

Historical and Projected Future Climatic Trends in the Great Lakes Region



Grand River Flooding
Grand Rapids, MI
21 April, 2013
Photo: MichiganRadio.org

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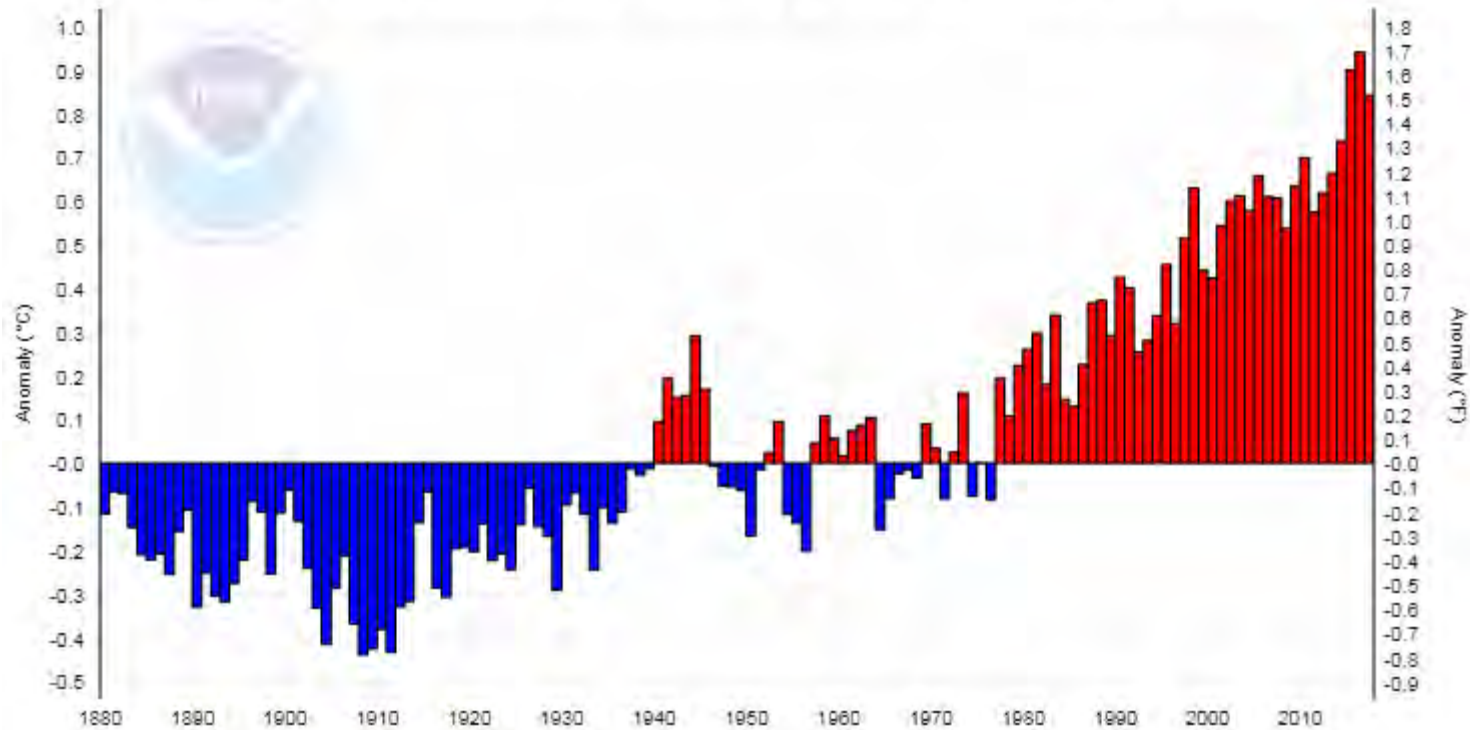
Outline

- Historical Trends
- Climatic Variability/Extreme Events
- Future Projections

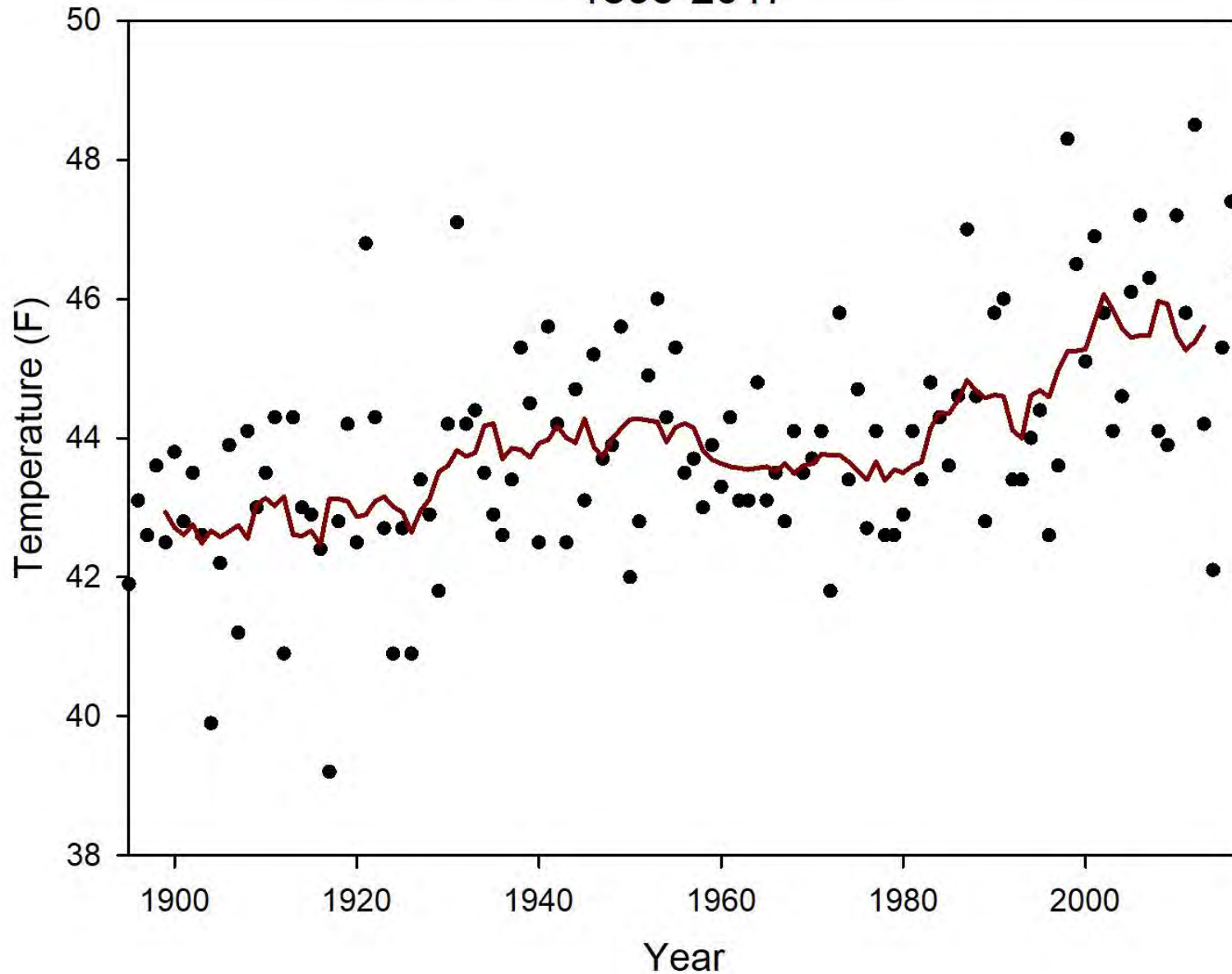
Historical Climatic Trends: Instrumental Record

Global Land and Ocean Temperature Anomalies 1880-2017

Global Land and Ocean Temperature Anomalies, January-December



Annual Temperatures vs Year, Michigan
1895-2017



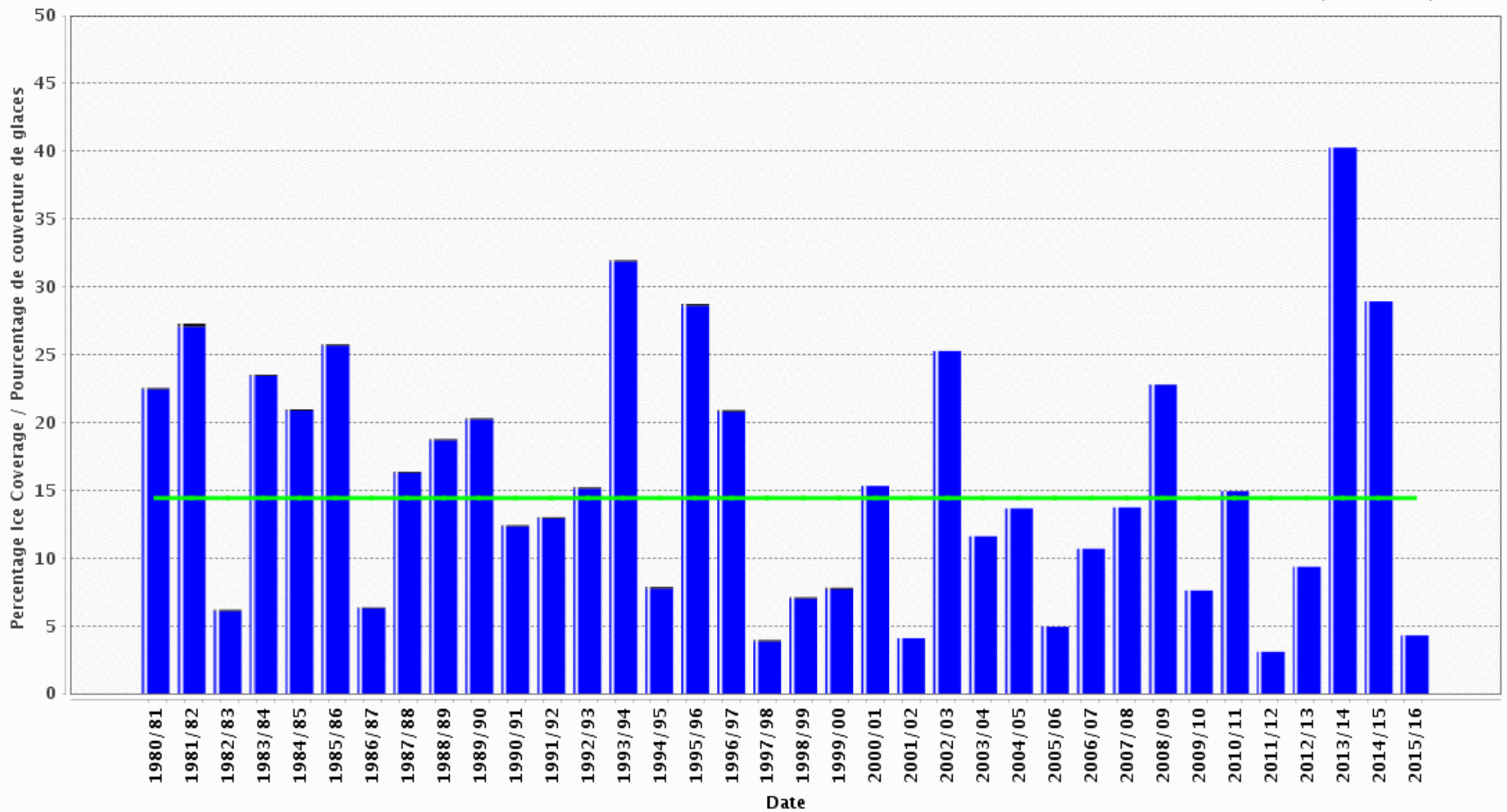
**Historical Total Accumulated Ice Coverage (TAC) for
the weeks 1105-0507, seasons:1980/81-2015/16**



**Total accumulé de la couverture des glaces historique
(TAC) pour les semaines 1105-0507,
saisons:1980/81-2015/16**

Regional Great Lakes /
Régionale Grands Lacs

Area / Aire : 254,689 km²

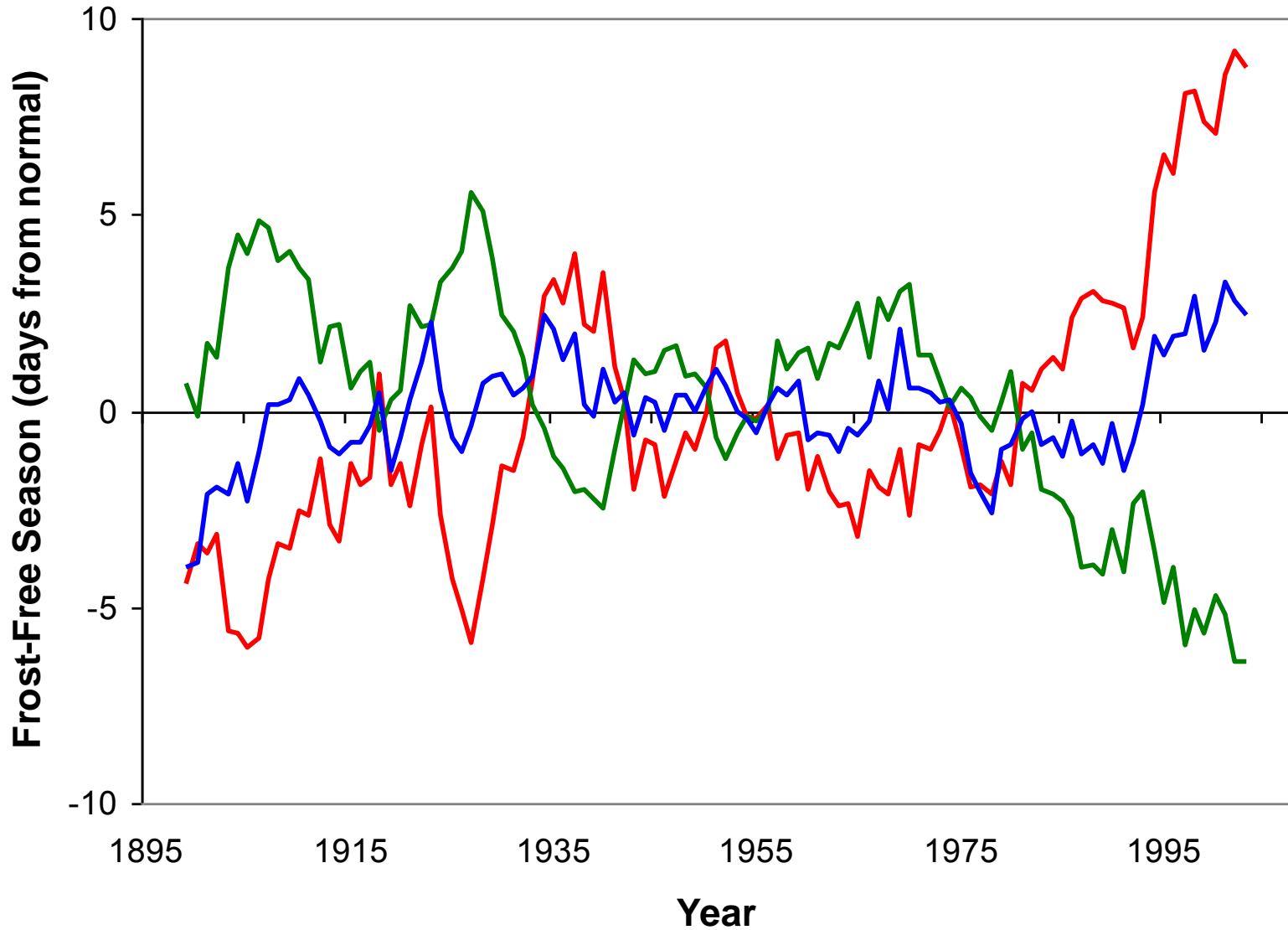


Canadian Ice Service - Environment Canada / Service canadien des glaces - Environnement Canada
(2016-05-10 11:13 IceGraph - Canadian Ice Service/Graphe des glaces - Service canadien des glaces 2.0.7 2014/01/21)

■ Ice Coverage / couverture des glaces ■ No Data / Aucune donnée — Median / médiane 1980/81-2009/10

Changes in the Length of the Frost Free Season

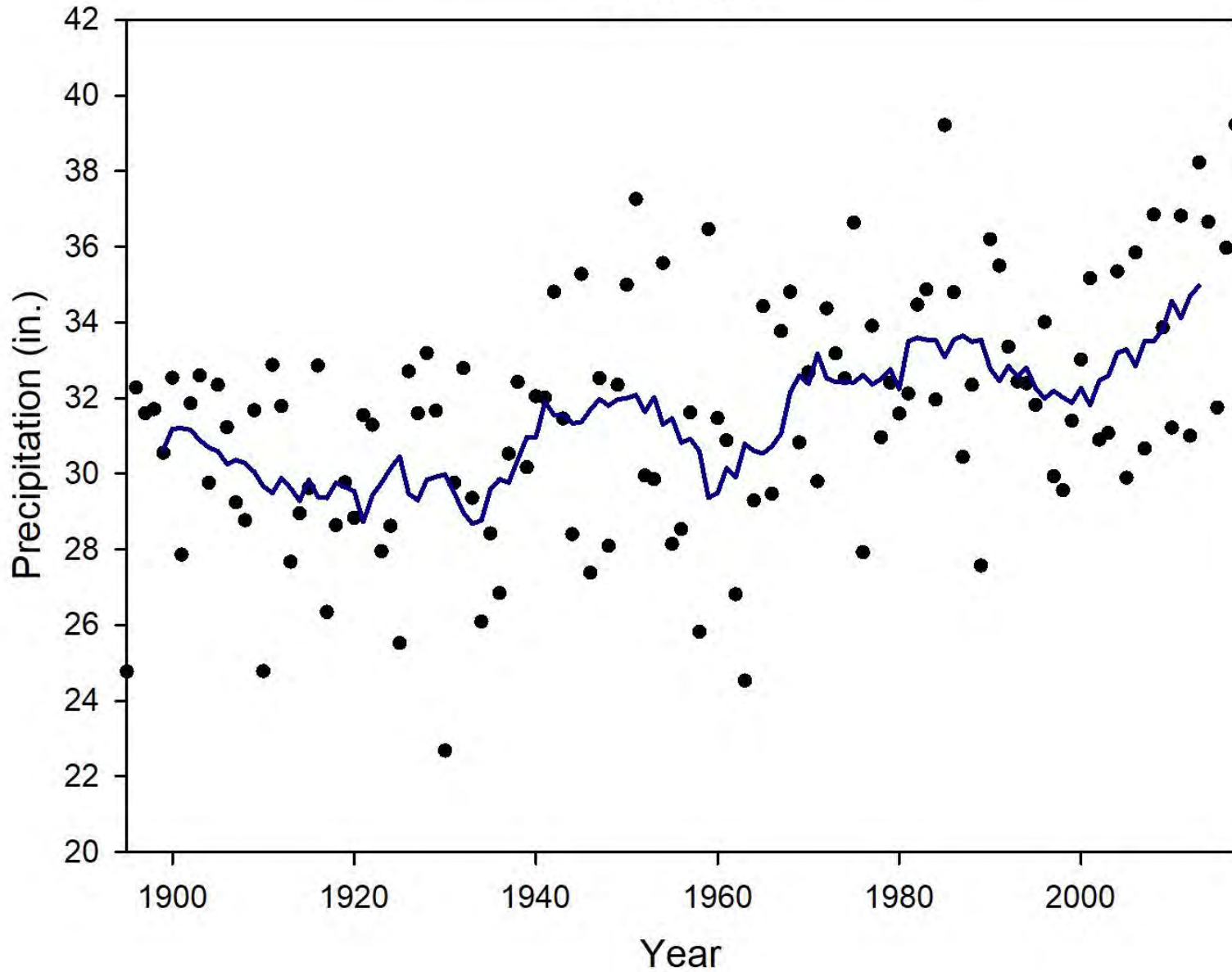
Great Lakes Region



— Length — Spring — Fall

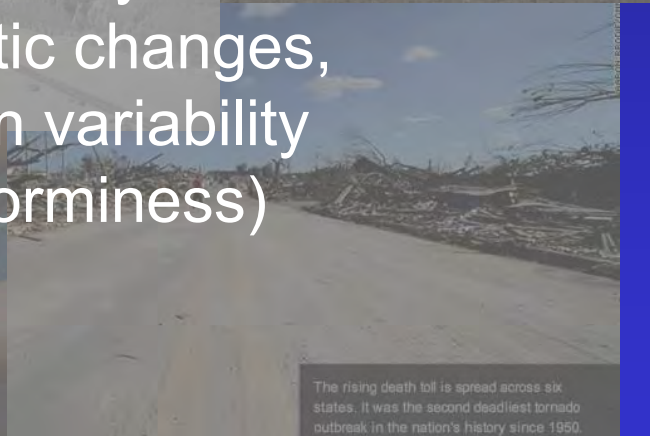
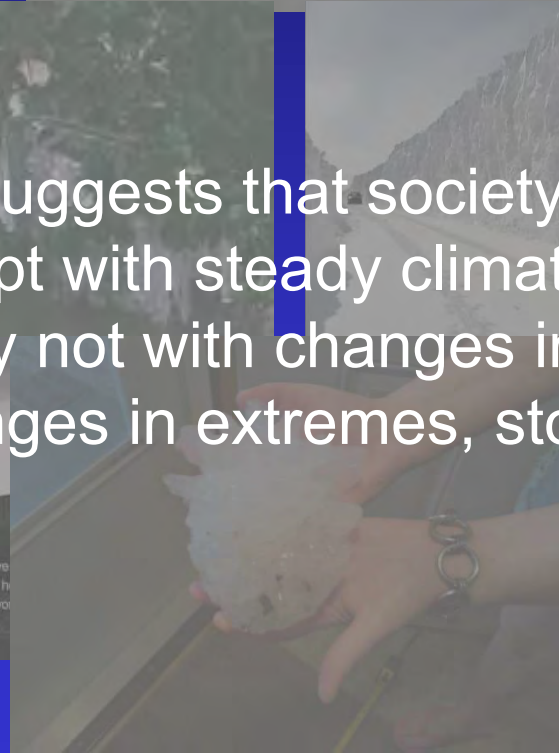
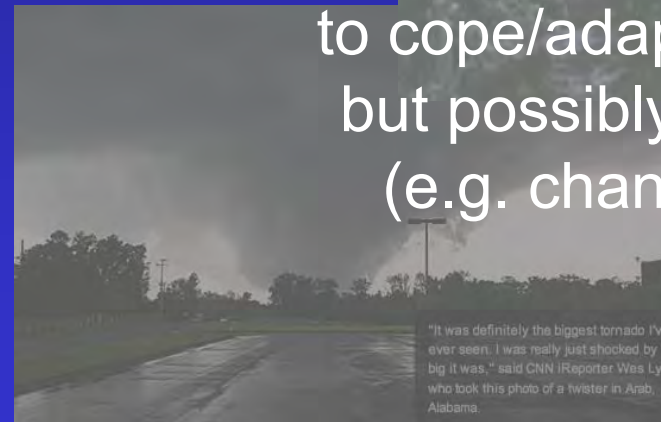
Source: K. Kunkel, Midwest. Reg. Clim. Center

Annual Precipitation vs Year, Michigan
1895-2017



Impacts of Climatic Variability

Past history suggests that society may be able to cope/adapt with steady climatic changes, but possibly not with changes in variability (e.g. changes in extremes, storminess)



Some Recent Extreme Weather Events in Michigan

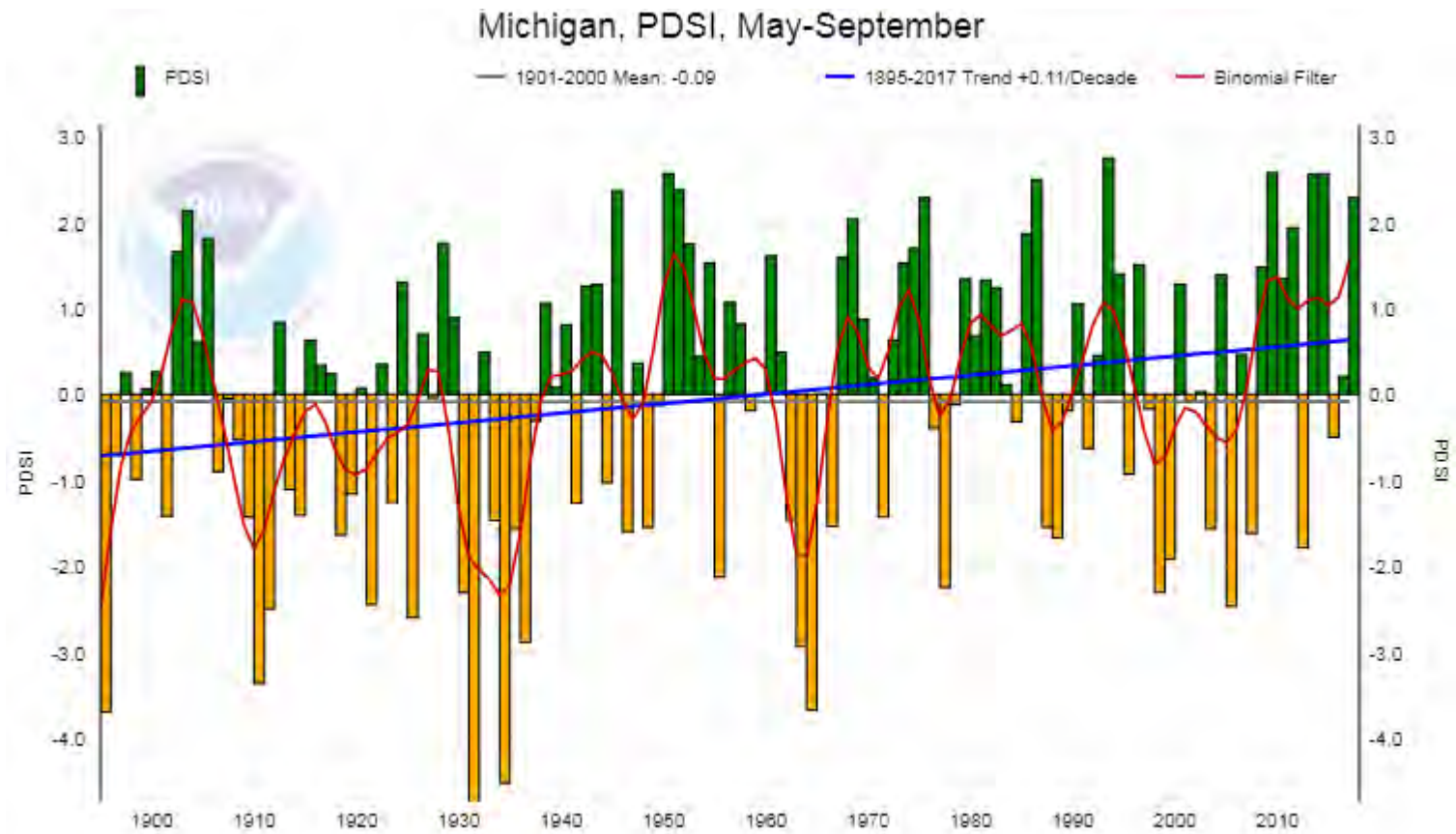
- Heat wave, March 2012
- Major drought, summer 2012
- Third wettest year on record in MI 2013
- Coldest winter in more than 100 years, 2013/2014
- Top ten coldest winter 2014/2015
- Record warm December 2015
- Wettest year on record in MI 2017

24-Hour Precipitation Totals (inches) for 2-100 Year Recurrence Intervals Lansing, MI

	Recurrence Interval			
	2 Year	10 Year	50 Year	100 Year
TP 40 (1938-1957)	2.35	3.70	4.45	4.80
Huff and Angel (1948-1991)	2.35	3.25	4.45	5.25
NOAA Atlas 14 Vol. 8 (POR, 2013)	2.43	3.42	4.80	5.50

Growing Season Drought Severity

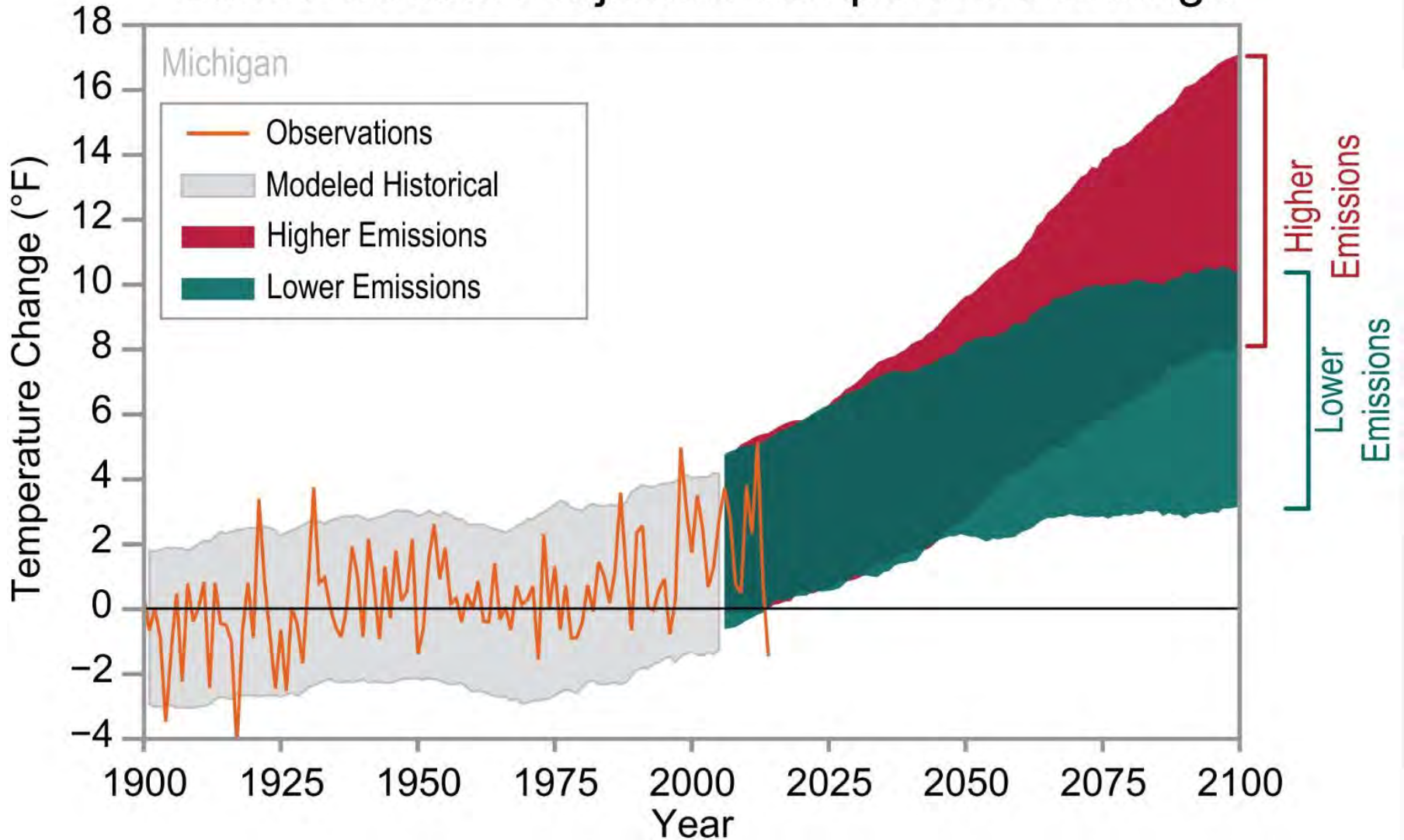
Michigan, 1895-2017



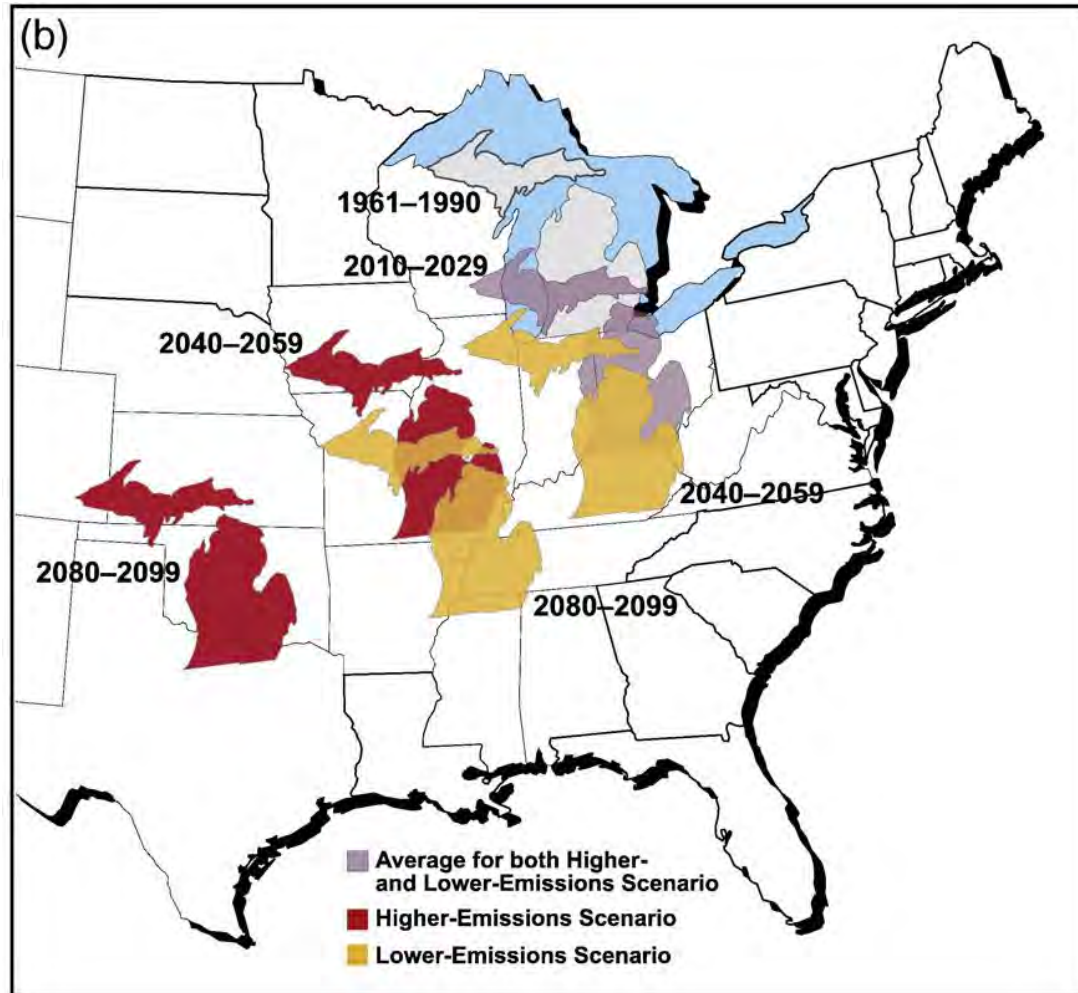
(Source: NOAA/NCEI, 2018)

Projecting the Future: Global Climate Models (GCMs)

Observed and Projected Temperature Change

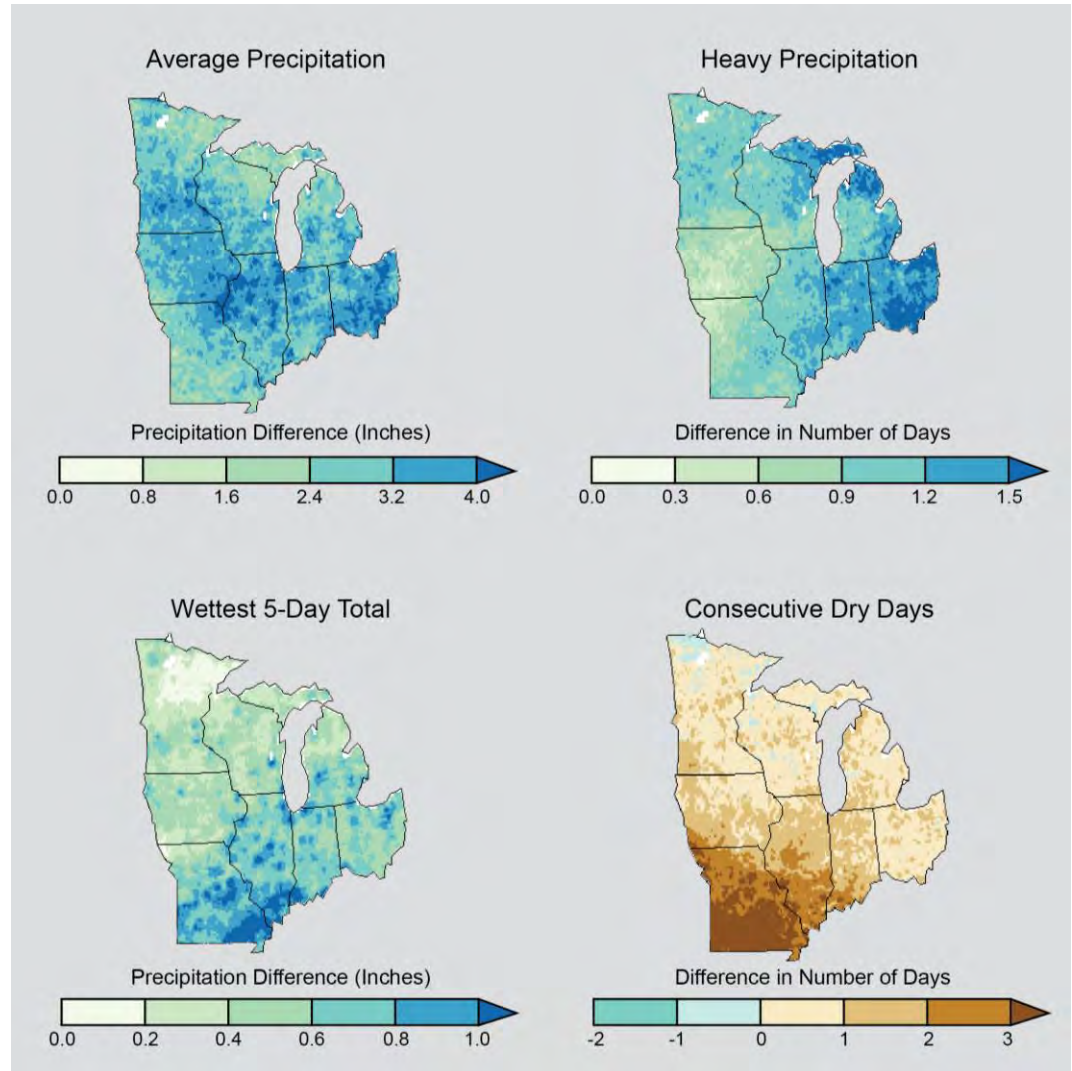


Projected Temperature Changes








Projected Precipitation-Related Changes 2041-2070 vs. 1971-2000

While possibly heavier, precipitation becomes more extreme and erratic



Projected Great Lakes Regional Changes

Average Temperature	Total Precipitation	Heavy Storm Precipitation	Number of Hot Days (T > 90F)	Frost-Free Season
 3.5 – 6.0 ° F	 5 - 15 %	 10-60%	 0-90 Days	 30-70 Days
2041- 2070	2041-2070	2041-2070	2041-2070	2070-2099

Summary

- Overall, mean average temperatures in Michigan rose approximately 1.0°F during the past century. Warming of about 2.0°F has occurred between 1980 and the present.
- Milder winter temperatures have led to less ice cover on the Great Lakes and the seasonal spring warm-up is occurring earlier than in the past.
- Annual precipitation rates increased from the 1930's through the present, due both to more wet days and more extreme events.
- Most recent GCM simulations of the Great Lakes region suggest a warmer and wetter climate in the distant future, with much of the additional precipitation coming during the cold season months.
- Projections of future climate change in Michigan suggest a mix of beneficial and adverse impacts.
- A changing climate leads to many potential challenges for dependent human and natural systems, especially with respect to climate variability.
- Given the projected rate of climate change, adaptive planning strategies should be dynamic in nature

Questions?

