

# The Great Lakes Region: Past, Present, and Future

## 2. HISTORICAL OVERVIEW AND CURRENT SITUATION

prepared by

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The Great Lakes region, for the purpose of this report, consists of the Great Lakes drainage basin, Wisconsin and Minnesota. The drainage basin includes portions of Ontario and Quebec, as well as portions of Minnesota, Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, and New York, and all of Michigan. The Great Lakes themselves are the geographical centerpiece of the region. The Lakes and other physical characteristics of the region were formed nearly 3 billion years ago, during the Precambrian Era. Early sedimentary and volcanic rock were repeatedly heated, folded, and eroded into the gentle rolling hills that still exist today in the northwestern portions of the region as part of the remnants of the Canadian Shield. The Paleozoic Era brought repeated flooding by marine seas, which were responsible for the formation of a layer of sedimentary rock consisting of limestone, shales, sandstone, halite, and gypsum – remnants of marine life. The Pleistocene Epoch brought with it repeated advancements and retreats of glaciers – sometimes over a mile high – to the region. The glaciers scoured the terrain, leveled hills, and turned river valleys into what now constitute the Great Lakes drainage basin. Each glacial retreat left behind a mixture of sand, silt, clay, and boulders – the glacier drift. The melting water from the glaciers filled the deeply scoured regions as lakes that were even larger than the present

day versions. The warm periods also allowed vegetation and wildlife to return to the region before the next glacial advance began scouring the region once more.

The Great Lakes - St. Lawrence Basin watershed spans an area of about 400,000 mi<sup>2</sup> (1,000,000 km<sup>2</sup>). Twenty five percent of that amount, 100,000 mi<sup>2</sup> (250,000 km<sup>2</sup>), is covered by the Great Lakes themselves. These Lakes contain over six quadrillion gallons of water – nearly 20% of the world's fresh water supply. Only the polar ice caps contain more fresh water. The water in the Great Lakes-St. Lawrence Basin serves as a resource for sustaining human life, ecology, agriculture, trade, energy generation, and recreation, to name a few.

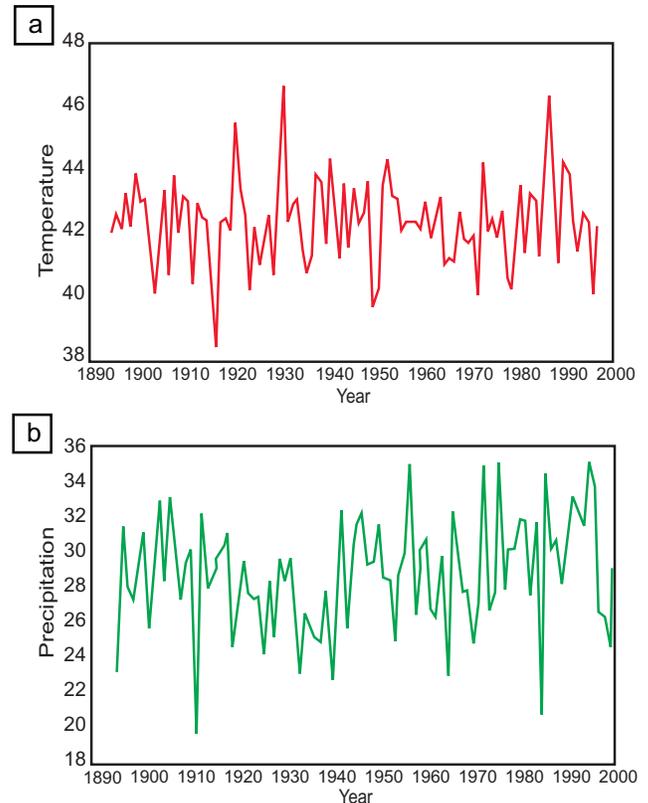


Figure 2.1: Historical trends of mean a) temperature and b) precipitation for Upper Great Lakes region: Michigan, Minnesota and Wisconsin. [2-1].

## Climate

The region's location within the interior of the North American continent contributes to the current (non-glacial) climate characteristics consisting of warm summers, cold winters, and significant amounts of precipitation year-round (Figures 2.1 and 2.2). Additionally, the Great Lakes are large enough and close enough to each other to exert significant impacts on local and regional weather. Areas in the north and west (International Falls, Minnesota) have lower temperatures, a larger seasonal temperature range, and less annual and less seasonally distributed precipitation than areas in the south and east (Detroit, Michigan). Areas close to the lakes (Traverse City, Michigan and Buffalo, New York) have a smaller annual temperature range

than areas farther away (Lansing, Michigan). The primary moisture source is the Gulf of Mexico, although the Pacific and Atlantic Oceans are not insignificant sources.

In winter, nighttime low temperatures typically range from sub-zero in the northwest to the teens (°F) in the southeast. Strong low pressure systems typically approach the region from the southwest, bringing Gulf of Mexico moisture to the region in the form of heavy rain, snow, or a frozen mix. Weaker systems with less moisture from the Pacific or Canada (Alberta Clippers) approach from the west or northwest [2-1]. As these systems move through the region, northwesterly flow on the back sides of the lows can bring bitterly cold (arctic) air masses into the Great Lakes region. Temperatures can plunge to  $-40^{\circ}\text{F}$  or

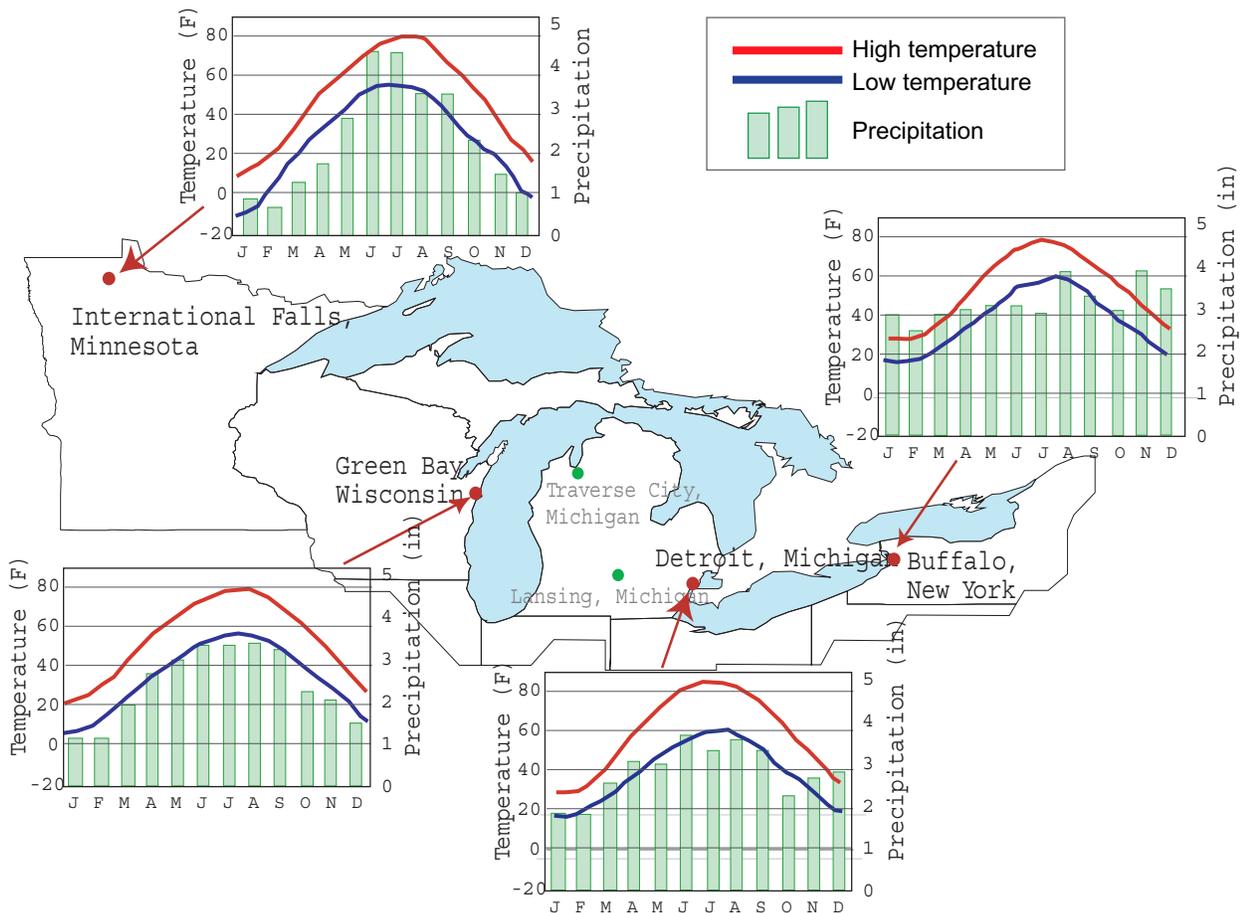


Figure 2.2: Monthly high and low temperatures (red curves, °F), and precipitation (bars, inches) for International Falls, Minnesota, Green Bay, Wisconsin, Buffalo, New York, and Detroit, Michigan [2-2].

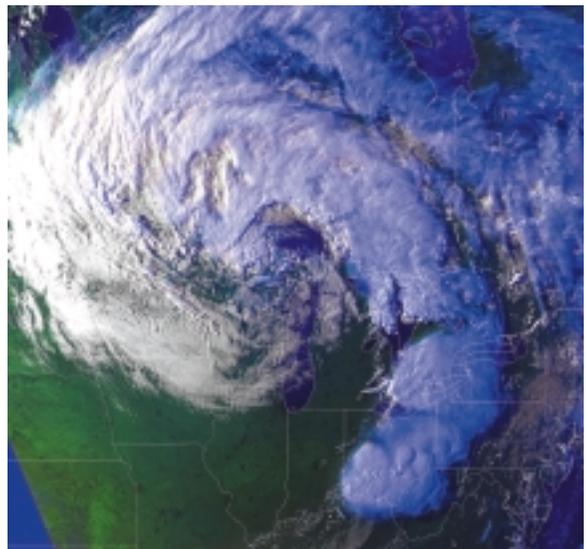
lower, especially in the northern parts of the region. As this cold air travels across the much warmer lakes, it is warmed, moistened, and destabilized. Intense lake-effect snowstorms typically develop on the leeward sides of the lakes. Snow storm totals can often exceed 10 inches. Lake-effect snows are most prominent along the southern and eastern shores of Lake Superior, the eastern shores of Lakes Michigan and Huron, and the southeastern shores of Lakes Erie and Ontario where such snow can account for more than half of the annual snowfall totals [2-3]. For example, 80 of the 160 inches that usually fall in Traverse City, Michigan typically come from lake-effect. The amount of lake-effect snow that any location gets in any year depends on how much cold air and what the prevailing wind direction is among other factors. During El Niño years, lows move north and/or west of the region, typically bringing less precipitation, fewer cold air outbreaks, and less (lake-effect) snow.

A northward retreat of the jet stream during the summer allows relatively tranquil conditions to exist most of the time. Daytime high temperatures range from near 80°F (26°C) in the northwest to the mid 80s °F (30°C) in the southeast. Cooler conditions exist near the lakeshores. Southerly flow on the back side of the Bermuda High can bring high heat and humidity from the Gulf of Mexico and the Atlantic Ocean into the region. Although low pressure centers rarely cross through the region in summer, cold fronts do move through the region every 1-2 weeks, bringing at times severe weather, intense precipitation, and relief from intense heat. Tornadoes range in frequency from 1-2 per year in the northwest to 2-4 per year in the southeast to 12-16 per year just south of Chicago (Figure 2.3). As a result of the more tranquil large-scale flow, the lakes play a significant role near the lakeshores. Lake-air temperature differences affect thunderstorm and possibly tornado development in complicated ways. For example, near Lake Michigan, lake-land temperature differences lead to thunderstorm increases in the north but thunderstorm decreases in the south. On the whole, the lakes themselves are estimated to account for a net decrease (e.g., ~6% for Lake Michigan) of summertime precipitation over the Lakes. In Fall, the lakes contribute to hail storms that can cause considerable crop damage [2-4].

## Population & Economy

The first inhabitants of the region moved in as last glacier retreated nearly 10,000 years ago. A few thousand years later, the natives had established hunting and fishing communities and were using copper from the region. They grew corn, squash, beans, and tobacco and moved once or twice each generation when the resources in an area became exhausted. By the sixteenth century, an estimated 60,000-120,000 Native (Americans) occupied the region before the region began being settled by Europeans [2-1].

The area was first settled primarily by the French, but soon thereafter by the British, and Americans. The Native American people were slowly squeezed out (of existence, in many cases). A series of military struggles between the French and the British and Americans culminated with the war of 1812. Both the Americans and the British claimed victory. The Native Americans, who were involved to save their homeland, did not share in the victory.



*Figure 2.3: Visible satellite image of a tornado outbreak taken at 2335 UTC 02 July 1997. Source: National Oceanic and Atmospheric Administration (NOAA), The National Environmental Satellite, Data and Information Service (NESDIS), Operational Significant Event Imagery (OSEI).*

Development of the region from that time to the present has evolved dramatically. The population alone since 1900 has increased from approximately 10 million to over 40 million (Figure 2.4). In the last half of the 19th century, lumbering, farming, mining, and early manufacturing dominated the economies of Michigan, Wisconsin and Minnesota – the Upper Great Lakes region.

Lumbering began as early as the 1830s and grew throughout the region. In the period after the Civil War it became a dominant industry, with Michigan woodlands alone producing about a quarter of the nation's total supply. The harvest of wood resources was rapid and unsustainable. By the 1870s the great forests of the region were drastically reduced.

The climate and fertile soil of Michigan, Wisconsin, and Minnesota were ideal for wheat production. Between the 1880s and the 1920s the prairies and valleys were converted to a checkerboard of fields and pastures. During this period Minneapolis became the country's largest producer of flour. Like lumber, the prairie soil was depleted and farmers had to turn from wheat to a mix of crops.

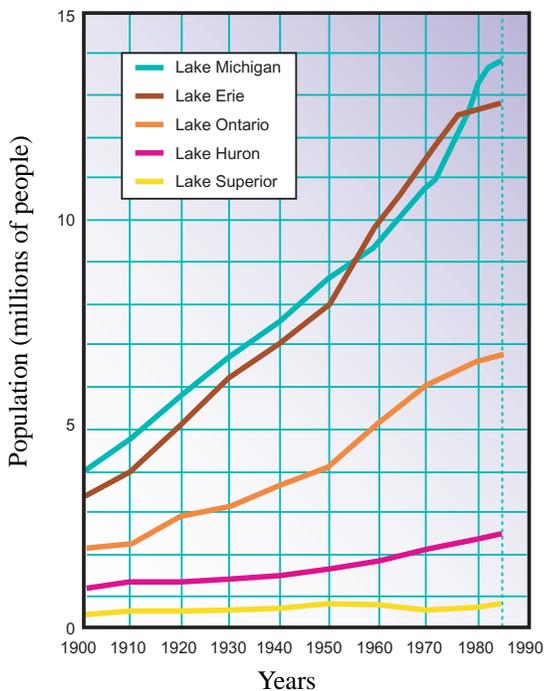


Figure 2.4: Population growth in the Great Lakes basin since 1900 [2-1].

Iron ore mining in Minnesota began in the 1890s as thousands of laborers worked on the Mesabi, Vermillion and Cuyuna iron ranges. They built towns and dug huge pits to remove the valuable ore. The Hull-Rust mine in Hibbing, Minnesota became the largest open-pit mine on Earth.

Henry Ford, R.E. Olds, William Durant, and Walter Chrysler used the assembly line to make automobile manufacturing the greatest wealth creator of the 20th century. Like lumbering and mining before it, automobile manufacturing needed labor and it drew people to the region, this time in unprecedented numbers.

Between 1900 and 1930 Flint grew by a factor of 12 to 156,000 people and Detroit grew from less than 300,000 to 1.6 million! Earlier immigrants were from Canada and Europe with very large numbers of Germans going to Wisconsin. The automobile industry brought immigrants from new areas such as Poland, Hungary, Italy and Greece as well as African-Americans from the south. The Great Lakes-St. Lawrence Basin is now home to more than 42 million Americans and Canadians. An estimated 97% of Quebec's population lives within the St. Lawrence River Basin watershed; two-thirds of its population lives within a 6 mile (10 km) wide strip on either side of the St. Lawrence River [2-5].

Although there has been dramatic change in the economic structure of the Upper Great Lakes region over the past 200 years, Minnesota still provides about 70% of the iron ore/taconite produced in the US; automobiles are still a very large component of Michigan's economy dominating the durable goods manufacturing sector; and farming is a \$2 billion/yr industry in Wisconsin.

The Great Lakes region as a whole is suitable for growing eight of the top ten food crops in the world. Hog production is important in Minnesota, dairy production is important in Wisconsin, and specialty crops are important in Michigan, which ranks first in the US in tart cherry production. The wine industry is

important in upstate New York. Other specialty crops are important elsewhere. These specialty crops grow well in these areas, in part because of microclimates that are unique to the region.

The St. Lawrence Seaway is currently the world's longest deep draft inland waterway. It consists of a series of 19 locks and 6 canals spread across 60 miles. The locks can raise ships that are 730 feet in length and 76 feet at the beam more than 591 feet above sea level. The Seaway serves 50 regional ports as well as a region that: 1) is home to more than 90 million people (nearly 25% of North America's population); 2) creates more than a third of the continent's gross national product; 3) produces two-thirds of Canada's industrial output; 4) grows almost half the soybean and corn in the US; and 5) accounts for some 40% of US manufacturing. It allows access to 15 major ports that ship products around the world. The Seaway allows shipping routes to Europe that are shorter than comparable routes from east coast cities. It is used for commercial shipping and pleasure craft traffic. Four principal dry bulk commodities (iron ore, limestone, coal, and grain) constitute 85% of the regional shipping industry. Fourteen regional companies use the Great Lakes - St. Lawrence Basin for shipping. The Seaway has carried more than two billion tons of cargo and has accounted for \$300 billion in trade since its opening in 1959. The Seaway is managed and operated by The St. Lawrence

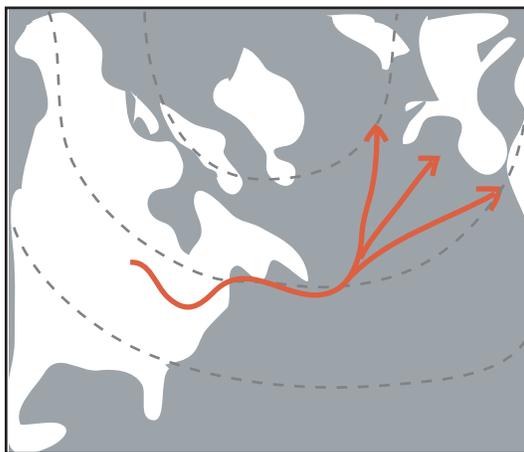


Figure 2.5: Common shipping routes from the Great Lakes to Europe [2-7].

Seaway Authority of Canada and the United States Saint Lawrence Seaway Development Corporation. It is currently open to navigation from early April to mid-December [2-6].

The New York Power Authority provides about a quarter of New York State's electricity by operating 12 generating facilities and more than 1,400 miles of transmission lines. Two hydroelectric facilities on the St. Lawrence River are the St. Lawrence-Franklin D. Roosevelt Power Project and the Niagara Power Project. The St. Lawrence-Franklin D. Roosevelt Power Project has a net dependable capability of 800,000 kilowatts. The Niagara Power Project has a net dependable capability of 2,400,000 kilowatts. Together these two facilities supply more than 10% of New York State's electricity. Or put another way, they supply enough electricity to light Washington, D.C. four times over [2-8]!

Ontario Power Generation is one of the largest utilities in North America in terms of installed generating capacity. Ontario Power Generation (formerly Ontario Hydro), a self-sustaining corporation without share capital, was created by provincial statute and operates today under the Power Corporation Act of Ontario. Its net dependable capability of 30,284,000 kilowatts is generated from: 69 hydroelectric stations, 5 nuclear stations, and 6 fossil-fueled stations [2-9].

Summer and winter recreation are economically important to the region. There are more registered boaters in the state of Michigan than in any other state. The eight state region as a whole accounts for nearly one-third of all registered boaters in the US. The large numbers demonstrate the importance of recreational boating to the regional economy. The boating industry is represented by boat manufacturers and retailers, marina operators, marine business suppliers, and the hundreds of thousands of boaters and anglers. Retail sales of marine equipment in 1988 accounted for more than \$3 billion in spending.

