



ILLINOIS  
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

# Future Climate Change Scenarios for Lake Michigan Levels

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# Introduction

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- ▶ Water Supply Planning in Illinois
- ▶ Climate Change
- ▶ Impact of future climate change on Lake Michigan



# Water Supply Planning in Illinois

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- ▶ Initiated by executive order in 2006
- ▶ Projected demand of 20 to 50 percent more water in coming decades.
- ▶ Where will we get this water?
- ▶ How much will it cost?
- ▶ Need to plan now



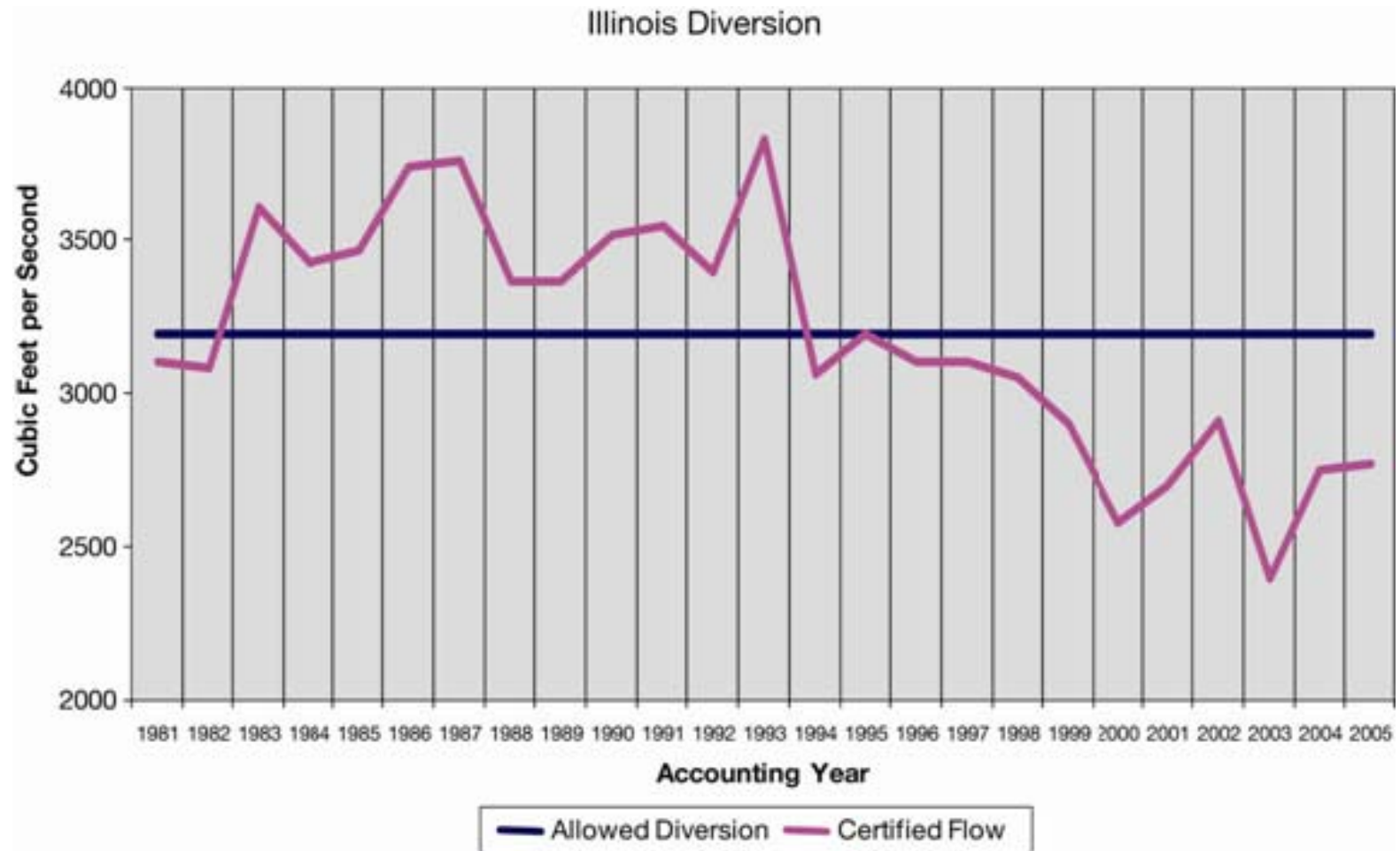
# Water Supply and Lake Michigan

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- ▶ Lake Michigan is a key source of fresh water
- ▶ Communities within the basin have unlimited access
- ▶ Chicago is allowed by the Supreme Court to divert 3,200 cfs down the Chicago River
- ▶ Change in Lake Michigan water levels
  - ▶ Impact water intakes & water quality
  - ▶ Diversion



# Illinois Diversion

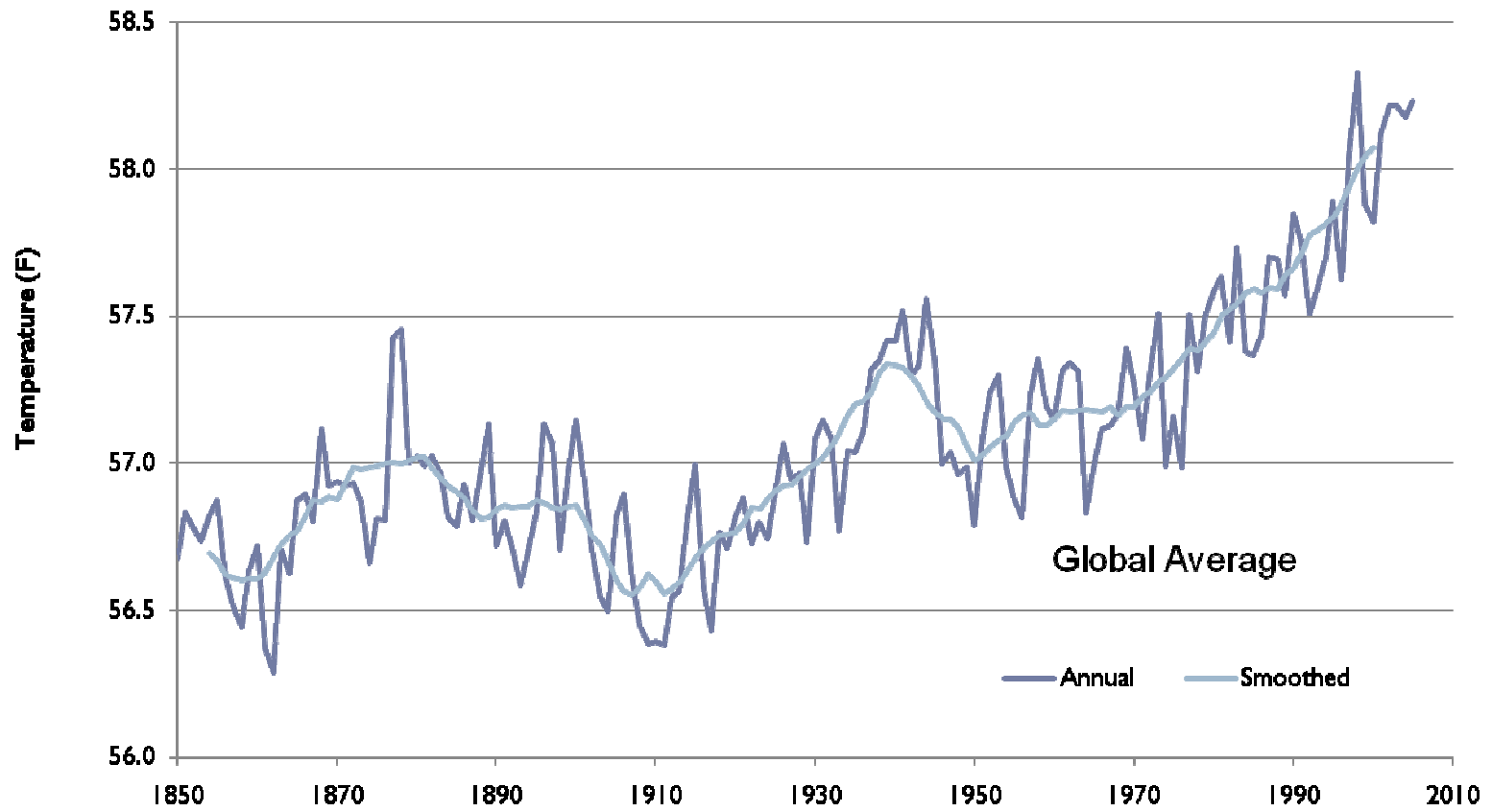


# Impact of Climate Change on Lake Michigan

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- ▶ Concern with changing temperature & precipitation
- ▶ Lack of ice cover in winter – more evaporation
- ▶ Warmer and drier conditions will strain water resources throughout NE Illinois



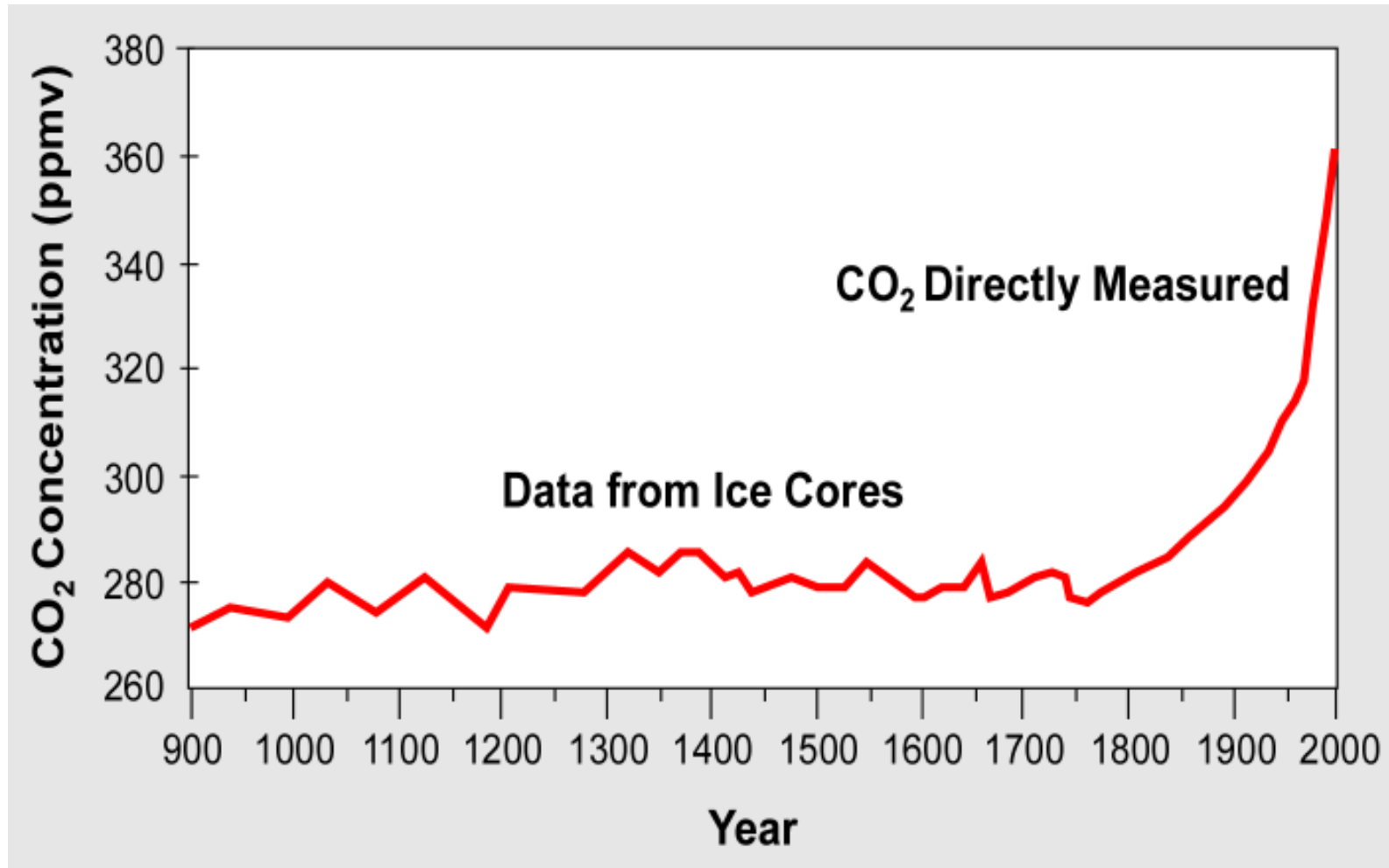


Source: Climate Research Unit, University of East Anglia, UK



# CO<sub>2</sub> Concentration in Global Atmosphere

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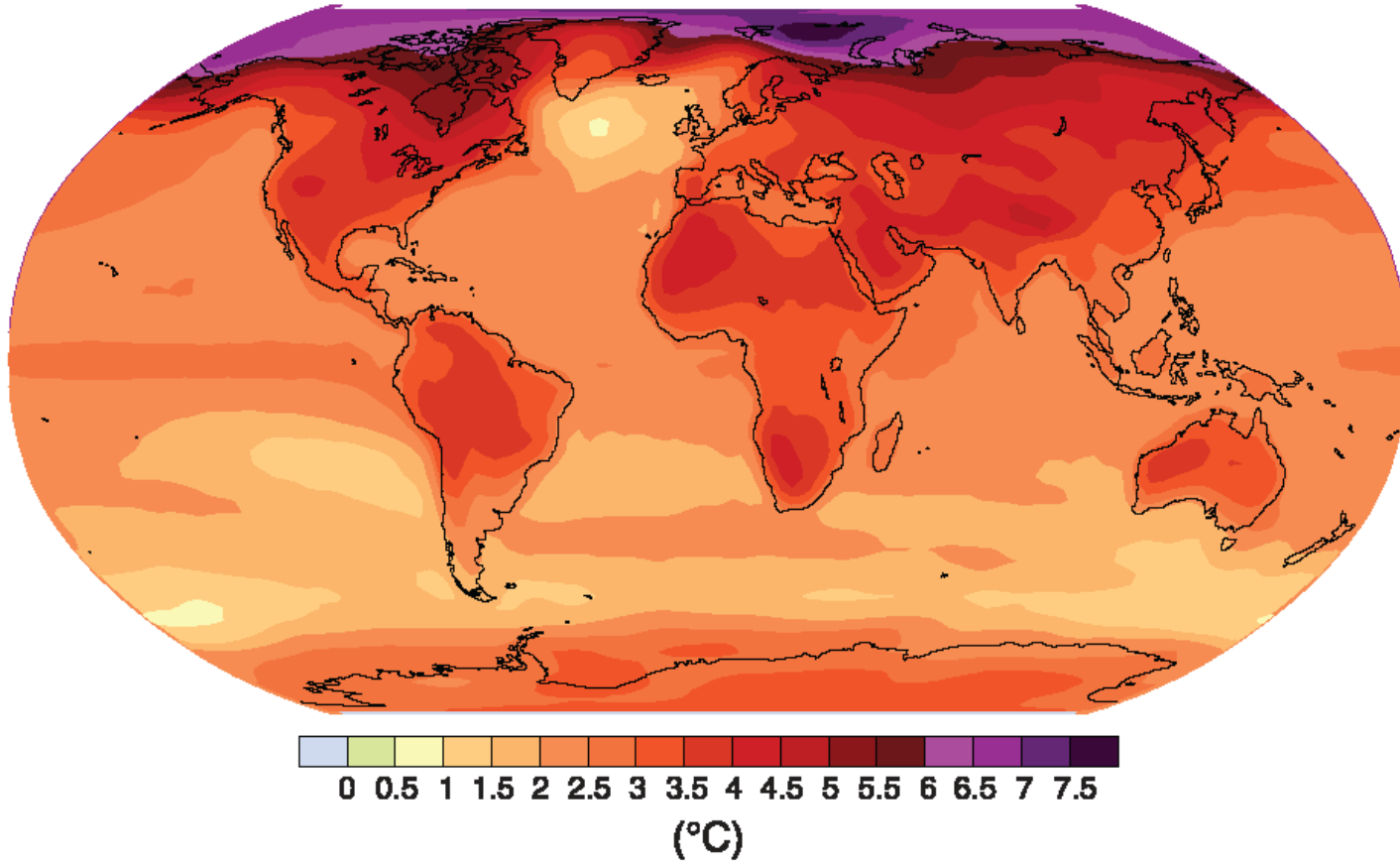
## 2007 IPCC report

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- ▶ “Most of the observed increase in global average temperature since the mid-20<sup>th</sup> century is likely due to the observed increase in anthropogenic “greenhouse gasses” concentrations.”



### Geographical pattern of surface warming



# Methodology

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- ▶ Great Lakes Environmental Research Lab (GLERL)
  - ▶ Advance Hydrologic Prediction System (AHPS)
  - ▶ Used in both operations and research
  - ▶ Daily runoff models for each of 121 watersheds
  - ▶ Lake thermodynamic model of each lake
  - ▶ Hydraulic models for connecting channels and outflow points, taking into account operating plans



# IPCC models

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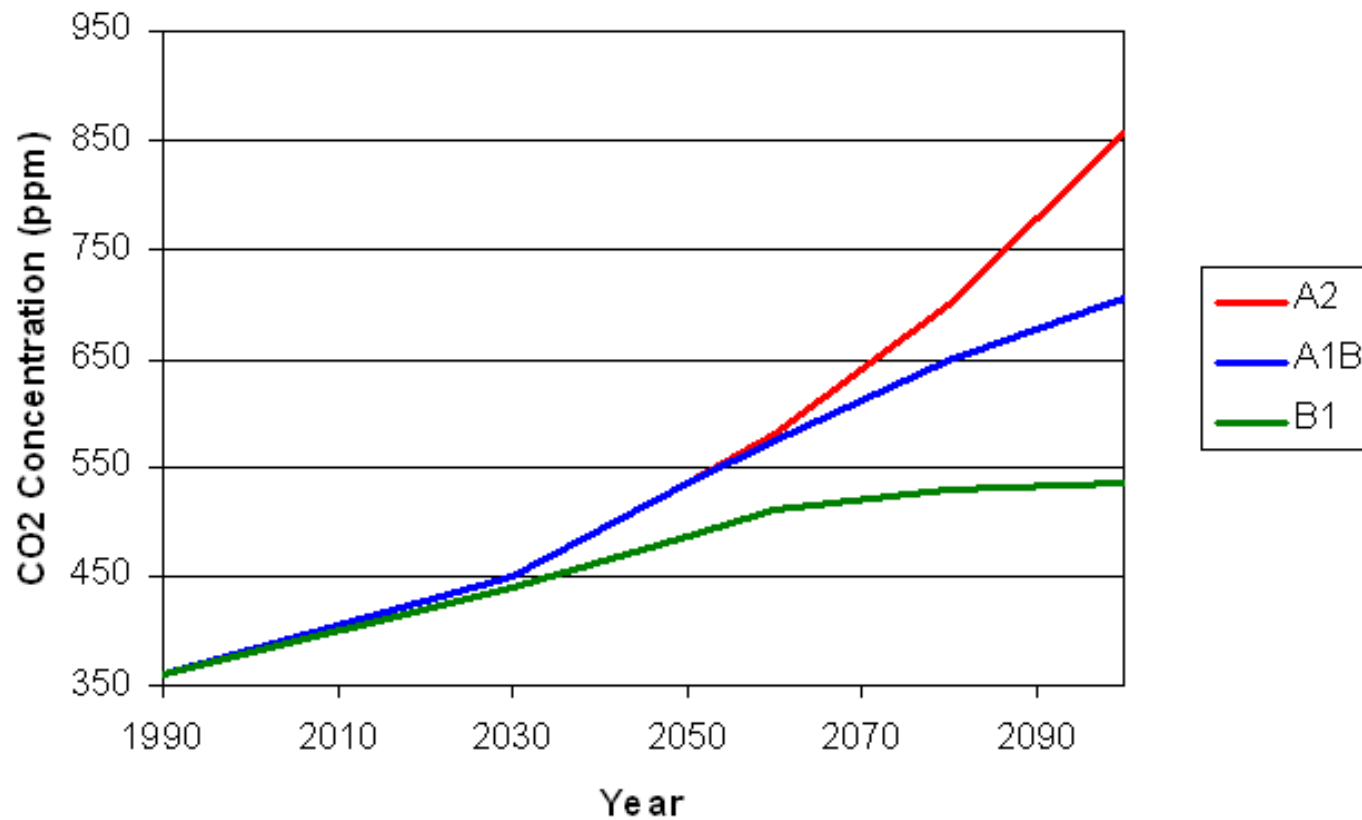
- ▶ General Circulation Models
  - ▶ Modeling the Earth-Ocean system
  - ▶ Limited by our knowledge of the system
  - ▶ Limited by our ability to model finer details
- ▶ Between 18 and 23 GCMs used, depending on scenario
- ▶ Examined three CO<sub>2</sub> emission scenarios



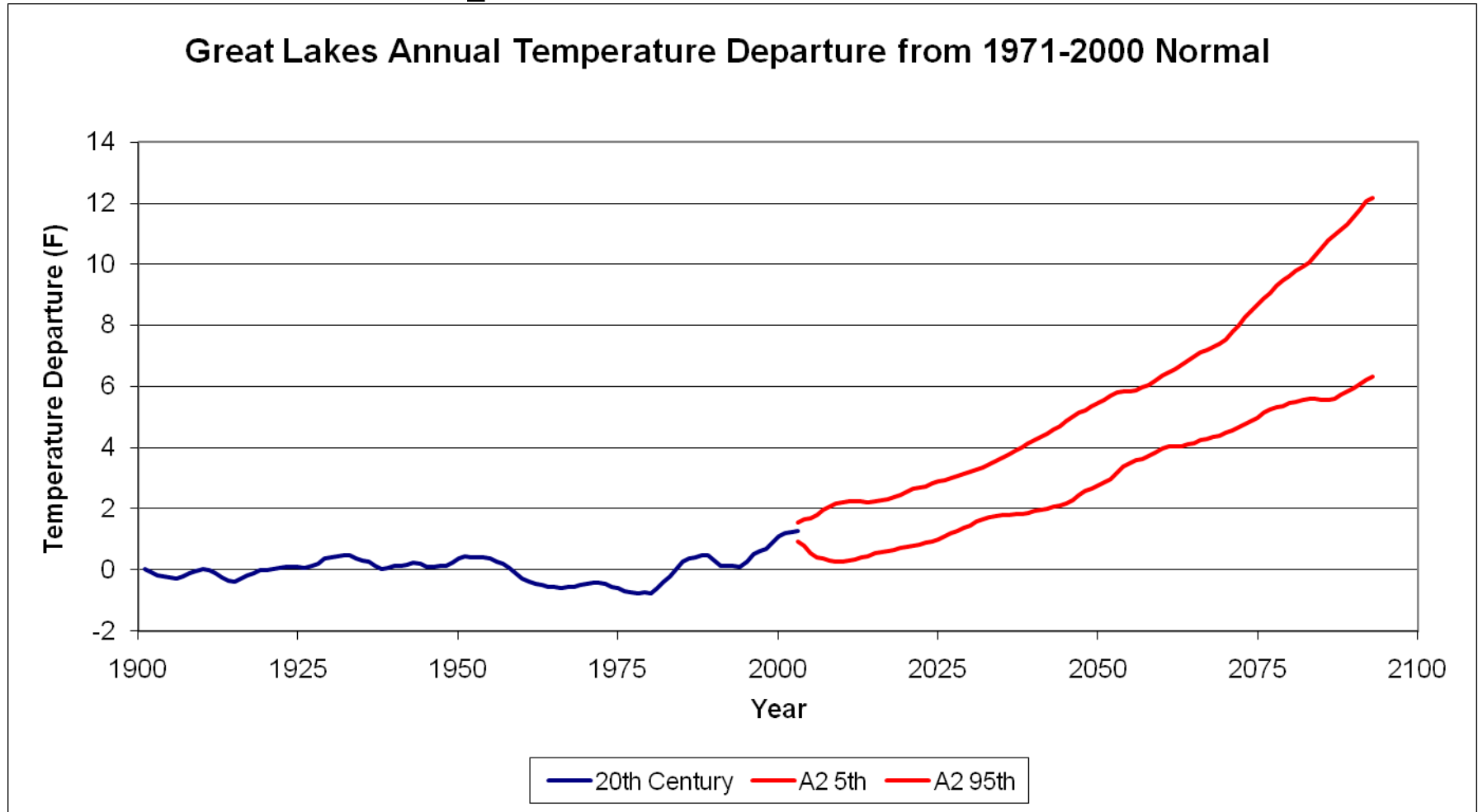
# Three scenarios used

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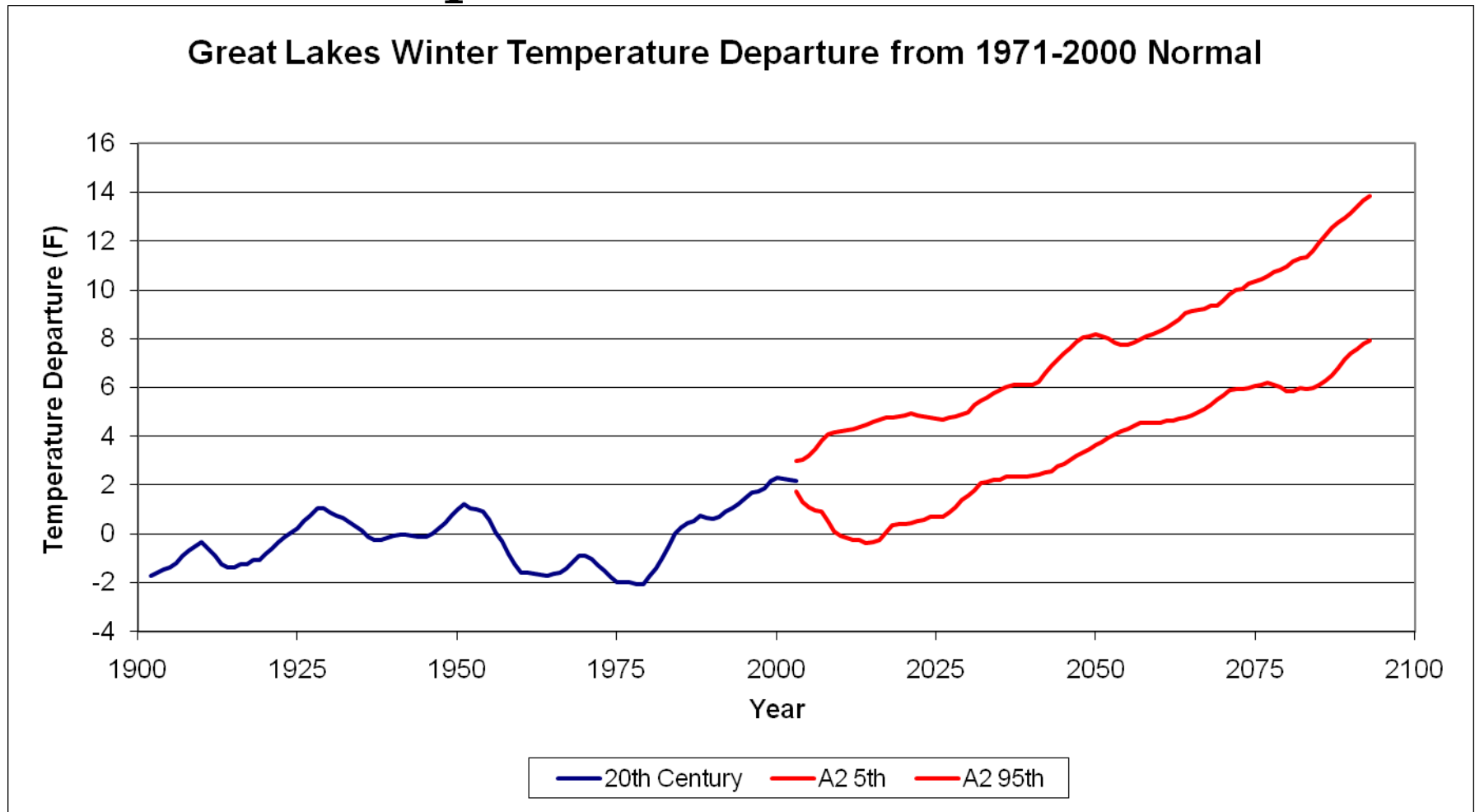
**CO2 Concentrations for Select Scenarios**



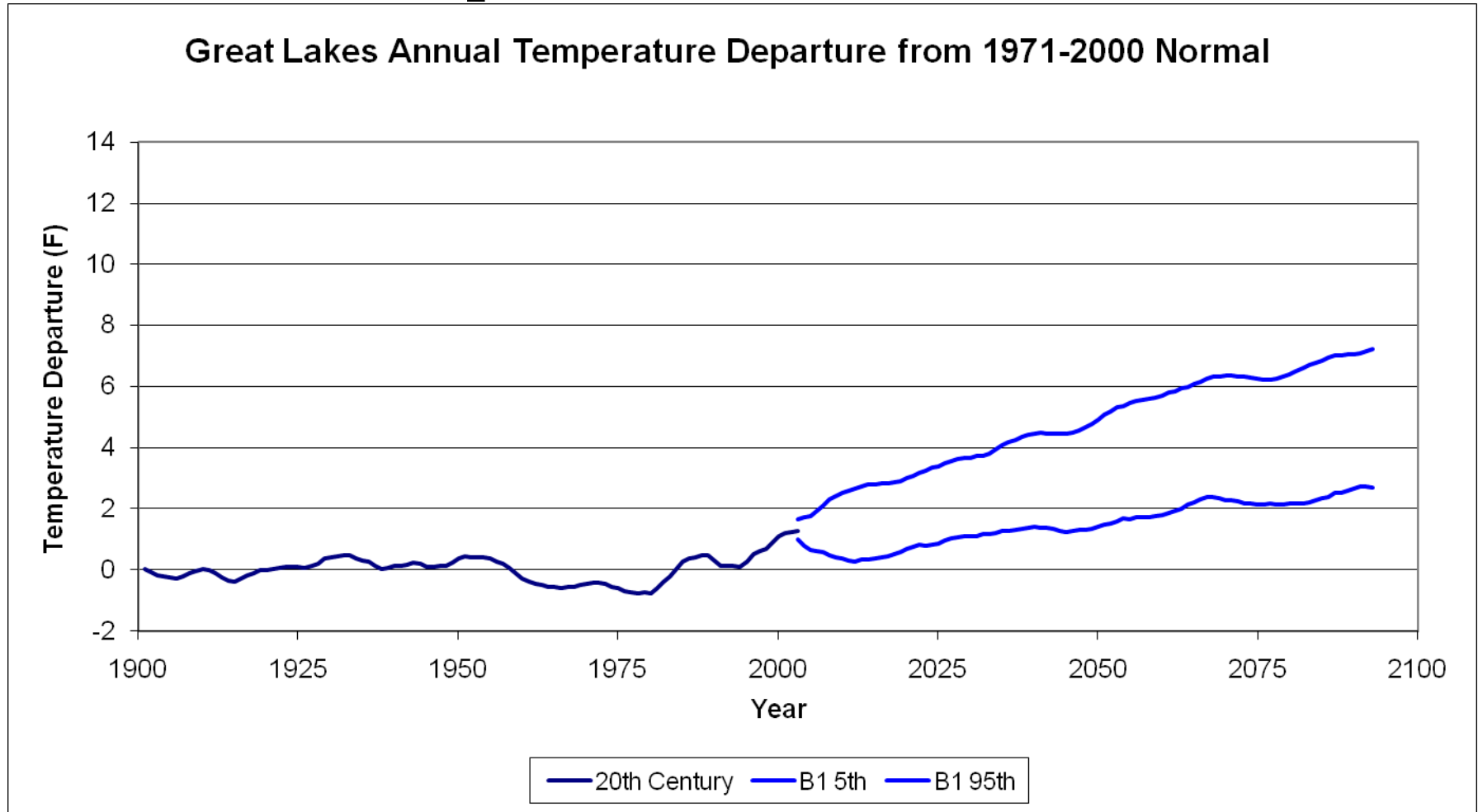
# Annual Temperature – A2 scenario



# Winter Temperature – A2 scenario

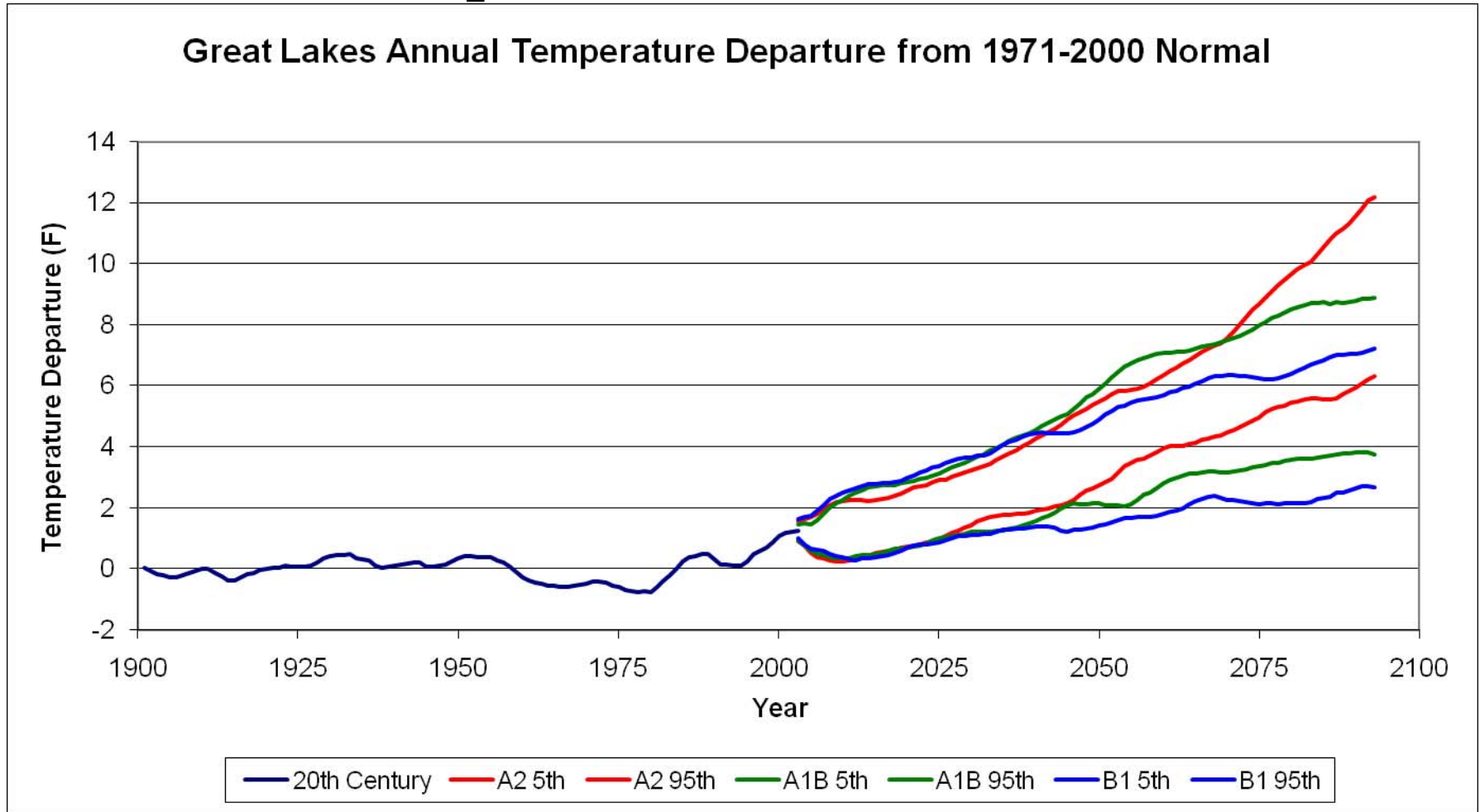


# Annual Temperature – B1 scenario



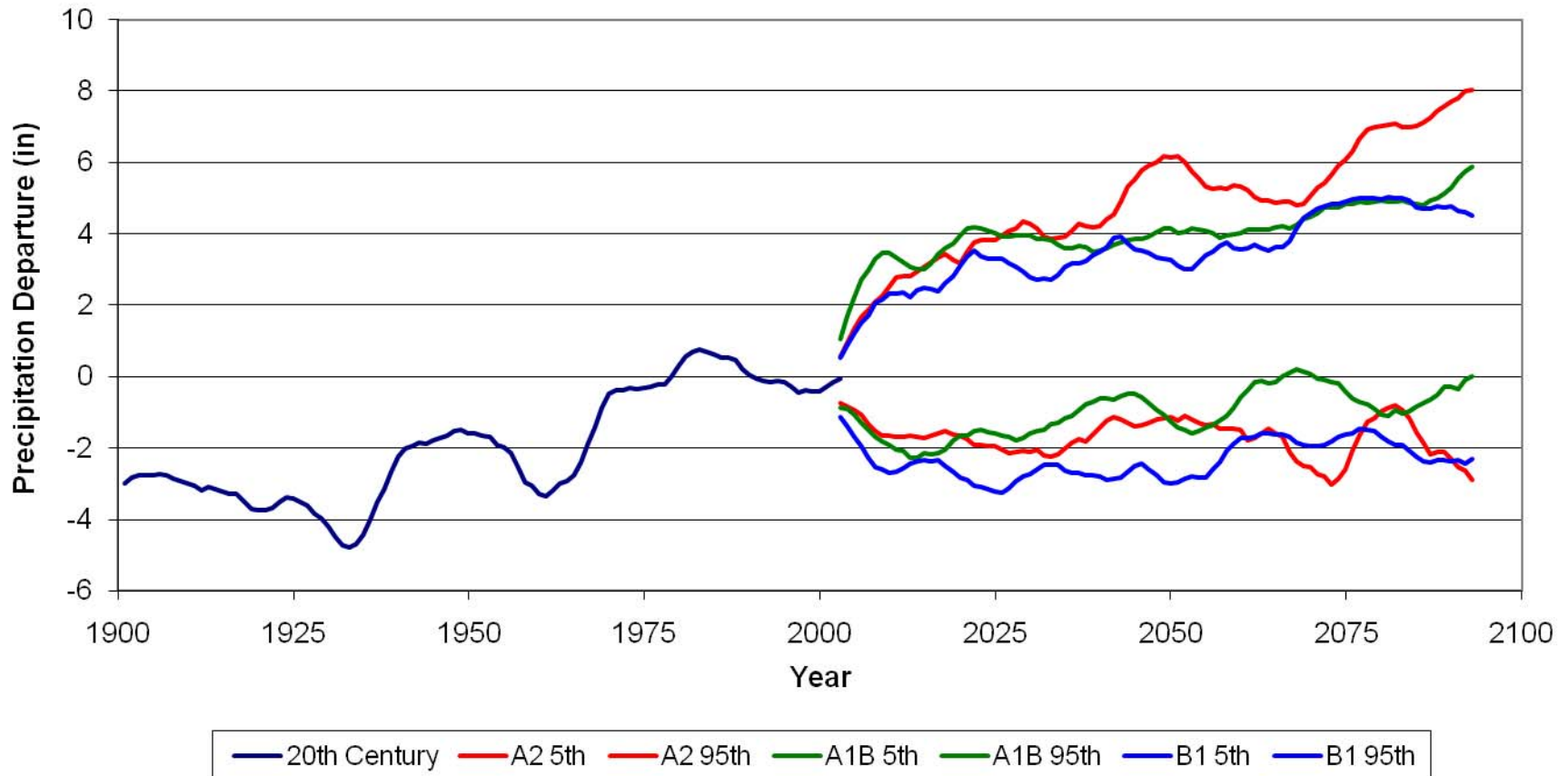


# Annual Temperature – all scenarios



# Great Lakes – Annual Precipitation

## Great Lakes Annual Precipitation Departure from 1971-2000 Normal



# Input GCM results into GLERL model

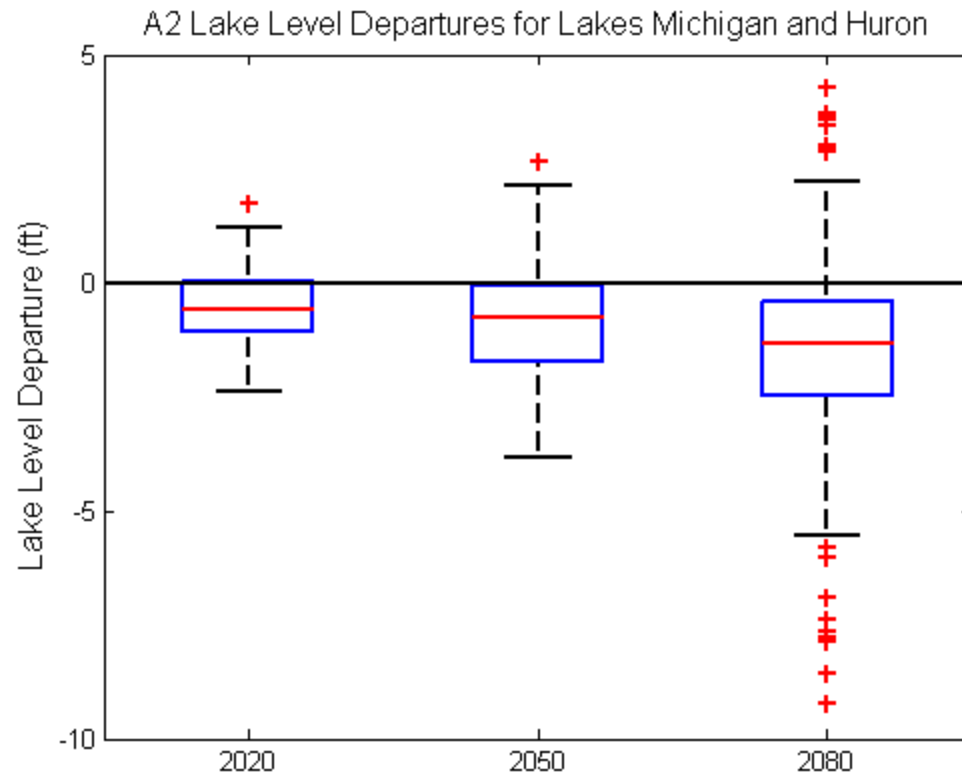
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- ▶ Calculated “climate change functions” – difference between 30 year segments of the future and the baseline of 1971-2000.
- ▶ These functions used to adjust the finer resolution GLERL model climatology of 1970-1999.
- ▶ Functions included temperature (high, low, mean), winds, humidity, and cloudiness.



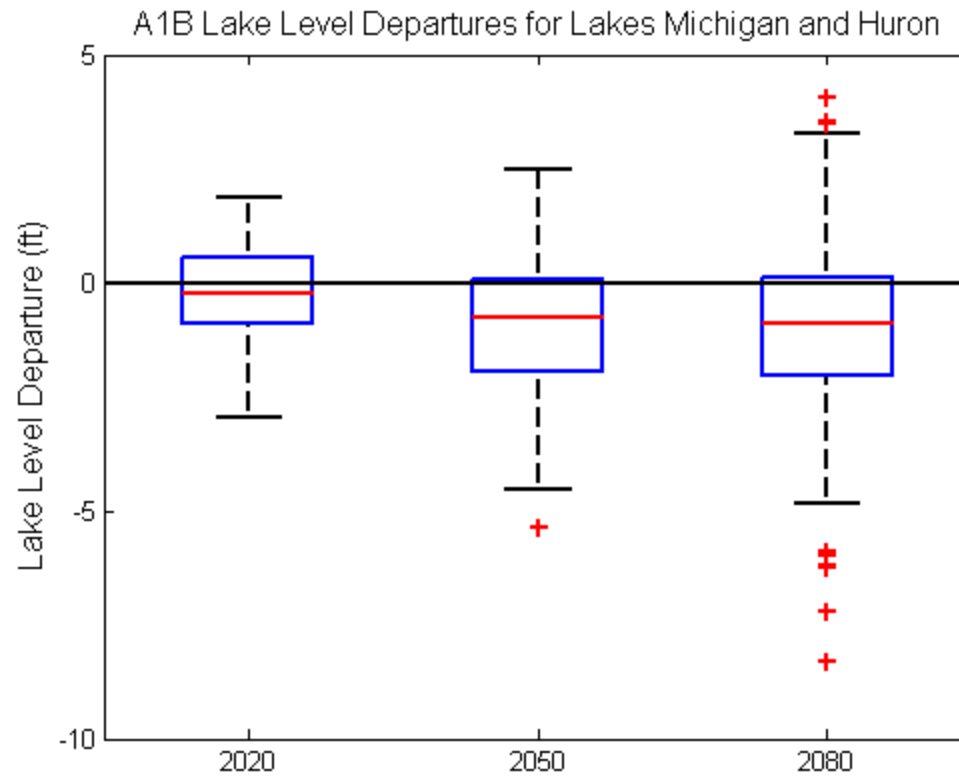
# A2 – high emission scenario

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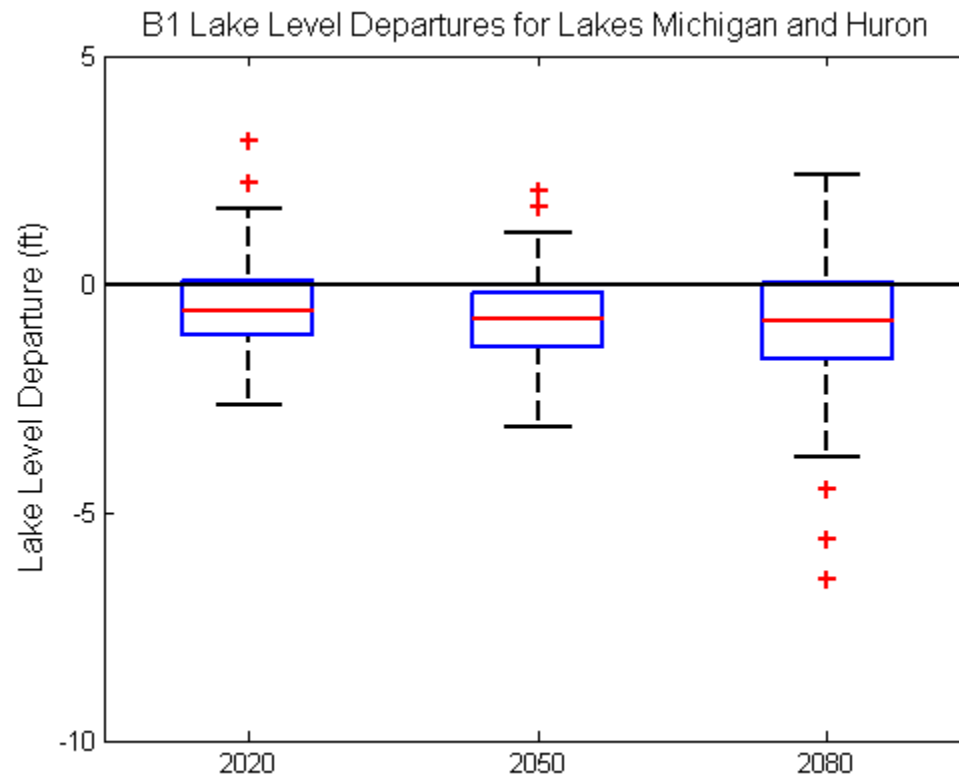
# A1B – moderate emission scenario

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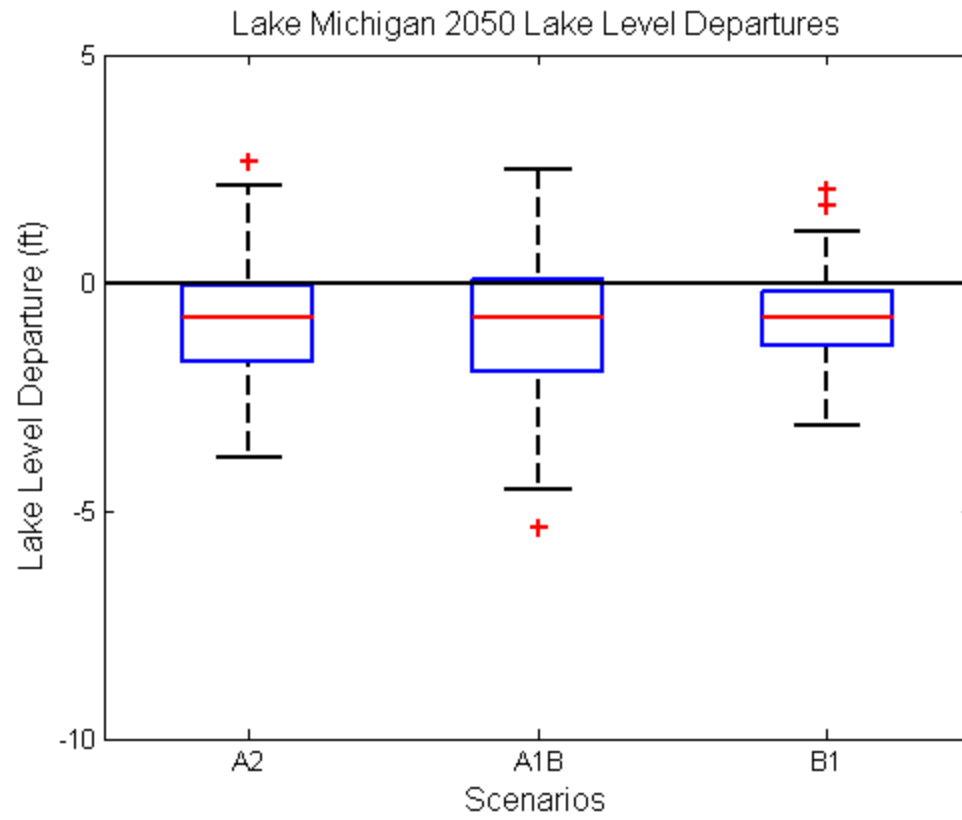
# B1 – low emission scenario

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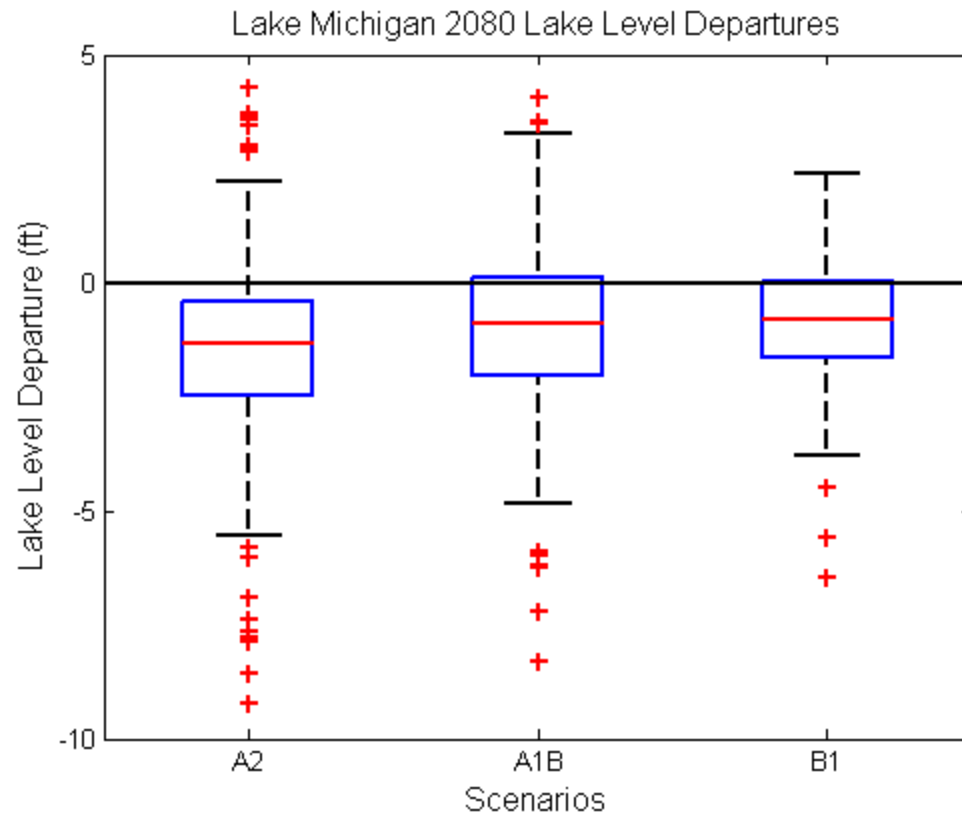
# 2050 Lake Levels

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# 2080 Lake Levels

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# Summary

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- ▶ GCM simulations show **increases** in temperature of:
  - ▶ 2 to 7 F in the low emission scenario (B1)
  - ▶ 6 to 12 F in the high emission scenario (A2)
- ▶ GCM simulations show ranges in precipitation of:
  - ▶ -2 to +5 inches in the low emission scenario (B1)
  - ▶ -2 to +8 inches in the high emission scenario (A2)



# Summary

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- ▶ Majority of scenarios showed a drop in lake levels.
- ▶ Some showed an increase in lake levels.
- ▶ The high emission scenario (A2) showed the strongest response with the widest range.
- ▶ Lake level response was strongest in 2080.

