Why Care About Climate Change?

"Everybody talks about the weather, but nobody does anything about it."
—Mark Twain, 1897

Climate regulates life on the planet.
Climate determines how we live.

Photo credits: michigan.org, MSU, Daniel Brown, Wikipedia.org, ahajokes.com
Observed and Projected Global Temperature

NASA, based on IPCC

Emission scenarios:
- high growth (A2)
- moderate growth (A1B)
- low growth (B1)
- constant CO₂

Variability between models

3.2°F
6.5°F
Global Trends and Regional Trends

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.
Observed Southwest Ohio Temperature Changes in Mean Temperature (°F) from 1951-1980 to 1981-2010

Annual 0.2
Winter 0.8
Spring 0.1
Summer -0.01
Fall 0.02
Observed Dayton Temperature

Changes in Mean Temperature (°F) from 1951-1980 to 1981-2010

<table>
<thead>
<tr>
<th>Season</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual</td>
<td>0.2</td>
</tr>
<tr>
<td>Winter</td>
<td>0.9</td>
</tr>
<tr>
<td>Spring</td>
<td>0.4</td>
</tr>
<tr>
<td>Summer</td>
<td>-0.2</td>
</tr>
<tr>
<td>Fall</td>
<td>-0.05</td>
</tr>
</tbody>
</table>
Longer Midwestern Growing Season

Growing season longer by ~1-2 weeks
Earlier last winter frost in spring
Date of first winter frost is often unchanged

Based on data from the National Climatic Data Center for the cooperative observer network and updated from Kunkel et al. (2004)
Observed Dayton Growing Season and Freezing Days

Number of Freeze-thaw Cycles

Length of Growing Season

Days with Low Temp. < 32°F
Observed Hot Days

Dayton Downtown
Days with High Temp. > 90°F

Dayton Airport
Days with High Temp. > 90°F

<table>
<thead>
<tr>
<th>Very Hot, Humid Days</th>
<th>Hot, Dry Days</th>
<th>Cool, Dry Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased^ 208% 2 Days</td>
<td>Decreased 45% 2 Days</td>
<td>Decreased 26% 2 Days</td>
</tr>
</tbody>
</table>

GLISA
Projected Midwest Temperature

Winter, December - February 2070-2099

High Emissions Scenario

~8°F

Low Emissions Scenario

~4°F

Summer, June - August

~12°F

~6°F

Modified from Hayhoe et al, 2010
Projected Increase in Hot Days

2041-2070

Increase in Days > 95°F

Increase in Consecutive Days > 95°F

Kunkel (2011)
Projected Increase in Hot Days

Days per year over 90°F

- **Cincinnati**
  - Days over 100°F:
    - 1961-1990: <2
    - 2070-2099: 29

<table>
<thead>
<tr>
<th>Period</th>
<th>Lower emissions</th>
<th>Higher emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1961-1990</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>2010-2039</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>2040-2069</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>2070-2099</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>
By the end of the century, Ohio summers may feel like those of current-day Arkansas.
Southwest Ohio Precipitation

Changes in Total Precipitation (%) from 1951-1980 to 1981-2010

- Annual: 5.7
- Winter: 2.8
- Spring: 10.5
- Summer: -0.4
- Fall: 9.7
Observed Dayton Precipitation

<table>
<thead>
<tr>
<th>Season</th>
<th>Change in Total Precipitation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual</td>
<td>17.4</td>
</tr>
<tr>
<td>Winter</td>
<td>5.9</td>
</tr>
<tr>
<td>Spring</td>
<td>8.3</td>
</tr>
<tr>
<td>Summer</td>
<td>2.4</td>
</tr>
<tr>
<td>Fall</td>
<td>15.6</td>
</tr>
</tbody>
</table>
The Intensity of the heaviest 1% of precipitation events increased by 31% in the Midwest from 1958 to 2007.
Observed Dayton Extreme Precipitation

Days with Precipitation > 99th Percentile

10-yr Total
Observed Dayton Extreme Precipitation

99th Percentile Storm Magnitude

Number of Storms Exceeding the 1951-1980 99th Percentile

19% increase in storm intensity
88% increase in storm frequency
Projected Precipitation

2041-2070 vs. 1971-2000

Winter
+10 to 20%

Spring
+5 to 10%

Summer
-5 to 0%

Fall
-5 to +5%

Annual
+5 to 15%

Kunkel (2011)
Total Confirmed Tornadoes in the U.S.

January–December Number of Tornadoes (1950–2012)
EF-1+ Tornadoes in the U.S.

U.S. Annual Count of EF-1+ Tornadoes, 1954 through 2012

Data Source: NOAA/NWS Storm Prediction Center
Observed Southwest Ohio Drought Index

Summer Palmer Drought Index

- 3-year Average
- 9-year Average

Summer PDSI

1940 1960 1980 2000

GLISA
Snowfall has generally increased across the Northern Midwest, remained stable in the central latitudes, and has decreased in the southern areas.
Projected changes in the frequency or severity of winter precipitation types are very uncertain.

- More precipitation may fall as rain or freezing rain instead of snow.
- Reduced snow accumulation with warmer surface temperatures.
Projected Shifts in Forest Types

USGCRP (2009)
Key Climate Changes for Dayton

• Warmer winter temperatures

• Shorter winters

• More severe precipitation events
Key Potential Impacts

- **Public Health**
  - Increased heat wave intensity and frequency
  - Degraded air quality
  - Reduced water quality
  - Changing ecology, new pests, disease

- **Infrastructure Damage**
  - Stormwater management challenges with increased extreme precipitation and flooding
  - Potential changes in the number of freeze-thaw cycles
  - Potential changes in the form of winter precipitation
Questions?