

Confronting Climate Change in the Great Lakes Region

Technical Appendix Climate Change Projections

EMISSION SCENARIOS

Forecasts of changes in future climate due to emissions from human activities begin with the development of emission scenarios. These scenarios are not predictions, but represent plausible future conditions under particular assumptions. Based on a consistent set of assumptions, projections of population, demographics, economic growth, energy supply and demand, land use, and technological developments are developed. These projections are used as input to complex socio-economic models that estimate emissions of greenhouse and other important gases resulting from human activities in a number of sectors, including agriculture, commercial and residential energy, forestry, industry, transportation, and other sectors of the economy.

Due to the complex nature of such scenarios, input from a wide range of social, economic and physical sciences are required to develop consistent storylines describing potential futures for today's world. The reference standard for emission scenarios are the suites of scenarios developed by an interdisciplinary team of integrated assessment modelers under the auspices of the Intergovernmental Panel on Climate Change (IPCC).

In 1992, the IPCC provided a standard set of Integrated Science (IS92) emission scenarios that have been used in a number of previous assessments, including the U.S. Global Change Research Program regional climate change impact assessments (USGCRP, 2000; IPCC, 1992). However, the IS92 scenarios contain a number of inconsistencies and assumptions that are considered limited in the face of current uncertainty as to how the world will develop over the next century. For example, IS92 emissions of sulfur and other aerosol precursors were projected to triple by the end of the century despite the fact that they were already being reduced through air quality legislation. Also, IS92 scenarios failed to cover an adequate range of possible futures, in particular tending to underestimate the results of a non-intervention policy towards climate change (Figure 2). In response to these issues, a new set of emission scenarios were approved for use by the IPCC in 2000. These are called the SRES scenarios after the report entitled "Special Report on Emission Scenarios" (IPCC 2000).

Four qualitative "storylines" (Figure 1) developed for the Special Report on Emissions Scenarios (IPCC, 2000) cover a wide range of possible futures (Figure 2). Each storyline describes alternative future developments in economics as well as technical, environmental, and social dimensions. Unlike previous scenarios developed by the IPCC, sulfur emissions are consistent with current

and anticipated air quality regulations. This eliminates the strong regional cooling patterns resulting from earlier scenarios used in the U.S. GCRP reports. It is important to note that all of these scenarios are intended to represent the possible range for a business-as-usual situation with no significant policy intervention to reduce emissions in order to slow down climate change.

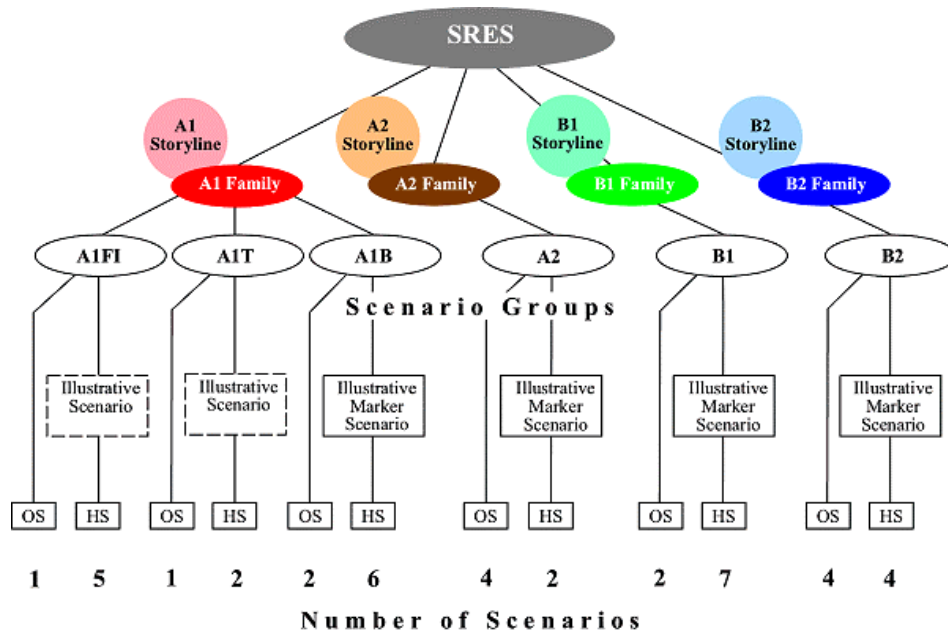


Figure 1. Schematic illustration of SRES family storylines. Climate projections plotted in the Great Lakes report are those resulting from the A1FI, A2, B1 and B2 scenarios. (Source: IPCC, 2000)

Our analysis considers one scenario from each of the four SRES storylines in order to capture divergent futures spanning a significant portion of the underlying uncertainties in the main forces driving emissions. The scenarios considered span the full range from ‘high’ (A1FI) through ‘mid-range’ (A2 and B2) to ‘low’ (B1) emissions (IPCC, 2000):

A1FI – high end of range - where a rapid rate of temperature change is driven by a continued dependence on fossil fuels and rapid economic growth throughout the next century.

A2 – upper mid-range - for a very heterogeneous world where economic development is regionally-oriented and economic growth and technological change are relatively slow.

B2 – lower mid-range – where the emphasis is on local solutions to economic, social, and environmental sustainability with less rapid and more diverse technological change.

B1 – low end of range – where the focus is on global solutions to economic, social and environmental sustainability. Clean, efficient technology is introduced but no specific climate initiatives are taken.

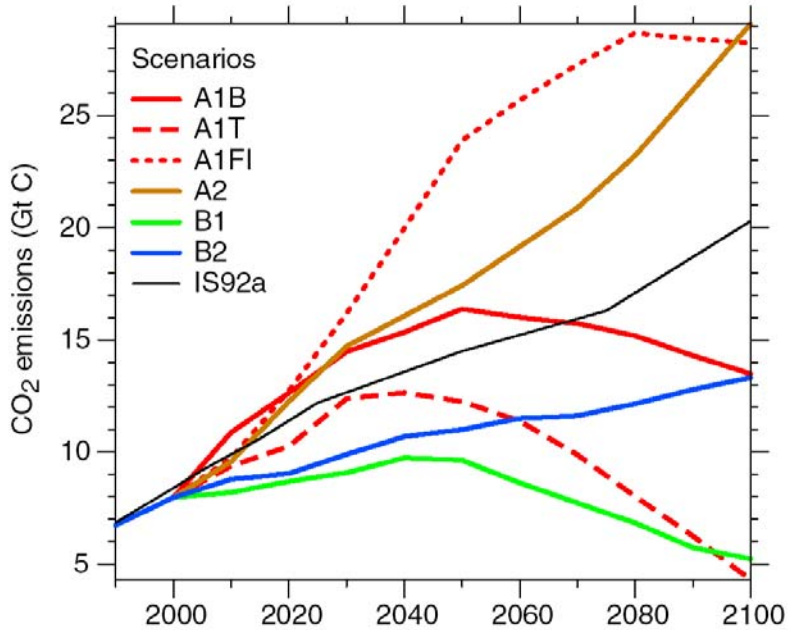


Figure 2. Carbon dioxide emissions for the SRES scenarios and the earlier IS92a scenario. (Source: IPCC, 2000)

Using the SRES scenarios as input, current models estimate global temperature to increase by 2.5°F to 10.4°F (1.4°C to 5.8°C) by 2100, as compared to previous estimates of 1.2°C to 3.9°C based on the IS92 scenarios (Figure 3). This rate is faster than any since at least the end of the last ice age, ten thousand years ago, and illustrates the severity and magnitude of the potential threat from climate change.

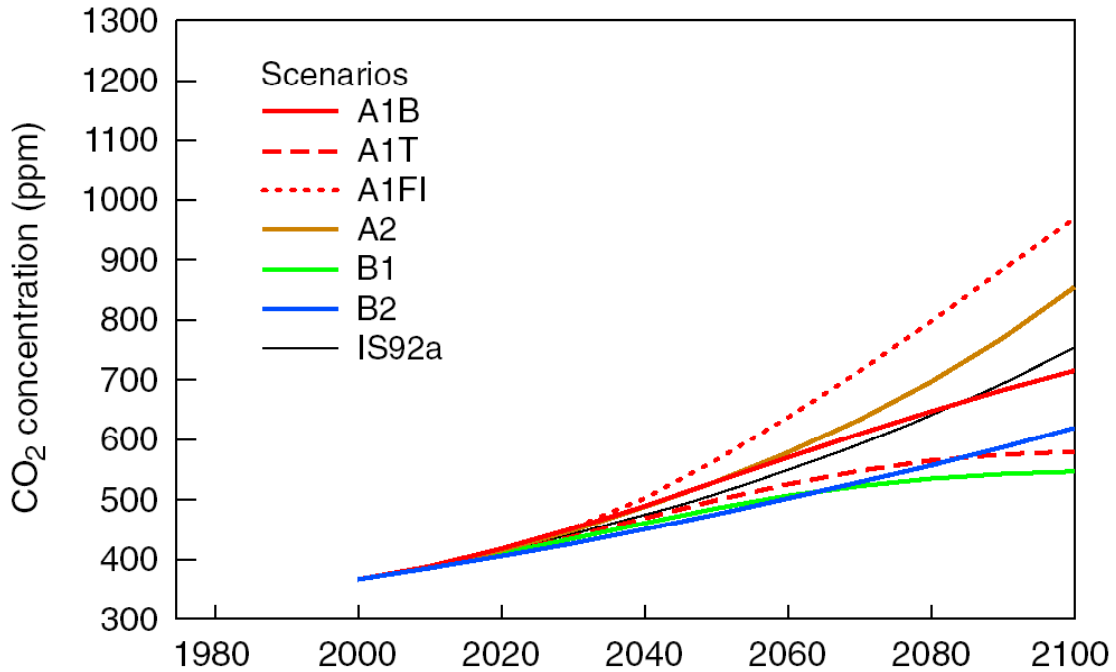


Figure 3. Carbon dioxide concentrations resulting from projected emissions for the SRES scenarios and the earlier IS92a scenario. (Source: IPCC, 2001)

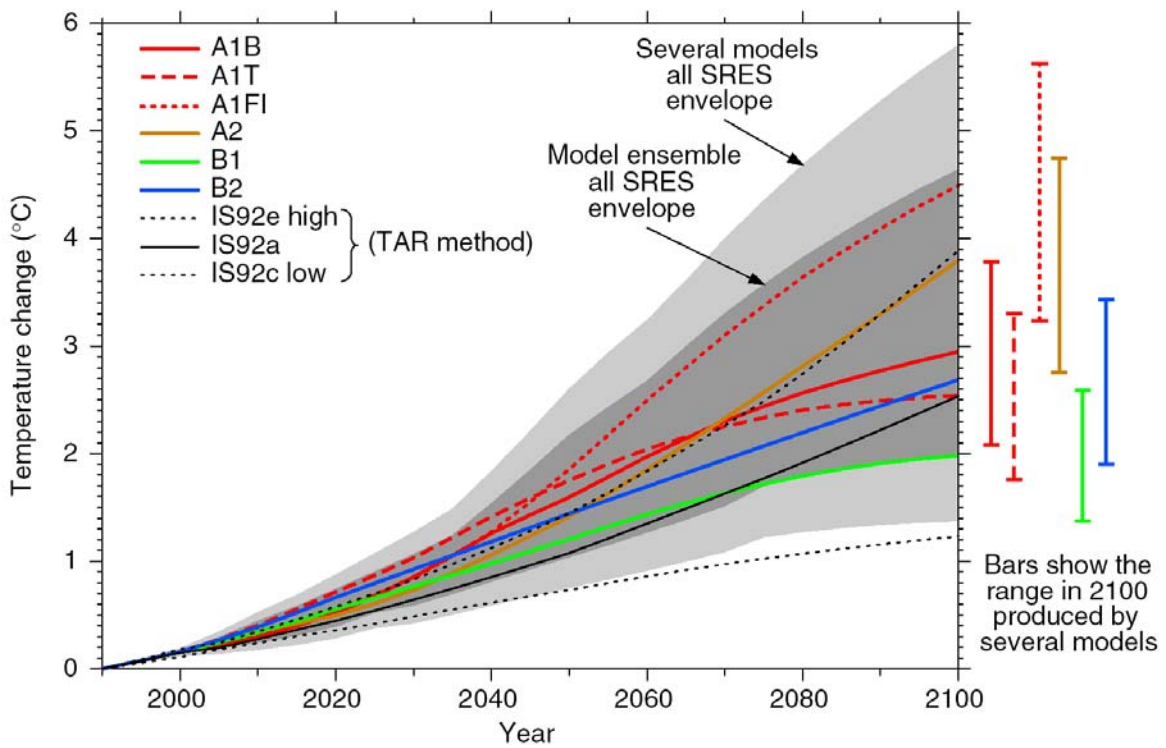


Figure 4. Temperature projections corresponding to emissions for the SRES scenarios and the earlier IS92a scenario. (Source: IPCC, 2000)

References

Intergovernmental Panel on Climate Change: 1992, 1992 IPCC Supplement, J.T. Houghton, B.A. Callander and S.K. Varney (eds.), Cambridge, Cambridge University Press.

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