Impacts of Climate Change on Tourism and Parks in the Midwest
(and what to do about it!)

Melissa Widhalm
Operations Manager

PURDUE CLIMATE CHANGE RESEARCH CENTER

Exploring the causes and impacts of climate change, improving predictive models to project future climate conditions, and pursuing novel ideas for mitigation and adaptation.

ESTABLISHED IN 2004
Broad-based support from academic and administrative units at Purdue
INTERDISCIPLINARY
50+ faculty representing 22 departments
NON-PARTISAN
Objective, science-based information
COLLABORATIVE
Partnerships with schools, NGOs, businesses, government agencies, farmers

www.purdue.edu/climate

IN CCIA Reports
Putting global change into local perspective

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@PurdueCCRC

Melissa Widhalm
Operations Manager

Today we will cover:
- Past climate trends
- Future climate projections
- Impacts of climate change on outdoor activities
- Strategies for adapting to change
Human activities are rapidly adding heat-trapping gases to the atmosphere.

For 800,000 years, CO$_2$ had never been above this line... until now.

Global Temperature and Carbon Dioxide

Global Temperature and Carbon Dioxide

Heat-Trapping Gases

It's like adding another blanket when we're already perfectly warm.
Global & Average Temperature

2019 ranked 2\textsuperscript{nd} warmest on record at 1.71 \(^\circ\text{F}\) above average

Weather Vs. Climate

Weather is what happens in a specific place, at a specific time

Climate is the long-term average of weather over many decades

Arctic Sea Ice Extent

1984

2012

U.S. Indicators of Change

Learn more at www.GlobalChange.gov

Indiana has warmed 1.3\(^\circ\text{F}\) over the last 125 years.

Length frost-free season

Fewer cold days

Significantly warmer overnight temperatures

Average temperature trend over the last 125 years

MINNESOTA, 2.5\(^\circ\text{F}\)

MICHIGAN, 2.5\(^\circ\text{F}\)

WISCONSIN, 2.5\(^\circ\text{F}\)

ILLINOIS, 1.3\(^\circ\text{F}\)

IOWA, 1.3\(^\circ\text{F}\)

OHIO, 1.3\(^\circ\text{F}\)

Source: NOAA Climate at a Glance
Linear trend from 1895 - 2019
### Annual precipitation trend over the 125 years

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<table>
<thead>
<tr>
<th>State</th>
<th>Precipitation (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota</td>
<td>4&quot;</td>
</tr>
<tr>
<td>Michigan</td>
<td>5.4&quot;</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>4.5&quot;</td>
</tr>
<tr>
<td>Illinois</td>
<td>5.9&quot;</td>
</tr>
<tr>
<td>Iowa</td>
<td>5.8&quot;</td>
</tr>
<tr>
<td>Ohio</td>
<td>3.9&quot;</td>
</tr>
</tbody>
</table>

Source: NOAA Climate at a Glance
Linear trend from 1895 - 2019

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### Heavy rainfall is more intense & happening more often.

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- **42%** increase in the amount of rain falling in heavy downpours

Source: NOAA Climate at a Glance
Linear trend from 1895 - 2019

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### Streamflows are increasing

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Source: National Climate Assessment, 2014

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### Trends in Flood Magnitude

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Source: National Climate Assessment, 2014

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### It’s happening now...

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Climate change is projected to continue and intensify.

...it’s hurting The Heartland
Today we will cover

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National Level Resources

2018
2017
2014

Federally mandated, contributions from over 300 federal and non-federal experts, reviewed by external experts and the public, relies on robust published scientific data.

State Level Resources

- State climate assessments (Indiana, Wisconsin)
- State climate offices (mostly for historical data)
- State level summaries developed by NCA
- University Extension

Tourism & Recreation

Climate change will directly and indirectly impact the timing, enjoyment & safety of outdoor activities, affecting visitors and the businesses / communities serving the tourism and recreation industry.

Midwest will get warmer

4°F to 5°F of warming expected by mid-century.

- Warming expected in ALL seasons
- Longer frost-free season
- More frequent and intense extreme heat

Source: National Climate Assessment, 2018

Indiana will get warmer

5°F to 6°F of warming expected by mid-century.

- Warming expected in ALL seasons
- Longer frost-free season
- More frequent and intense extreme heat
Indiana will lose best weather days

<table>
<thead>
<tr>
<th></th>
<th>Past</th>
<th>2050s</th>
<th>2080s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cool (≤ 65°F)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild days lost</td>
<td>21</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Hot/Extreme days gained</td>
<td>43</td>
<td>53</td>
<td>82</td>
</tr>
</tbody>
</table>

MONTHLY DATA

More extreme heat, shift timing of seasons

Summer heat rises, lasts longer
Shoulders push out

More extreme heat, shift timing of seasons

More extreme heat, shift timing of seasons

More extreme heat, shift timing of seasons

Mild days decline, shoulder seasons shift – comfortable days from May to Sept are replaced with hot/extremely hot days. Months with predominantly mild weather will start earlier and end later in the year.

Summer heat on the rise, lasting longer – extremely hot days dominate summer months by end of century. Hot weather days in spring and fall increase.

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**Lowest Temperature of the Year**

**MIDWEST**

Average coldest day in the future (2036-2065)

9°F warmer than the average coldest day in the past (1976-2005).

Source: National Climate Assessment, 2018

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**Indiana will get wetter**

Annual precipitation has increased 6.5” over the last century.

6% to 8% increase in annual rainfall is projected by mid-century.

**Some seasons will be wetter**

- WINTER: 16 to 20% increase by mid-century
- SPRING: 13 to 16% increase by mid-century

- More falling as rain, not snow
- Increased risk of flooding
- Stress on transportation infrastructure (roads, bridges, trails, access lanes, etc.)

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**Some seasons will be drier**

- **Summer & fall** show slight declines by mid-century, with less certainty in the projections

- Increased water demand from added heat
- Reduced plant available water
- Water use conflicts

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Projected changes for mid-century, high emissions pathway

Source: National Climate Assessment, 2014
Winter weather impacts in a changing climate, implications for tourism

Chin, N. et al., 2018, Journal of Hydrology

Fewer number of days per year suitable for...
- Downhill skiing
- Snowmobiling
- Making artificial snow

More Rain
Less snow
Less ice

Warmer & wetter winters

Indiana Tourism and Recreation Report
- Water-based recreation
- Land-based activities
- Agritourism
- Sports and events
- Winter activities

www.IndianaClimate.org
Health Threats for Hoosiers

- More heat-related injuries & death
- Reduced air quality from ozone
- Longer, more intense allergy season
- More vector-borne disease pests
- Algal blooms & toxic algae
- Increase in flood-related injuries & disease

Infrastructure

Water Quality

Flood Control

Combined effects of changing T & P
Hypoxia (low oxygen) in Aquatic Systems

Cisco declines

Climate change likely to exacerbate decline of cisco

Increased air temperatures +
More spring phosphorous runoff =
Warmer surface temperatures &
More severe hypoxia for longer duration
Our forests will look & function differently

- Changing habitat suitability
- Shift in species abundance
- Shift in biological timing
- More/new types of invasive species
- Consequences for wildlife
- Consequences for recreation

Shift in habitat suitability

**Increased suitability**
- American elm
- Black walnut*
- Eastern redbud
- Hackberry
- Silver maple
- White ash*
- Yellow poplar*

**Decreased suitability**
- American beech
- Black cherry
- Flowering dogwood
- Northern red oak*
- Sassafras
- Shagbark hickory*
- White oak*

**New habitat**
- Black hickory
- Blackjack oak
- Cedar elm
- Lobolly pine
- Pecan
- Sweetgum
- Water oak

Red = Consequential for bats
Blue = Consequential for woodrats, mice, deer
* Important timber species
+ Declining due to emerald ash borer

Data for northern Indiana, high-emissions scenario, year 2100

Impact Recap

The Midwest is getting warmer and wetter

**Extreme heat & heavy rainfall** will challenge us

Seasonal changes are critical to managing risks

Impacts are far-reaching, affecting all of us

Where we end up depends on the choices we make

Today we will cover

- Past climate trends
- Future climate projections
- Impacts of climate change on outdoor activities
- Strategies for adapting to change

Climate change will hit us where we’re already vulnerable.

U.S. Forest Service
Northern Institute of Applied Climate Science

Provide training and technical assistance to natural resource professionals and landowners to support climate-informed land management. Examples of their work include:

- Providing resources and on climate change impacts to recreation and adaptation responses
- Creating tools to support the adaptation of forests to climate change, while also considering recreation
- Develop real-world examples of how climate-informed management of forests can achieve goals related to the management of recreation areas

https://forestadaptation.org/focus/recreation
**Menu of Adaptation Strategies for Recreation**

**Methods and Objectives:**
- All lands approach – public and private, wherever people recreate.
- Continental U.S. scope.
- Literature review of academic journals, state action plans, handbooks, case studies, and other grey literature.
- Interviews of 28 recreation professionals, researchers, academics, and climate change scientists.
- Focus on those aspects most relevant to natural resource management.
- The menu is designed for recreation professionals and land managers to inform planning.

**Strategy 1: Protect and sustain key infrastructure**
- 1.1 Stabilize shorelines to reinforce vulnerable infrastructure
- 1.2 Maintain and improve infrastructure using materials that can withstand a range of climate stressors
- 1.3 Maintain and improve infrastructure using designs that reduce impacts from variable water levels
- 1.4 Employ technological innovations to maintain the viability of developed winter recreation areas
- 1.5 Employ protective measures to minimize damage from disturbance events

**Strategy 2: Enhance measures to prevent ecological damage from variable precipitation**
- 2.1 Maintain and increase the capacity of stormwater infrastructure to accommodate variable precipitation
- 2.2 Enhance the capacity of natural systems to accommodate variable precipitation
- 2.3 Minimize impacts of existing roads and trails that are compromised by changing conditions

**Strategy 3: Manage impacts from shifting visitation and use trends**
- 3.1 Redirect visitor access away from at-risk areas
- 3.2 Optimize timing of opportunities to align with changing conditions
- 3.3 Provide alternative means of access

**Strategy 4: Account for and communicate risks to health and safety**
- 4.1 Train employees to be aware of climate-induced risks to public safety
- 4.2 Prevent or minimize hazards from wildland fire and smoke
- 4.3 Prevent or minimize hazards from extreme heat events
- 4.4 Improve public awareness regarding climate change and climate-induced risks
- 4.5 Communicate the reality of environmental change
Strategy 5: Manage recreational opportunities to address impacts of expected conditions

- 5.1 Recondition campgrounds and infrastructure located in vulnerable areas
- 5.2 Use appropriate vegetation to increase resilience of recreation settings to climate-related stressors
- 5.3 Alter infrastructure to better capture and use natural and man-made snow
- 5.4 Employ snow-based options that are functional in low-snow conditions

Strategy 6: Alter recreational opportunities to accommodate expected conditions

- 6.1 Focus on four-season and non-skiing recreation at winter sports areas
- 6.2 Relocate existing infrastructure and opportunities to areas with less risk of climate-induced damage
- 6.3 Integrate long-term siting and climate considerations into recreation management
- 6.4 Use materials and designs that are impermanent
- 6.5 Remove or decommission vulnerable infrastructure

Download the full report

Climate Change Adaptation Strategies and Approaches for Outdoor Recreation
By: Daniel O’Toole and co-authors from the USDA Forest Service

https://www.mdpi.com/2071-1050/11/24/7030

What can I do? #INCCIA

Talk about it

DID YOU KNOW...
only 52% of Hoosiers are worried about climate change
and just 35% think climate change will harm them personally
2018 Yale Climate Opinion Poll

What can I do? #INCCIA

Talk about it

31% of Hoosiers discuss climate change at least occasionally
2018 Yale Climate Opinion Poll

85% say they feel comfortable discussing climate change with friends or family
2019 IU ERI Poll

What can I do? #INCCIA

Talk about it

People who talk about climate change are more concerned about risks and have greater support for action.
Yale Program on Climate Change Communication, 2019
Supporting Climate Conversations for Hoosiers

Online Resources
Community Events
Media Briefs

Personal stories
Communication tips
Credible science

Stay informed, stay connected

http://IndianaClimate.org

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Biological events (fall colors, spring blooms, insect emergence)

Habitat suitability for invasive species

Bird migration