Climate Change in the Great Lakes Region

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GREAT LAKES INTEGRATED SCIENCES + ASSESSMENTS

There is a high level of scientific certainty that the climate has changed in significant ways in recent decades and that it will continue to change in the future. This is a summary of the potential changes and impacts of climate in the Great Lakes region from the best research available across many scientific disciplines.

Temperature

- Average temperatures increased by 2.3°F (1.3°C) from 1968 to 2002 in the Great Lakes region.
- By 2050, an average air temperature increase of 1.8 to 5.4°F (1 to 3°C) is projected.
- By 2100, an average air temperature increase of 3.6 to 11.2 °F (2 to 6.2°C) is projected.
- Winter temperatures will likely experience a greater increase than the summer months.

Precipitation

- Projections of future precipitation vary widely.
- Annual average precipitation will likely increase or remain nearly stable.
- Winter and spring precipitation may increase more significantly.
- Warmer temperatures will lead to less precipitation falling as snow, and more falling as rain.
- Lake-effect precipitation may increase in some areas.

Extreme Weather Events

- The frequency and intensity of severe storms has increased, and current models suggest that this trend will continue as the effects of climate change become more pronounced.
- More severe storms may have a negative economic impact due to resulting damages and increased costs of preparation, clean up, and business disruption.

Water Quality and Stormwater Management

- Increased risk of droughts, severe storms, and flooding events may increase the risk of erosion, sewage overflow, lead to more interference with transportation, and more flood damage.
- Future changes in land use could have a far greater impact on water quality than climate change. The coupling of climate change and land use change could therefore result in even stronger effects in some areas.

A sailboat on Lake Michigan near Milwaukee in a sewage overflow plume. Photo: Milwaukee Journal Sentinel

Ice and snow cover on Lake Superior. Photo courtesy of NASA.

Snow and Ice Cover

- Since 1975, the number of days with land snow cover has decreased by 5 days per decade, and the average snow depth has decreased by 1.7 cm per decade.
- From 1973 to 2010, annual average ice coverage on the Great Lakes declined by 71%.
- Snow and ice levels on the Great Lakes and on land will likely continue to decrease.
- Reduced lake freezing will result in more exposed water that could increase lake-effect precipitation.
- Earlier spring warming may decrease the length of the snow season and cause precipitation in some lake-effect events to fall as rain rather than snow.

Lake Temperature and Stratification

- Lake temperatures have been increasing faster than surrounding air temperatures.
- Both inland lakes and the Great Lakes will likely experience longer warm seasons.
- Warmer water surface temperatures may increase the stratification of the lakes, decrease vertical mixing in the spring-winter, and lead to more low-oxygen, "dead zones" and toxic algal blooms.

Lake Erie algal bloom, Oct. 20, 2011. Photo courtesy of NASA.

Fish and Wildlife

- Coldwater fish populations will likely decline in population as warmwater fish populations become more abundant.
- Overall biomass productivity in lakes and waterways could be reduced by lake stratification and increased frequency of hypoxic conditions.
- In general, many animal species may need to migrate north to adapt to rising temperatures, and increased evaporation rates may decrease total wetland area in the region, both of which may lead to additional stresses on some species.

Forests

- Climate change will likely have mixed effects on forests that vary based on the species involved and other factors.
- With increasing atmospheric CO2, forest productivity will likely increase until other impacts of climate change, such as increased risks of drought, forest fire, and invasive species present additional stressors to forests.
- As temperatures rise, the distribution and composition of tree species will likely shift northward.

Lake Levels

- Water levels in the Great Lakes have been decreasing since a record high was reached in 1980.
- Lake levels are rising and falling a month earlier than during the 19th century.
- Other factors, such as land use and lake regulations also affect lake level, however, and it is still unclear how much of the recent trend in lake levels may be attributed to climate change.
- Future projections of lake levels for the Great Lakes vary, though most indicate a greater decline in lake levels with increasing greenhouse gas emissions.

Water Availability

- Overall, the Great Lakes region is expected to become drier due to increasing temperatures and evaporation rates.
- More frequent droughts could affect soil moisture, surface waters, and groundwater supply.
- The seasonal distribution of water availability will likely change. Warmer temperatures may lead to more winter rain and earlier peak streamflows.

Agriculture

- The growing season will likely lengthen and positively impact some crop yields.
- An increased frequency and intensity of severe weather, increased flooding and drought risks, as well as more pests and pathogens will likely negatively impact crop yields.
- Water availability and quality will likely pose challenges for agriculture.

Energy and Industry

- Drier summers may lead to reduced hydroelectric output during periods of peak usage.
- Reduced water availability may interfere with some industrial operations.
- Warmer temperatures and more frequent heat waves will likely increase electricity demands, particularly in urban areas and during the summer months.

Transportation

- With increasing temperatures, damage to paved surfaces due to expanding and softening pavement is more likely.
- The most significant impact on roadways will likely be the increased risk of flood damage.
- Shipping lanes will likely be open earlier and longer due to reduced ice cover on the Great Lakes.
- Lower lake levels may lead to decreased depth of navigation channels and a reduction in the maximum loads carried by vessels.

Public Health

- Increased risk of heat waves and increased humidity may increase the number of heat-related deaths and illnesses.
- Increased frequency of flooding events may lead to watershed contamination, while warmer surface waters could mobilize pollutants in sediment and contaminate fish.
- Diseases such as West Nile virus and Lyme disease may become more widespread since carrier insects will be more likely to survive milder winters.

Tourism and Recreation

- Winter recreation and tourism are likely to suffer due to reduced snow cover.
- Many species of fish important to recreation are likely to decline while the populations of some warmwater species may grow.
- Increased lake contamination and decreasing lake levels may lead to less desirable shorelines, but increasing summer temperatures and a longer summer season, may increase demand for beaches and some summer activities.
- Winter tourism and recreation may decline as summer tourism grows.

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Photos courtesy of Shanty Creek Resorts and the National Park Service.