Incorporating climate change into planning – Tools and Approaches to Coastal Resilience

State of Lake Michigan Conference
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Overview

- Introduce methods for integrating climate information into decision making
- Highlight two local case studies
  - Sault Ste. Marie Tribe of Chippewa Indians
  - Ravine Managers of NE Illinois and SE Wisconsin
- Demonstrate two online tools for accessing climate impacts
  - Cities Impacts and Adaptation Tool
  - Great Lakes Climate Atlas

Matching science to practice

Research

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Integration
Collaboration
Extension

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A NOAA RISA TEAM

Service

Matching science to practice

Global trends are more certain than regional trends.

Natural variability plays a larger role at the regional scale.

Local changes in land use can alter the severity of climate change impacts.

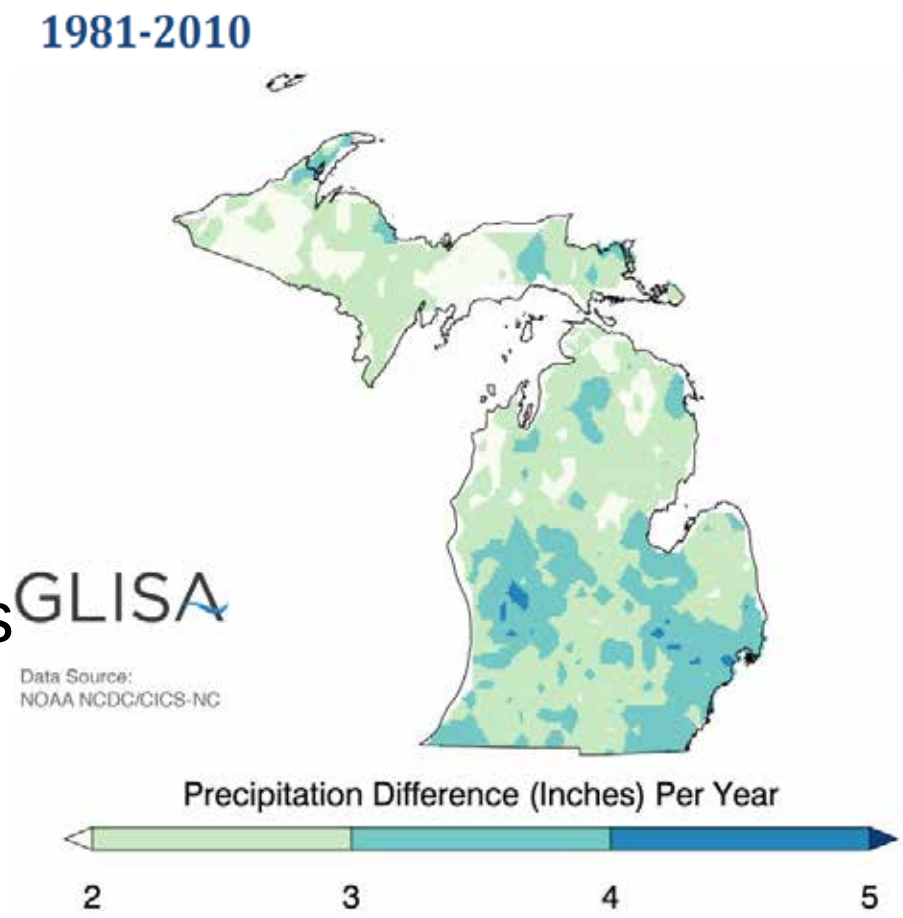
Matching science to practice

- Temperature
  - Averages
  - Extremes
  - Seasonality
- Precipitation
  - Averages
  - Extremes
  - Seasonality

Scientists often discuss changes in terms of averages, but *our environments are managed in terms of timing and extremes.*

Understanding Climate Resources

- Data
  - Historic/Observations
  - Future/Projections
- Information
  - Synthesized narratives
  - Tables and graphs



Understanding Climate Resources

Role of Historic/Observations

Answering “What has happened?”

- Provides certainty
- Produced at various spatial scales
  - Station data
  - U.S. climate division data
  - State
  - Regional

1981-2010
Temperature and Precipitation Summary

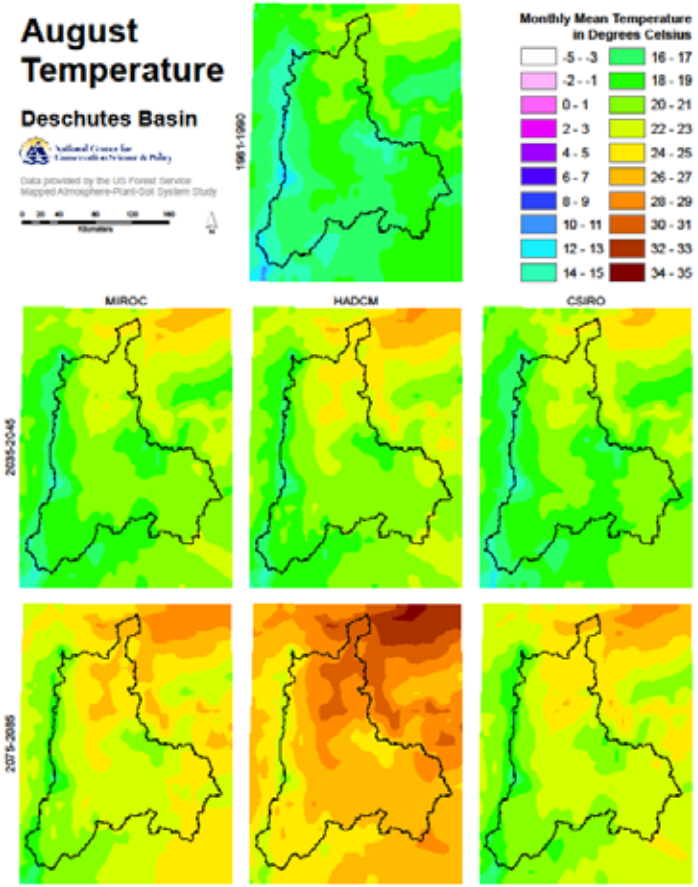
Mean Annual Temperature (°F)	49.8
Mean Annual Minimum Temperature (°F)	40.5
Mean Annual Maximum Temperature (°F)	59.1
Mean Number of Days per Year that exceed 90°F	8
Mean Number of Days per Year that fall below 32°F	122
Lowest Mean Annual Temperature (°F)	47.8
Highest Mean Annual Temperature (°F)	53.2
Mean Annual Total Precipitation (inches)	37.4
Lowest Mean Total Precipitation (inches)	30.5
Highest Mean Total Precipitation (inches)	47.6
Mean Number of Days/Year with > 0.1" Precip.	78
Mean Number of Days/Year with > 0.25" Precip.	47
Mean Number of Days/Year with > 0.5" Precip.	23
Mean Number of Days/Year with > 1" Precip.	6

Understanding Climate Resources

Role of Future Projections

Answering, “What will happen”

- Provides a model of what future climate may look like
- Occur at broad geographies
  - Global
  - Regional
  - Downscaled through Statistical or Dynamic processes
- May or may not accommodate unique climate drivers
  - Mountains, lakes etc



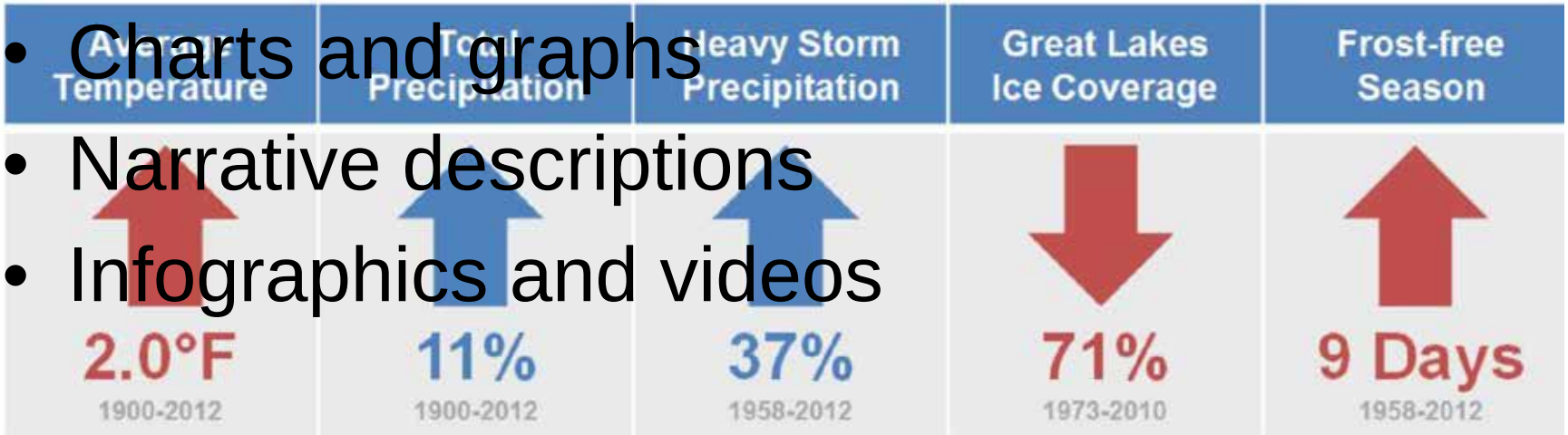
Understanding Climate Resources

Role of Climate Information

Answering “What are the Impacts?”

Identify likely climate impacts → Identify corresponding system impacts → Identify vulnerabilities to those impacts

- Charts and graphs
- Narrative descriptions
- Infographics and videos



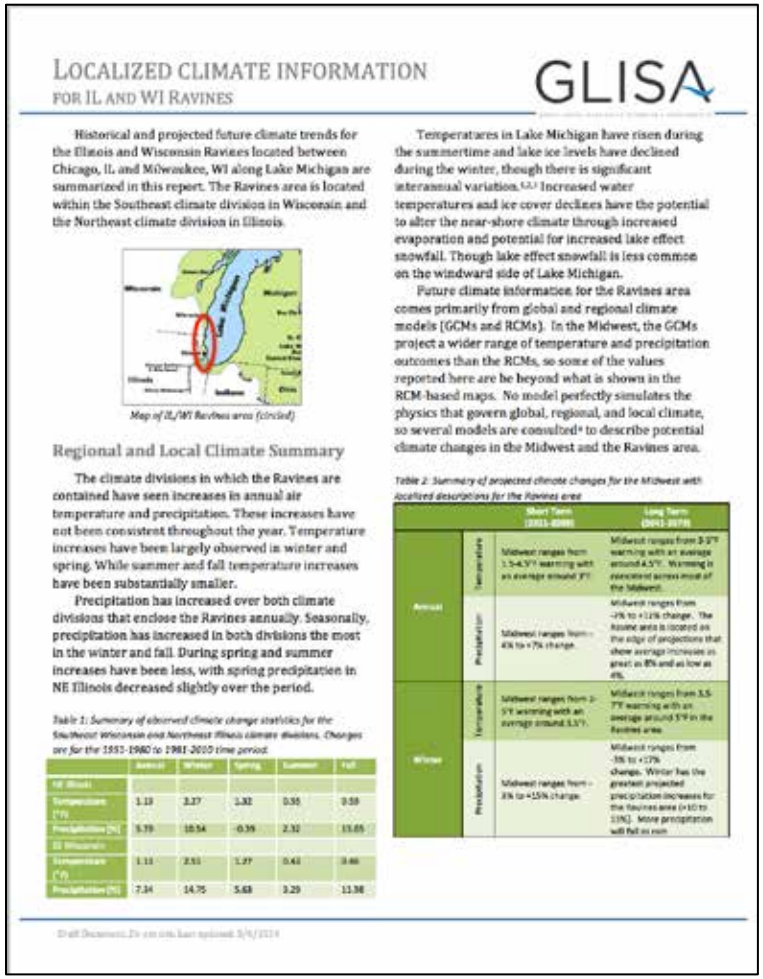
Applying Resources in our Region

2 Case Studies

- Sault Saint Marie Tribe of Chippewa
- Ravine Managers in Greater Chicago

Case Study: Ravine Managers

- Summary establishes a locally focused narrative of existing climate information
  - Temperature, Precipitation
  - Annual, Seasonal
- Relates local trends/projections to larger regional trends/projections.
- Discussion is broken into two time frames.
  - Historical Observations
  - Future Projections



LOCALIZED CLIMATE INFORMATION
FOR IL AND WI RAVINES

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Historical and projected future climate trends for the Illinois and Wisconsin Ravines located between Chicago, IL and Milwaukee, WI along Lake Michigan are summarized in this report. The Ravines area is located within the Southeast climate division in Wisconsin and the Northeast climate division in Illinois.

Map of IL/WI Ravines area (circled)

Regional and Local Climate Summary

The climate divisions in which the Ravines are contained have seen increases in annual air temperature and precipitation. These increases have not been consistent throughout the year. Temperature increases have been largely observed in winter and spring. While summer and fall temperature increases have been substantially smaller.

Precipitation has increased over both climate divisions that enclose the Ravines annually. Seasonally, precipitation has increased in both divisions the most in the winter and fall. During spring and summer increases have been less, with spring precipitation in NE Illinois decreased slightly over the period.

Table 1: Summary of observed climate change statistics for the Southeast Wisconsin and Northeast Illinois climate divisions. Changes are for the 1931-1960 to 1981-2010 time period.

	Annual	Winter	Spring	Summer	Fall
NE Illinois					
Temperature (°F)	1.13	3.27	1.32	0.55	0.59
Precipitation (%)	5.79	18.54	-0.39	2.32	15.65
SE Wisconsin					
Temperature (°F)	1.11	2.51	1.27	0.43	0.46
Precipitation (%)	7.34	14.75	5.68	3.29	11.38

Temperatures in Lake Michigan have risen during the summertime and lake ice levels have declined during the winter, though there is significant interannual variation.[1,2,3] Increased water temperatures and ice cover declines have the potential to alter the near-shore climate through increased evaporation and potential for increased lake effect snowfall. Though lake effect snowfall is less common on the windward side of Lake Michigan.

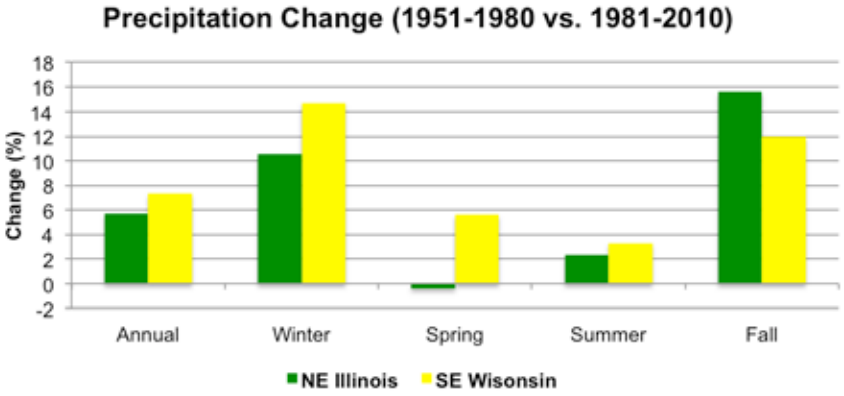
Future climate information for the Ravines area comes primarily from global and regional climate models (GCMs and RCMs). In the Midwest, the GCMs project a wider range of temperature and precipitation outcomes than the RCMs, so some of the values reported here are be beyond what is shown in the RCM-based maps. No model perfectly simulates the physics that govern global, regional, and local climate, so several models are consulted[4] to describe potential climate changes in the Midwest and the Ravines area.

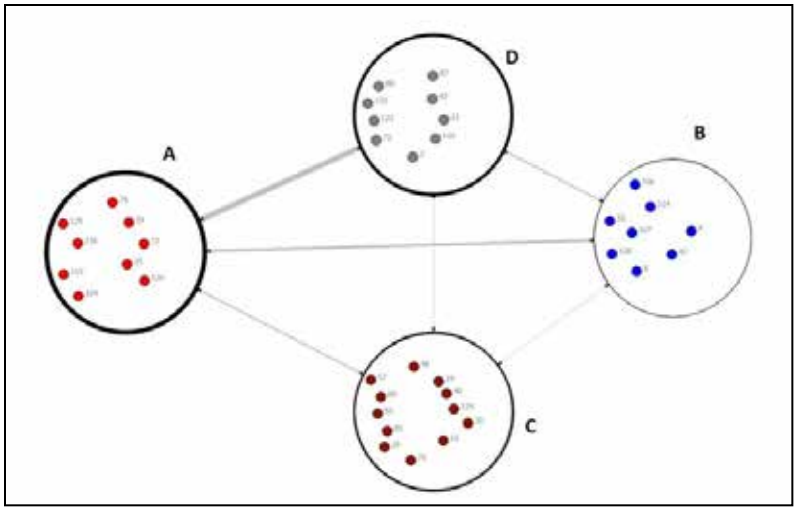
Table 2: Summary of projected climate changes for the Midwest with localized descriptions for the Ravines area

		Short Term (2011-2040)	Long Term (2041-2070)
Annual	Temperature	Midwest ranges from 1.5-4.5°F warming with an average around 3°F.	Midwest ranges from 3-5°F warming with an average around 4.5°F. Warming is expected across most of the Midwest.
	Precipitation	Midwest ranges from -4% to +7% change.	Midwest ranges from -2% to +12% change. The Ravine area is located on the edge of projections that show average increases as great as 8% and as low as 4%.
Winter	Temperature	Midwest ranges from 2-5°F warming with an average around 3.5°F.	Midwest ranges from 3.5-7°F warming with an average around 5°F in the Ravines area.
	Precipitation	Midwest ranges from -8% to +15% change.	Midwest ranges from -3% to +17% change. Winter has the greatest projected precipitation increases for the Ravines area (+10 to 15%). More precipitation will fall as rain.

Case Study: Ravine Managers

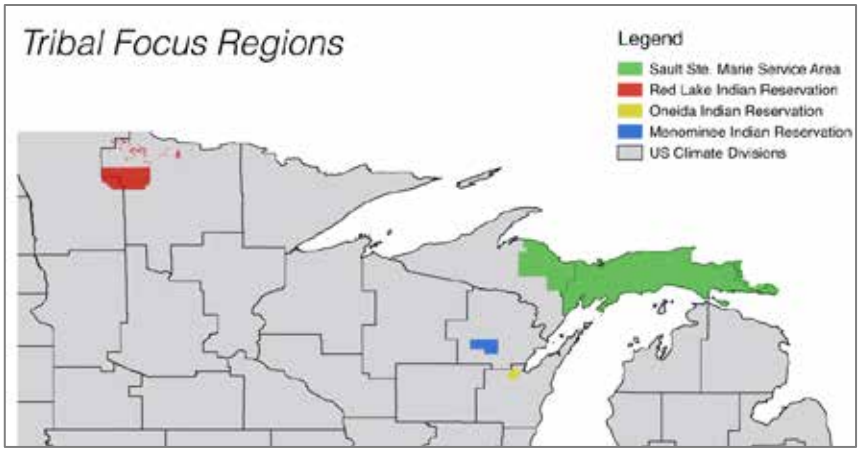
- Focus: climate variables identified by technical committee
- Understanding network:
  - Natural
  - Social





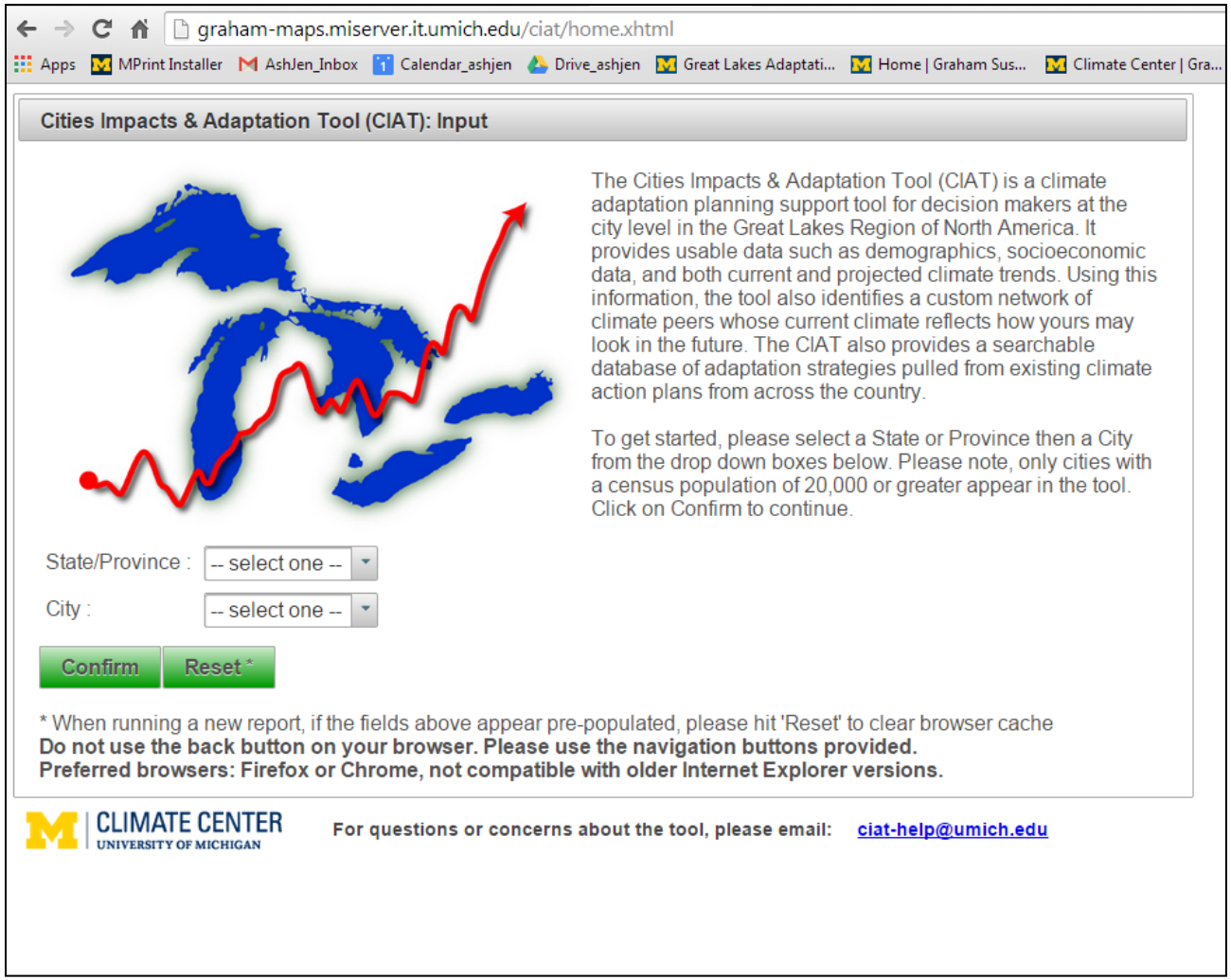
Case Study: Sault Ste. Marie Tribe of Chippewa

- Co-develop usable climate information for adaptation planning
  - Information was applied to stakeholder workshops for foresight development
- Tribes want to know how their local climate differs from regional trends



Decision Support Tools –

Cities Impacts and Adaptation Tool



Region-Wide Information:

- Climate Data
- Peer Network Map
- Climate Adaptation Strategies Databse

Cities Impacts & Adaptati ×

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Cities Impacts & Adaptation Tool (CIAT): Input

The Cities Impacts & Adaptation Tool (CIAT) is a climate adaptation planning support tool for decision makers at the city level in the Great Lakes Region of North America. It provides usable data such as demographics, socioeconomic data, and both current and projected climate trends. Using this information, the tool also identifies a custom network of climate peers whose current climate reflects how yours may look in the future. The CIAT also provides a searchable database of adaptation strategies pulled from existing climate action plans from across the country.

To get started, please select a State or Province then a City from the drop down boxes below. Please note, only cities with a census population of 20,000 or greater appear in the tool. Click on Confirm to continue.

State/Province : Indiana

City : -- select one --

- Fishers
- Fort Wayne
- Franklin
- Gary
- Goshen
- Granger
- Greenfield

Confirm | Re

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concerns about the tool, please email: ciat-help@umich.edu

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Cities Impacts & Adaptation Tool (CIAT): Report for Gary, Indiana

- User Guide
- Climate
- Map
- Adaptation Strategies

New Report

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For questions or concerns about the tool, please email: ciat-help@umich.edu

Overview

1. Season

Select a season based on your climate change concern (heat waves = summer)
Click on the blue highlighted Climate Divisions to show all cities within that division above 20,000 people

Season:
Summer

Peer Matching Climate Criteria:
Temperature Only

2. Population

3. Demographics

4. Climate Stations

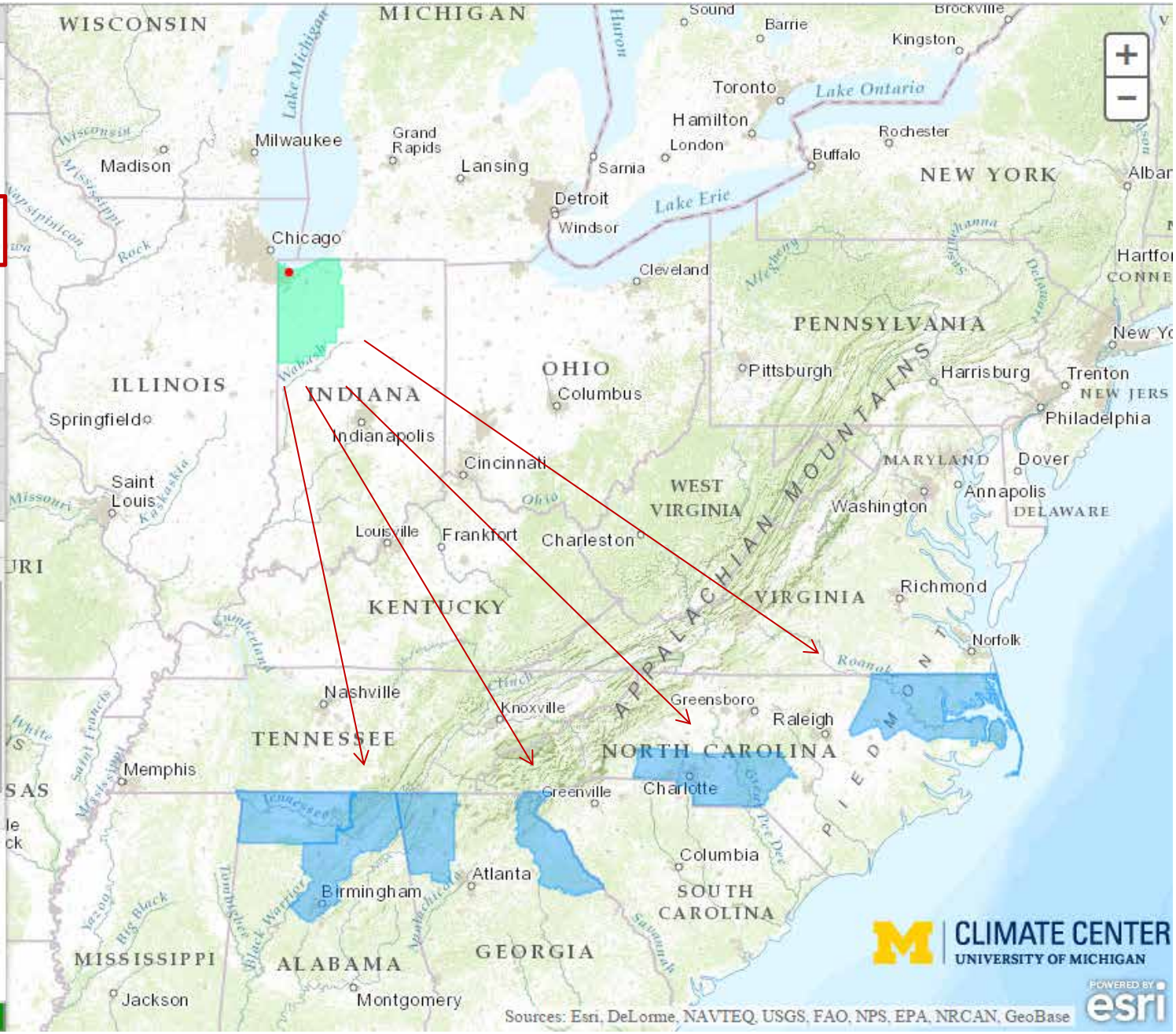
5. Printing

Selections

Gary, Indiana
Population: 80294
Per capita income($): 15383
Poverty(%): 30.01
Owner occupied(%): 55.62
over 65(%): 14.510424
Median Construction Date: 1954

Your climate division
Peer climate divisions
Your city
Peer cities
Climate stations

Return to Report



Overview

1. Season

Select a season based on your climate change concern (heat waves = summer)
Click on the blue highlighted Climate Divisions to show all cities within that division above 20,000 people

Season:
Winter

Peer Matching Climate Criteria:
Temperature and Precipitation

2. Population

3. Demographics

4. Climate Stations

5. Printing

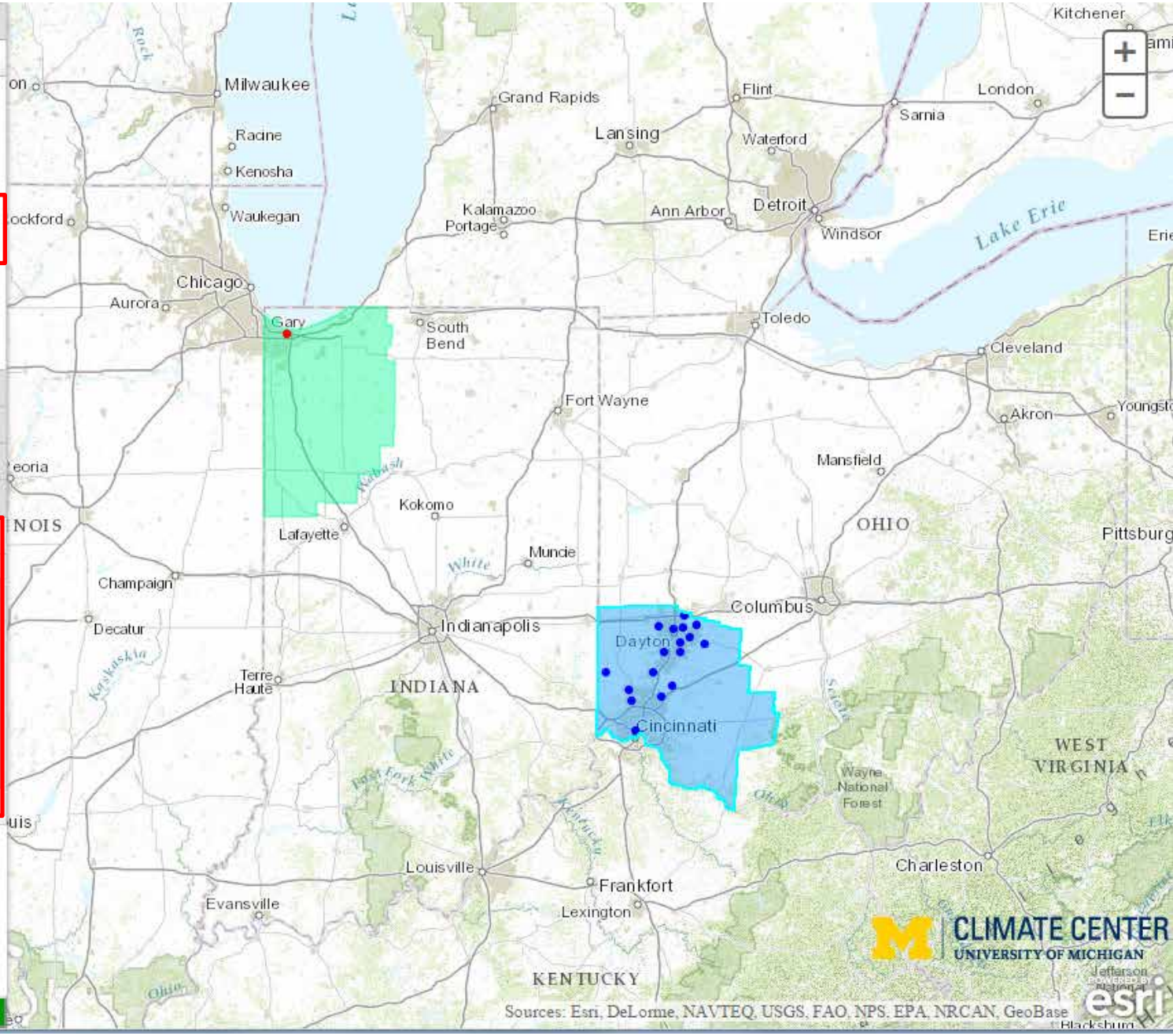
Selections

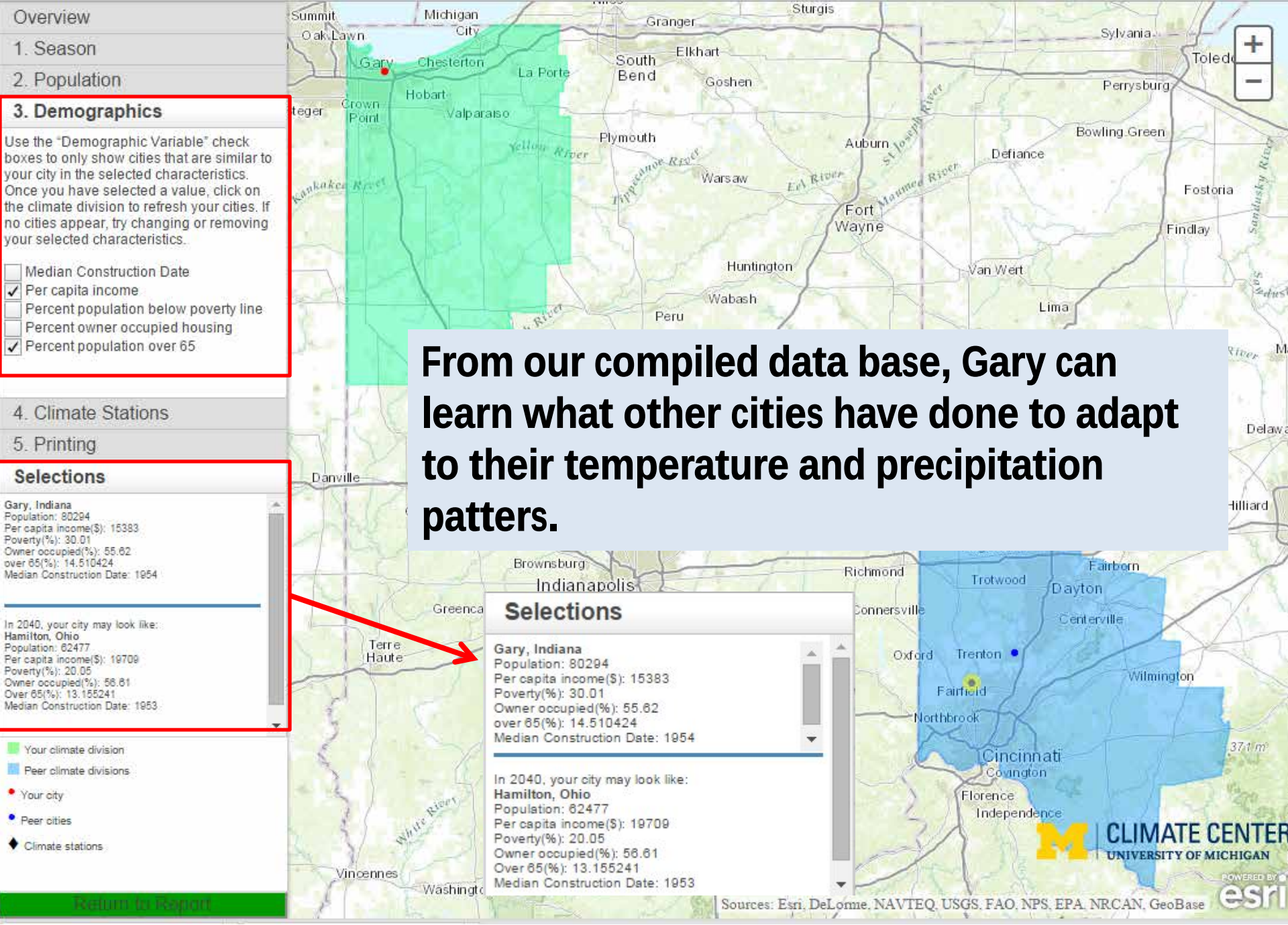
NORTHWEST, Indiana
1981 - 2010 Winter Averages:
Temp: 27.051 degrees F
Precip: 6.425 inches
2041 - 2070 Projected Winter Averages:
Temp: 32.17 degrees F
Precip: 7.12 inches

SOUTHWEST, Ohio
1981 - 2010 Winter Averages:
Temp: 31.721 degrees F
Precip: 8.582 inches

- Your climate division
- Peer climate divisions
- Your city
- Peer cities
- Climate stations

Return to Report





From our compiled data base, Gary can learn what other cities have done to adapt to their temperature and precipitation patters.

Overview
1. Season
2. Population
3. Demographics
4. Climate Stations

Turn on Climate Stations and click one near a peer city to find information on extreme events
Turn off Climate Peers before clicking station.
This function is only available in the Great Lakes Region

- [ ] Closest Climate Station
- [x] Climate Stations
- [x] Climate Peers
- [x] My Climate Division

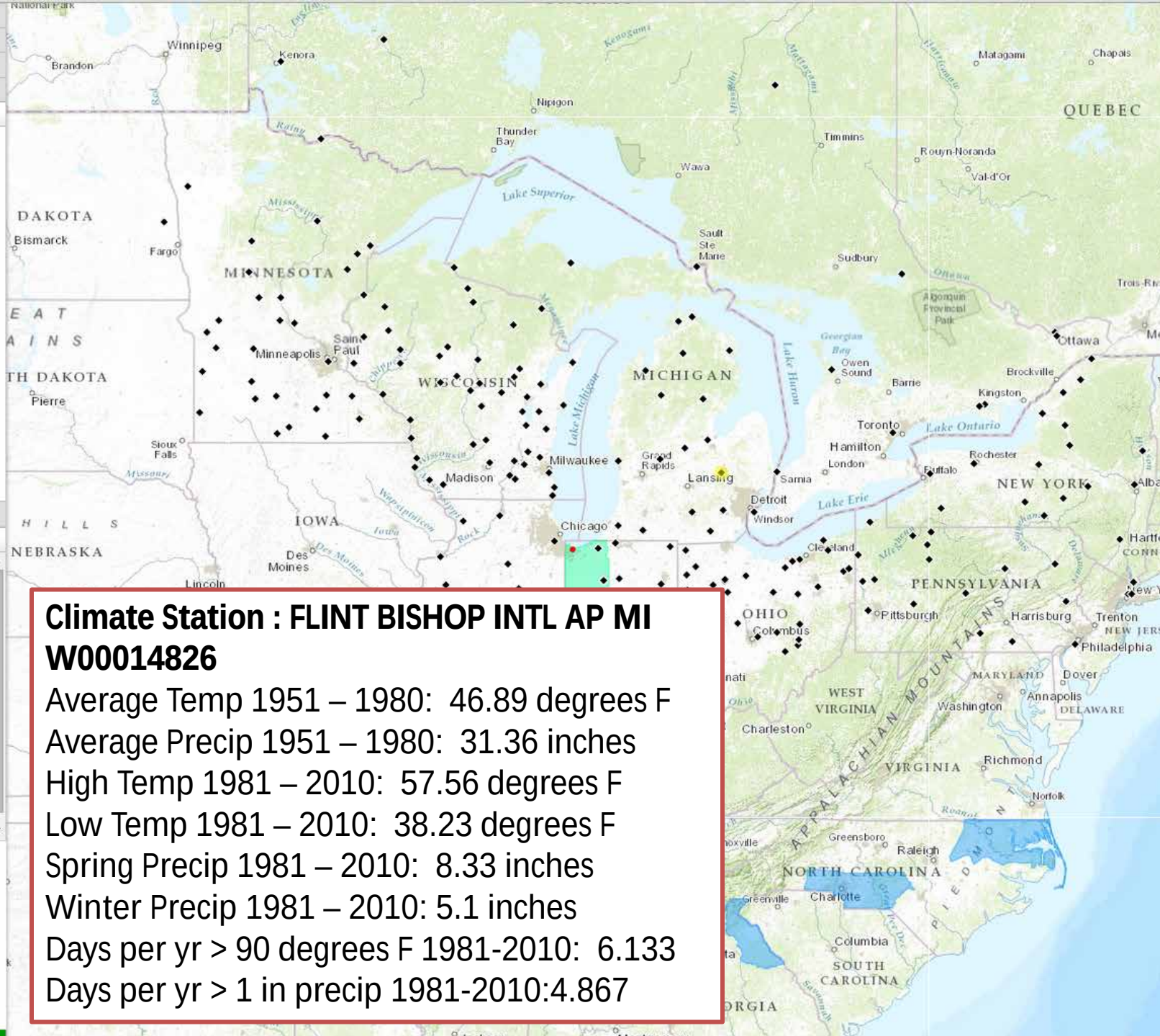
5. Printing

Selections

Closest Climate Station : CHICAGO MIDWAY AP 3SW IL C00111577
Average Temp 1951 - 1980 = 50.7 degrees F
Average Precip 1951 - 1980 = 38.59 inches
High Temp 1981 - 2010 = 60.04 degrees F
Low Temp 1981 - 2010 = 43.33 degrees F
Spring Precip 1981 - 2010 = 10.72 inches
Winter Precip 1981 - 2010 = 6.56 inches
Days per yr > 90 degrees F 1981-2010 = 16.167
Days per yr > 1 in precip 1981-2010:8.633

Climate Station : FLINT BISHOP INTL AP MI W00014826
Average Temp 1951 - 1980 = 46.89 degrees F
Average Precip 1951 - 1980 = 31.36 inches
High Temp 1981 - 2010 = 57.56 degrees F
Low Temp 1981 - 2010 = 38.23 degrees F
Spring Precip 1981 - 2010 = 8.33 inches
Winter Precip 1981 - 2010 = 5.1 inches
Days per yr > 90 degrees F 1981-2010 = 6.133
Days per yr > 1 in precip 1981-2010:4.867

- Your climate division
- Peer climate divisions
- Your city
- Peer cities
- Climate stations

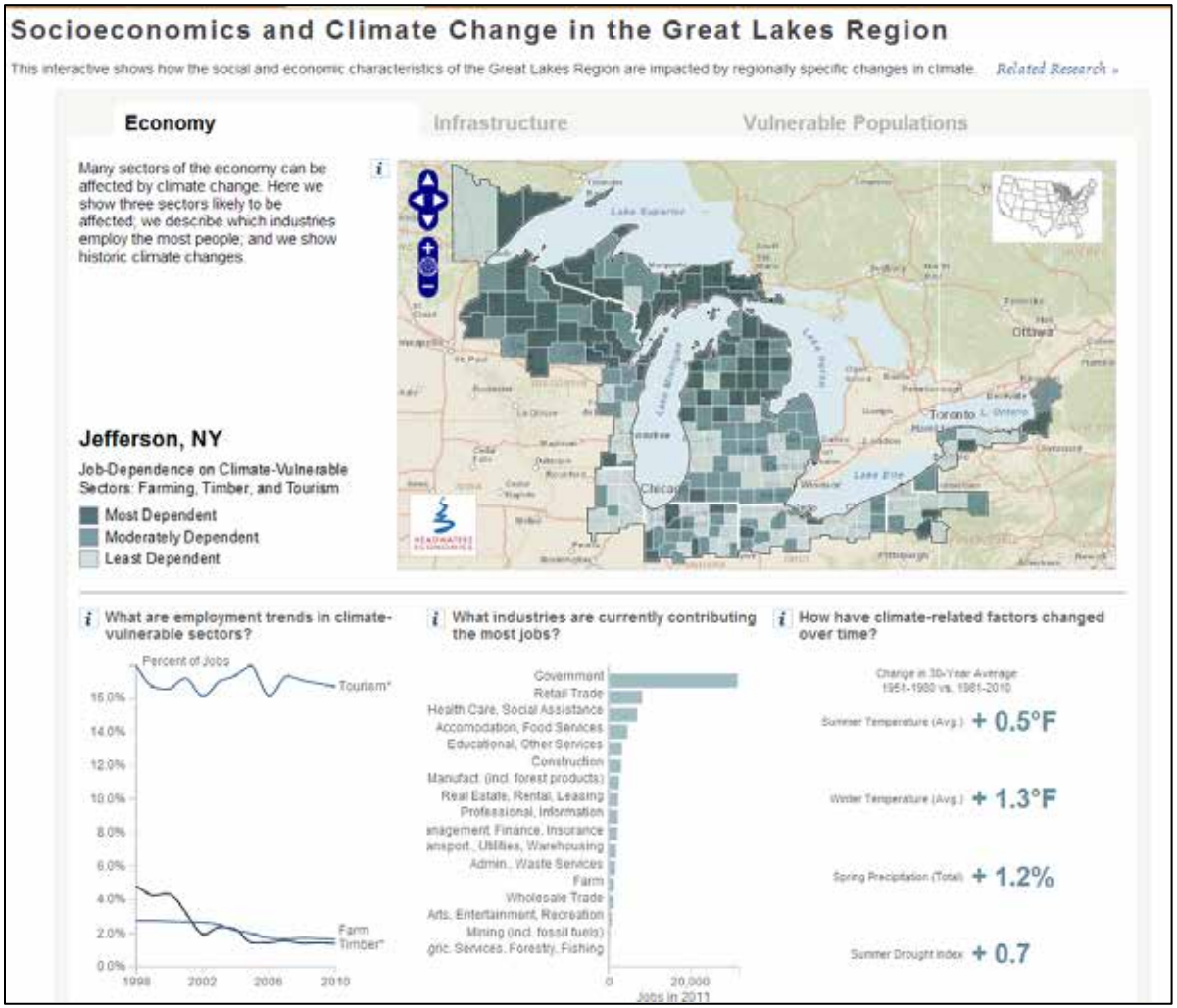


Climate Station : FLINT BISHOP INTL AP MI W00014826

Average Temp 1951 – 1980: 46.89 degrees F
Average Precip 1951 – 1980: 31.36 inches
High Temp 1981 – 2010: 57.56 degrees F
Low Temp 1981 – 2010: 38.23 degrees F
Spring Precip 1981 – 2010: 8.33 inches
Winter Precip 1981 – 2010: 5.1 inches
Days per yr > 90 degrees F 1981-2010: 6.133
Days per yr > 1 in precip 1981-2010:4.867

Decision Support Tools –

Great Lakes Climate Atlas

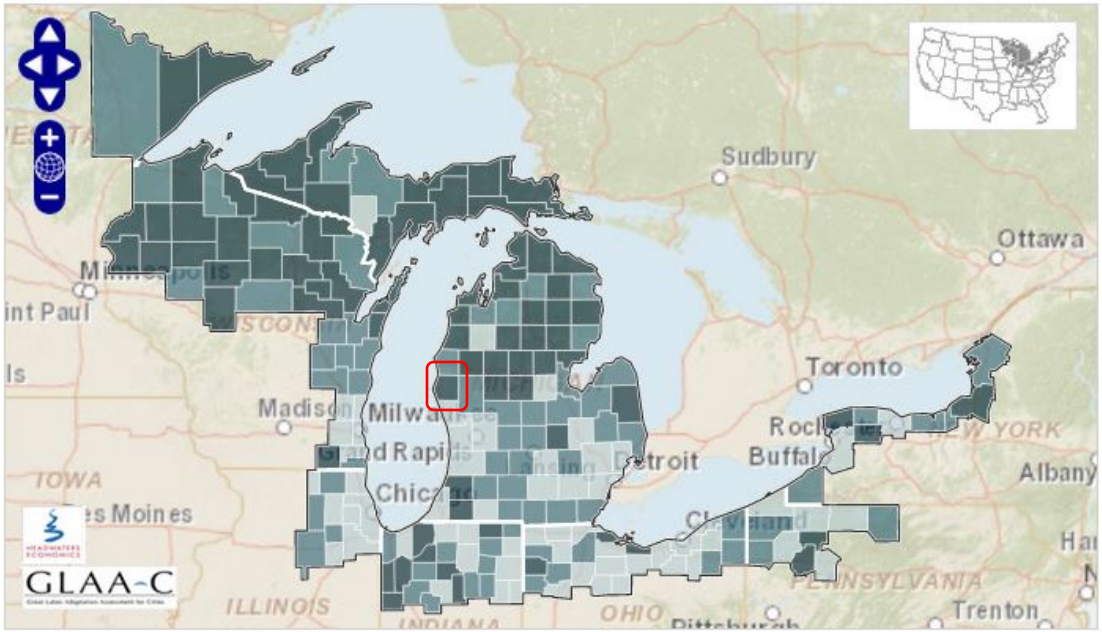


County-level information:

- Economics
- Infrastructure
- Demographics
- Vulnerability

Economy | Infrastructure | Vulnerable Populations

Many sectors of the economy can be affected by climate change. Here we show three sectors likely to be affected; we describe which industries employ the most people; and we show historic climate changes.

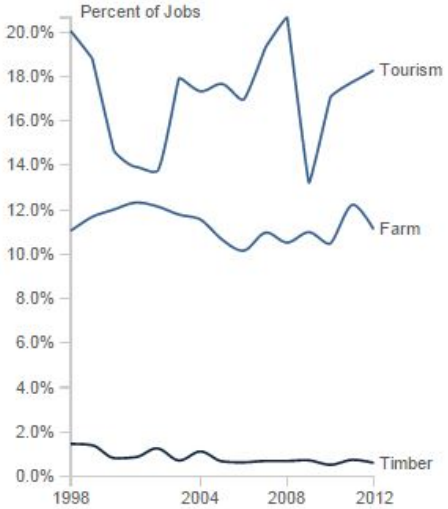


Oceana, MI

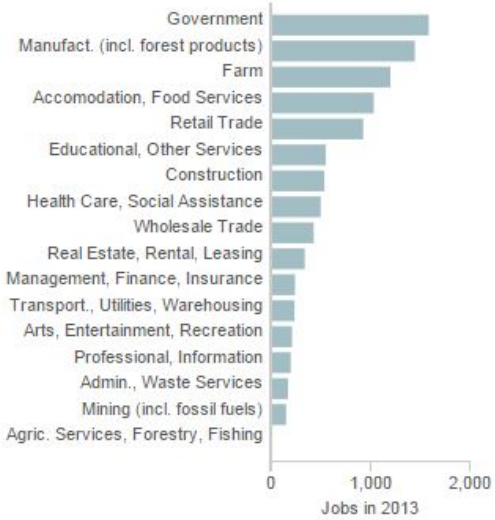
Job-Dependence on Climate-Vulnerable Sectors: Farming, Timber, and Tourism

- Most Dependent
- Moderately Dependent
- Least Dependent

What are employment trends in climate-vulnerable sectors?



What industries are currently contributing the most jobs?



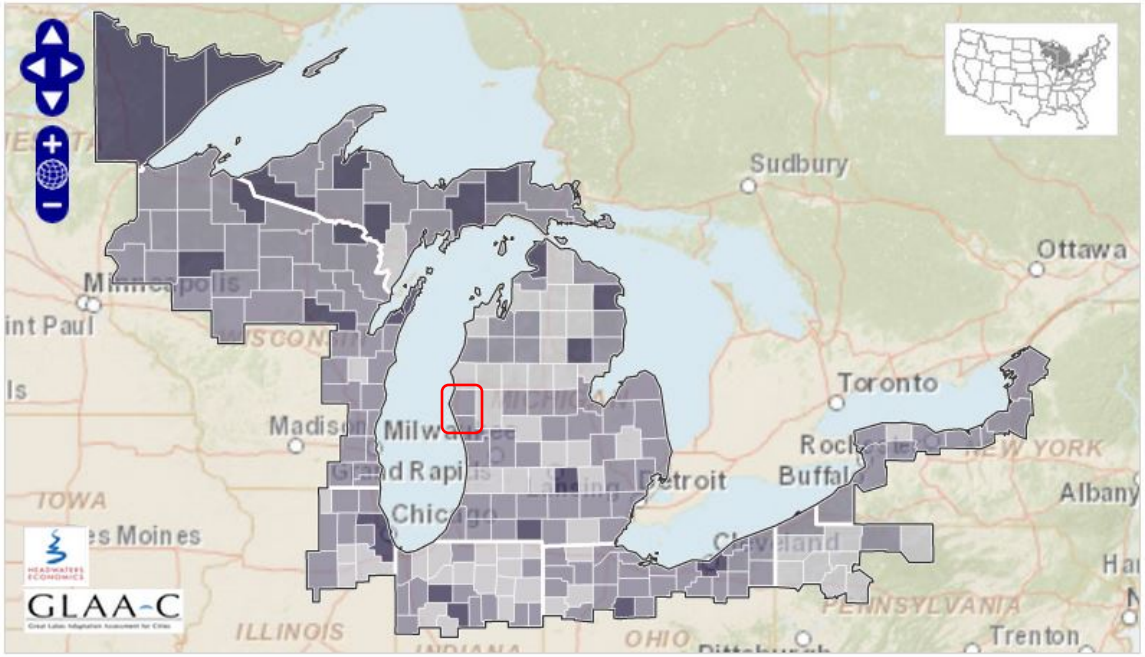
How have climate-related factors changed over time?

Change in 30-Year Average
1951-1980 vs. 1981-2010

Summer Temperature (Avg.)	+ 0.4°F
Winter Temperature (Avg.)	+ 2.3°F
Spring Precipitation (Total)	+ 5.6%
Summer Drought Index	+ 0.5

Economy | **Infrastructure** | Vulnerable Populations

Climate change has the potential to affect government finances. Expenditures on potential climate related infrastructure are shown, along with land cover and residential growth.

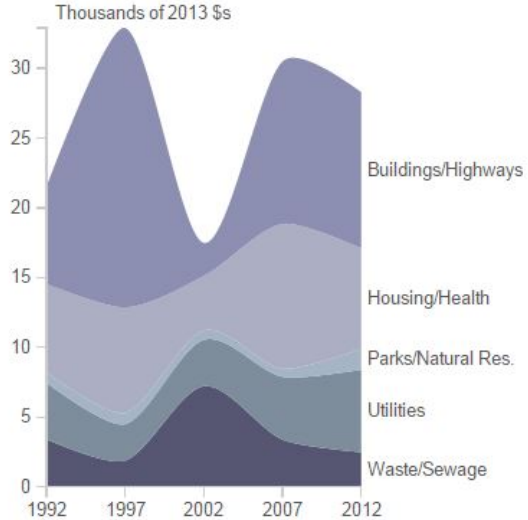


Oceana, MI

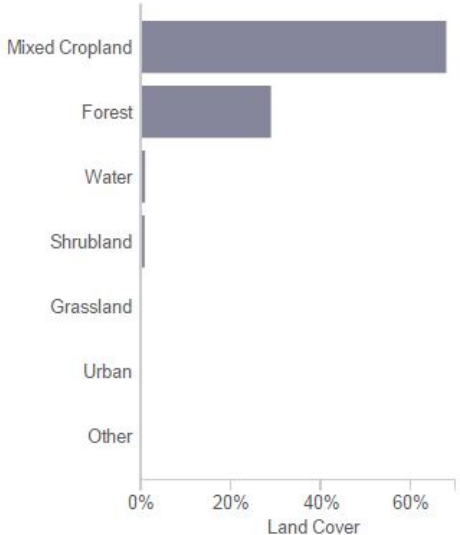
Infrastructure Spending by Local Government (per capita)

- $2.50 - $6.66
- $1.00 - $2.49
- $0.26 - $0.99

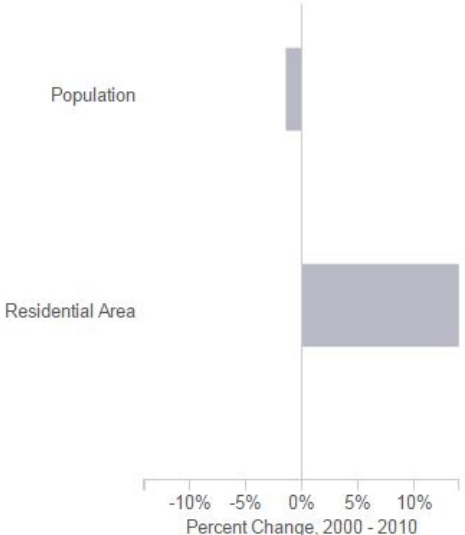
What are trends in infrastructure spending by local government?



What is the breakdown of land cover?

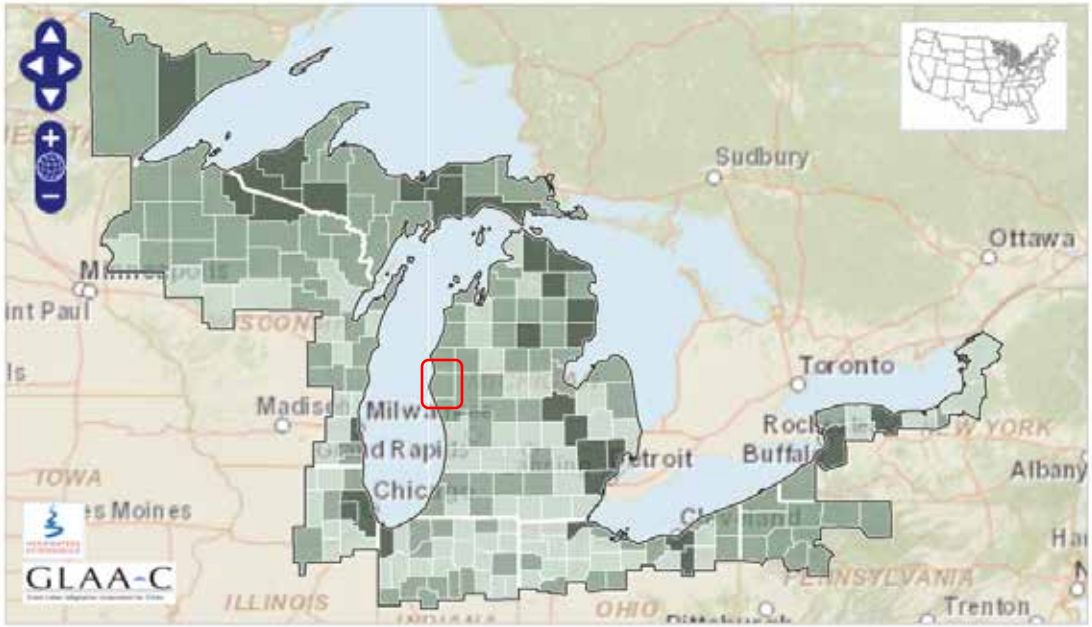


How has population and residential development changed?



Economy | Infrastructure | **Vulnerable Populations**

Some populations may be disproportionately affected by climate change, in particular through increasing heat. Here we show an index of heat vulnerability and changes in summer temperature.

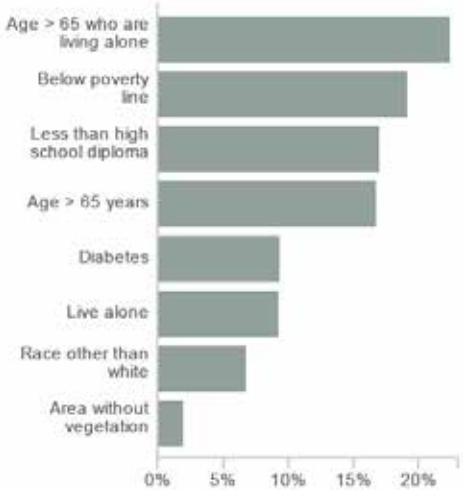


Oceana, MI

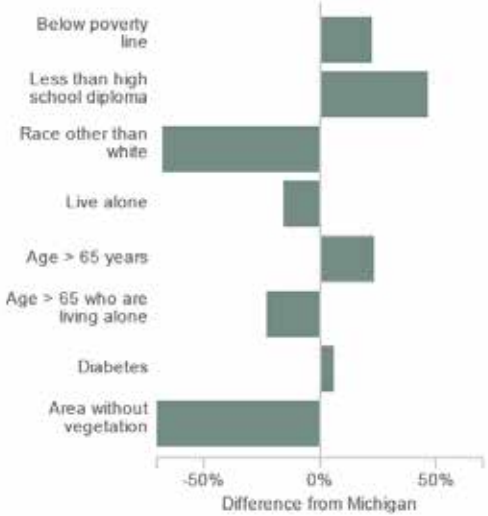
Heat Vulnerability Index

- Most Vulnerable
- Moderately Vulnerable
- Least Vulnerable

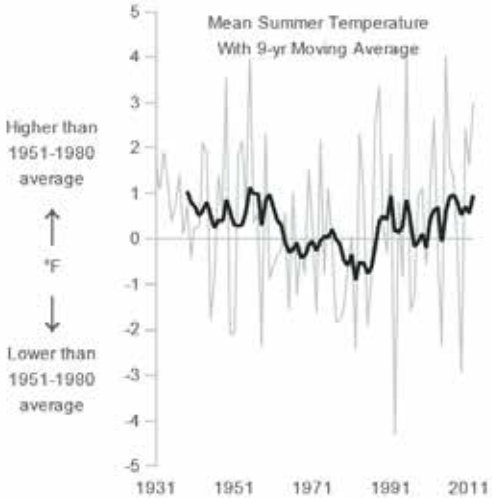
What are county characteristics that affect heat vulnerability ?



How do these county characteristics differ from their respective state"s?



How have summer temperatures changed over time?



Thank You!

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