Climate Change in Illinois - Water

Dr. Jim Angel, former State Climatologist for Illinois

Logistics

- PowerPoint slides will be uploaded and available for anyone
- At around 30 minutes, there will be a pause for questions about material already covered
- At the end of the lecture, there will be plenty of time for additional questions

Overview of the course

- The focus will be on Illinois with limited discussion about national issues
  - Week 1: Overview of current trends and future projections for Illinois.
  - Week 2: Impacts on agriculture.
  - **Week 3: Impacts on water resources.**
  - Week 4: Impacts on health

Pictured: CHICAGO, ILLINOIS - FEBRUARY 26: An aerial view shows people on the beach along Lake Michigan as temperatures climbed to 71 degrees on February 26, 2024 in Chicago, Illinois. The unusually warm day broke a previous high record of 64 degrees, set in 2000. Credit: Getty Images.

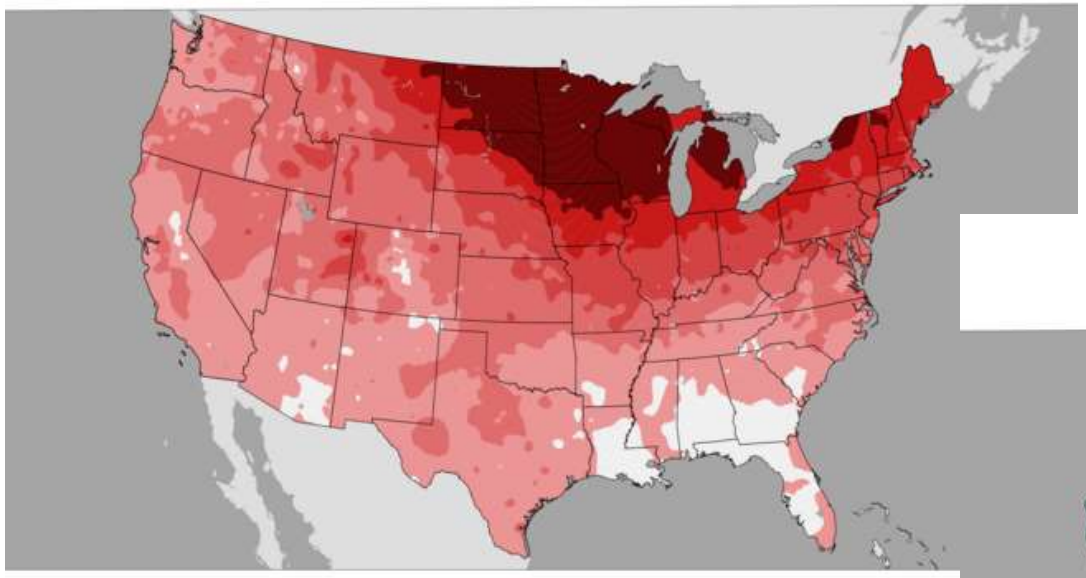
NOAA National Centers for Environmental Information NOAA Climate.Gov

Mean Temperature Departures from Average

December 2023–February 2024

Average Period: 1901–2000

NOAA's National Centers for Environmental Information



−10 −8 −6 −4 −2 0 2 4 6 8 10

Degrees Fahrenheit

Created: Wed Mar 06 2024

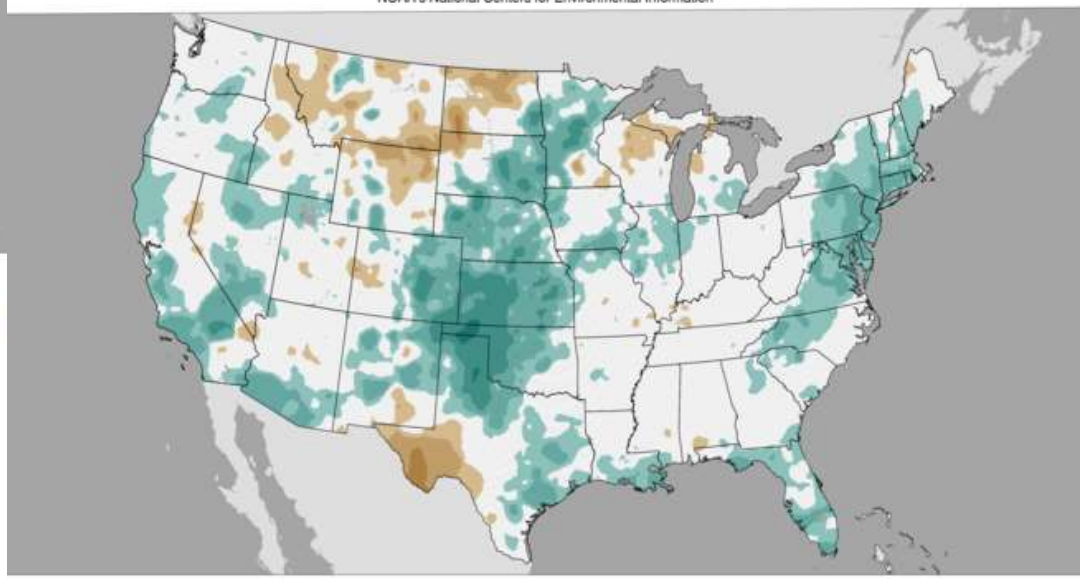
Source: nClimGrid-Monthly

Precipitation Percent of Average

December 2023–February 2024

Average Period: 1901–2000

NOAA's National Centers for Environmental Information



5 10 25 50 75 100 125 150 200 300 500

Percent

Created: Wed Mar 06 2024

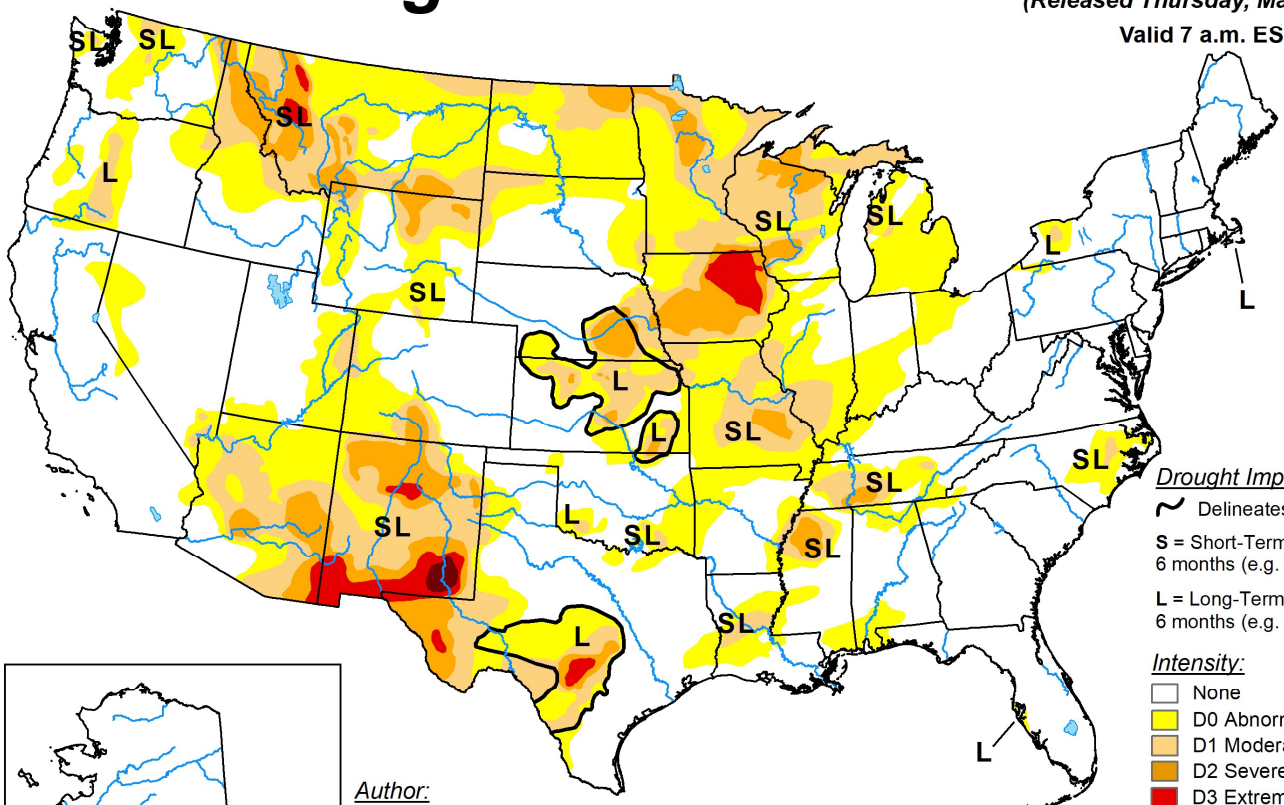
Source: nClimGrid-Monthly

U.S. Drought Monitor

March 5, 2024

(Released Thursday, Mar. 7, 2024)

Valid 7 a.m. EST



Drought Impact Types:

Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Author:

Curtis Riganti

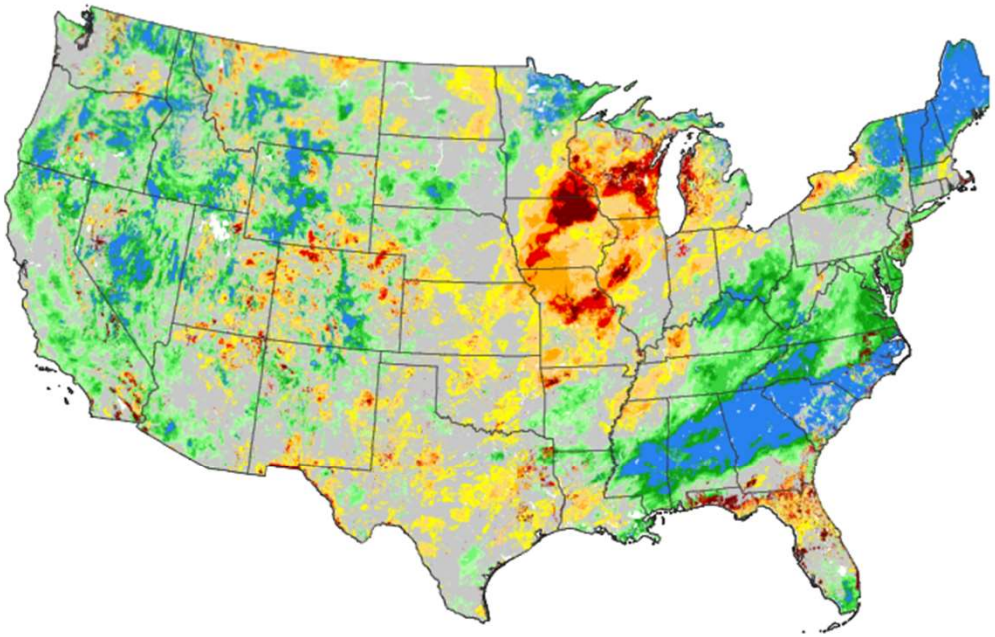
National Drought Mitigation Center

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to https://droughtmonitor.unl.edu/About.aspx

USDA NDMC NOAA

droughtmonitor.unl.edu

0–100 cm Soil Moisture Percentile



0–100 cm Soil Moisture Percentile

0 2 5 10 20 30 70

70 80 90 95 98 100

Source(s): NASA
Data Valid: 03/10/24

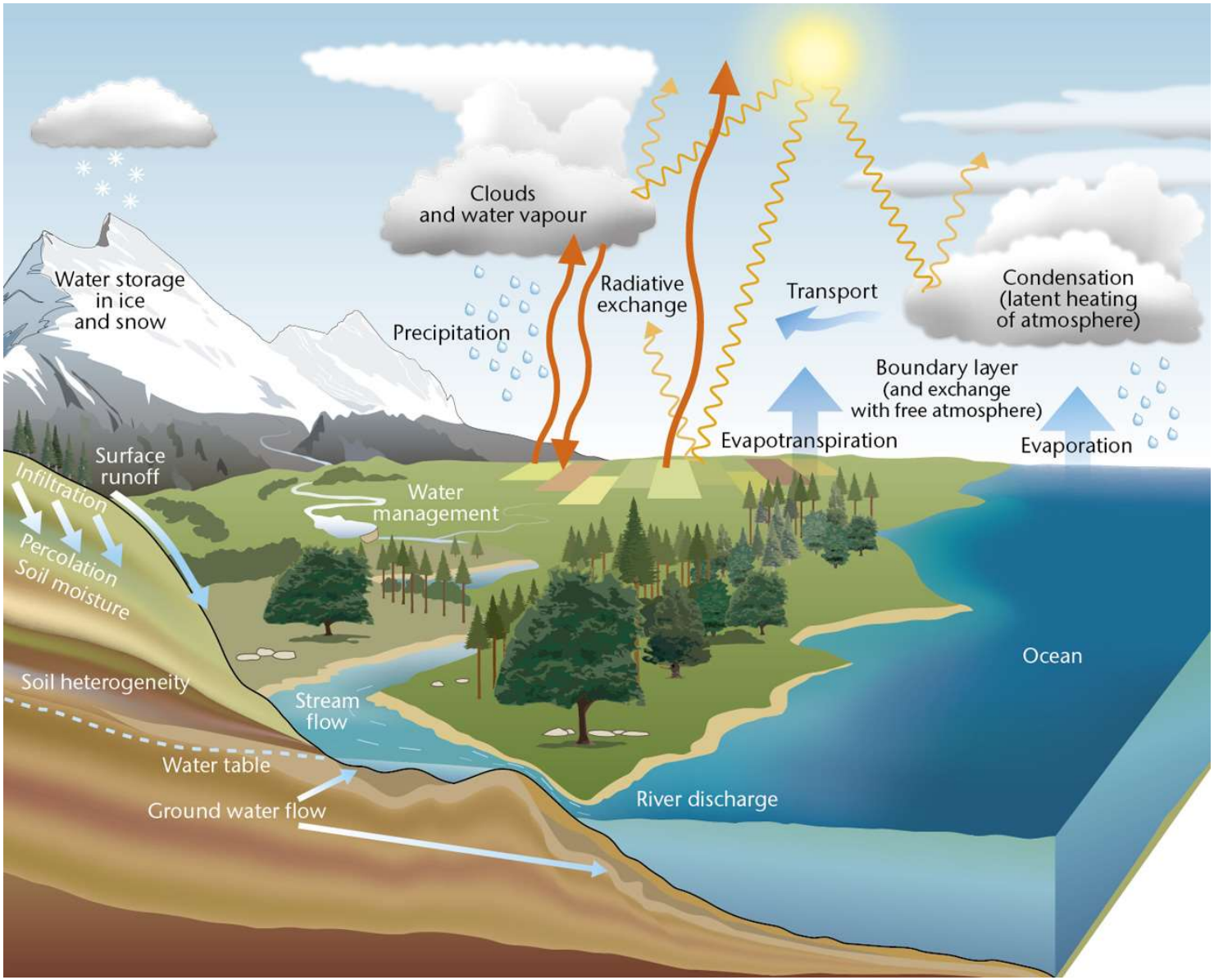
Drought.gov

Mississippi River at Chester, IL - 07020500

January 1, 2019 - March 10, 2024

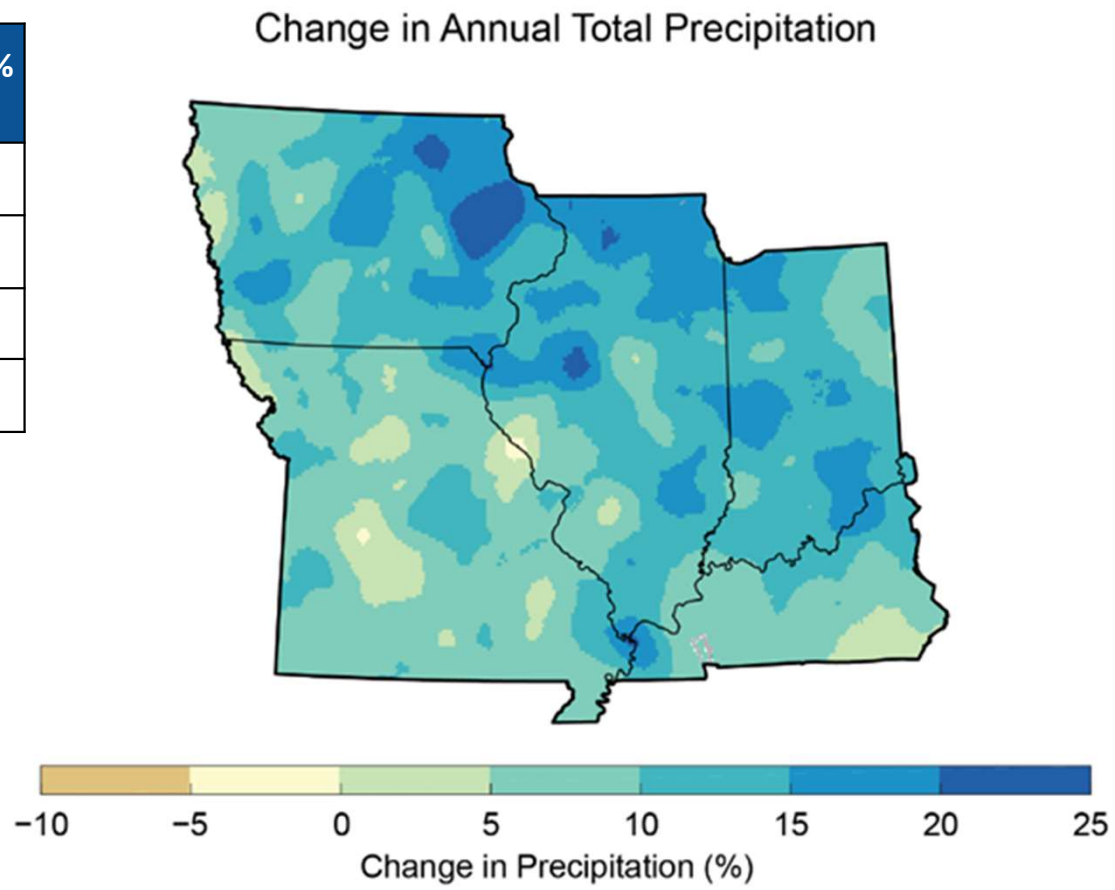
Gage height, feet

IMPACTS TO WATER RESOURCES

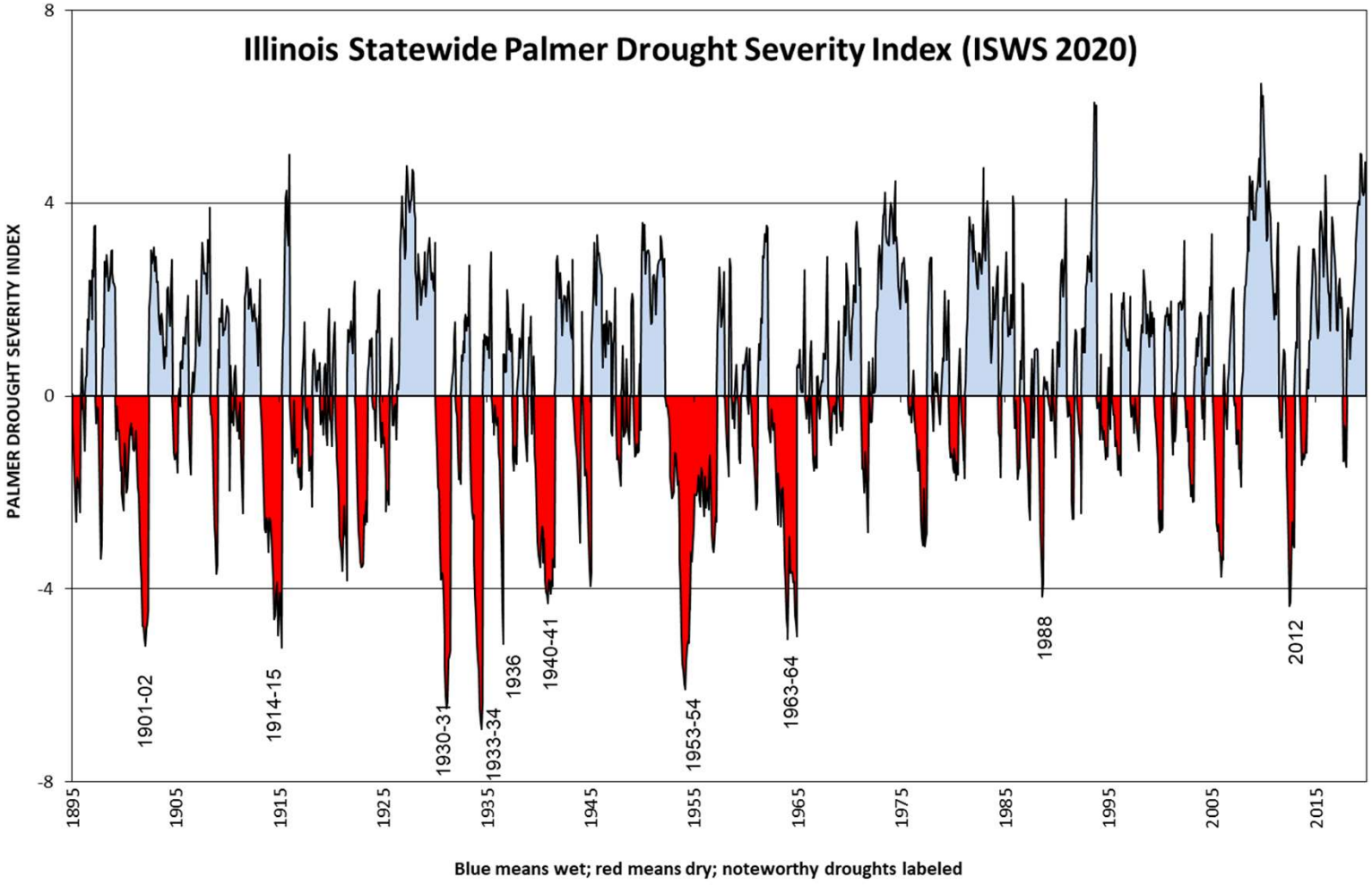

Clouds
and water vapour
Water storage
in ice
and snow
Precipitation
Radiative
exchange
Transport
Condensation
(latent heating
of atmosphere)
Boundary layer
(and exchange
with free atmosphere)
Evapotranspiration
Evaporation
Surface
runoff
Infiltration
Percolation
Soil moisture
Water
management
Soil heterogeneity
Stream
flow
Water table
Ground water flow
River discharge
Ocean

Observed Precipitation Changes

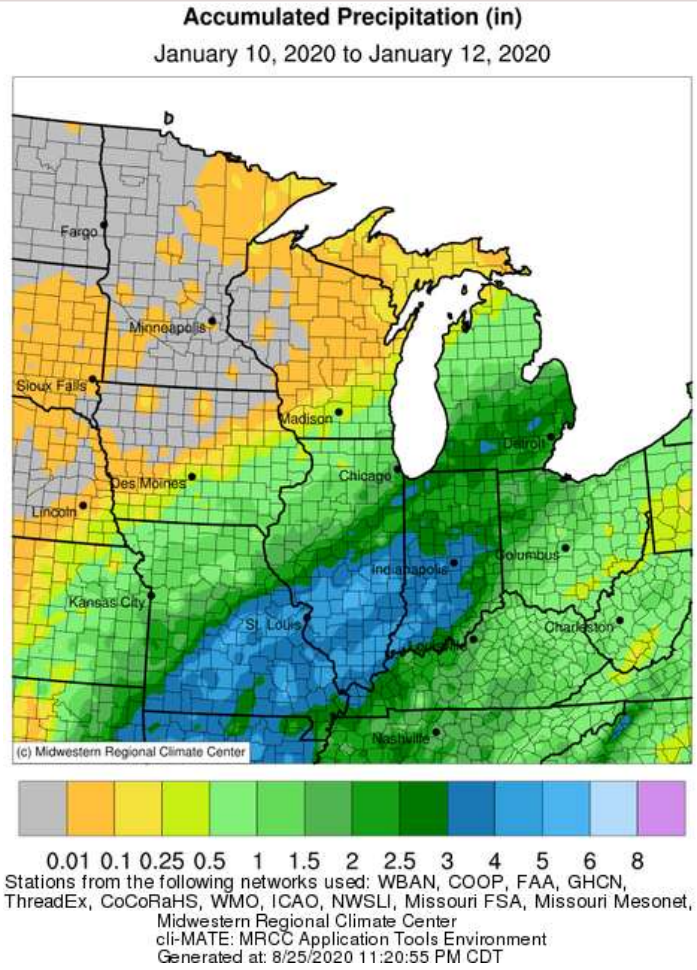
Season	Precipitation (inches)	Precipitation (% Change)
Winter	+0.54	+8.5%
Spring	+1.33	+ 12.5%
Summer	+1.55	+ 14.3%
Fall	+1.33	+ 15.9%

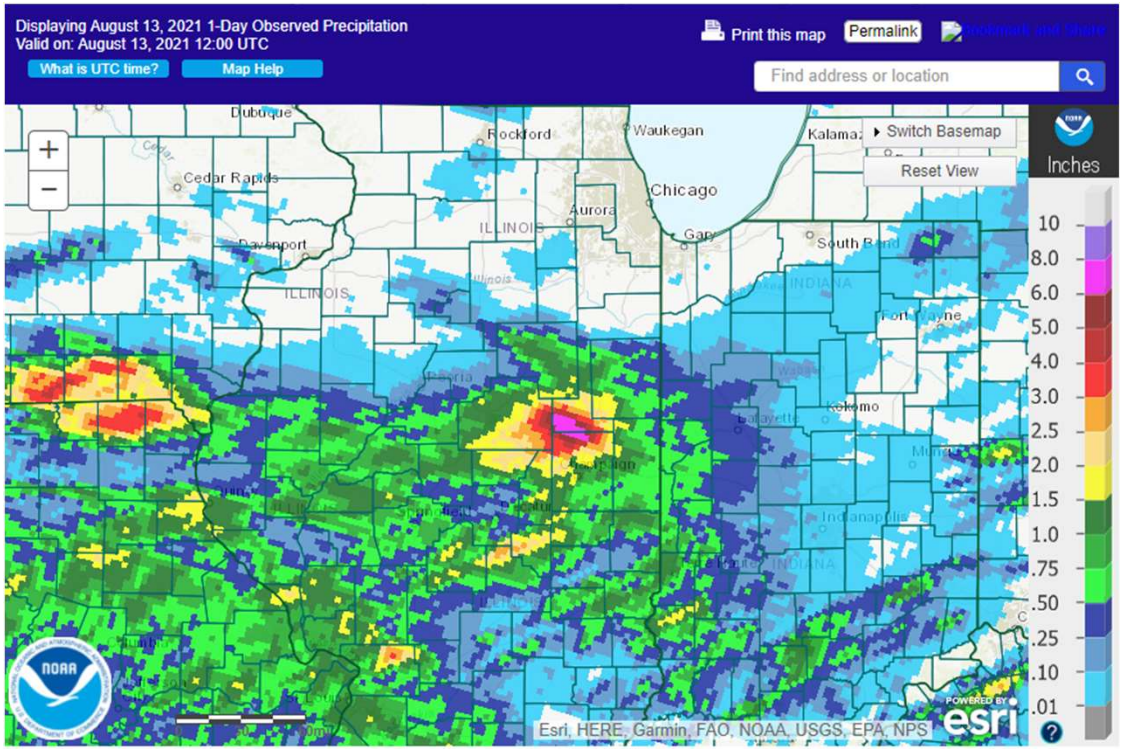


Changes between the early 20th century (1895-1924) and early 21st century (1990-2019)

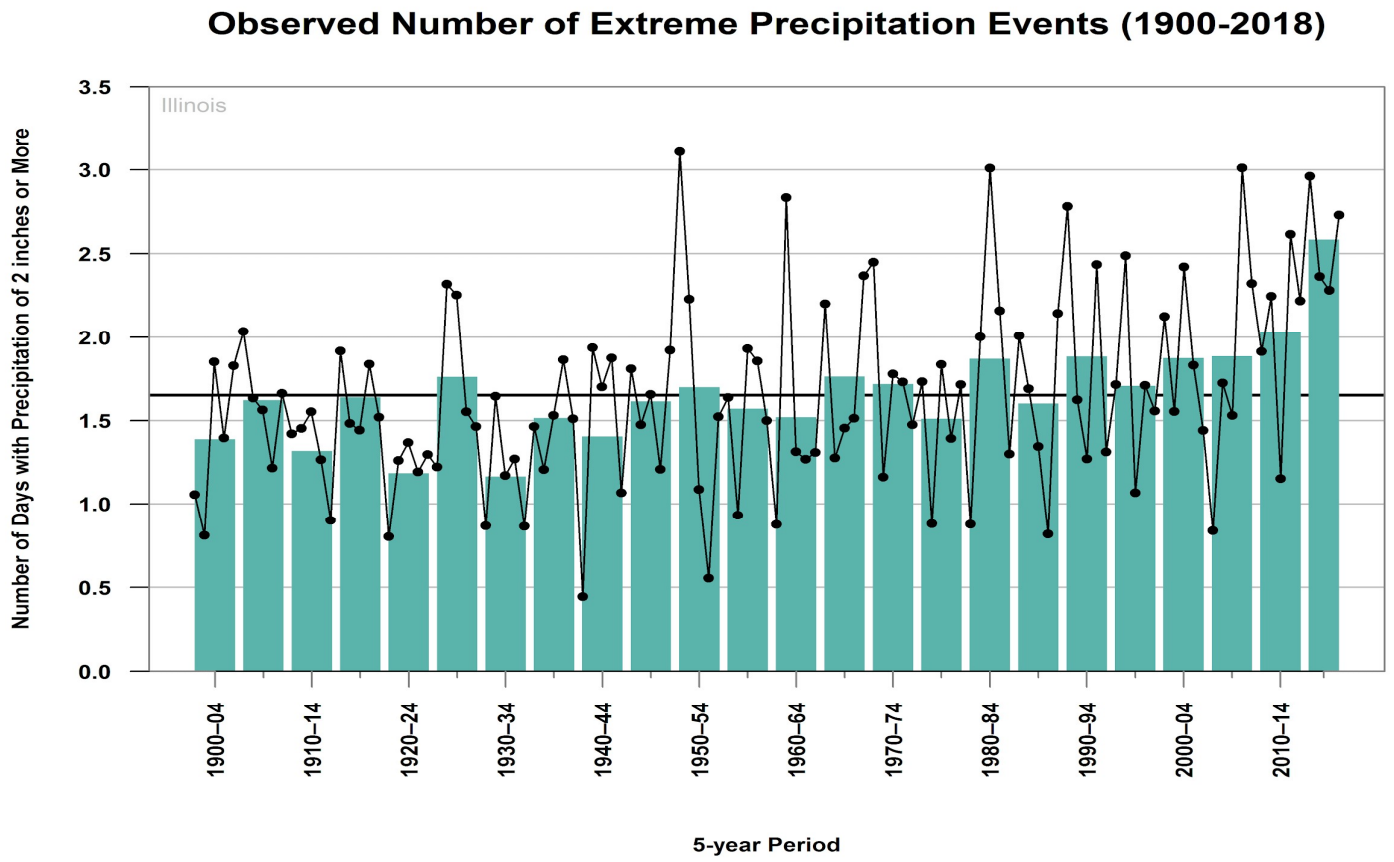

Illinois Statewide Palmer Drought Severity Index (ISWS 2020)
PALMER DROUGHT SEVERITY INDEX
8
4
0
-4
-8
1895
1905
1915
1925
1935
1945
1955
1965
1975
1985
1995
2005
2015
1901-02
1914-15
1930-31
1933-34
1936
1940-41
1953-54
1963-64
1988
2012
Blue means wet; red means dry; noteworthy droughts labeled

More Heavy Rains

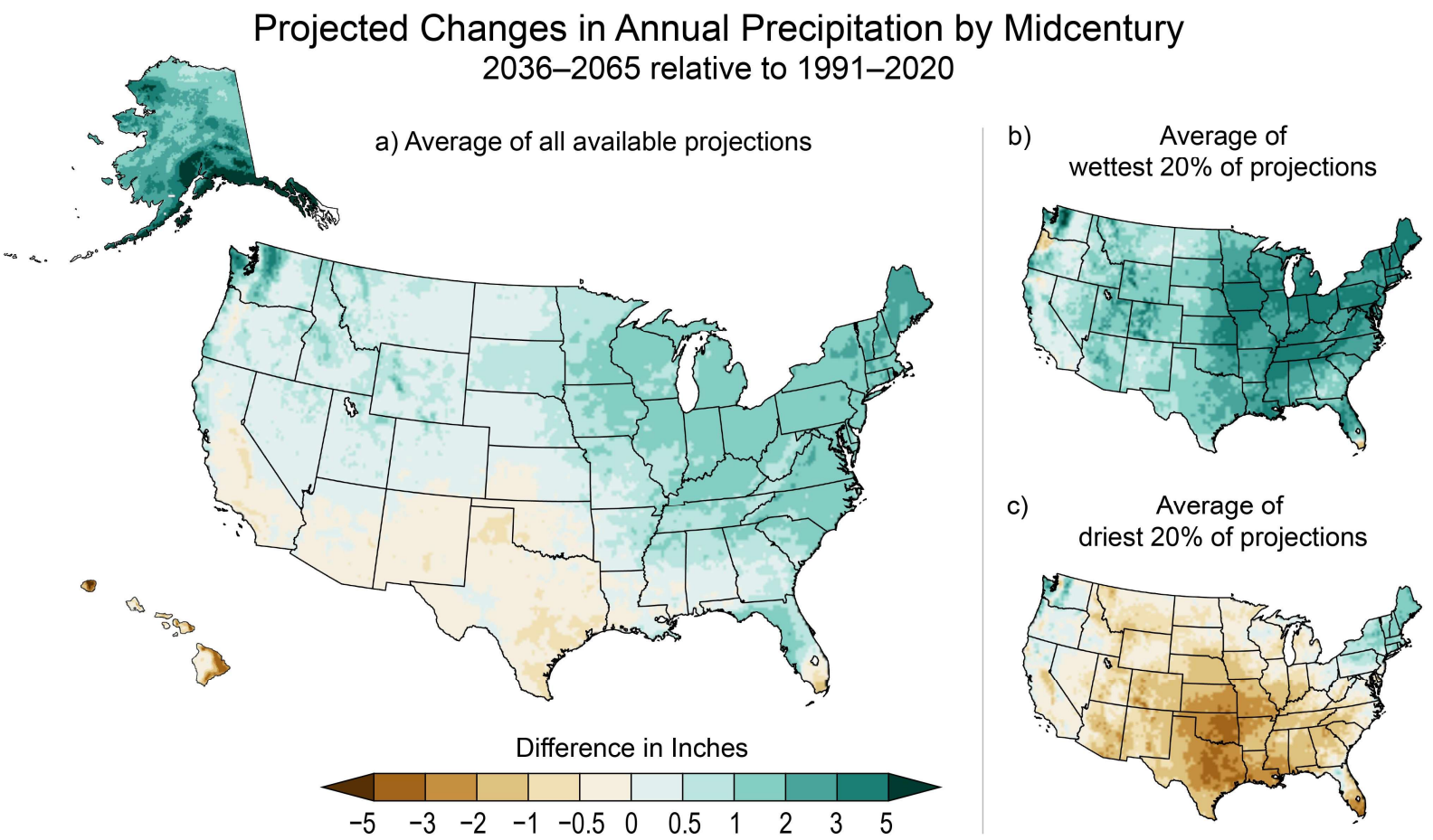




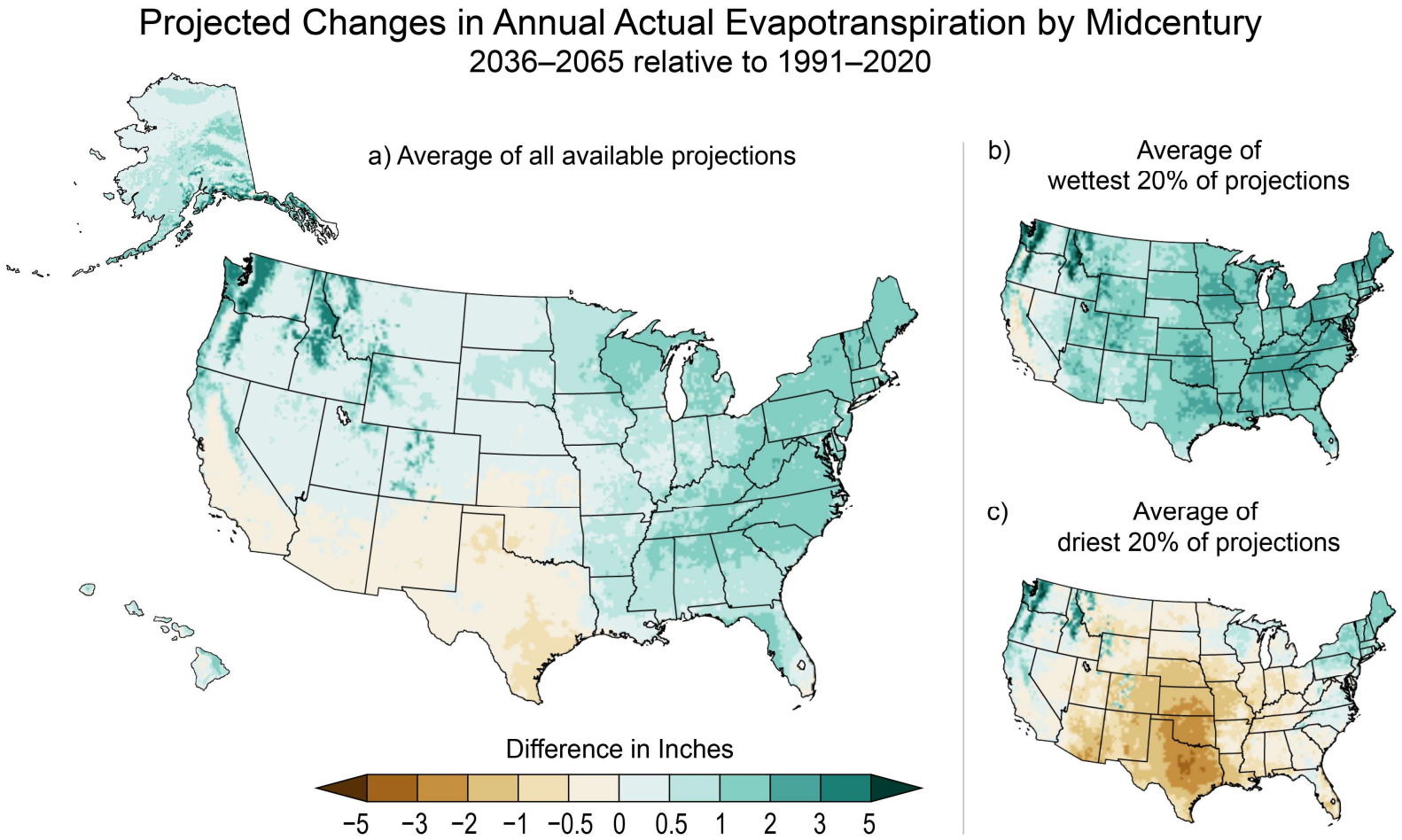
Increasing Heavy Rains



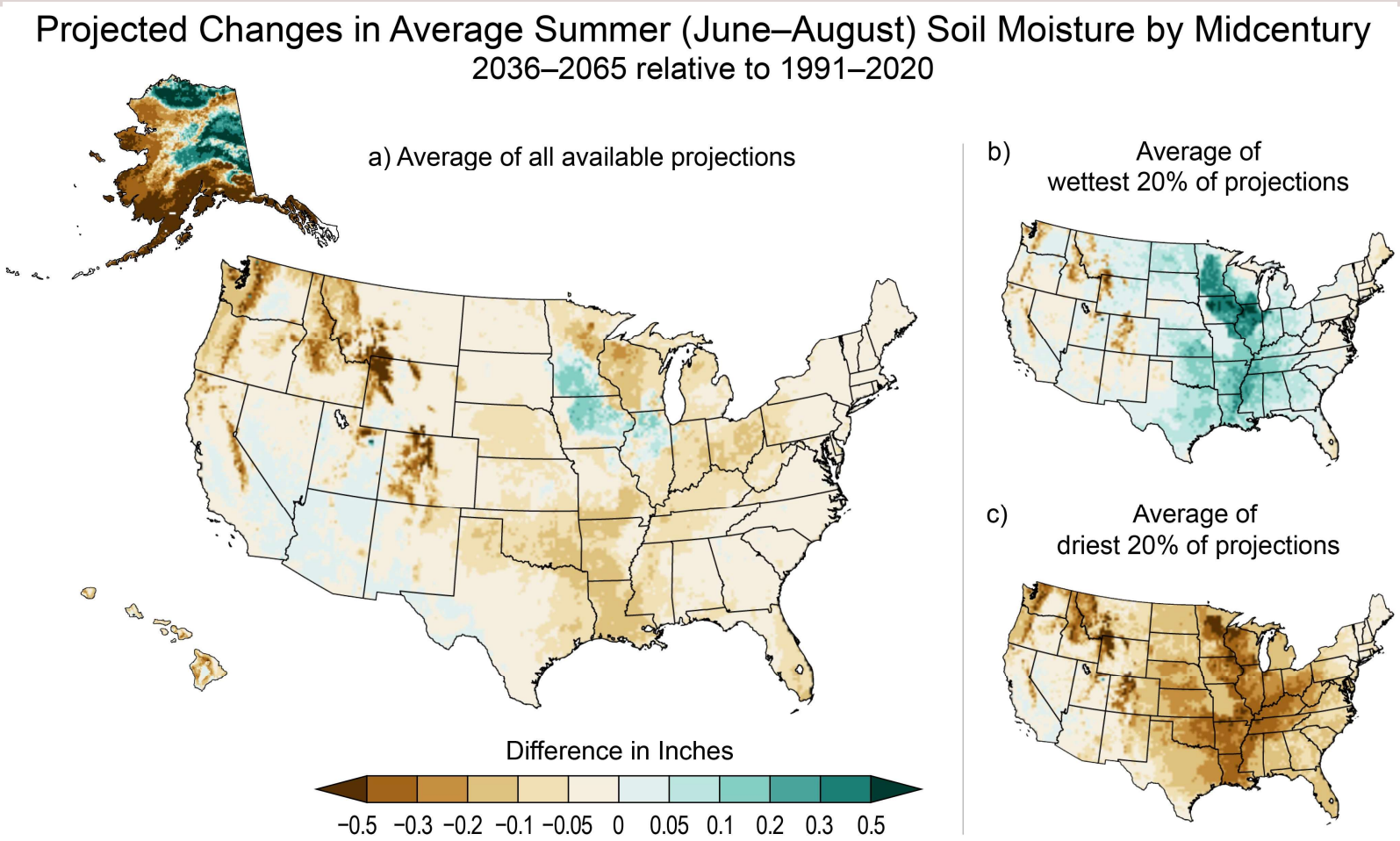
Projected Precipitation (RCP 4.5)



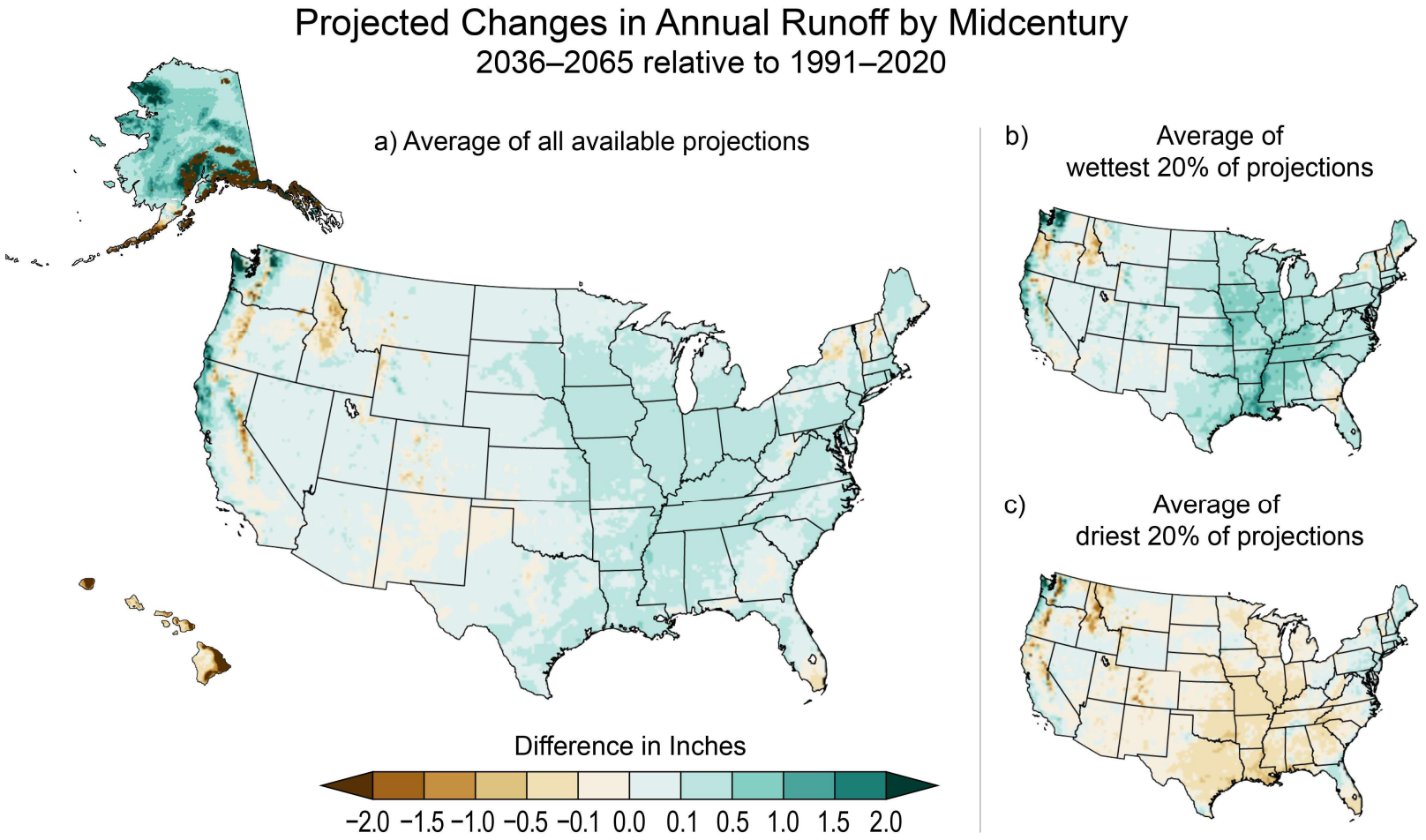
Projected Evapotranspiration



Projected Soil Moisture

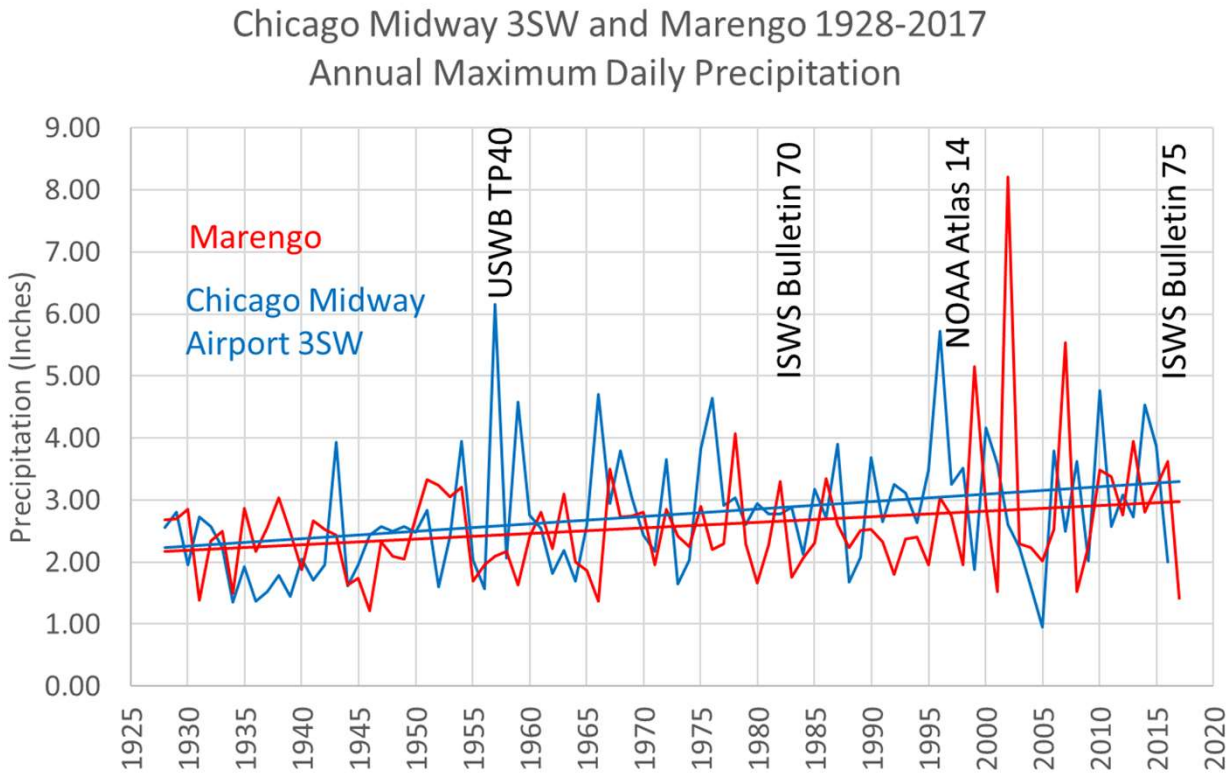


Projected Runoff

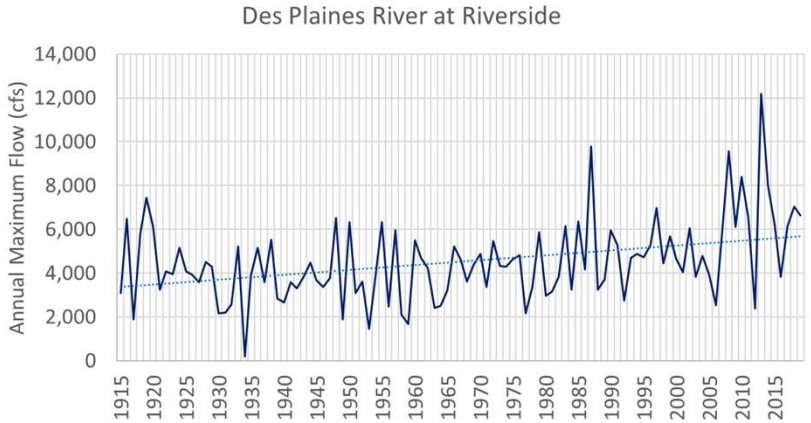


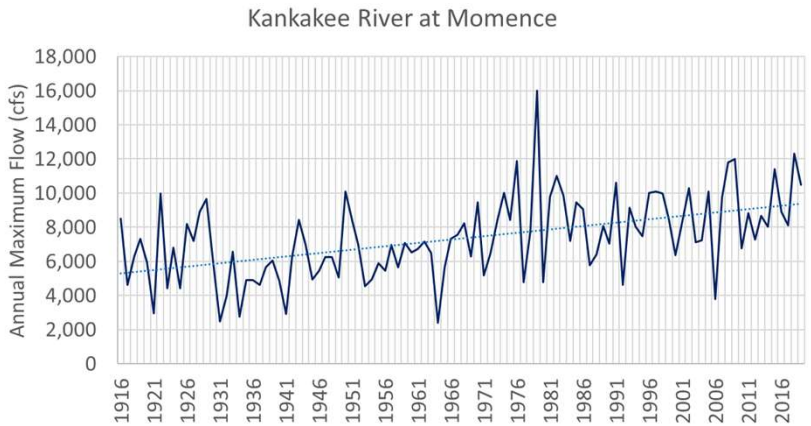
Impacts to Water Resources

Increase in heavy precipitation

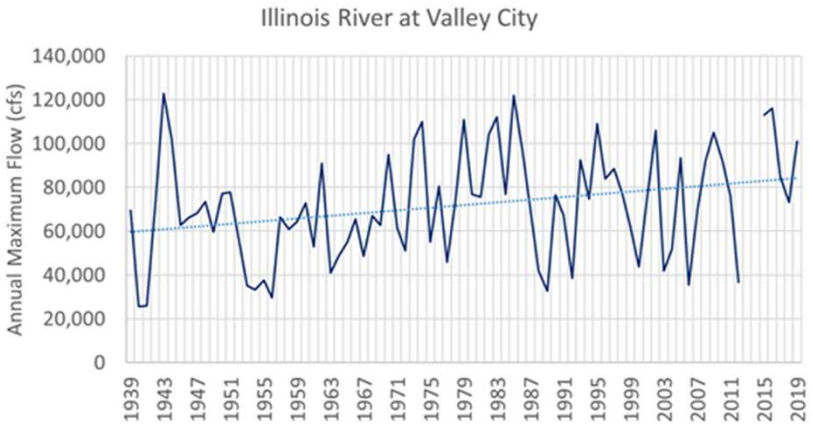


Impacts to Water Resources





Increase in river flows



Source: USGS 2020

Impacts to Water Resources

Projected base flood will increase

Managing Increases in Extreme Precipitation

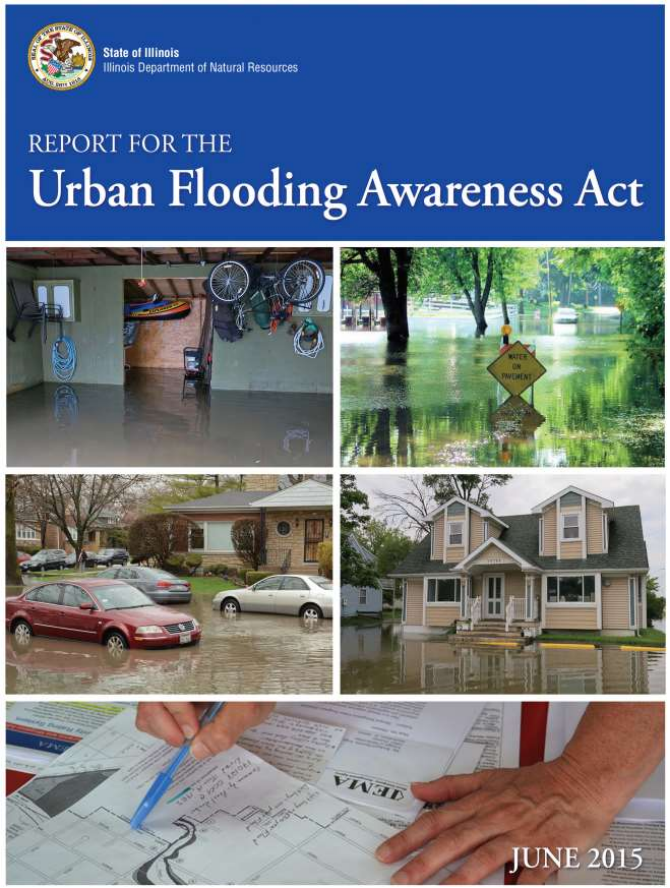
In Cook County, IL:

The 100-year rainfall in 2050 is
The 165-year rainfall today

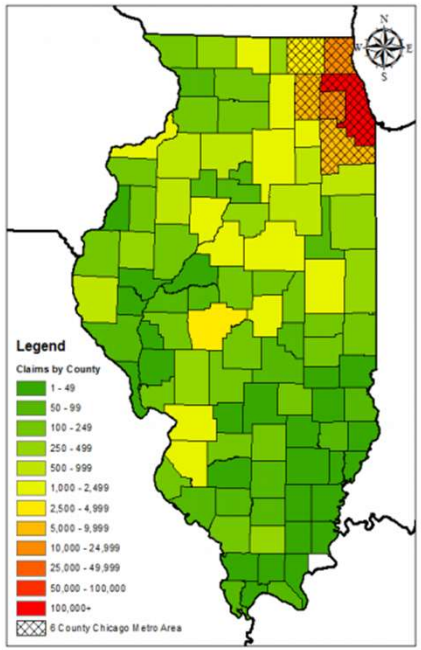
The 100-year rainfall in 2100 is
The 250-year rainfall today

SRES A2. 24-hour Precipitation

The 1% Annual Chance (100-year) floodplains of Upper Salt Creek (left) and Stony Creek (right) respond very differently to changes in extreme precipitation, highlighting the need for climate modeling and mapping of impacts at a local scale.

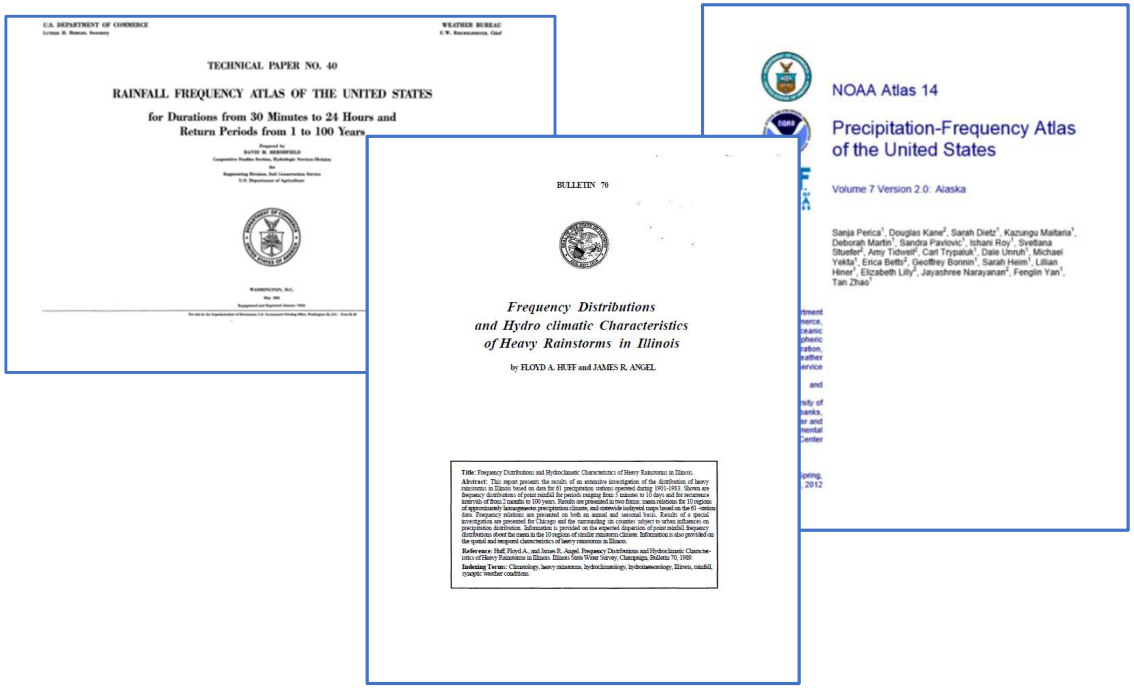


- Wetter climate
- Aging infrastructure
- Urbanization - runoff

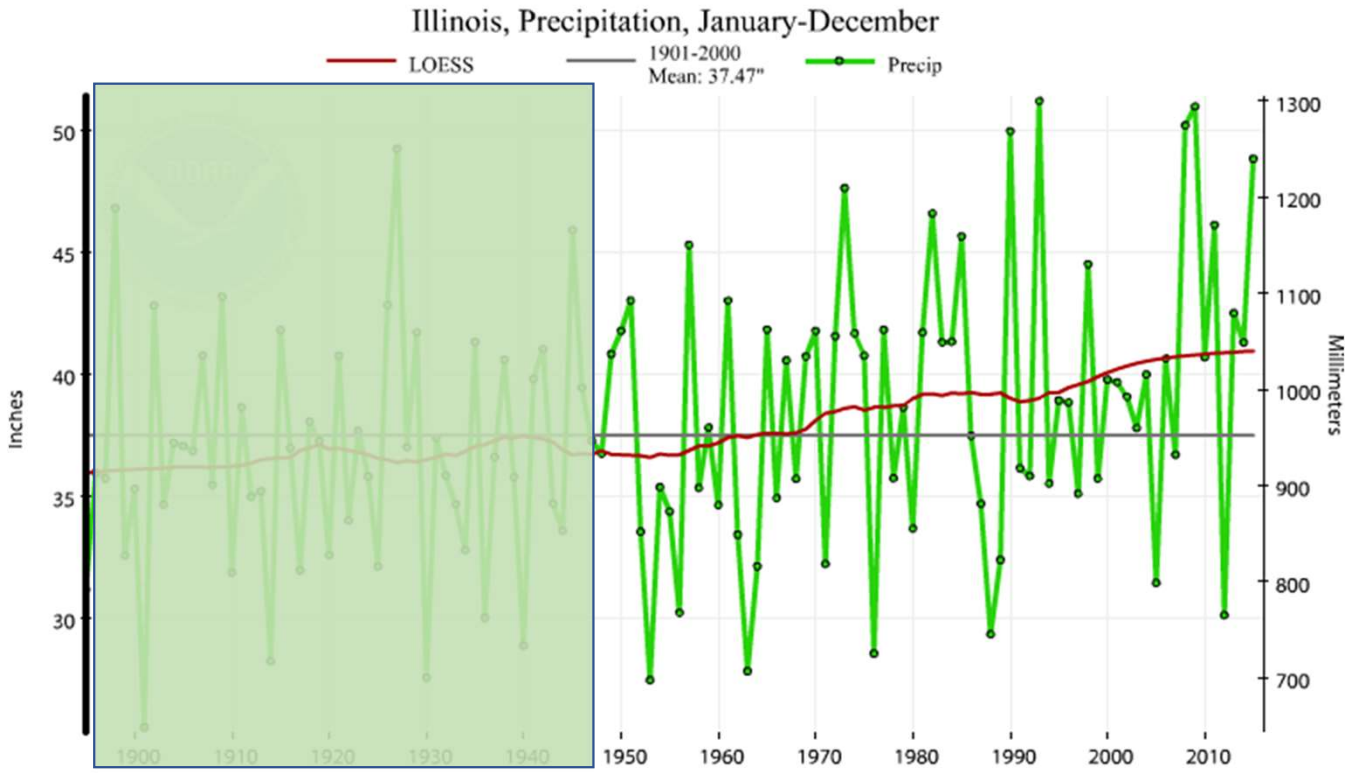


Disrupt transportation

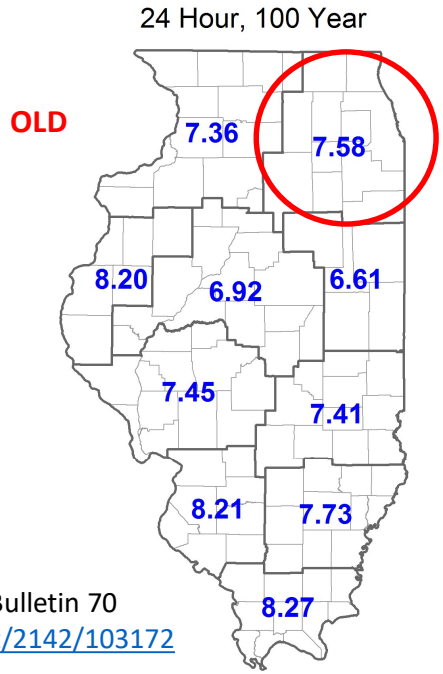
Rainfall frequency sources
TP-40, ISWS Bulletin 70, NOAA Atlas 14, ISWS Bulletin 75

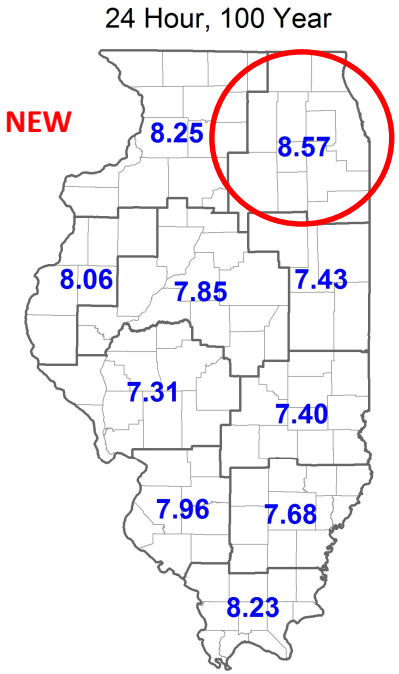


For example, the “100-year storm”

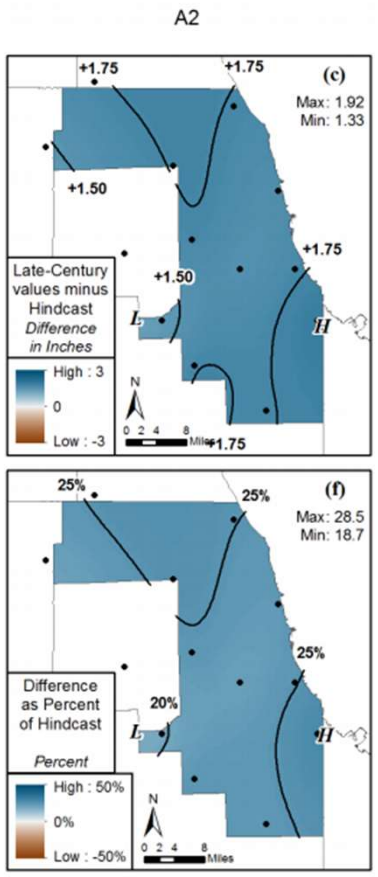

Illinois, Precipitation, January-December
LOESS
1901-2000
Mean: 37.47"
Precip
Inches
Millimeters
50
45
40
35
30
1300
1200
1100
1000
900
800
700
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

Old and New 100-Yr, 24-Hour Storm





From the Update to Bulletin 70
http://hdl.handle.net/2142/103172



Modeled Increase in the late 21st Century 100-year, 24-hour storm based on a high emission scenario

https://www.isws.illinois.edu/pubdoc/CR/ISWSCR2016-05.pdf

Champaign County's press-brake tub girder bridge has a 100-year total bridge service life for an upfront cost that is less than the concrete beam option.

FOR IMMEDIATE RELEASE
December 1, 2023

CONTACTS:
Kim Biggs, Illinois EPA - (217) 558-1536
Lori Harlan, IDOA - (217) 558-1546

Illinois' Efforts to Improve Water Quality Detailed in 2023 Nutrient Loss Reduction Strategy Biennial Report

SPRINGFIELD, Ill. — Illinois' ongoing commitment to water quality is demonstrated in the 2023 Biennial Report of the Illinois Nutrient Loss Strategy (NLRS). The report has been developed by the Illinois Environmental Protection Agency (Illinois EPA), Illinois Department of Agriculture (IDOA), and University of Illinois Extension, and is available at go.illinois.edu/NLRS.

The 2023 Biennial Report is the fourth update to the strategy since its inception in 2015. Implementation of the NLRS is guided by research to optimize nutrient loss reduction while fostering deep collaboration and innovation across academia, the private sector, non-profits, wastewater agencies, and local, state, and federal government agencies. The report details the progress of the State's efforts to improve water quality by reducing nutrient pollution, which affects both local waterways and the Gulf of Mexico. It outlines initiatives in 2021–22 that reduce nutrient loss across the agricultural, wastewater, and urban stormwater sectors and stresses the multifaceted challenges to addressing nutrient loss.

Statewide water yields and nitrate loads

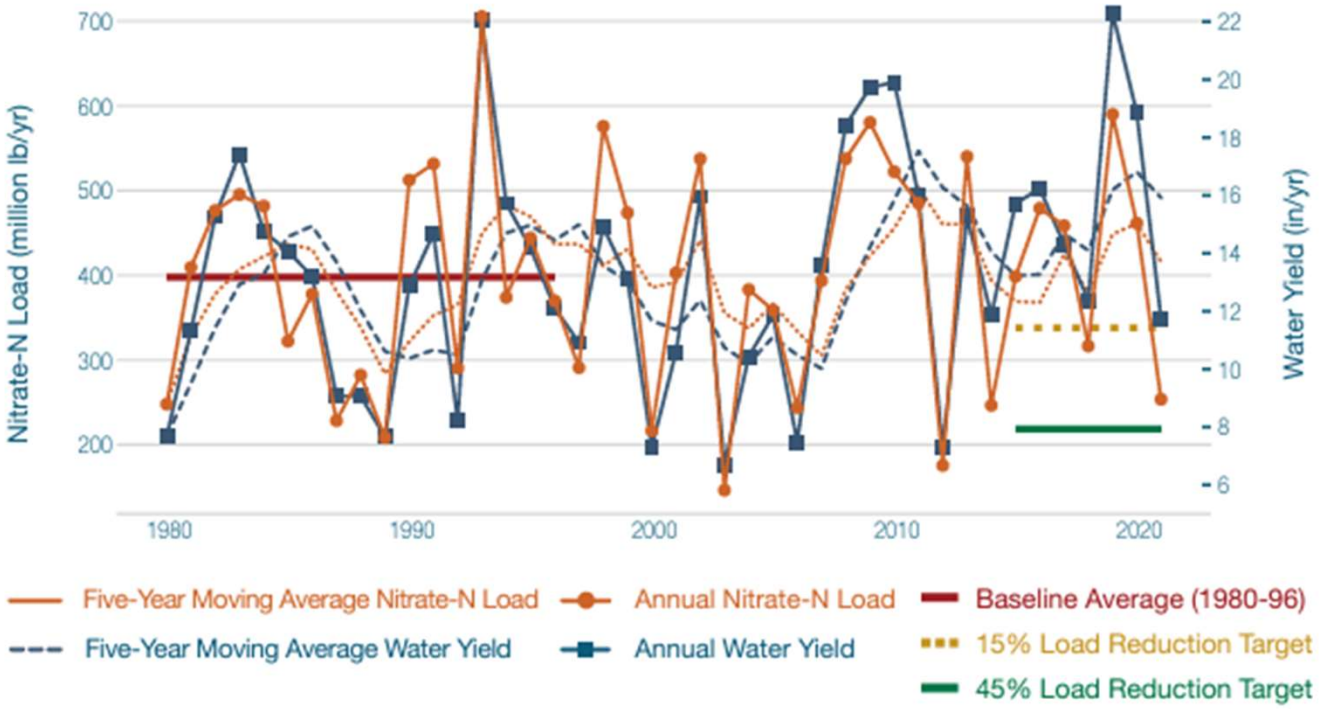
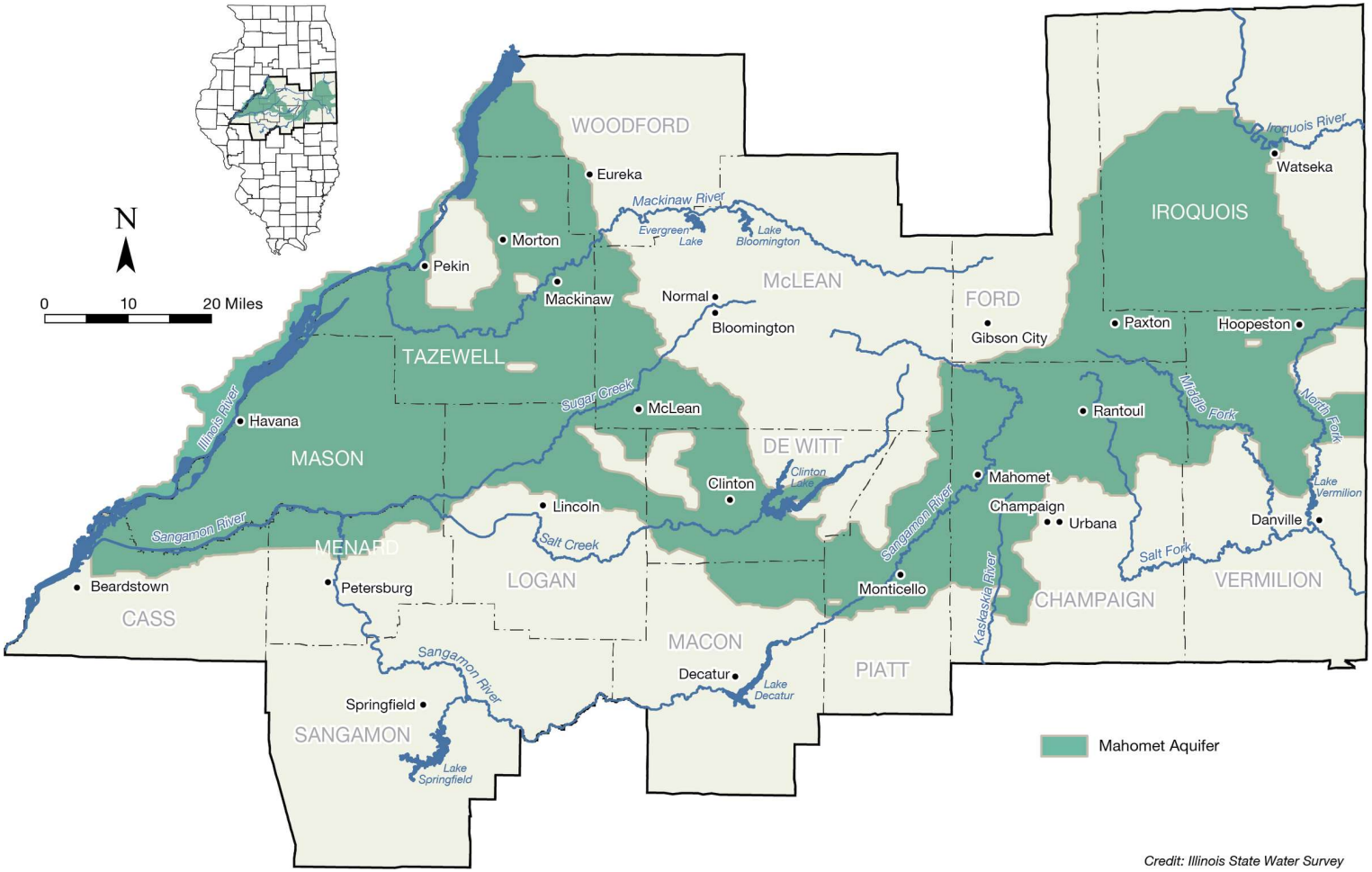


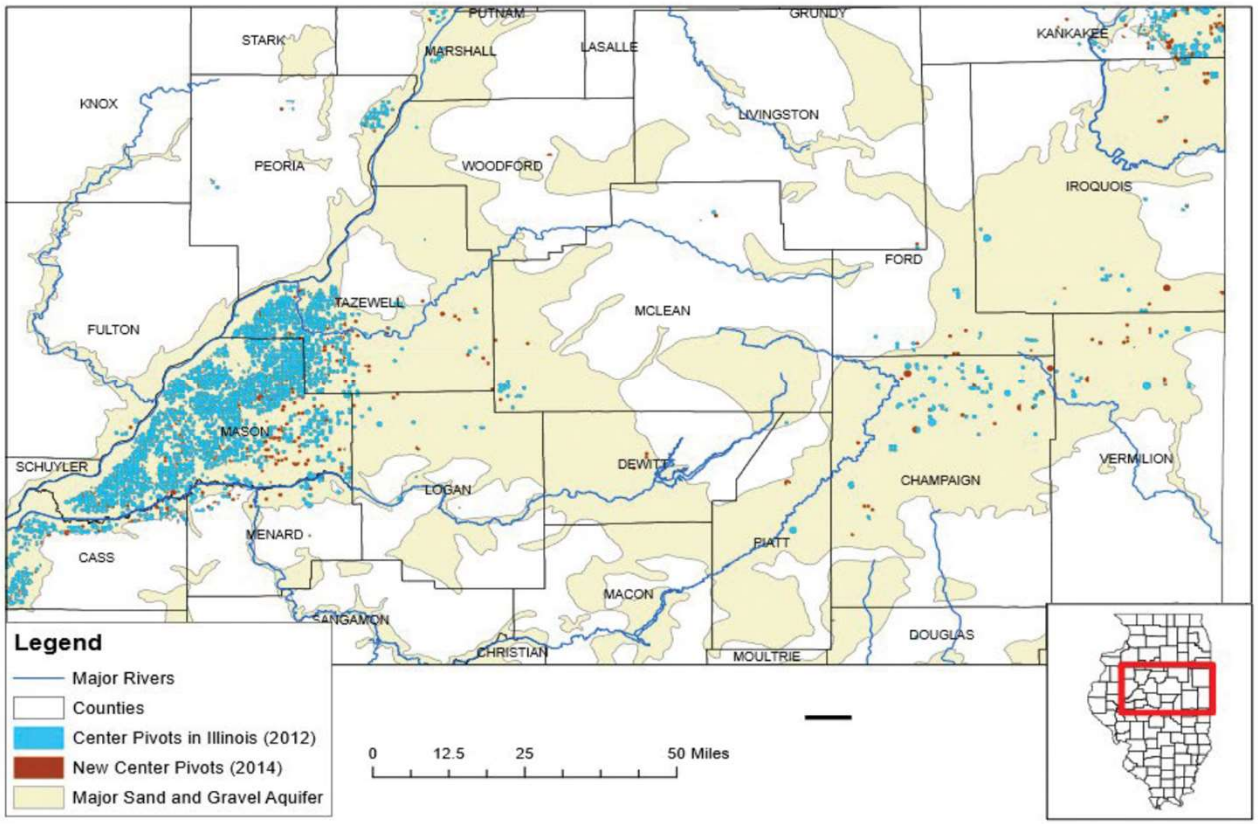
Figure 3.2. *Statewide estimated annual water yields, annual nitrate-nitrogen loads, five-year moving averages, and average load for the 1980–96 baseline period*

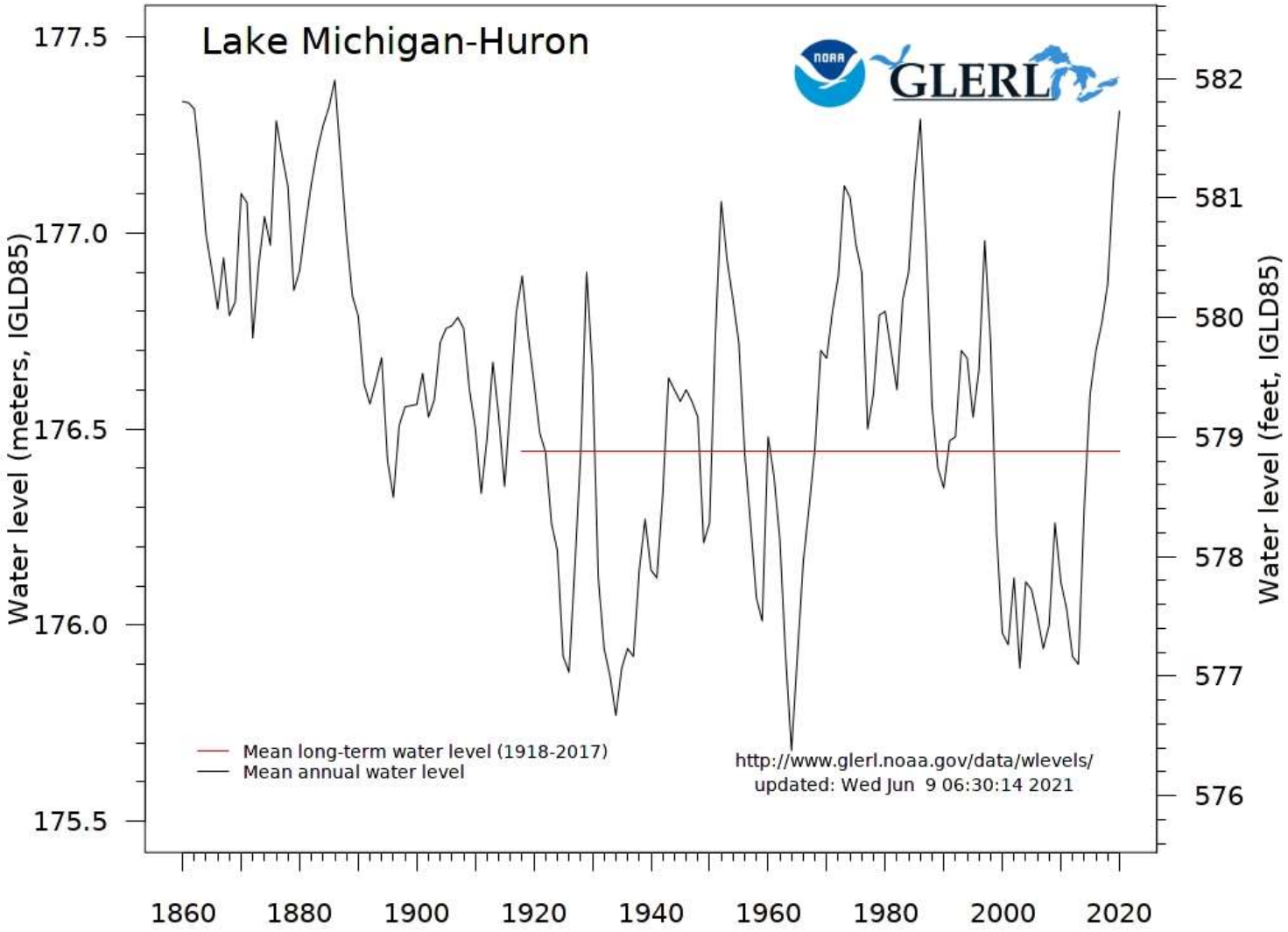
Mahomet Aquifer



Credit: Illinois State Water Survey

Irrigation


PUTNAM
GRUNDY
KANKAKEE
STARK
MARSHALL
LASALLE
KNOX
LIVINGSTON
PEORIA
WOODFORD
IROQUOIS
FORD
TAZEWELL
MCLEAN
FULTON
MASON
SCHUYLER
DEWITT
VERMILION
CHAMPAIGN
LOGAN
MENARD
PIATT
CASS
MACON
SANGAMON
DOUGLAS
CHRISTIAN
MOULTRIE
Legend
Major Rivers
Counties
Center Pivots in Illinois (2012)
New Center Pivots (2014)
Major Sand and Gravel Aquifer
0
12.5
25
50 Miles



Source: https://www.glerl.noaa.gov/data/wlevels/lowlevels/plot/MichHuron.jpg

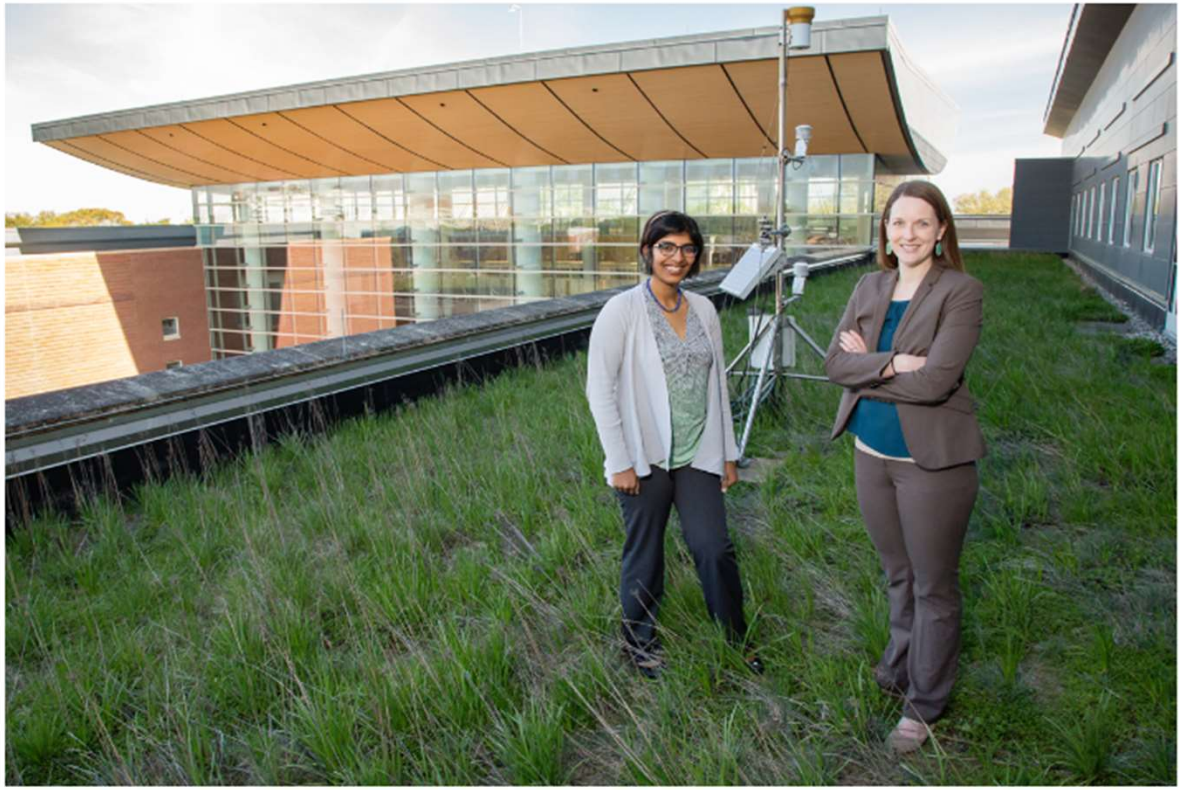
Eliana Brown says “As the first rain garden on campus, this garden is both beautiful and smart. It addresses flooding in an innovative way—by planting an attractive landscape feature that captures and cleans up stormwater.” The garden plants, which are mostly native to Illinois, have extensive root systems that are excellent at soaking up water.

Before and After

Impervious Pavers

City of Niles, IL, 2020

Green Roofs



Graduate student Reshmina William, left, and civil and environmental engineering professor Ashlynn Stillwell pause on the green roof over the Business Instructional Facility at the University of Illinois. Their research is helping to simultaneously evaluate the performance of green roofs and communicate their findings with urban planners, policymakers and the general public.

Photo by L. Brian Stauffer

https://news.illinois.edu/view/6367/527083

Boneyard Creek Project

Impacts to Water Resources

All major water issues in Illinois have been affected by climate change. Some of the key issues in Illinois include floods, droughts and water quality:

- Flooding affects water quality in urban and other areas, causing economic costs, environmental damage and public health hazards. River/urban flooding, driven primarily by precipitation trends, has been increasing and is expected to continue to increase.

Impacts to Water Resources

All major water issues in Illinois have been affected by climate change. Some of the key issues in Illinois include floods, droughts and water quality:

- Extended droughts may increase risks of inadequate water supply.
- Increased precipitation intensity tends to increase nutrient loads (nitrogen and phosphorus) in rivers.

Thank you

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