Great Lakes Water Budget

A SUMMARY OF THE AMOUNT AND FLOW OF WATER IN THE GREAT LAKES BASIN

When we consider household budgets, we think of money that flows in and out. The Great Lakes water budget takes into account all of the water that flows in and out of the basin. The Great Lakes – St. Lawrence River system spans an area of nearly 300,000 square miles (750,000 square km). Freshwater flows from the highest elevation in northwest Ontario, Canada, through the Great Lakes basin, to the lowest elevation in Quebec, Canada, and to the Atlantic Ocean. The components of the water budget between these two ends of the system are monitored at key points.

Figure 1. Values are shown in thousands of cubic meters per second (CMS). Averages for evaporation (e), precipitation (p), runoff (r), and artificial diversions, over the period of 1953-2010, are shown for each lake and connecting channel. Figure modified by the Graham Sustainability Institute from original, used with permission by Michigan Sea Grant. Data source: NOAA-GLERL Hydrometorological database. Not to scale.

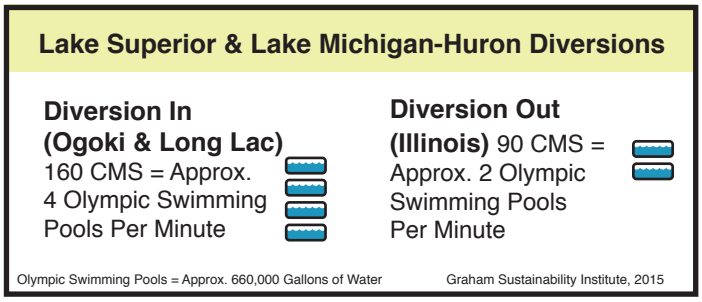

Figure 2. The average amount of water diverted from Ogoki and Long Lac to Lake Superior, from 1953-2010, compared to the amount diverted out of Lake Michigan-Huron near Chicago, IL. Values shown are cubic meters per second (CMS), converted to gallons per minute, and compared to a swimming pool.

INPUTS AND OUTPUTS

The key factors monitored include precipitation, evaporation, runoff, water flow through connecting channels, artificial diversions, and consumptive water use. Information from gauges and models is analyzed to improve our understanding of what has happened recently, and what might happen in the future. The key factors monitored and the direction of water flow through the system provide an overview of the amount and flow of water in the Great Lakes system (See fig. 1).

NET BUDGET

The Illinois diversion, near Chicago, the flow from Lake Ontario to the St. Lawrence River, evaporation, and consumption reflect the total water lost and not returned to the system. The amount of diversion entering Lake Superior is significantly more than the amount diverted out of Lake Michigan-Huron, near Chicago, Illinois (See fig. 2).

EVAPORATION

One of the top three factors in analyzing the water budget is evaporation from the lake surface. Peak evaporation occurs in late fall to early winter, when water temperatures are warm, compared to air temperatures. Evaporation is challenging to measure accurately. Computer models currently use meteorological conditions and observation data from satellites, buoys, and gauging stations on the land to produce over-lake estimates. In recent years, several evaporation stations have been established on lighthouse towers. This data will help to improve model estimates.

DIVERSION AND CONSUMPTION

The diversion into the Great Lakes basin at the northwest end of Lake Superior (Ogoki and Long Lac) is significantly larger than the diversion out of the basin. The Illinois diversion (near Chicago) diverts water from Lake Michigan-Huron to the Mississippi River watershed. Evaporation, diversions out of the system, and consumptive use not returned to the system contribute to water lost from the Great Lakes basin. Consumptive use includes water withdrawn from the system for public water supplies and irrigation (See Fig. 3).

MONITORING AND INTERNATIONAL COOPERATION

Water level gauges collect accurate and site-specific information used to determine lake-wide averages of water levels. There are 53 water level gauging stations in the Great Lakes basin monitored by the US government, and 33 stations monitored by the Canadian government. US and CA federal agencies monitor Great Lakes water levels continuously, through a binational partnership. The National Oceanic and Atmospheric Administration's (NOAA) Center for Operational Oceanographic Products and Services, and the Department of Fisheries and Oceans Canadian Hydrographic Service, operate water level monitoring stations. The US Army Corps of Engineers (USACE) and Environment Canada have crucial roles in research, coordination of data and operational seasonal water level forecasts for the Great Lakes basin. The NOAA Great Lakes Environmental Research Laboratory (NOAA-GLERL) uses water level data to conduct research and improve predictive models.

GREAT LAKES COMPACT

The Great Lakes Compact includes detailed guidelines for how the States and Provinces will manage and protect the Great Lakes basin, and provides a framework for each State and Province to enact laws for its protection. The Council of Great Lakes Governors is charged with reporting on the state of the Great Lakes water budget every five years. New diversions out of the basin are prohibited, with very limited exceptions. The Compact became law in 2008, and was endorsed by all Great Lakes state governors and the Premiers of Ontario and Quebec.

LEARN MORE

- Fluctuating Great Lakes Water Levels, A Summary of Information, Public Perception, Trends, and Technology (Graham Sustainability Institute)
- Water Levels Integrated Assessment Website (Graham Sustainability Institute)
- Great Lakes Water Levels Website (NOAA-GLERL)
- Great Lakes Water Level Dashboard (NOAA-GLERL)
- Hydro-climate Dashboard (NOAA-GLERL)

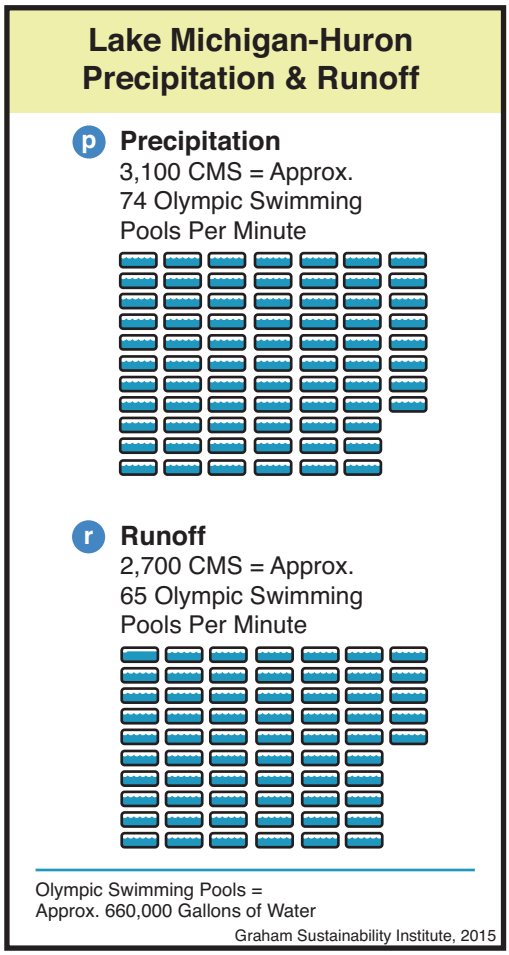

Figure 3. This graphic shows the average amount of precipitation and runoff into Lake Michigan-Huron over the period of 1953-2010. Values shown are converted from CMS to gallons per minute. The amount of precipitation, runoff, and evaporation are factors that contribute to seasonal fluctuations in lake levels.

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Sources:

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- National Oceanic and Atmospheric Administration, Coastal Resiliency Grant Program, http://coast.noaa.gov/resilience-grant/
- NOAA Great Lakes Environmental Research Laboratory, Great Lakes Hydro-climate Dashboard Project, http://www.glerl.noaa.gov/data/dashboard/GLHCD.html
- NOAA Lake Level Viewer, http://coast.noaa.gov/llv/
- U.S. Army Corps of Engineers Detroit District Water Level Forecast, http://www.lre.usace.army.mil/Missions/GreatLakesInformation/GreatLakesWaterLevels/WaterLevelForecast.aspx

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