Perspectives on Weather and Climate in Kentucky

Stuart A. Foster
State Climatologist for Kentucky
Kentucky Climate Center
Western Kentucky University

Nature's Call to Action II
Kentucky Transportation Cabinet
Frankfort, Kentucky

April 9, 2014

Weather and Climate Matter

- Growing population and a growing economy
- Societal expectations of mobility
- An economic system based on just-in-time shipping
- Intensity of economic competition on a global scale
- The challenge and opportunity of uncertainty

KENTUCKY CLIMATE CENTER

Topics

- Distinguishing between weather and climate
- Physical influences on Kentucky's climate
- Historical climate variability and trends
- Climate projections
- Extremes of weather and climate
- Kentucky's weather and climate monitoring infrastructure
- National Climate Services Partnership

KENTUCKY CLIMATE CENTER

Contrasting Weather and Climate

NASA

The difference between weather and climate is a measure of time. Weather is what conditions of the atmosphere are over a short period of time, and climate is how the atmosphere "behaves" over relatively long periods of time. (http://www.nasa.gov/mission_pages/noaa-n/climate/climate_weather.html)

University Corporation for Atmospheric Research

Weather is the mix of events that happen each day in our atmosphere including temperature, rainfall and humidity. … Climate is the average weather pattern in a place over many years. (http://www.eo.ucar.edu/basics/index.html)

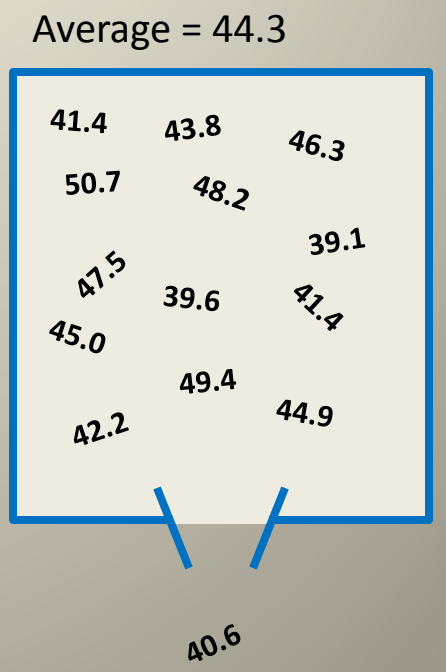
KENTUCKY CLIMATE CENTER

A Statistical Perspective

Climate is what you expect, weather is what you get.

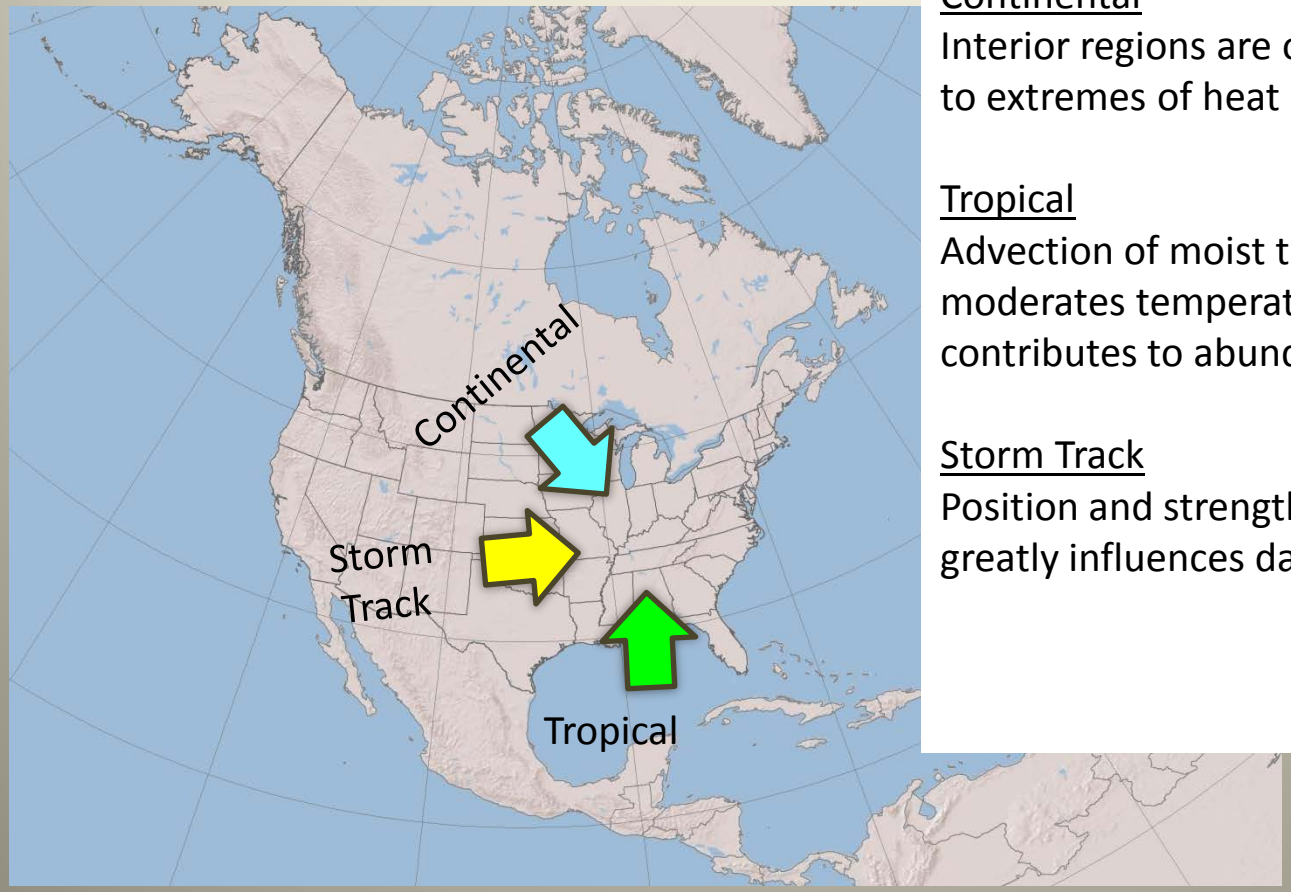
- A simplified definition with a foundation in statistical probability, where *expectation* is associated with *average*.

- A more complete statistical definition would address aspects of the *variability* of possible weather that could be experienced.



KENTUCKY CLIMATE CENTER

Key Climate Influences



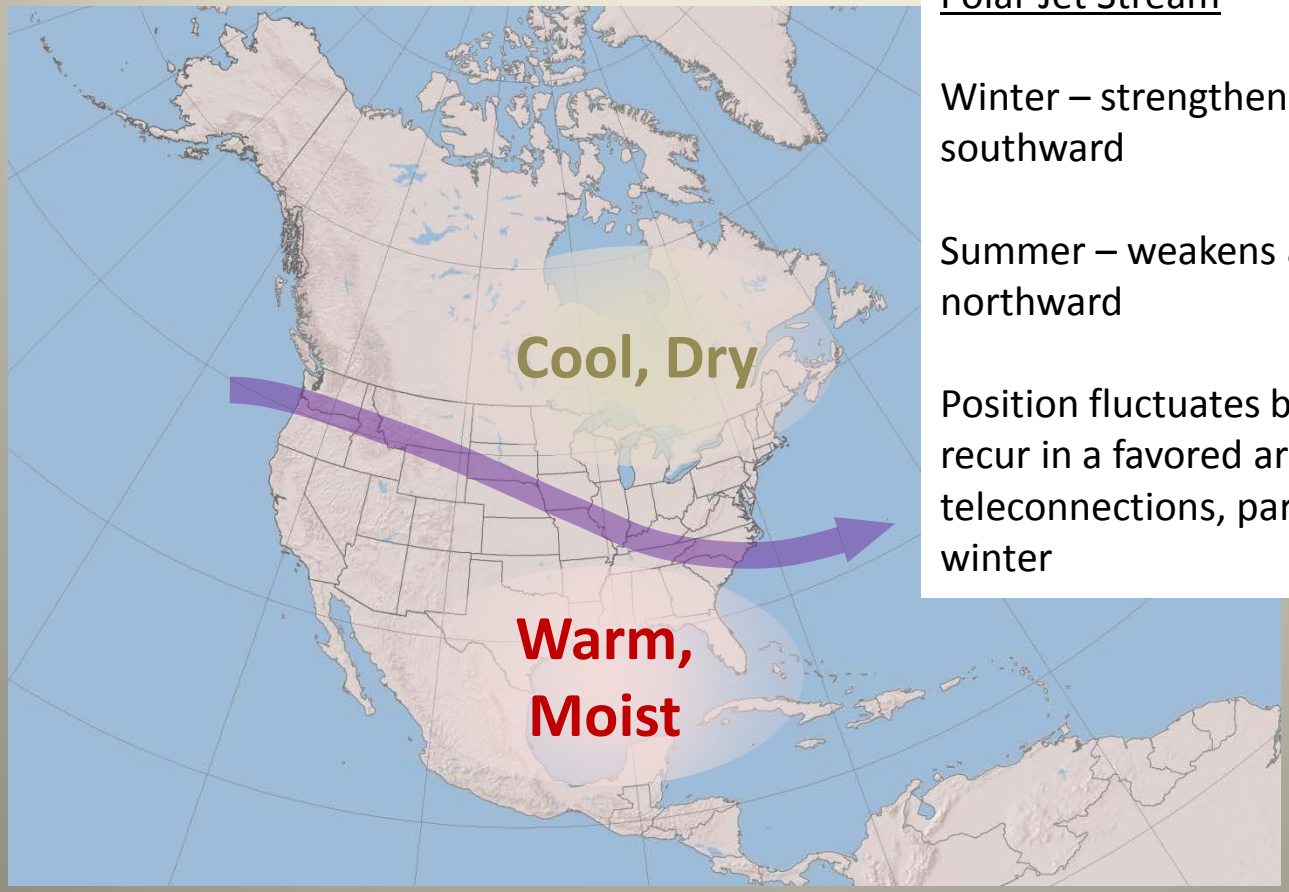
<u>Continental</u>
Interior regions are often dry and prone to extremes of heat and cold

<u>Tropical</u>
Advection of moist tropical air moderates temperature extremes and contributes to abundant precipitation

<u>Storm Track</u>
Position and strength of the jet stream greatly influences day-to-day weather

KENTUCKY CLIMATE CENTER

Polar Jet Stream



Polar Jet Stream

Winter – strengthens and moves southward

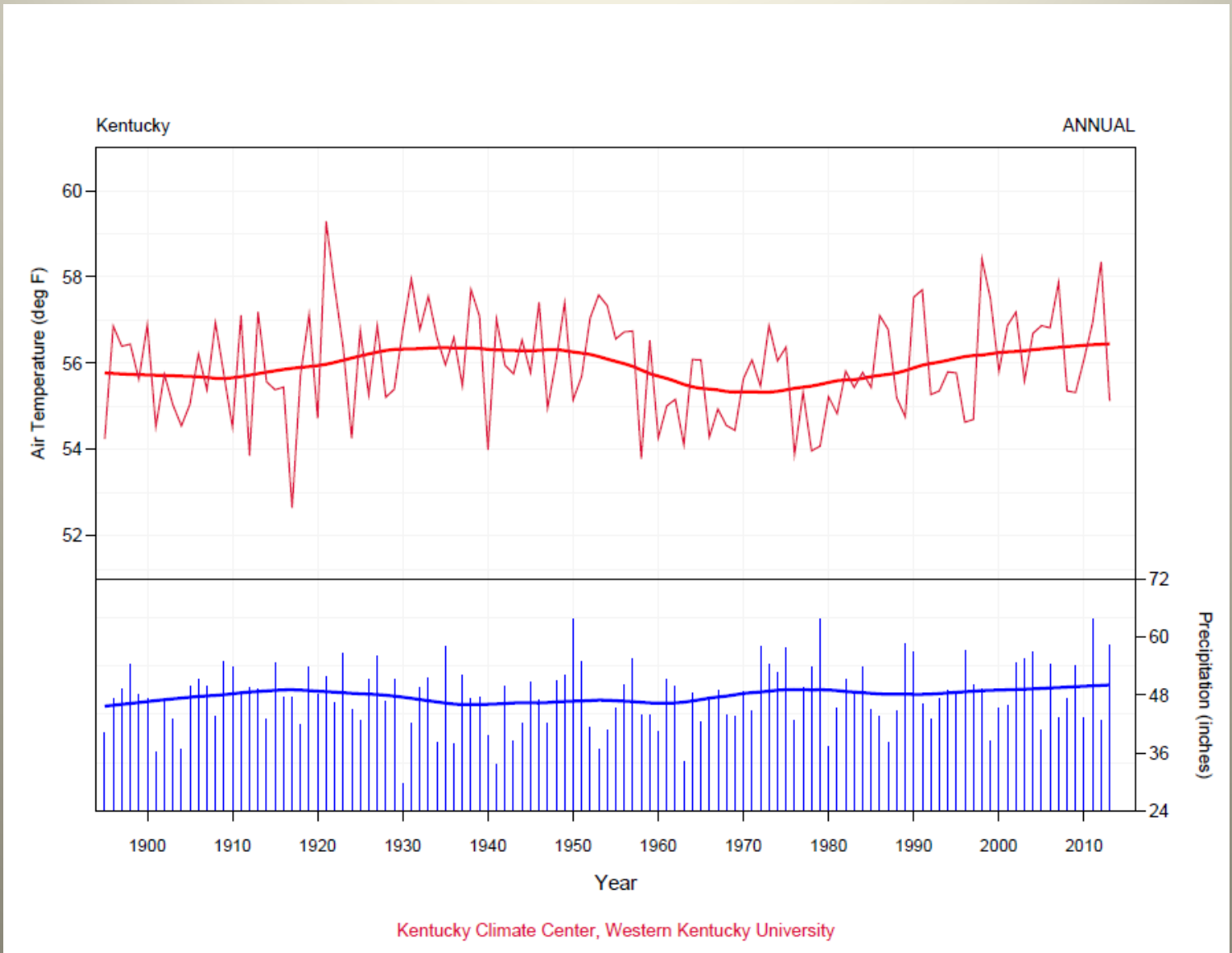
Summer – weakens and moves northward

Position fluctuates but can persist or recur in a favored area due to teleconnections, particularly during winter

KENTUCKY CLIMATE CENTER

Climate Trends in Kentucky

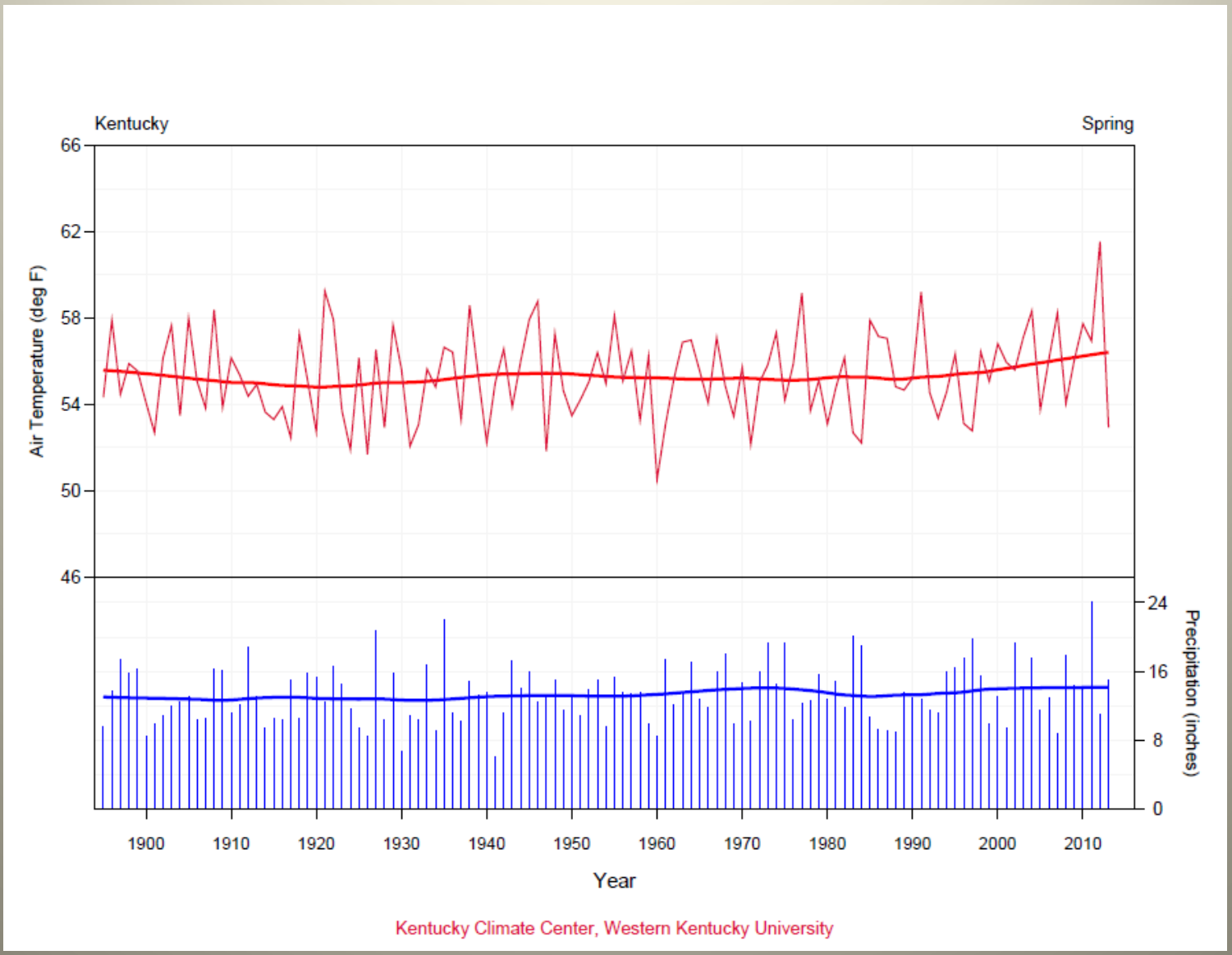
Statewide Average **Annual** Temperature and Precipitation



Graph produced using data retrieved from Midwestern Regional Climate Center's cli-MATE Database

Climate Trends in Kentucky

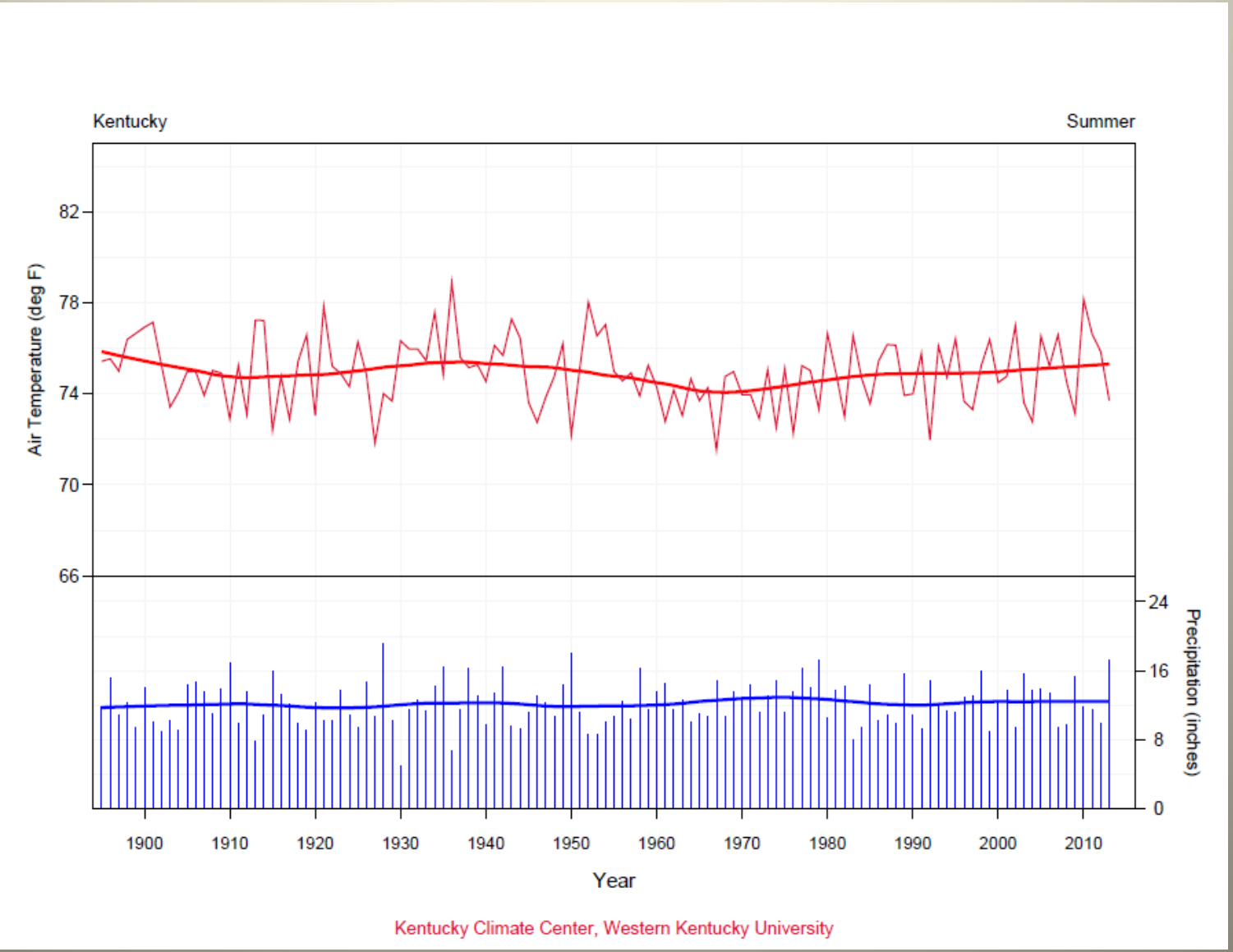
Statewide Average **Spring** Temperature and Precipitation



Graph produced using data retrieved from Midwestern Regional Climate Center's cli-MATE Database

Climate Trends in Kentucky

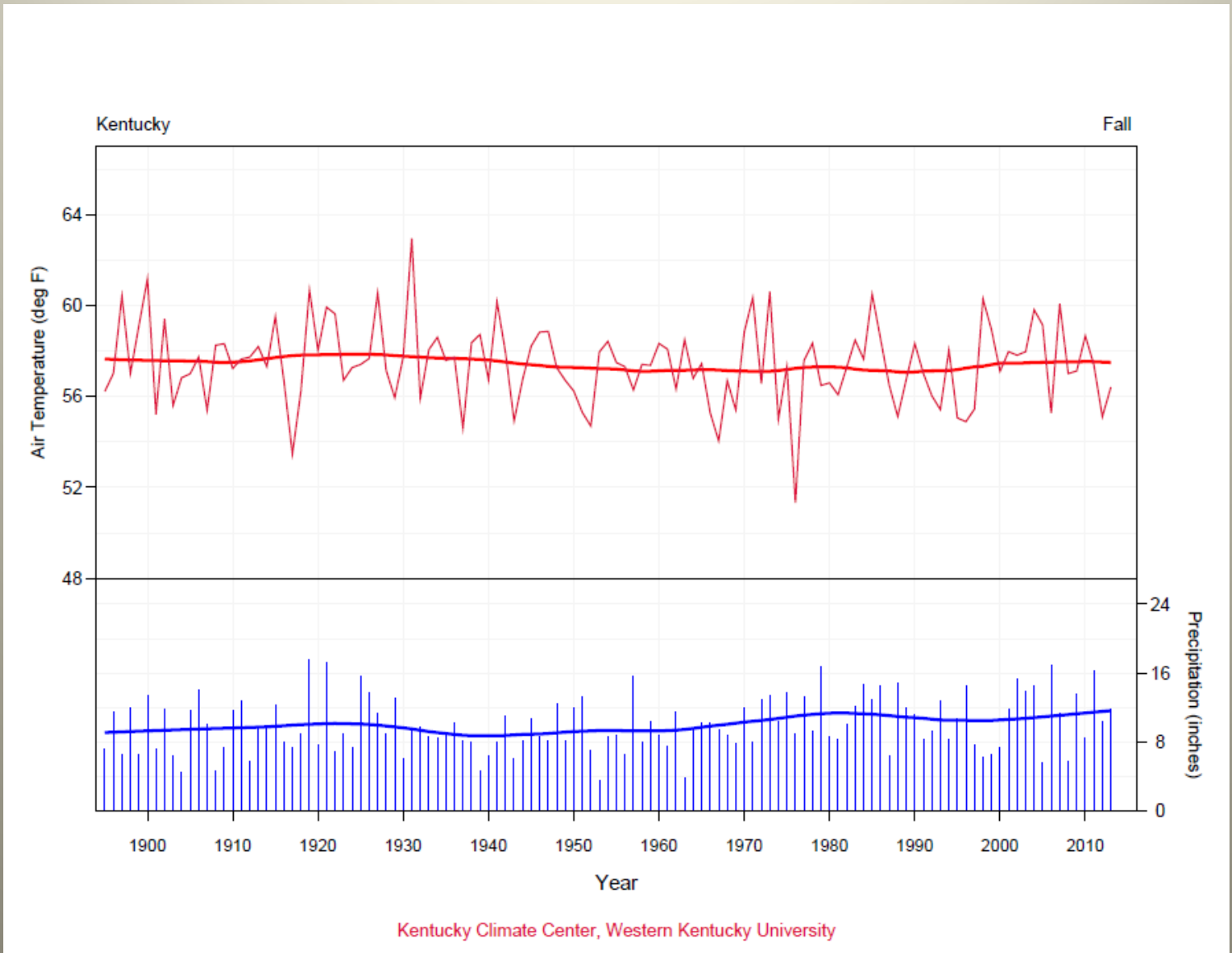
Statewide Average **Summer** Temperature and Precipitation



Graph produced using data retrieved from Midwestern Regional Climate Center's cli-MATE Database

Climate Trends in Kentucky

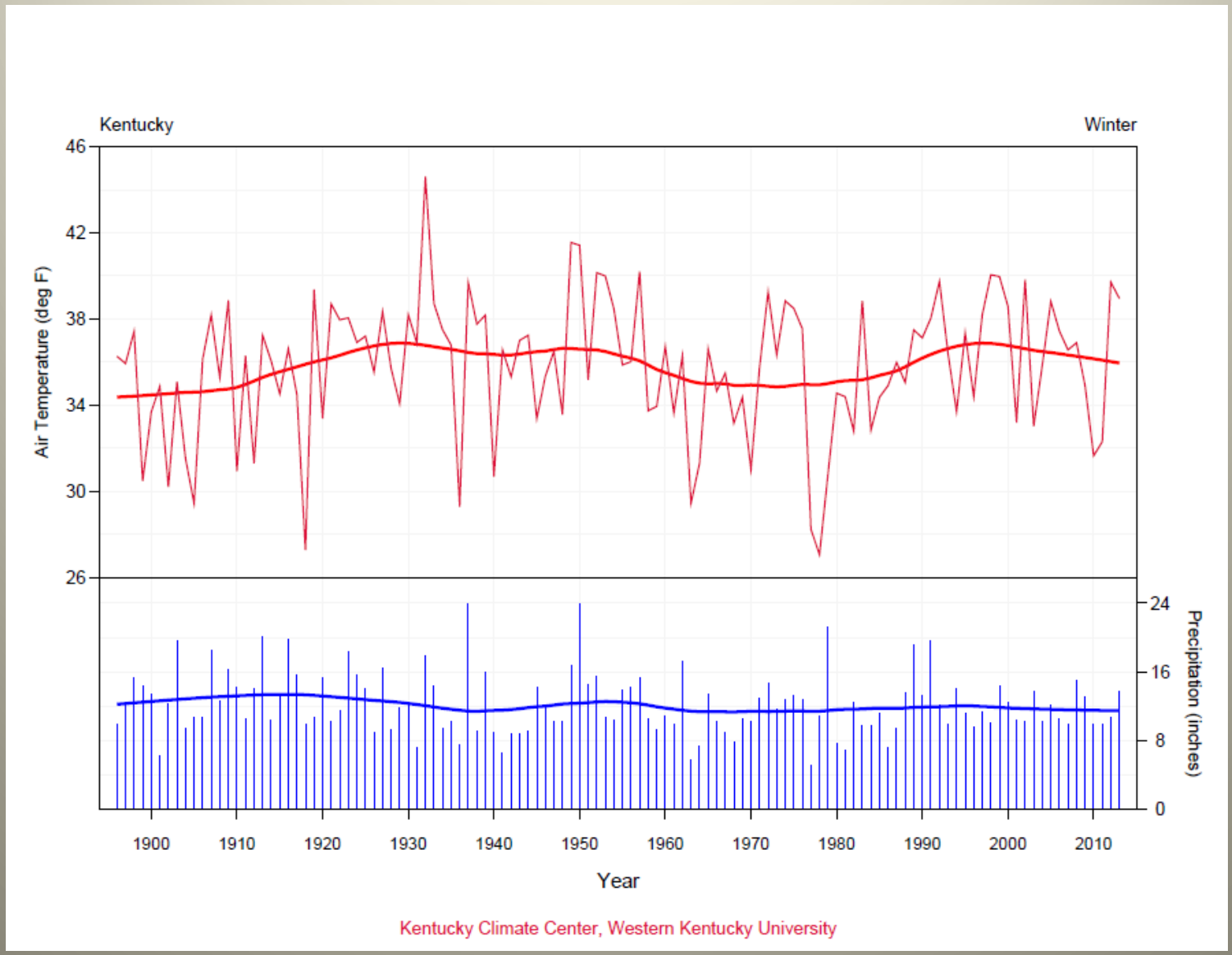
Statewide Average **Fall** Temperature and Precipitation



Graph produced using data retrieved from Midwestern Regional Climate Center's cli-MATE Database

Climate Trends in Kentucky

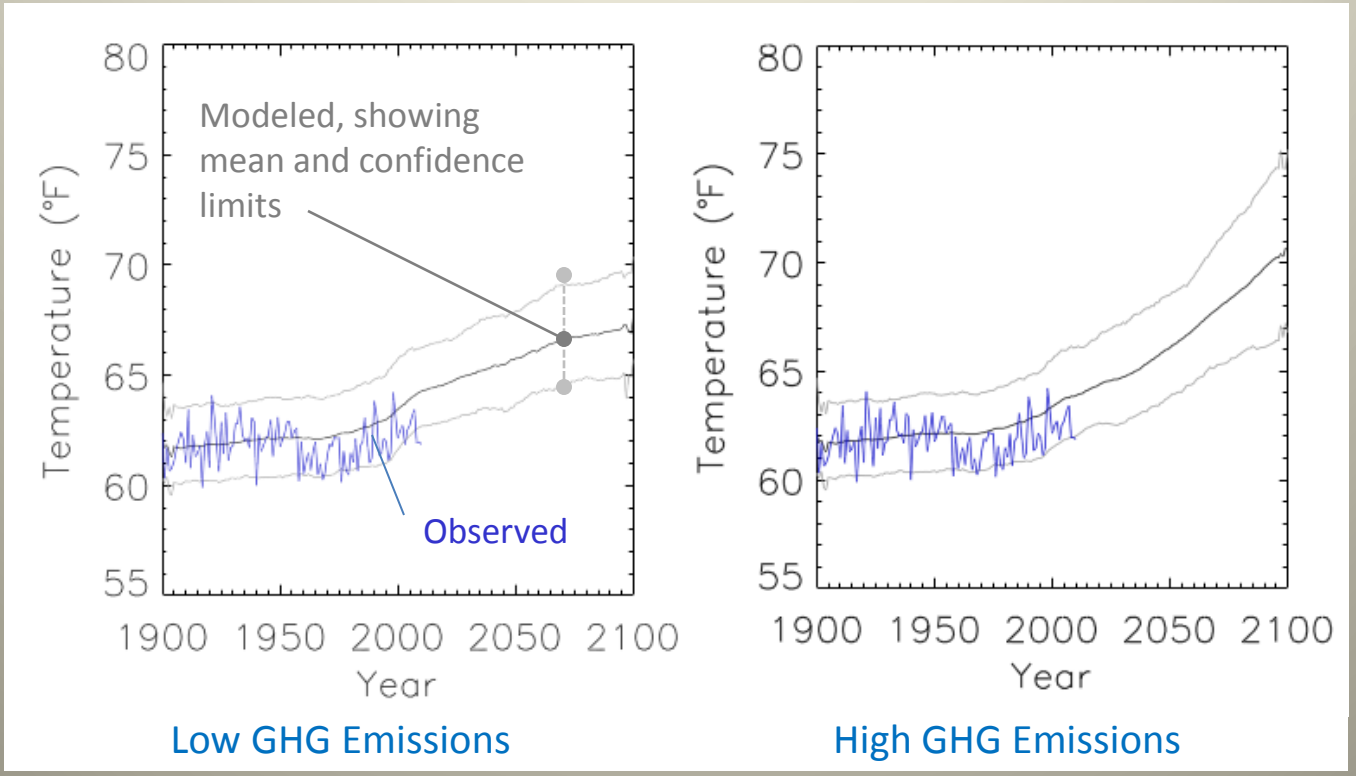
Statewide Average **Winter** Temperature and Precipitation



Graph produced using data retrieved from Midwestern Regional Climate Center's cli-MATE Database

Climate Change Scenarios for the U.S. Southeast

Future Temperature Scenarios

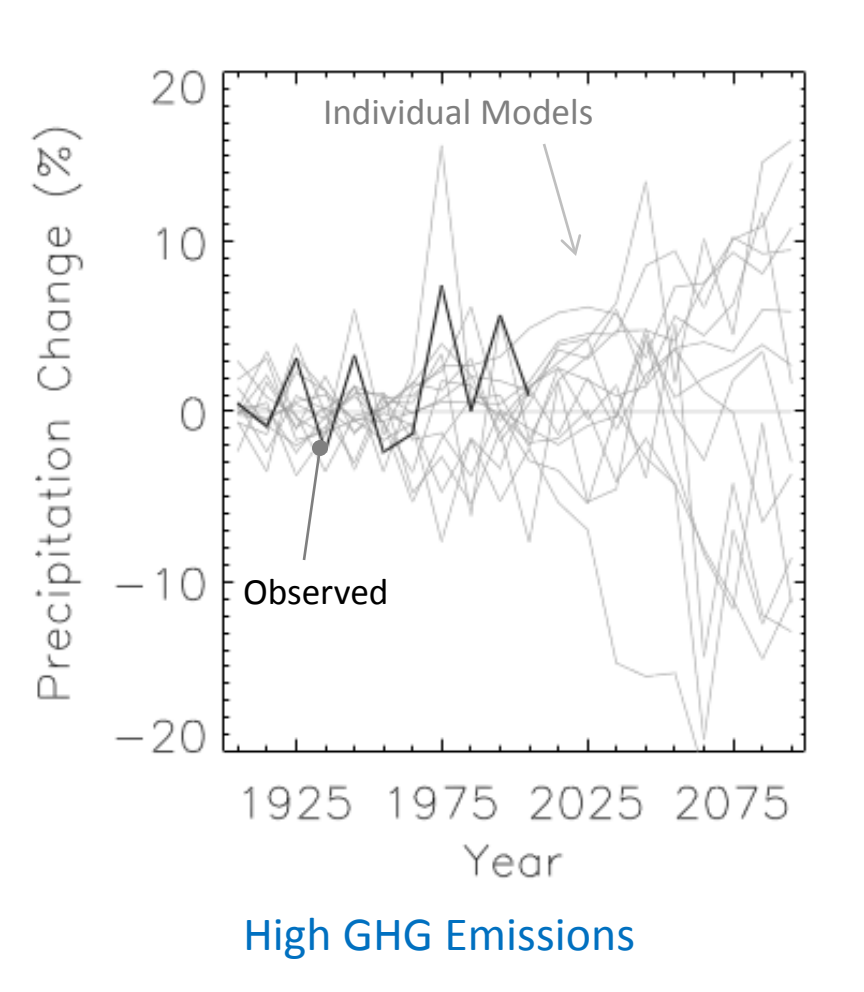


http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-2-Climate_of_the_Southeast_U.S.pdf

KENTUCKY CLIMATE CENTER

Climate Change Scenarios for the U.S. Southeast

Future Precipitation Scenarios



http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-2-Climate_of_the_Southeast_U.S.pdf

KENTUCKY CLIMATE CENTER

Expectations of Climate Change in Kentucky Under the ***High*** Emissions Scenario

- Number of days with maximum temperature of 95°F or higher is expected to increase by 15 to 30.
- Number of days with minimum temperature of 32°F or lower is expected to decrease by 20 to 25.
- Length of the freeze-free season is expected to increase by 20 to 30 days.
- Annual precipitation expected to increase by less than 10 percent with wetter winters and drier summers.

http://www.nesdis.noaa.gov/technical_reports/NOAA_NESDIS_Tech_Report_142-2-Climate_of_the_Southeast_U.S.pdf

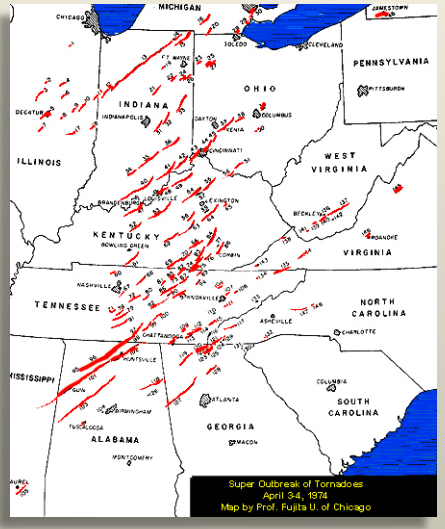
KENTUCKY CLIMATE CENTER

In a nutshell …

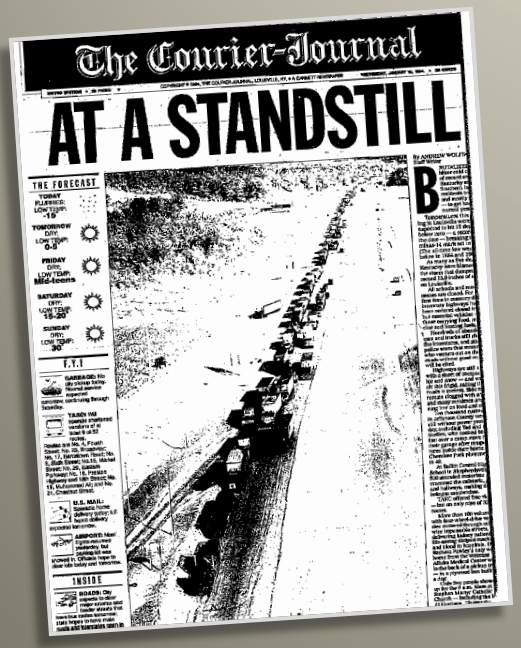
- Recent trends and historical context highlight variability with only minimal change
- Models project that Kentucky's future climate will lie beyond the range of recent historical variability
- Even small changes in climate can lead comparatively large changes in the frequency of extreme weather and climate events

KENTUCKY CLIMATE CENTER

Weather and Climate Extremes



- Floods and Droughts
- Heat and Cold Waves
- Tornadoes, hail, wind, lightning
- Snow and ice

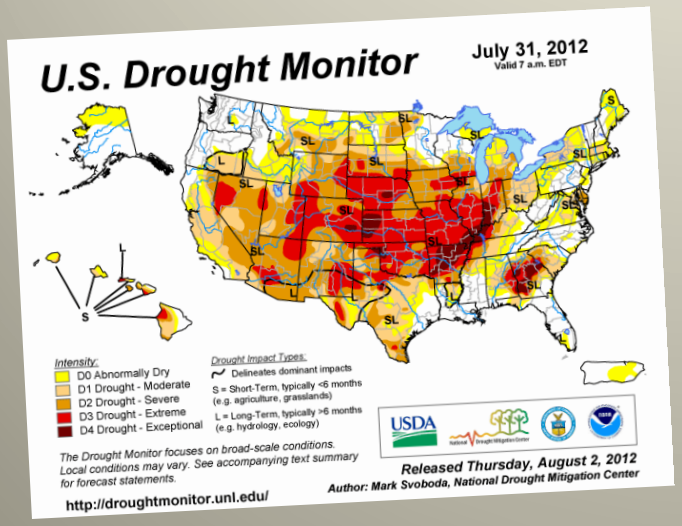

The Courier-Journal

AT A STANDSTILL

Extreme Drought

Triggered by a record warm March in 2012, extreme drought developed in the western portion of Kentucky. Some areas received more precipitation on March 8th than they would see the entire spring season. High temperatures averaged near 100 °F for a ten-day period with the onset of summer.

Was this the worst drought on record in Kentucky?



Sand bars on the Mississippi River at Columbus, KY

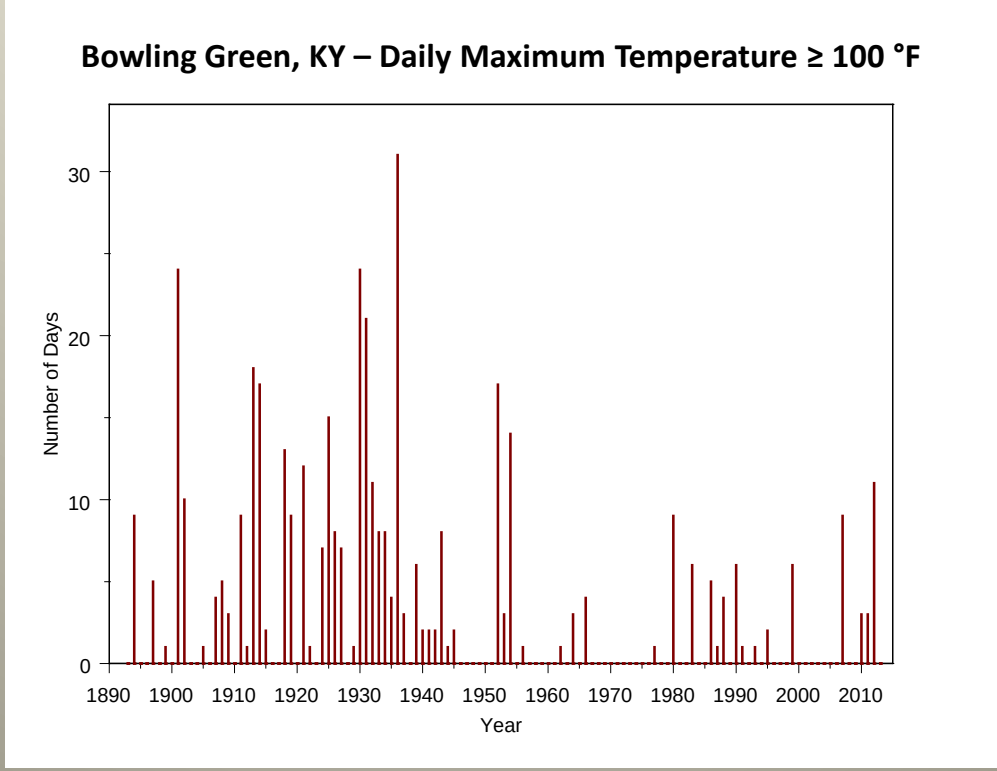
While very intense in western portions, the Drought of 2012 was short, sparing Kentucky the longer and more expansive impacts of droughts in the 1930s and 1950s.

KENTUCKY CLIMATE CENTER

Extreme Heat

In the midst of a drought and heat wave during the summer of 2012, Bowling Green recorded ***11* days** on which the temperature reached as high as 100 °F.

Was this climate event historically significant?

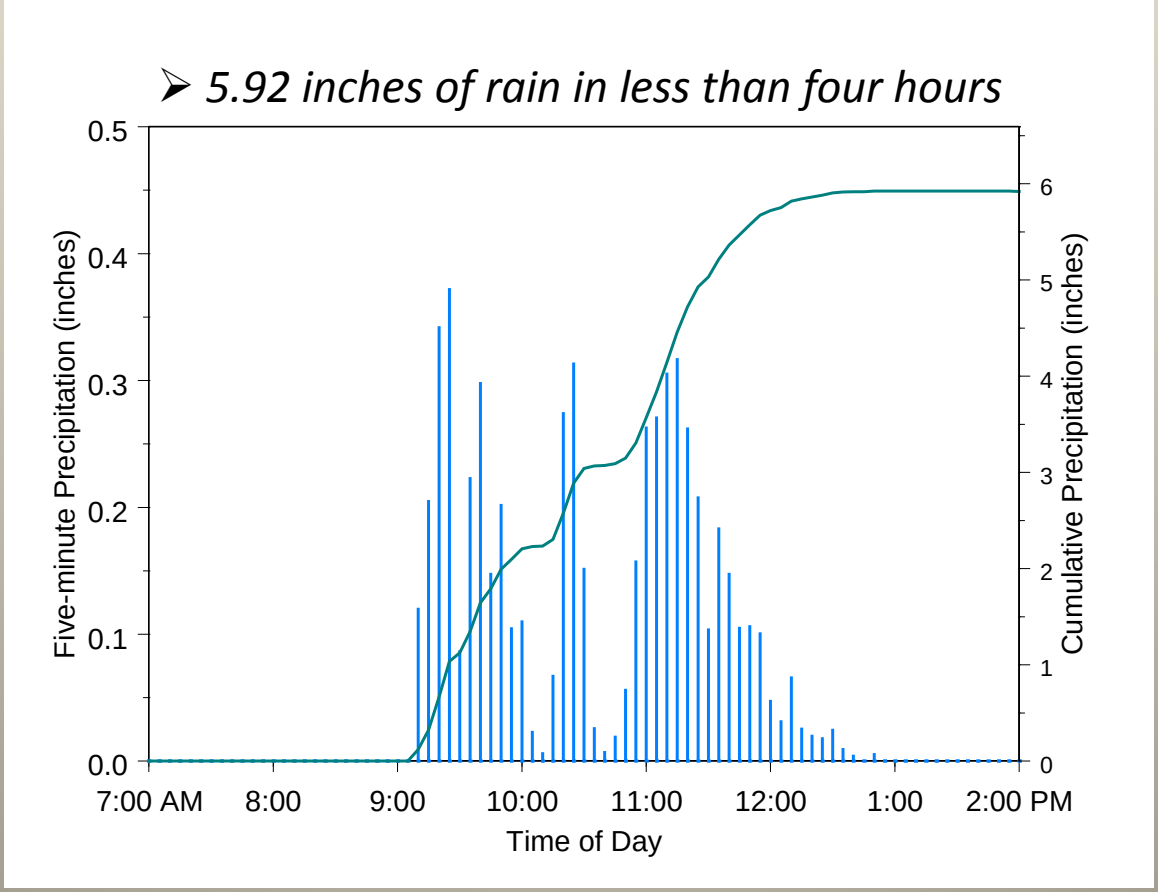


Cognitive biases often lead to misinterpretations in the absence of objective analysis.

KENTUCKY CLIMATE CENTER

Extreme Storm-Event Precipitation

Kentucky Mesonet, Hopkins County, June 24, 2013

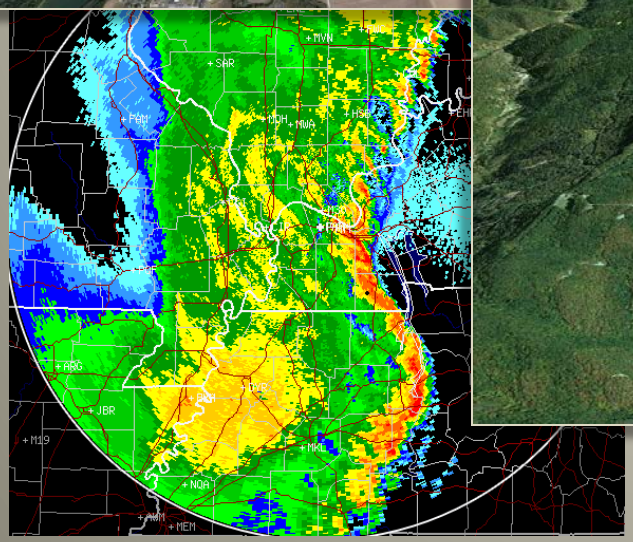


➢ Estimated as a 500-year event based on NOAA NWS Atlas 14

In a changing climate, extreme precipitation events are expected to become more frequent.

KENTUCKY CLIMATE CENTER

KENTUCKY CLIMATE CENTER



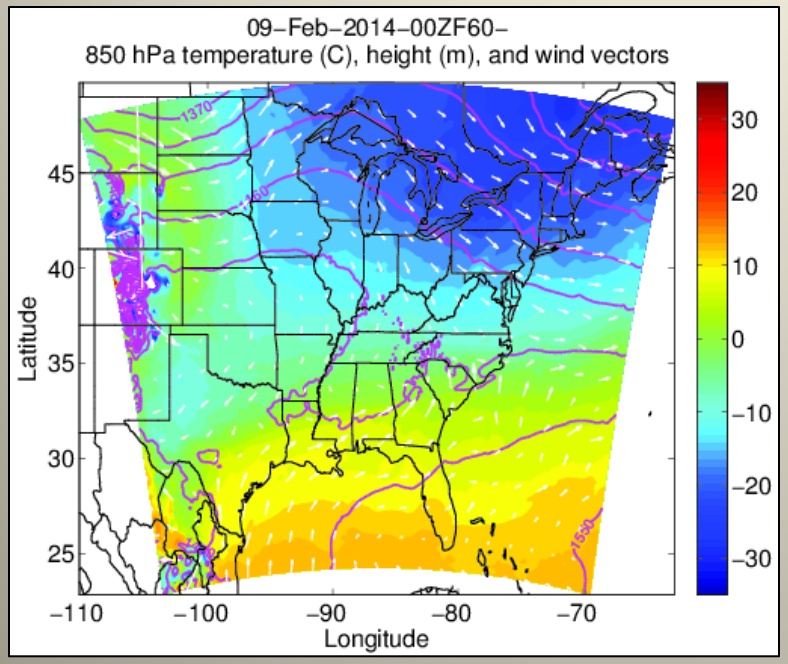
Kentucky's diverse topography creates distinct local vulnerabilities to weather and climate extremes.

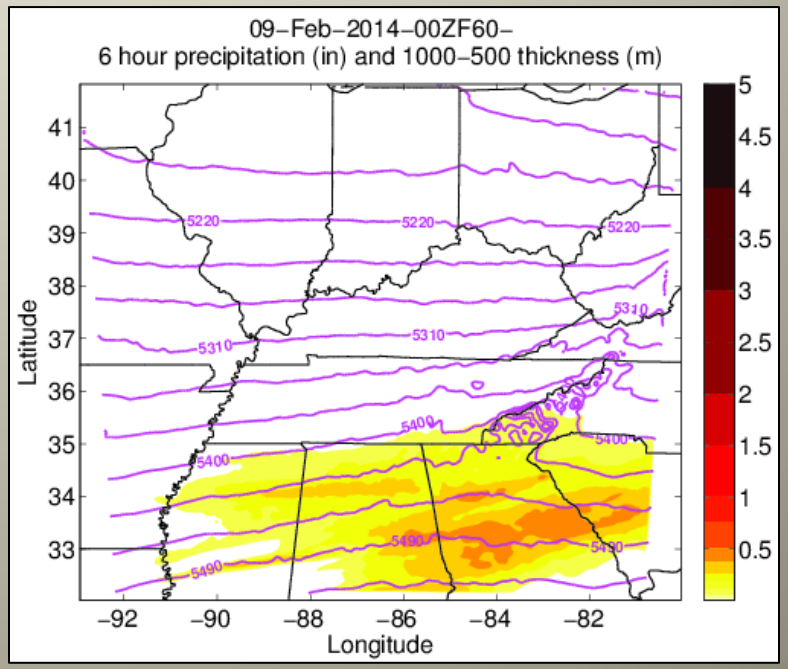
Kentucky Mesonet Across the Commonwealth

KENTUCKY CLIMATE CENTER

Weather Forecast Model Run

Experimental Product from the Kentucky Climate Center





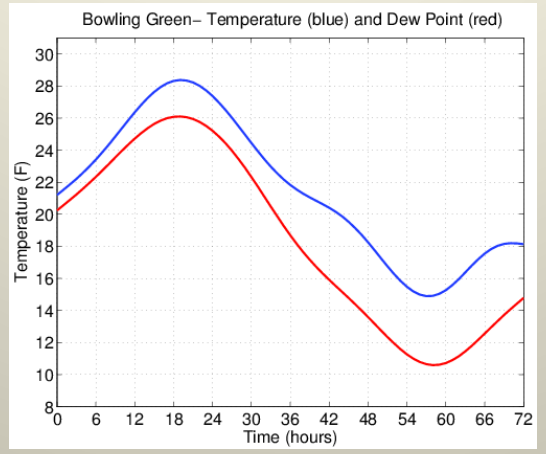
Model initialized with observations from the Kentucky Mesonet.

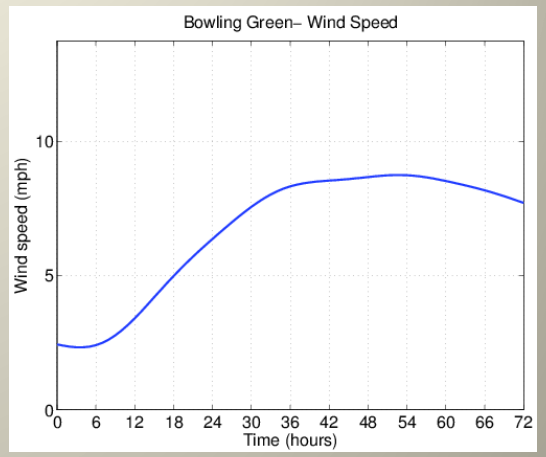
KENTUCKY CLIMATE CENTER

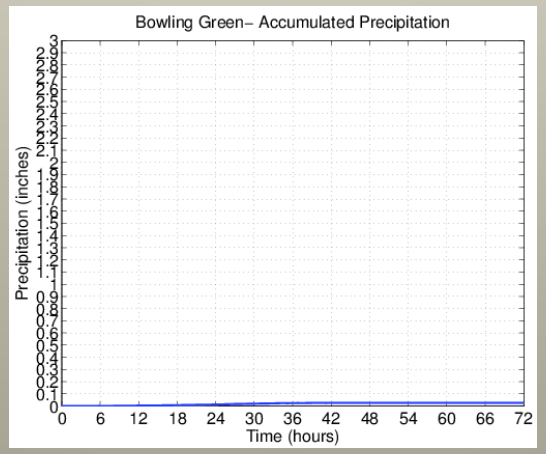
Sample Point Forecast

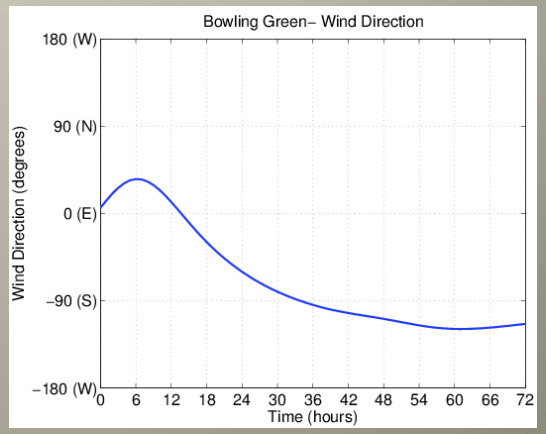
Experimental Product from the Kentucky Climate Center

- Custom point forecasts with 36-hour lead time
- Model runs on WKU's High-performance Computing Cluster



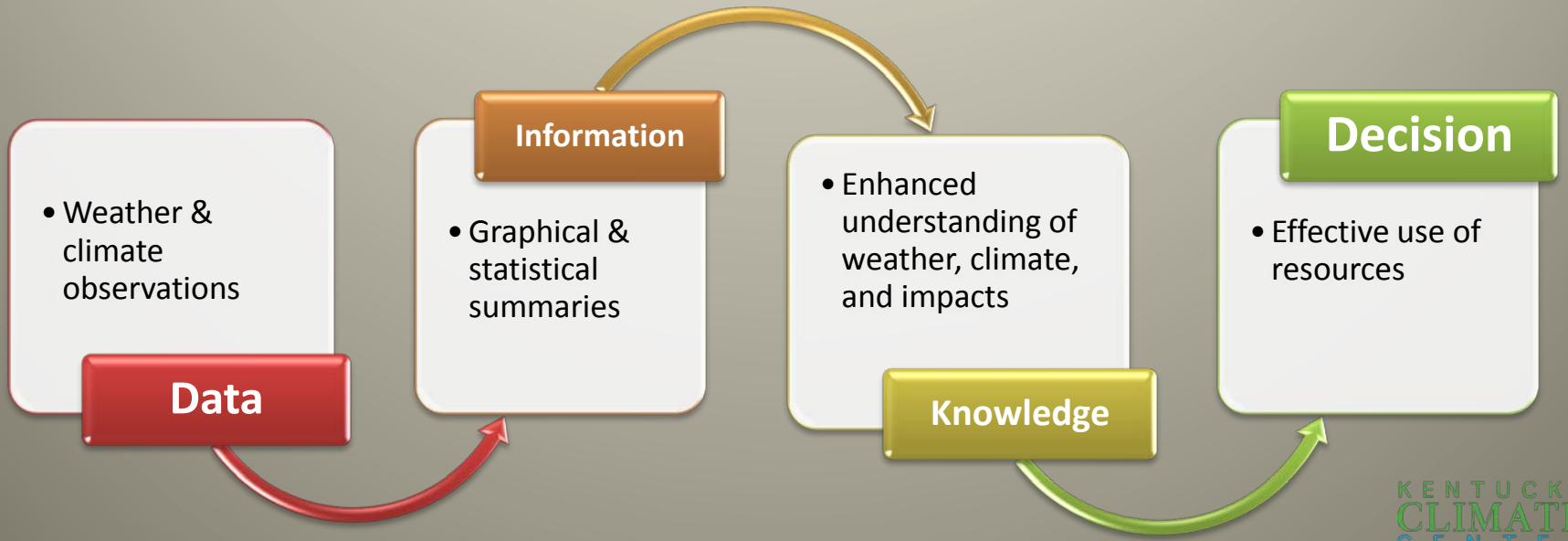






National Climate Services Partnership

- National Partner
  - NOAA's National Climatic Data Center
    Asheville, North Carolina
- Regional Partner
  - Midwestern Regional Climate Center
    University of Illinois, Champaign, IL
- State Partner
  - Kentucky Climate Center
    Western Kentucky University, Bowling Green, KY




Questions?