



Temperature

Historical Trends, Future
Changes, & Potential
Impacts

Overview

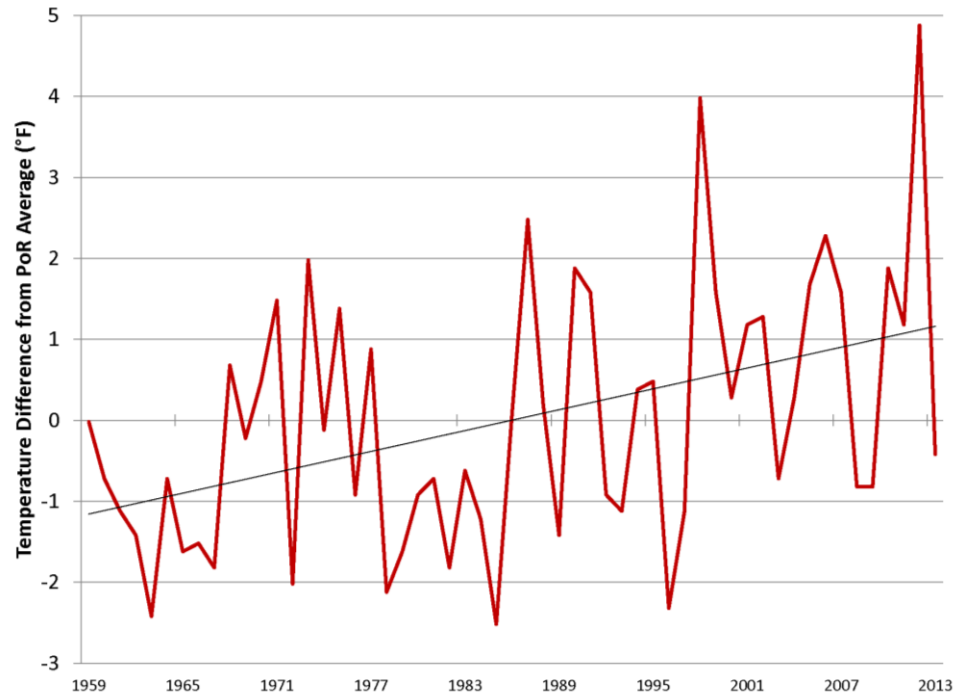
- Historical trends & future projections
 - Annual temperature
 - Extreme temperatures
 - Frost-free season
 - Heating and cooling degree days
- Potential impacts from expected changes



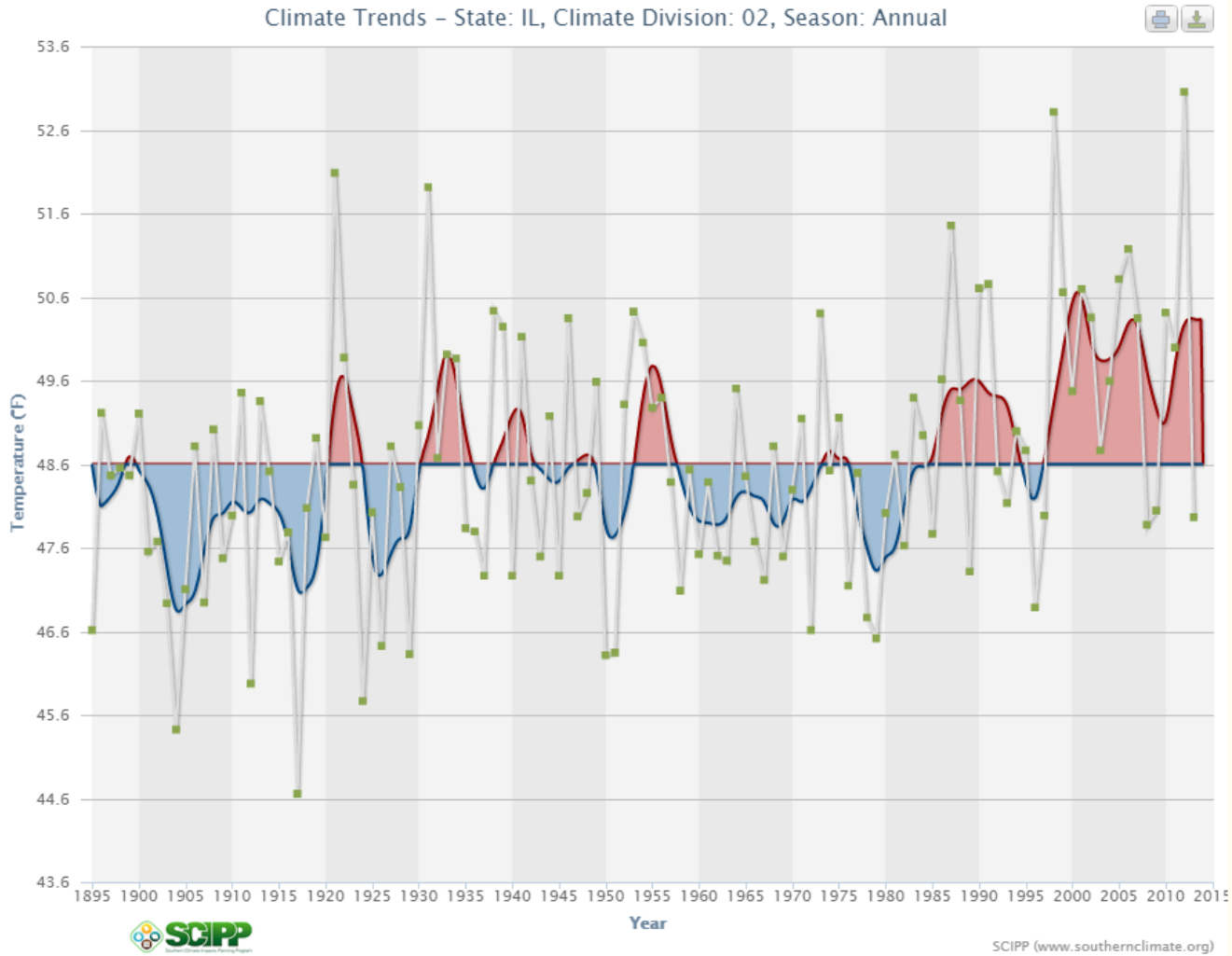
Annual Temperature: Historical

- Warming in the Midwest
 - Average temperature increased by more than 1.5 °F from 1900-2010 (2014 NCA)
- Chicago
 - +2 °F since 1959

Temperature difference from average (red line) for Chicago O'Hare Airport (trend line in black)

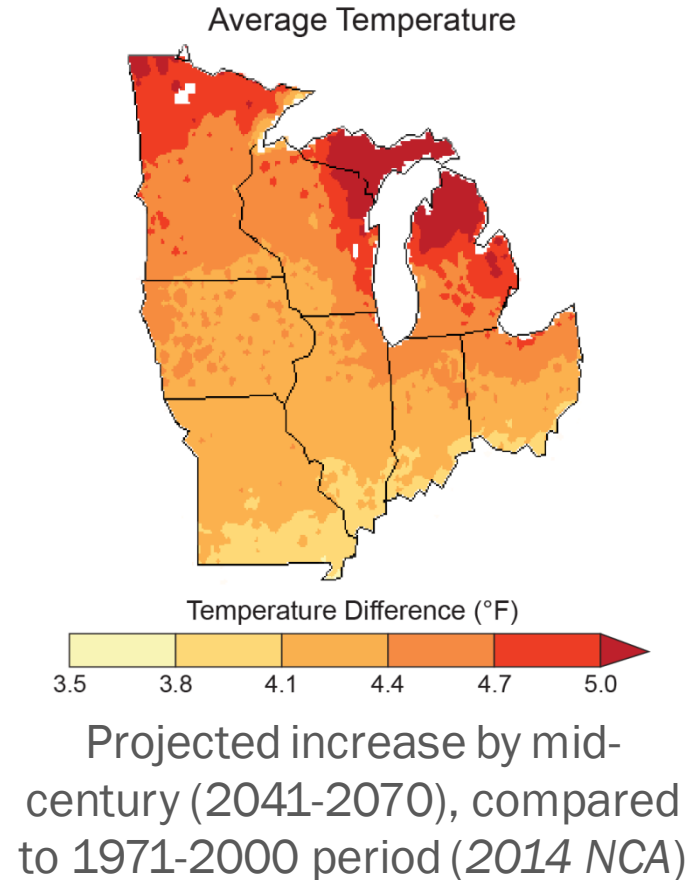


NE Illinois Annual Temperature



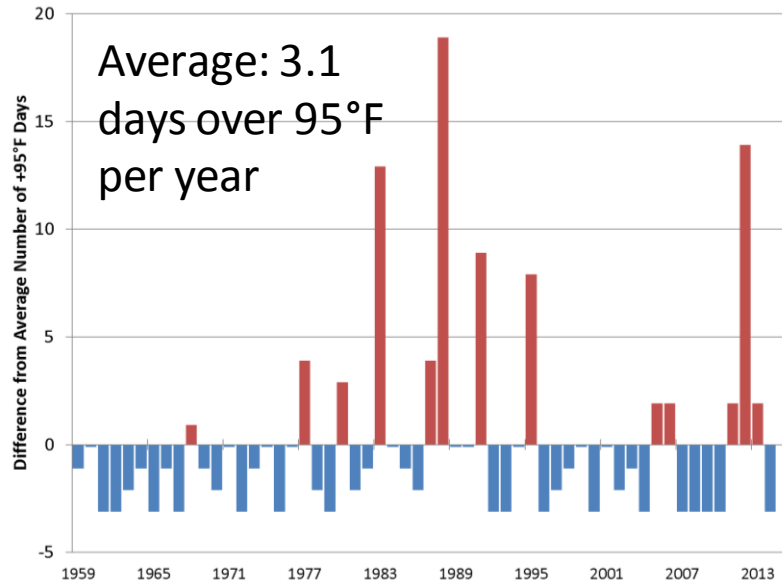
Annual Temperature: Future

- Midwest
 - 3.5 °F to 5 °F warmer by mid-century
- Chicago
 - 4.4 °F to 4.7 °F warmer by mid-century



Extreme Temperature: Hot Days

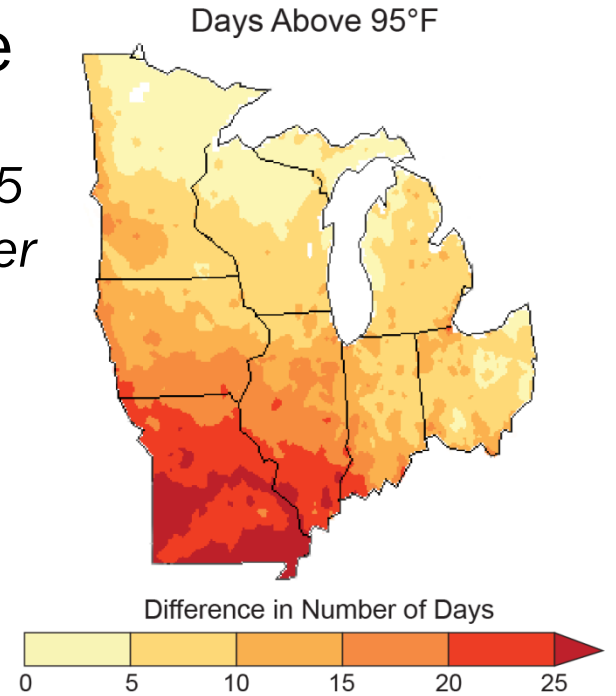
- Historical



Difference from average number of +95°F days for Chicago O'Hare Airport

- Future

+10-15 days per year



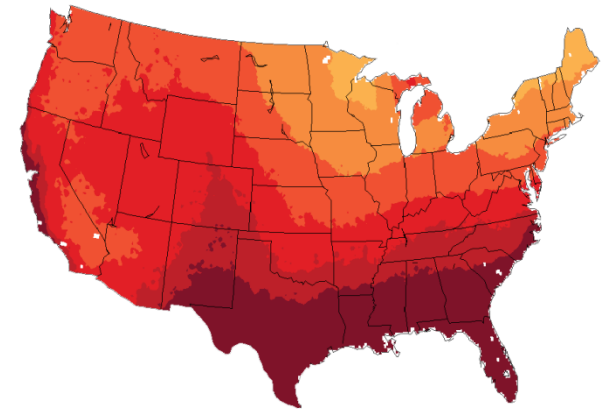
Number of +95°F days per year by mid-century (2041-2070), compared to 1971-2000 (2014 NCA)



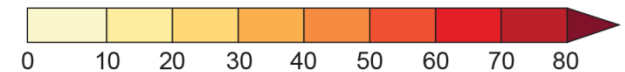
Extreme Temperature: Hot Nights

- Historical
 - Average 13.5 days per year when nighttime temperature stays above 70 °F
- Future
 - Chicago: +30-40 days per year with nighttime temperatures in the top 2%

Change in Number of Hot Nights



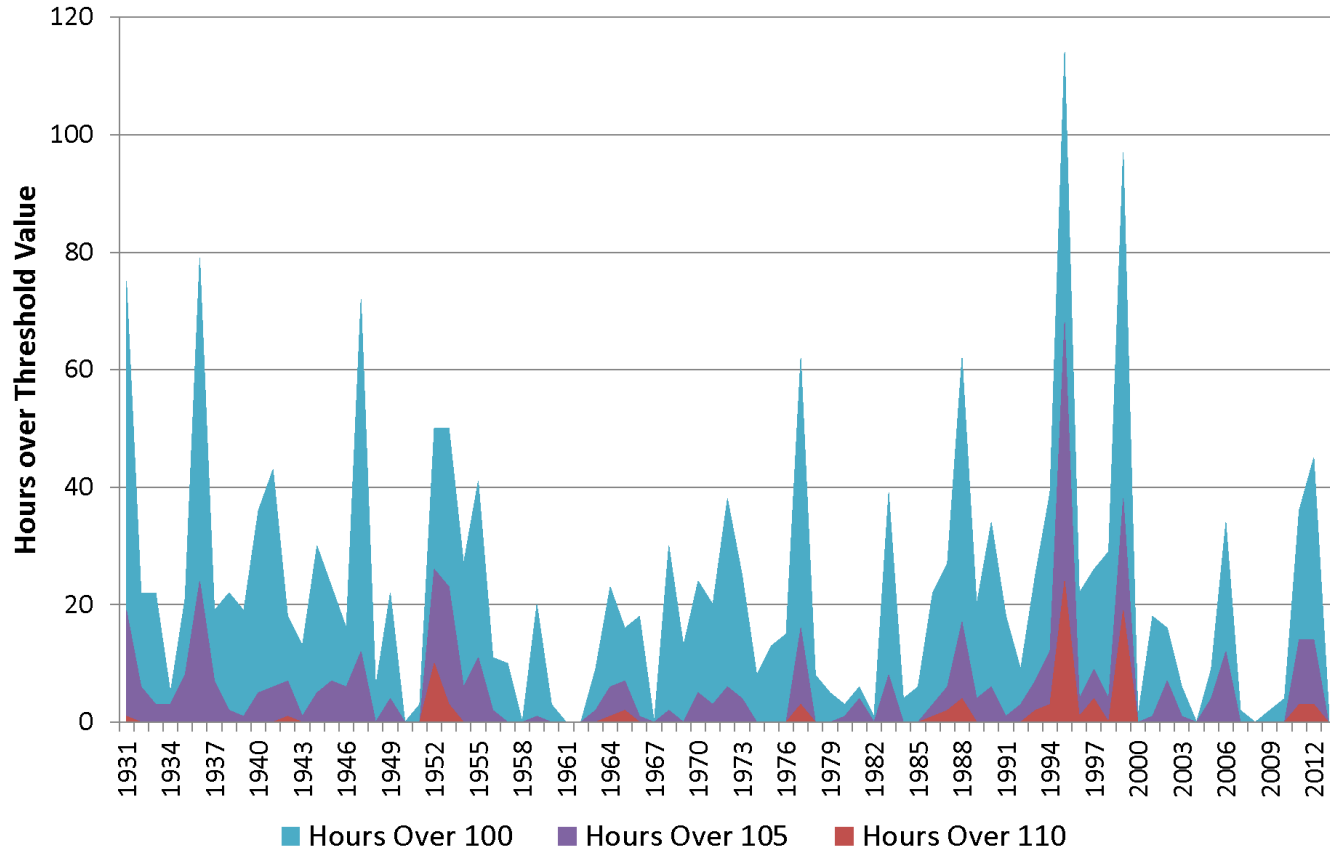
Number of Nights



Change in number of hot nights (top 2% of warm nights) by end of century (2070-2099), compared to 1971-2000 (2014 NCA)



Heat Wave: Historical



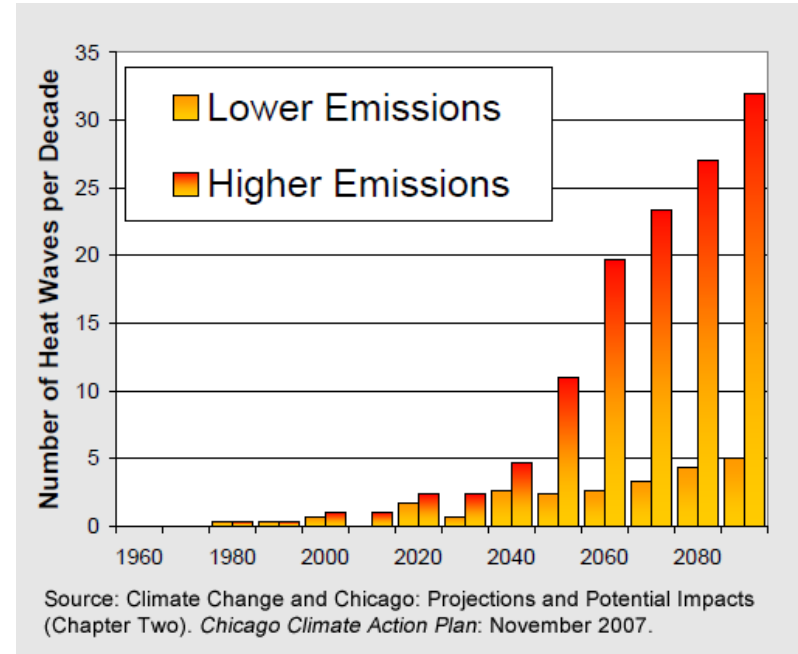
Hours of heat index over threshold values for June – September
(Chicago Midway Airport)



Heat Wave: Future

2014 National Climate Assessment
Key Message 3 for the Midwest

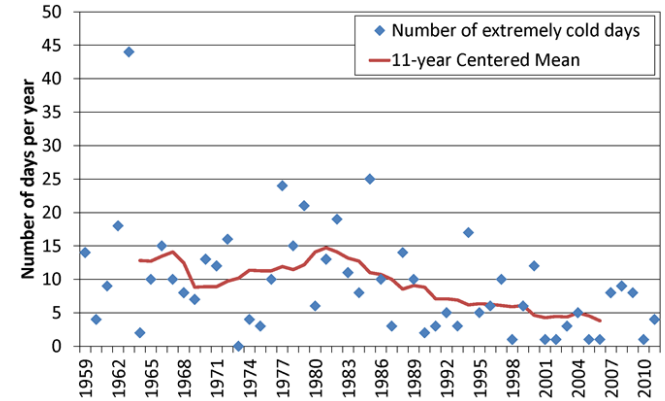
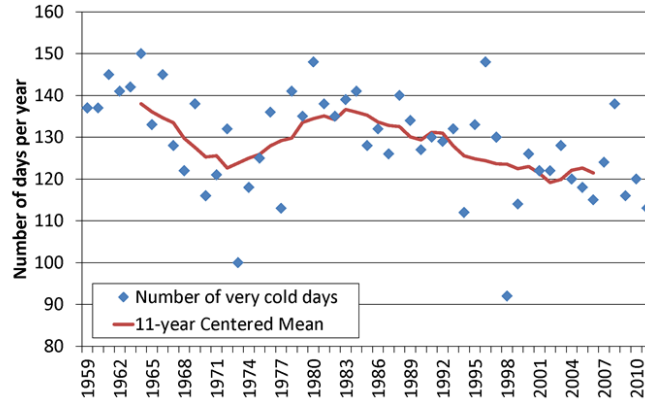
Increased heat wave intensity and frequency, increased humidity, degraded air quality, and reduced water quality will increase public health risks.



- *Chicago heat wave-related mortality*: increase between 166 and 2,217 excess deaths per year by 2081-2100 (Peng et al. 2011)

Extreme Temperature: Cold

- Historical



Very cold days (left) and extreme cold days (right) for Chicago O'Hare.

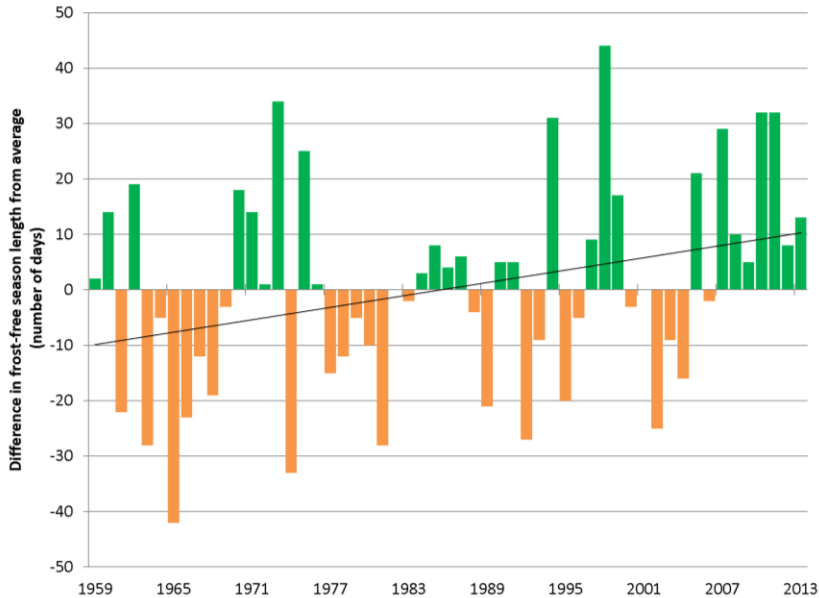
- Future

- Continue to decrease
- Extremely cold days: 50%-90% reduction by end of century



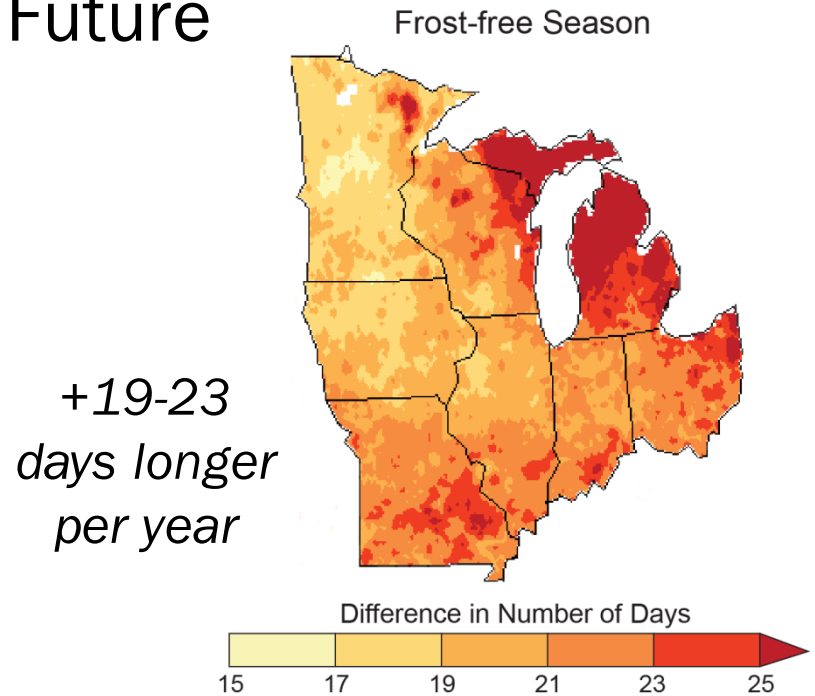
Frost-Free Season

- Historical



Difference in frost-free season length from period of record average for Chicago O'Hare Airport

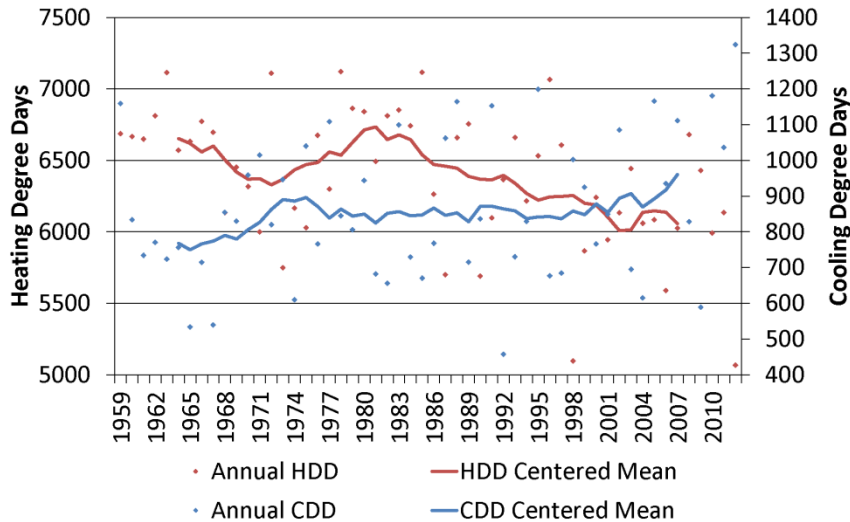
- Future



Length of frost-free season by mid-century (2041-2070), compared to 1971-2000 (2014 NCA)



Heating & Cooling Degree Days: Historical

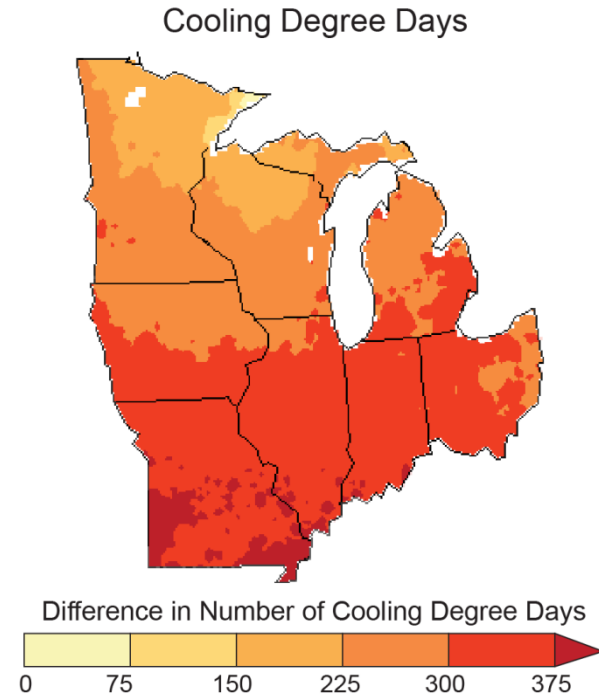


- Highest demand is for winter heating (HDD)
 - Demand for heating typically 5 to 7 times that for cooling
- Already experiencing decrease in HDD and increase in CDD

Heating degree days in red (left axis)
Cooling degree days in blue (right axis)
Chicago O'Hare Airport

Heating and Cooling Degree Days: Future

- ↑ Chicago temperatures
 - 300-375 more CDD per year
- ↑ summer energy demand
 - Increased demand for cooling by mid-century projected to exceed 10 gigawatts



Increase in CDD by mid-century
(2041-2070), compared to 1971-
2000 (2014 NCA)

Potential Cold-Season Impacts

- Decreased energy use in winter
- Reduced risk of cold-related illness and death
- Reduced killing of pests
 - *NCA 2014 Key Message 3: increased vulnerability of Midwest residents to diseases carried by insects and rodents*



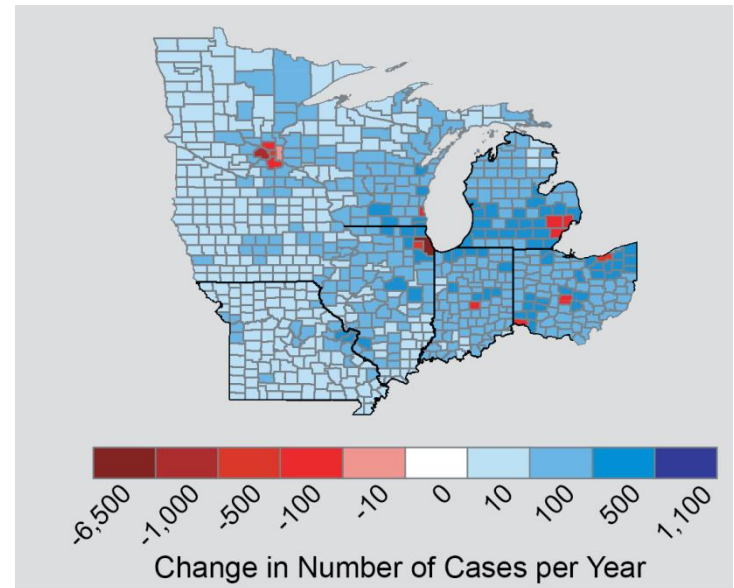
Potential Warm-Season Impacts

- Increased energy use in summer
- Public health issues

2014 National Climate Assessment
Key Message 3 for the Midwest

Public Health

Increased heat wave intensity and frequency, increased humidity, degraded air quality, and reduced water quality will increase public health risks.



Annual change in # of cases with acute respiratory symptoms by eliminating round trips <5 miles (2014 NCA)



Potential Warm-Season Impacts

- Longer growing season

2014 National Climate Assessment
Key Message 1 for the Midwest

Impacts to Agriculture

In the next few decades, longer growing seasons and rising carbon dioxide levels will increase yields of some crops, though those benefits will be progressively offset by extreme weather events.

Though adaptation options can reduce some of the detrimental effects, in the long term, the combined stresses associated with climate change are expected to decrease agricultural productivity.



Other Temperature-Related Impacts

- Increased Great Lakes water temperature
 - Favor production of toxic algae
 - Heighten impact of invasive species
- Decreased Great Lakes ice cover
 - Shores vulnerable to erosion and flooding
 - Could harm property and fish habitat
 - Lengthen the shipping season
 - Increased evaporation, lower lake levels

