# Observed and Projected Climate Change Trends in Michigan

Omar Gates

Great Lakes Integrated Sciences and Assessments

9/12/17

GLISA
A NOAA RISA TEAM

# Matching Science to Practice

**Research**


**Service**

- Interpret *existing* information and data for stakeholders
- Provide locally relevant synthesis:
  - What has happened?
  - What will happen?
  - What are the impacts?

# Climate on Global to Local Scales

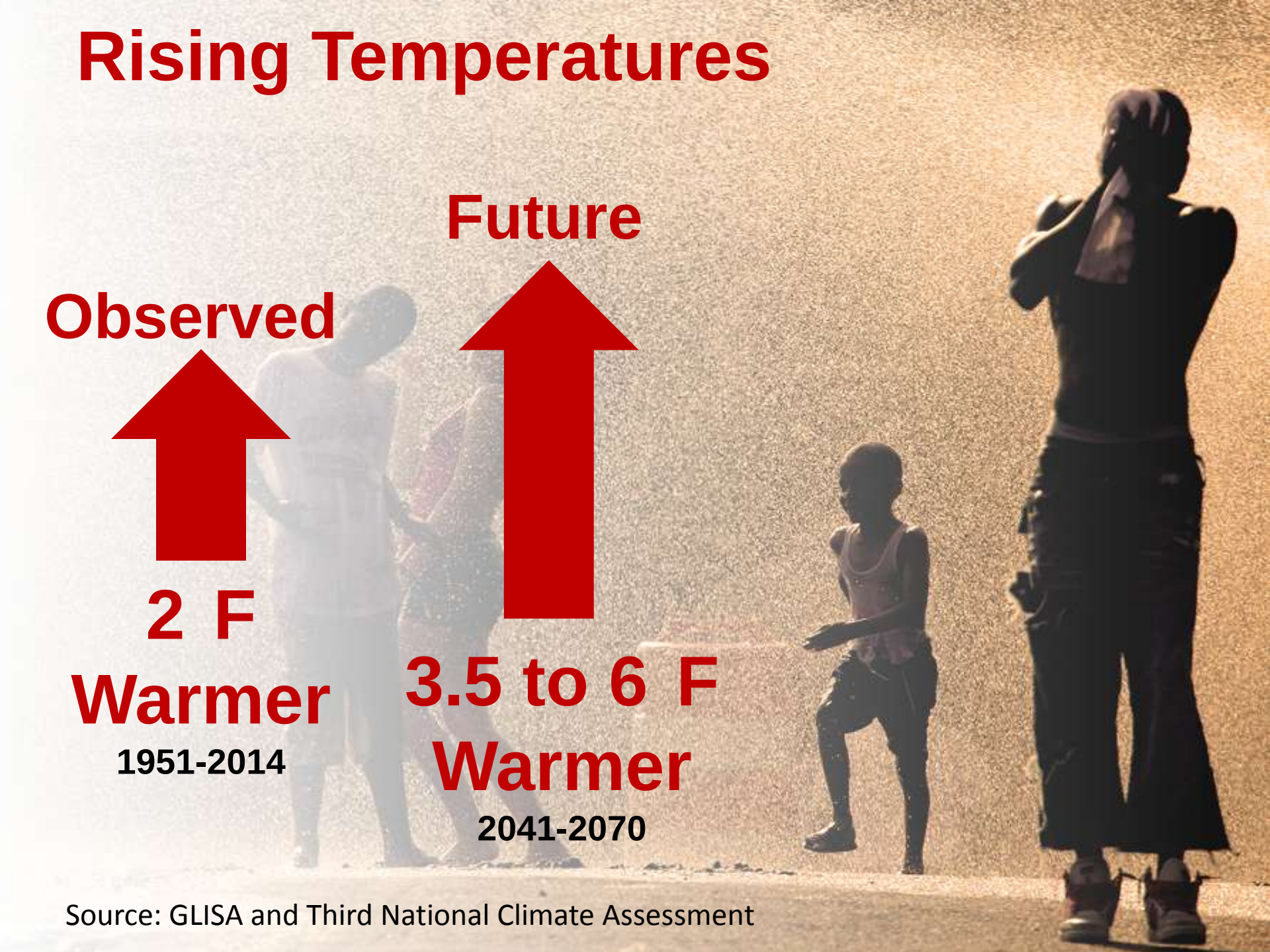
***There are multiple ways of looking at climate change:***

- ***Global***
- ***Regional***
- ***Local***

***Local factors can drastically alter the magnitude of climate change impacts, but can also be adapted to more readily.***

GLISA
A NOAA RISA TEAM

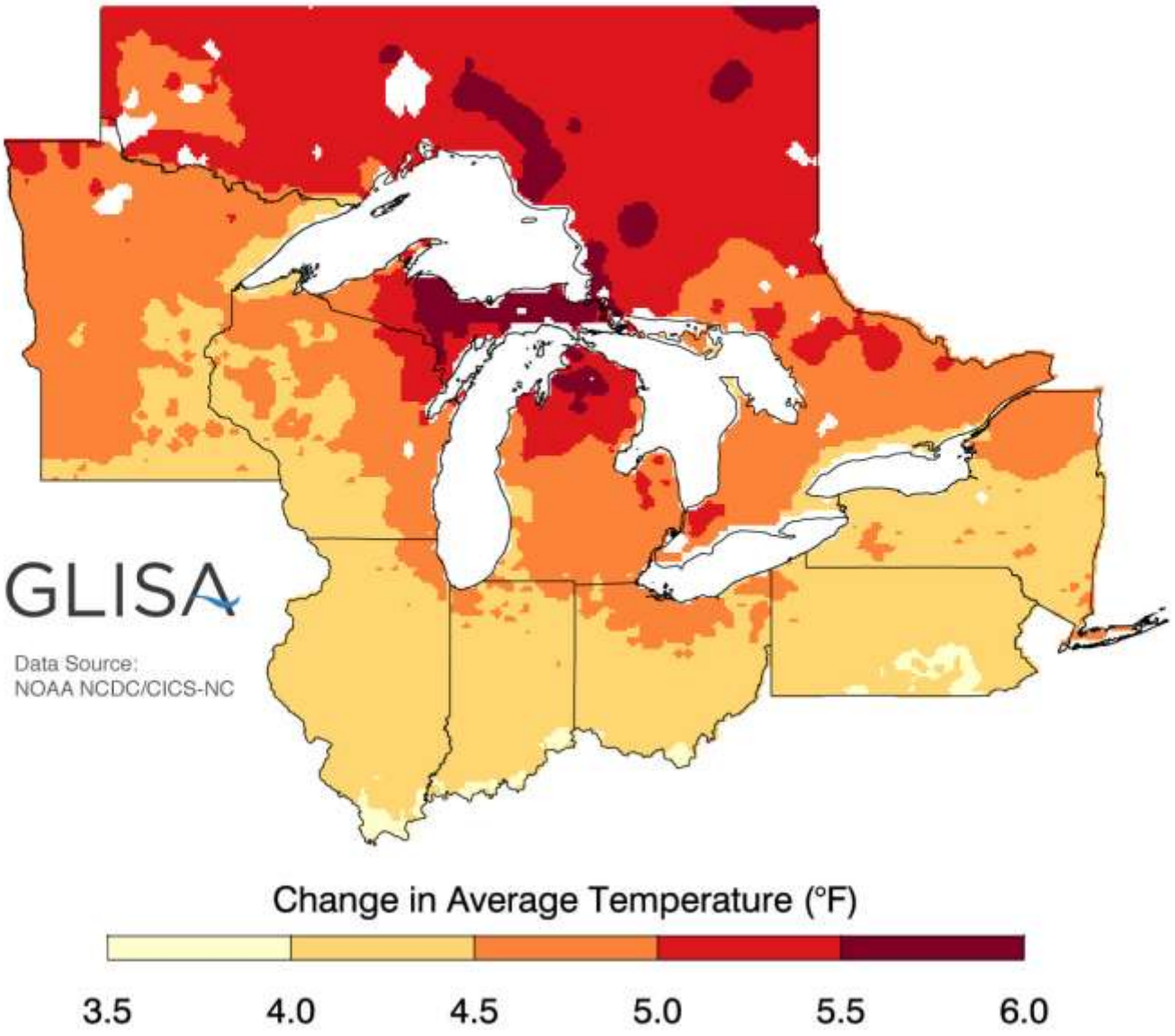
# Rising Temperatures




Source: GLISA and Third National Climate Assessment

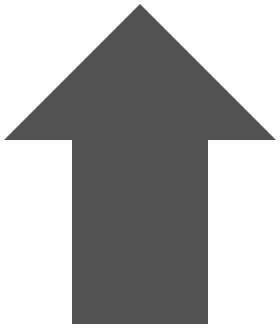
# Projected Change in Average Temperature

## Period: 2041-2070 | Higher Emissions: A2



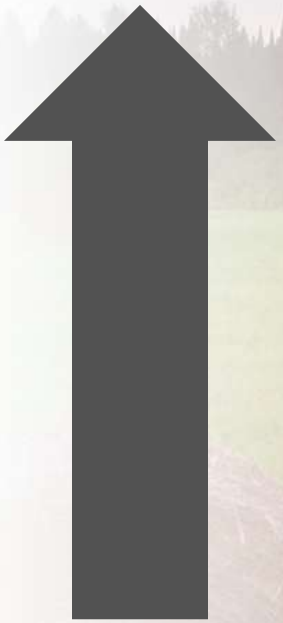
# A Longer Freeze-free Season

**Observed**



**11 Days**
**Longer**
**1951-2014**

**Future**



**30 to 70 Days**
**Longer**
**2070-2099**

Observed changes due mostly to **earlier last winter freeze**

Source: GLISA and Third National Climate Assessment

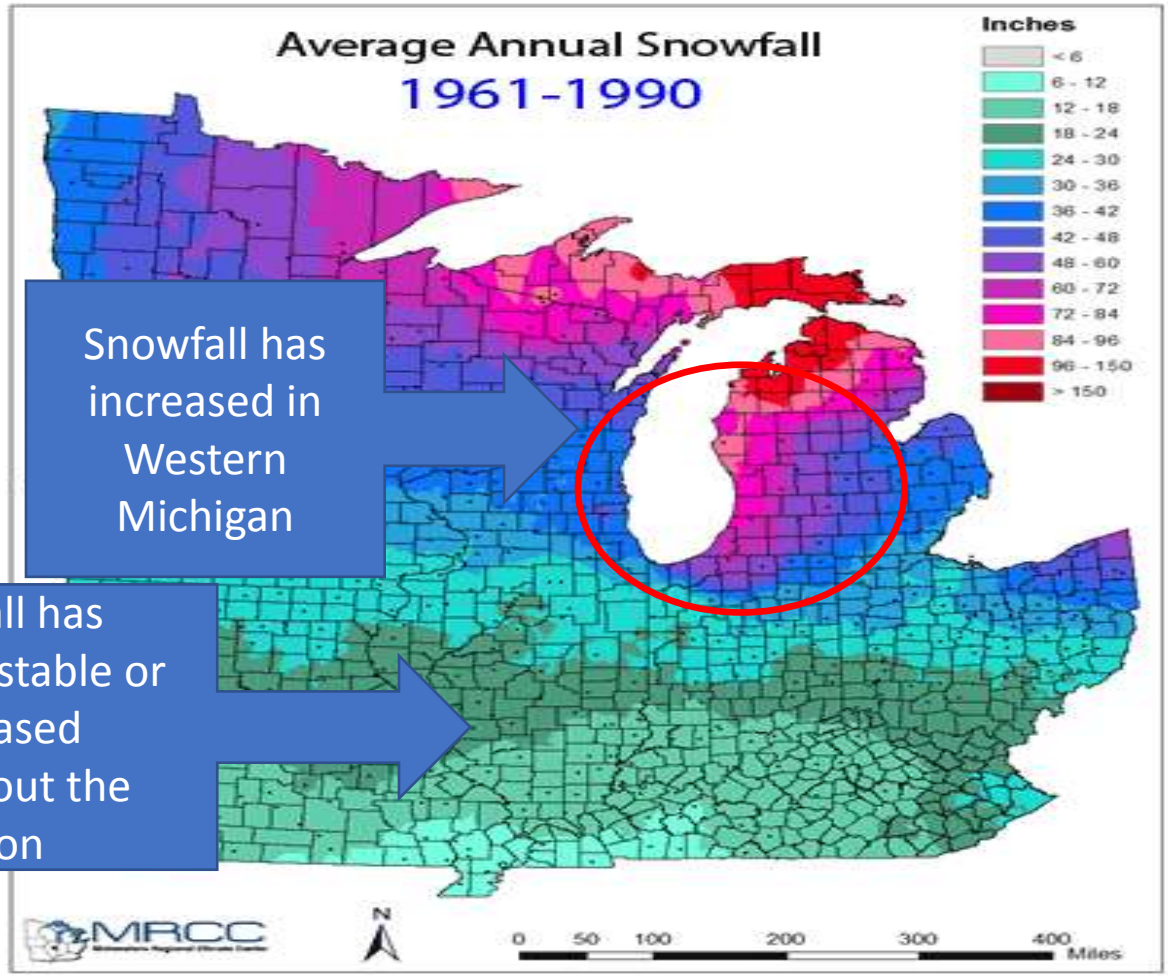
# Winters are warming faster.

**2°F increase averaged over the entire year**

**3.2°F increase during winter (December – February)**

Source: GLISA and Third National Climate Assessment

# Differences in Snowfall




Snowfall has increased in Western Michigan

Snowfall has remained stable or decreased throughout the region

GLISA
A NOAA RISA TEAM

# More Precipitation

**Total annual precipitation has increased by:**

**8.9%**

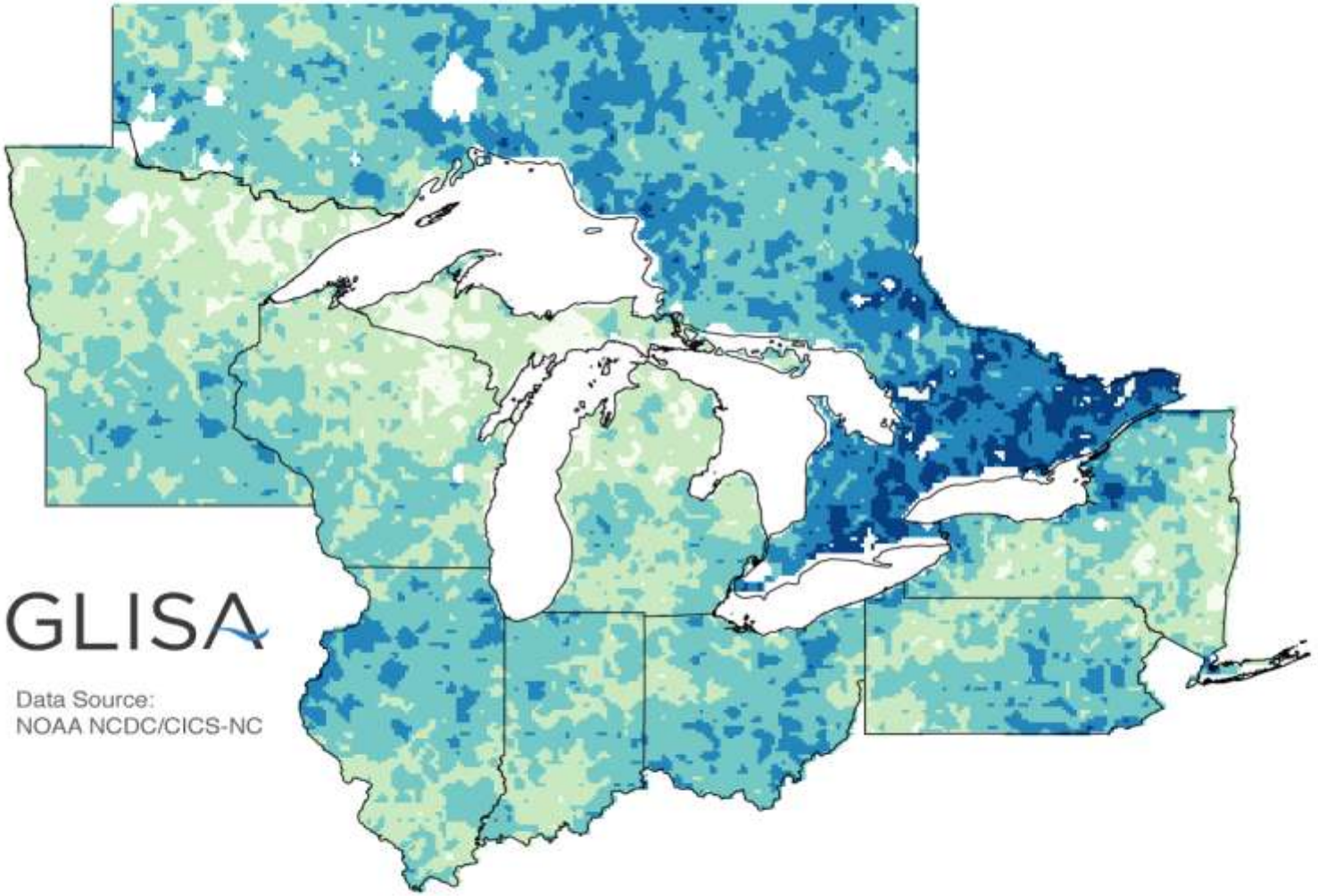
**Not even across the state. Has increased most in SE MI (+17%). Decreased over the Western UP (-6%)**

Changes are calculated from linear best fits of annual totals from 1951-2014.

Source: National Climatic Data Center

# Projected Change in Average Precipitation

## Period: 2041-2070 | Higher Emissions: A2



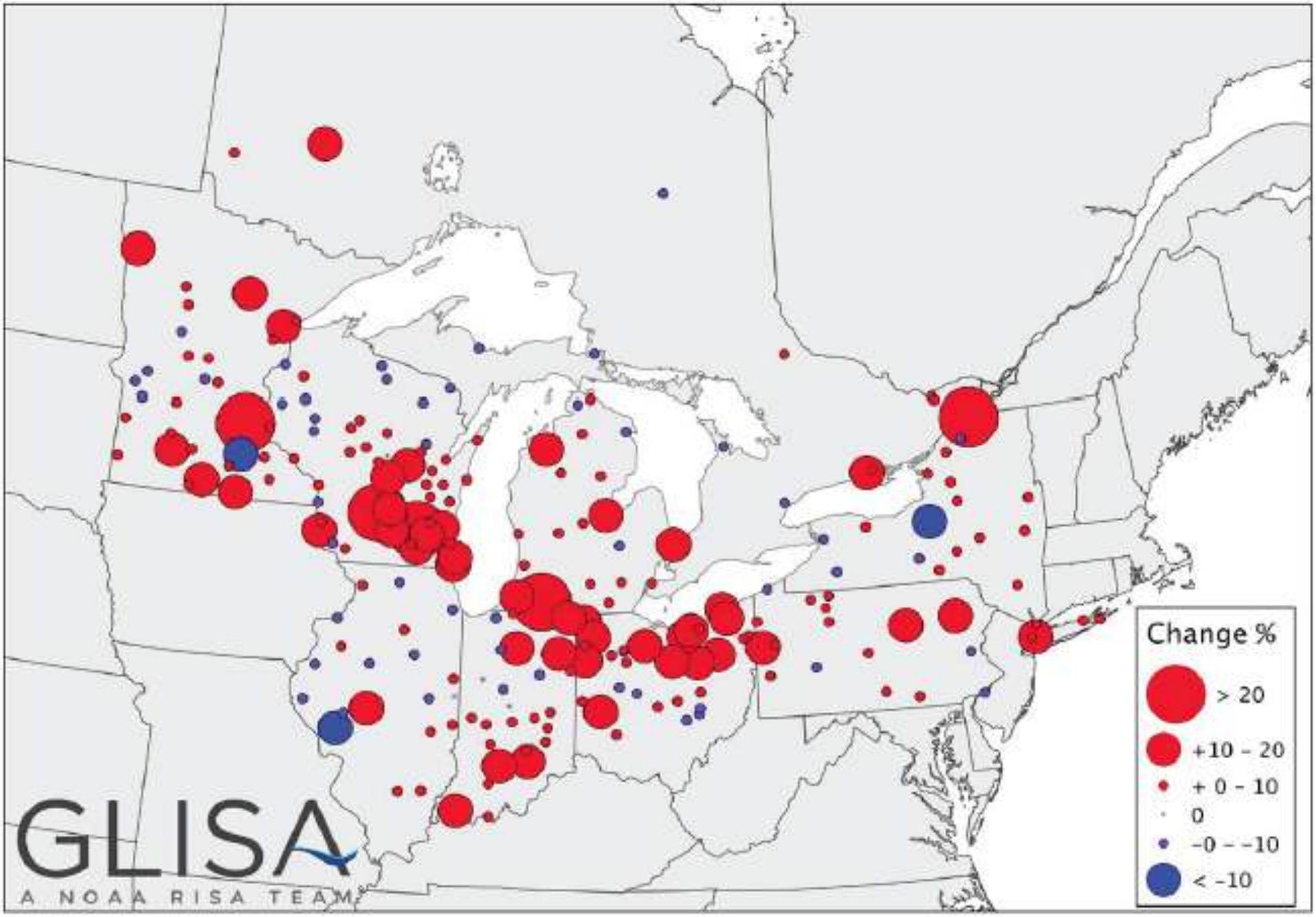
GLISA

Data Source:
NOAA NCDC/CICS-NC

Precipitation Difference (Inches) Per Year

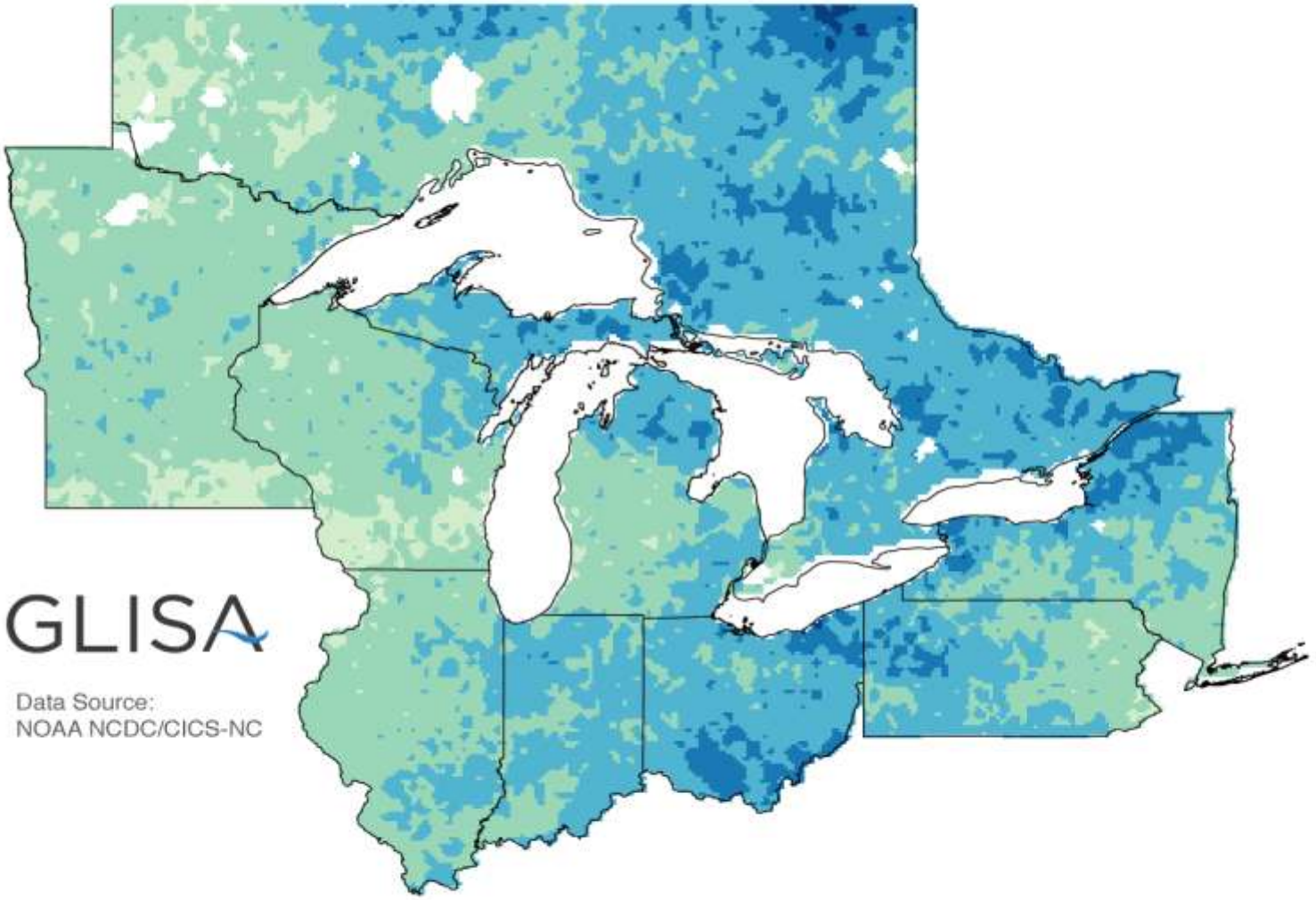
1 2 3 4 5 6

Observed Changes (%) in the Intensity of the 1% Heaviest Precipitation Days
(1951-1980 vs. 1981-2010)



# Projected Change in Days with Heavy Precipitation

## Period: 2041-2070 | Higher Emissions: A2




Change in Number of Heavy Precipitation Days Per Year

0.0 0.4 0.8 1.2 1.6 2.0 2.4

# Extreme Heat and Humidity

**By mid-century, models project Michigan could see:**

**90°F Days**

**10-50 more days per year**

**95°F Days**

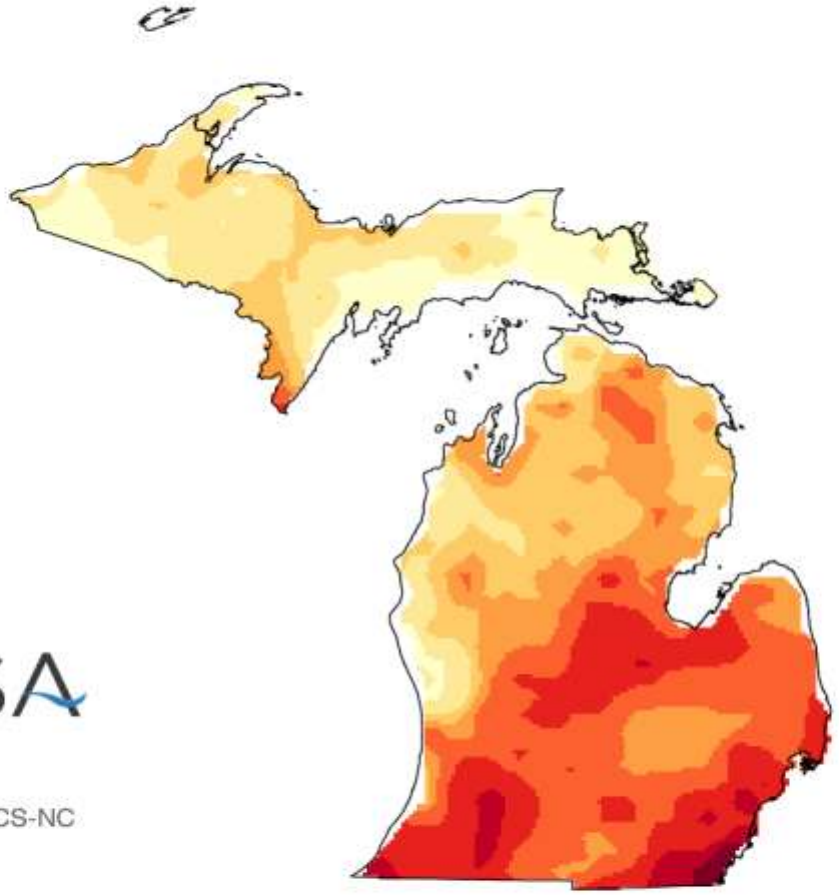
**5 to 20 more days per year***

**But, it is unclear if there has been a significant observed change in hot days.**

GLISA
A NOAA RISA TEAM

# Projected Change in the Number of Days Over 90°F

## Period: 2041-2070 | Higher Emissions: A2



GLISA

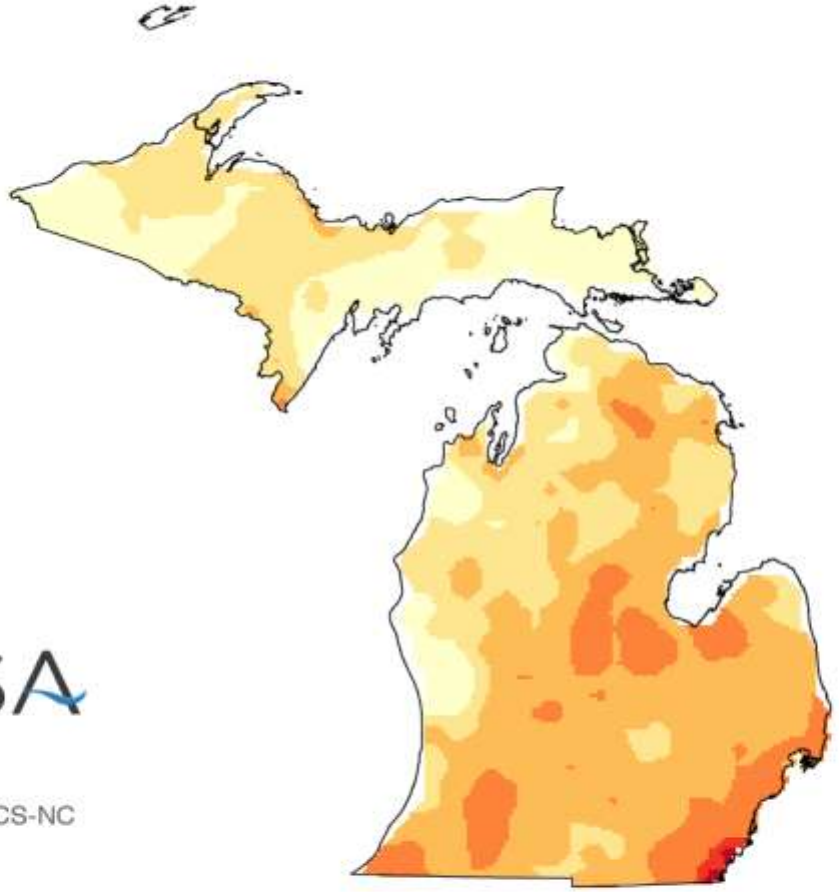
Data Source:
NOAA NCDC/CICS-NC

Number of Days Per Year

10 15 20 25 30 35 40

# Projected Change in Number of Days Over 95°F

## Period: 2041-2070 | Higher Emissions: A2



GLISA

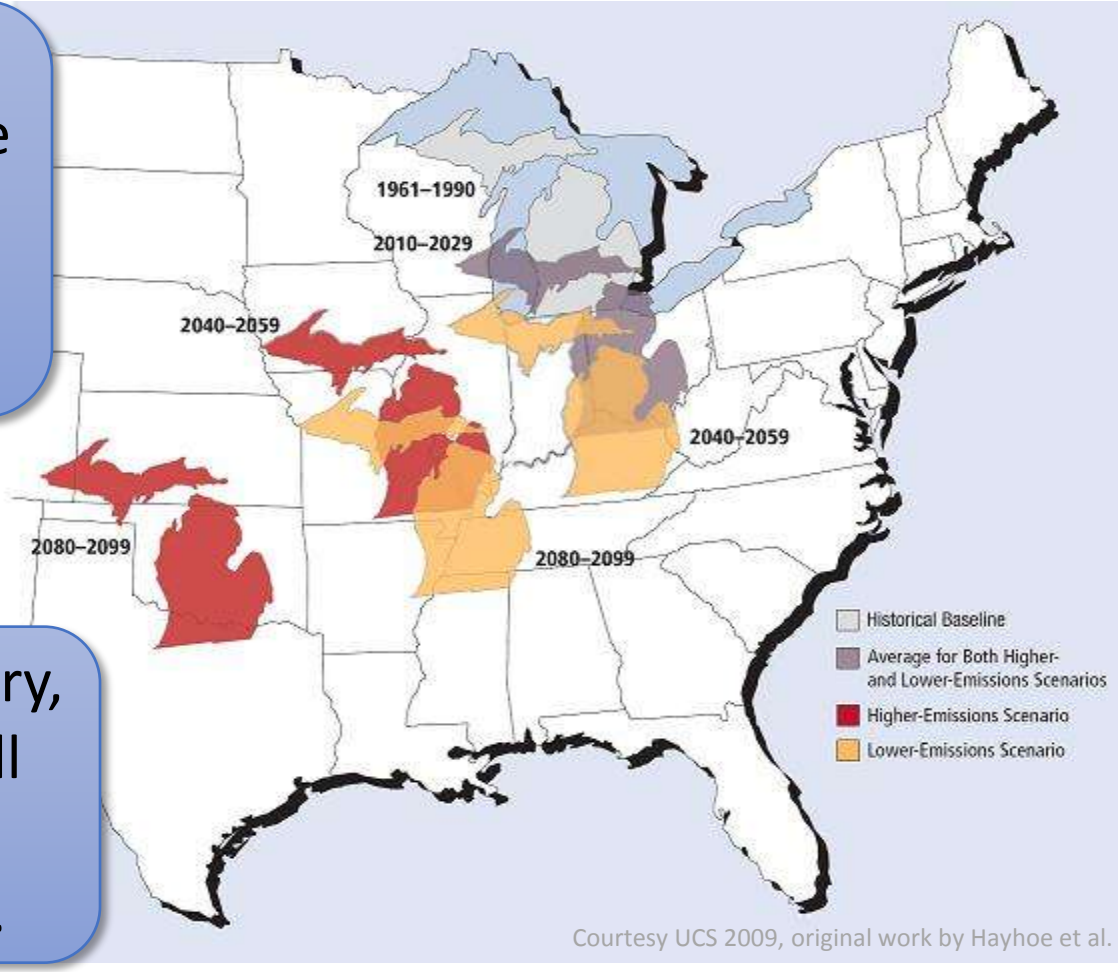
Data Source:
NOAA NCDC/CICS-NC

Number of Days Per Year

3 6 9 12 15 18

# A **Migrating Climate**

The climate future generations experience will be fundamentally different than the climate today.




Courtesy UCS 2009, original work by Hayhoe et al.

By the end of this century, Michigan summers will *feel* more like current summers in Arkansas.

GLISA
A NOAA RISA TEAM

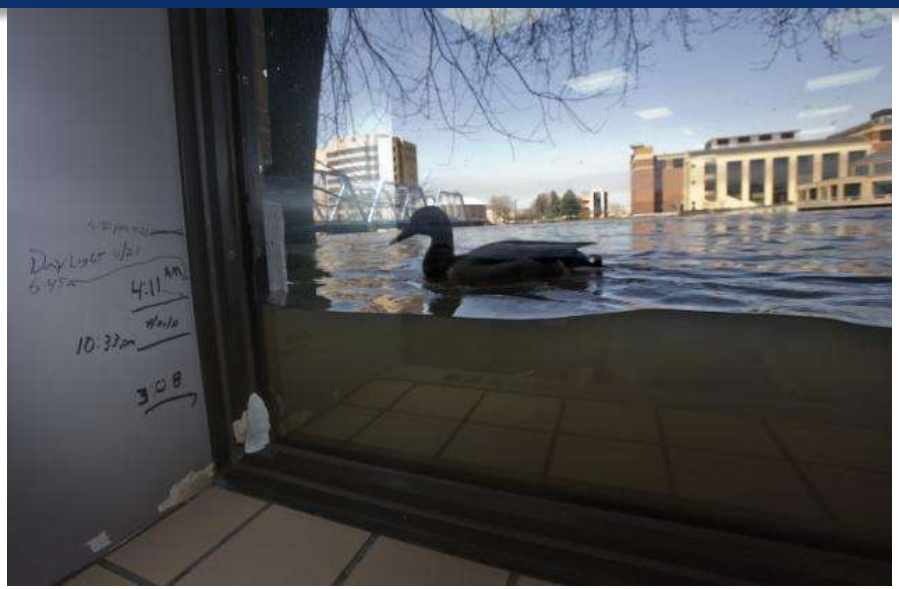
# Precipitation Impacts: Seasonal Changes and Water Supply

**Changing Seasonal Precipitation:**
Warmer springs and more precipitation increase the potential for mixed precipitation and variable spring weather.

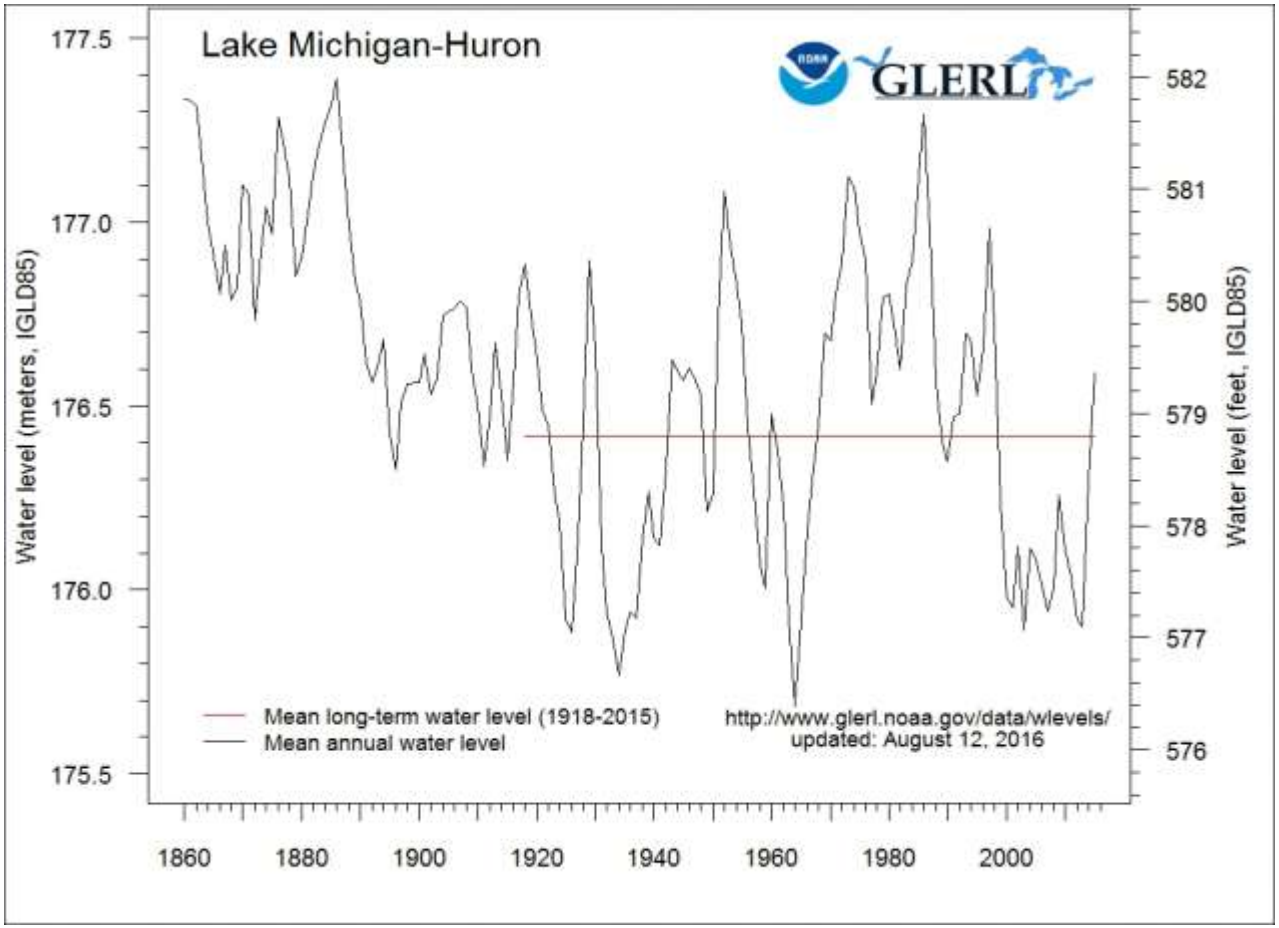
**Summer Water Availability:**
Even as annual total precipitation increases, summers may become drier.

# Stormwater Impacts

With increased extreme precipitation events, intense, flashy runoff amplify flooding risks.



# Lake Levels



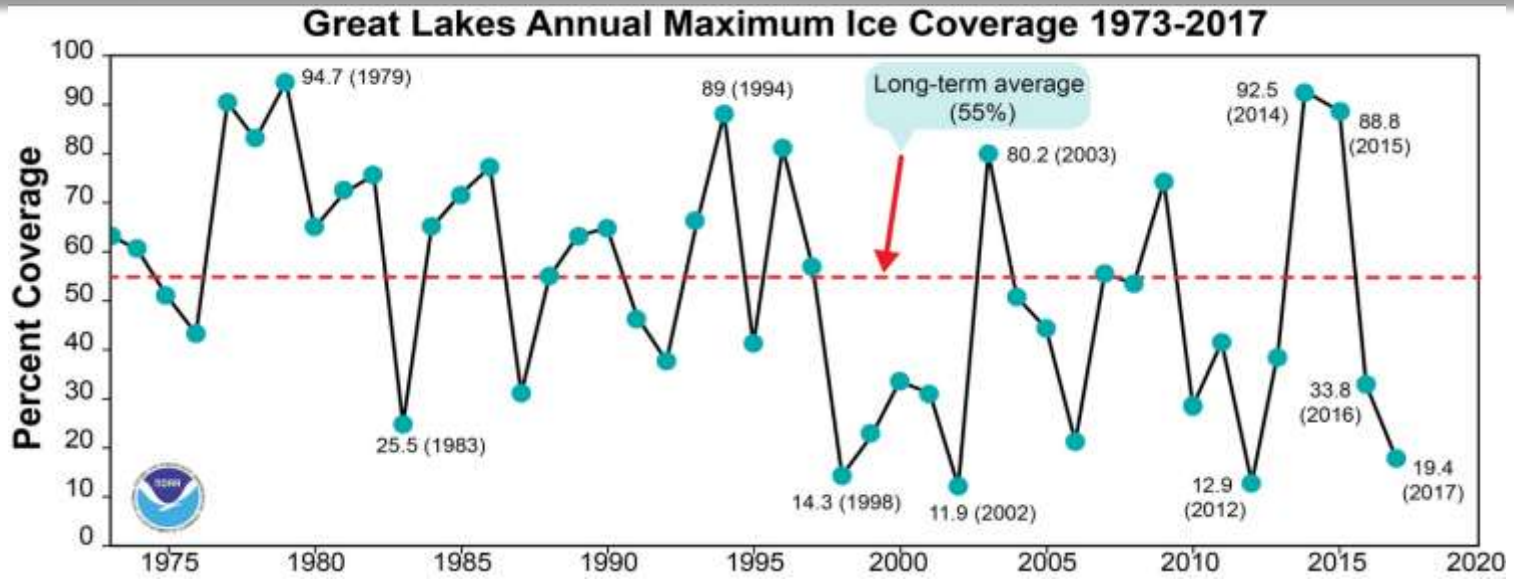

GLERL Great Lakes Water Level Dashboard

Lake levels had declined since reaching record highs in the 1980s until recently where levels have increased.

While most models project continued declines in long-term lake levels, there remains significant uncertainty.

Short-term variability and periods of high lake levels are still anticipated.

# Impacts of Declining Great Lakes Ice Cover




- **Fishing Industry:** Ice cover protects whitefish spawning areas. Great Lakes commercial fishing is $4 billion industry.
- **Coastal Zone:** In nearshore areas, ice provides stable platform for recreation and protects wetland areas from erosion.
- **Water Levels and Navigation:** Heavy ice cover can reduce evaporation and contribute to higher water levels in the following seasons—good news for shipping.

# Potential Impacts on Shipping

Every lost inch of water depth:

- Reduces cargo capacity 50-270 tons
- Costs $10k-30k per transit.

…but less lake ice cover allows for a longer shipping season

# For More Information

glisa.umich.edu
glisa.msu.edu

Contact Info:

gateso@umich.edu
glisa-info@umich.edu

GLISA
A NOAA RISA TEAM

Photo Credit: Dan Brown