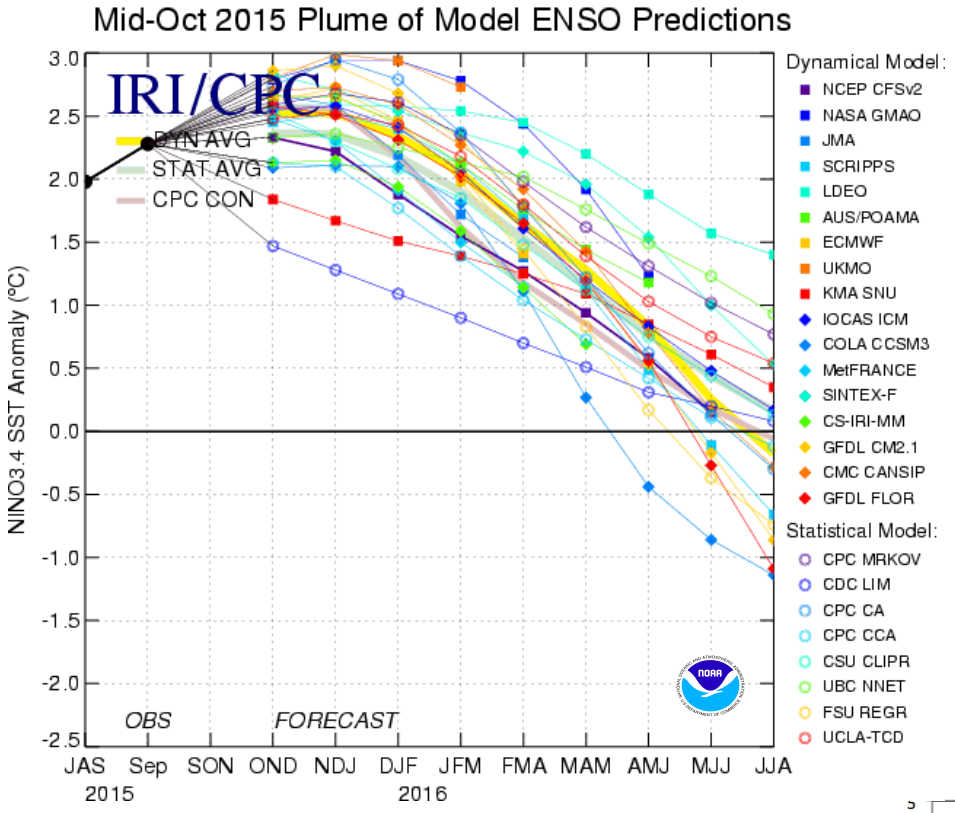
Outline

Water level drivers: hydrologic cycle



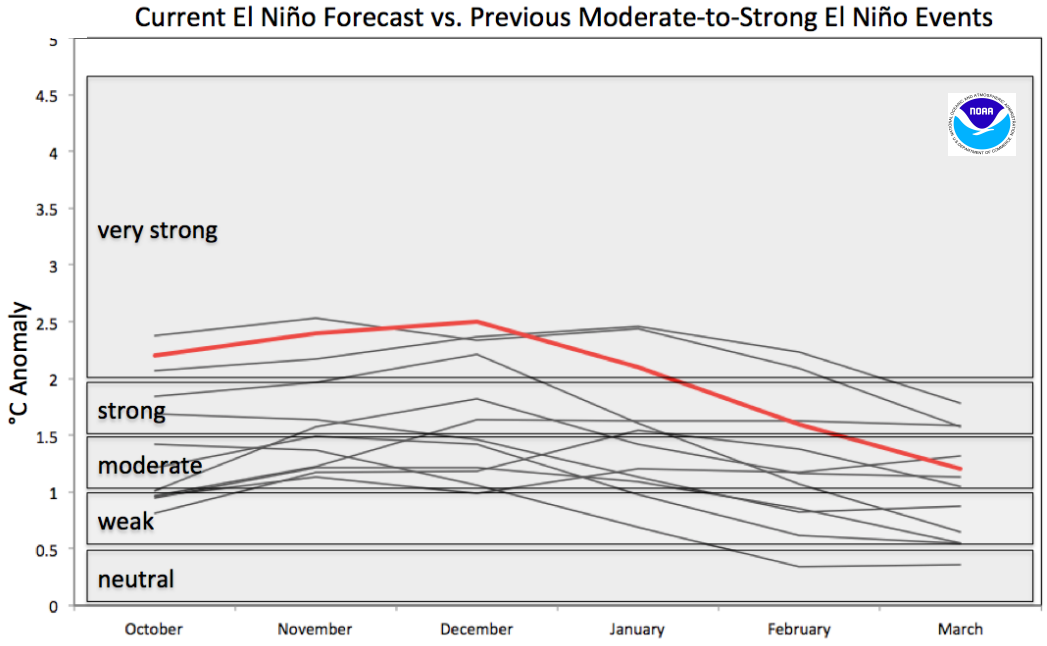
From: USEPA, Great Lakes Atlas

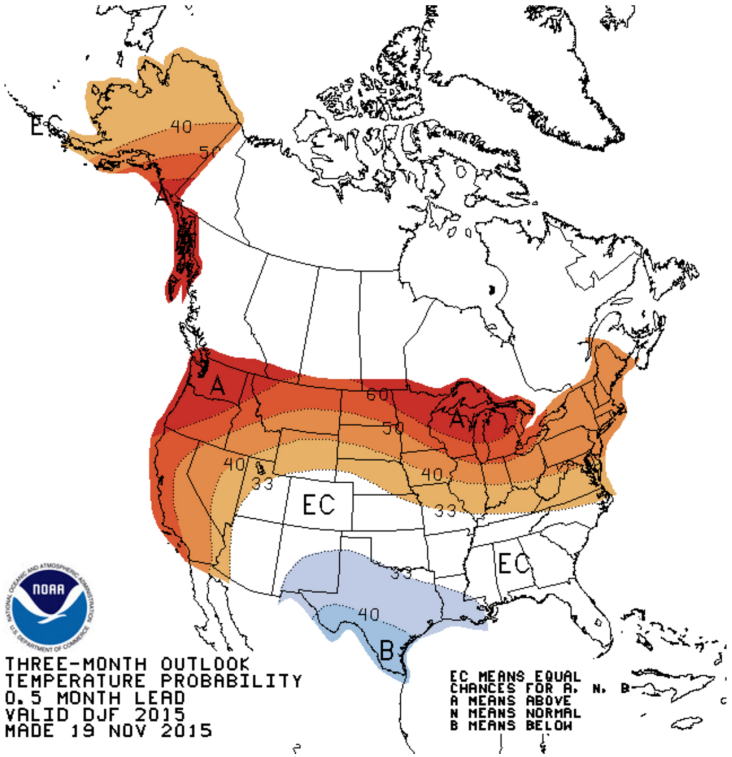
Water level drivers: regional climate

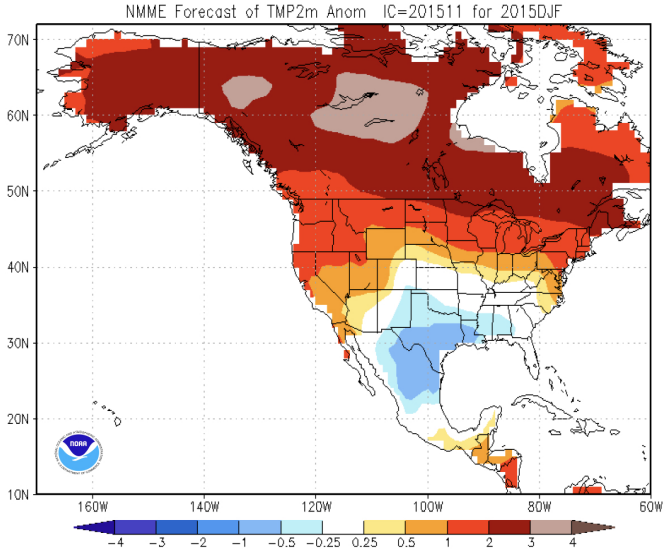


Model forecasts of ENSO

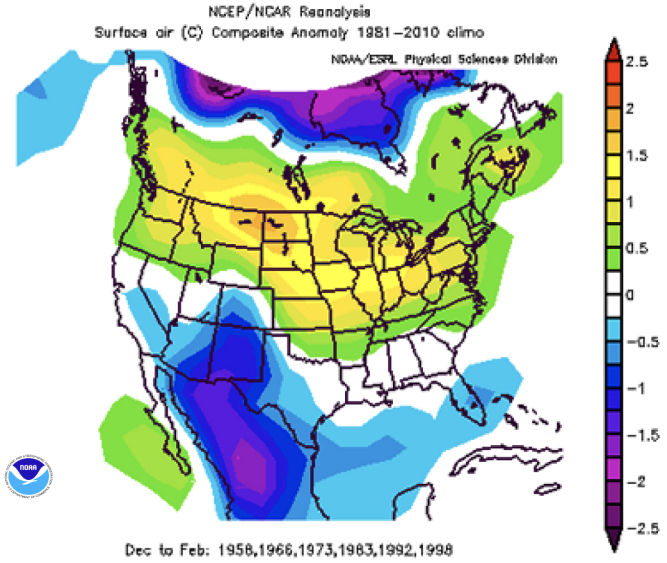
How does the current forecast of an El Niño this winter compare to previous El Niño winters?



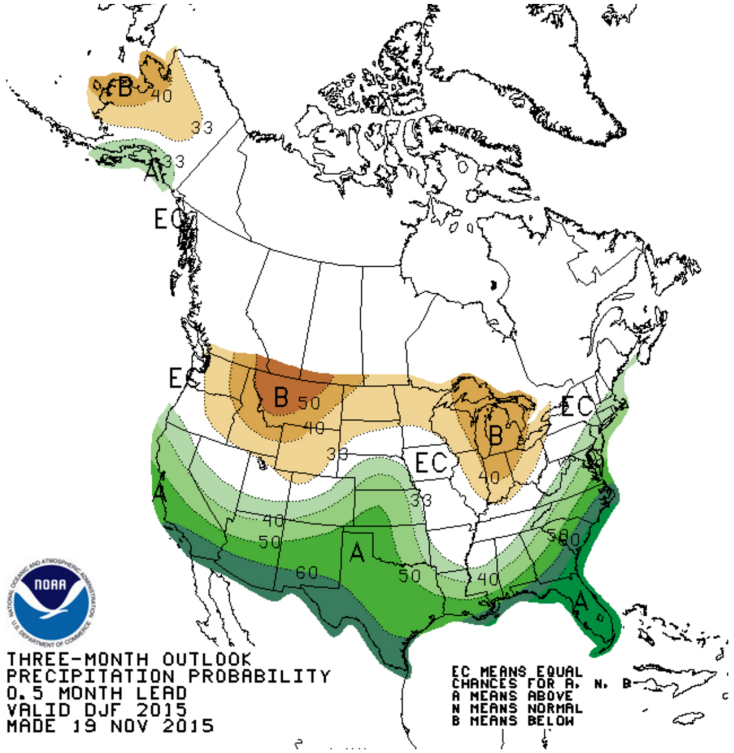


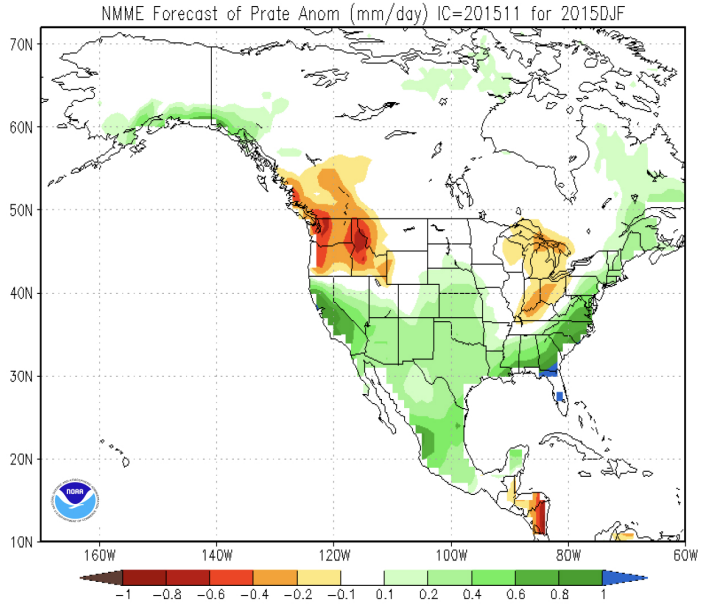


Forecast of air temperature (deg C) for December 2015, January 2016, and February 2016

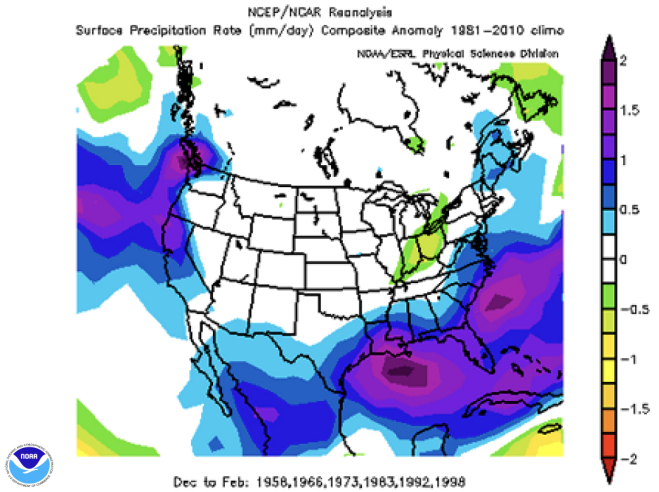


Composite image of air temperature (deg C) during six strong El Nino winters



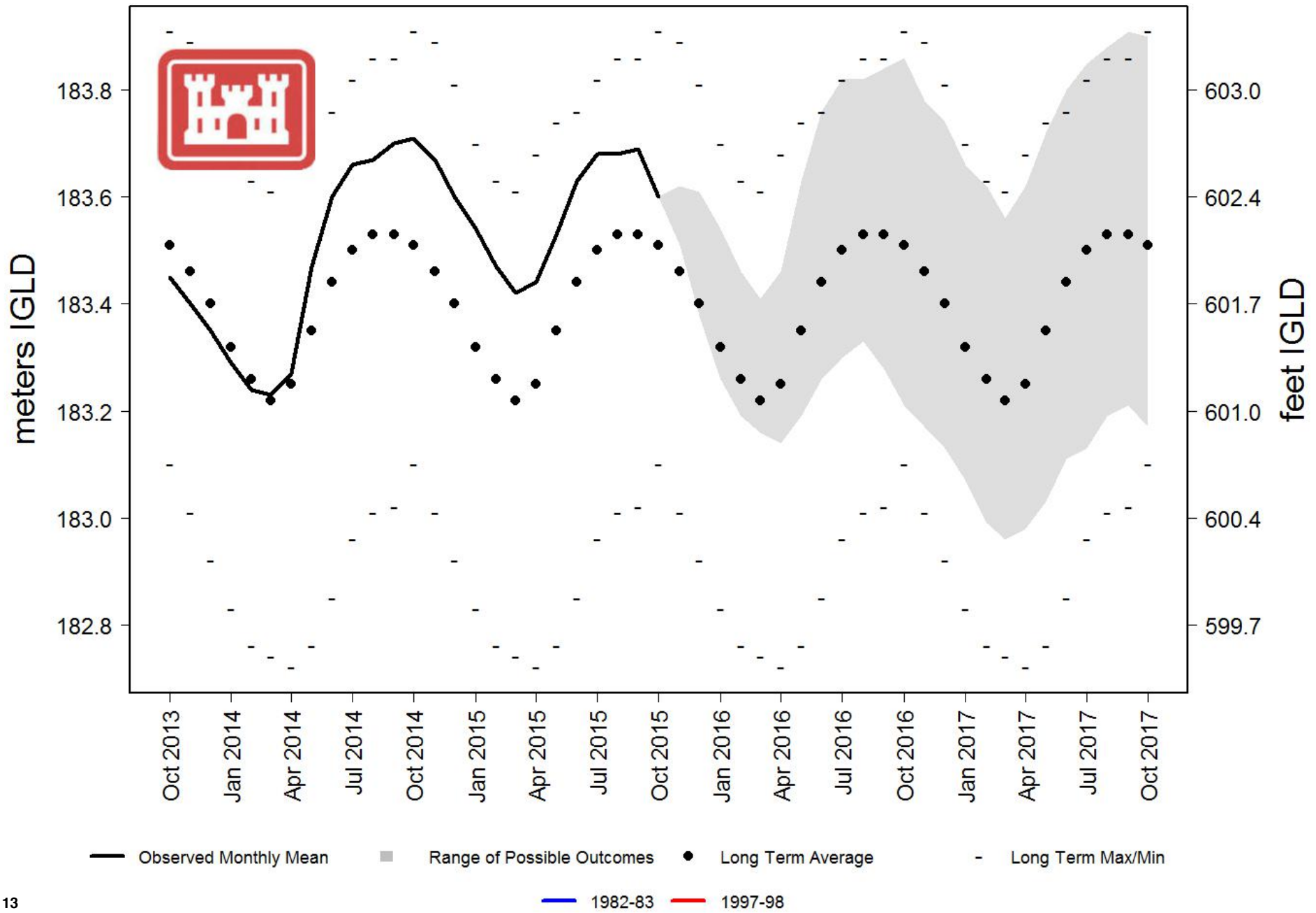


Forecast of daily precipitation (in mm) for December 2015, January 2016, and February 2016



Composite image of daily precipitation (in mm) during six strong El Nino winters

Lake Superior Monthly Mean Water Levels



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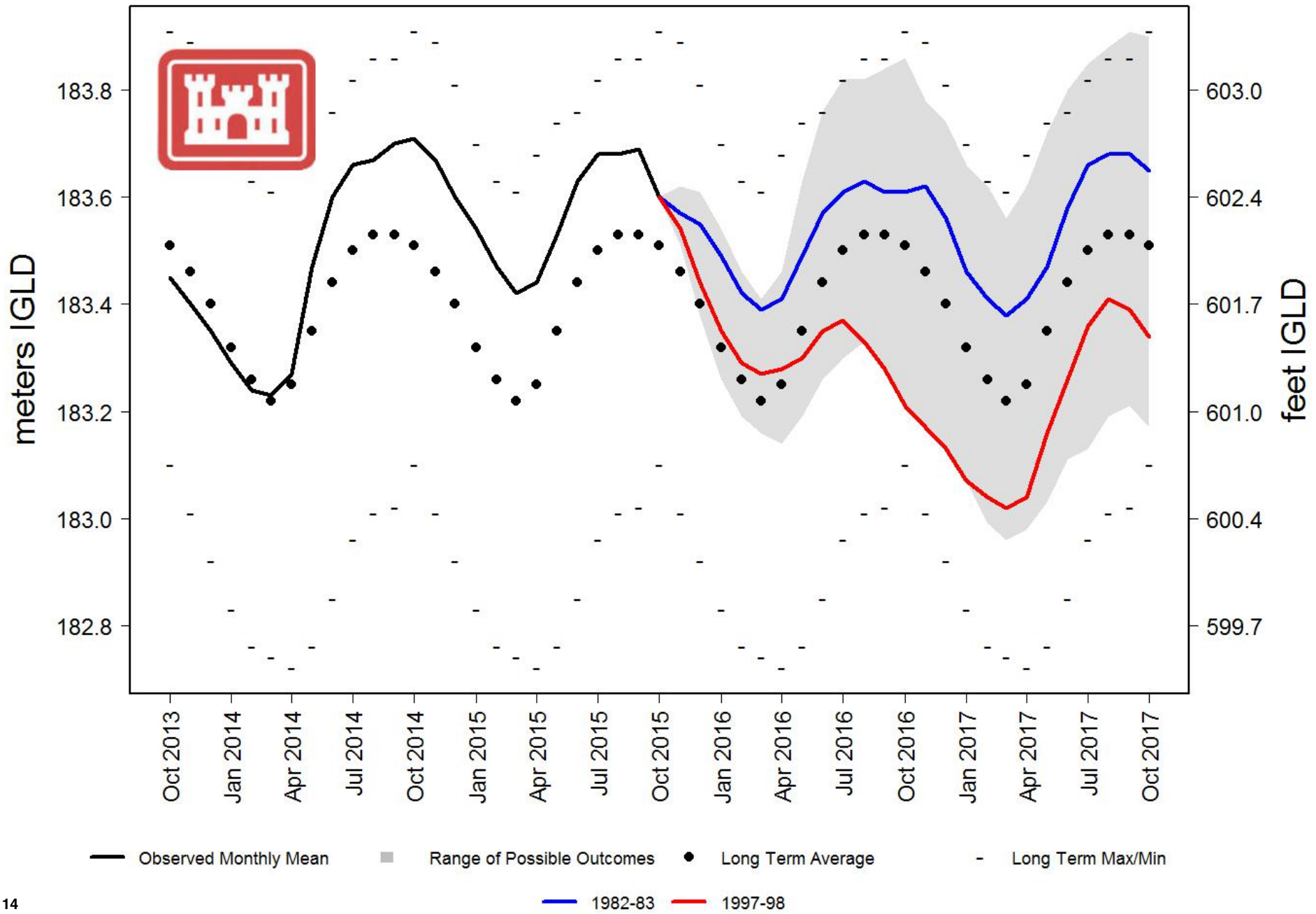

Outline

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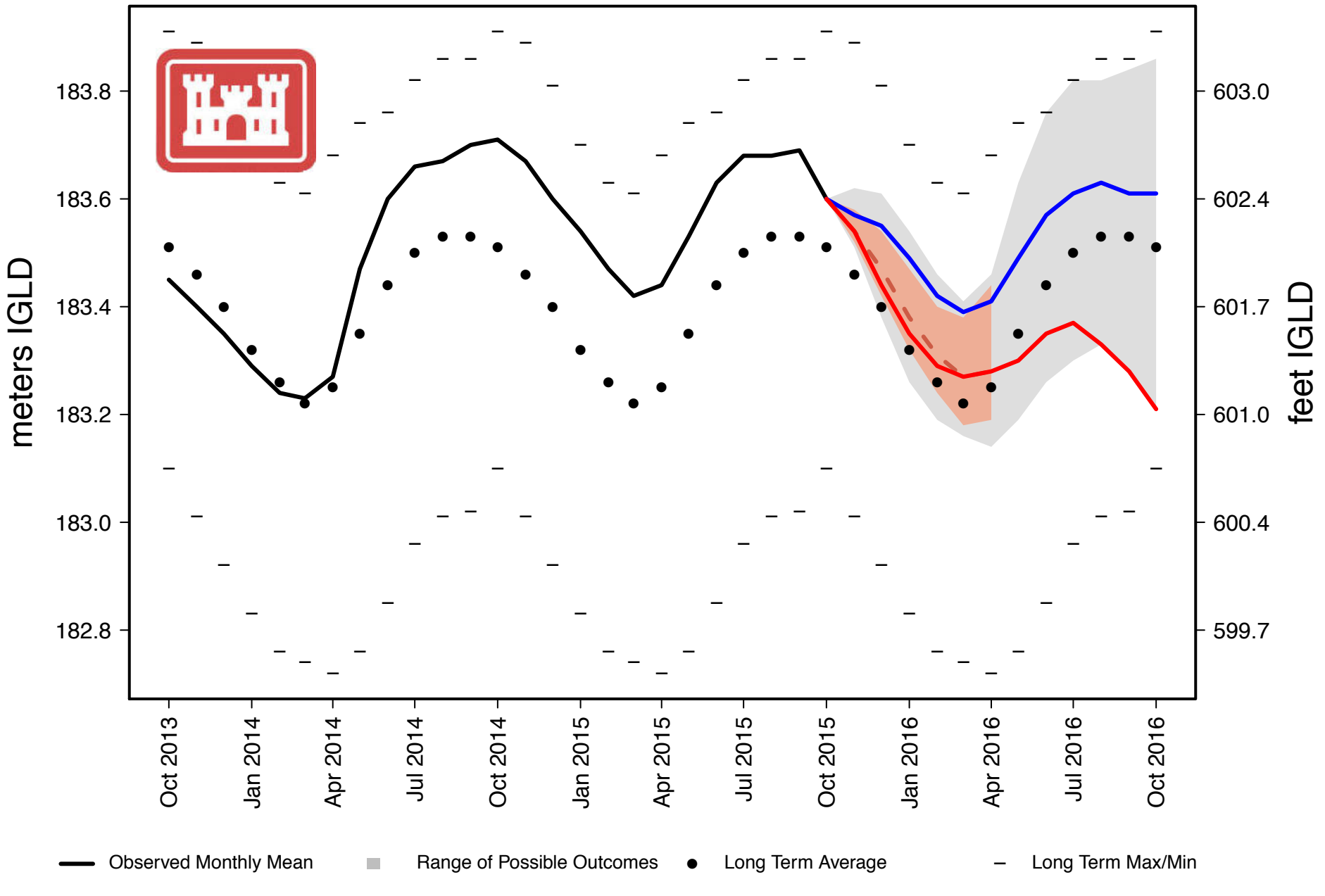
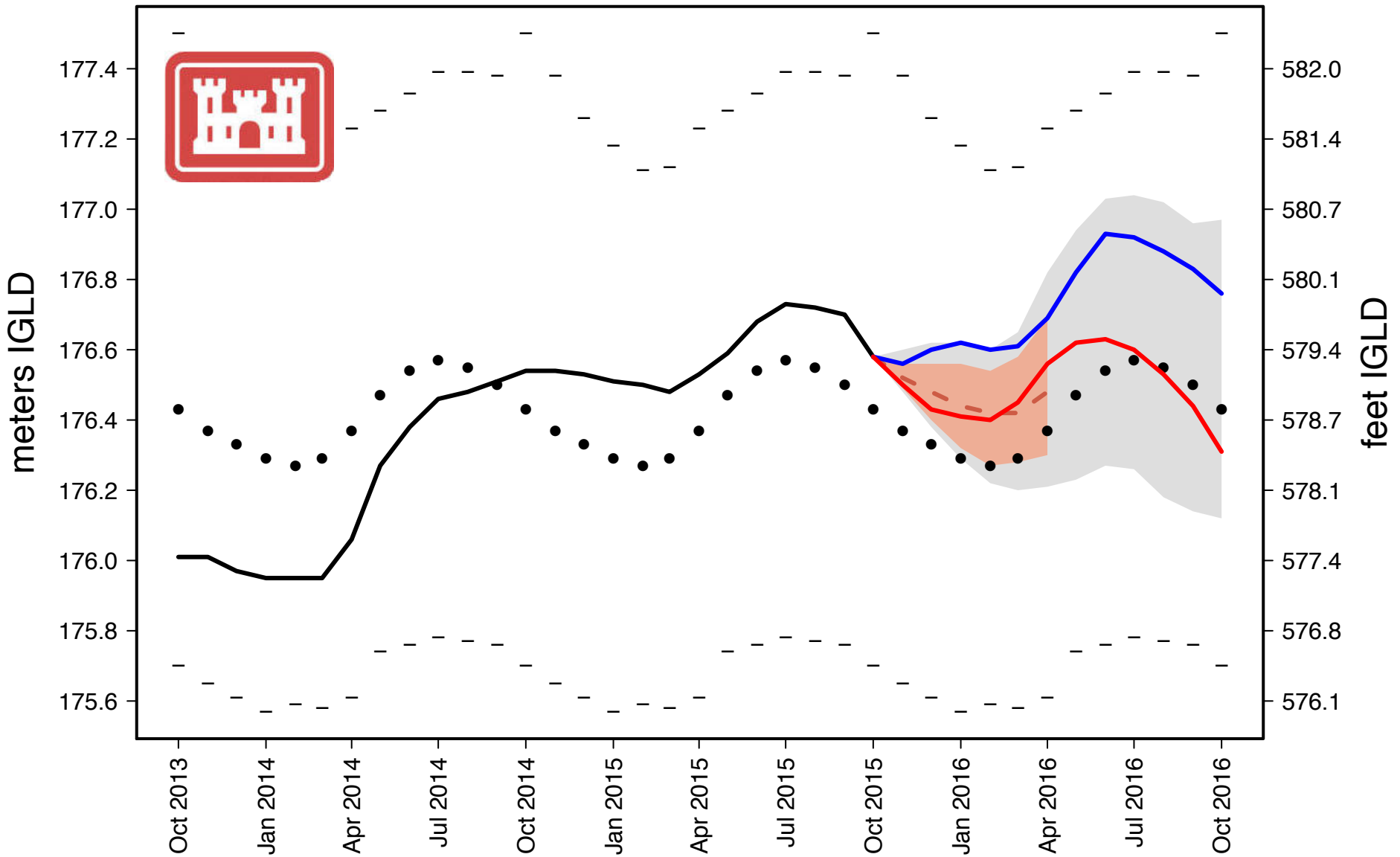
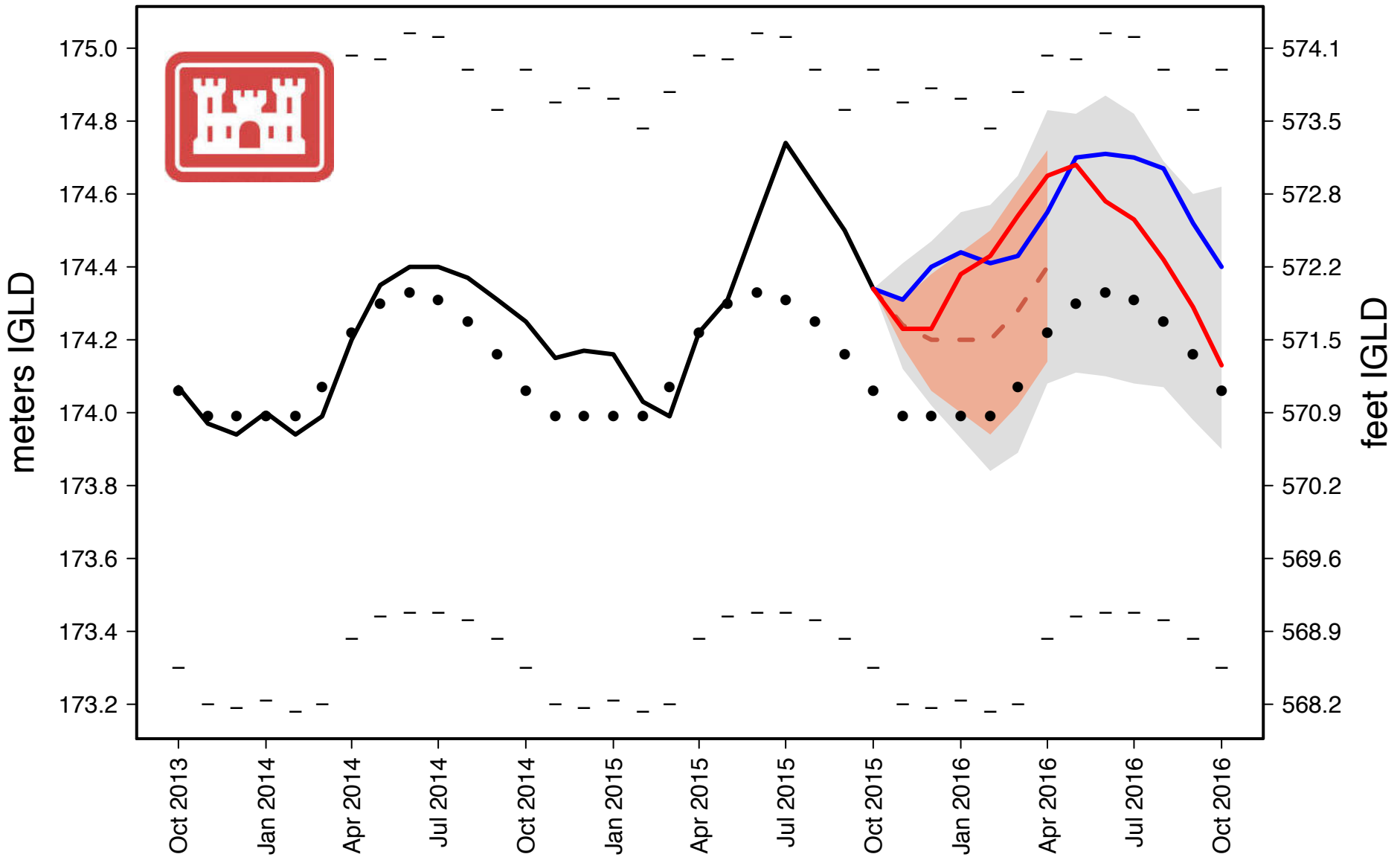


Lake Michigan–Huron Monthly Mean Water Levels



Observed Monthly Mean
Range of Possible Outcomes
Long Term Average
Long Term Max/Min
1982–83 Strong El Niño
1997–98 Strong El Niño
Nov Bulletin Forecast Range
Bulletin Forecast Most Probable

Lake Erie Monthly Mean Water Levels



Observed Monthly Mean
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A recording of this event can be found at: http://www.glerl.noaa.gov/data/now/wlevels/docs/elNinoLevelsCall20151119.mp3.

Send media inquiries to: Monica Allen, Director of Public Affairs, NOAA Research, at Monica.Allen@noaa.gov or 301-734-1123

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Additional resources:

Midwest Climate Center Great Lakes El Nino Outlook

NOAA Great Lakes Water Levels

NOAA-GLERL Great Lakes Water Levels factsheet

Website Tutorial: Great Lakes Water Level Dashboard

NOAA Real-Time Water Level Observations

NOAA Great Lakes Water Level Hydro-Climate Dashboard

NOAA Lake Level Viewer

U.S. Army Corps of Engineers Monthly Bulletin of Great Lakes Water Levels

U.S Army Corps of Engineers Water Level Outlook

NOAA Lake Level Images on GLERL Flickr or Michigan Sea Grant Flickr

A recording of this event can be found at: http://www.glerl.noaa.gov/data/now/wlevels/docs/elNinoLevelsCall20151119.mp3.

Send media inquiries to: Monica Allen, Director of Public Affairs, NOAA Research, at Monica.Allen@noaa.gov or 301-734-1123

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- Lauren Fry, lead forecaster, U.S. Army Corps of Engineers Detroit District
- Stephen Gill, senior scientist, NOAA National Ocean Service Center for Operational Oceanographic Products and Services