NIFA Stakeholder Advisory Committee Meeting

March 27, 2023

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

Agenda

- 10:00 – Welcome and Housekeeping (Robyn); Tabletop exercise (Jason, Aaron, Kristi)
- 11:30 – Break
- 11:45 – Land use/land mgmt. models & ecosystem services update (Yang, Dale, Brian)
- 12:30 – Lunch break
- 1:00 to 2:30 - Policy discussion (Alan, Robyn, Kristi)
- 2:30 - Wrap-up and evaluations
- 3:00 – Dismiss!

- Housekeeping: honorarium paperwork, evaluation survey

https://tinyurl.com/NIFAEval

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https://tinyurl.com/NIFAEval

Tabletop Exercise

Team: Jason Cervenec and Aaron Wilson

The Ohio State University

College of Food, Agricultural, and Environmental Sciences

Activity Part I

Activity Part 2

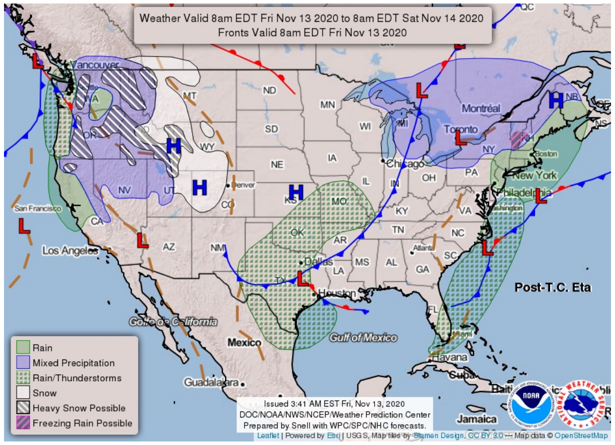
CFAES

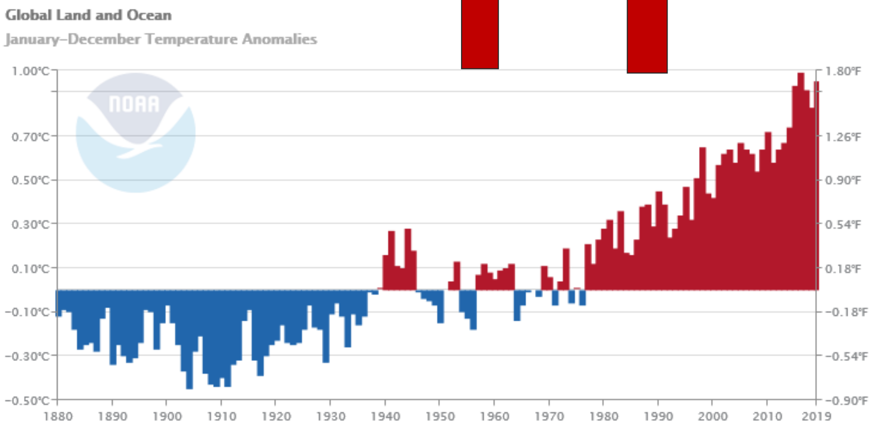
Weather Patterns and Climate Trends

Aaron B. Wilson
Assistant Professor – Ag Weather & Climate Field Specialist
Department of Extension – CFAES; The Ohio State University
28 March 2023

The Ohio State University
COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

CFAES


Weather Valid 8am EDT Fri Nov 13 2020 to 8am EDT Sat Nov 14 2020
Fronts Valid 8am EDT Fri Nov 13 2020
Post-T.C. Eta
Gulf of Mexico
Mexico
Rain
Mixed Precipitation
Rain/Thunderstorms
Snow
Heavy Snow Possible
Freezing Rain Possible
Issued 3:41 AM EST Fri, Nov 13, 2020
DOC/NOAA/NWS/NCEP/Weather Prediction Center
Prepared by Snell with WPC/SPC/NHC forecasts.


Global Land and Ocean
January–December Temperature Anomalies
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
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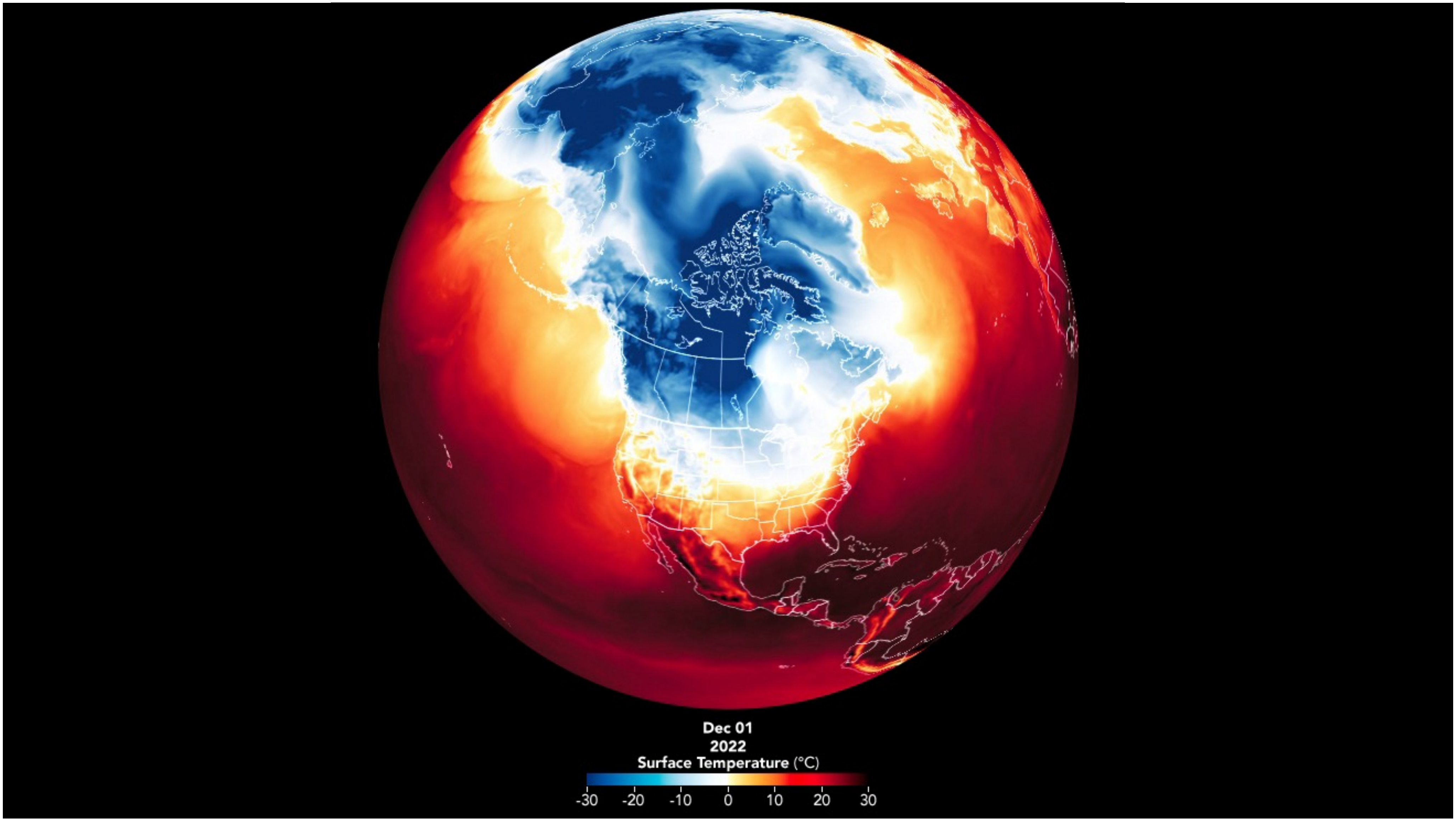
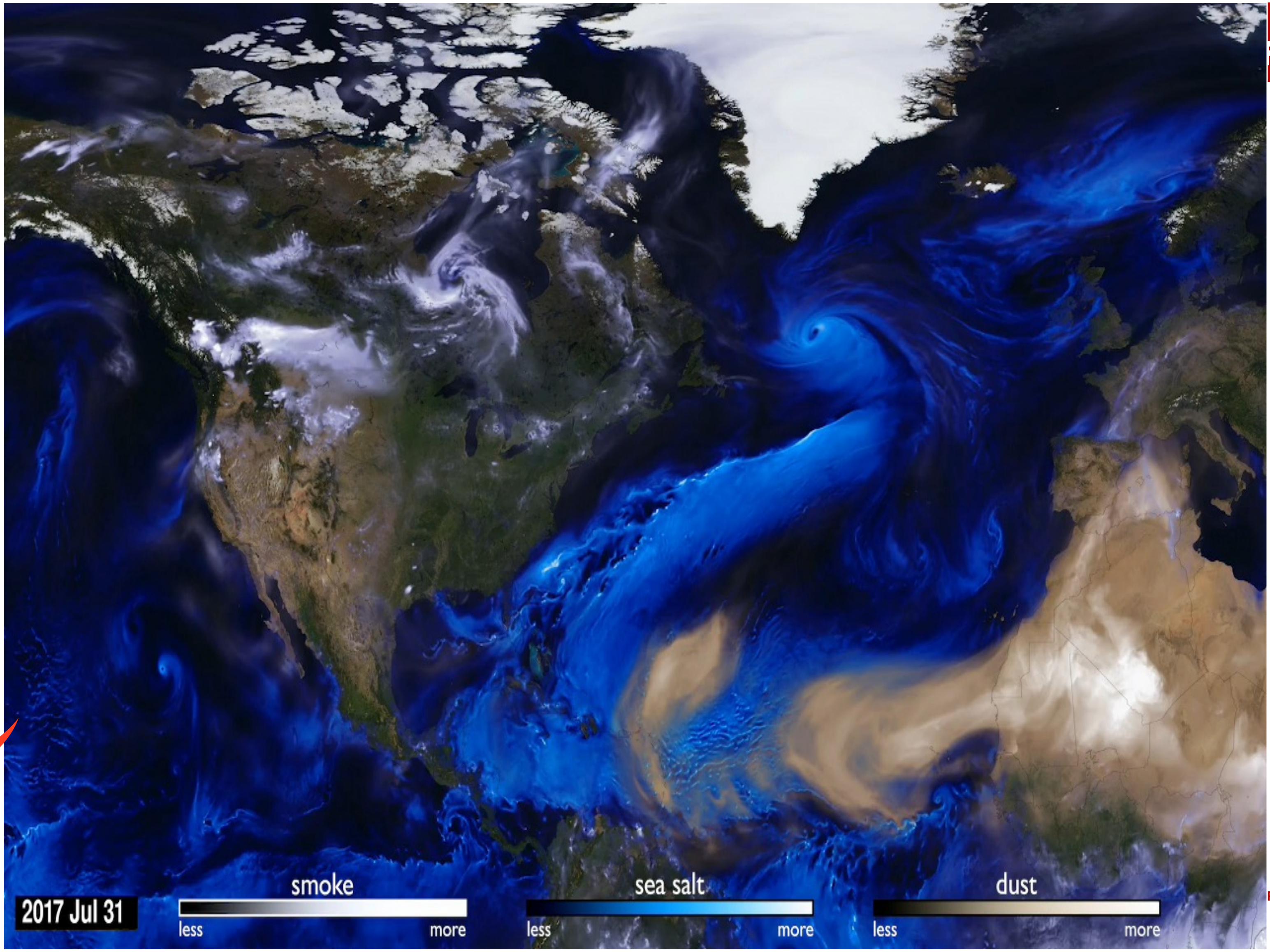
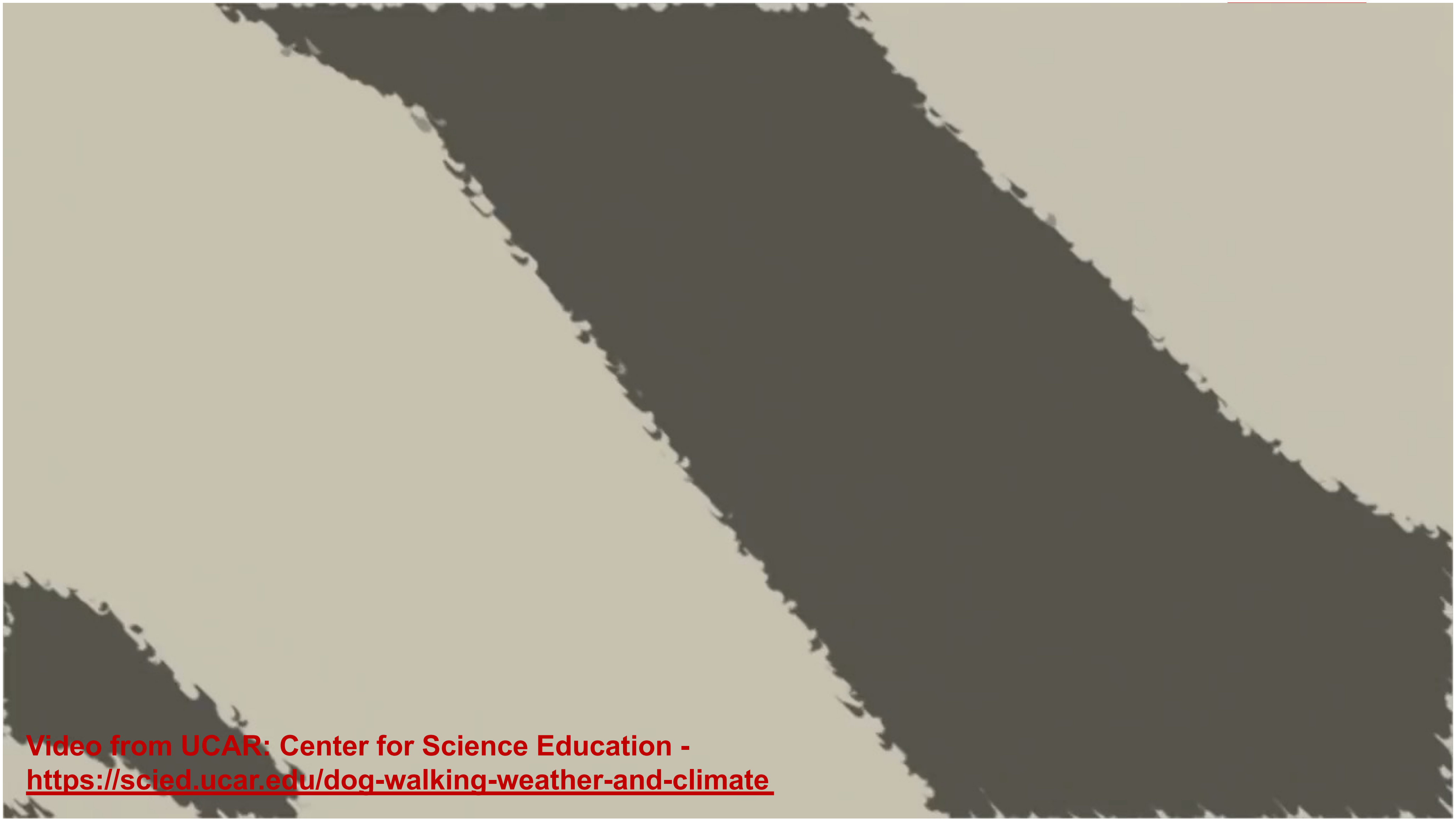

Dec 01
2022
Surface Temperature (°C)
-30 -20 -10 0 10 20 30

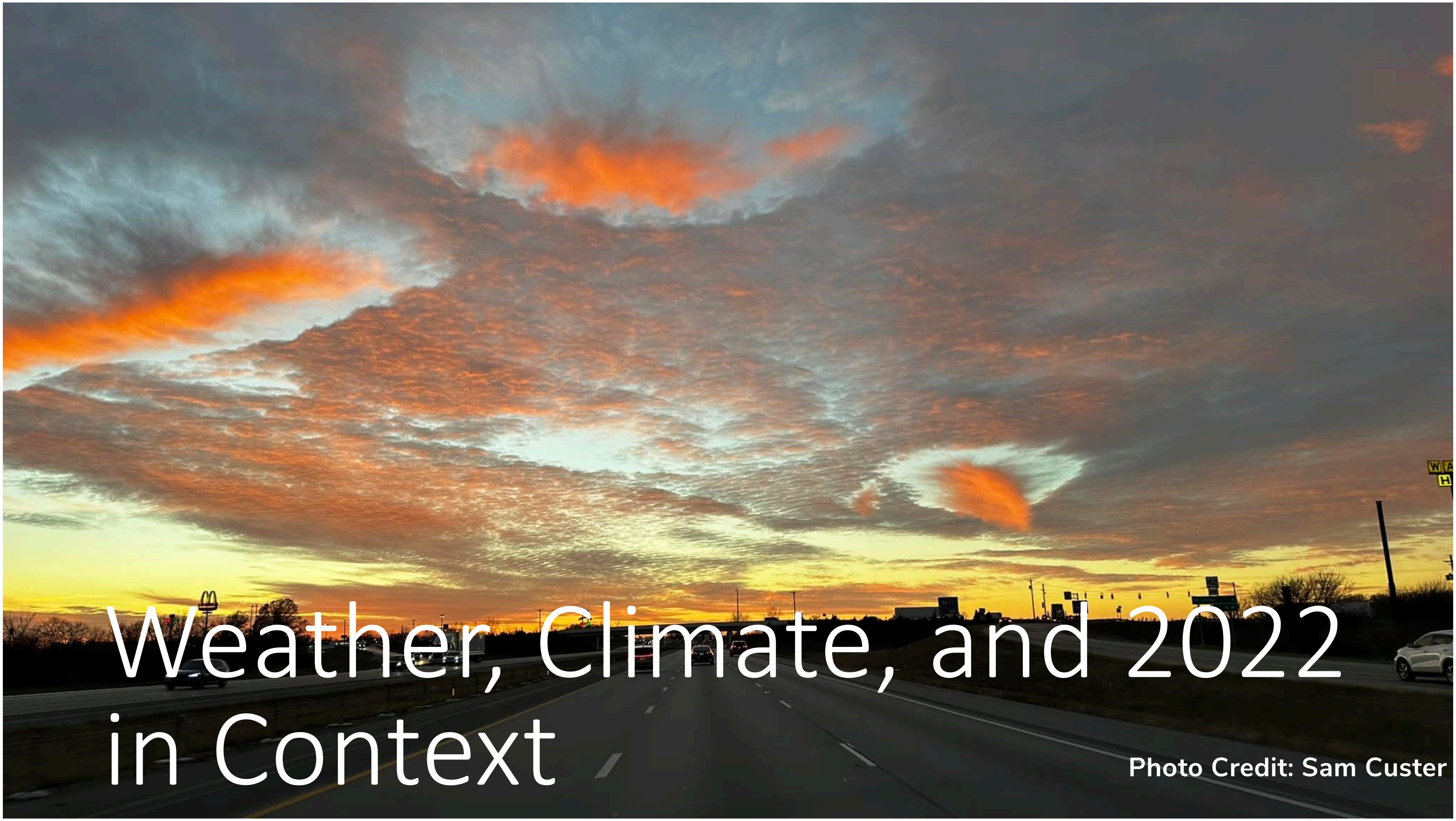


FAES

RONMENTAL SCIENCES



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

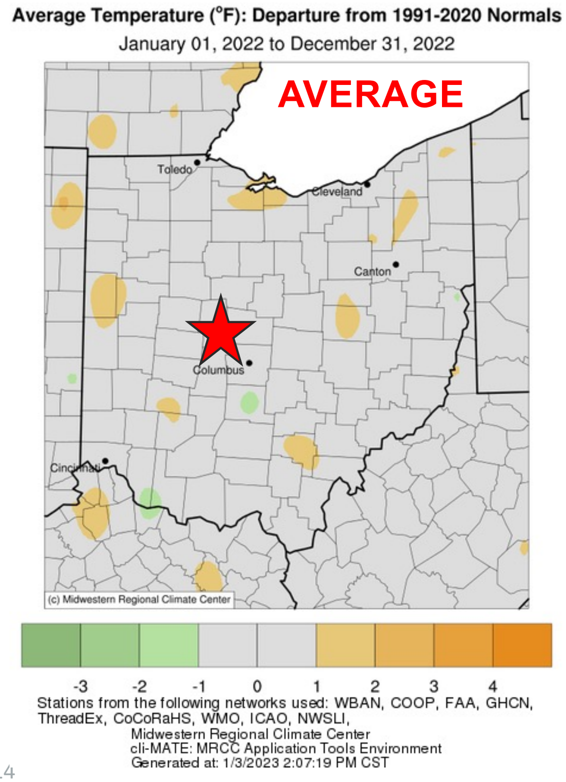


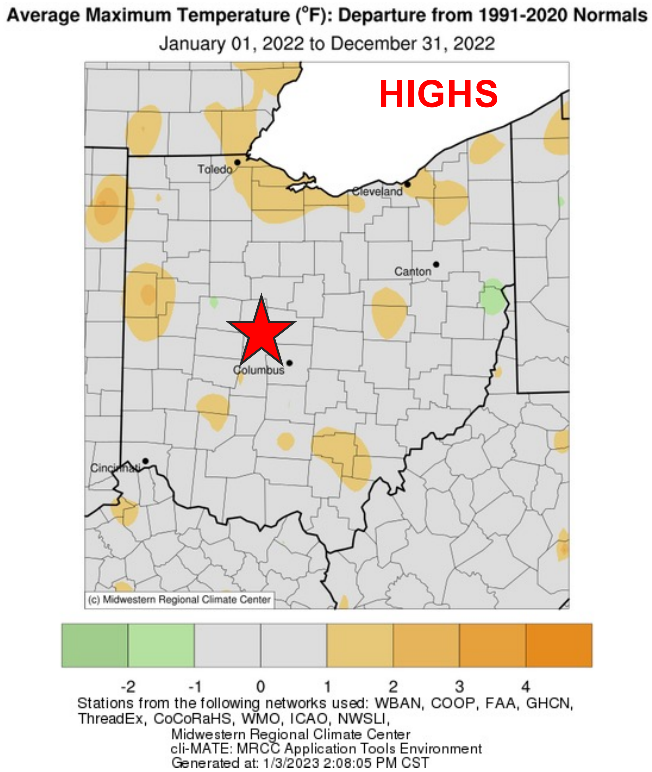
Weather, Climate, and 2022 in Context

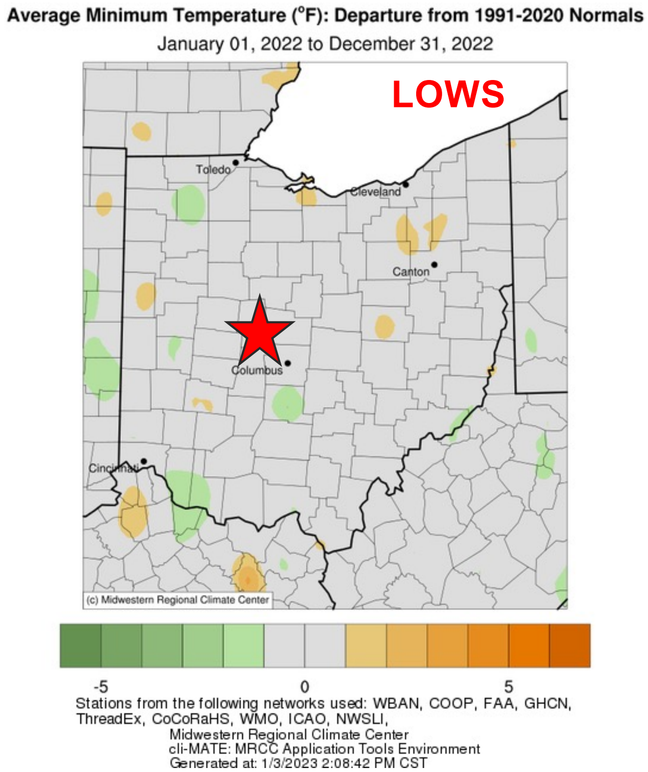
Photo Credit: Sam Custer

2022 Ohio Temperatures

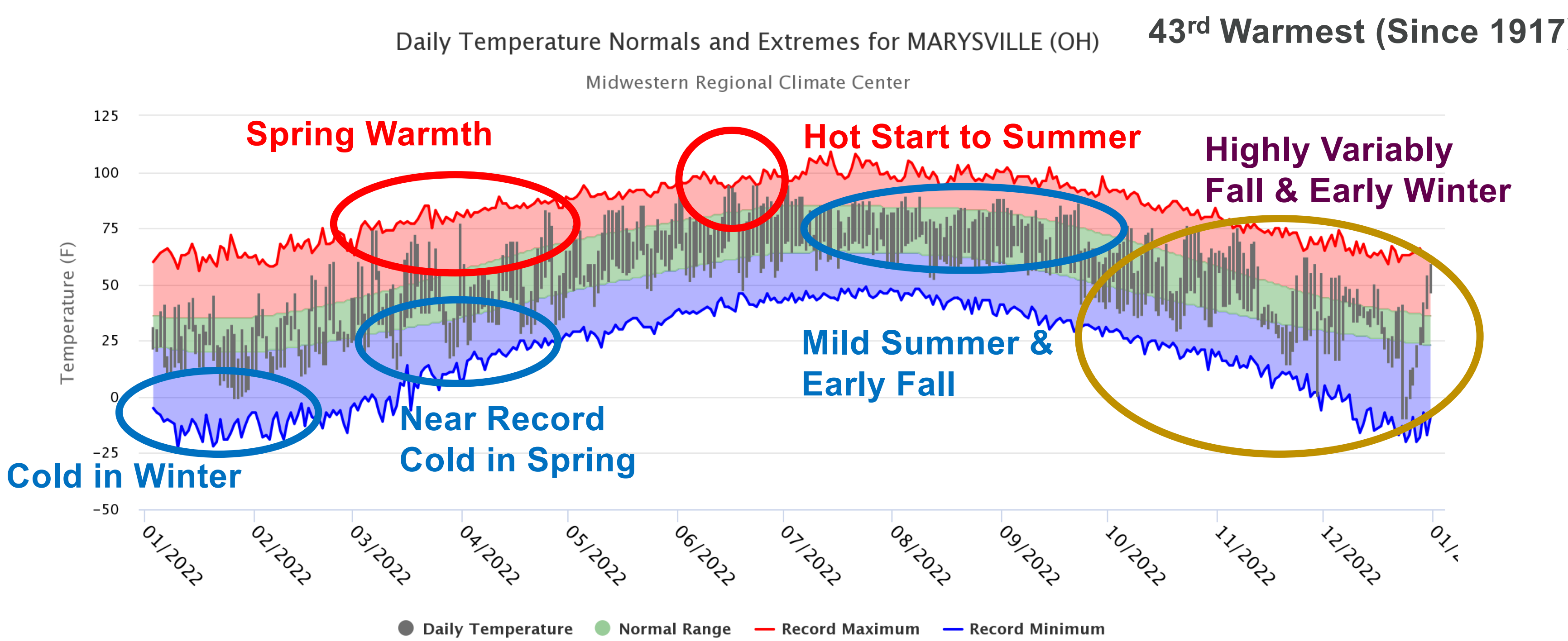
26th Warmest (1895-2022)



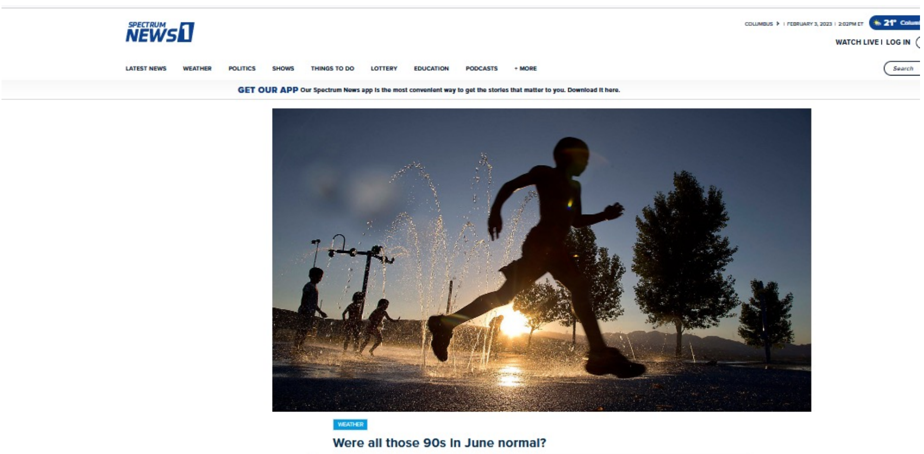




2022 Temperature Summary: Marysville, Ohio



Temperature Headlines



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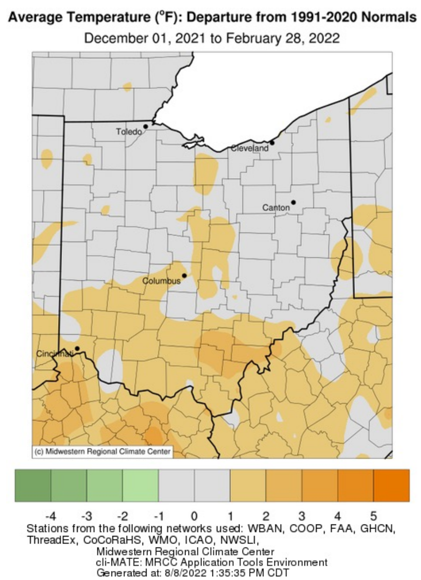
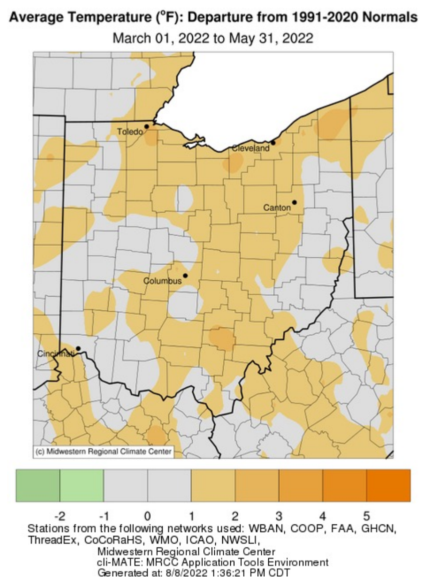
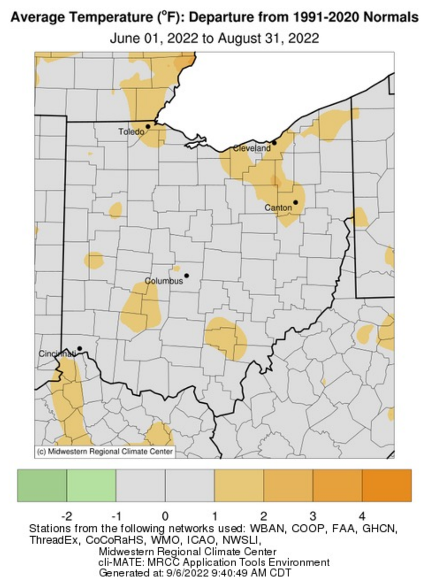
2022 Seasonal Temperatures



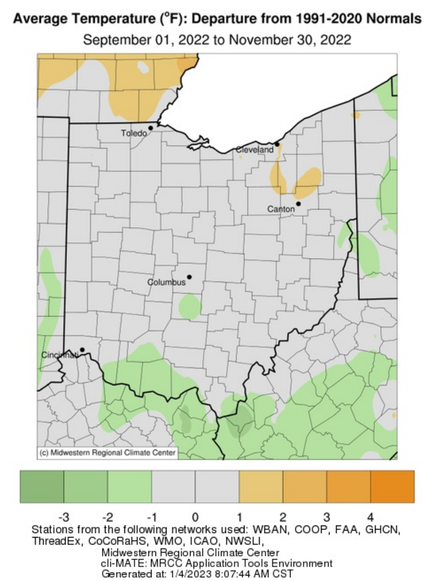
WINTER



SPRING



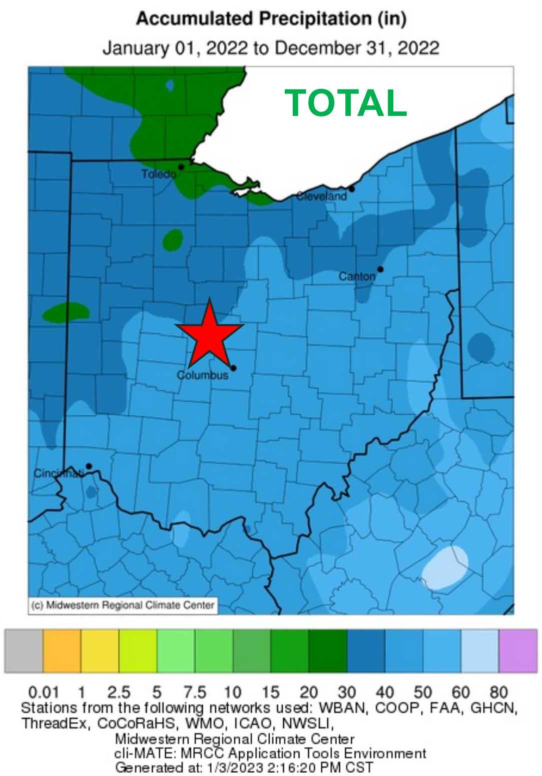
SUMMER

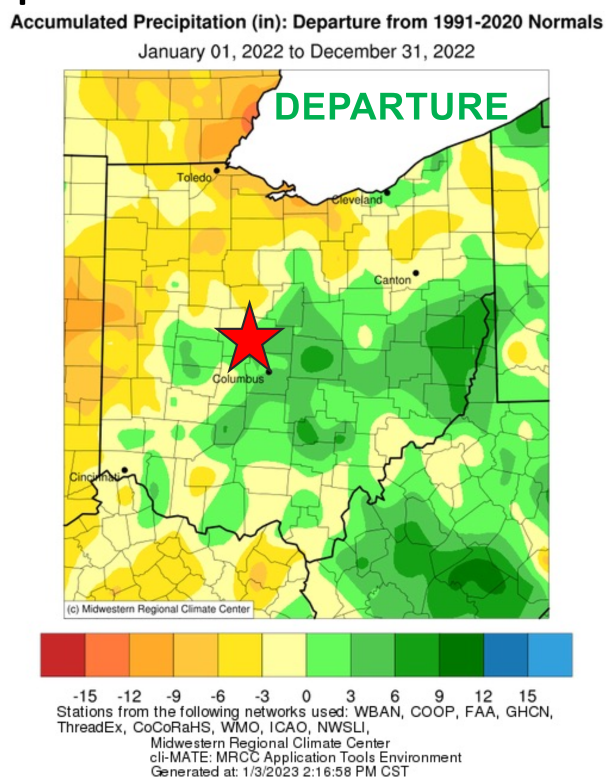


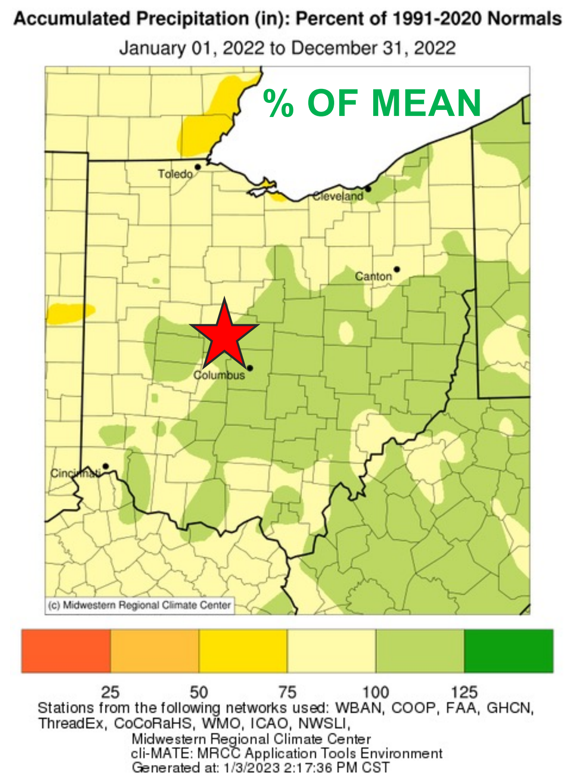
Fall

2022 Ohio Precipitation

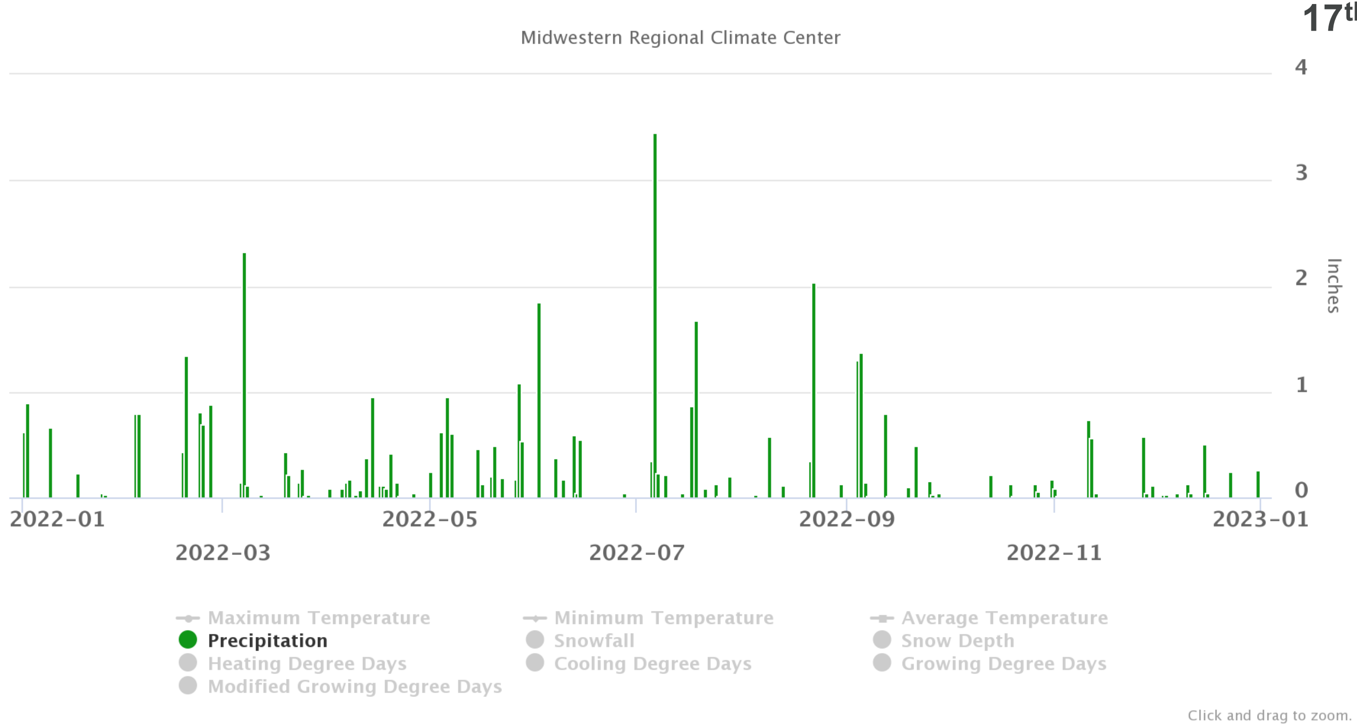
47th Wettest (1895-2022)







2022 Precipitation Summary: Marysville



17th Warmest (Since 1917)

4 events 1-1.50” (~12%)
5 events over 1.5” (~26%)
9 days = ~38% of precipitation (43.55”)

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Precipitation Headlines

Ohio Valley derecho confirmed from Monday night

Confirmed Ohio Valley Derecho (whsv)

By Aubrey Urbanowicz

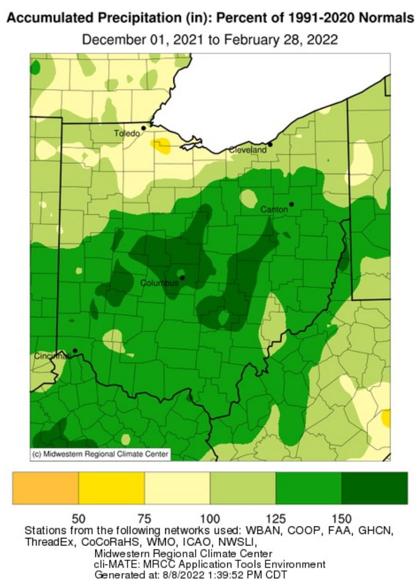
Columbus and Central Ohio Weather

COLUMBUS, Ohio (WCMH) – Rainfall totals from storms Tuesday and Wednesday came in the running for the most in 143 years in central Ohio.

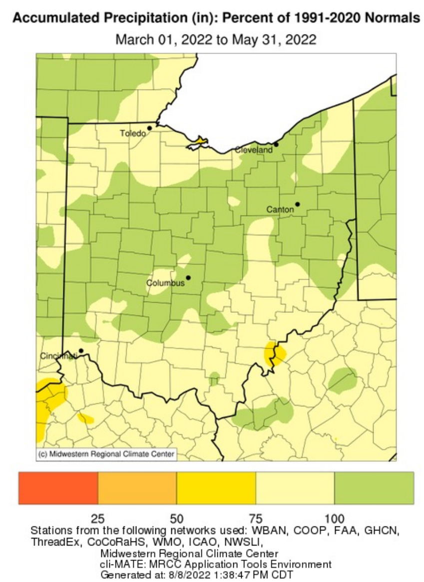
As additional on-and-off showers loom for Friday, Storm Team 4 compiled rainfall totals for the last three days. Wednesday was the fourth wettest day in Columbus records since 1879, with a total rainfall of 3.70 inches at John Glenn Columbus Internation Airport. Adding up the rainfall on Tuesday and Wednesday, Columbus ended up receiving 4.56 inches.

| OhioHealth laying off more than 600 workers for outsourcing plan ›

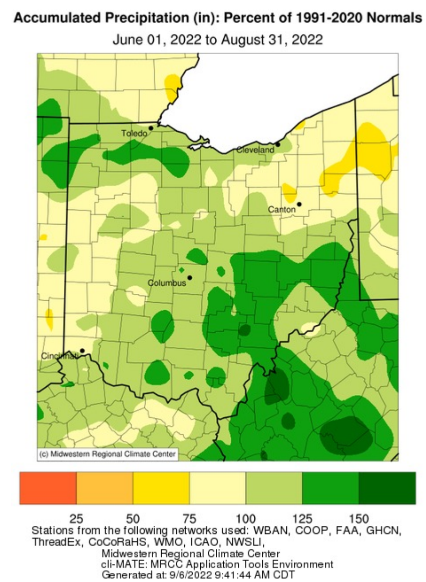
2022 Seasonal Precipitation



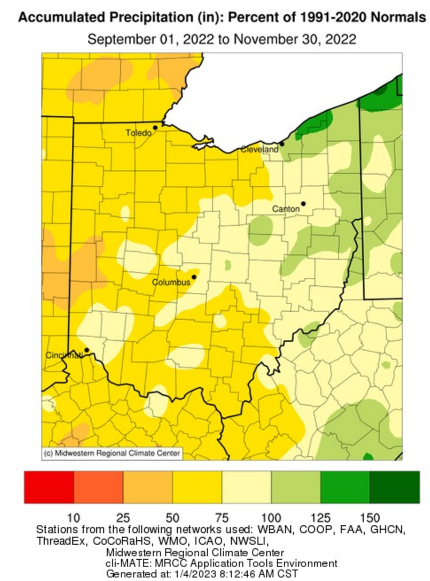
WINTER



SPRING



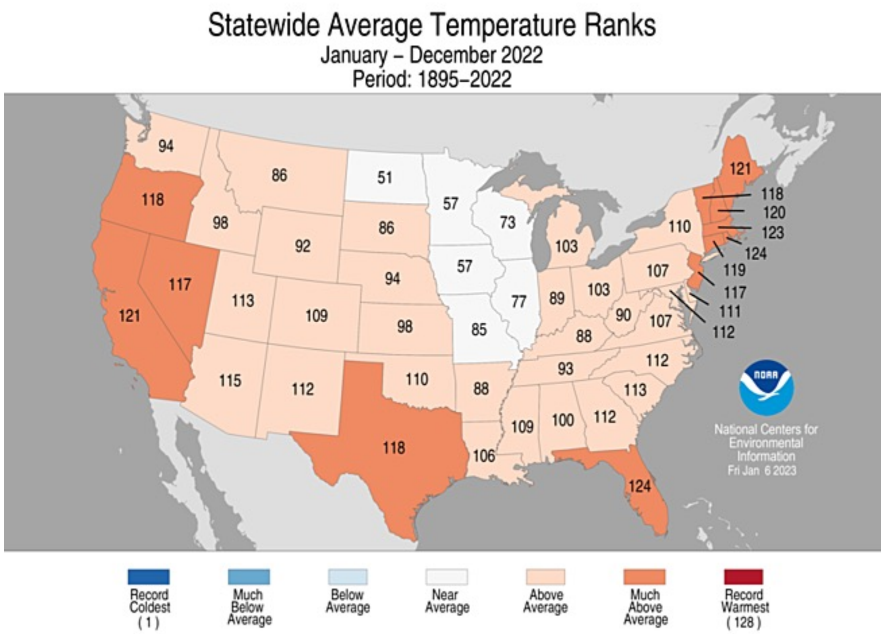
SUMMER

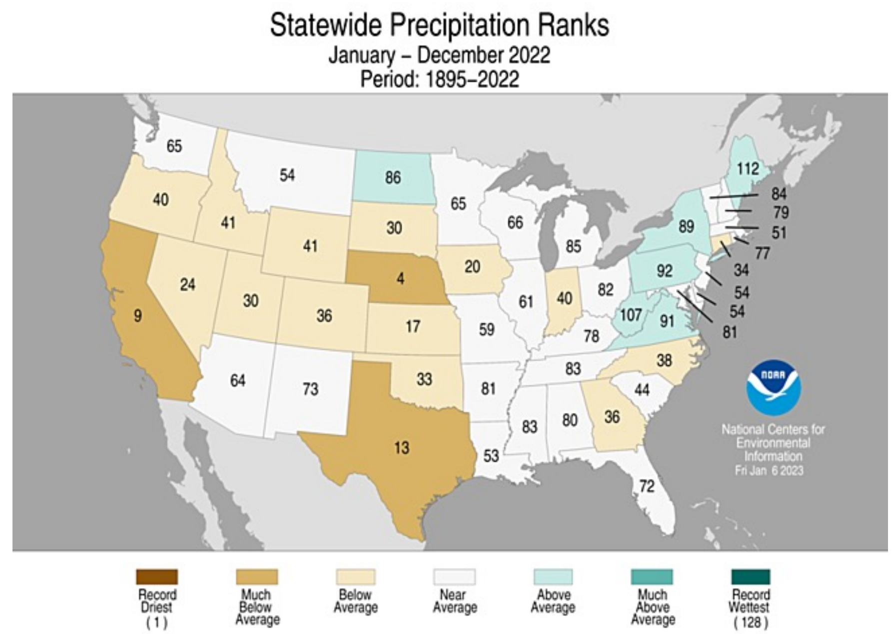


Fall

U.S. Assessment

***Ranks as the 18th warmest and 27th driest since 1895**





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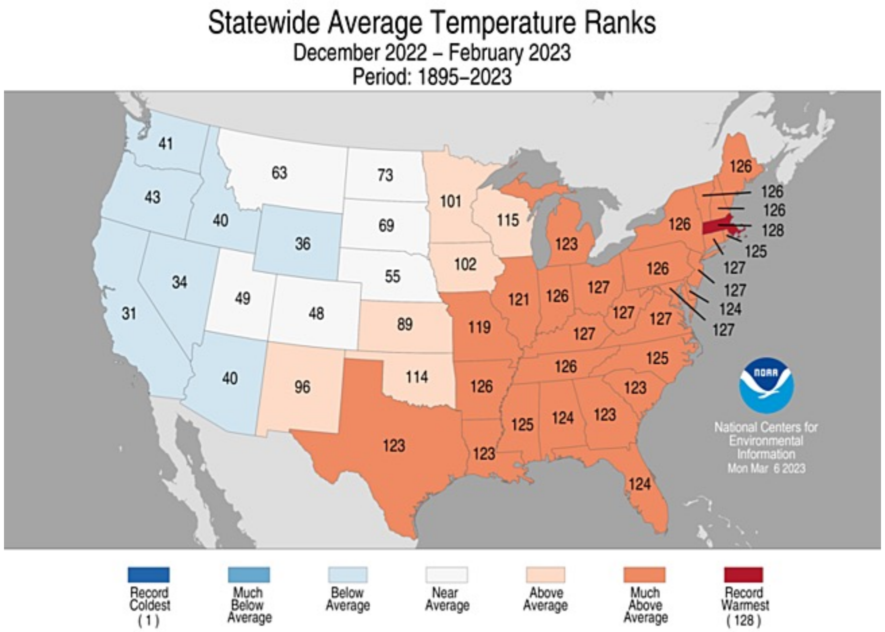
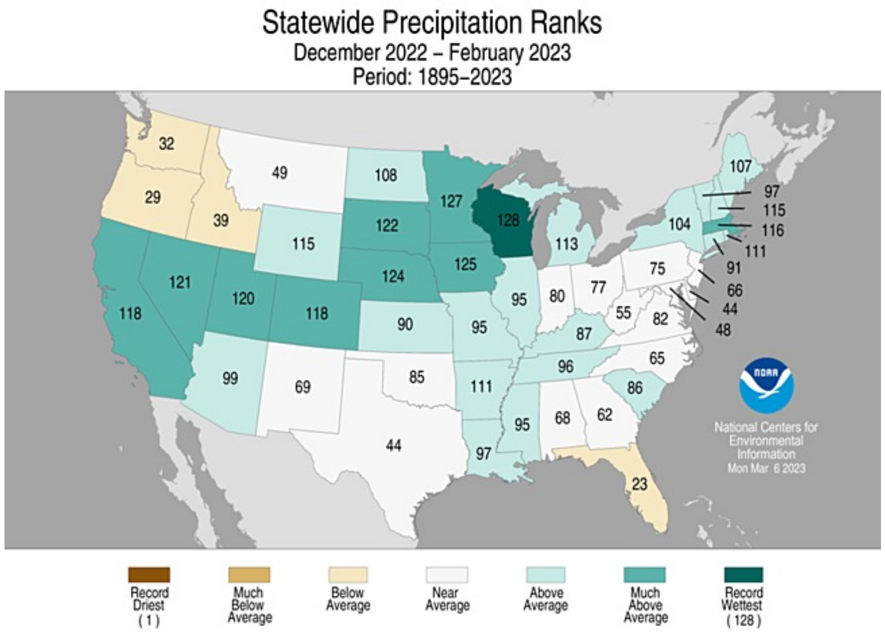
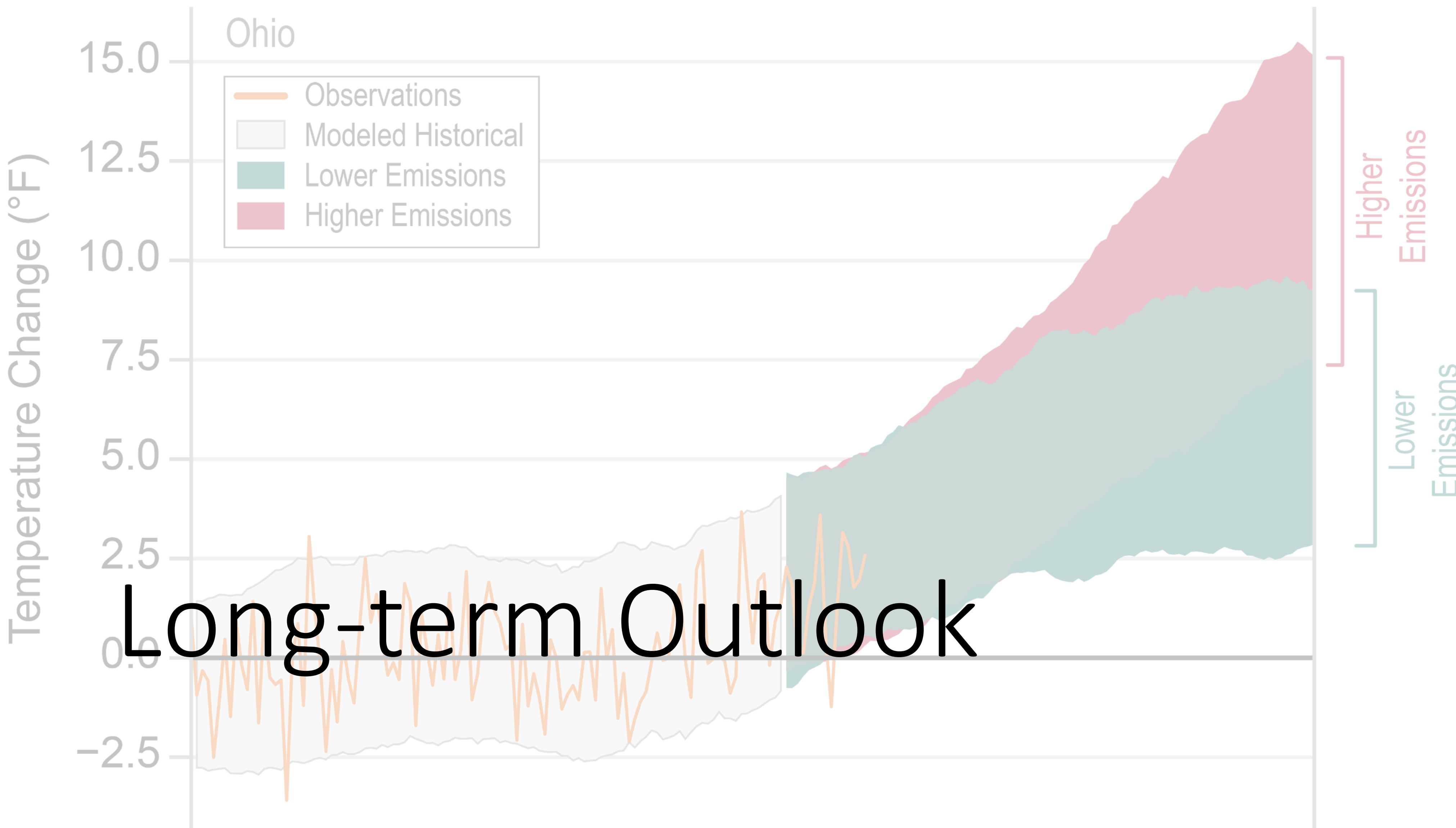
Winter 2022-2023 Perspective





https://www.ncei.noaa.gov/access/monitoring/monthly-report/

Long-term Outlook



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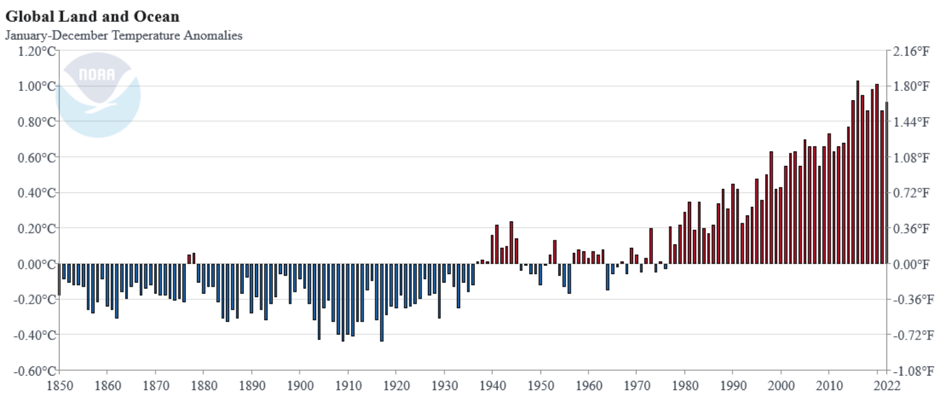
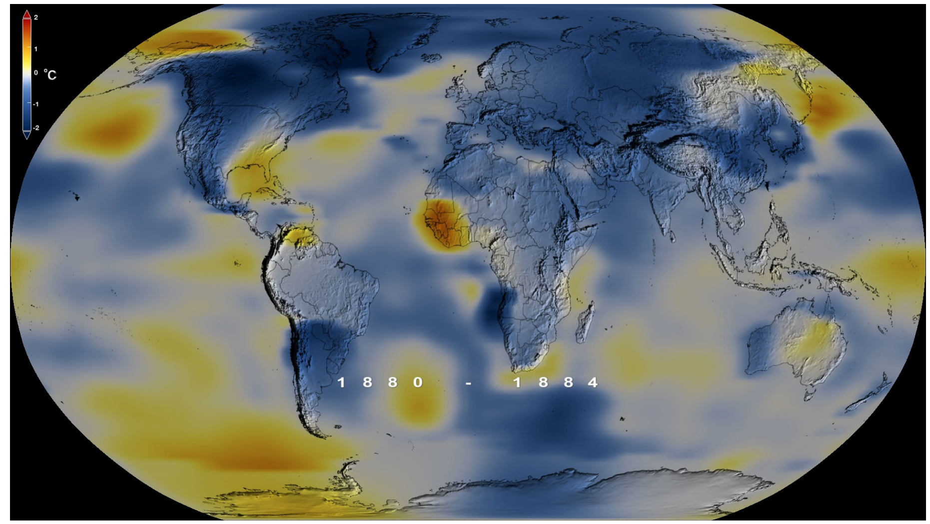
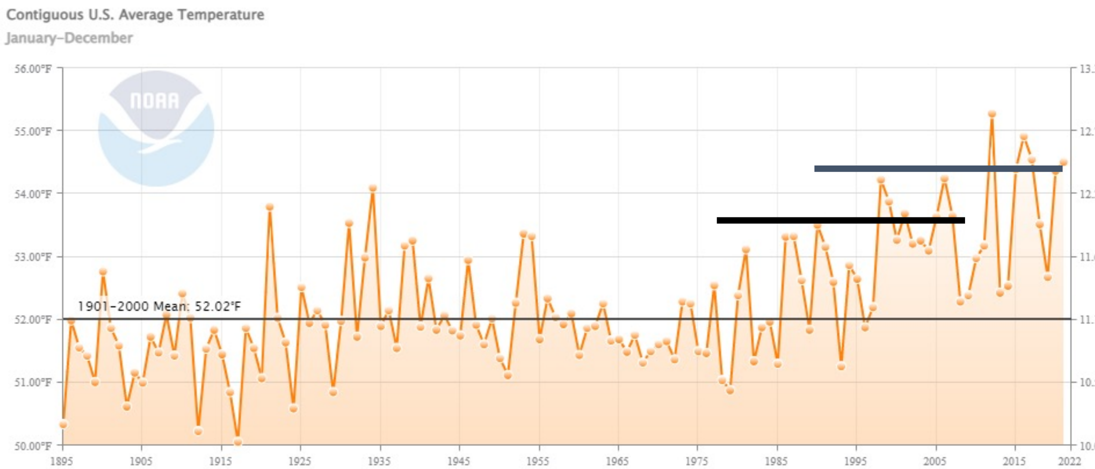
Global Assessment



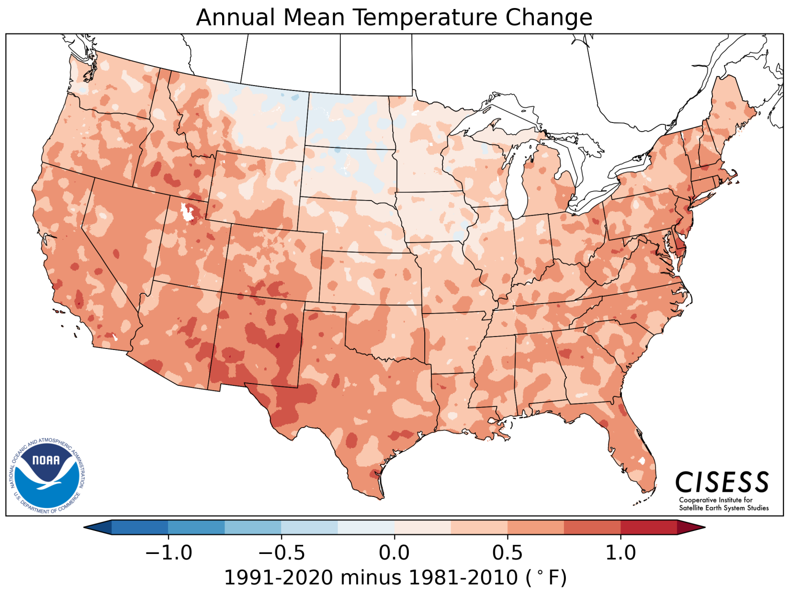


- 2022 is the 6th warmest year since 1850
- Top 10 warmest years have occurred since 2010
- If you were born after February 1985, you have never experienced a cooler than average month for the planet!

NWS New “Normals”: Temperature



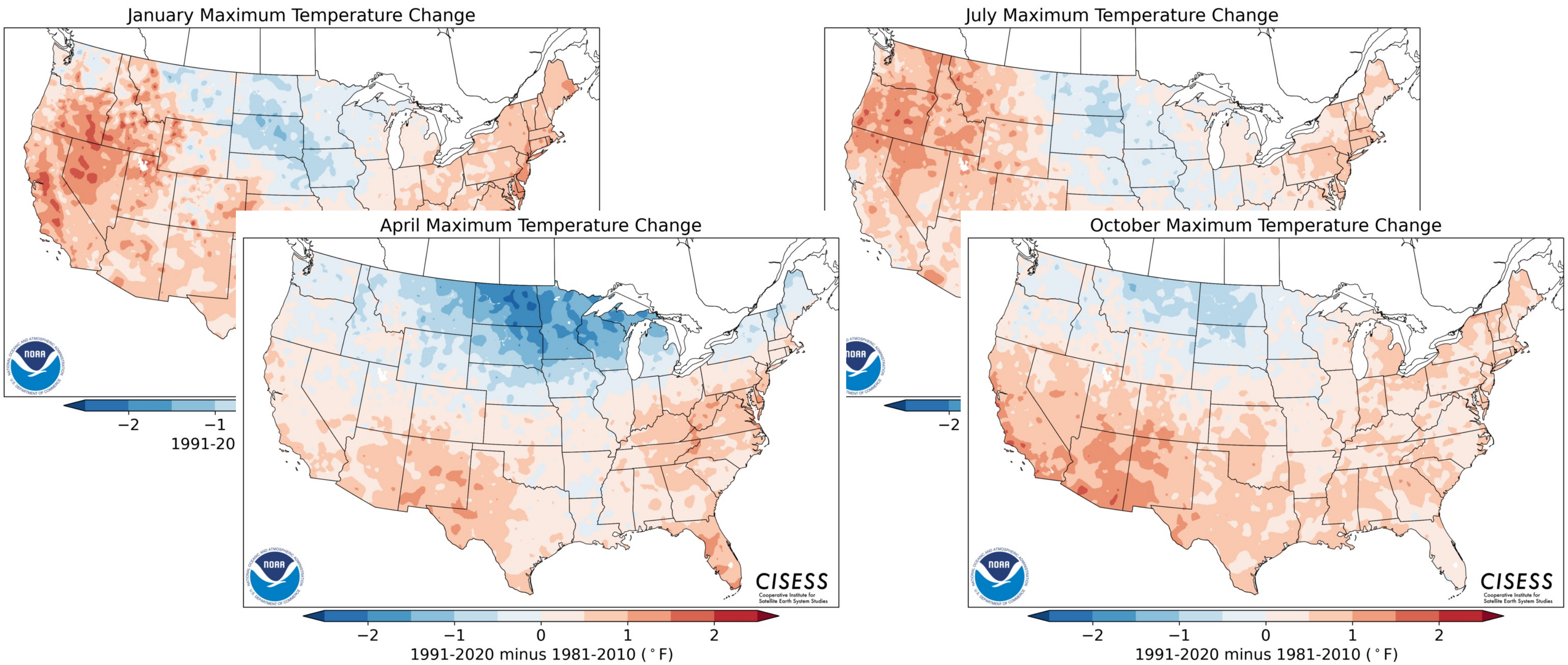
NOAA National Centers for Environmental information, Climate at a Glance: Statewide Time Series, published January 2022, retrieved on January 11, 2022 from https://www.ncdc.noaa.gov/cag/



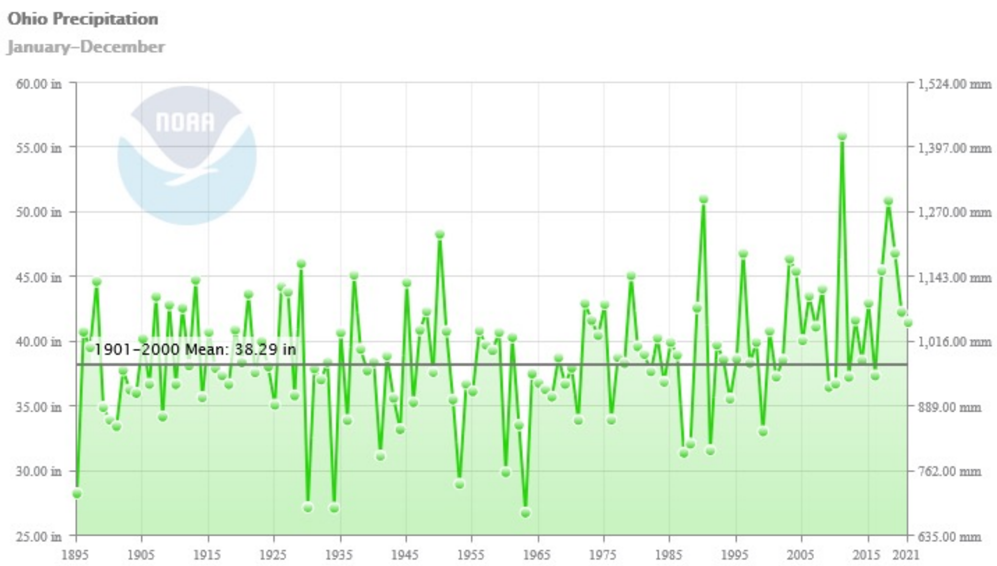
https://www.ncei.noaa.gov/products/us-climate-normals

Seasonal Changes

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



NWS New “Normals”: Precipitation



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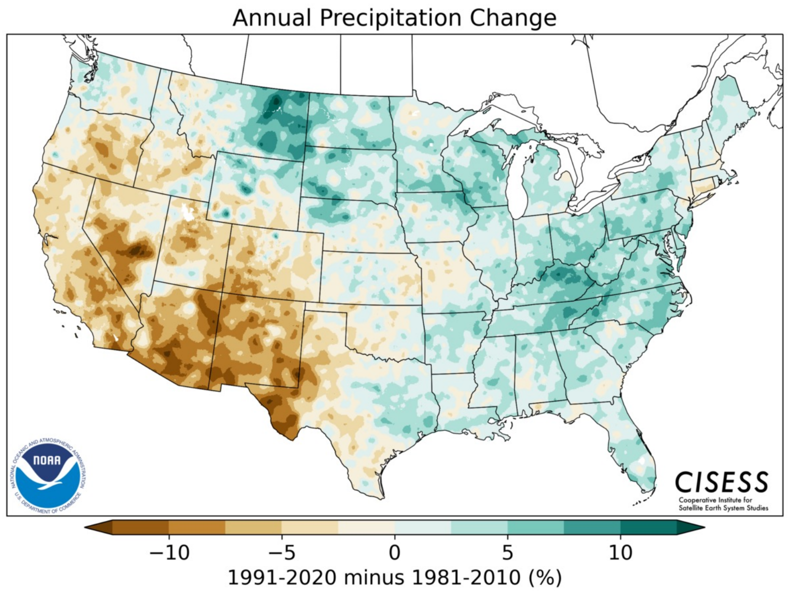

https://www.ncei.noaa.gov/products/us-climate-normals

Seasonal Changes

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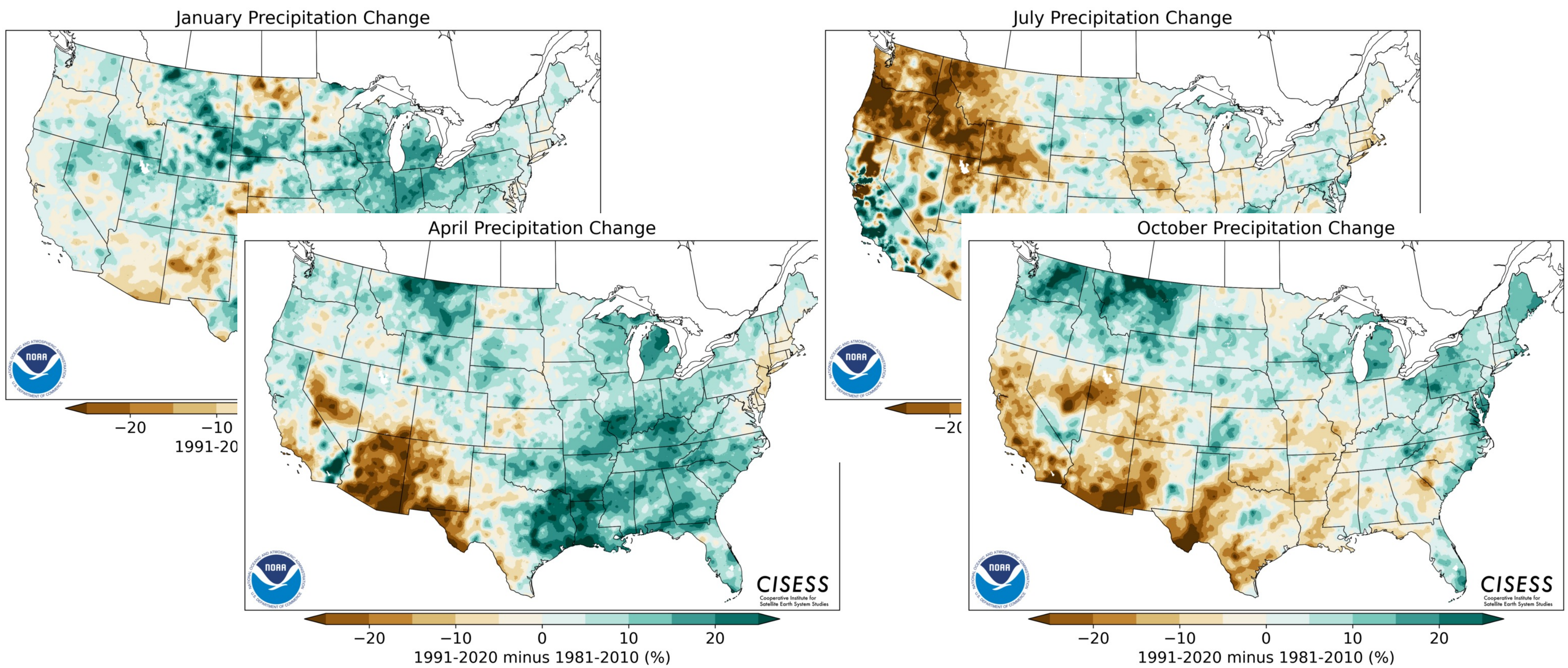
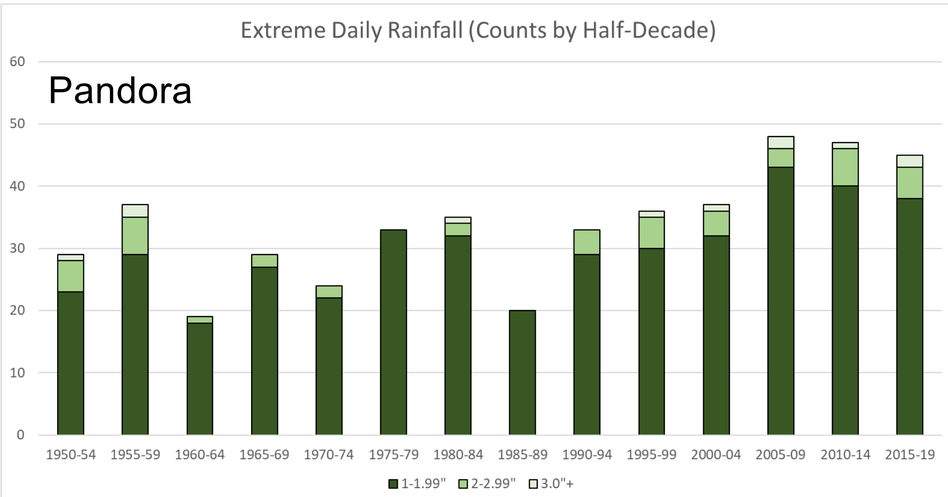
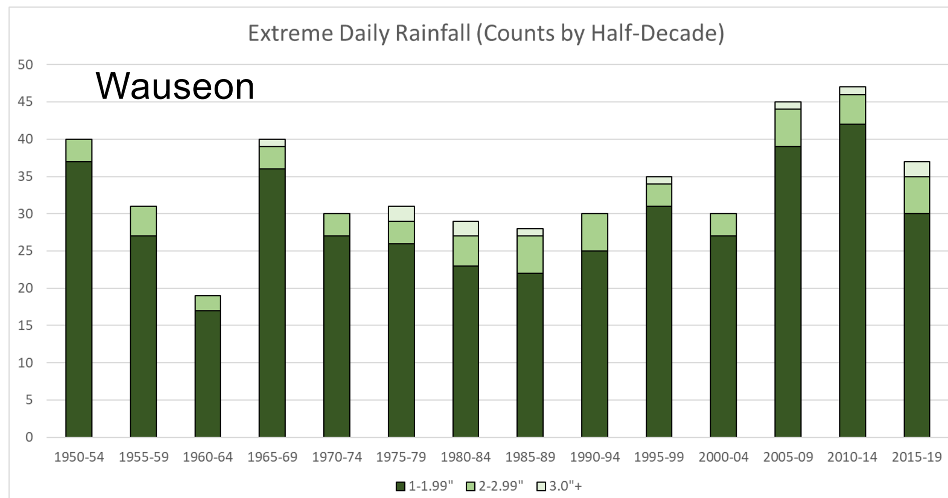
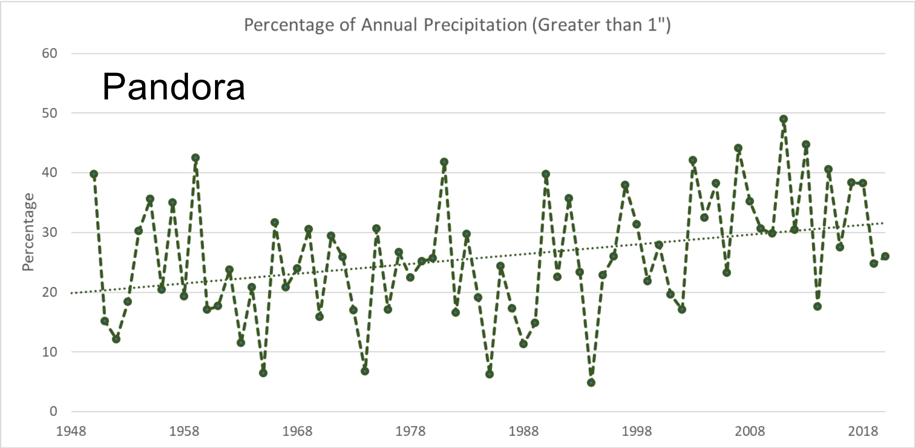


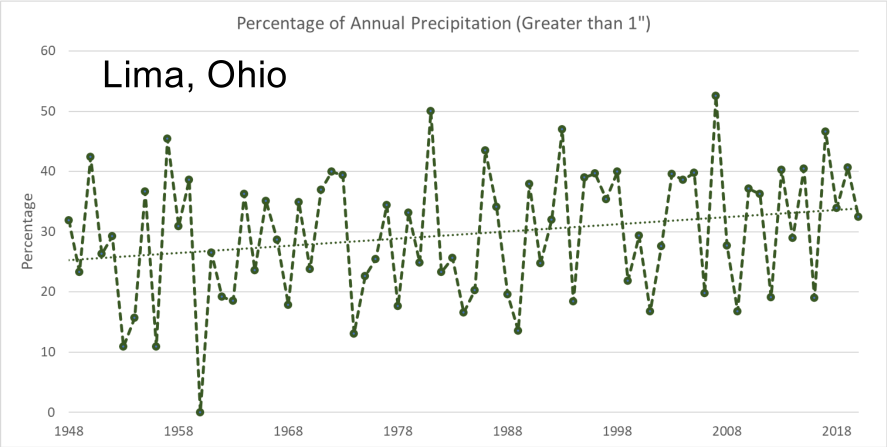
Extreme Daily Event (Pentad) Trends





Portion of Rainfall Falling as Heavier Events





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Top 10

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
5	2021	53.2	1.6
7	1991	53.1	1.5
8	2020	53.0	1.4
9	1931	52.9	1.3
10	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

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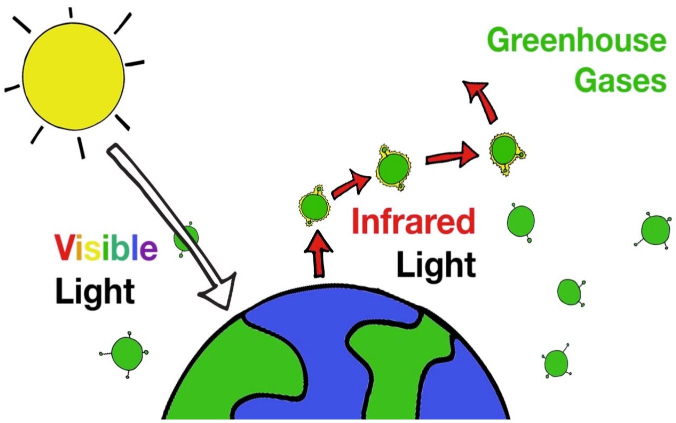
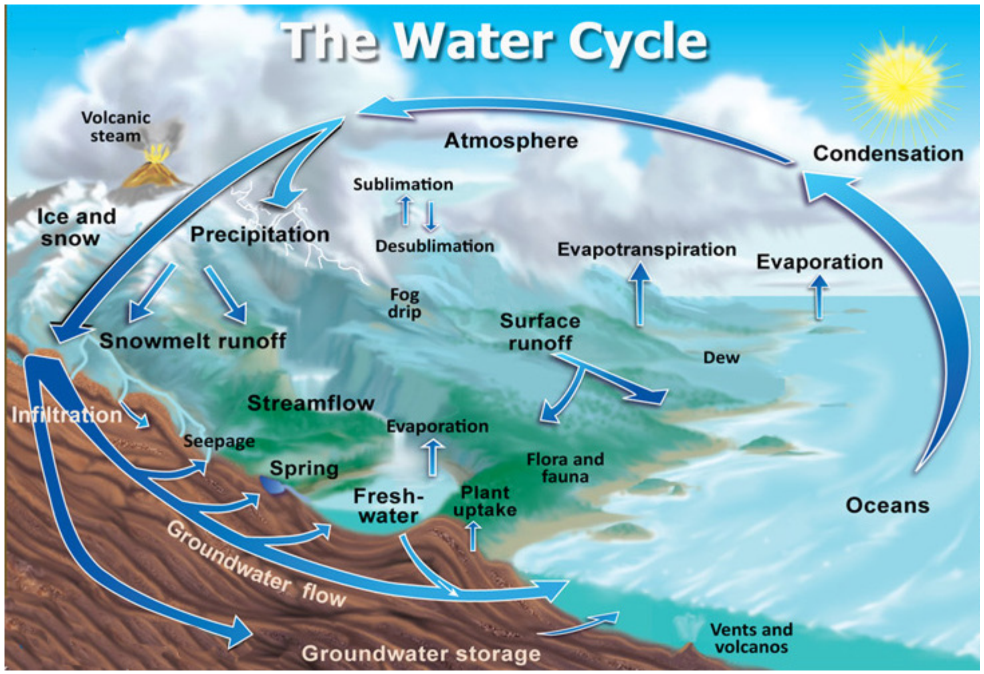
Impacts on the Water Cycle

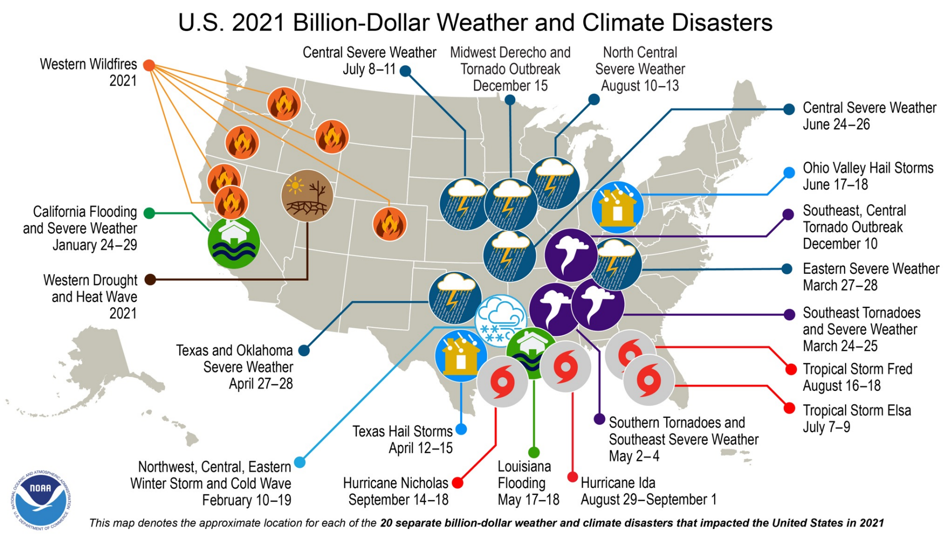


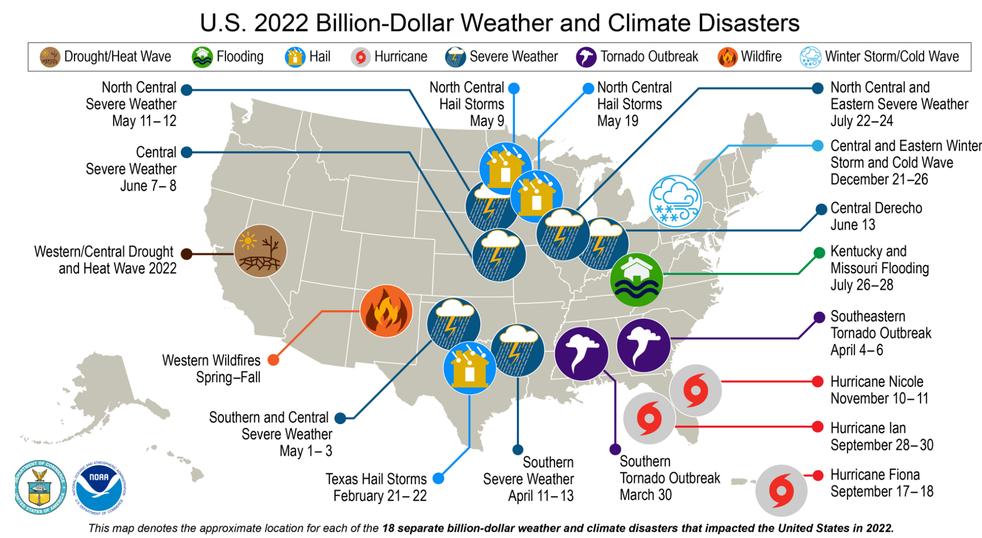
CO_2 and evaporated water become warmer as they absorb infrared radiation from earth's surface trying to escape to space.



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

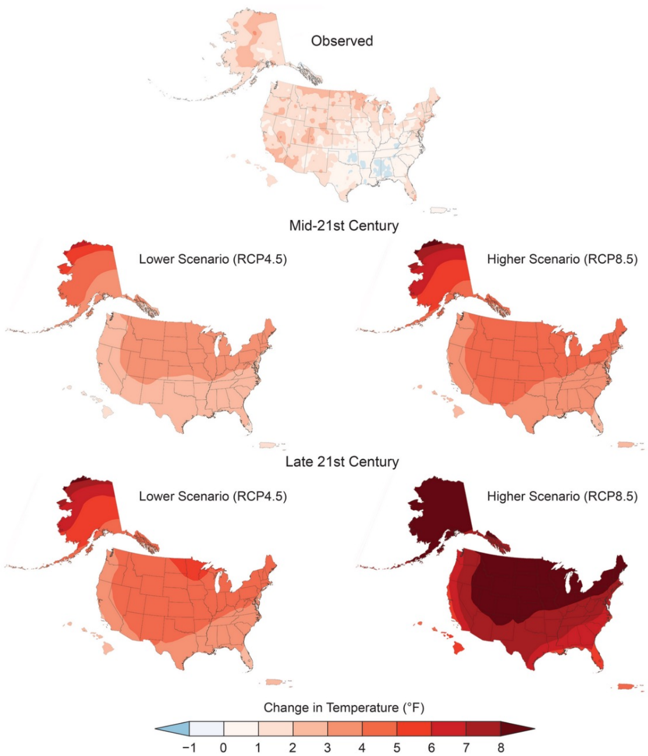
2021 & 2022 Billion Dollar Disasters





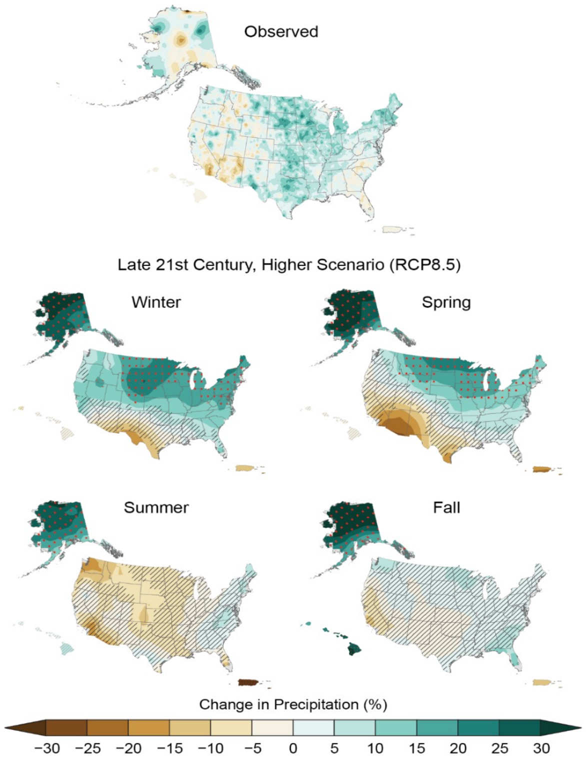
NOAA National Centers for Environmental Information (NCEI) U.S. Billion-Dollar Weather and Climate Disasters (2022). https://www.ncei.noaa.gov/access/billions/, DOI: 10.25921/stkw-7w73

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

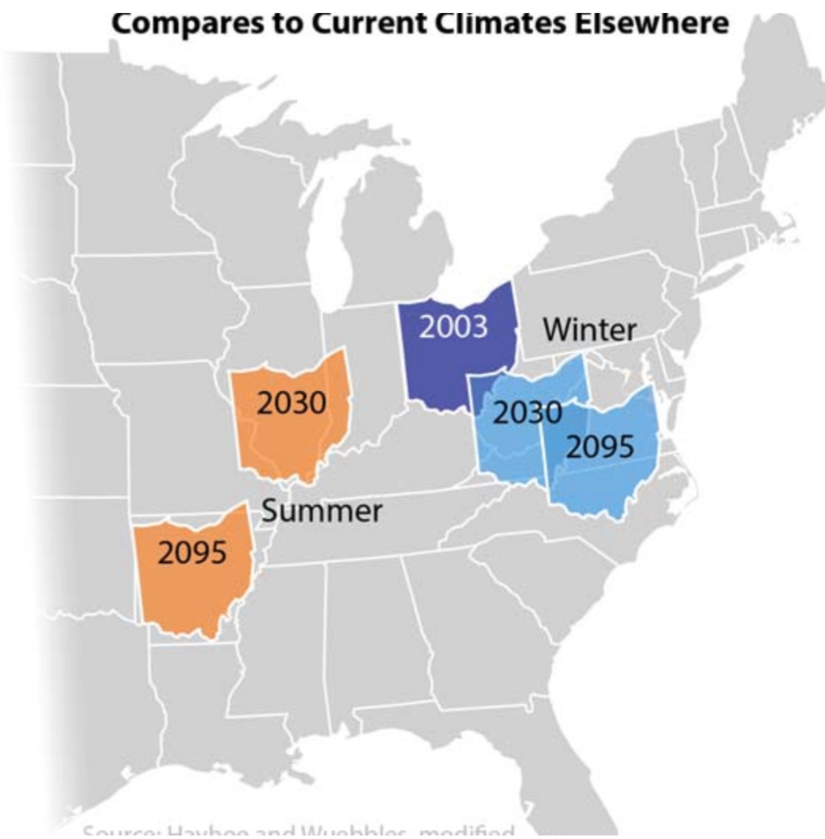
Our Future Climate: Precipitation



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

Our New Normal

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



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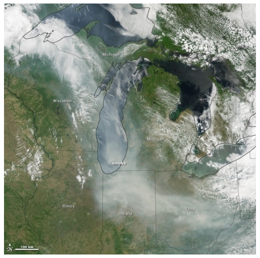
Assessing the Risk

Temperature

- Demand for water and energy increases
- Heat-related illnesses increase
- Heatwave burdens on small and local business, gardeners
- Deteriorated air quality – western wildfire smoke induced health issues

Precipitation

- Increased risk of damage to energy & water infrastructure
- Management challenges of rapid oscillations between extreme wet and dry
- Exposure to waterborne pathogens and vector control
- Property damage due to extreme weather events
- Reduced water quality



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Balancing the Ag Impacts

OPPORTUNITIES

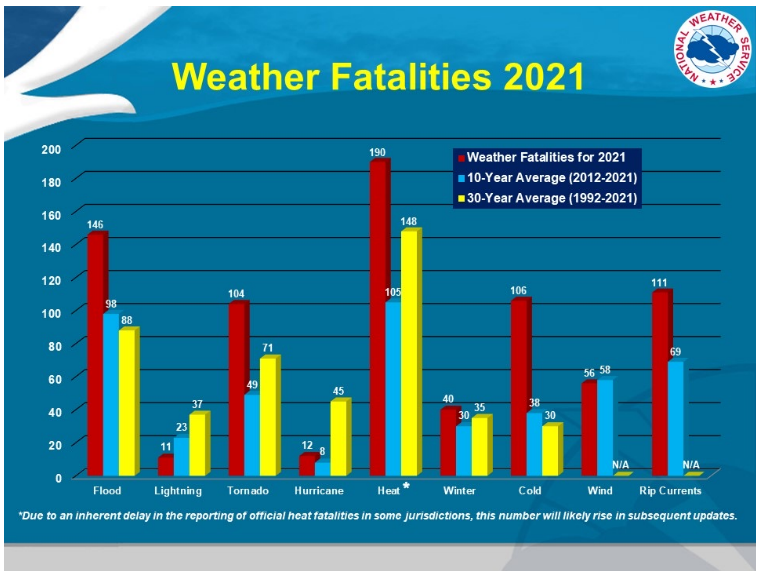
- **Longer growing seasons**
- Crops grown in new areas – new markets
- Longer grazing period
- **Reduced maintenance costs**
- Opportunities in carbon sequestration and improved soils
- Less heating costs in the winter/tradeoff with summer cooling costs

CHALLENGES

- Heat stress on humans and livestock
- Lower food productivity and reduced quality
- **Increased weed pressure, insects, and potential disease**
- Unpredictable growing seasons
- Invasive, non-native plants
- Greater flood risk
- Health risks associated with floods
- **Reduced Days Suitable for Fieldwork**
- **More erosion, intense runoff, nutrient loss**
- Reduced water quality

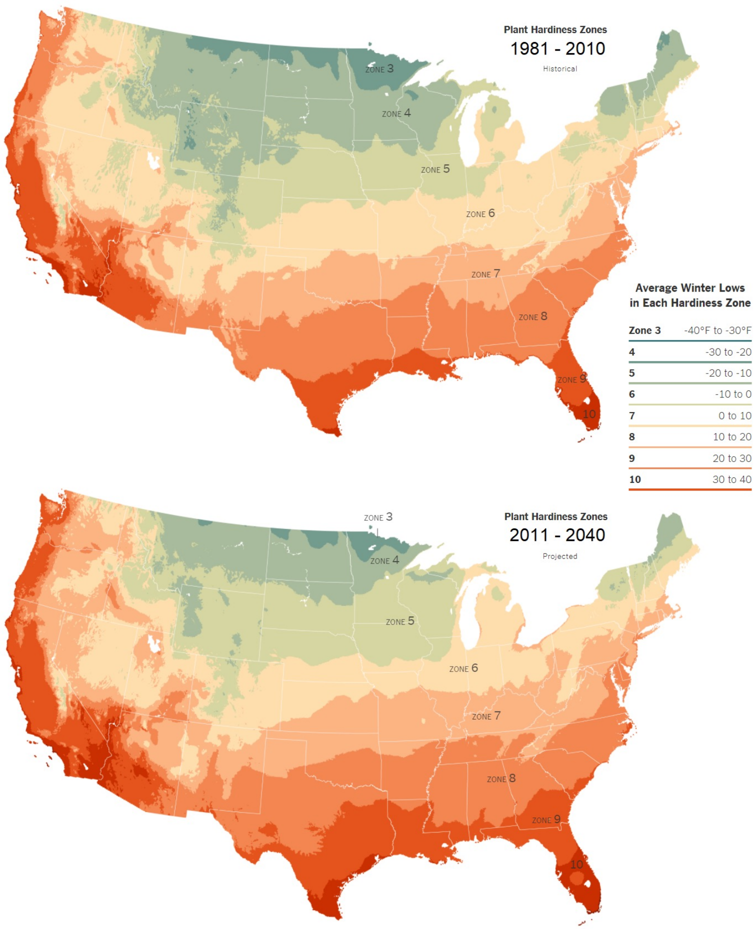
Impacts: Increasing Temperatures

- Additional (sustained) heat stress on humans and livestock
- Lower food productivity and reduced quality



CFAES

Impacts: Shifts in Plant, Animal, and Insect Ranges

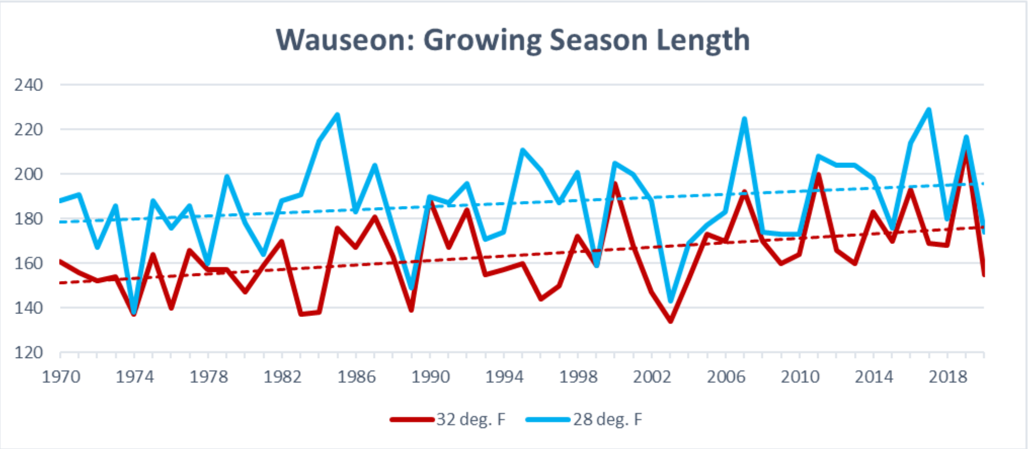


Source: National Oceanic and Atmospheric Administration

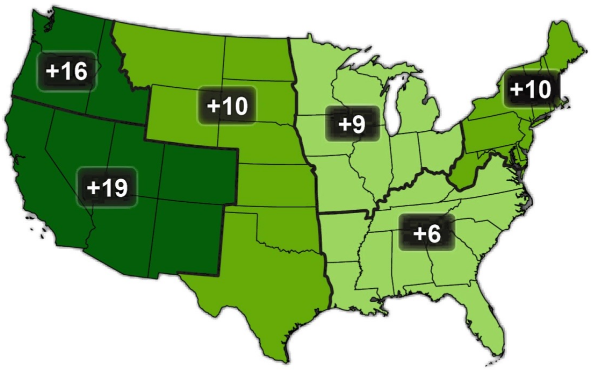
- Unpredictable growing seasons/extreme temperature swings
- Invasive, non-native plants and animals' ranges are expanding; outcompete native species.
- Native and iconic plants may no longer be able to survive in portions of their historic range. (e.g., Ohio without the Ohio buckeye)

Longer Growing Seasons and False Springs

- Benefit: (Growing Season is Longer/Date of Last Spring Freeze is Earlier/Date of First Fall Freeze is Later
- 4 out of top 10 Warmest Feb-Mar have occurred since 2000



Observed Increase in Frost-Free Season Length

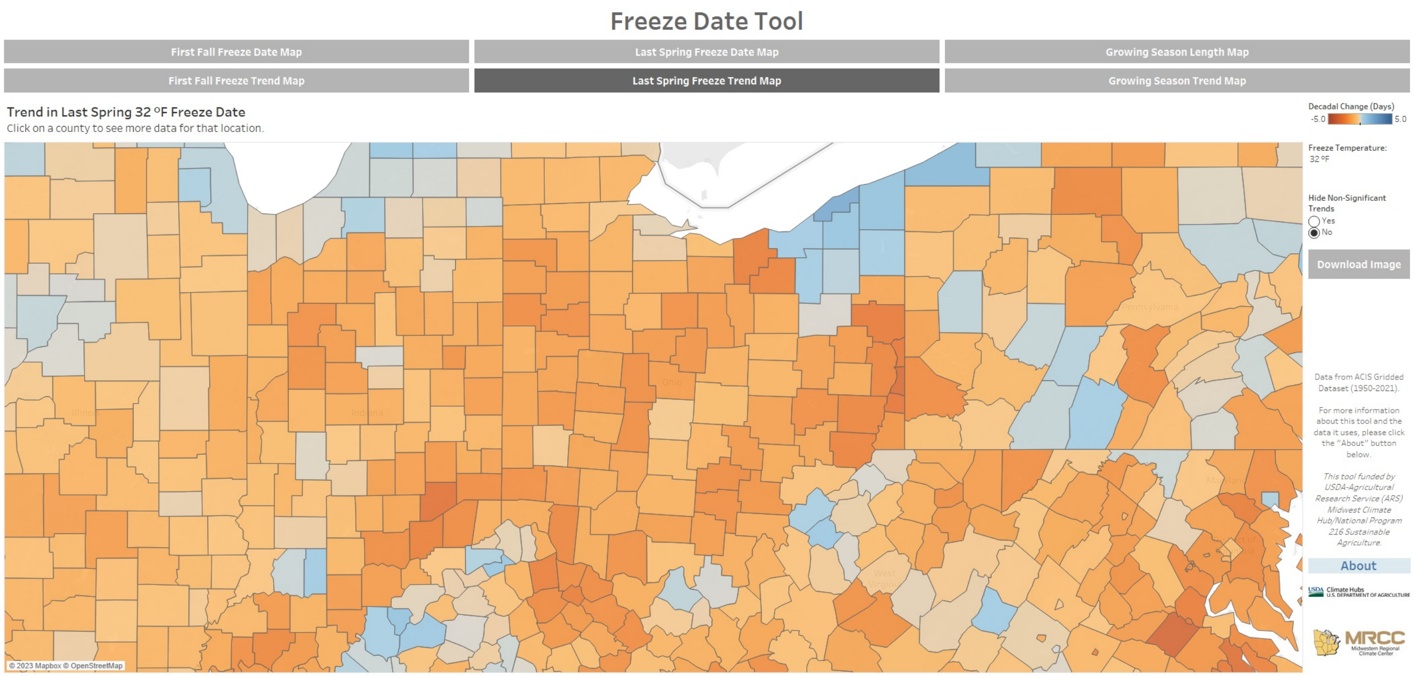


Morphologically damaged apple caused by spring frost events during flowering that partly damaged the blossoms, which resulted in a "Frost Ring". The image was provided by Door Creek Orchard, Cottage Grove, WI, USA.

Dalhaus, T., Schlenker, W., Blanke, M.M. *et al.* The Effects of Extreme Weather on Apple Quality. *Sci Rep* **10**, 7919 (2020). https://doi.org/10.1038/s41598-020-64806-7

Midwestern Freeze Tool

https://mrcc.purdue.edu/freeze/freezedatetool.html



Madison County (1950-2021)

- Last Spring Freeze: **~14 days earlier**
- First Fall Freeze: **~13 days later**
- Growing Season **~27 days longer since 1950**

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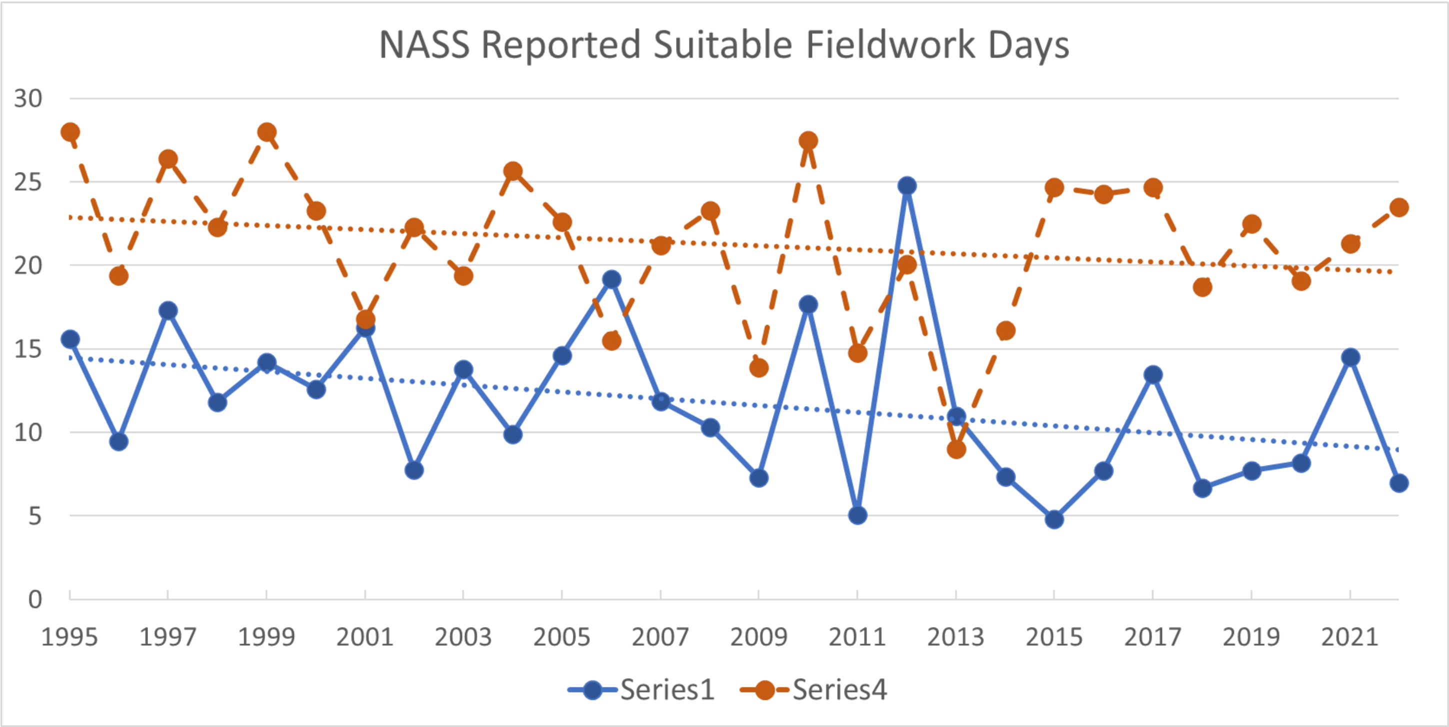
Extreme Precipitation and Cascading Impacts

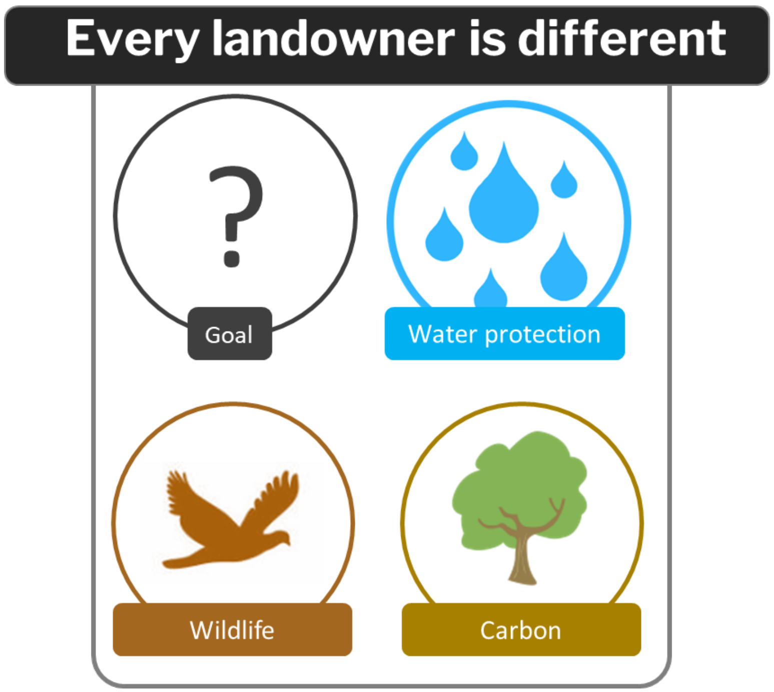
- Excess moisture (row crops, specialty crops, nutrient impacts)

- Droughts too!
  - Rapid oscillations between dry and wet periods
  - Poor timing during pollination and ear-filling

Timing of Production



Adaptation: No single answer



Each decision is unique and will vary based upon:

People: Values, Culture, & Resources

Place: Location & Site Conditions

Purpose: Goals & Objectives

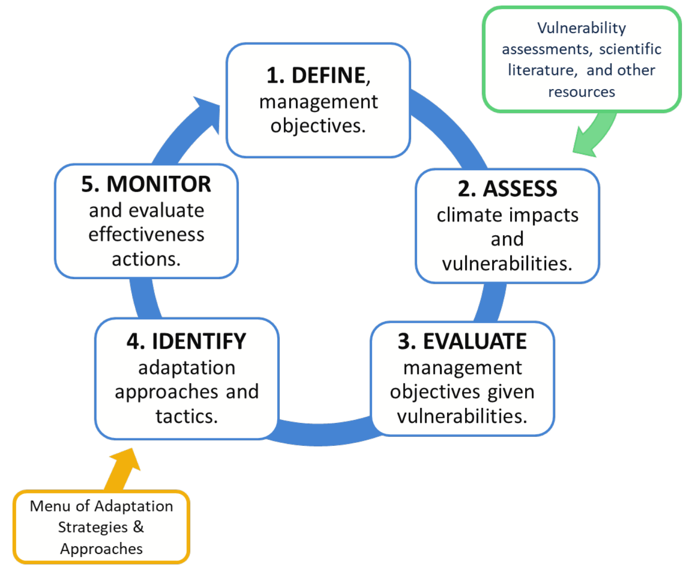
Practices: Equipment, Procedures, & Methods

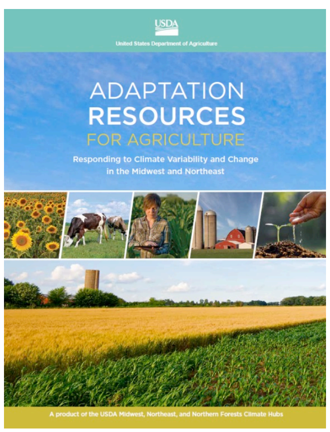
Activity Part 4

Activity Followup

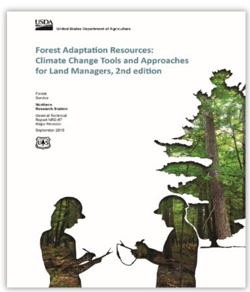
Agricultural Adaptation Resources

- Strategy 1: Sustain fundamental functions of soil and water.
- Strategy 2: Reduce existing stressors of crops and livestock.
- Strategy 3: Reduce risks from warmer and drier conditions.
- Strategy 4: Reduce the risk and long-term impacts of extreme weather.
- Strategy 5: Manage farms and fields as part of a larger landscape.
- Strategy 6: Alter management to accommodate expected future conditions.
- Strategy 7: Alter agricultural systems or lands to new climate conditions.
- Strategy 8: Alter infrastructure to match new and expected conditions.





https://www.climatehubs.oce.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf



Swanston et al. 2016
www.nrs.fs.fed.us/pubs/52760

NIACS
Northern Institute of Applied Climate Science

TREE ATLAS: https://www.fs.usda.gov/nrs/atlas/tree/

https://adaptationworkbook.org

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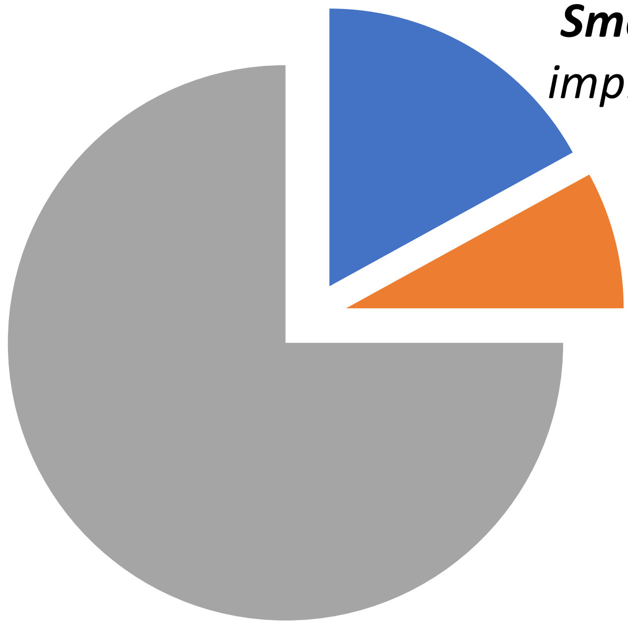
Adaptation Actions Many Not Look Different

***Same actions–** climate change just makes them that much more important*

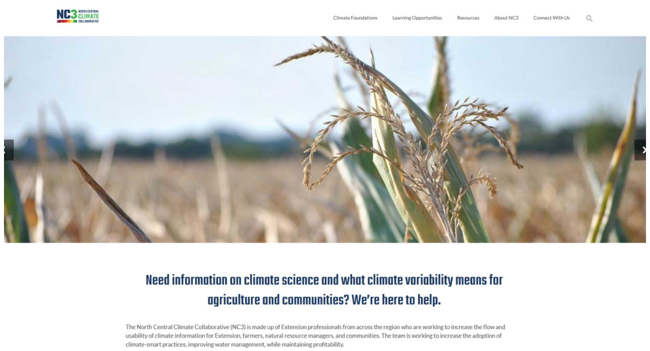


***Small "tweaks"** that improve effectiveness*

New & different** actions to consider, even some that may seem **wild & crazy

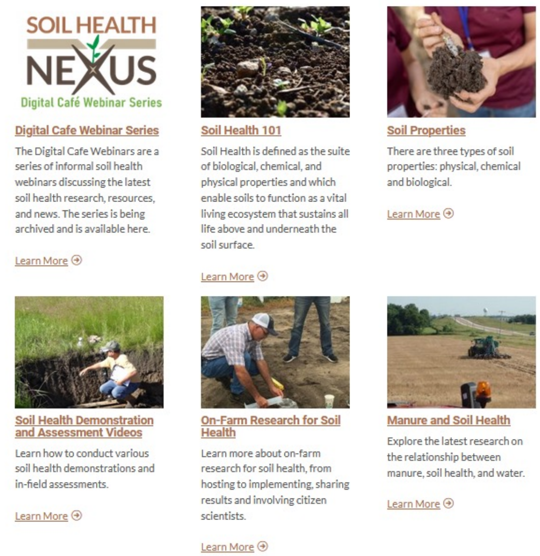
NIACS
Northern Institute of Applied Climate Science

Additional Resources



https://northcentralclimate.org

https://climateready.msu.edu/



https://soilhealthnexus.org/

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Climate Ready Midwest

https://northcentralclimate.org/climate-ready-midwest/

Climate Ready Midwest is a multi-state Extension (Ohio State, Wisconsin, Michigan State, Purdue)-USDA Midwest Climate Hub Partnership working to increase the adoption of regionally scalable climate-smart agriculture by helping to:

- ***Define what climate smart agriculture means to the Midwest Extension and agricultural community, and***
- ***Empower Extension professionals to lead climate-informed agricultural programming across the Midwest.***

Climate Smart Agriculture – Climate Smart Agriculture – "The implementation of farm management practices that are informed by climate science to increase farm resiliency in the face of climate impacts and work toward net-zero carbon emissions (e.g., effectively managing water supplies, weeds, and nutrient applications, implementing soil health practices, diversifying crop varieties, adjusting planting and harvest timing, and better carbon management).

According to the USDA, when applied appropriately, these activities may deliver quantifiable reductions in greenhouse gas emissions and/or increases in carbon sequestration.

Example: Enhancing MI Climate Ready Farm Assessment (already in progress) to provide producers a better understanding farm preparedness for weather and climate related issues.

http://climateready.msu.edu/

Adapting to Changing Water Cycle

- What strategies slow the progress of water from fields to streams?
- What strategies improve the quality of the soil, thereby improving plant health and water storage capacity?
  - Improve water harvesting and storage
  - Improve irrigation efficiency
  - Reduced evaporation of soil water through mulching with organic materials, mulching with plastic, rapid crop canopy development/closure
  - Combatting higher humidity and/or extreme weather

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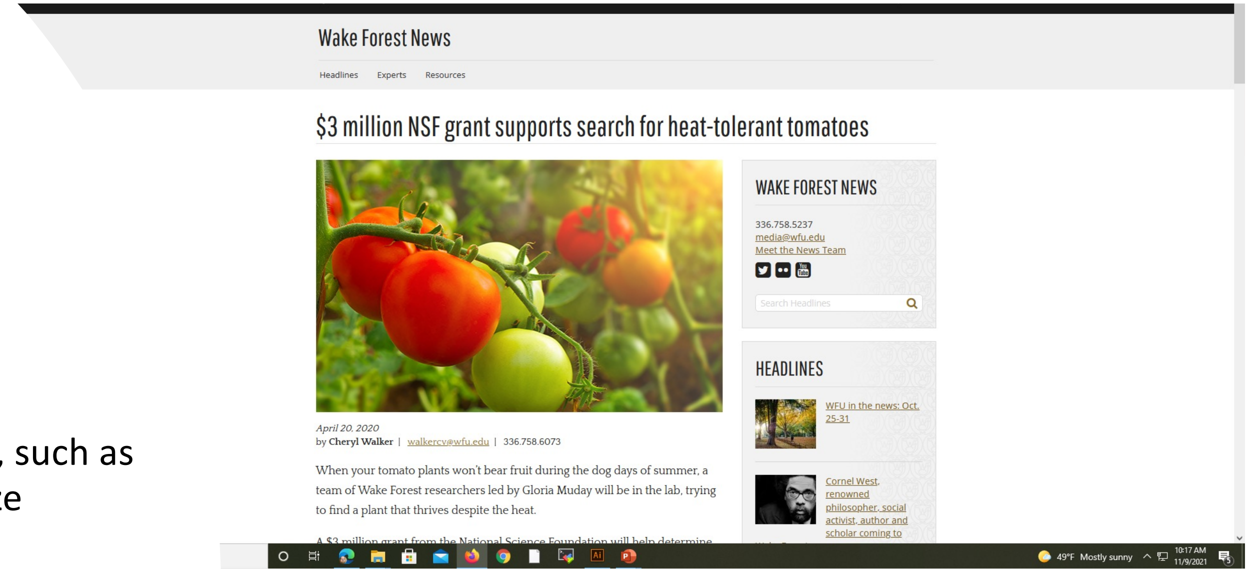
Managing Weeds

- Warmer winters and less winter kill
- Warm, moist conditions lead to advantageous conditions for weeds
- Probably means more time and resources devoted to weed control

Horticulture and Adaptation

- Crop regulation and canopy management, such as using temperature data loggers to optimize temperatures; greenhouse modifications
- Using irrigation to ameliorate temperature extremes; sprinkler irrigation can reduce canopy temperatures.
- Vegetable/Fruit hybrids with greater heat tolerance
- Diversity of plants – flexible and adaptive
- Drought tolerant plants



Wake Forest News

Headlines Experts Resources

$3 million NSF grant supports search for heat-tolerant tomatoes

April 20, 2020
by Cheryl Walker | walkercv@wfu.edu | 336.758.6073

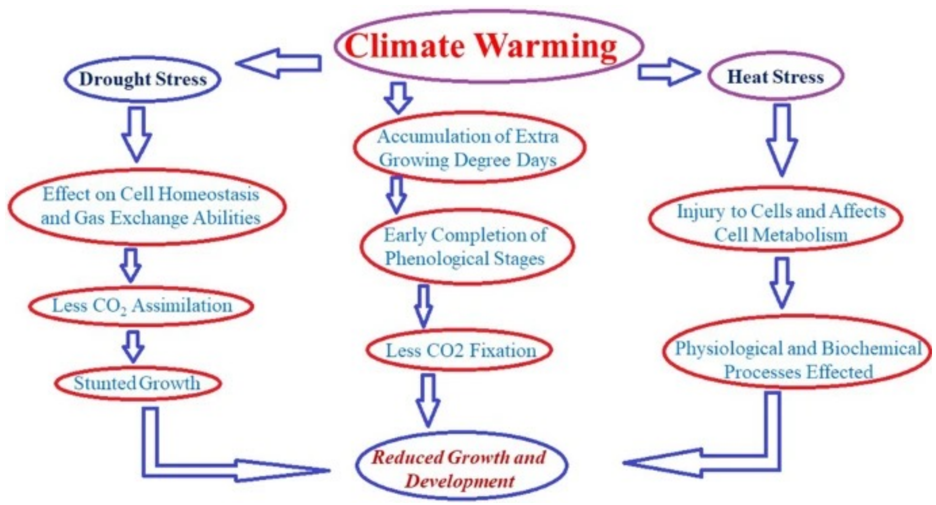
When your tomato plants won't bear fruit during the dog days of summer, a team of Wake Forest researchers led by Gloria Muday will be in the lab, trying to find a plant that thrives despite the heat.

WAKE FOREST NEWS
336.758.5237
media@wfu.edu
Meet the News Team

HEADLINES
WFU in the news: Oct. 25-31
Cornel West, renowned philosopher, social activist, author and scholar coming to

Adapting Plants and Seeds

- Accelerated GDD accumulation → rapid crop development → affect gluten accumulation during grain fill (life cycle of grain)
- High quality seed
- Cultivars adapted to a diverse range of conditions (e.g., greater heat tolerance, drought tolerance, withstand periods of extreme wetness)
- Early sowing/planting data adjustments



Fatima, Z., Ahmed, M., Hussain, M. *et al.* The fingerprints of climate warming on cereal crops phenology and adaptation options. *Sci Rep* **10**, 18013 (2020). https://doi.org/10.1038/s41598-020-74740-3

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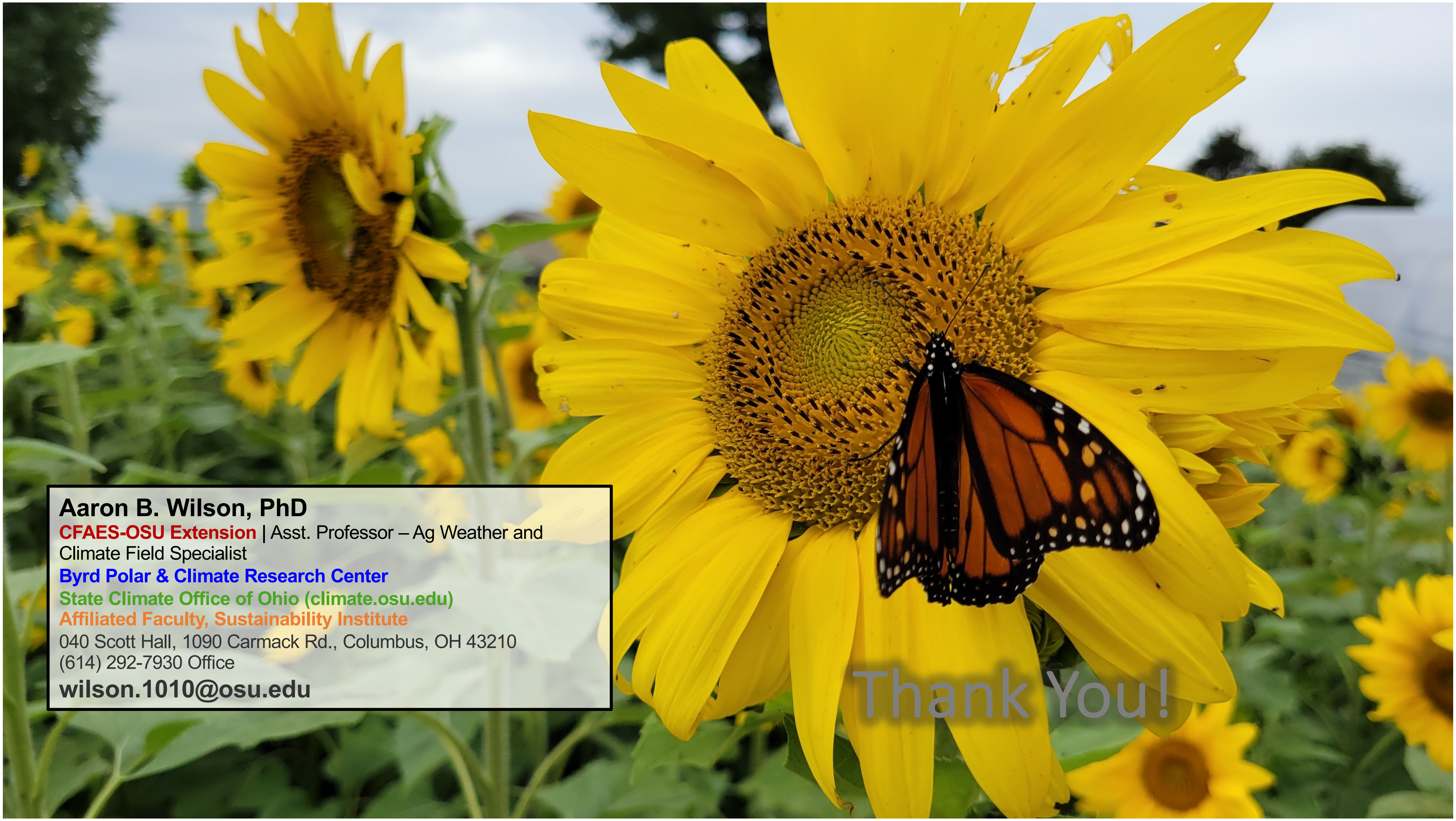
Soil Health at the Heart of Adaptation and Mitigation

- Healthy soils impacted by erosion, compaction, and loss of organic matter.
- Looking for win-win practices: cover crops, reduced or no-till, crop diversification – Sustainable Ag is Climate Ready
- Food and Agriculture Organization of the United Nations: “It is estimated that soils can sequester around 20 Pg C in 25 years, more than 10 % of the anthropogenic emissions.” – Rattan Lal

Takeaways

- Weather and Climate are related but describe different scales of events.
- It's personal!
- It is getting warmer and wetter in Ohio – especially winters and springs.
- Intensity of rainfall increasing along with seasonal distribution changes.
- Future looks even warmer with swings between extreme hydro extremes likely
- Identify the win-win opportunities to improve quality of soil and water, manage large swings in temperatures and precipitation, while building resilience to expected changes in climate



Aaron B. Wilson, PhD
CFAES-OSU Extension | Asst. Professor – Ag Weather and Climate Field Specialist
Byrd Polar & Climate Research Center
State Climate Office of Ohio (climate.osu.edu)
Affiliated Faculty, Sustainability Institute
040 Scott Hall, 1090 Carmack Rd., Columbus, OH 43210
(614) 292-7930 Office
wilson.1010@osu.edu

Tabletop Exercise

1. What was effective about this activity?

2. What could be improved about this activity? What could be added, removed, and/or changed?

3. What audiences do you think it would be most effective with? Why?

4. How could it be altered to work with different audiences? What are these audiences?

5. Is there anything else you would like to add?

Break

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Land use/Land mgmt. and Ecosystem Services Update

Team: Yang Li, Brian Cultice, C. Dale Shaffer-Morrison

The Ohio State University
College of Food, Agricultural, and Environmental Sciences

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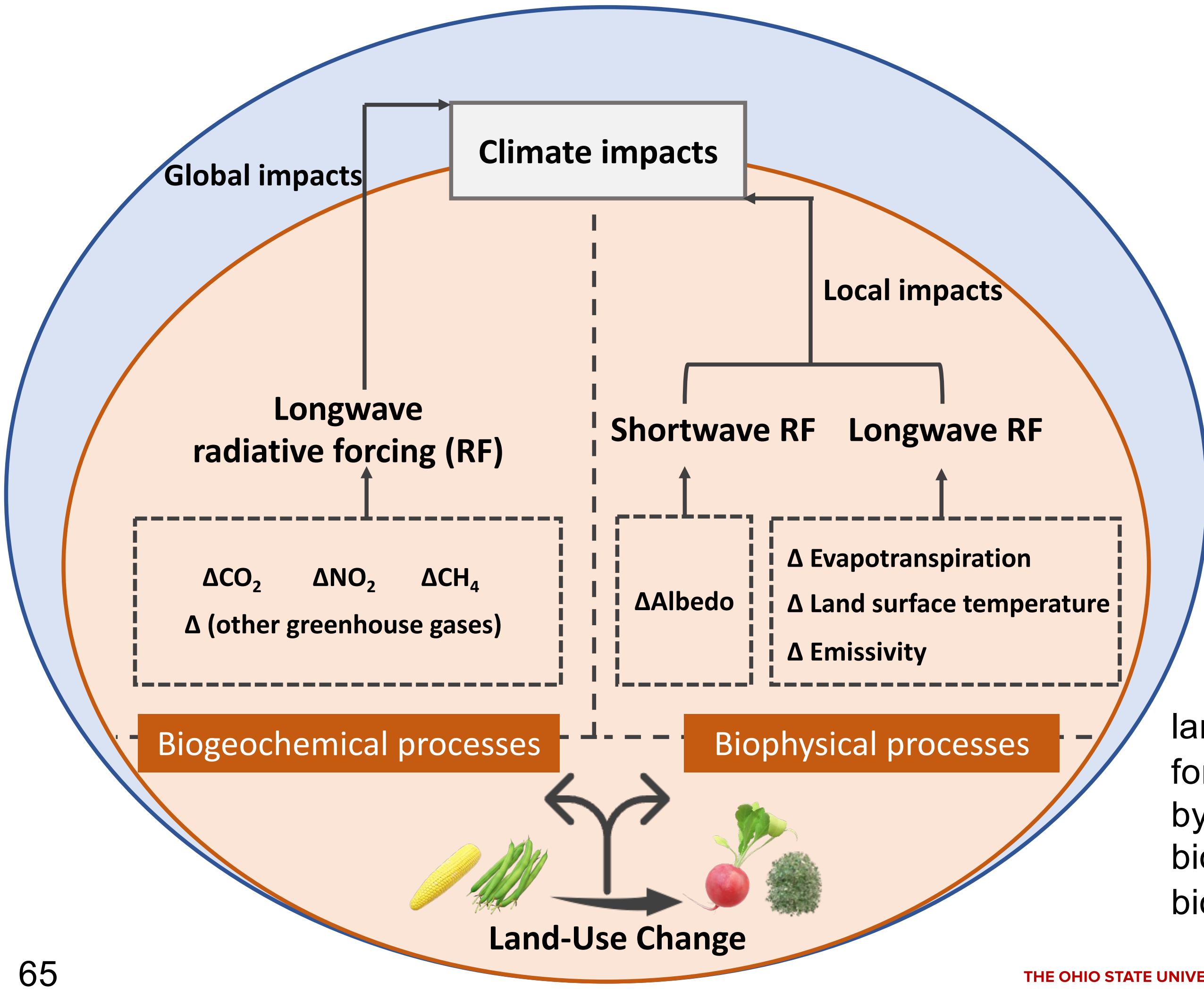
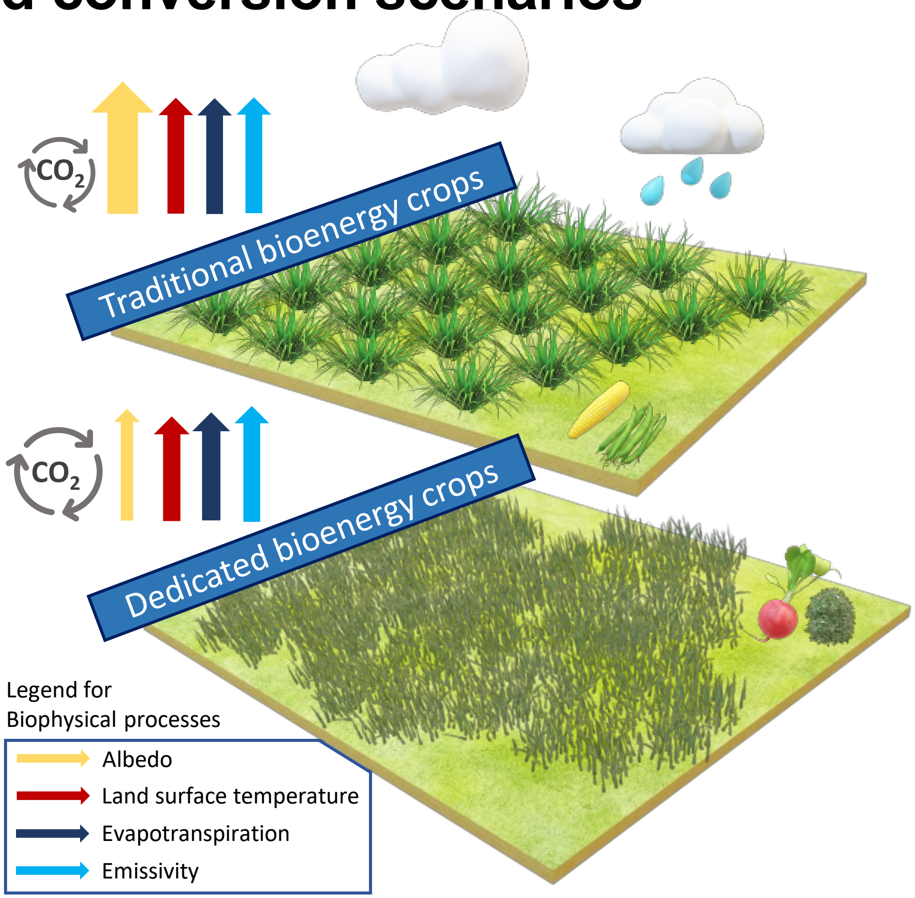
Integrating biophysical impact of bioenergy crops into the carbon-centric life cycle assessment

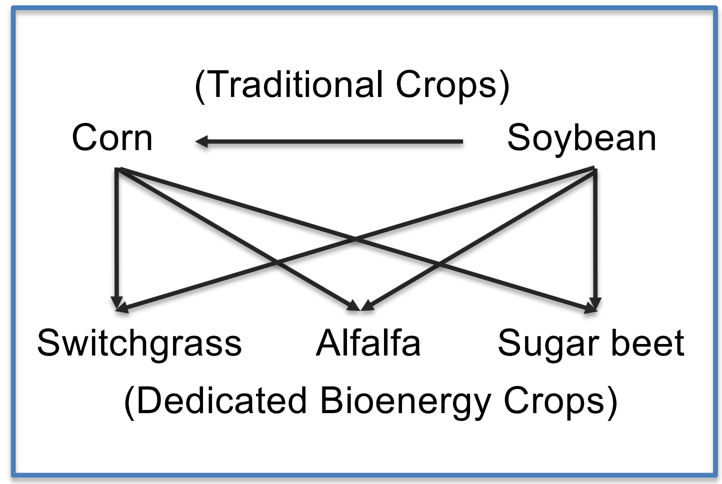
Yang Li, Kaiguang Zhao, Yongyang Cai



land conversions and management for bioenergy production affect climate by altering both GHG balances (i.e., biogeochemical) and surface biophysics (i.e., biophysical).

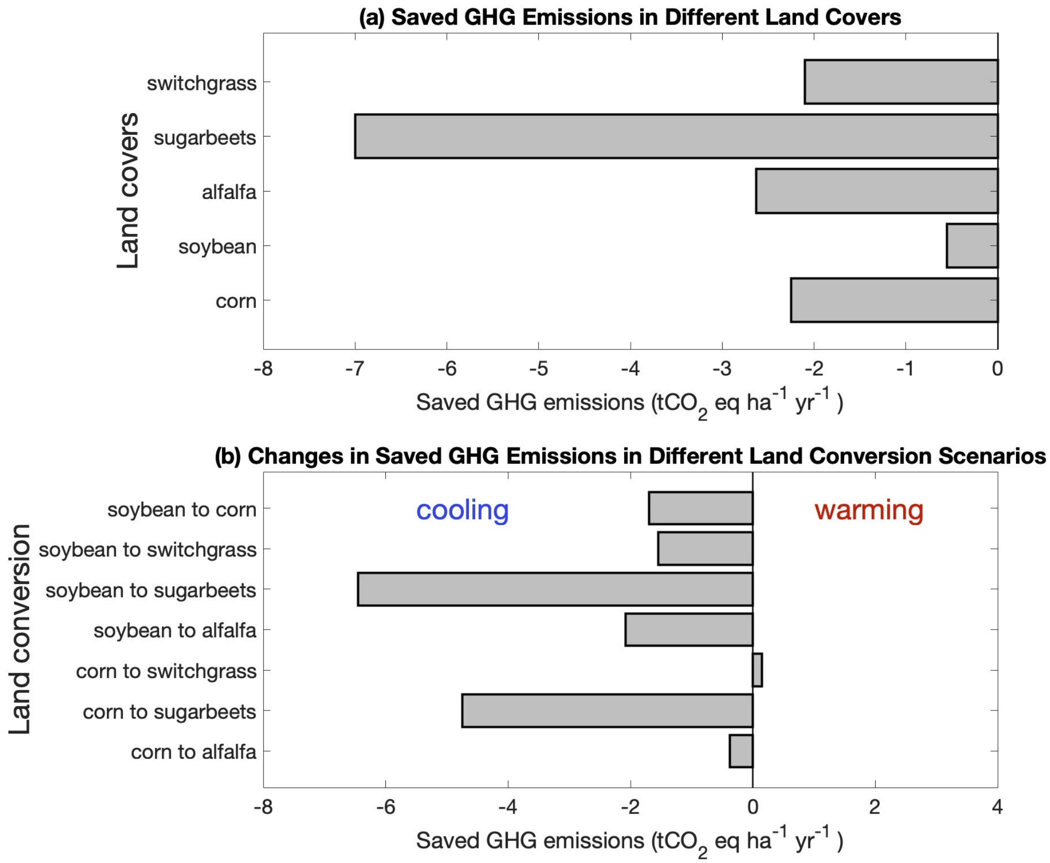
Land conversion scenarios





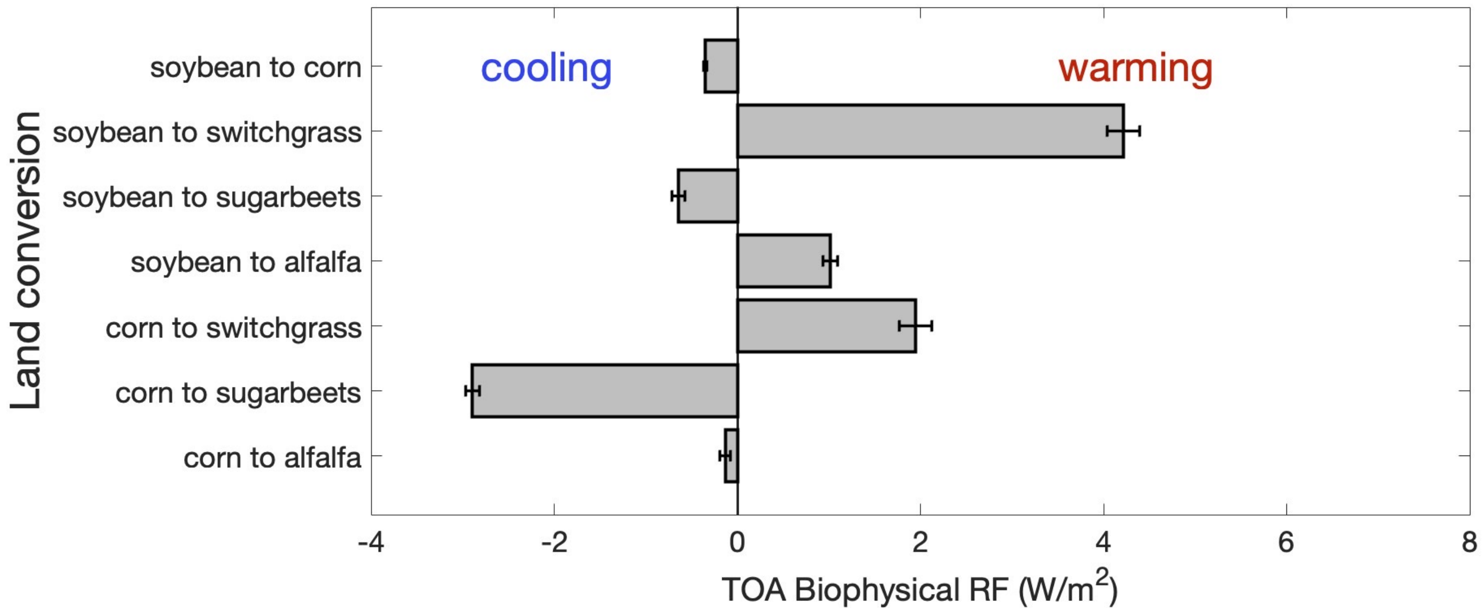
Changes in land surface properties (e.g., albedo, evapotranspiration, and temperature/emissivity) modify land-air interactions, either amplifying or dampening the climate benefits associated with GHG footprints.

Biogeochemical impact



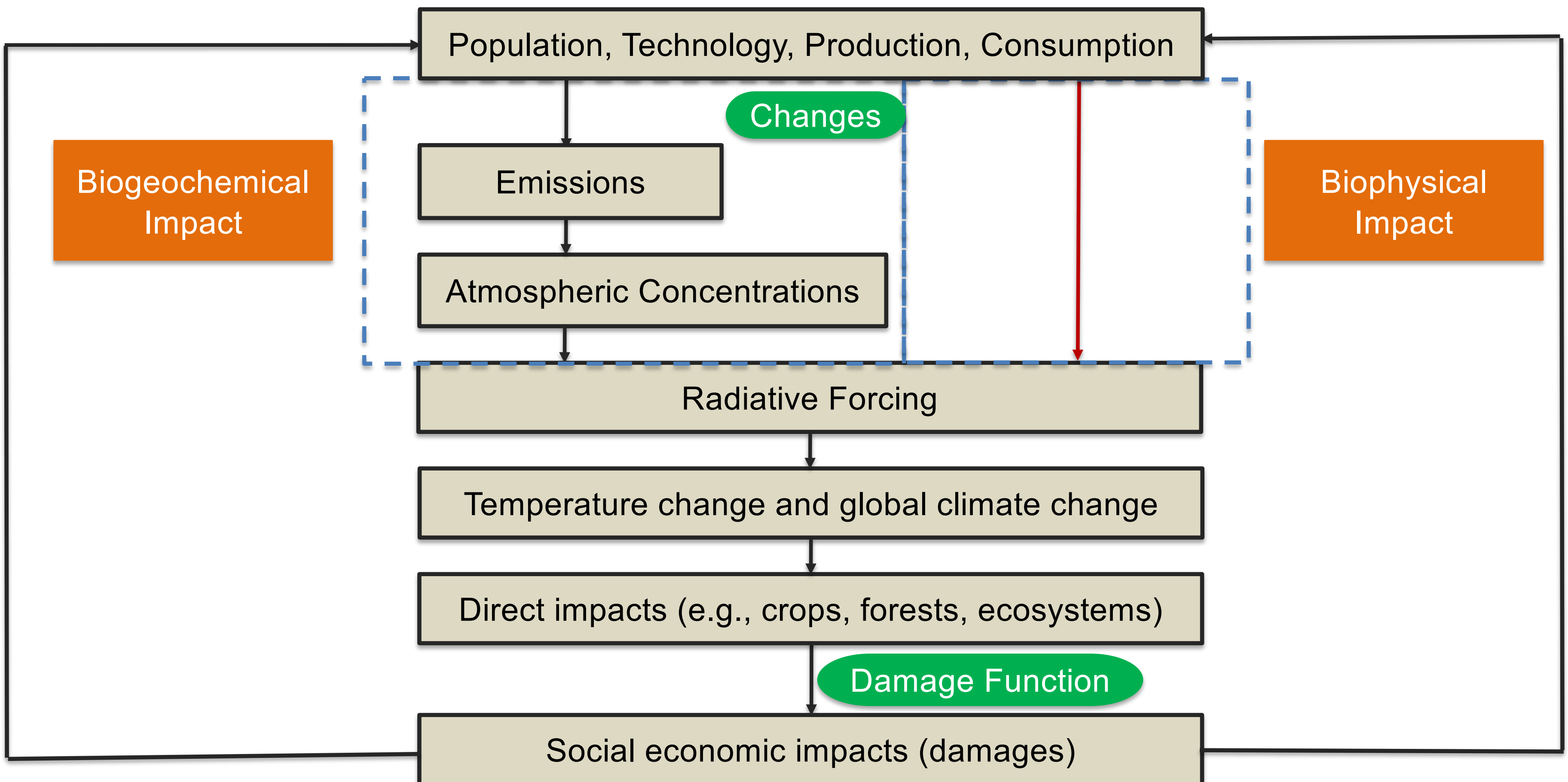
- Sugar beet saved the most GHG emissions, while soybean saved the least.
- The conversion from corn to switchgrass increased GHG emissions. Other conversion scenario decreased GHG emissions.

Biophysical impact

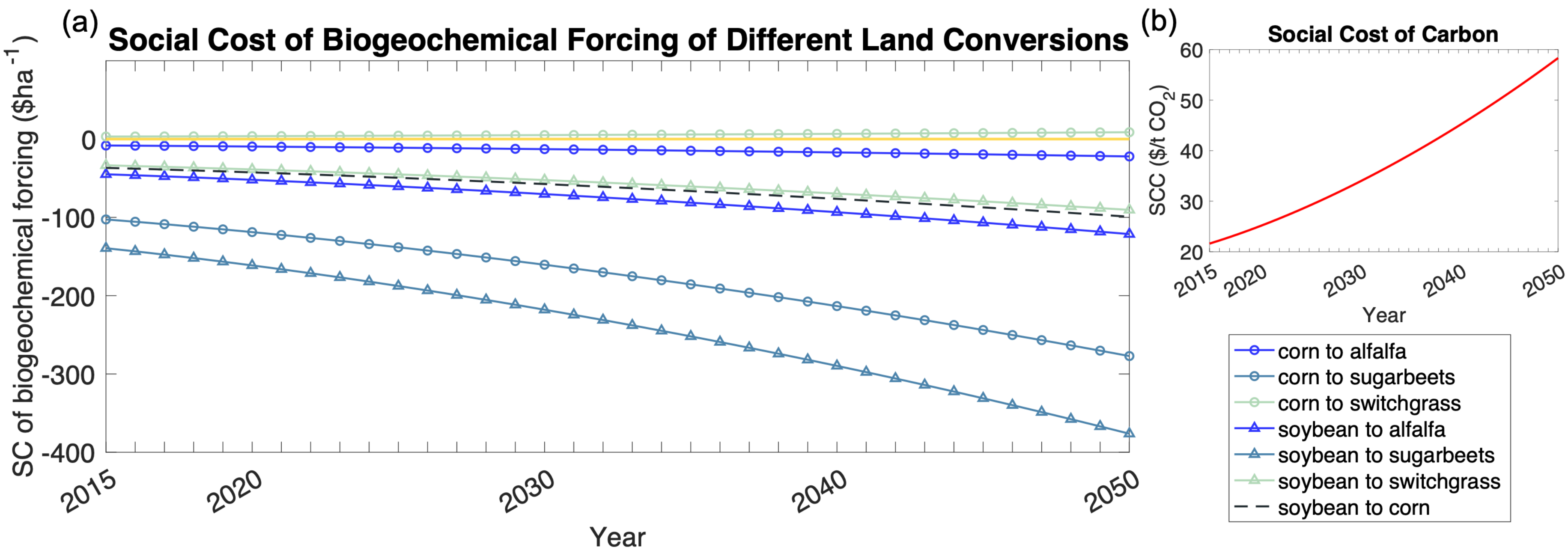


- Corn/soybean-to-switchgrass, and soybean-to-alfalfa conversions resulted in positive biophysical radiative forcing at the top of atmosphere (TOA), which contributed to warming.

Framework of DICE Model

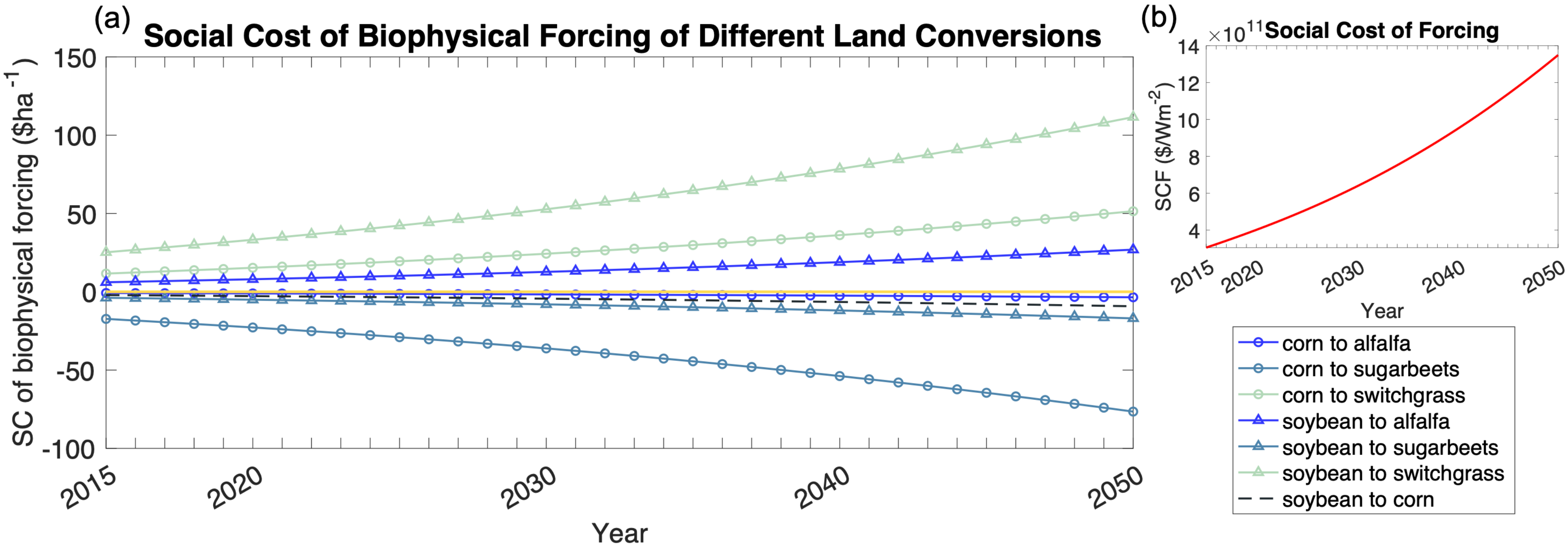


Social cost of biogeochemical impact



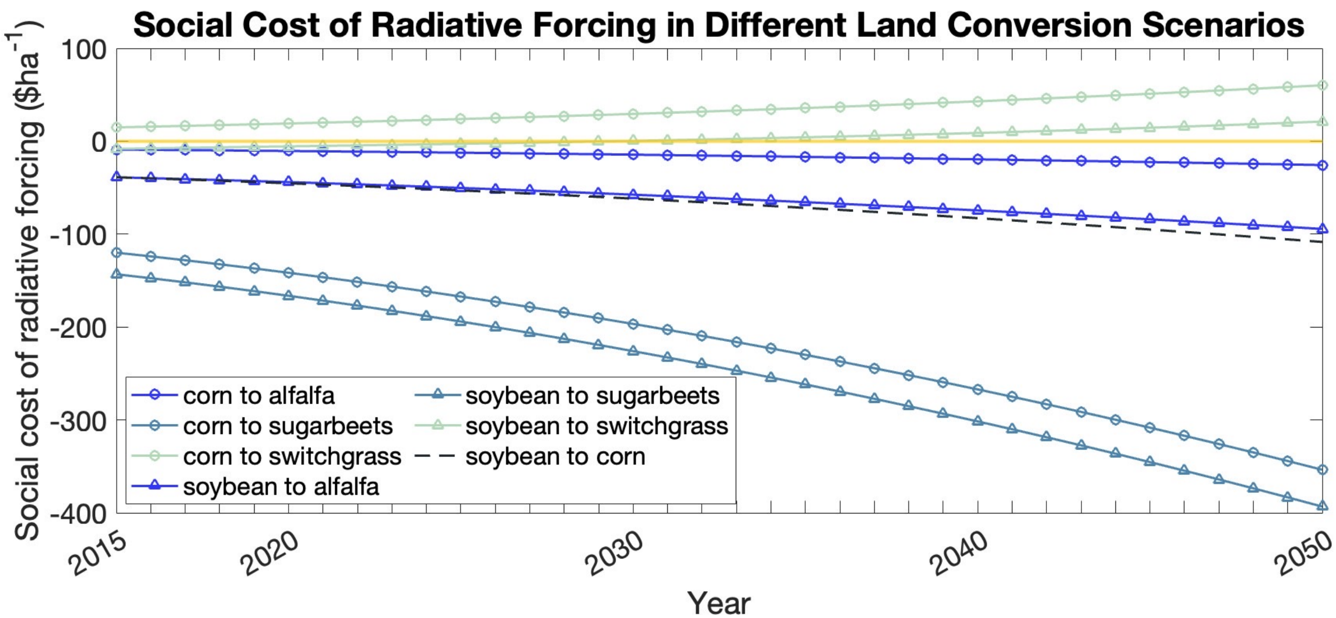
- Social cost of biogeochemical impact (a) is the product of saved GHG emissions (in CO_2 equivalent) of land conversions and social cost of per ton CO_2 (b).
- Among all the scenarios considered, the only one where the social cost of biogeochemical forcing was positive was the conversion from corn to switchgrass.

Social cost of biophysical impact



- Social cost of biophysical forcing (a) is the product of the resultant biophysical forcing of land conversions and social cost of per unit forcing (b).
- Corn/soybean-to-switchgrass, and soybean-to-alfalfa conversions resulted in social costs, while other conversion scenarios resulted in social savings.

Social cost of total radiative forcing



- Social cost of radiative forcing is the summation of social cost of biogeochemical forcing and biophysical forcing.
- Social cost was positive for the conversion from corn to switchgrass since the very beginning and was positive for the conversion from soybean to switchgrass since the year 2030. Other land conversions had negative social costs (i.e., social savings).

Implications

- The first attempt to incorporate the full climate impact (i.e., biogeochemical and biophysical) into the Life Cycle Assessment (LCA).
- With the biophysical impact of bioenergy crops being considered in the LCA, the overall benefit of bioenergy crops should be reevaluated, in particular the conversions from corn and soybean to switchgrass, as well as from soybean to alfalfa .
- A comprehensive LCA can assist governments and policymakers in formulating more effective land management policies.
- As an illustration, it is suggested that in 2020, 2030 and 2050, the subsidies for converting from corn to switchgrass should be reduced by $19.07, $29.38, and $60.19, respectively, to account for the climate impact, while subsidies for converting from corn to sugar beet should be increased by $141.59, $196.65, and $353.63, respectively .

Understanding Adaptation Plans

C. Dale Shaffer-Morrison
Robyn Wilson
Brian Cultice
Hugh Walpole

What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

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What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

- *Answer*:
  Depends on the
  adaptation practice!

- NIFA survey question

- Sample size =
  650 farmers

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What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

- *Answer*:
  Depends on the adaptation practice!
- NIFA survey question
- Sample size = 650 farmers

Changing weather conditions may require you to change the way you do some things on your farm. First, indicate whether you have already done the following on your farm ***in an attempt to adapt to changing weather conditions***. Whether or not you have already done these activities in response to the changing weather, ***please indicate how likely you are to do each of the following in the next ten years to minimize the expected impacts***.

	Not at all likely	Not likely	Somewhat likely	Likely	Very likely	Certain (already doing this)
More cover crops						
More filter strips						
More fertilizer						
More tile drainage						

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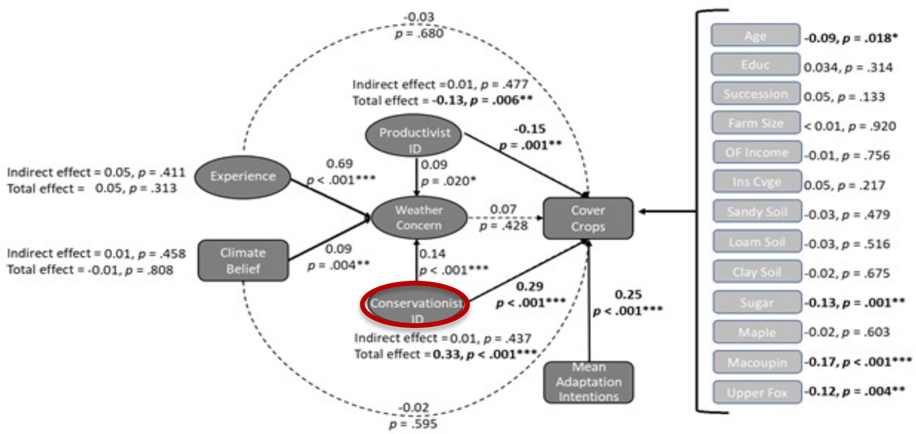
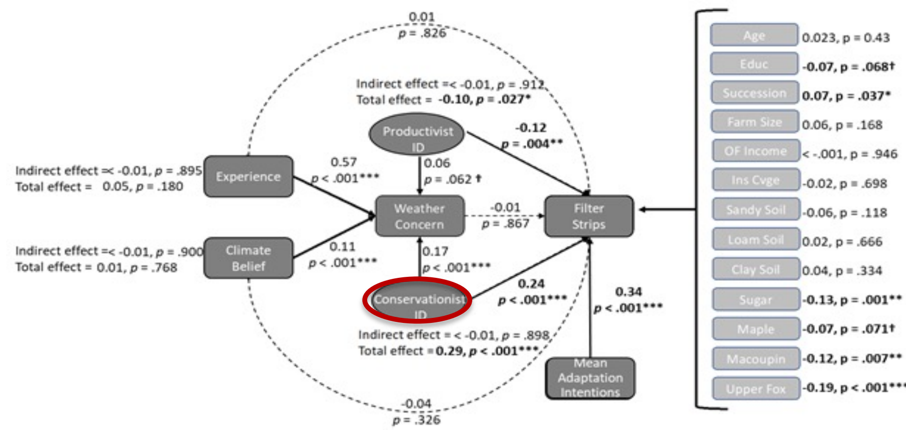
What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

- Results show that:
  - **Cover crops** and **filter strips** plans were related to higher conservationist identity ("A good farmer is one who… cares about health of streams", etc.)

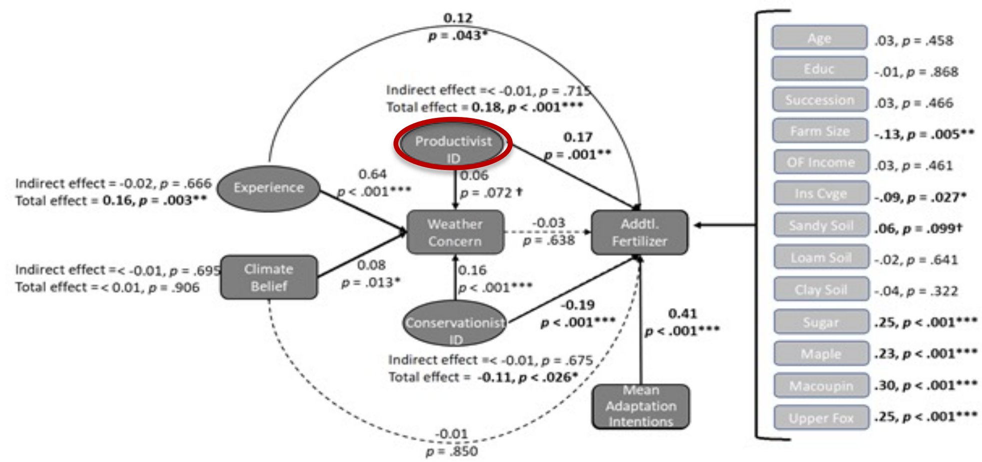




Wilson, Shaffer-Morrison, & Walpole, 2023

What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

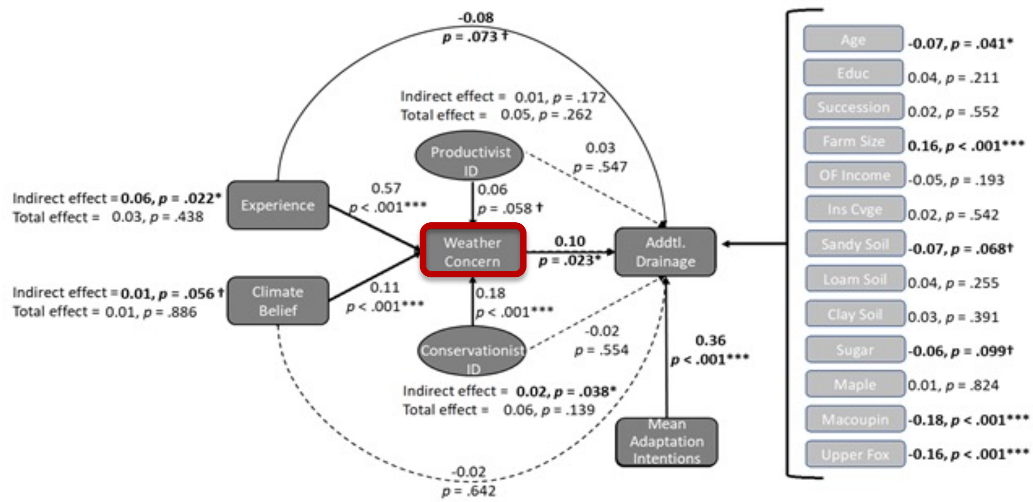
- Results show that:
  - **Plans to use more fertilizer** predicted by productivist concerns
    (“A good farmer is one who… maximizes yield/profit” etc.)



Wilson, Shaffer-Morrison, & Walpole, 2023

What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

- Results show that:
  - Planning to **install more tile drainage** predicted by weather concern



Wilson, Shaffer-Morrison, & Walpole, 2023

What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

- So that was overall intentions…

- **…but what about responses to changes in weather patterns and payments?**

What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

- So that was overall intentions…
- **…but what about responses to changes in weather patterns and payments?**
- Vignette experiment
- Sample size: ~450 famers

Choice 1. Please read the following scenario and indicate what changes (if any) you would make to your operation. Suppose that instead of current payment rates, you would receive $320 per acre enrolled in a land retirement program. Additionally, suppose that five out of the next ten years were characterized by the following weather conditions:

Planting date	March 22 (30 days earlier than usual)
Average rainfall during the growing season	15" (15" less than usual)
Harvesting date	November 12 (50 days later than usual)

Under these conditions, what changes would you be likely to make to your farm operation?
Please check all that apply or select the last option if you would not make any of these changes.

☐ Change my rotation to allow for double cropping
☐ Install more tile drainage on my farm
☐ Change my crop insurance coverage (*select one option in each row if applicable*)

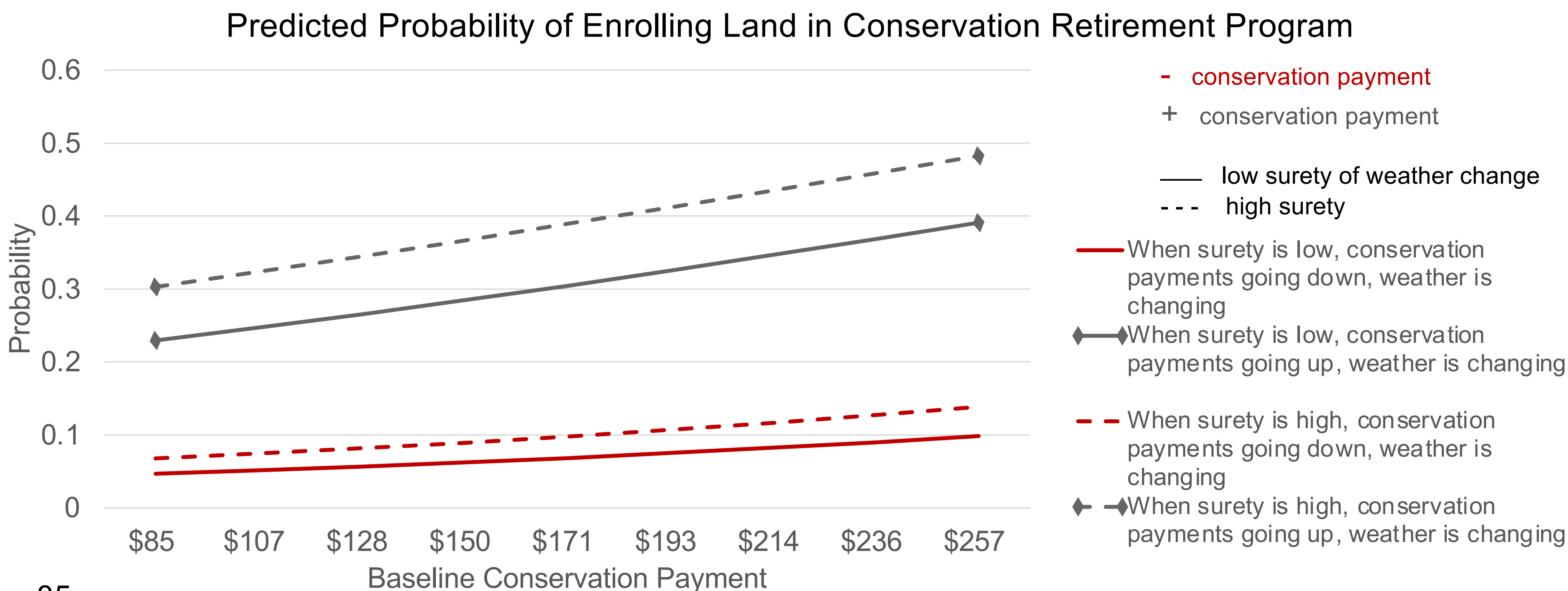
☐☐ Yield insurance ☐ Revenue insurance
☐☐ Increase coverage ☐ Decrease coverage

☐ Increase my use of no-till/conservation tillage
☐ Enroll more of my land in conservation programs ☐ ___________acres
☐ Invest in new or additional irrigation on my farm
☐ I would not make any of these changes

What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?

- Note: controlling for
  - Conservationist identity
  - Productivist identity
  - Yield
  - Clay soil percent
  - Rents land
  - Crop insurance
  - Age
  - Baseline conservation payment
  - All experiment parameters

What Predicts Planning to Adapt to Changes in Weather Patterns and Payments?



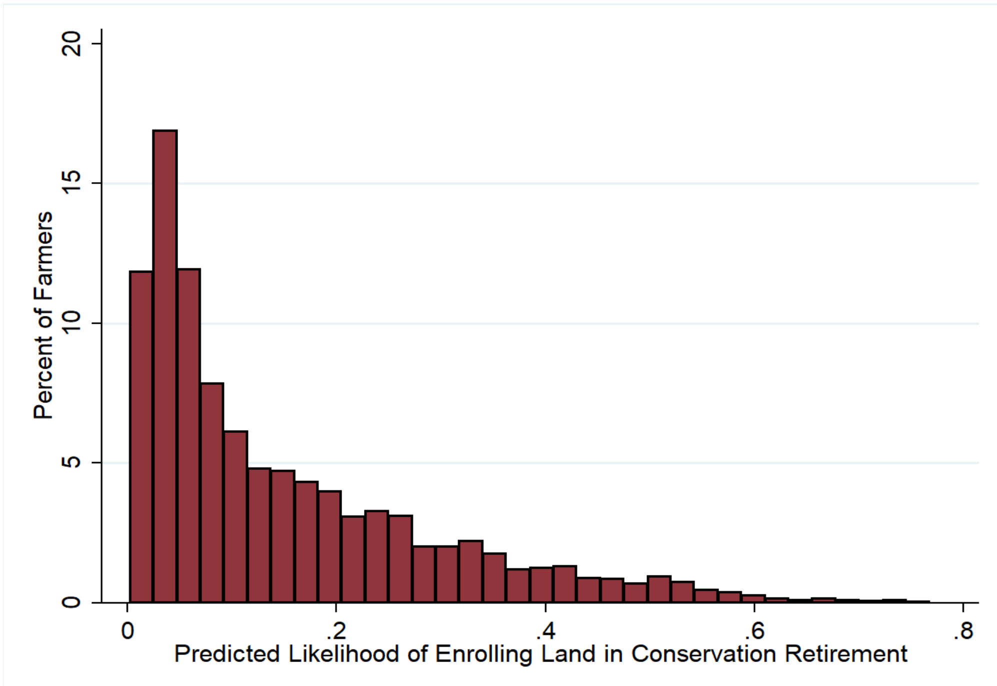
How do we integrate this into the Land Use-Land Management Model?

- In the model:
  - Assume that rainfall levels becoming more variable
  - Payments are changing
  - Results show that *both* affect plans to retire land

How do we integrate this into the Land Use-Land Management Model?

- Experiment results give us a **predicted distribution** of how likely farmers are to put more land in conservation
  - Separate analysis shows *how many* acres are likely to be enrolled

- **In the Land Use Model**: Assume farmer falls somewhere on this distribution



Integrating Farmer Management Practices into Model

- To couple farmer behavior with economic and climate conditions…
  - 1) Create distributions of "pseudo" farmer/operators that match the characteristics from the USDA Ag Census (e.g. age, education, farm size, baseline conservation enrollment, etc) for our counties of interest
    - E.g. if the Census shows 400 operators in the county, we draw 400 times from the distribution of farmer characteristics
  - 2) In each period, the economic model, land use model, and climate scenarios update key decision variables which farmers are responsive to
  - 3) Farmers' bundles of practices are updated according to their decisions
  - 4) Decisions are aggregated to the appropriate scales

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Integrating Farmer Management Practices into Model

- We have estimates of individual farmer responsiveness to climate conditions/payments for some practices, and then breakdowns of participation by farmer type for others
- Divide these practices into two bins
  - **Responsive Practices** (e.g. we can model how farmers respond to external conditions via vignette experiments, and with some assumptions, we can update their behavior each period)
    - Conservation Enrollment
    - Tile Drainage
    - No-Till
  - **Descriptive Practices** (e.g. based on the characteristics of the farmers, we determine participation solely through the observed distributions of practices in the sample, or through their adaptation intentions)
    - Cover Crops
    - Filter Strips

Integrating Farmer Management Practices into Model

- This immediately raises the question**: How are these farmers changing over the time period of our simulations?** Two key areas where this matters:
  - 1) **Farmer Characteristics and Identities**: Who is farming, what do they look like, and how do some key characteristics evolve over time? (e.g. are newer farmers more conservationist minded?)
  - 2) **Model Stability or Consistency of Estimates**: For any type of farmer, how is behavior changing? Are farmers changing in their responsiveness to climate conditions, conservation payments, etc?
- Both areas determine the extent of management practice adoption, though for our purposes, 2) is essential to understand
- For example, if farmers become more likely to adopt mitigating practices as they are exposed to more extreme weather events, we would underpredict adoption over time.

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Discussion

- How will the composition of farmers evolve over time? Who will be farming in this region in 2050?
  - Bigger and bigger farms, less and less people farming; potentially greater education; maybe fewer people having OFI
  - More precision ag/using technology – more robotic/automated management takes less people but more specialized people
  - Increasing specialization, e.g., one person plants someone else sprays (division of labor), but also just livestock vs. just corn/soy
  - More owners (leased land owned by more people), but also more investors buying up big lots of land
  - Better risk managers/greater ability to manage risk due to scale
  - More women operators (not just owners)
  - More competition and/or more labor due to influx of climate migrants – depends on existing capital

Discussion

- Have the events of the last three years (weather and economic stressors) changed how farmers think about management - either short term actual changes or long-term plans? Basically, would you react differently to the forecasted changes rainfall/plant or harvest dates than you would have several years ago?
  - 2 or 3 years is not enough to change perceptions/strategies, generally – how long it takes depends on how bad you are burned - first time cover croppers won't try for too long before they give up, more experienced people will persist longer
  - Wind has been getting attention more compared to 3 years ago – breeders are working on shorter corn plants to avoid goosenecking/goosenecked corn slows down harvesting; this also impacts timing for spraying
  - Farmers spend A LOT of time outside so they are very aware of these changes – even though wind patterns are currently inconclusive
  - Seed tolerance to cold rain is a problem (right when it is coming out/up it is not tolerant to cold and wet conditions) – it's an issue of new varieties or better weather forecasting
  - Dramatic shift in timing of bean planting vs. corn – looking at shorter season corn hybrids (end of May planting)
  - Bigger farms (10,000 acres) vs. smaller (1500) can't be as nimble due to size/weather, hired labor, etc – cover crops don't work north of I-70 as farms get bigger
  - Will new, young farmers have the experience to persist? Probably not, unless they have a mentor with experience to help them out (mentors were needed for tillage shift in the 80's, need them now for cover crops)
  - 2 to 6 years might be the range before potential bankruptcy changes your plan, these likely have to be consecutive to really alter the plans, a good year sprinkled in between the bad years can help to persist
  - Most farmers have a rotation they believe in, that belief increases with age, it takes something drastic to have to adjust – this may be one of the few things successful farmers have in common, it is rare for one thing to work on all soil types and Ohio has a lot of soil types

Lunch

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

Policy Discussion

Team: Alan Randall, Robyn Wilson, Kristi Lekies

The Ohio State University
College of Food, Agricultural, and Environmental Sciences

Plan

- 40 minutes – work in small groups
  - Identify practices/changes to promote
    - E.g., Maximizing for all services over time
  - Identify mechanisms to promote that change
    - Education, regulation, incentives, etc.
- 20 minutes – report out and discussion

Groups

- Robyn (facilitator)
  - Luke, Kevin, Kai, Junyoung
- Dale (facilitator)
  - Carl, Greg, Aaron
- Kristi (facilitator)
  - Steve, Larry, YY, Jason

First 20 minutes…

- What could you (or a typical ECBR farmer) do differently to produce food/feed/fiber while sequestering carbon and protecting water quality?
- Brainstorm practices/approaches and place them on this matrix

	Immediate Benefit (~ 1 yr)	Future Benefit (>5 yrs)
Easy / Low cost		
Difficult / High cost		

Second 20 minutes…

- What would it take for you (them/a lot of farmers) to do this?
  - Education - What gaps need filled?
  - Marketing - What frame/messaging/etc. is needed?
  - Feedback - What information/feedback is needed about benefits/progress?
  - Collaborations - What partnerships are needed?
  - Subsidies/Incentives - How much? What kind? Verifiability?
  - Other approaches?

Report out – What needs to be done?

- Easy/ST Benefit
  - Rotating crops and buffers for pest control/N mgmt, pest traps
  - Improved drainage – more drainage/upgrade on rented land (greater yield, longer windows in the field)
  - More filter strips
  - More sophisticated water mgmt. (that reduces risk, maintains yield, and reduced runoff/impacts)
  - More precision in nutrient mgmt. (right rate, time, place, and source)
  - Reduced till (less erosion, less time/money)
  - Manure mgmt.
  - Cover crops
- Hard/ST Benefit
  - Irrigation
  - More grasses into management (buffer strips/pastures),
  - Smaller robotic equipment
  - Pest traps, cultivars for pest control
  - Subsurface placement
  - More continuous no-till (most is rotational) – hard because it takes more mgmt (weed/fert/pest) and decreases drainage
  - Tile line discharge mgmt

Report out – What needs to be done?

- Easy/LT Benefit
  - Subsurface placement (some say this is hard)
  - Cover crops (some say this is easy with a ST benefit)
  - Perennial crops
  - Converting non-prime farmland to forest
  - Continuous no till - decreases compaction, increases diversity, critical for carbon/soil health/water holding capacity/bio activity/nutrient release – which decreases inputs and increases profit – improving drainage could increase no-till (because the ground warms faster) – some say this is hard
- Hard/LT Benefit
  - Wetlands, ponds
  - Agrofroestry
  - Carbon markets (costs may fall in middle, along with benefit length)
  - Local sources of inputs
  - Converting land to solar/wind energy
  - Cover crops may fall here due to money/time/mgmt, return on investment is longer
  - Controlled tile drainage may fall here too as it has both immediate and future benefits but costs more money
  - Controlled environment production

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Starter ideas…

High Sustainability	Low Sustainability
Balancing production with sequestration and water quality	Maximizing production at the expense of other services
All continuous no-till	All conventional tillage
All cover crops	No cover crops
Convert non-prime farmland to trees/wetlands	Find ways to produce on non-prime farmland
Smaller, more efficient equipment	Bigger, less efficient equipment
Less fertilizer	More fertilizer
Less livestock	More livestock
More filters/buffers	Cropping to waters edge
More bioenergy crops	No perennials
More diverse rotations	Less diverse rotations

Report out – How will we do it? Who should be leading these efforts?

- Education – what gaps need filled?
  - Complexity/systems science
  - How to manage (not just production and economics)– make things work for your benefit vs. fighting them
  - Soils and climate - soil mgmt. details from a biological perspective
  - Educating decision maker/policy maker audience – need to understand results take time
  - Want to know what works, borne out by research
    - GPT equivalent for farming/adaptation – easy answers to practical questions
- Marketing – what frame/messaging is needed?
  - Targeting information to different motivations
  - What's in it for me? This question needs answered for everyone.
  - Climate/variability framing – how will your problems get worse?
  - Future vs. present framing – what will you change to get there?
  - Tailored recommendations/individualized approaches
    - Centralized, non-biased website for sharing experiences

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Report out – How will we do it? Who should be leading these efforts?

- Feedback
  - Track how effectively we are doing X (carbon sequestration)
  - Balancing in-person vs. on-demand resources – but providing more support/tech assistance/mentoring in the moment – accessible help from people you trust
  - Need to revitalize demonstration farms – examples of success from farmers like them
- Collaboration
  - Less siloing of different groups (researchers, practitioners, etc)
  - Conveying complexity to intermediaries (e.g., SWCS staff, Vo-Ag educators, etc)
  - Even more local collabs (e.g., between Extension and SWCS)
  - More national collabs for C markets (markets, design, laws, etc)
  - Public and private sector collaborations
- Incentives
  - Branding for operations as a marketing tool/point of pride (for carbon markets)
  - Too many unknowns cancels out potential payment, lock-in given uncertainty is unappealing, more flexibility
  - Programs must work with or better than commodity price drivers

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Report out – How will we do it? Who should be leading these efforts?

- Other considerations
  - Even neutral to positive recommendations don’t max out at 100% adoption – what do we do about this?
  - Examine crop insurance programs – do they penalize innovations that are necessary? Could be a source of information about what is insurable to not stifle innovation.
  - Social responsibility marketing for programs – leverages strong conservation identity “it’s the right thing to do”

Wrap up and Evaluations

THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL,
AND ENVIRONMENTAL SCIENCES

Next Steps…

- Project is extended to December 2023
- Finalize integration
  - Quantify changes in ecosystem services (carbon sequestration, water quality) and integrate w the land management module
  - Simulate the economic model under future baseline and alternative scenarios
  - Identify optimal policies robust to climate uncertainties
- Hold project end workshop – late August?? Participants?

Thank you!!!!

https://tinyurl.com/NIFAEval

The Ohio State University
College of Food, Agricultural, and Environmental Sciences