Water Levels of the Great Lakes

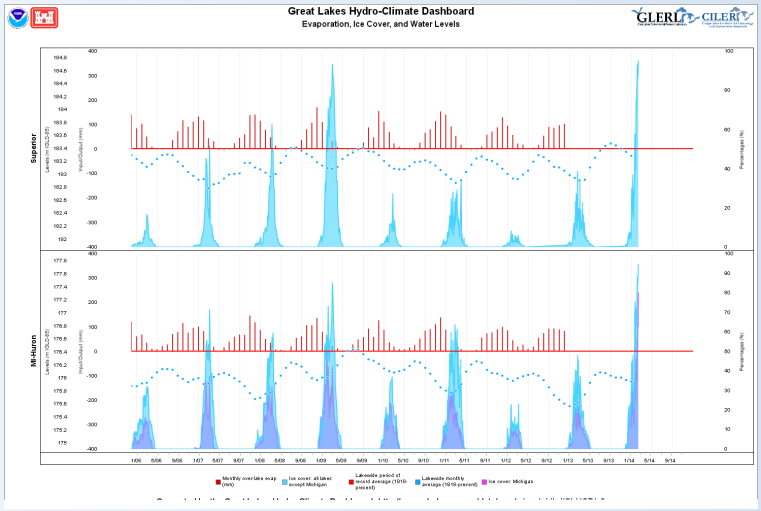
February 2014

The Great Lakes, their connecting waterways, and their watersheds, comprise the largest surface freshwater system on the planet. The monthly, seasonal, and annual surface water elevations of the lakes fluctuate in response to a variety of factors. This brochure provides a brief overview of historical Great Lakes water level patterns and current water levels, as well as the research NOAA conducts through its Great Lakes Environmental Research Laboratory (GLERL) on seasonal water level forecasts.

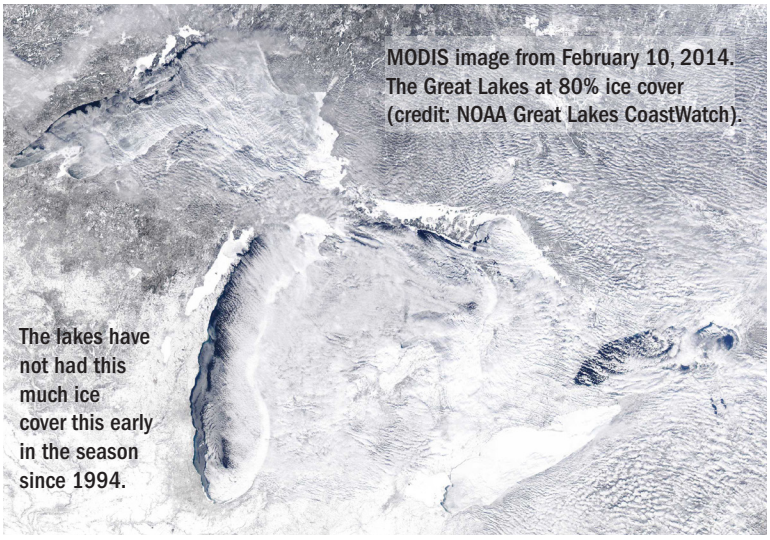
Water levels, ice, and evaporation - how are they related?

When a severe winter brings extensive ice cover to the Great Lakes, questions arise about potential impacts on water levels. Does more ice cover lead to higher water levels because of decreased evaporation? This is not a simple question, due to the complex relationship between these factors and the massive surface areas over which they interact in the Great Lakes. NOAA-GLERL has been exploring these relationships for over 30 years through development of model simulations and analysis of observations of ice cover, over-lake evaporation, surface water temperature, and lake levels.

The figure at right reveals the strong seasonality of evaporation and ice cover. Note that the majority of evaporation on each lake occurs before the onset of ice. It is likely that this winter's severe ice cover may impact the thermal structure of the Great Lakes through 2014, potentially causing lower water temperatures that will lead to less evaporation during the fall of 2014. Combined with this year's above average snow pack and increased spring runoff, it is not entirely unlikely that water levels could begin to approach their long-term average on Lakes Michigan and Huron in the next year. NOAA-GLERL is currently working with a team of regional research scientists to improve the monitoring networks that collect over-lake evaporation data, and to use that data to improve understanding of these important relationships.



This plot compares monthly average water levels (blue dots) with modeled evaporation (orange vertical bars) and observed ice cover (teal [Superior, Huron] and purple [Michigan] vertical bars) for Lakes Superior and Michigan-Huron for 2006 to present. Examine this data yourself at: http://www.glerl.noaa.gov/data/now/wlevels/dbd/GLHCD/



MODIS image from February 10, 2014. The Great Lakes at 80% ice cover (credit: NOAA Great Lakes CoastWatch).

The lakes have not had this much ice cover this early in the season since 1994.

How are water levels predicted?

Forecasts of Great Lakes monthly-average water levels are typically based on computer simulation models. One example is the Great Lakes Advanced Hydrologic Prediction System (AHPS), developed by NOAA-GLERL, which combines historical meteorological data with a series of mathematical models and climate forecasts from NOAA's Climate prediction Center to simulate multiple variables. The most important variables are overlake precipitation, overlake evaporation, and rainfall-induced runoff. The sum of these variables ("net" supply of water to the basin) is routed through the lakes and connecting channels using models that reflect flow patterns and regulation rules in order to produce a band of probability-based future water levels.

FOR MORE INFORMATION

http://www.glerl.noaa.gov/data/now/wlevels/levels.html

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