"GLOBAL WARMING HERE AT HOME: HOW LAKE MICHIGAN IS FARING"

OUR CLIMATE MATTER
October 20, 2007
Glenview, IL

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Chief
Illinois State Water Survey

ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ILLINOIS

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- Al Wehrmann, ISWS
- Doug Wilcox, USGS

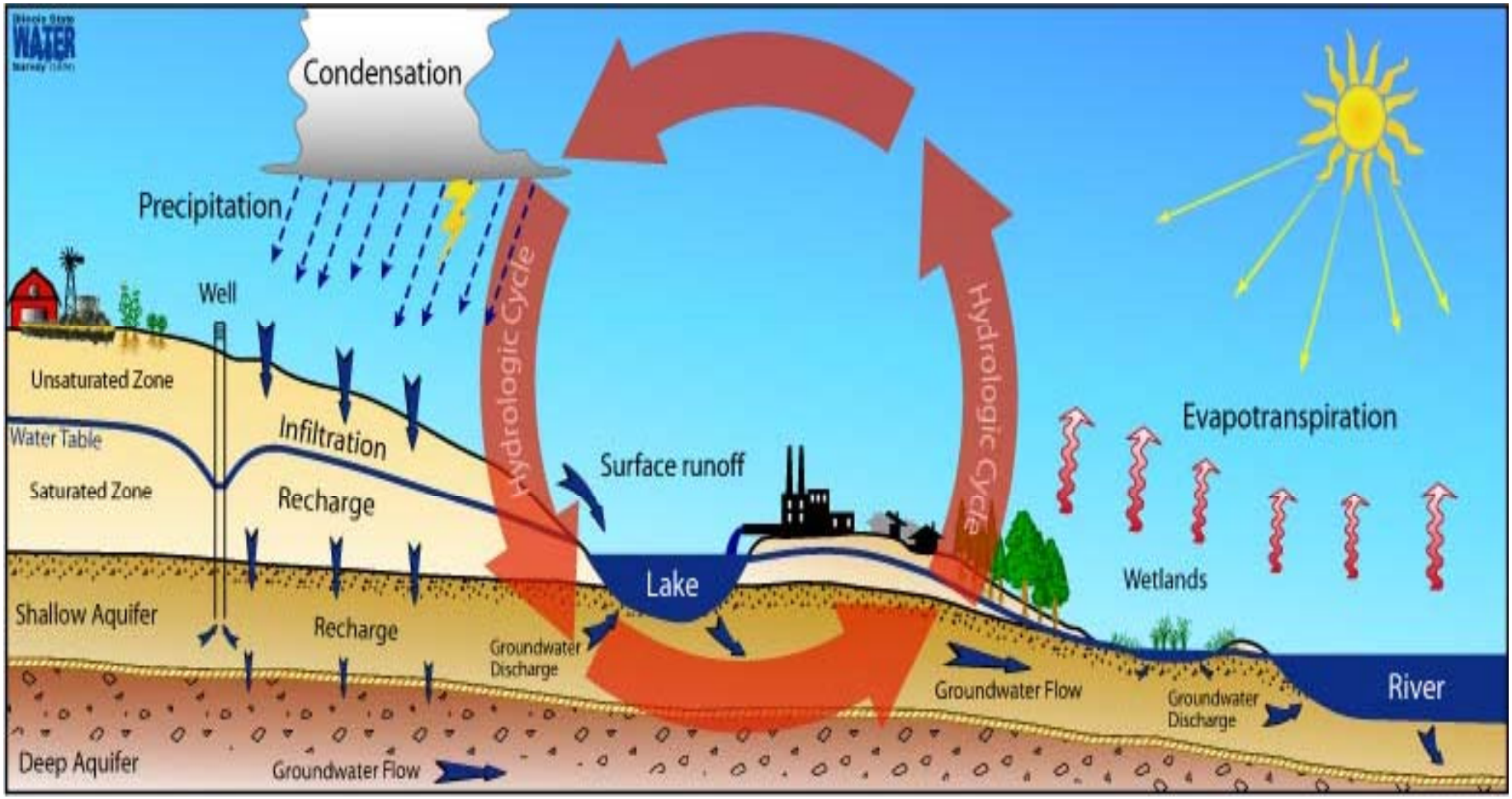
OUTLINE

- **Water cycle and water budgets**
- **Historical climate and lake level records**
- **Future climate and lake level changes**

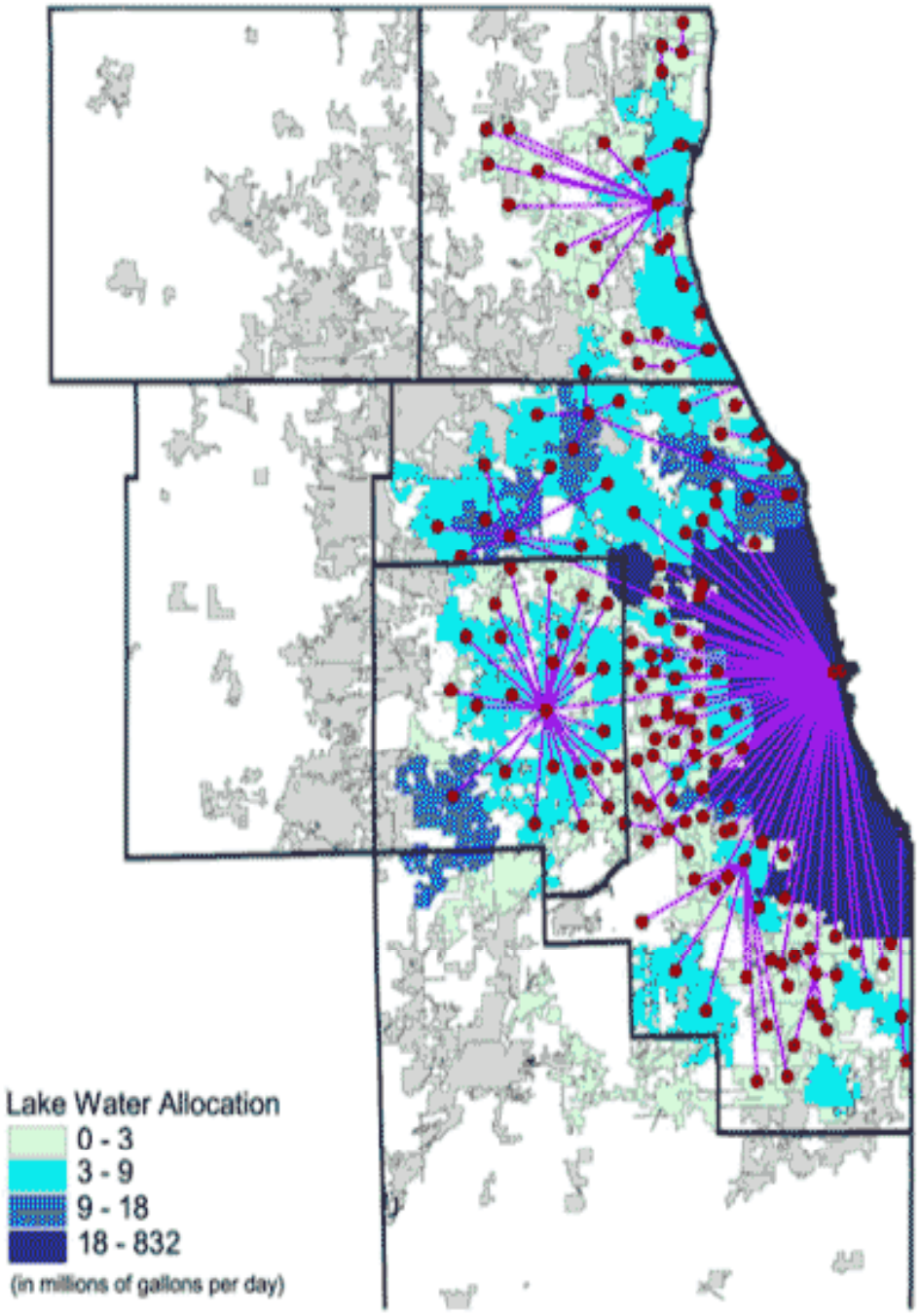
GREAT LAKES

http://tigger.uic.edu/~diane/GreatLakes1.jpg

THE WATER CYCLE: CLIMATE, SURFACE WATER, and GROUNDWATER ARE ALL LINKED



Lake Michigan Allocations In Year 2000

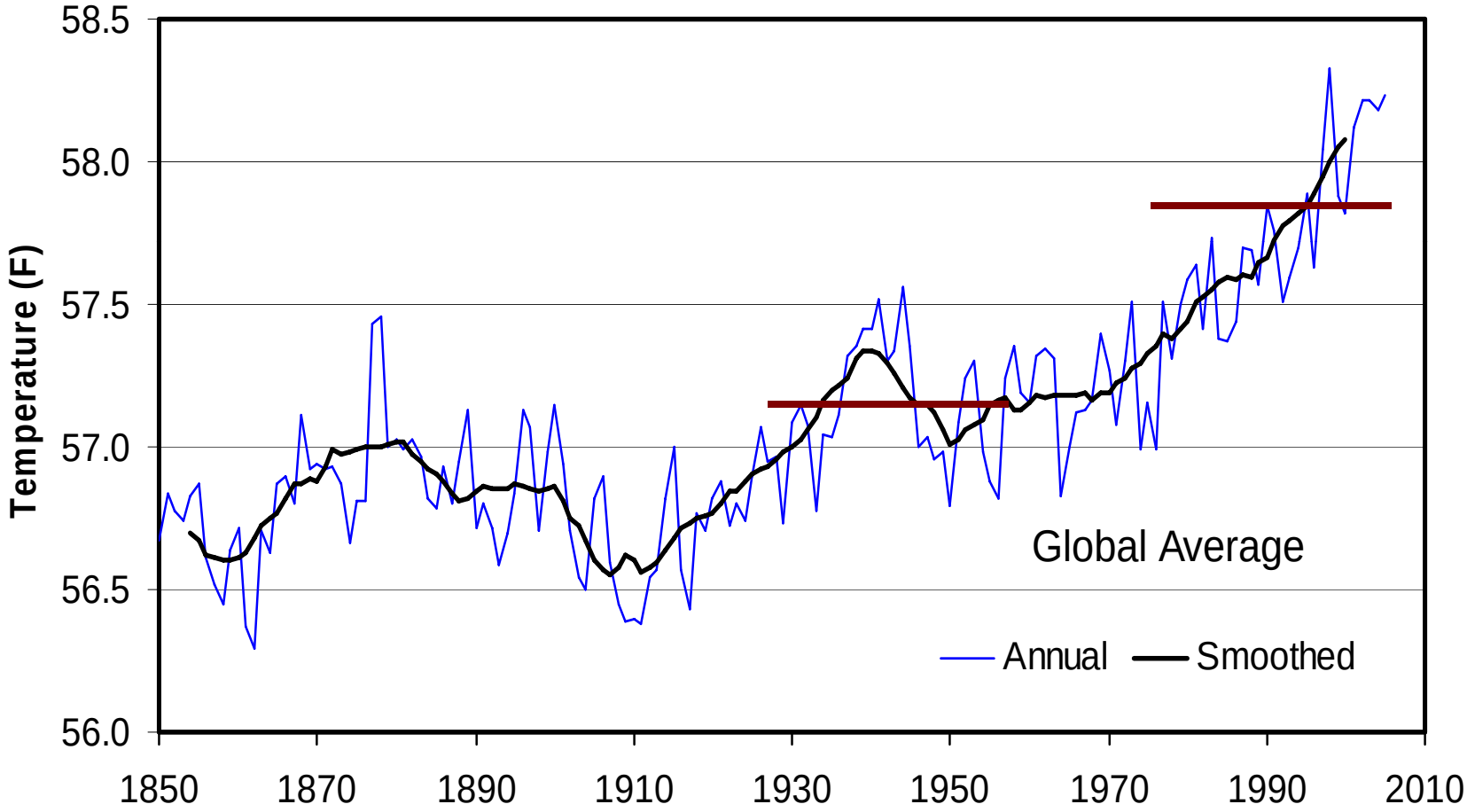


Graphic: Martin Jaffe, University of Illinois at Chicago

HISTORICAL CLIMATE CHANGES

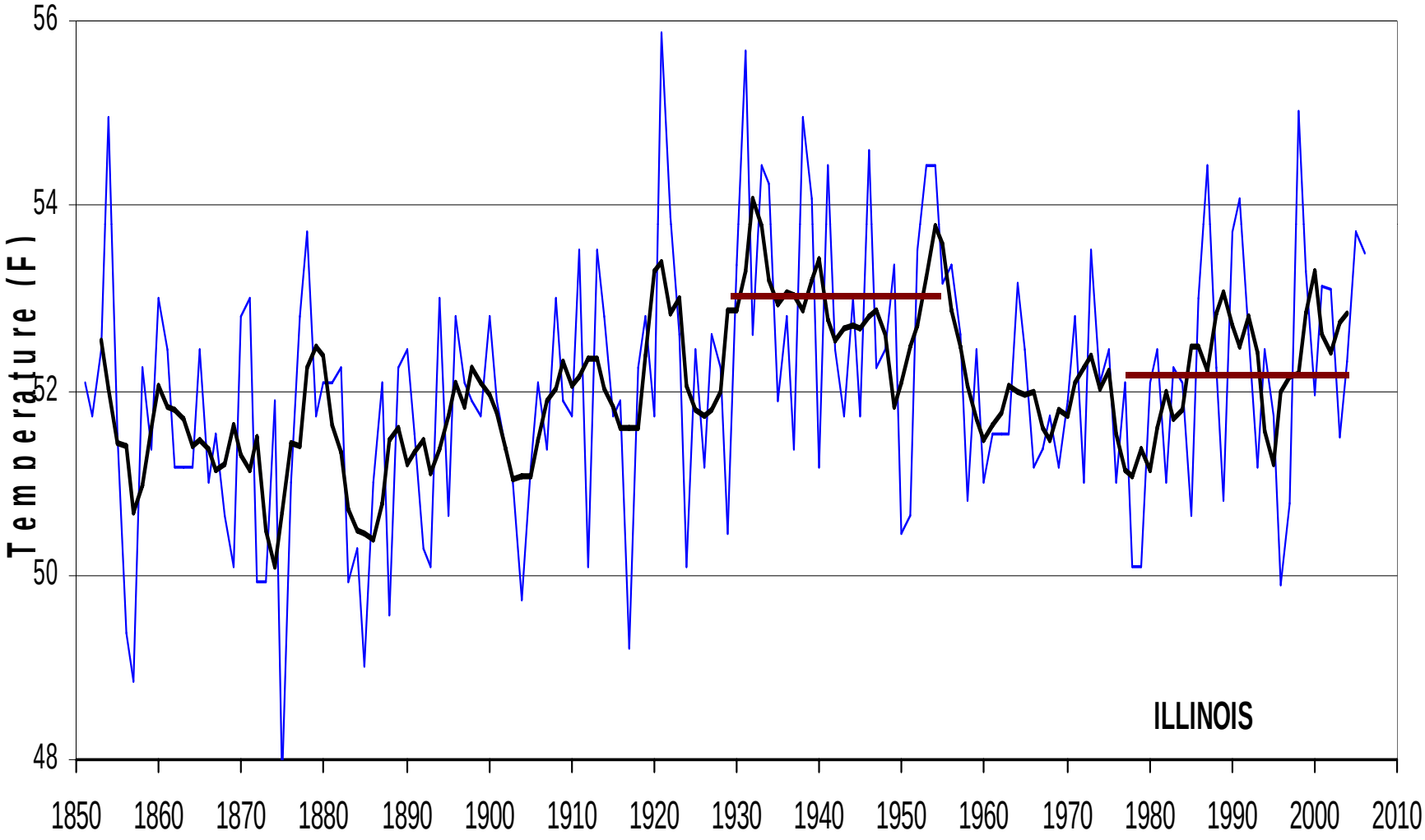
Global Warming

Source: Hadley Centre, UK

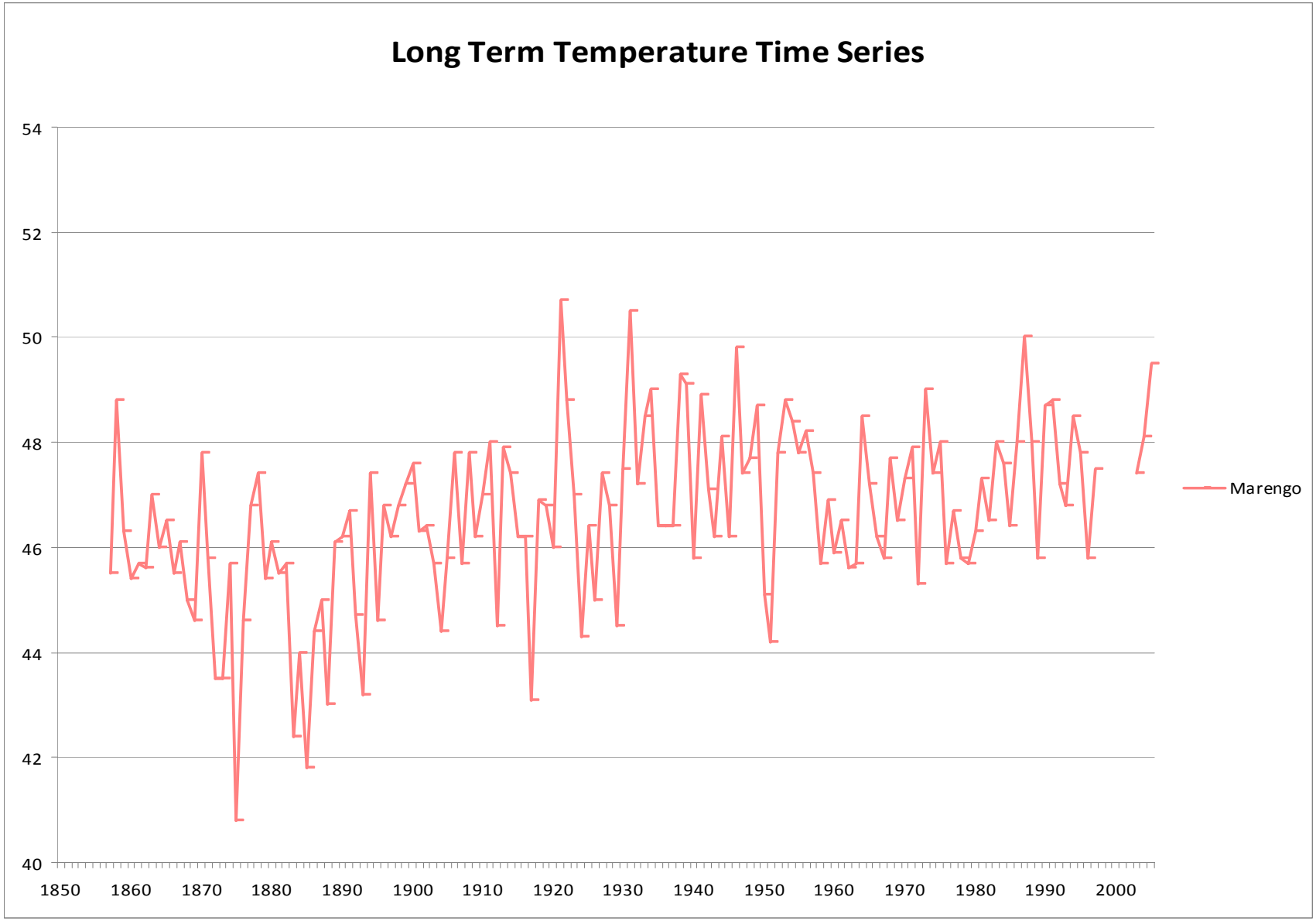


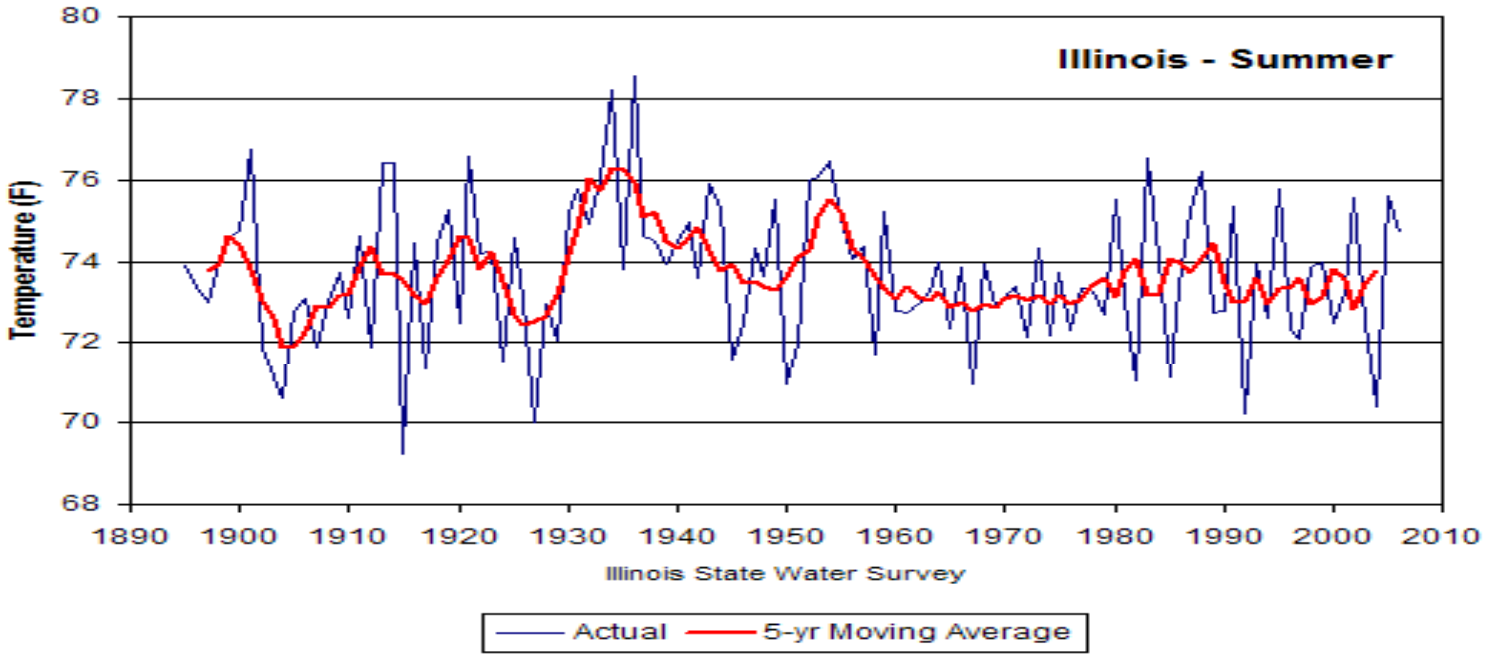
Illinois Temperature: — Annual — Smoothed

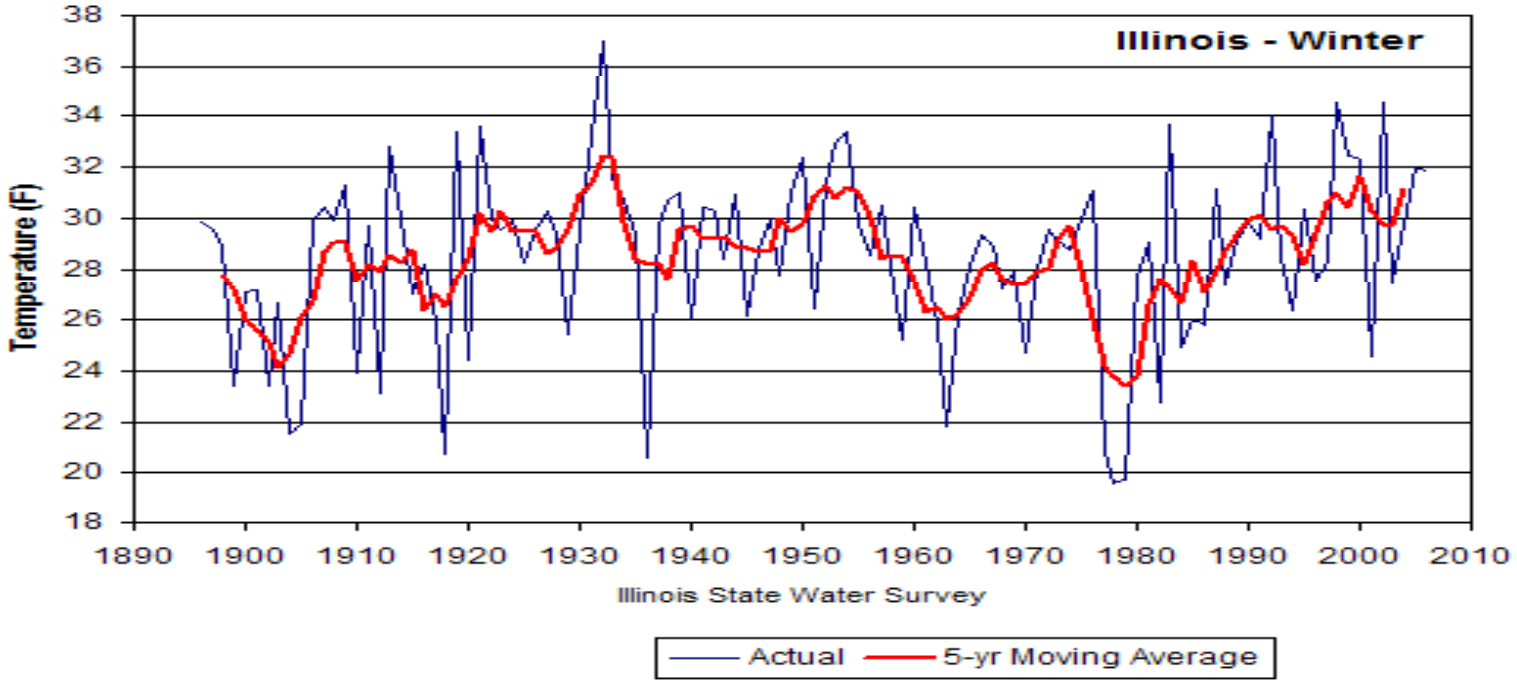
Source: Jim Angel, Illinois State Water Survey



Annual Temperature: Marengo (Jim Angel)

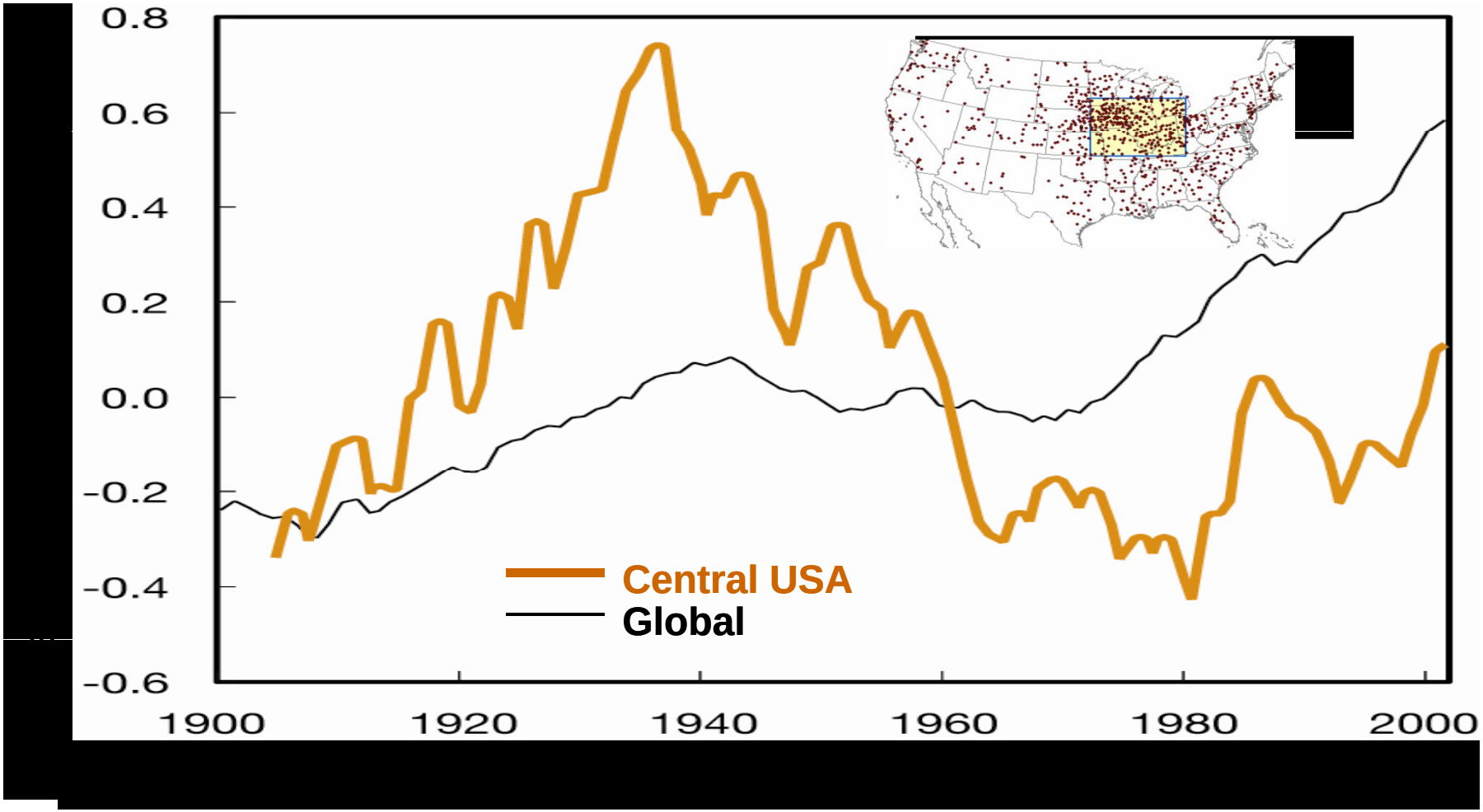



Illinois - Summer
Temperature (F)
80
78
76
74
72
70
68
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Illinois State Water Survey
Actual
5-yr Moving Average


Illinois - Winter
Temperature (F)
38
36
34
32
30
28
26
24
22
20
18
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
Illinois State Water Survey
Actual
5-yr Moving Average

Illinois and Central USA Temperature Changes Differ from Global Trends

Ken Kunkel *et al.*



ANNUAL TEMPERATURE TRENDS

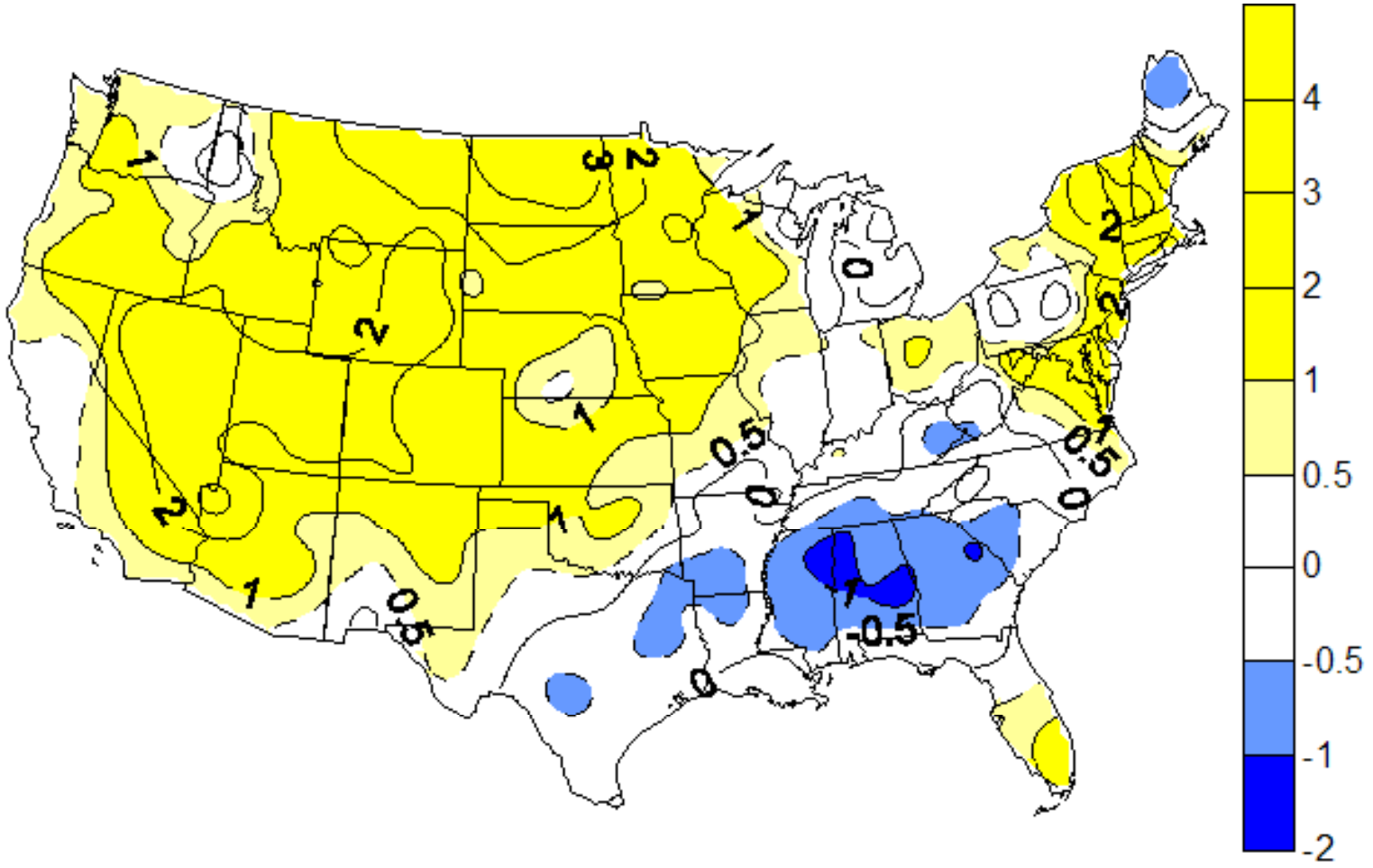


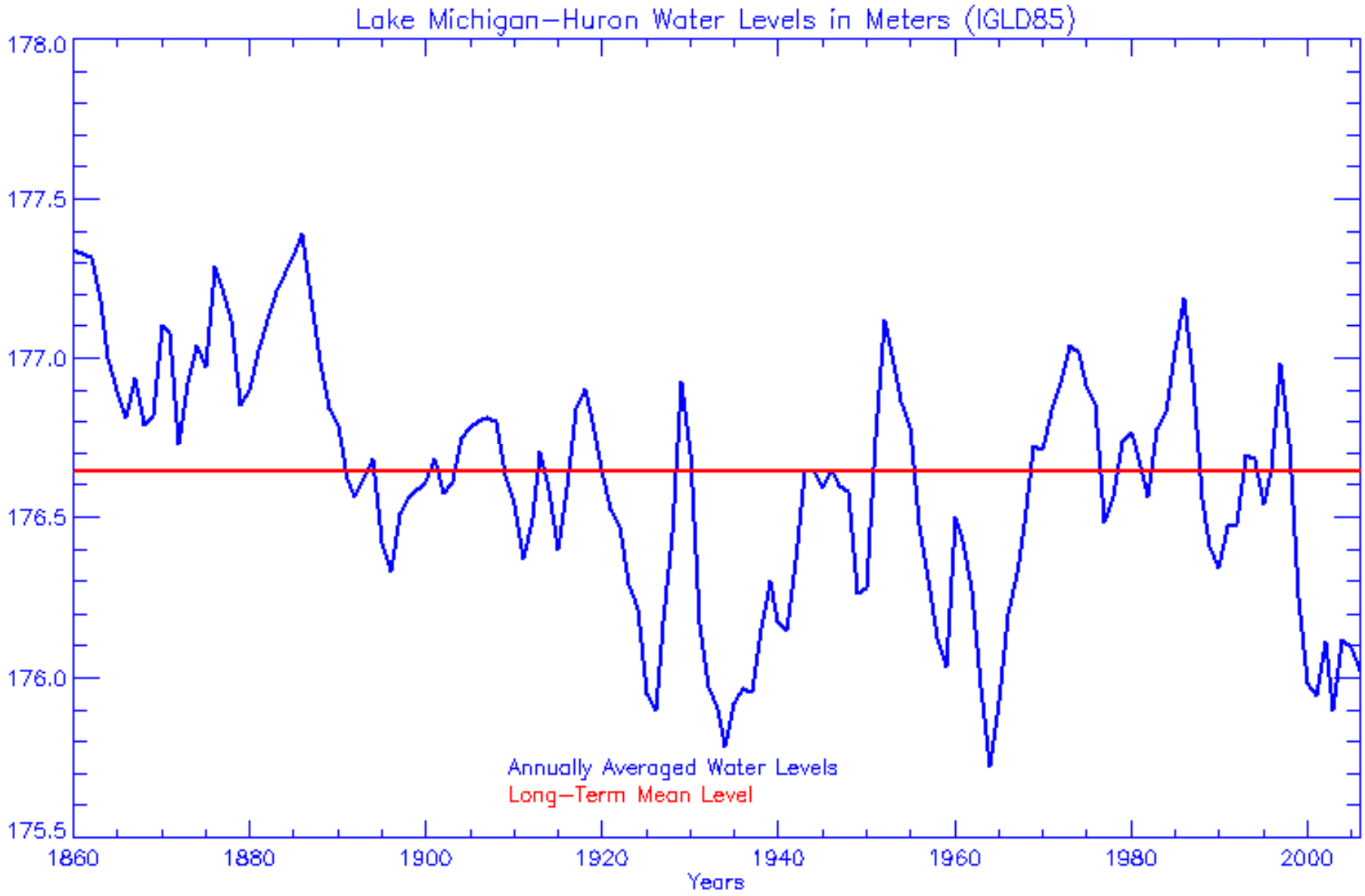
Figure 1. ANNUAL temperature trends in the U.S. expressed as the total change over the period 1895-2006 in degrees F and derived from climate division data. Copyright 2007. Illinois State Water Survey.

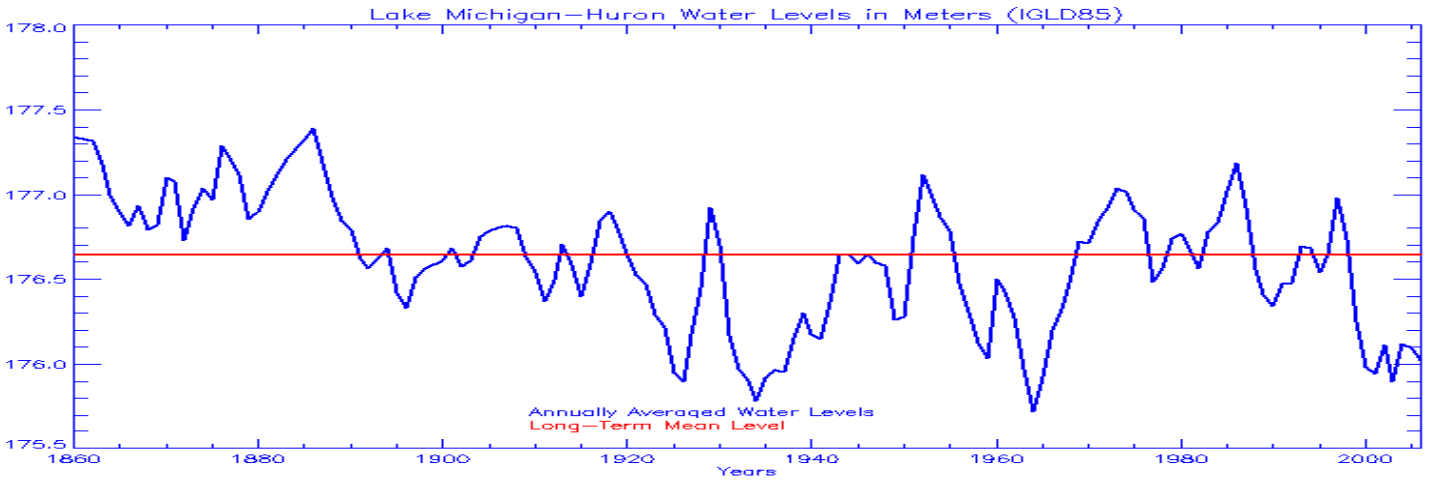
HISTORICAL VARIATIONS IN LAKE LEVEL

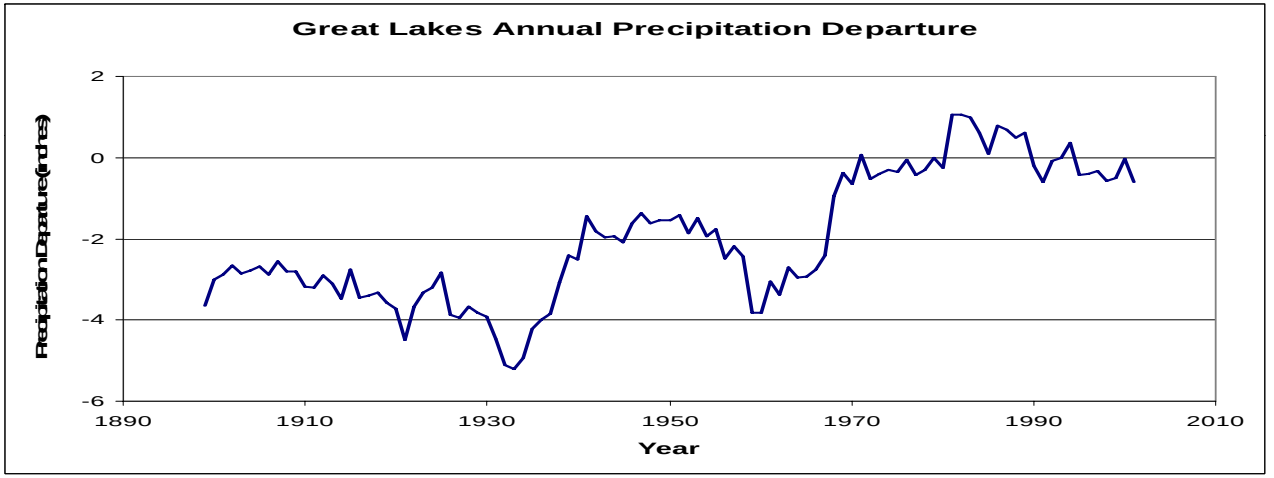
LAKE MICHIGAN/HURON LAKE LEVEL (USACE)

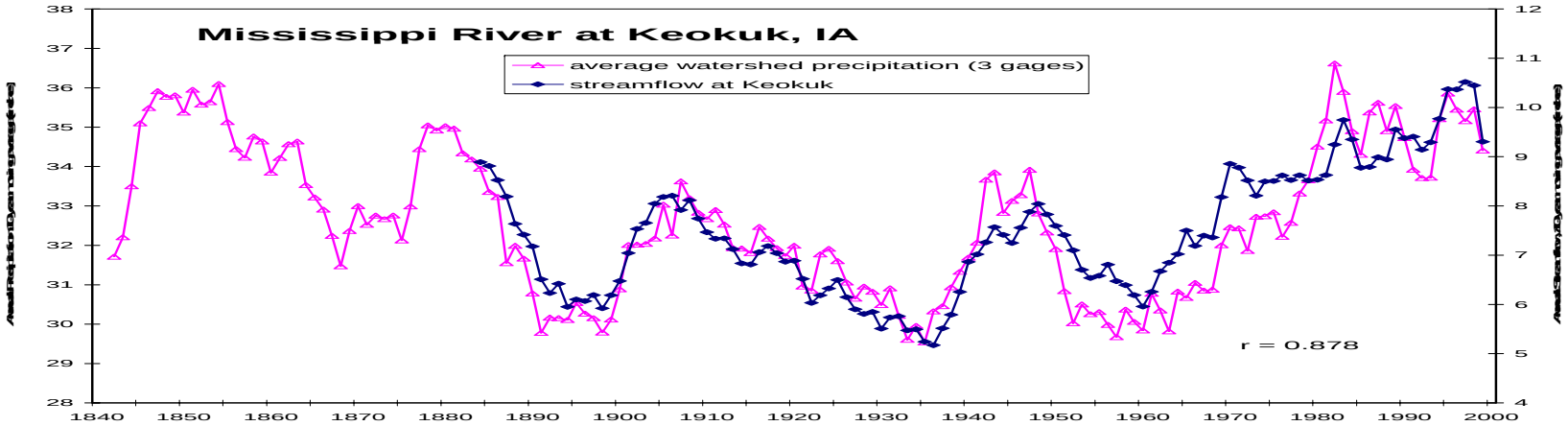
	OCTOBER
Current	577.0 ft
Long-term average	578.9 ft
Seasonal variation	1.3 ft
Lowest (1964)	576.4 ft
Highest (1986)	582.3 ft

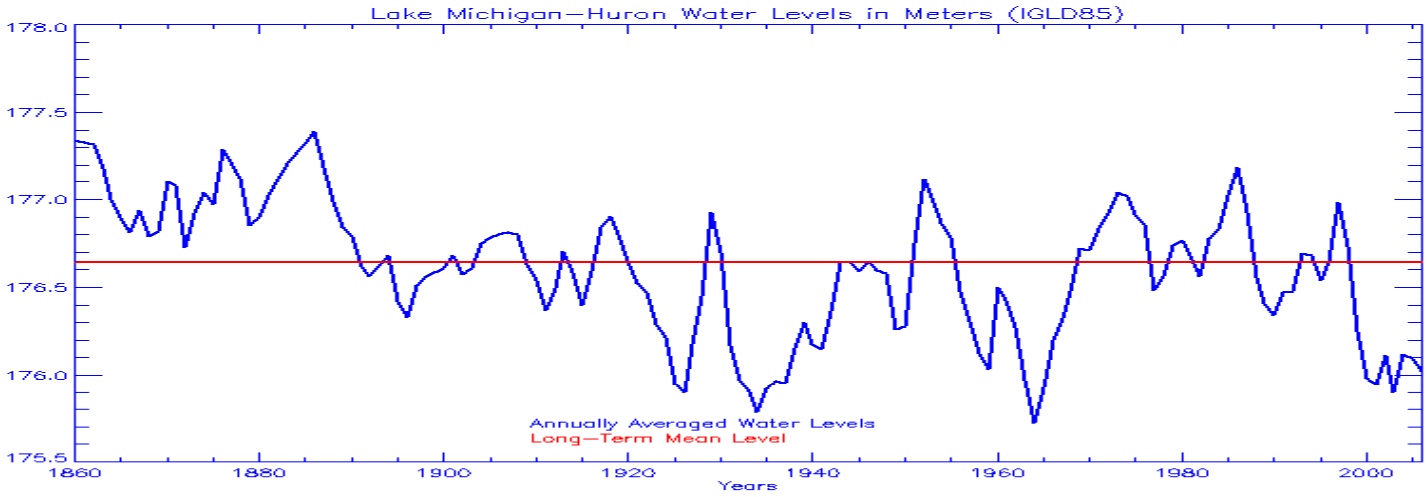
NOAA/GLERL

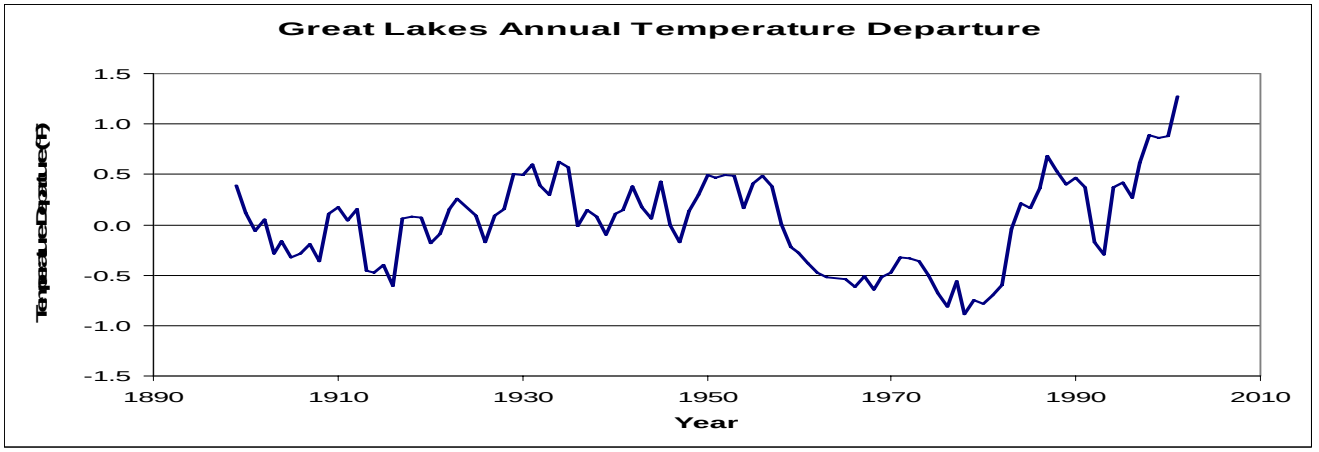

Lake Michigan–Huron Water Levels in Meters (IGLD85)
178.0
177.5
177.0
176.5
176.0
175.5
1860
1880
1900
1920
1940
1960
1980
2000
Years
Annually Averaged Water Levels
Long–Term Mean Level

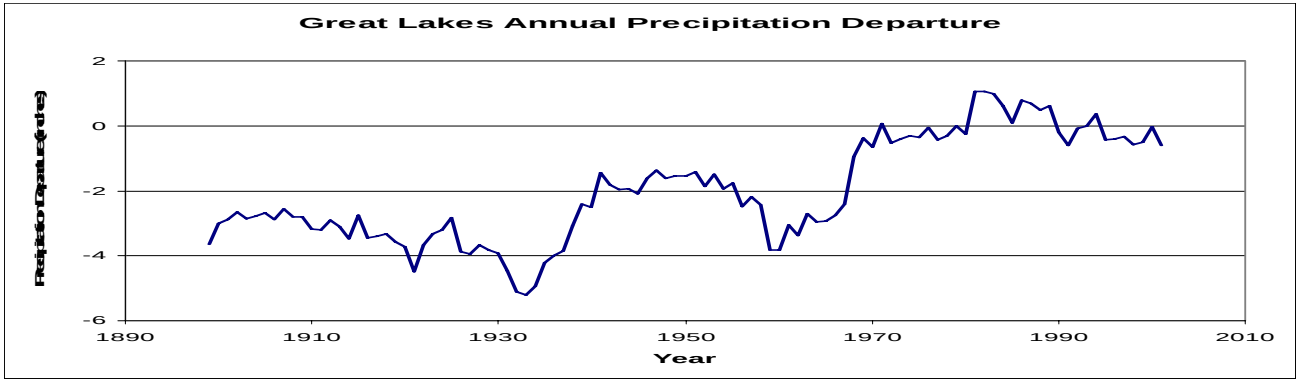

Lake Michigan–Huron Water Levels in Meters (IGLD85)
178.0
177.5
177.0
176.5
176.0
175.5
1860
1880
1900
1920
1940
1960
1980
2000
Years
Annually Averaged Water Levels
Long–Term Mean Level

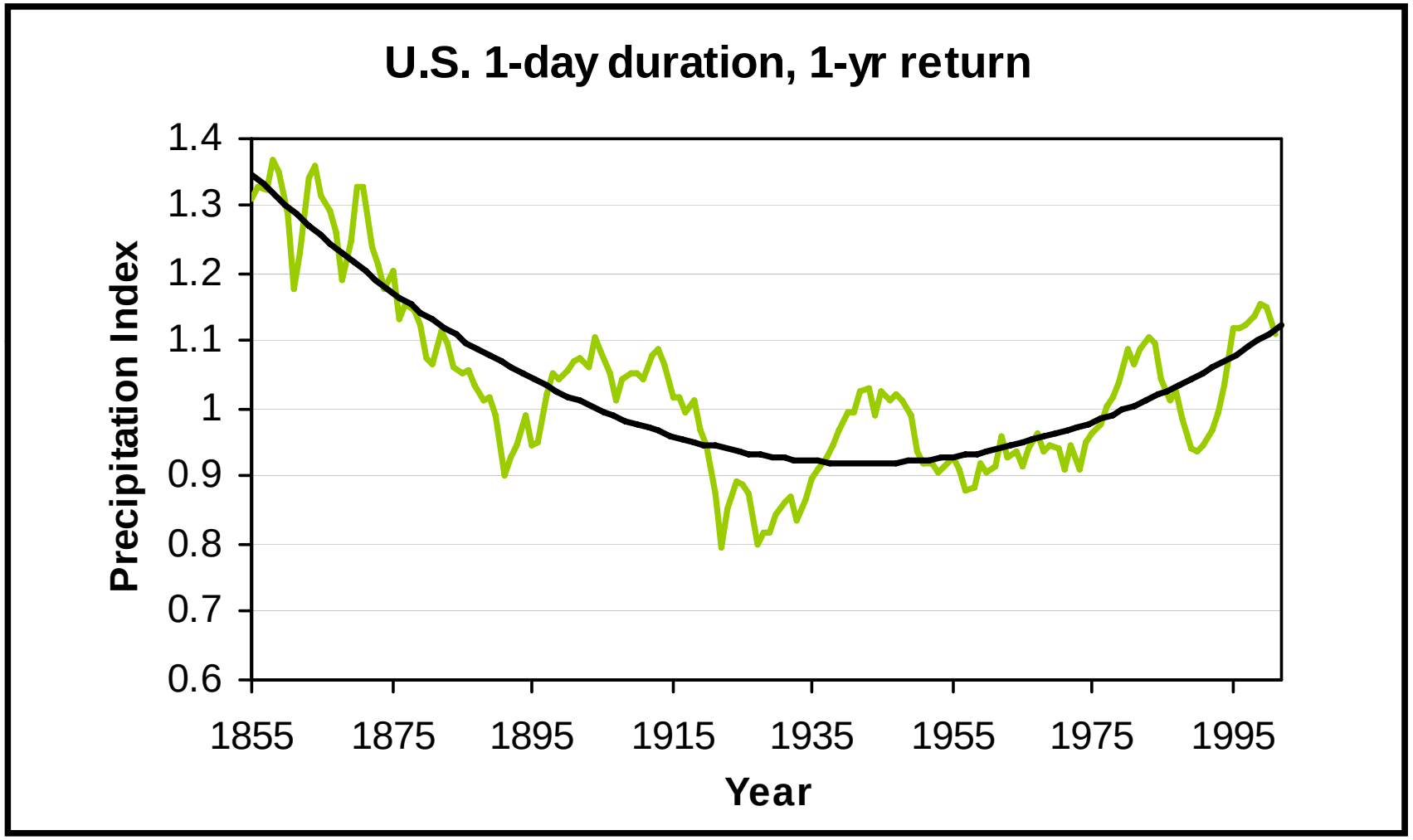

Great Lakes Annual Precipitation Departure
2
0
-2
-4
-6
1890
1910
1930
1950
1970
1990
2010
Year


Mississippi River at Keokuk, IA
average watershed precipitation (3 gages)
streamflow at Keokuk
r = 0.878
38
37
36
35
34
33
32
31
30
29
28
12
11
10
9
8
7
6
5
4
1840
1850
1860
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000


Lake Michigan–Huron Water Levels in Meters (IGLD85)
178.0
177.5
177.0
176.5
176.0
175.5
1860
1880
1900
1920
1940
1960
1980
2000
Years
Annually Averaged Water Levels
Long–Term Mean Level

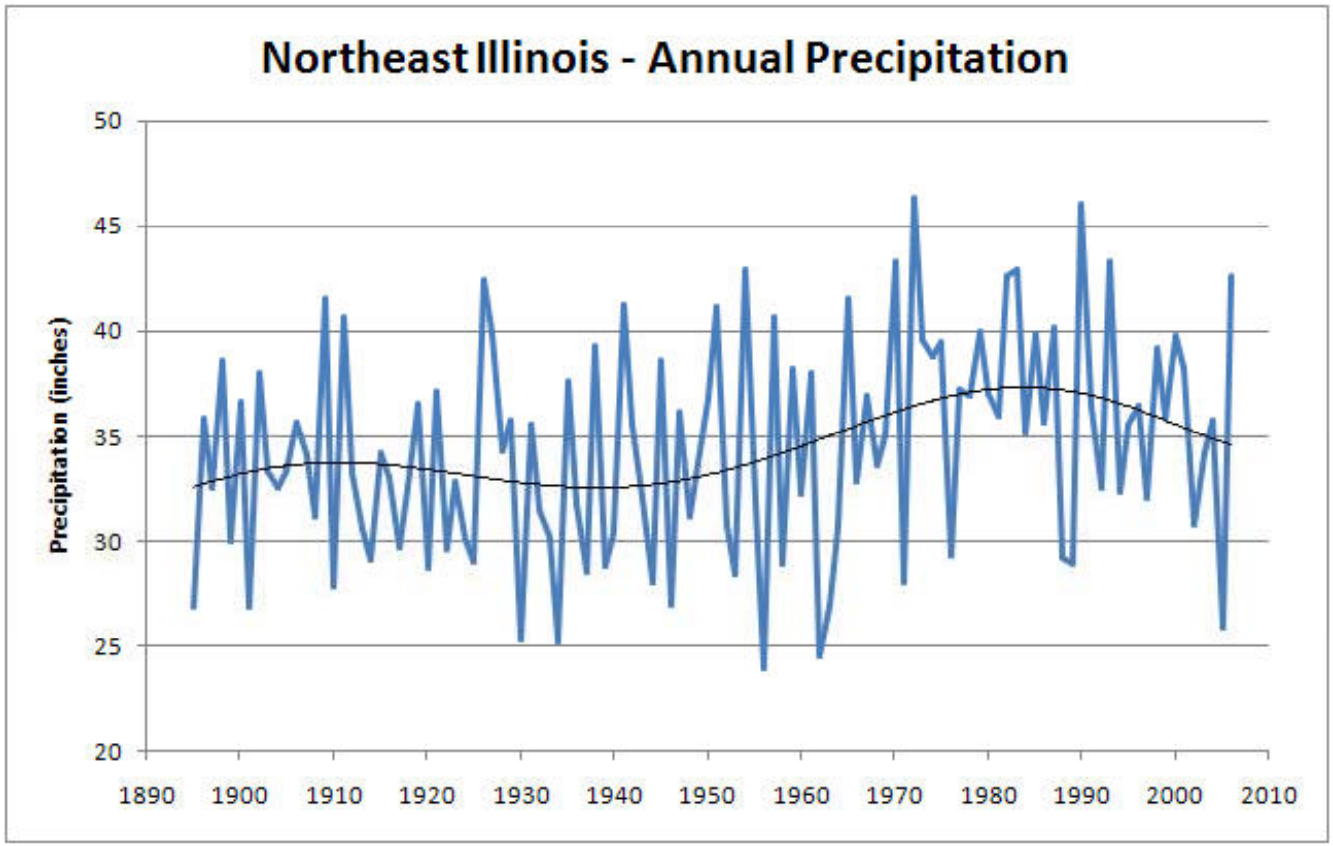

Great Lakes Annual Temperature Departure
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
1890
1910
1930
1950
1970
1990
2010
Year


Great Lakes Annual Precipitation Departure
2
0
-2
-4
-6
1890
1910
1930
1950
1970
1990
2010
Year

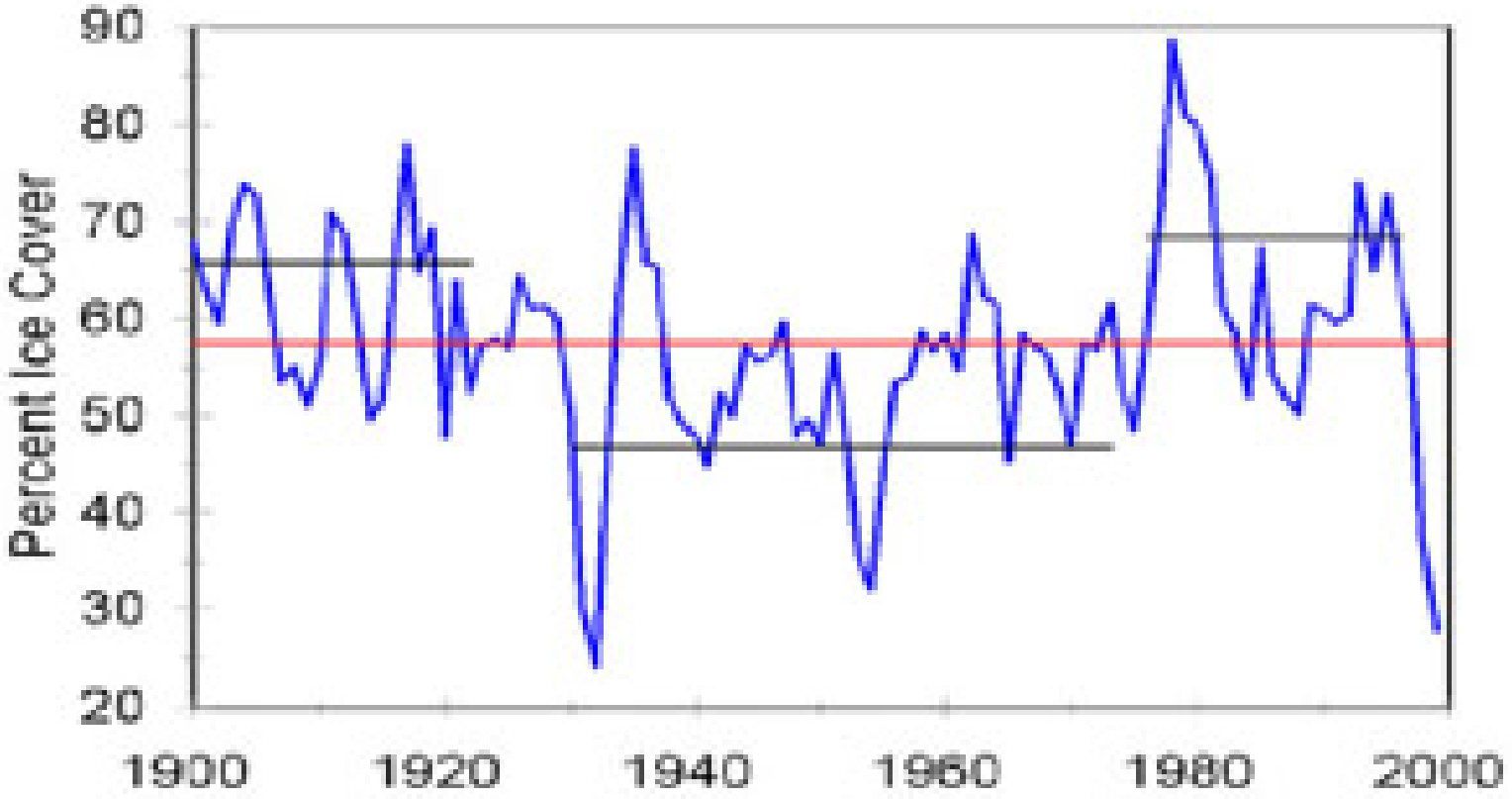

U.S. 1-day duration, 1-yr return
Precipitation Index
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
1855
1875
1895
1915
1935
1955
1975
1995
Year

Increasing Floods in NE Illinois

- Combination of increasing frequency of heavy precipitation events and urbanization of watersheds.



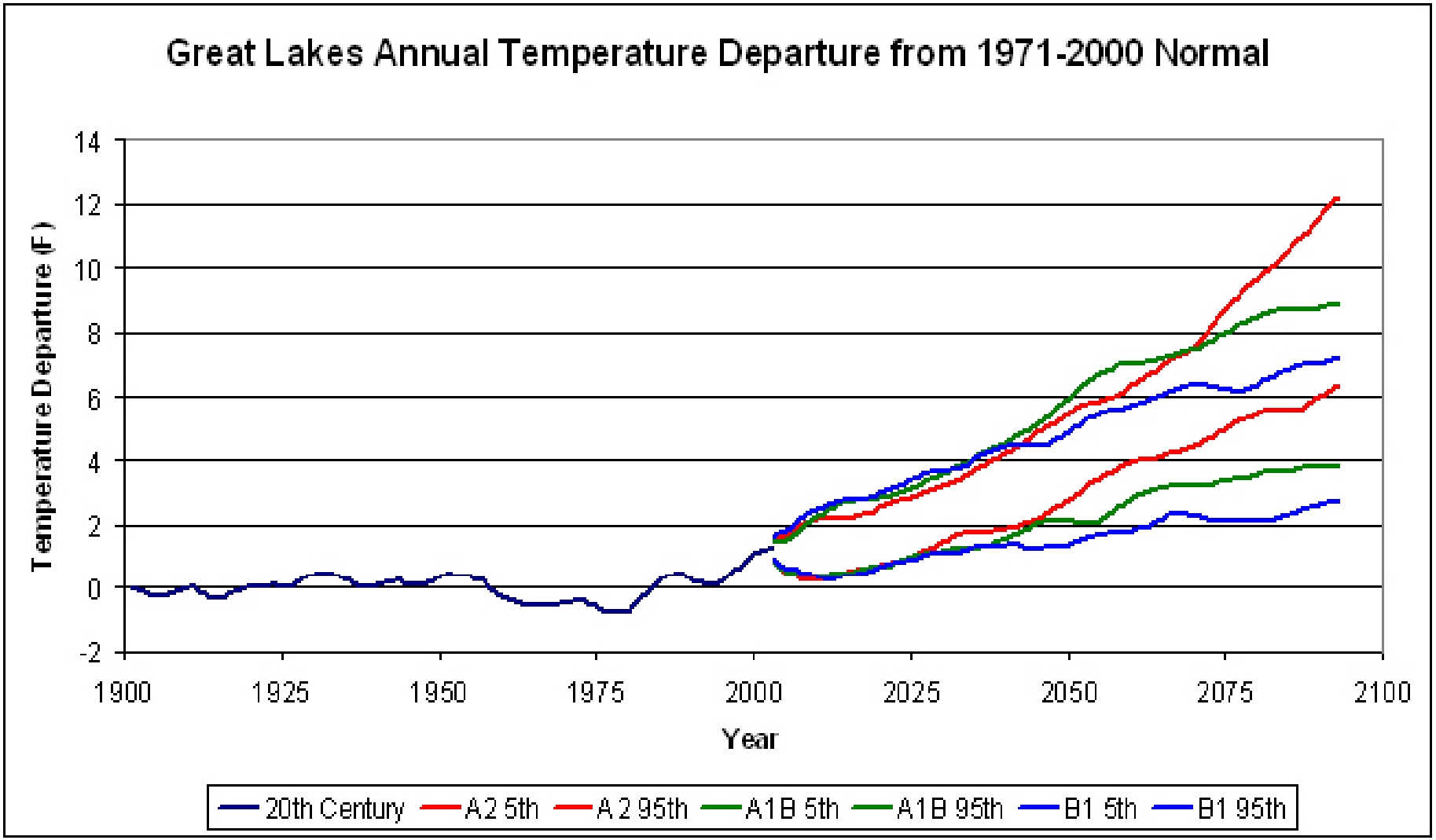
Great Lakes Ice Cover
NOAA/GLERL



FUTURE CLIMATE CHANGES

Ken Kunkel *et al*.

http://www.sws.uiuc.edu/wsp/climate/ClimateTom_scenarios.asp



Ken Kunkel *et al*.

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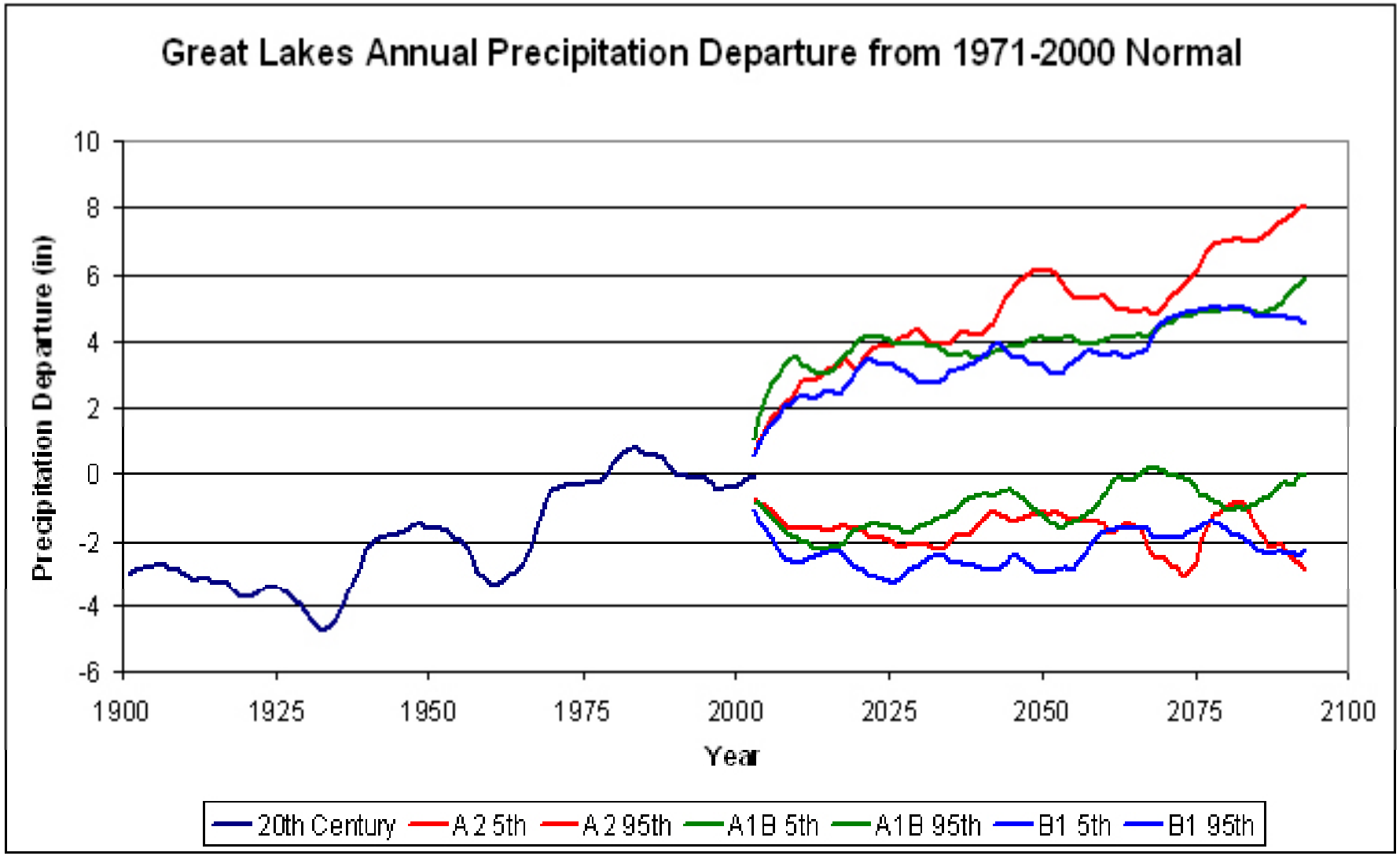
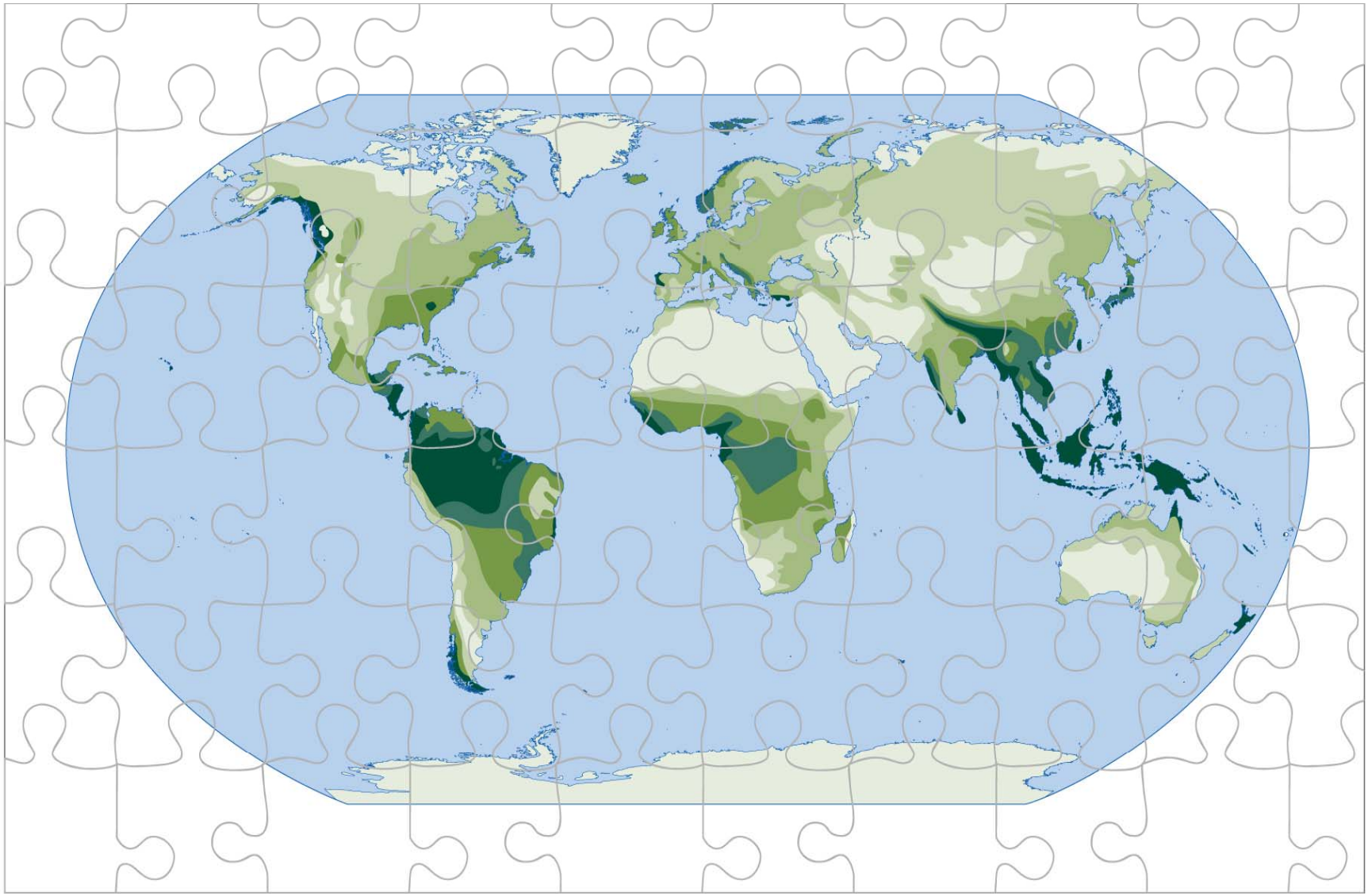
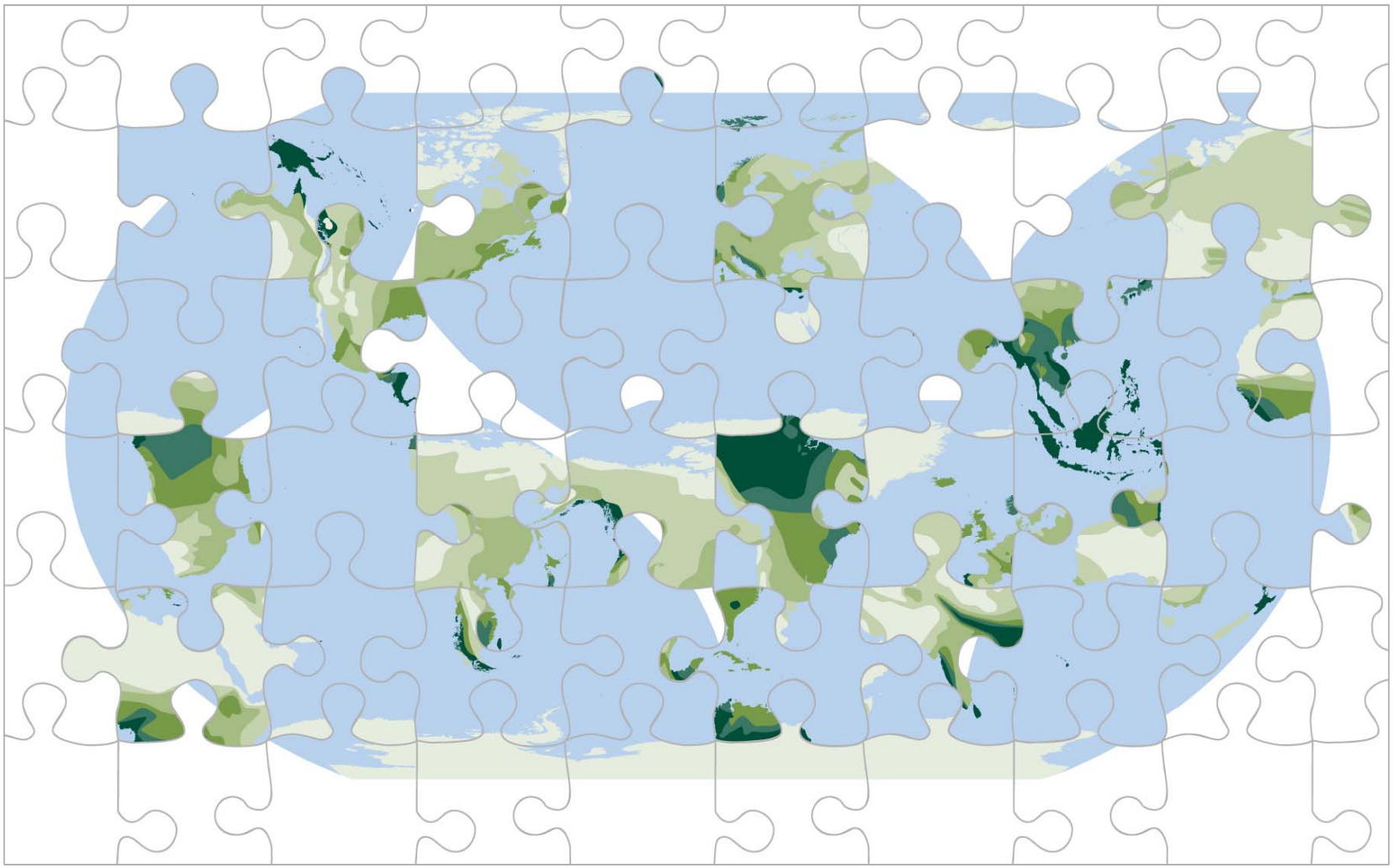


GLOBAL CLIMATE IS A COMPOSITE OF REGIONAL CLIMATES .....



… BUT GLOBAL CLIMATE MODELS DO NOT DO A GOOD JOB AT SIMULATING REGIONAL PRECIPITATION CHANGES



CONCLUSIONS

1. SHORT AND LONG-TERM CHANGES IN CLIMATE AFFECT LAKE LEVEL
2. RECENT LOW LAKE LEVEL PROBABLY DUE TO A COMBINATION OF LOW PRECIPITATION AND WARM TEMPERATURES
3. FUTURE CLIMATE AND LAKE LEVELS HIGHLY UNCERTAIN – POSSIBILITY OF MAJOR CHANGES
4. SWS DEVELOPING A NEW CRYSTAL BALL – A REGIONAL CLIMATE MODEL – TO PROVIDE A BETTER PLANNING TOOL

Illinois State WATER Survey (1895)

THANK YOU

HAVE A NICE DAY!

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