Climate Trends and Challenges in the Miami Valley

Aaron B. Wilson

2022 Climate Change Seminar: Making the Business Case for Climate Action
26 April 2022

THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Cox Media Group

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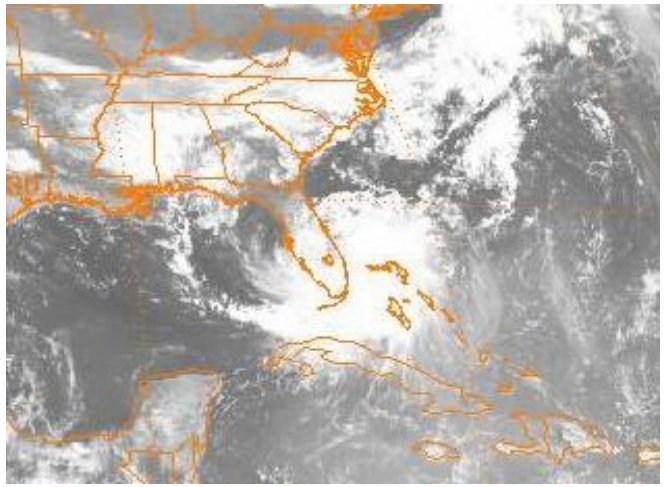
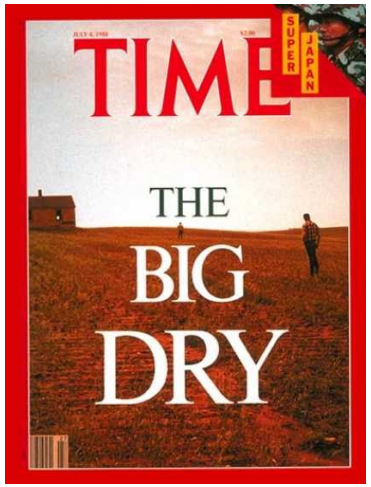
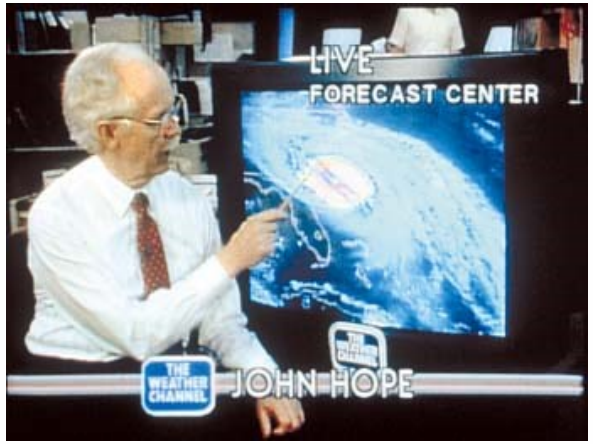
MY BACKGROUND







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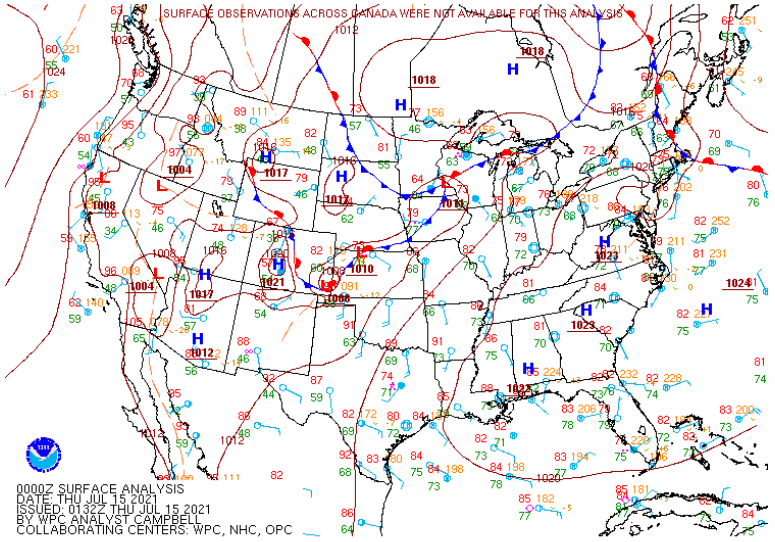
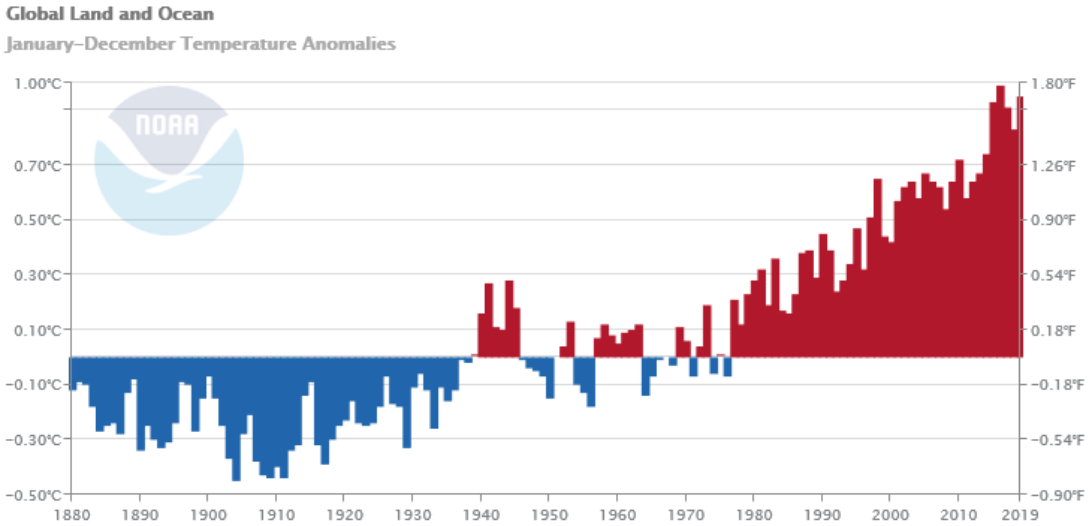

SURFACE OBSERVATIONS ACROSS CANADA WERE NOT AVAILABLE FOR THIS ANALYSIS
0000Z SURFACE ANALYSIS
DATE: THU JUL 15 2021
ISSUED: 0132Z THU JUL 15 2021
BY WPC ANALYST CAMPBELL
COLLABORATING CENTERS: WPC, NHC, OPC


Global Land and Ocean
January–December Temperature Anomalies
NOAA
1.00°C
0.70°C
0.50°C
0.30°C
0.10°C
-0.10°C
-0.30°C
-0.50°C
1.80°F
1.26°F
0.90°F
0.54°F
0.18°F
-0.18°F
-0.54°F
-0.90°F
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010
2019

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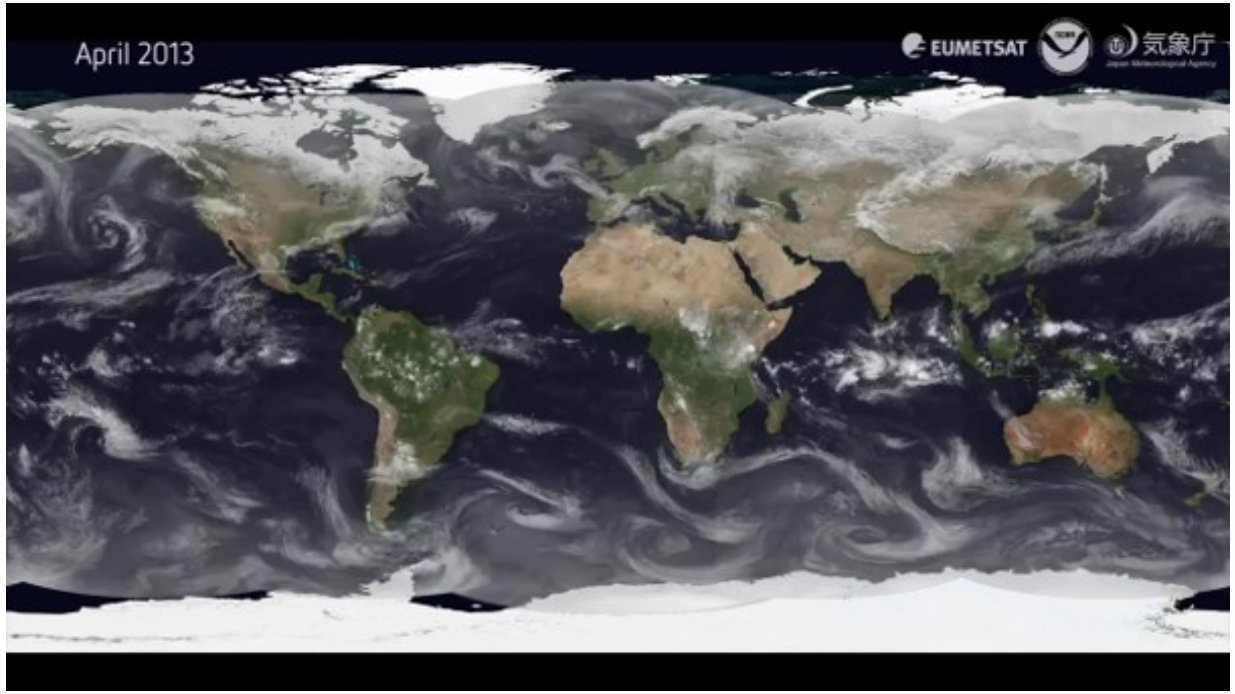
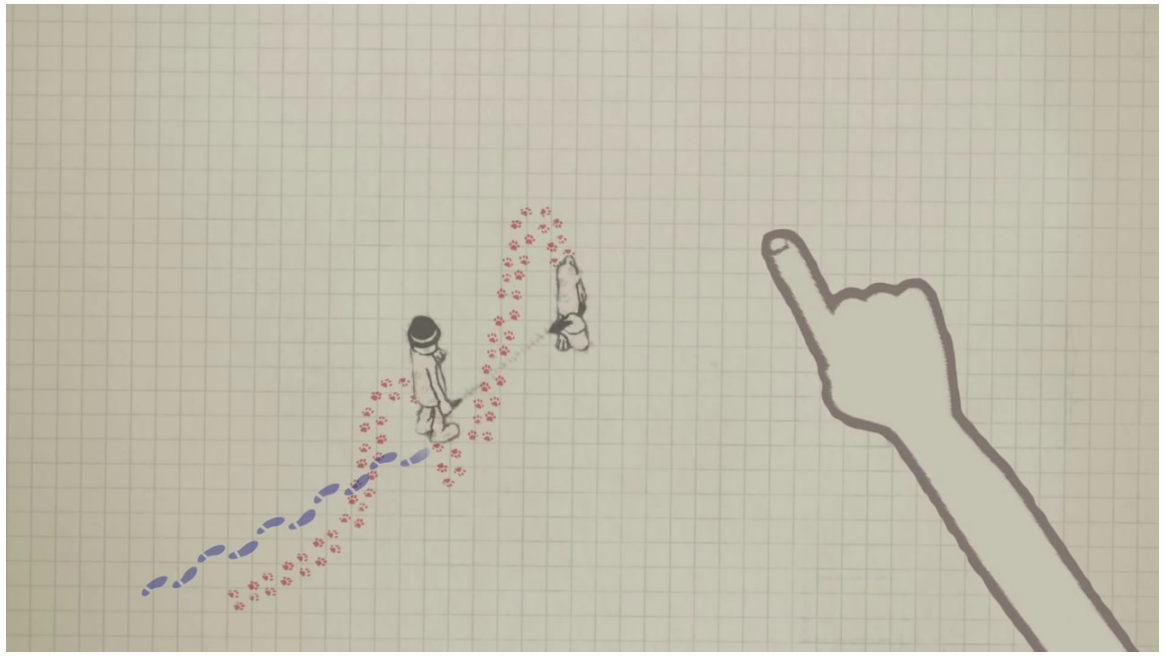
WEATHER AND CLIMATE

Video from UCAR: Center for Science Education - https://scied.ucar.edu/dog-walking-weather-and-climate



Climate: Slower-varying aspects; Averages over longer periods.



Weather: High-frequency changes in temperature, wind speed, etc; Caused by imbalance of energy across the globe.

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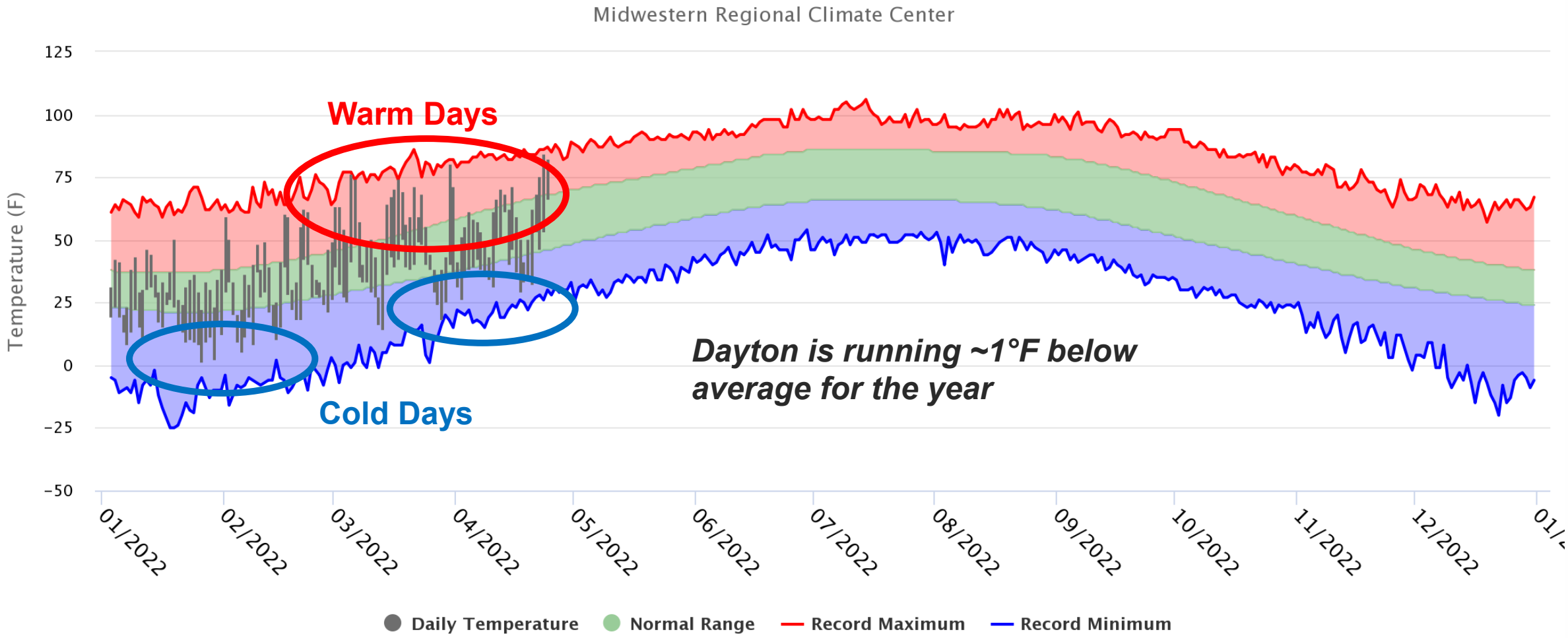
2022 TEMPERATURE SUMMARY: Dayton, Ohio



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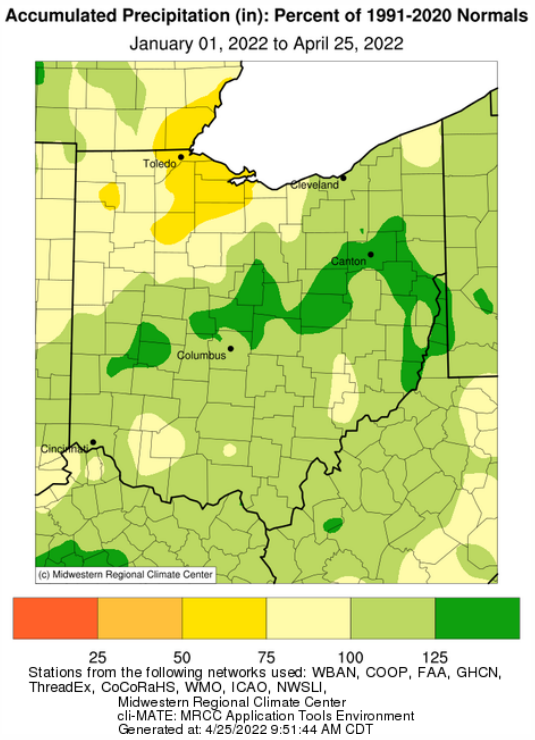
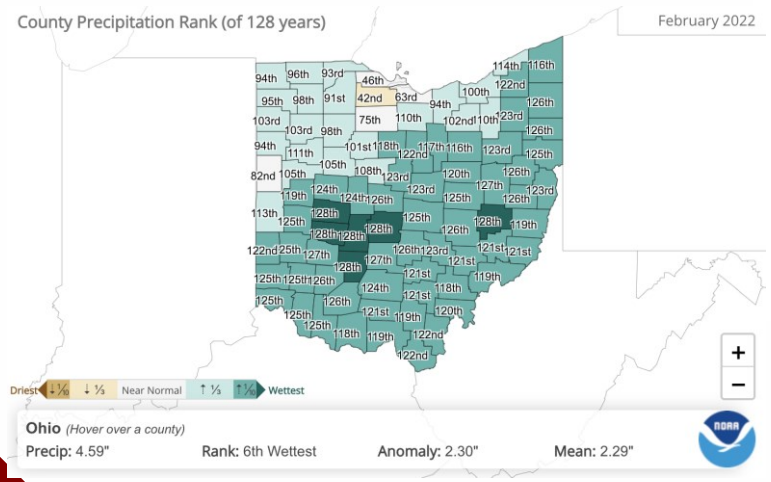
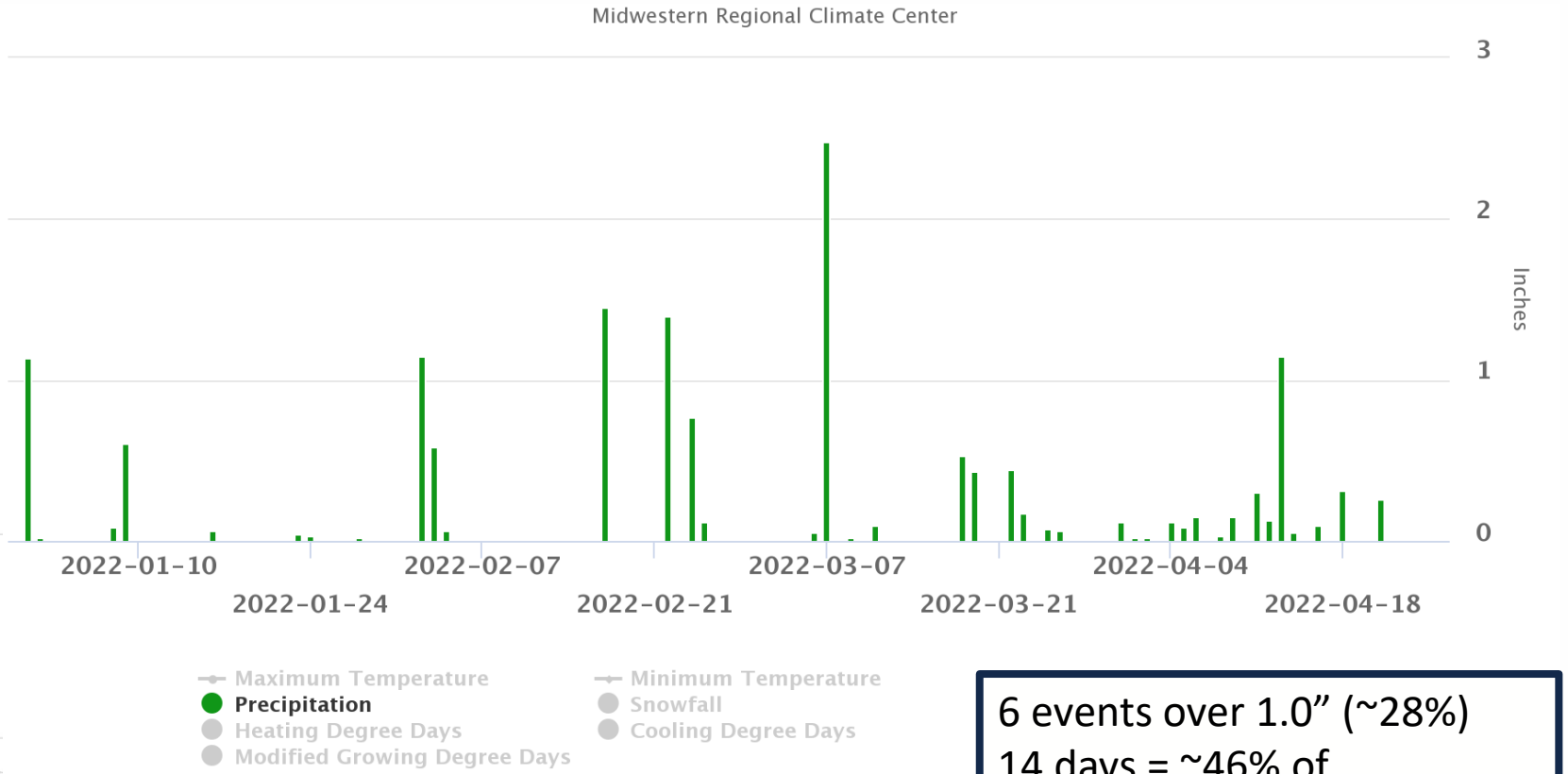
2022 PRECIPITATION SUMMARY: Dayton, Ohio







6 events over 1.0” (~28%)
14 days = ~46% of precipitation (47.79”)

FIRST TWO TAKEAWAYS

- Weather and Climate are related but describe different scales of events.
- What happens in your backyard or at your place of business matters and may vary significantly from neighboring counties and states.

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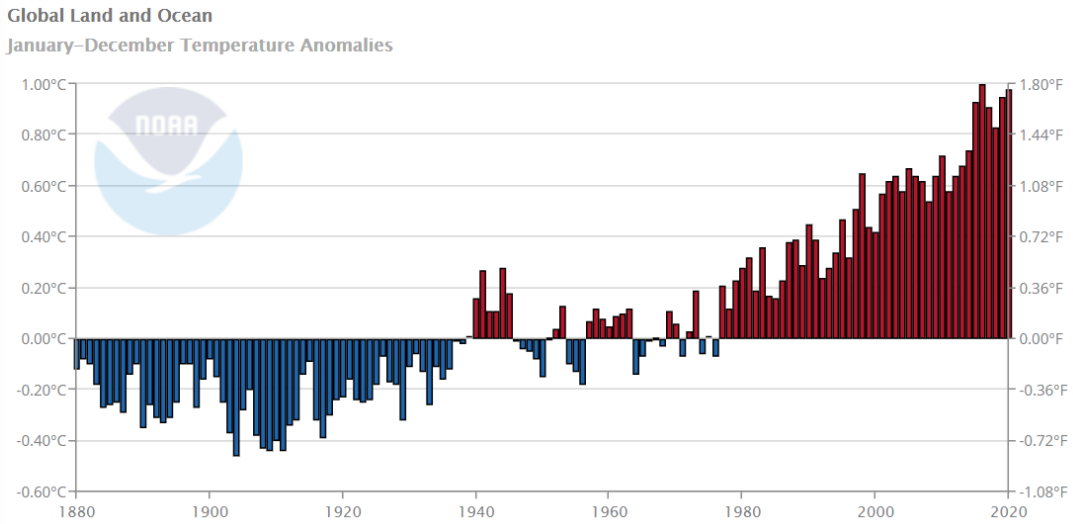
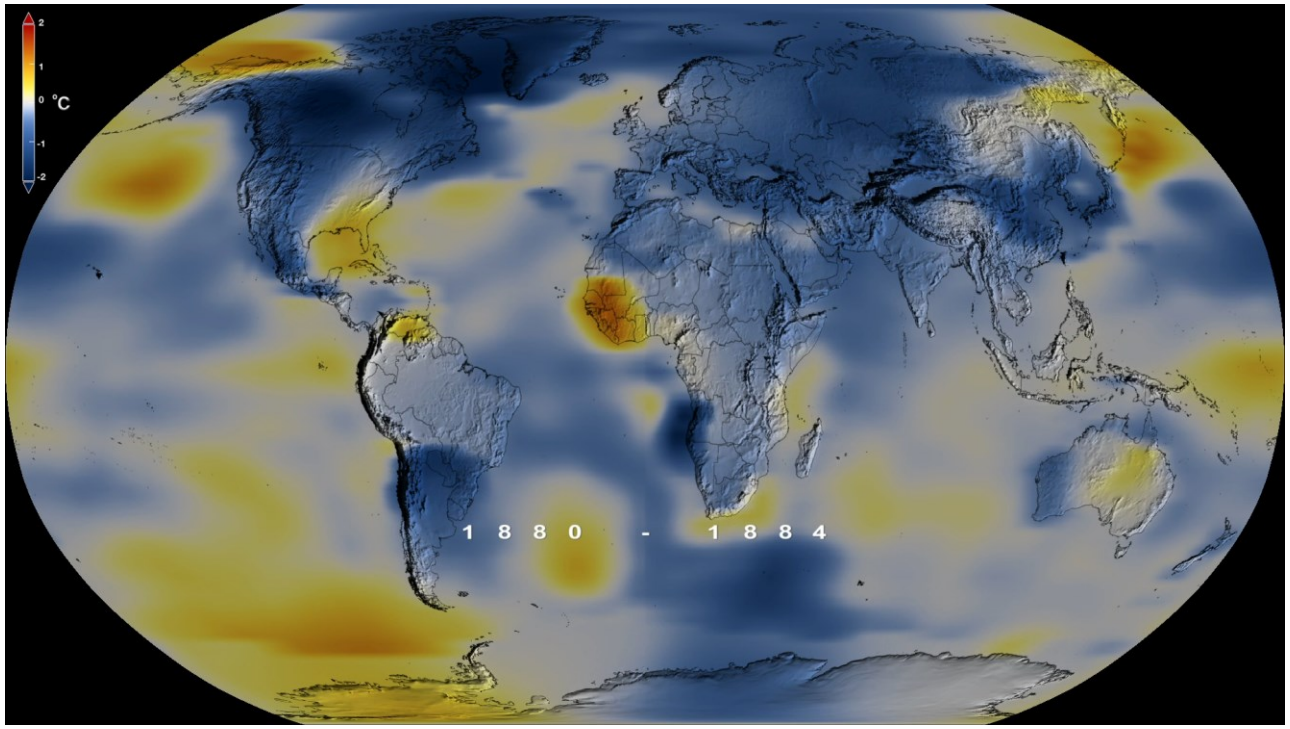
GLOBAL ASSESSMENT





- 2021 is the 6th warmest year since 1880
- Top 10 warmest years have occurred since 2005
- Last 7 years (since 2015) are top 7 warmest
- If you were born after February 1985, you have never experienced a cooler than average month for the planet!

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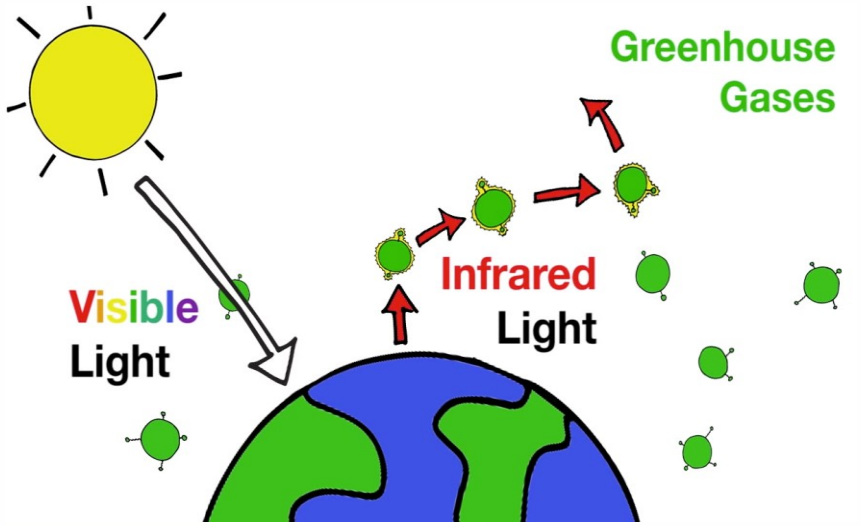
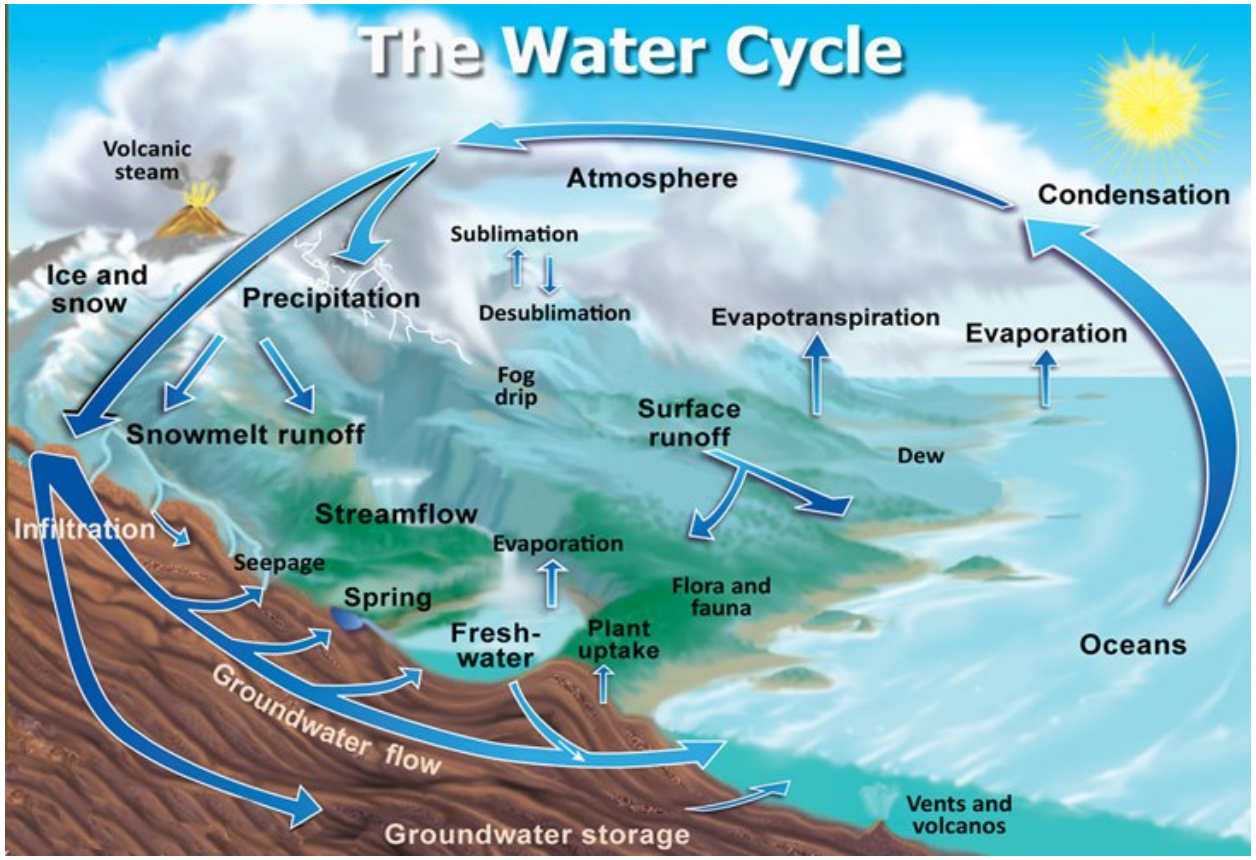
HOW THE ATMOSPHERE WARMS & WHY IT MATTERS



HowGlobalWarmingWorks.org, 2014

- Greenhouse Gases (Water Vapor, Carbon Dioxide, Methane, Nitrous Oxide) absorb energy from the Earth's Surface = Sustained Human Life

- Increase Water Vapor increasing is a function of temperature; Feedback loop → Warmer atmosphere intensifies Evaporation



John Evans and Howard Periman, USGS - http://ga.water.usgs.gov/edu/watercycle.html

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CO_2 AND TEMPERATURE

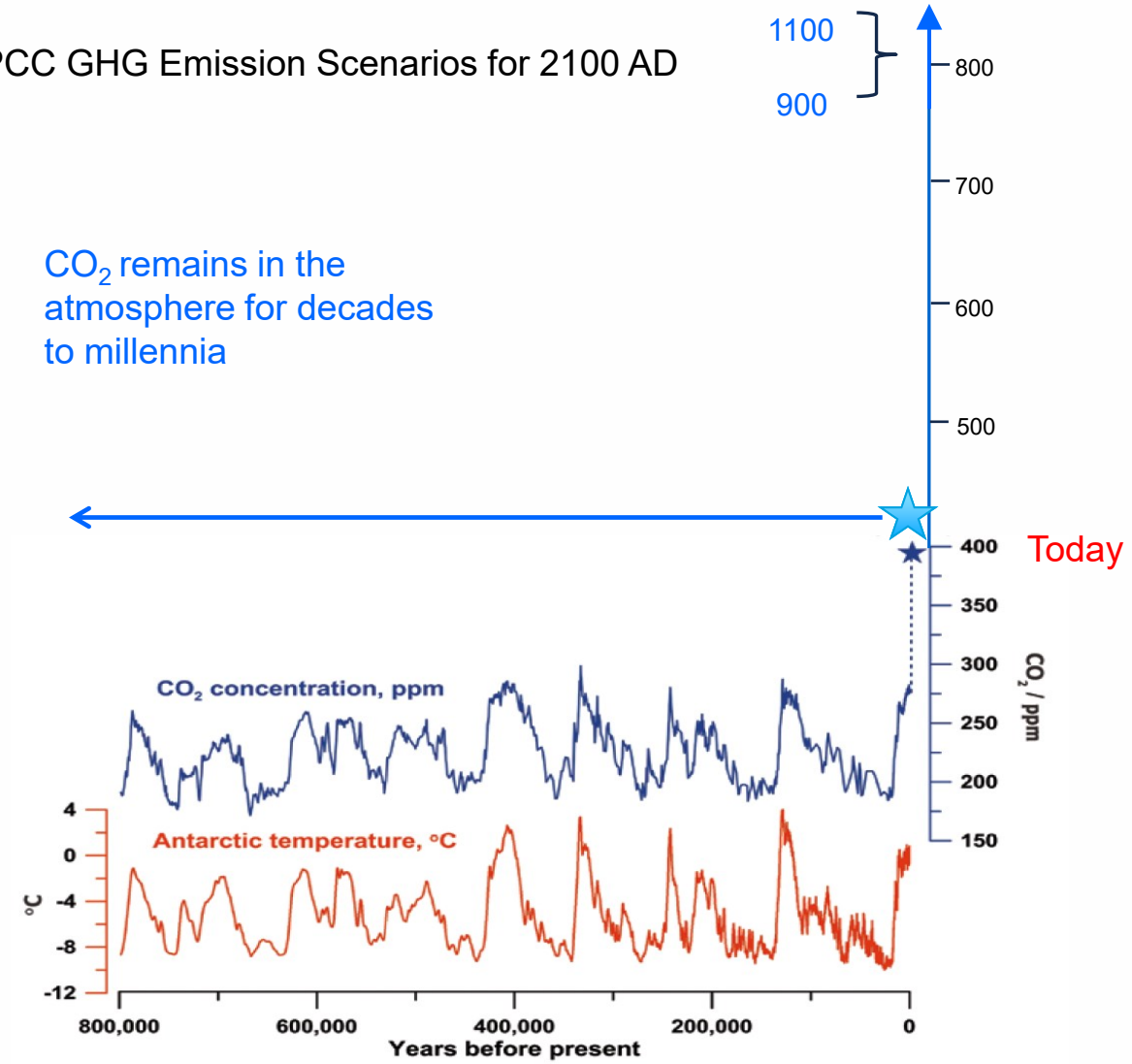
IPCC GHG Emission Scenarios for 2100 AD

1100

900

CO_2 remains in the atmosphere for decades to millennia

Today



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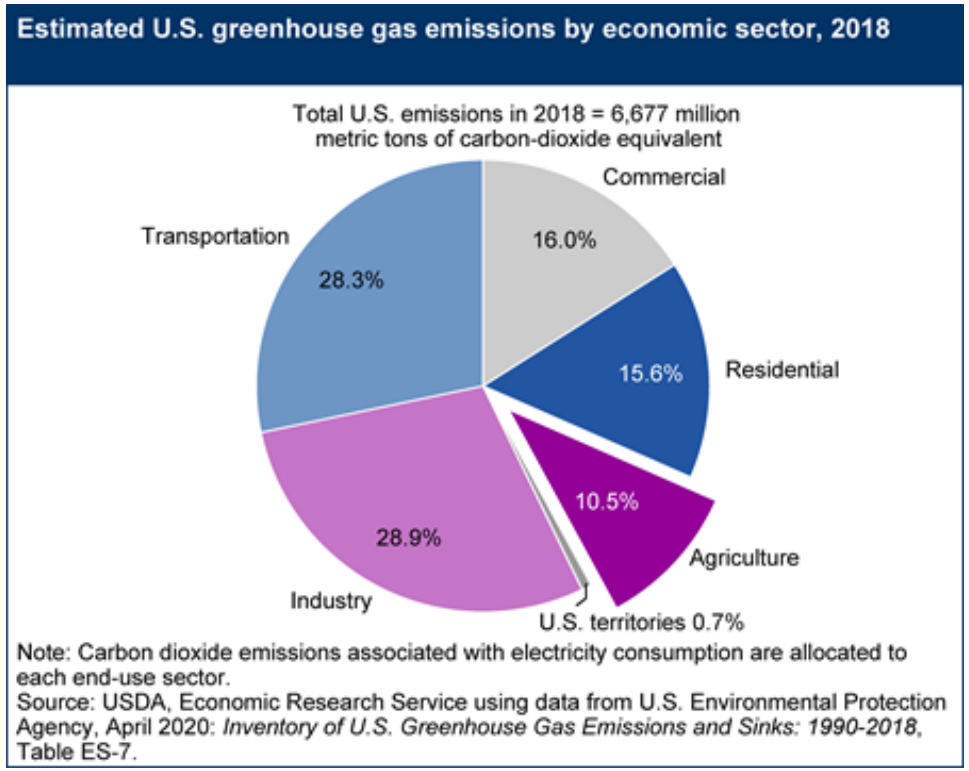
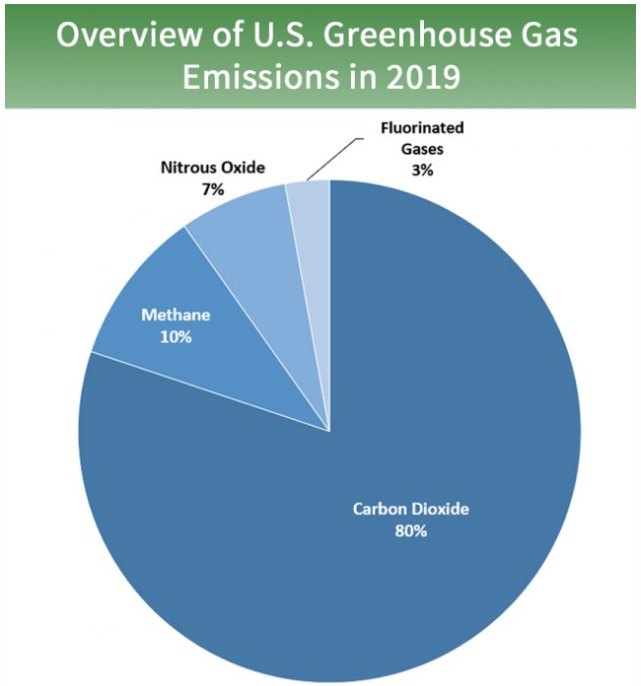
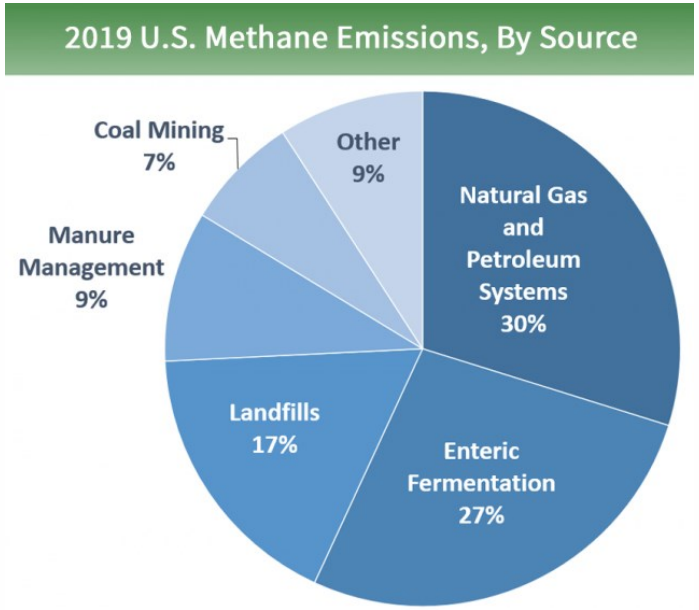
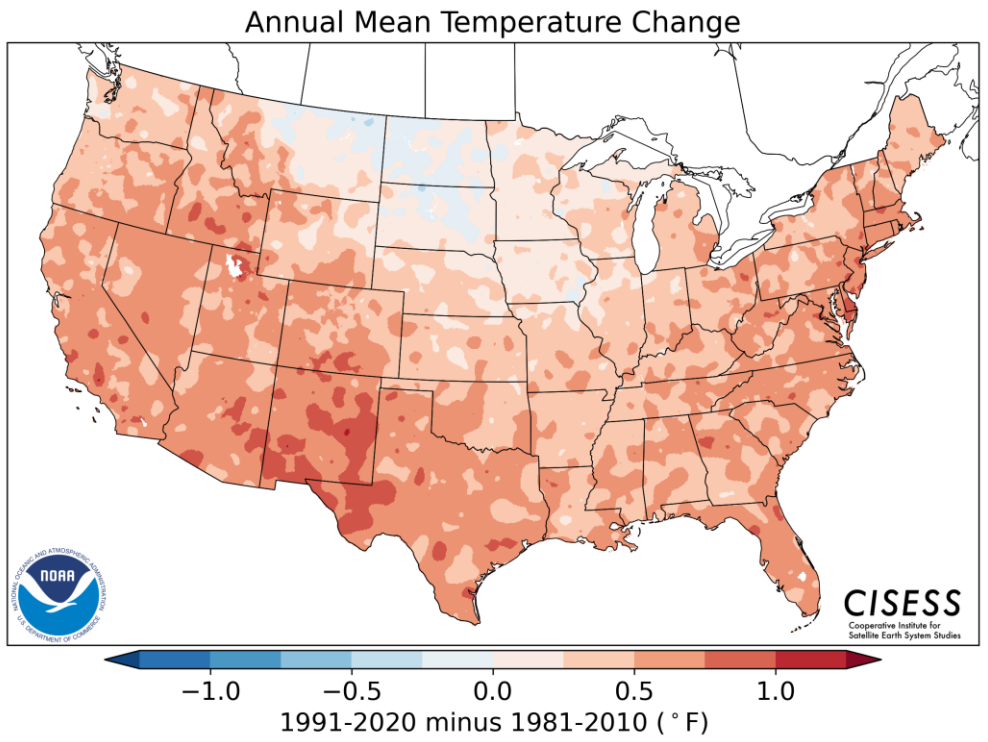
GHGs Emissions by Economic Sector

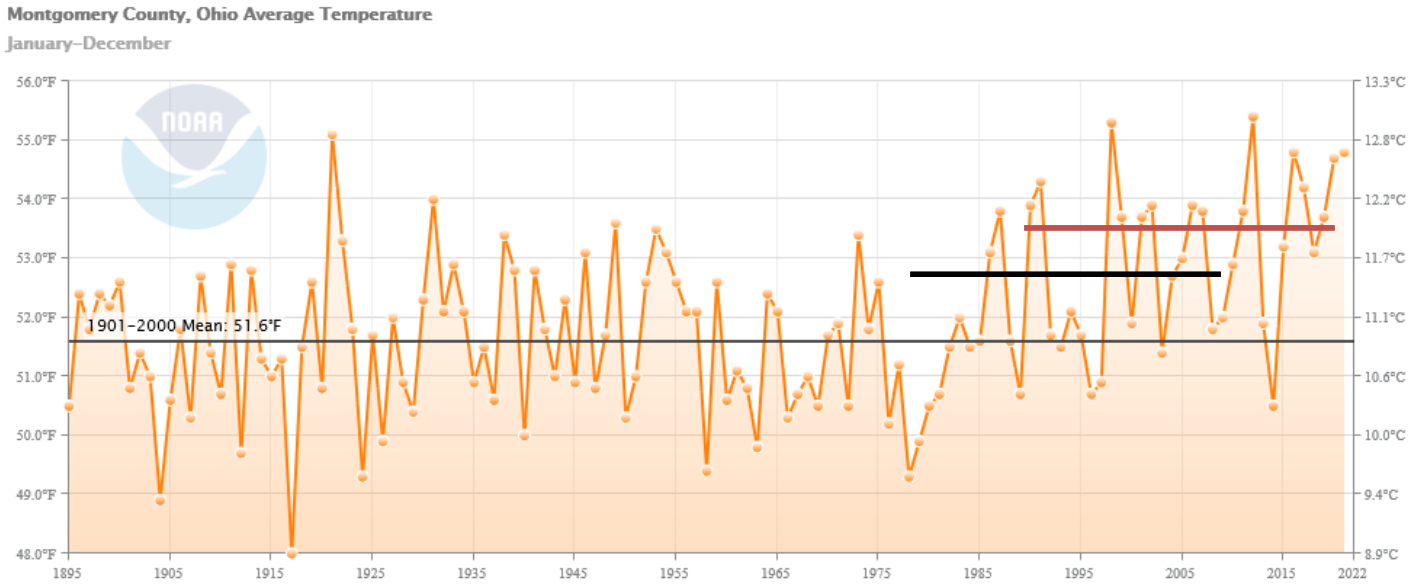






NWS NEW NORMALS: Temperature



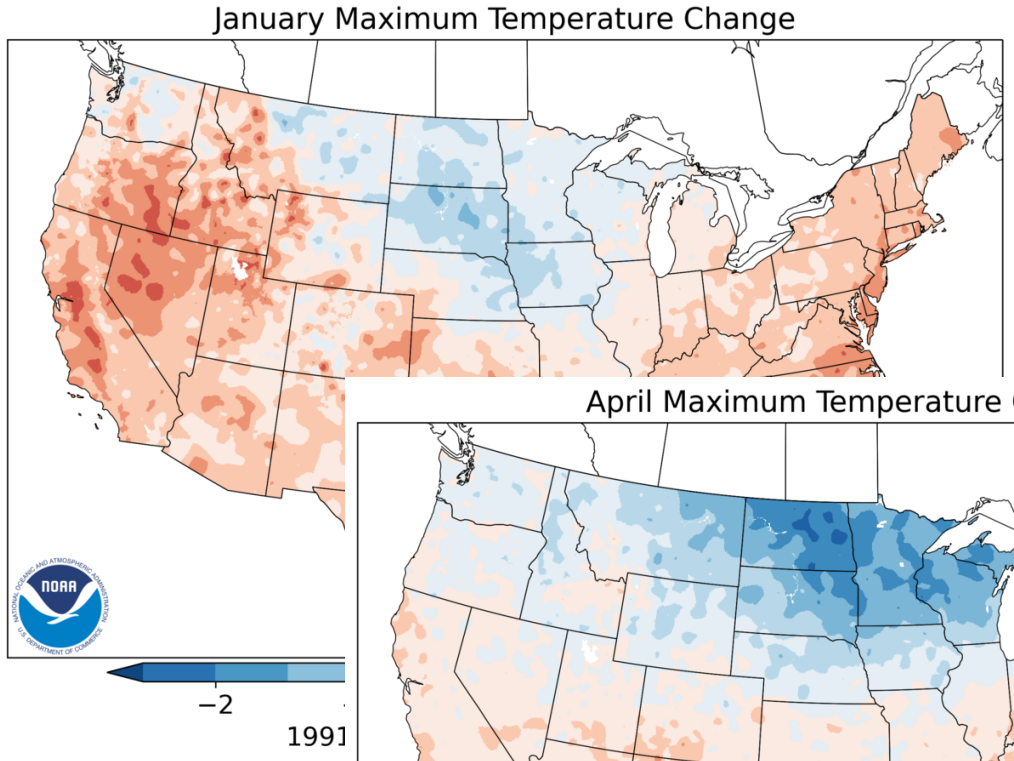


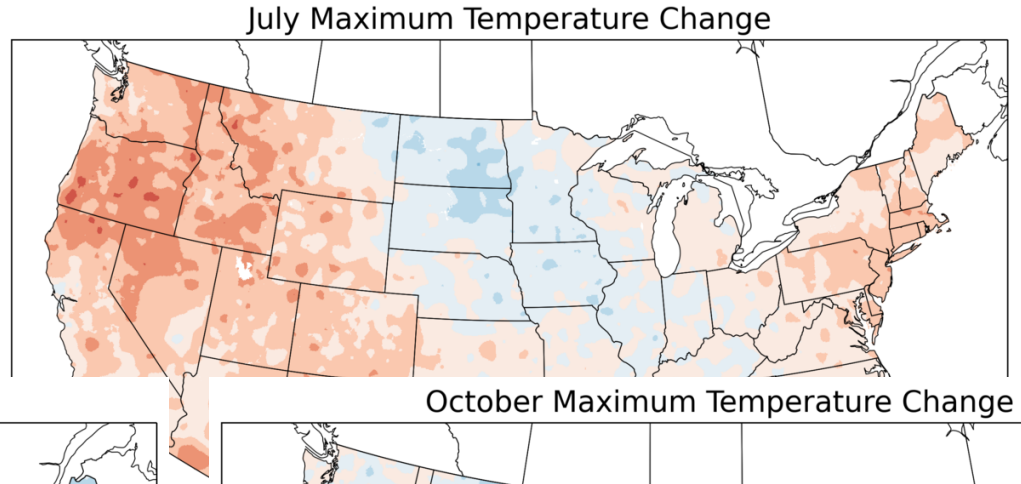
https://www.ncei.noaa.gov/products/us-climate-normals

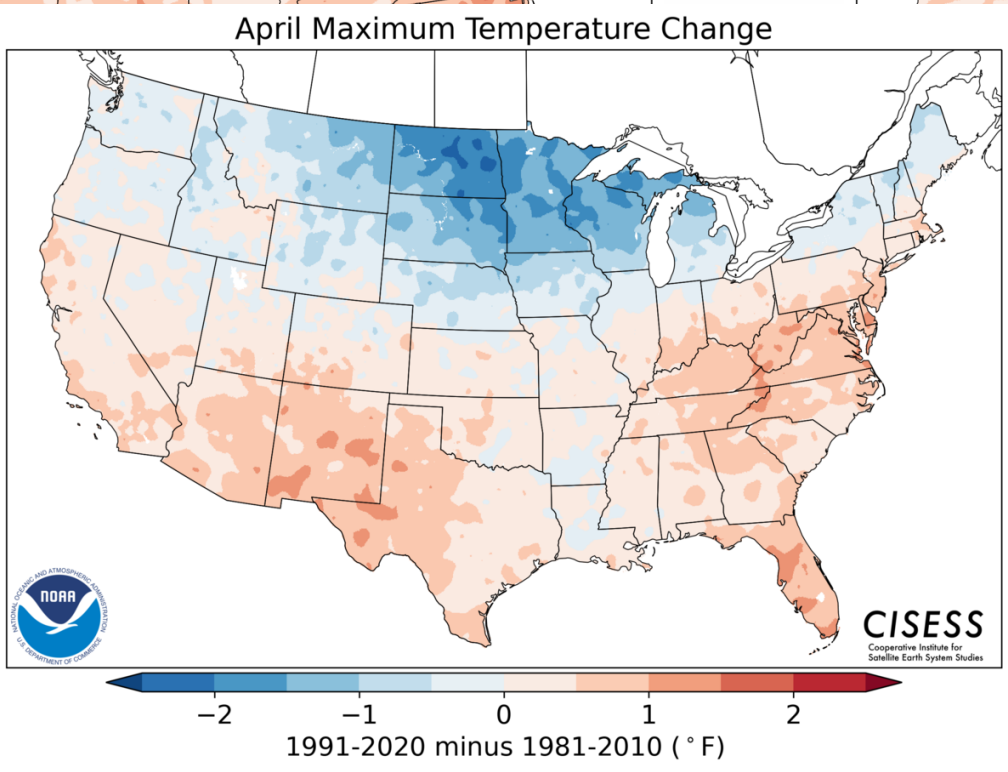
NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, published January 2022, retrieved on January 11, 2022 from https://www.ncdc.noaa.gov/cag/

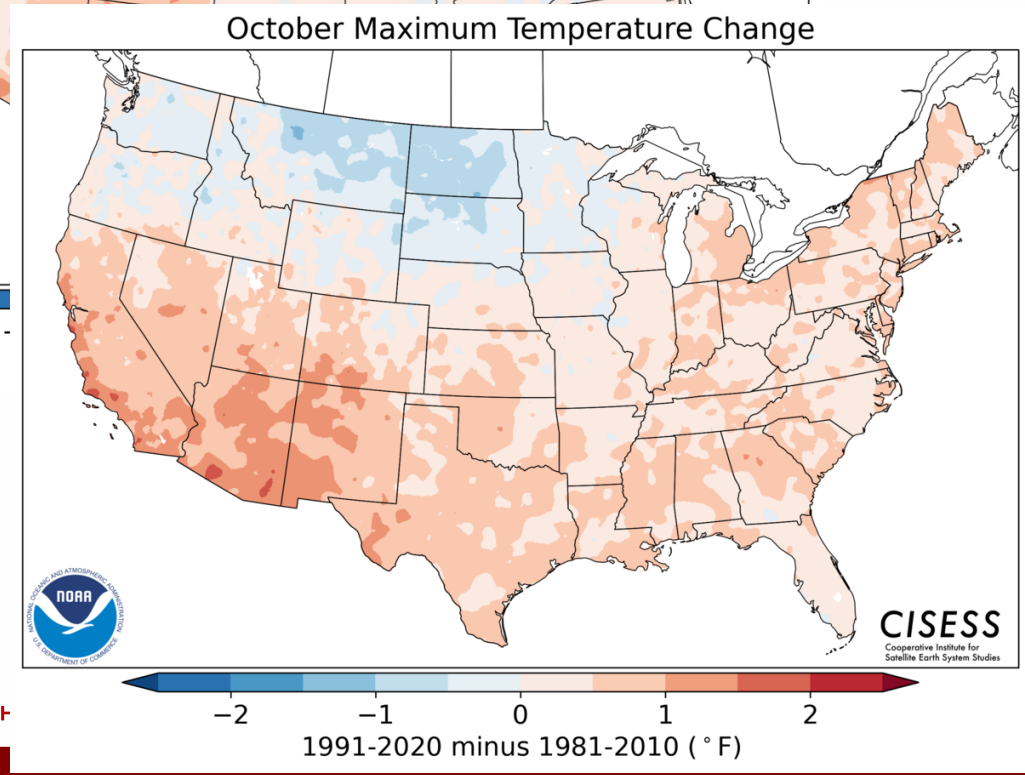
Seasonal Changes

https://www.ncei.noaa.gov/products/us-climate-normals









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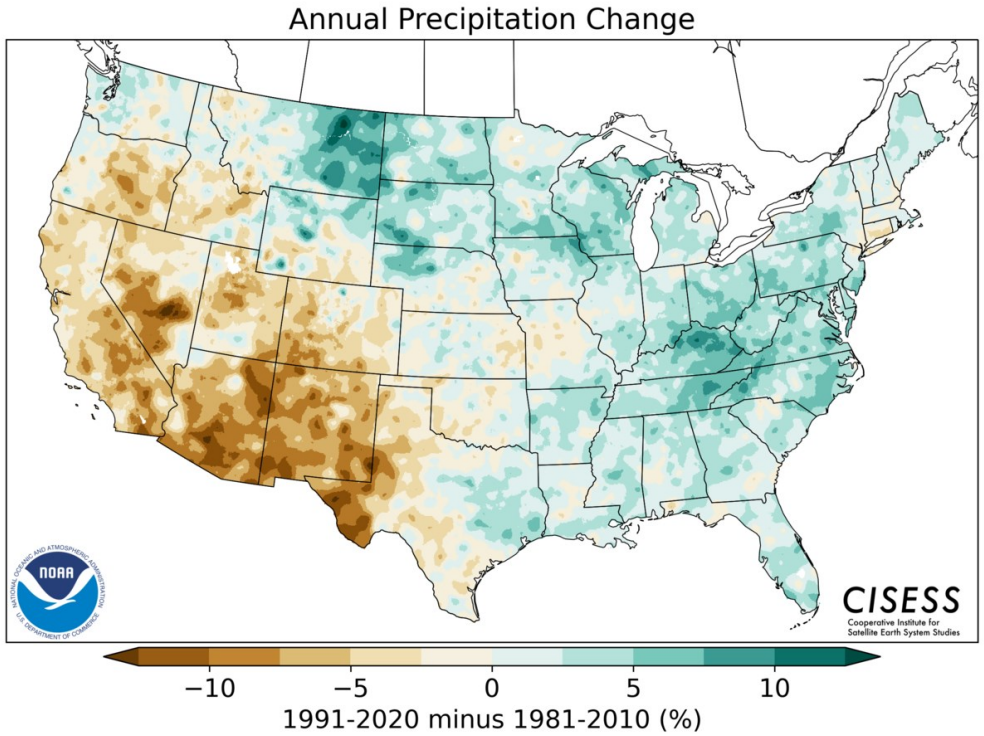
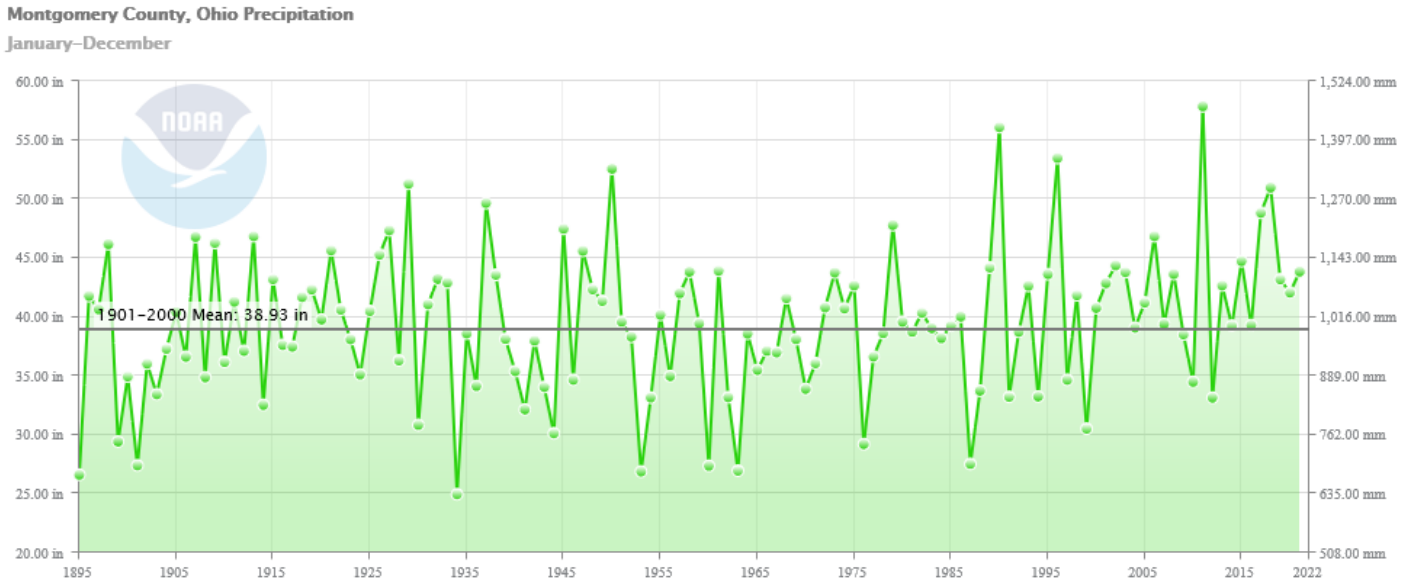
NWS NEW NORMALS: Precipitation





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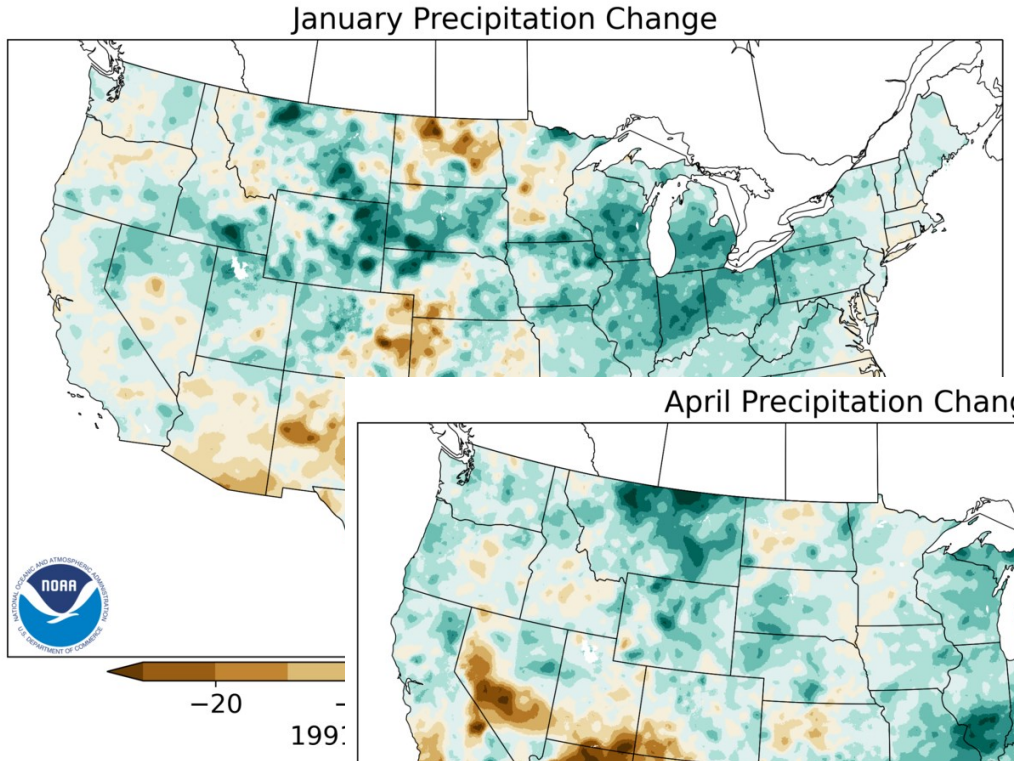

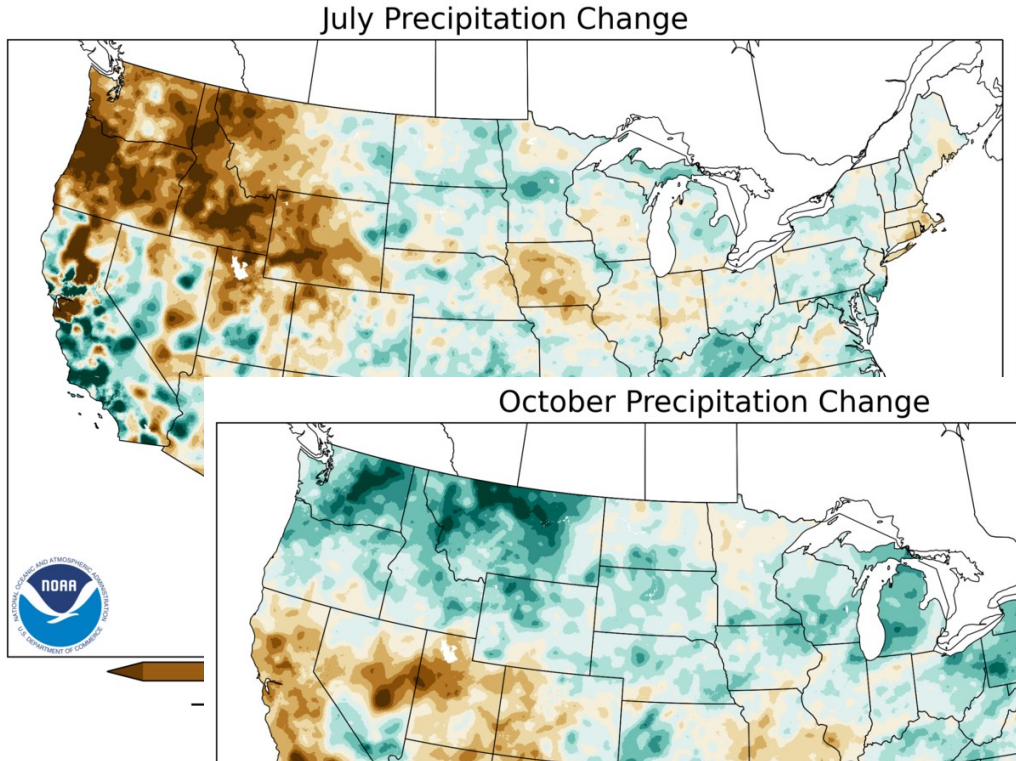

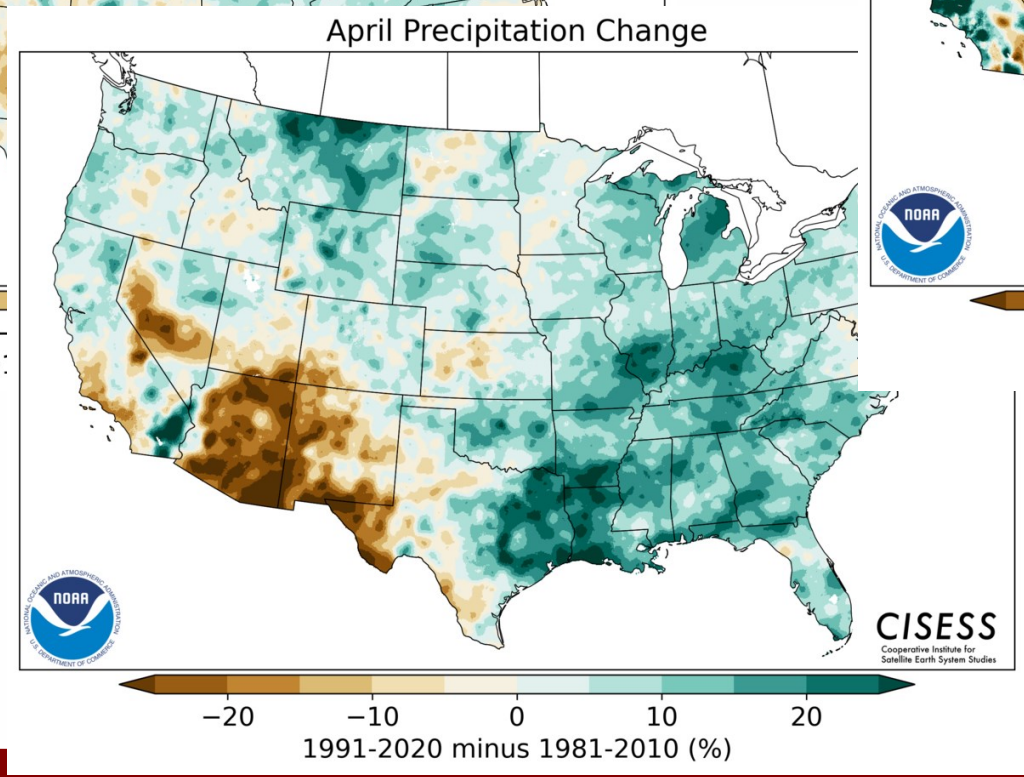

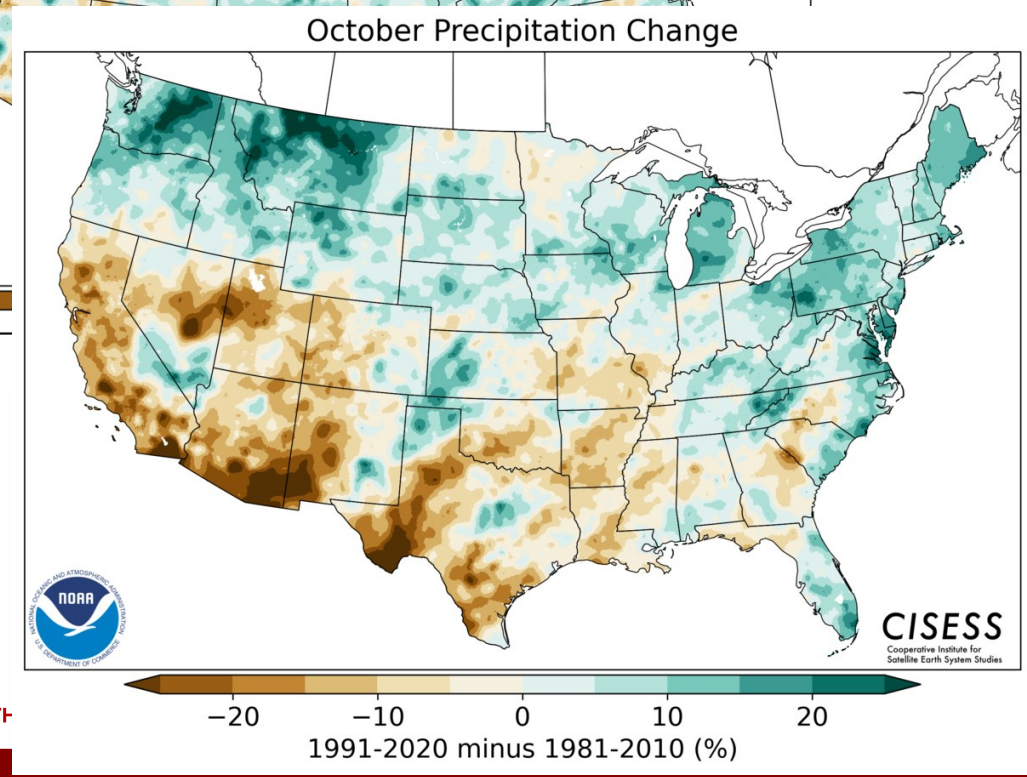

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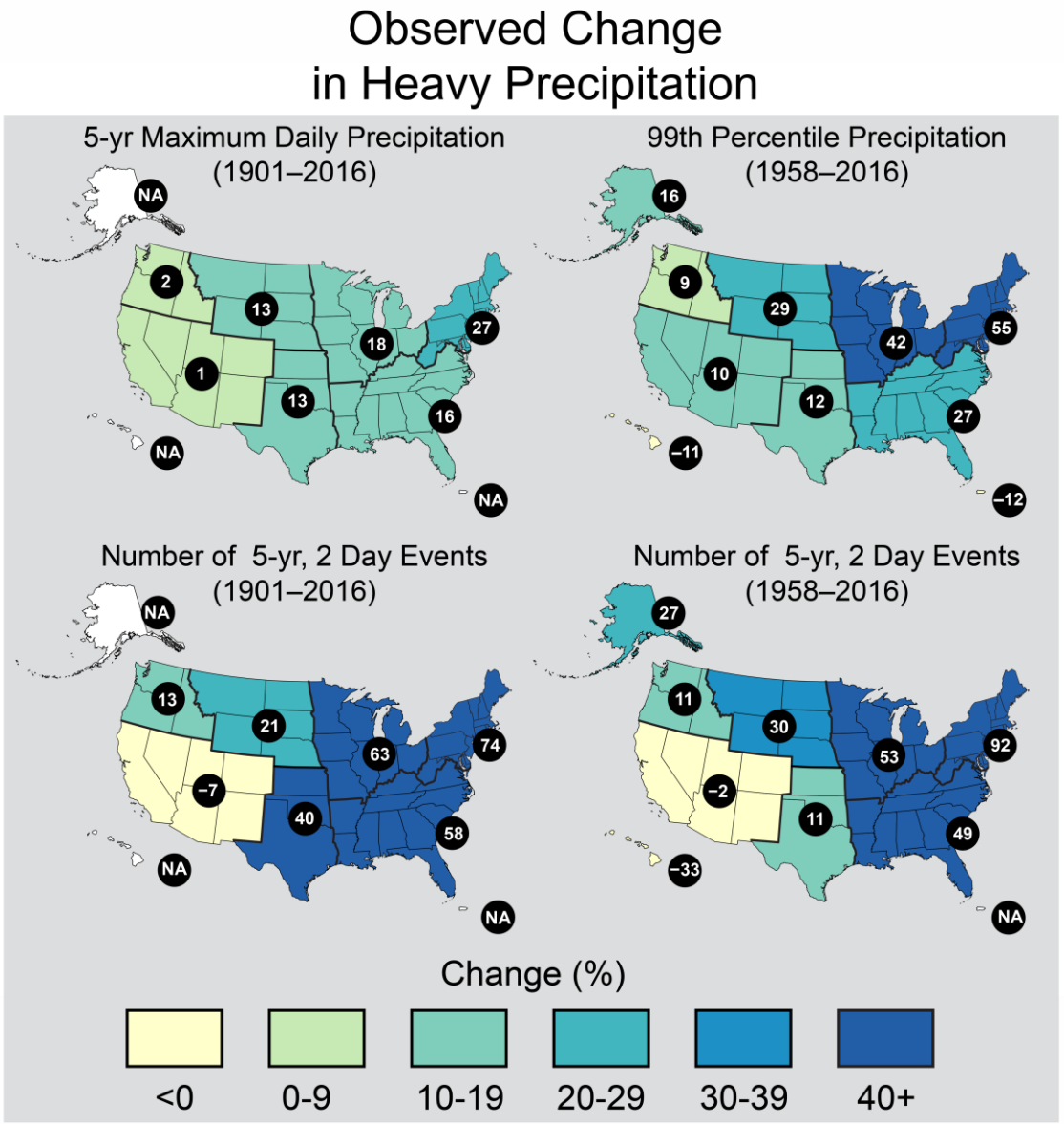
HEAVY PRECIPITATION

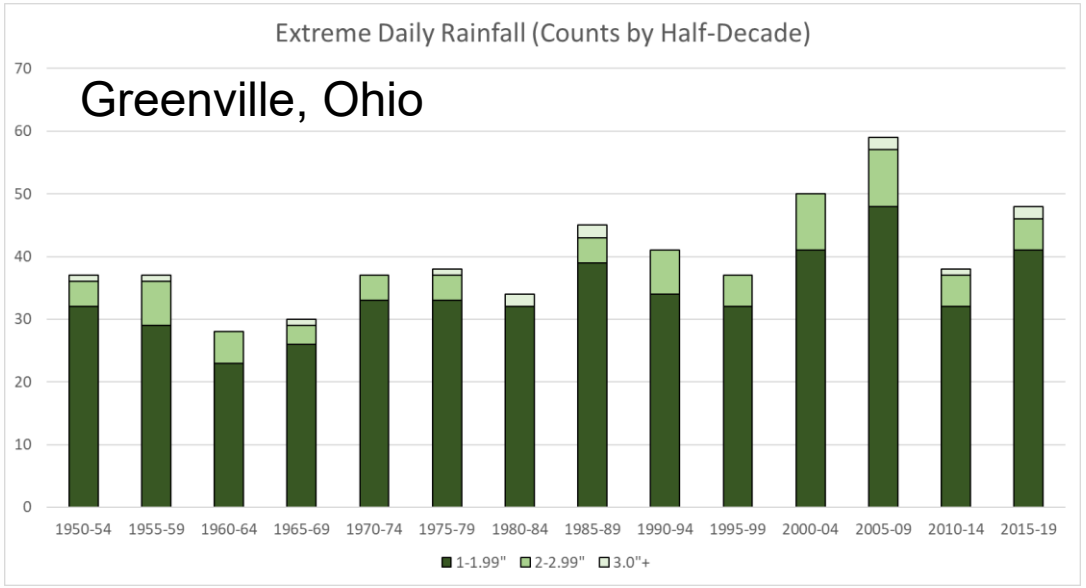


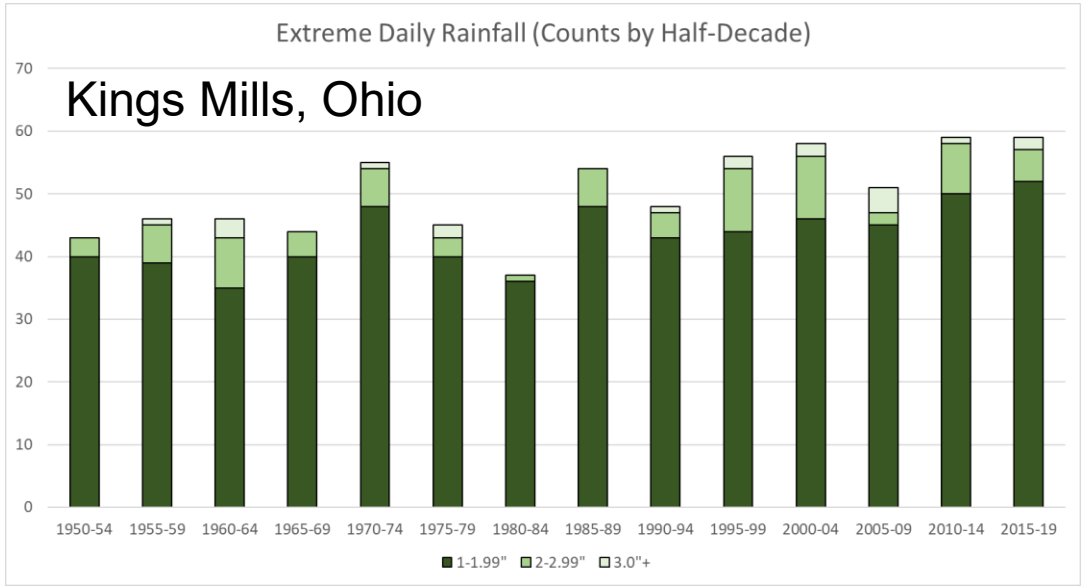
- Maximum daily precipitation totals were calculated for consecutive 5-year blocks from 1901
- The total precipitation falling in the top 1% of all days with precipitation
- Strongest events have a 42% higher probability of occurrence across the Midwest

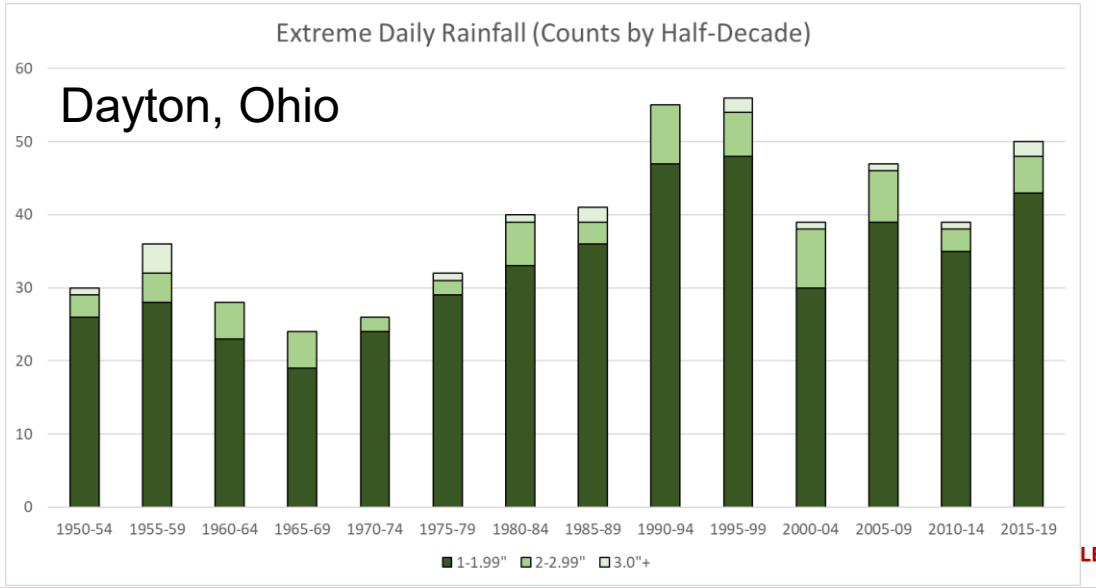
National Climate Assessment CCSR: https://science2017.globalchange.gov/

Easterling, D.R., K.E. Kunkel, J.R. Arnold, T. Knutson, A.N. LeGrande, L.R. Leung, R.S. Vose, D.E. Waliser, and M.F. Wehner, 2017: Precipitation change in the United States. In: *Climate Science Special Report*: Fourth National Climate Assessment, Volume I [Wuebbles, D.J., D.W. Fahey, K.A. Hibbard, D.J. Dokken, B.C. Stewart, and T.K. Maycock (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 207-230, doi: 10.7930/J0H993CC.

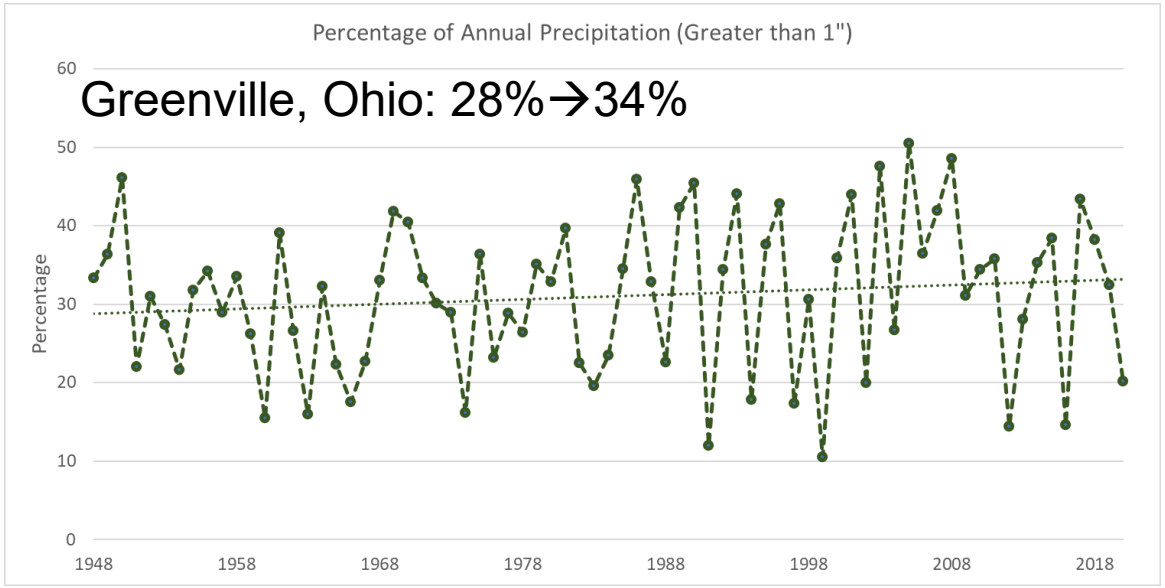
Extreme Daily Event (Pentad) Trends

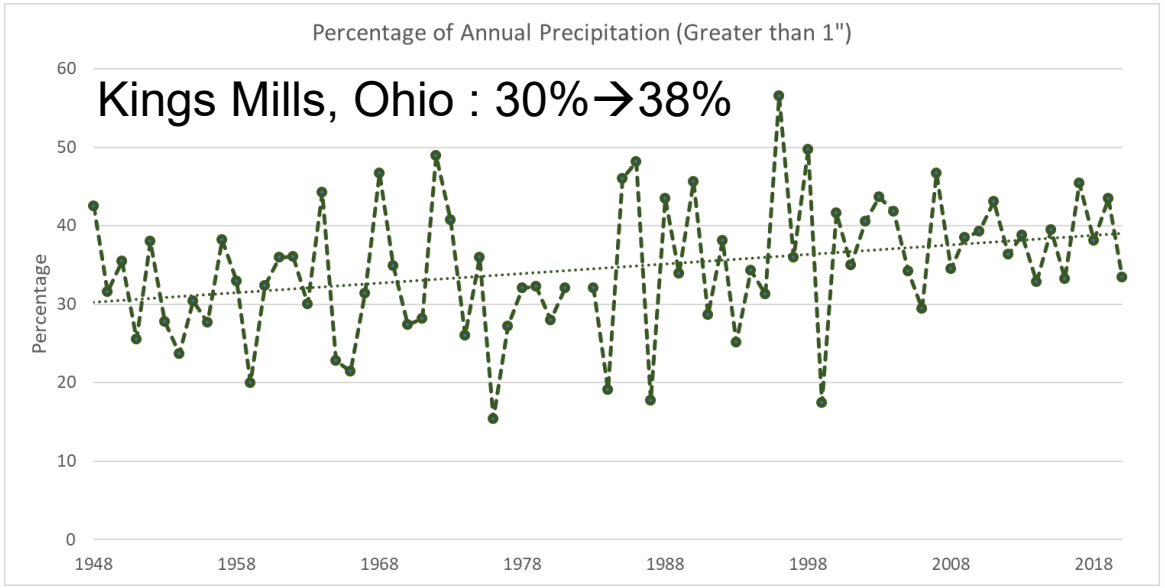


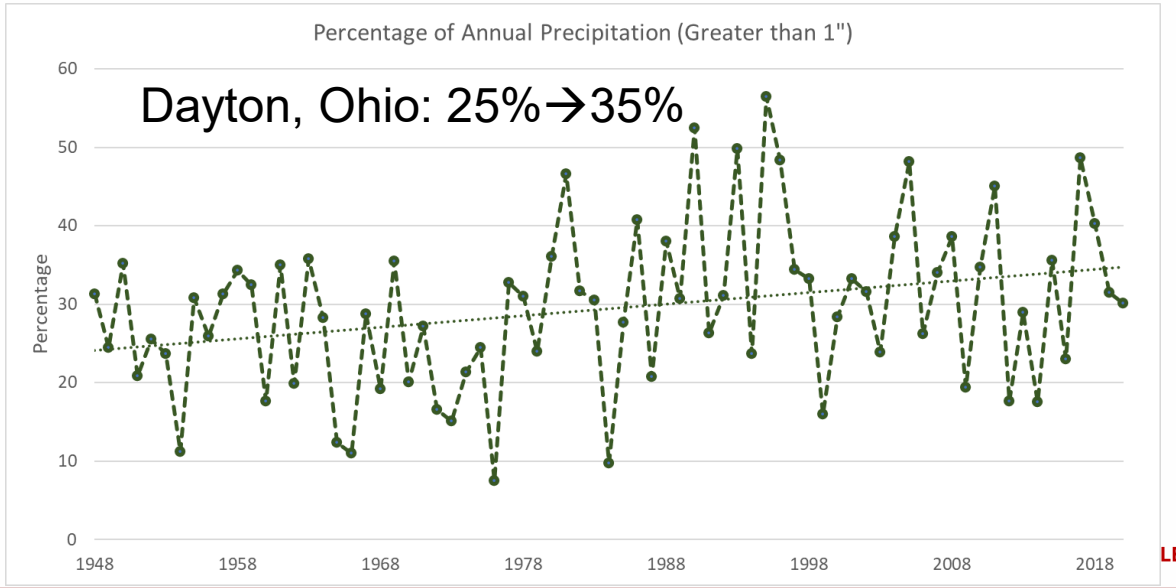




Portion of Rainfall Falling as Heavier Events







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LEGE *of* FOOD, AGRICULTURAL, *and* ENVIRONMENTAL SCIENCES

TEMPERATURE			
RANK	YEAR	AVERAGE	DIFFERENCE
1	1998	54.1	2.4
2	2012	54.0	2.4
3	2016	53.6	1.9
4	1921	53.5	1.8
5	2017	53.2	1.6
6	2021	53.2	1.5
7	1991	53.1	1.5
8	2020	53.0	1.4
9	1931	52.9	1.3
9	2006/1990	52.7	1.0

PRECIPITATION			
RANK	YEAR	TOTAL	DIFFERENCE
1	2011	55.95	14.85
2	1990	51.07	9.97
3	2018	50.93	9.83
4	1950	48.34	7.24
5	2019	46.87	5.77
6	1996	46.85	5.75
7	2003	46.42	5.32
8	1929	46.07	4.97
9	2017	45.51	4.41
10	2004	45.45	4.35

- 5 of the top 10 warmest/ 6 of the top 10 wettest have occurred since 2003
- 9 of the top 10 warmest/ 8 of the top 10 wettest since 1990

OHIO'S TOP 10

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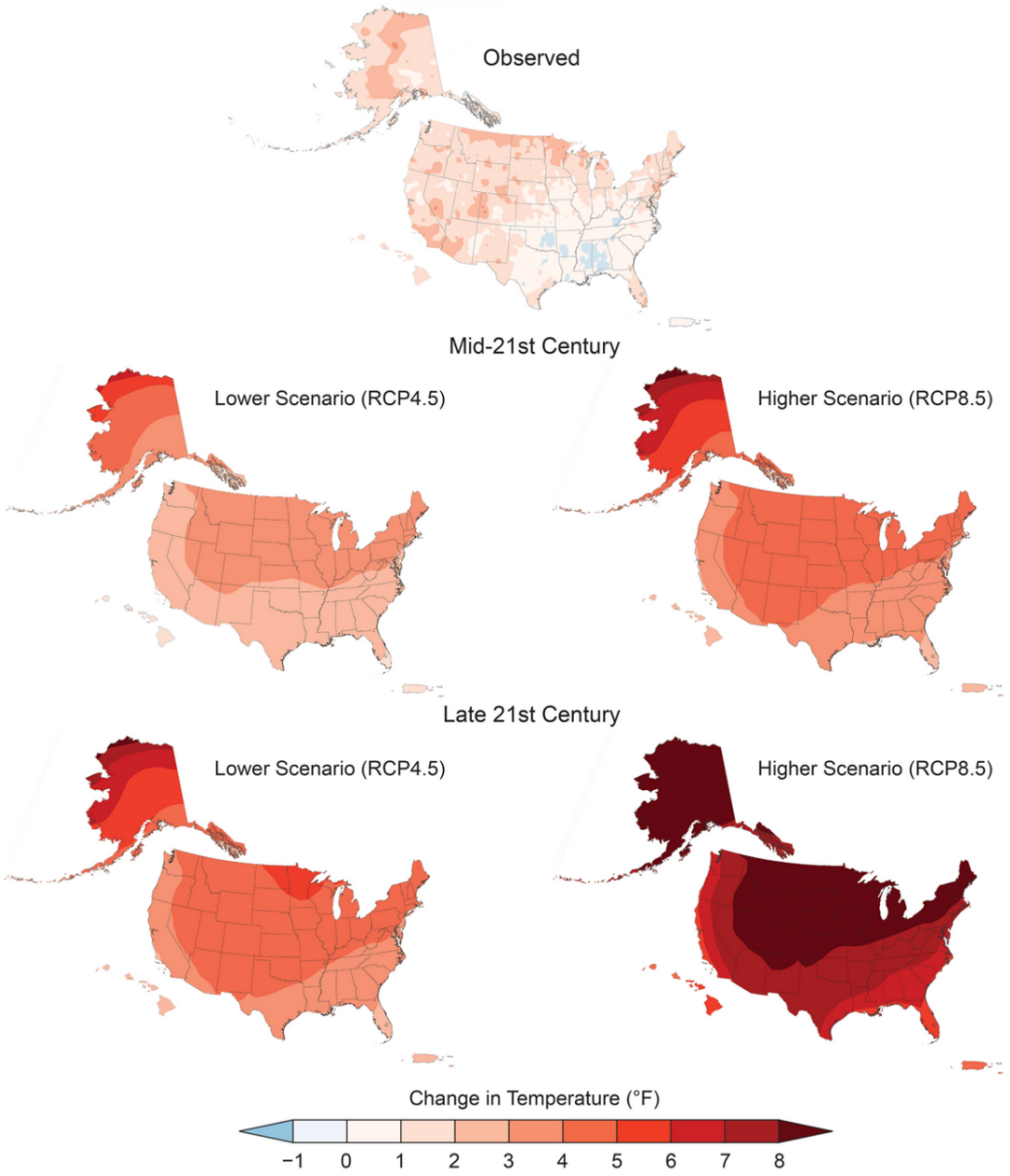

OUR FUTURE CLIMATE: TEMPERATURE

- Driven by winter warming and warmer nighttime temperatures
- Mid-Century Change: 3-5°F warmer
- Late-Century Change: 4-8°F warmer

Fourth National Climate Assessment CCSR: https://nca2018.globalchange.gov/

USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.

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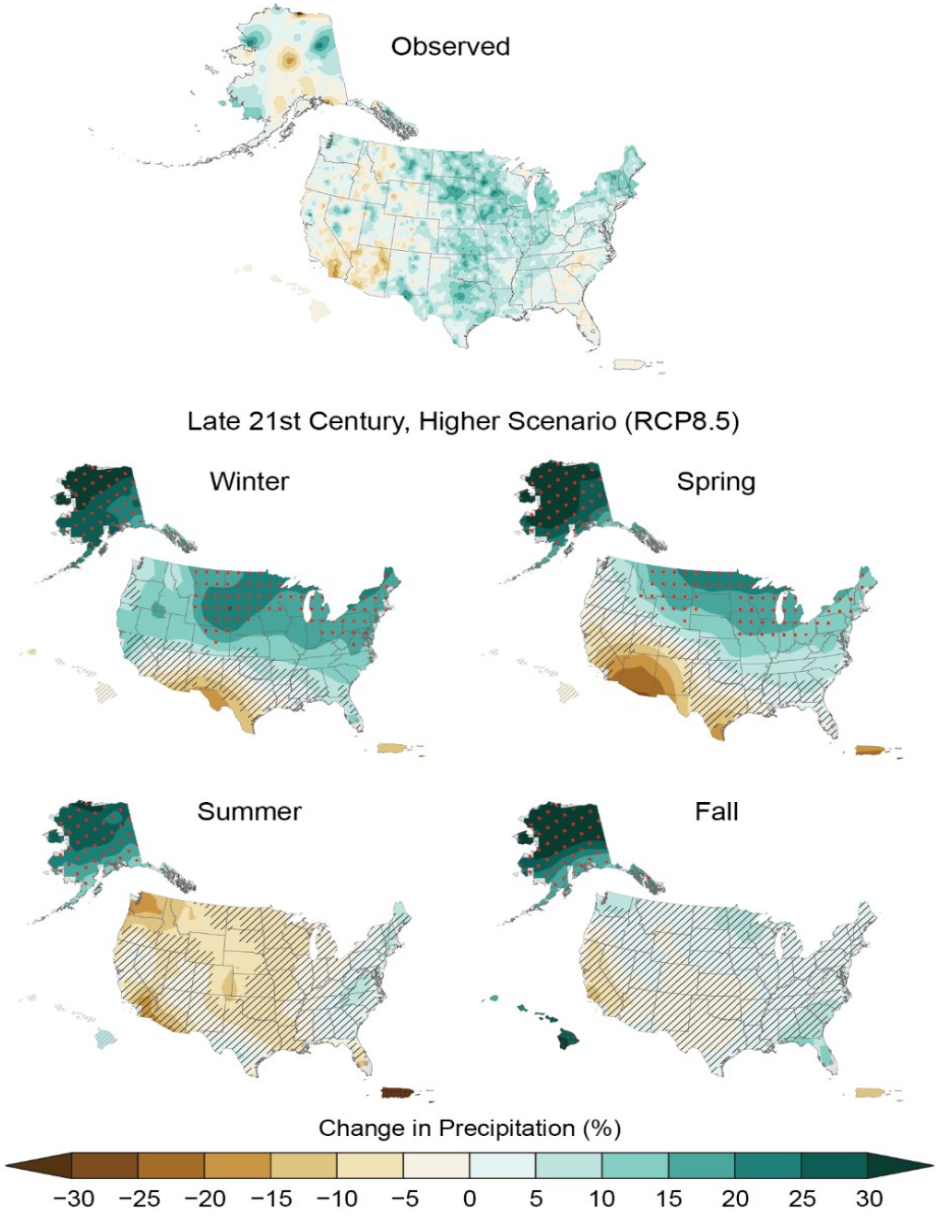


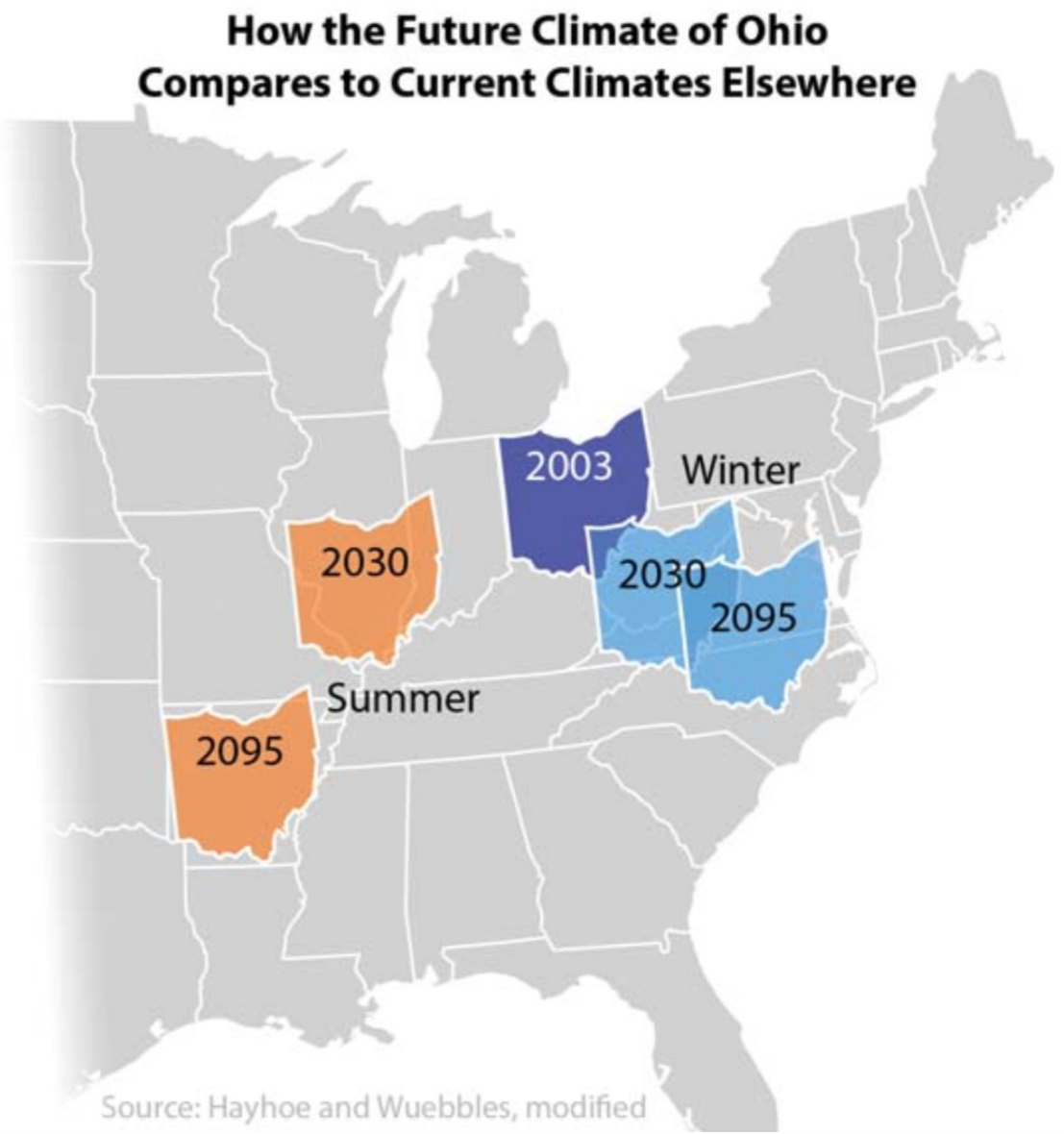
OUR FUTURE CLIMATE: PRECIPITATION

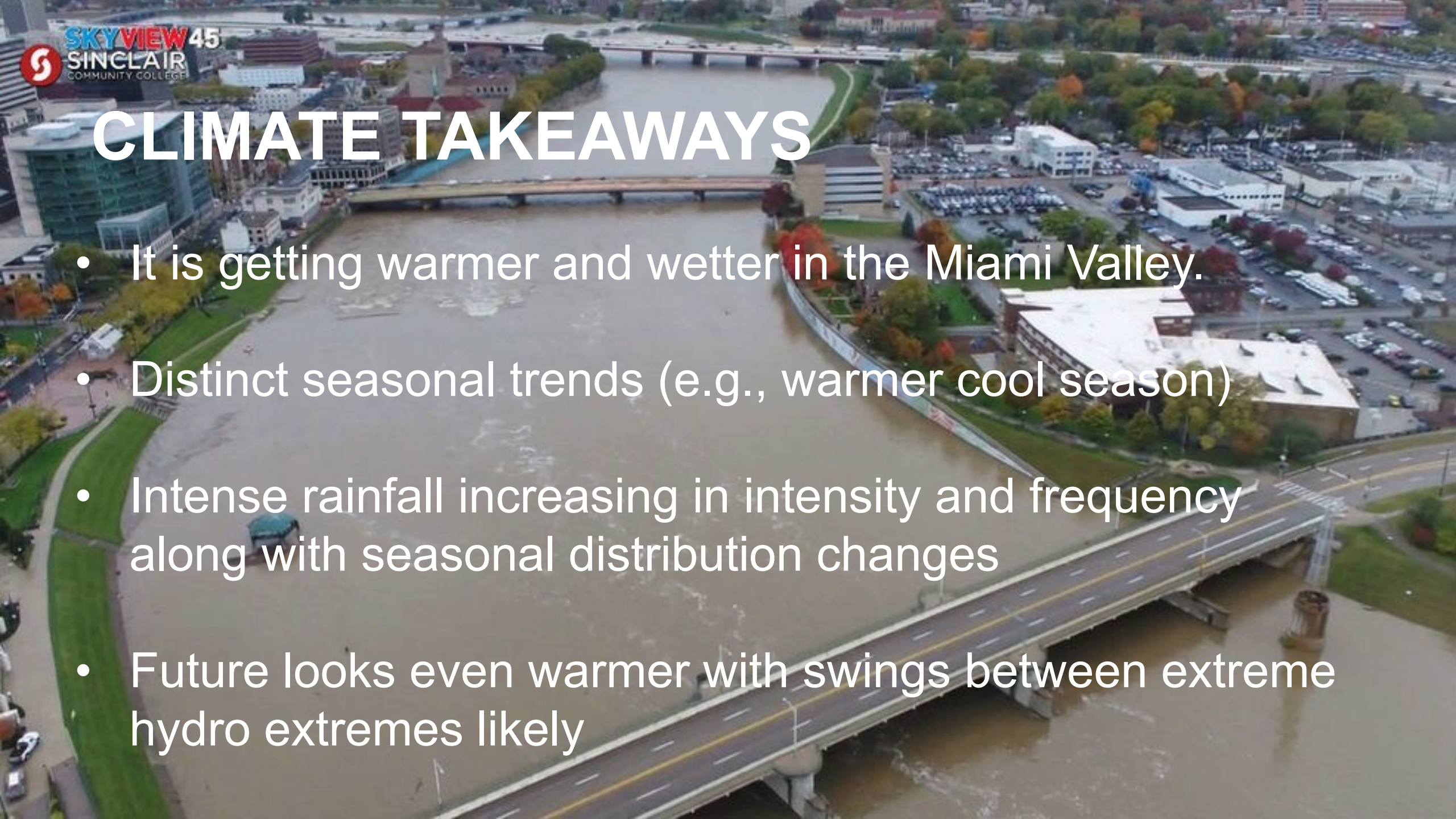
- Driven by increased water vapor (humidity)
- Seasonal changes atmospheric circulation
- Wetter cool season; drier summer season = could mean intensified drought

Fourth National Climate Assessment CCSR: https://nca2018.globalchange.gov/
USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.

WHAT IF THIS IS OUR NEW NORMAL?

- Longer Growing Season
- Warmer Temperatures (Winter and at Night)
- Higher Humidity
- More Rainfall
- More Intense Rainfall Events
- More Autumn Precipitation

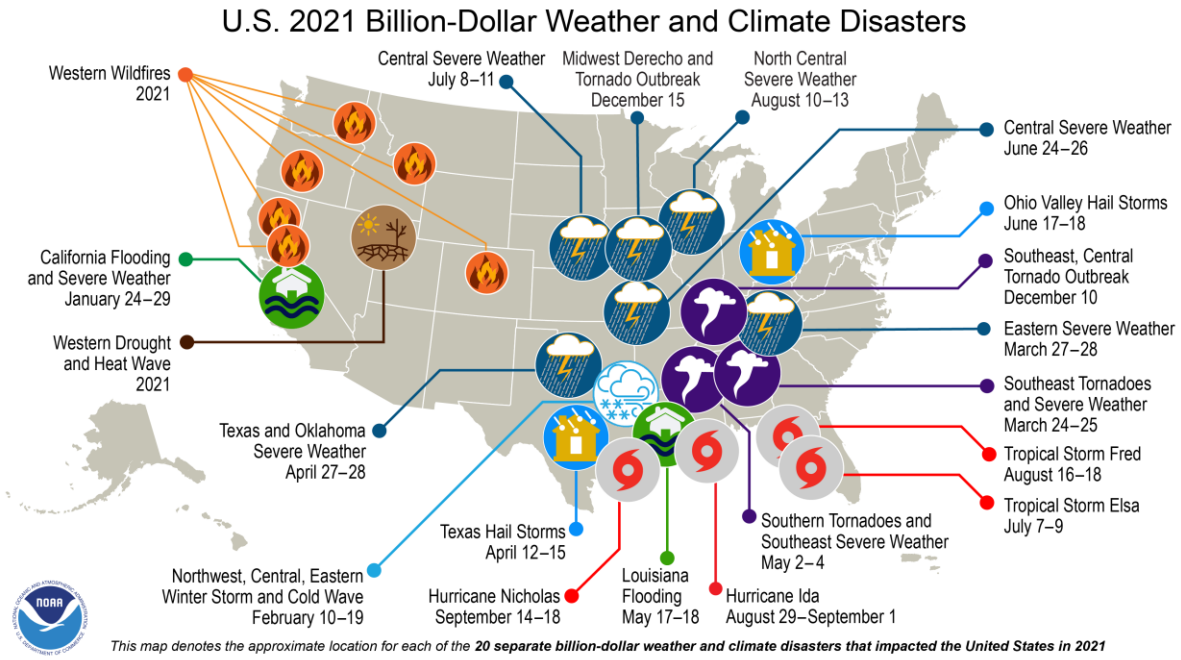


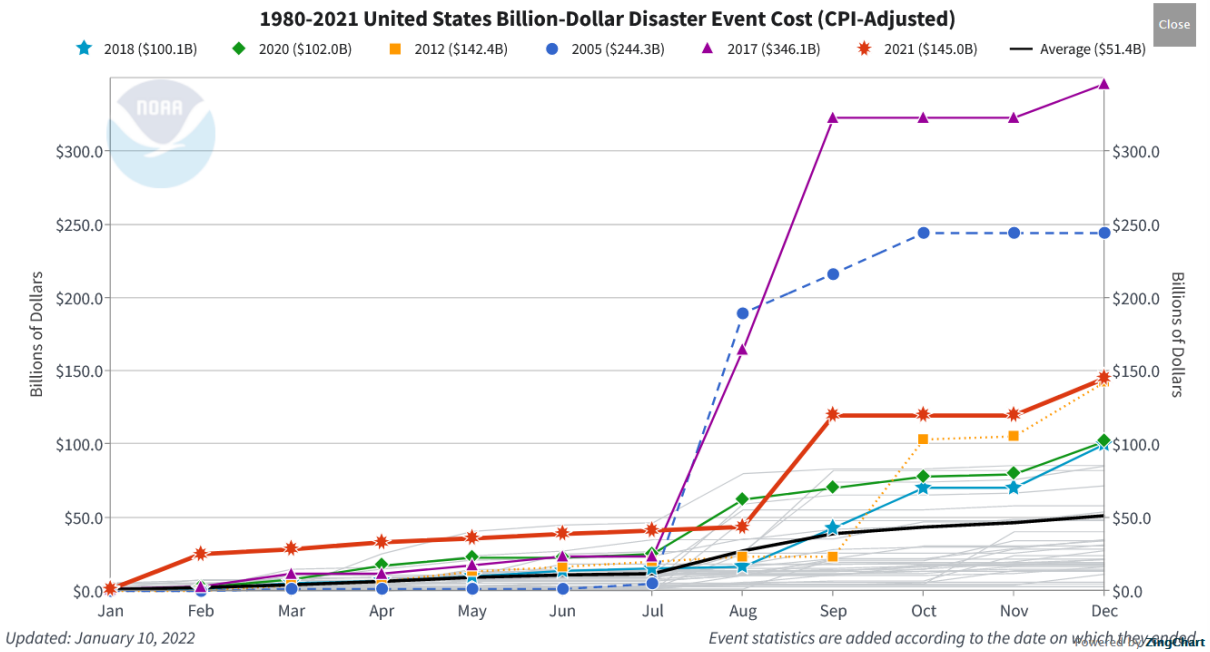


CLIMATE TAKEAWAYS

- It is getting warmer and wetter in the Miami Valley.
- Distinct seasonal trends (e.g., warmer cool season)
- Intense rainfall increasing in intensity and frequency along with seasonal distribution changes
- Future looks even warmer with swings between extreme hydro extremes likely


Leiserowitz Big Five – Yale Climate Project
1. Climate change is happening.
2. We are currently experiencing the effects.
3. Humans are the cause.
4. The scientific evidence is overwhelming.
5. We can do something about it.
Mitigate
Adapt
Suffer
WE NEED EVERYONE TALKING ABOUT CLIMATE CHANGE
(No matter what we call it)!
Photo Credit: Amanda Douridas





BILLION DOLLAR DISASTERS

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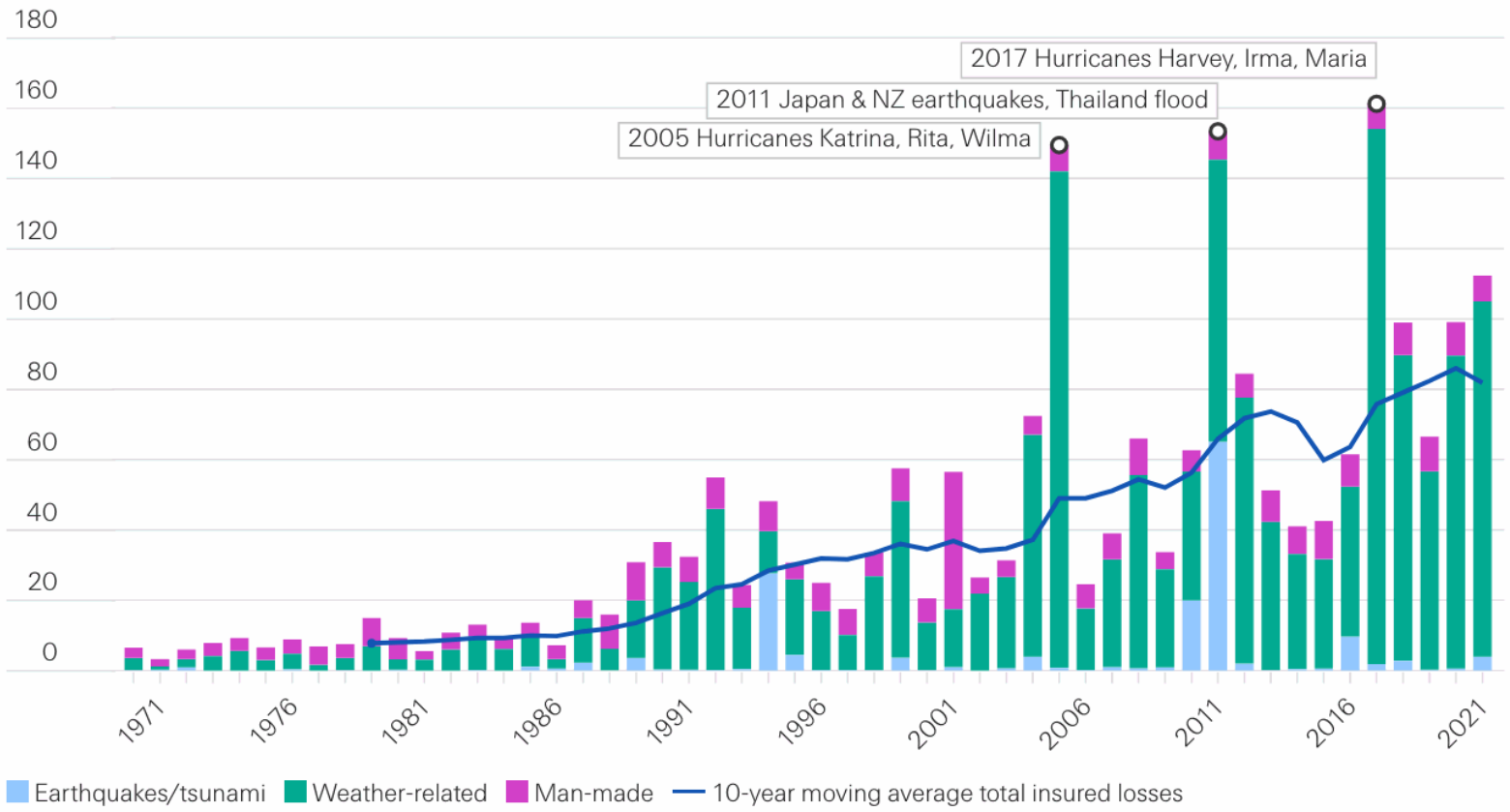
Losses are Increasing

Insured losses since 1970

USD billion (in 2021 prices)

Rollover/touch chart for details



Source: Swiss Re Institute

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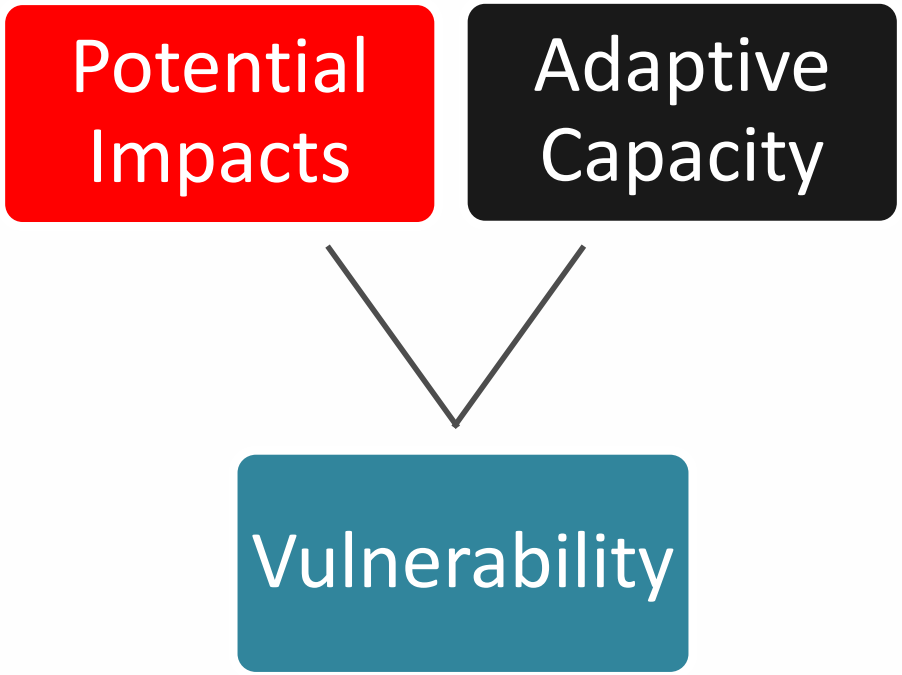
Adaptation: There is no single answer

Every business owner is different



Each decision is unique and will vary based upon:

People: Values, Culture, & Resources

Place: Location & Site Conditions

Purpose: Goals & Objectives

Practices: Equipment, Procedures, & Methods

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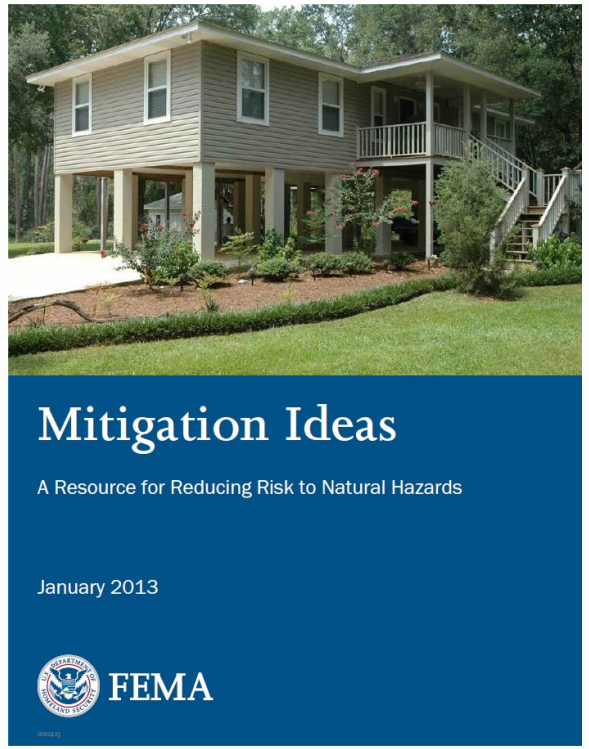
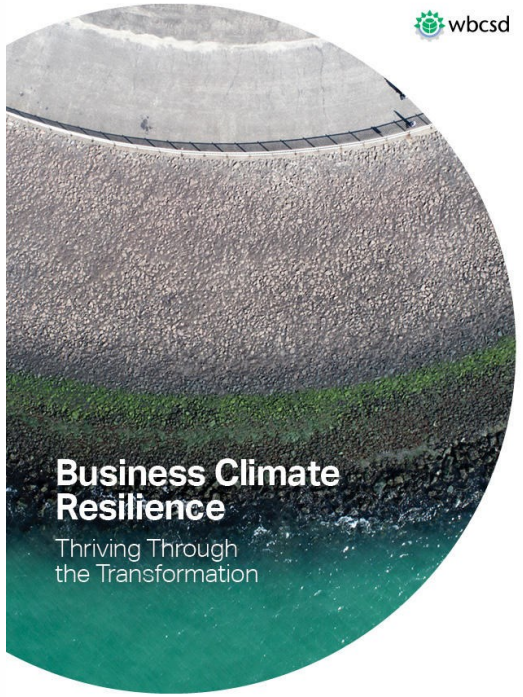
Resources Available for Businesses

- C2ES (Center for Climate and Energy Solutions), 2013: Weather the Storm: Building Business Resilience to Climate Change.
- FEMA, 2013: Mitigation Ideas: A Resource for Reducing Risk to Natural Hazards
- U.S. Federal Government, 2014: U.S. Climate Resilience Toolkit. http://toolkit.climate.gov
- WBCSD, 2019: Business Climate Resilience: Thriving Through the Transformation





"Businesses to prepare for both the physical risks that are associated with climate change, as well as the associated transitional risks on the path towards a net-zero economy."

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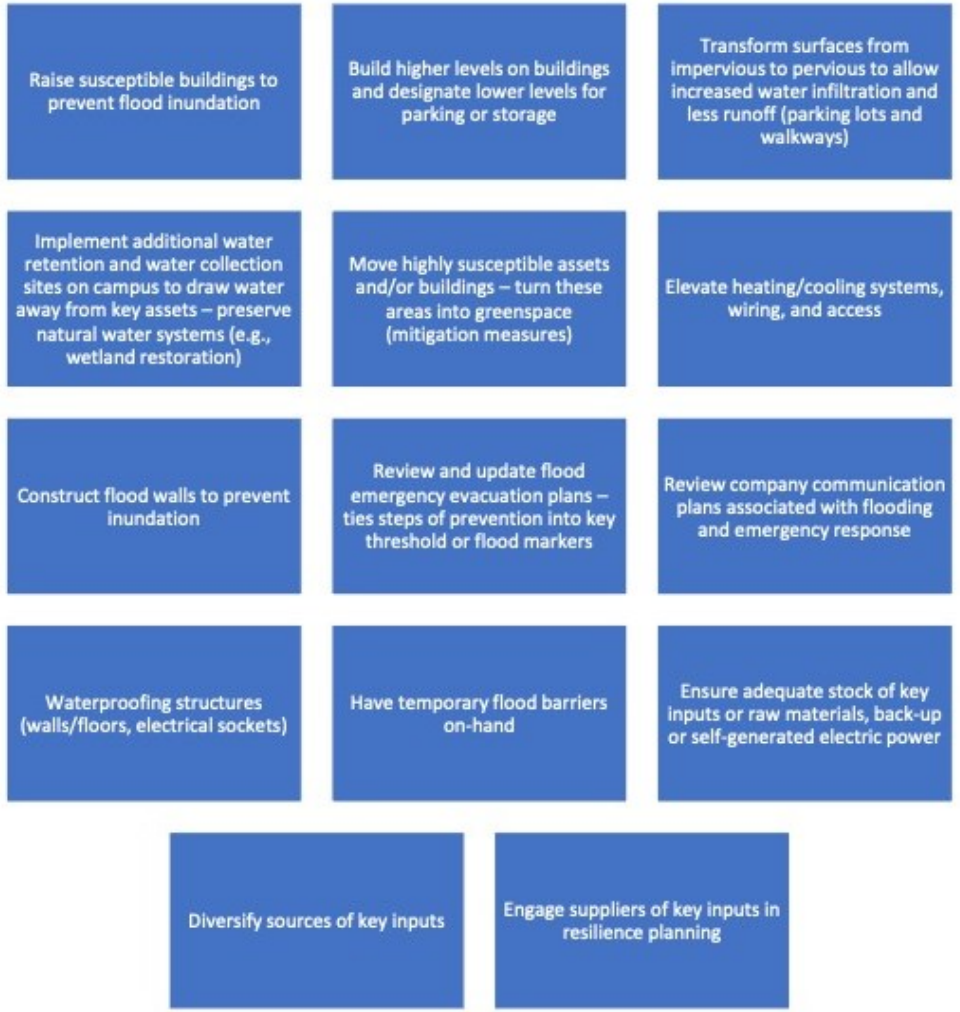
One Approach to Building Internal Resilience

- Survey Instrument designed to evaluate and prioritize actions that the company thinks are important to build resilience to the increasing precipitation extremes and potential flood inundation

- What is the company's will to act?
- What are the costs associated with actions?
- What is the current level of expertise in the company?

Potential Solutions to Increased Flood Risk



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Survey In Action

Solution: Build higher levels on buildings (or specifically, Building 'A') and designate lower levels for parking or storage

Hypothetical: Company has decided that it will evaluate adaptation strategies based on the following criteria:

potential positive impact of each proposed statement

feasibility of implementing each proposed statement (costs, local technical knowledge, company will/support)

Use focus groups and/or survey

Ask participants to mark answers from "strongly disagree" to "strongly agree"

Ask them to self-report their expertise pertaining to the potential action for the expertise question ranging from "no expertise" to "significant expertise"

Solicit additional comments for each statement.

Weight impact and feasibility by expertise reporting

Repeat for all potential solutions and rank according to scores

Use this ranking to prioritize company actions

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Energy and Low Carbon Alternatives

Thank You!

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