

Confronting Climate Change in the Great Lakes Region

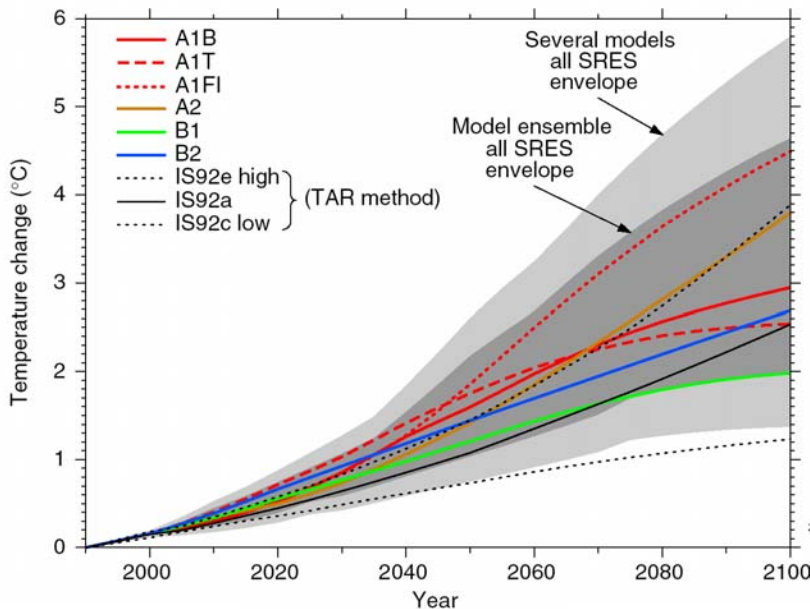
Technical Appendix Climate Change Projections

FULL RESULTS OF CLIMATE ANALYSIS

To directly view geographical plots and time series of historical and modelled changes in key climate variables projected by this analysis, use the following links:

- [Temperature](#)
- [Precipitation](#)
- [Agricultural and Hydrological Climate Variables](#)
- [Extreme events](#)
- [State/Province-Specific Projections](#)
- [Migrating Climates](#)

At the global scale, the impact of increased GHG concentrations is often measured by changes in annual and global average temperature and precipitation. Using the IPCC 2000 standard [emission scenarios](#) as input, current [climate models](#) estimate global average temperature to increase by 2.5°F to 10.4°F (1.4°C to 5.8°C) by 2100. Our uncertainty as to how human activities - and hence the emissions from these activities - will change in the future accounts for almost 60% of the 7.9°F range in temperature projections, while 40% is due to differences between models (Figure 1). In contrast to the uniform increases in temperature expected to occur around the globe, precipitation is projected to increase over some regions but decrease over others. However, all model simulations display a few common regional features, including an increase in high-latitude moisture, especially during the winter months (IPCC, 2001).



Several models all SRES envelope

Model ensemble all SRES envelope

Temperature projections corresponding to emissions for the SRES scenarios and the earlier IS92a scenario. (Source: IPCC, 2000)

Figure 3. Temperature projections corresponding to emissions for the SRES scenarios and the earlier IS92a scenario. (Source: IPCC, 2000)

Regional and seasonal changes in [temperature](#) and [precipitation](#) can potentially be quite different from these global averages, as they respond to natural variability and to local conditions. Climate in the Great Lakes is shaped by its geographical location in the middle of the North American continent. Topography is also a strong influence. In the northeast part of the Great Lakes region it combines with the predominant westward atmospheric circulation patterns to create distinctive microclimates and lake-effect snow zones downwind of the Great Lakes. In the southwest part of the region, the flat plain environments are uniquely amenable to severe weather and flooding.

Analyses of the indirect impacts of temperature and precipitation changes on [agricultural and hydrological variables](#) such as growing season, soil moisture and runoff or on [extreme events](#) such as heat waves, cold periods or heavy rainstorms imply important additional changes for regional ecosystems, agriculture, and human health and welfare.

By combining analyses of current climate models with the historical climate record, it is possible to make the following conclusions regarding future climate changes in the Great Lakes region:

- It is virtually certain that [temperatures](#) over the Great Lakes region will increase over the next 100 years. By the end of the century, it is likely that annual average daily temperatures increases will fall within the range of 5-15°F or 3-8°C. Increases are projected to be larger for winter and summer than for spring and fall.
- [Precipitation](#) is projected to increase (up to 40% more) in the winter, while summer precipitation in most U.S. states may decrease slightly. In Ontario, little change in summer precipitation is expected.
- [Growing seasons](#) have already lengthened over the last few decades, and are projected to continue to increase over the next century by as much as 4-8 weeks. While this in itself is likely beneficial to agriculture, there are also concerns of negative impacts on ecosystems and agriculture resulting from the shorter, warmer winters, the possibilities of more extreme rain storms, flooding, and drought.
- [Soil moisture](#) is projected to increase by as much as 80% during winter and spring, and decrease by as much as 30% in summer and autumn. Together with runoff, soil moisture exhibits large changes on a state-by-state basis that are likely to shift the balance of water distribution throughout the year.
- In terms of [temperature thresholds](#), by 2090 the region may see 20 to 50 more days where temperature exceeds 90°F or 32°C than found under

current climate conditions, and 40 to 75 less days where temperature falls below freezing.

- [Heavy rainfall events](#), measured over 24 hours and over 7-day periods, have been increasing steadily over the last century. Their frequency is projected to more than double relative to the 1900-2000 average by 2100.
- Temperature and precipitation changes will strongly alter our [regional climate](#), resulting in [‘migrating climates’](#). By the end of the century, an Illinois summer may well feel like one in East Texas today, while a Michigan summer will probably feel like an Arkansas summer does today. Residents in Toronto could experience a shift from a southern Ontario summer to one that resembles those of Northern Virginia today, while winters may be more like New York State.

Although uncertainty still remains regarding the exact magnitude and timing of the changes that may occur, it is clear that the Great Lakes climate over the next century will differ significantly from what we have been accustomed to over the past century. The most important factor in determining our future climate lies in our own hands – the emissions of heat-trapping gases responsible for this change.

Click here for geographical plots and time series of historical data and projected changes:

- [Temperature](#)
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