

An Action Plan for Climate Change in the Brodhead Watershed

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Brodhead Watershed Association

The Brodhead Watershed Association (BWA) is a non-profit environmental organization dedicated to protecting and improving water resources and the environment in the Brodhead and Cherry creek watersheds. The BWA assists municipalities, residents, businesses and groups with protecting natural resources through outreach, workshops, public programs, stream monitoring and baseline data collection.

<https://brodheadwatershed.org/>



What is the Climate Action Plan

- Describes current and future climate risks in our region with focus on the Brodhead Watershed
- Volunteer effort
- Presents actions we can take now and into the future to protect our natural resources and the health and safety of residents, businesses and infrastructure
- Identifies organizations and agencies that should work together to achieve action goals
- The plan is a draft which needs additional information and polishing; as well as input from others in our area and those with expertise



Why do we need such a plan

- We are currently experiencing a warming world and warming is expected to accelerate in the upcoming years
- This warming will have numerous impacts on water resources, fish and wildlife, our environment, agriculture, public health and safety, and the ability of our region to support a quality of life we expect
- All of the actions presented take time and money; delaying actions into the future will cost us more money and potentially limit the effectiveness on some actions before we experience the consequences of our warming world
- Dialogue, commitment, teamwork and identifying early quick actions are needed This needs to be a priority!!



What will be presented today

- What is climate change and its causes
 - Human population and activities
 - CO₂ emissions, other emissions
 - Emission scenarios and projections on temperatures, weather, global/regional systems
- Climate action themes
 - Air temperatures
 - Precipitation and Water Resources
 - Land Resources (urban and developed lands, forests/natural areas, agriculture)
 - People (liveability, health, public infrastructure, emergency preparedness)

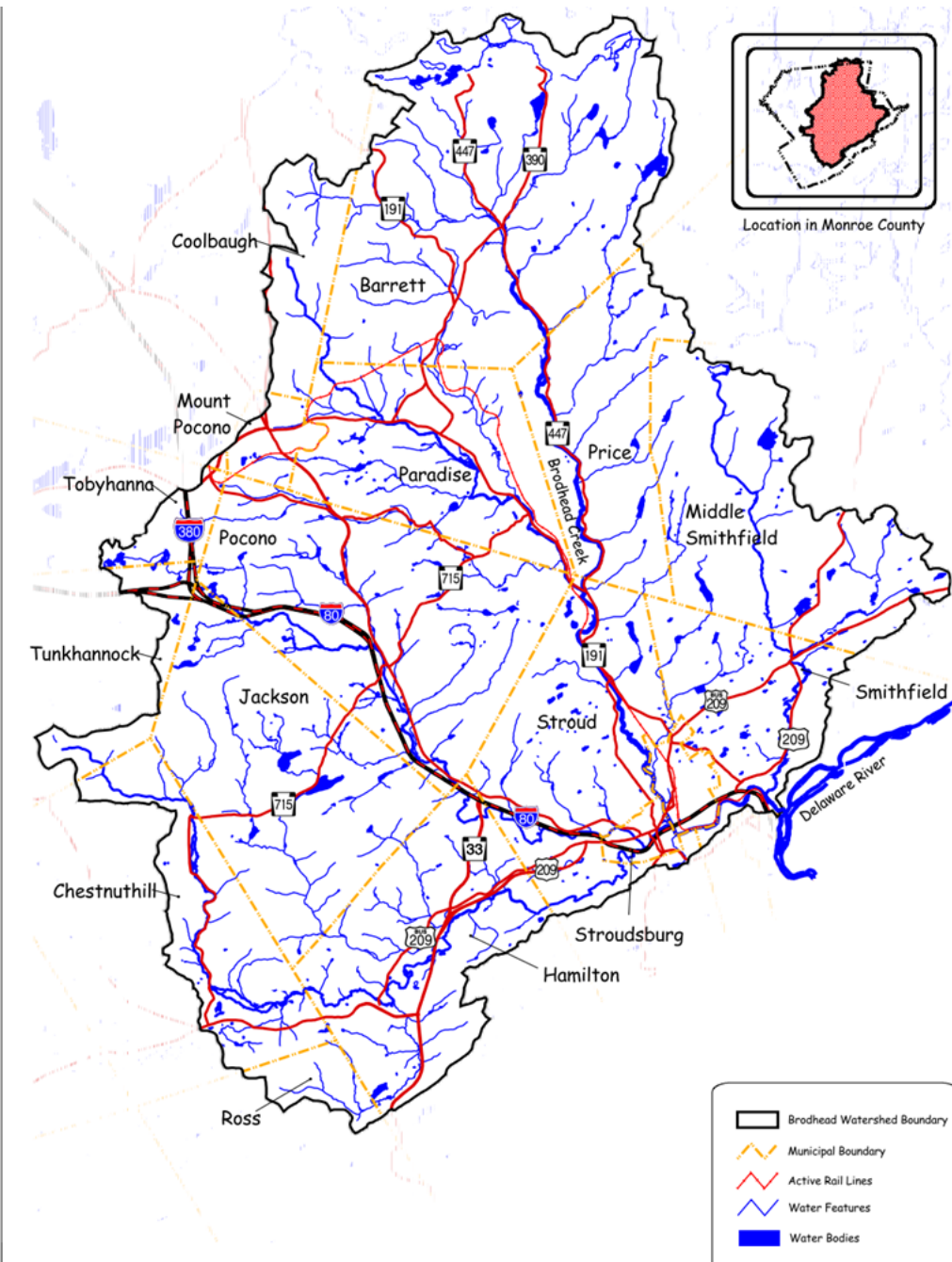
Brodhead Watershed

Drains about 285 square miles

Experiences distinct seasonal climate

Floods and droughts

Waters are important for area's
wildlife and fish as well as people
(drinking water, recreation)



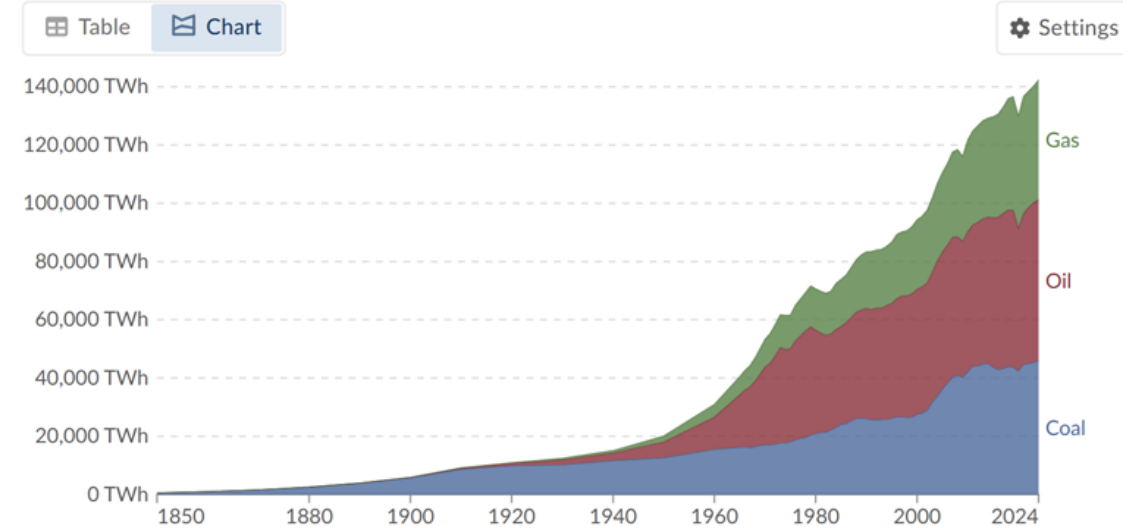
Our changing climate

- Being driven primarily by human activities
- CO₂, temperatures are exceeding levels humans have ever experienced in their history
- CO₂ from burning fossil fuels; methane from fossil fuels, agriculture

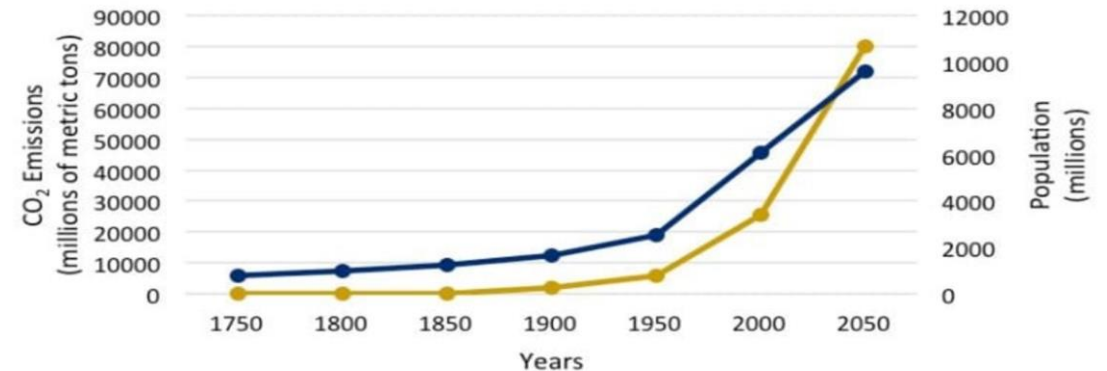


Global fossil fuel consumption

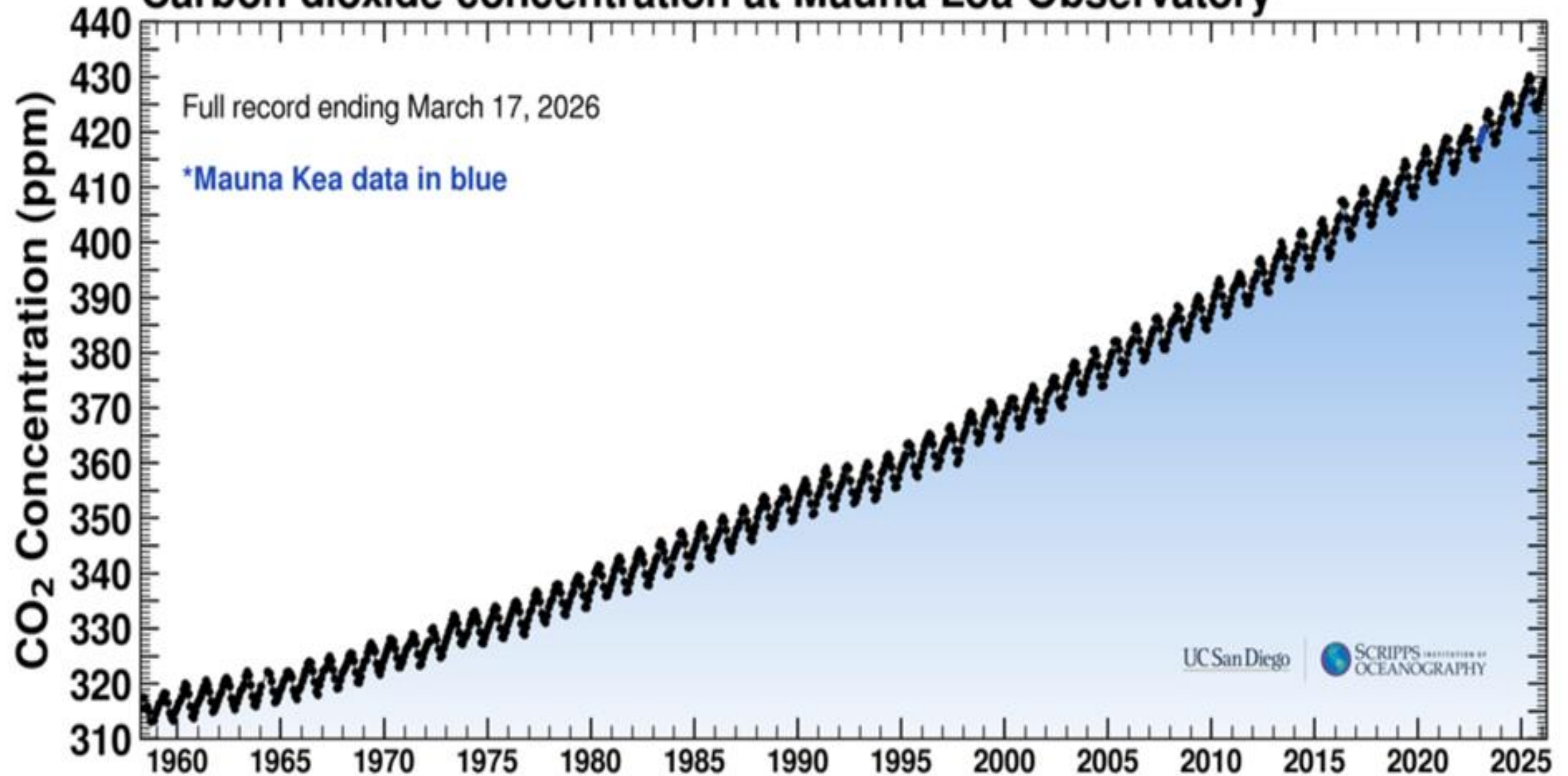
Measured in terawatt-hours of primary energy consumption.



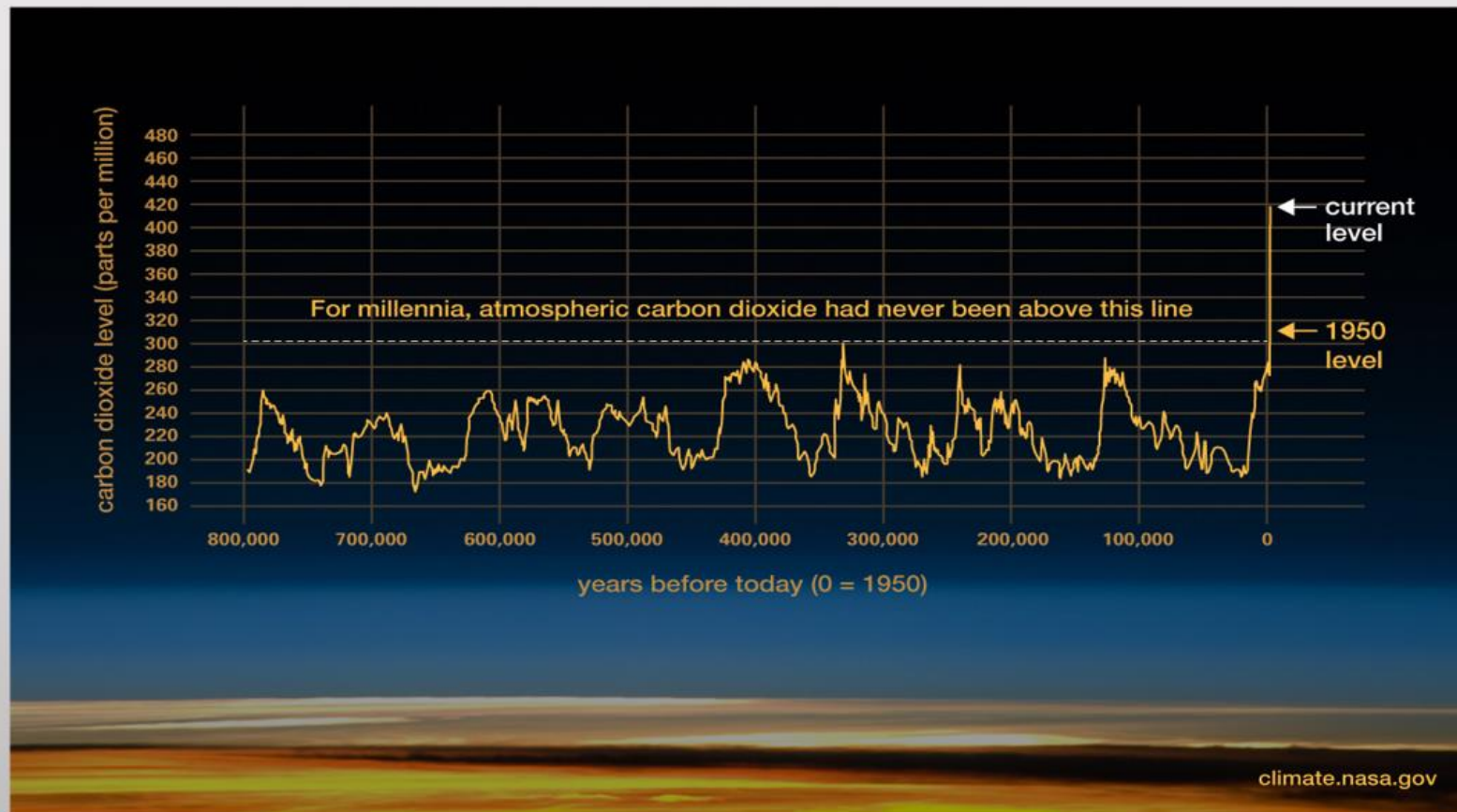
CO₂ Emissions and Population Growth



Carbon dioxide concentration at Mauna Loa Observatory*



Changing CO₂ in Recent Earth History

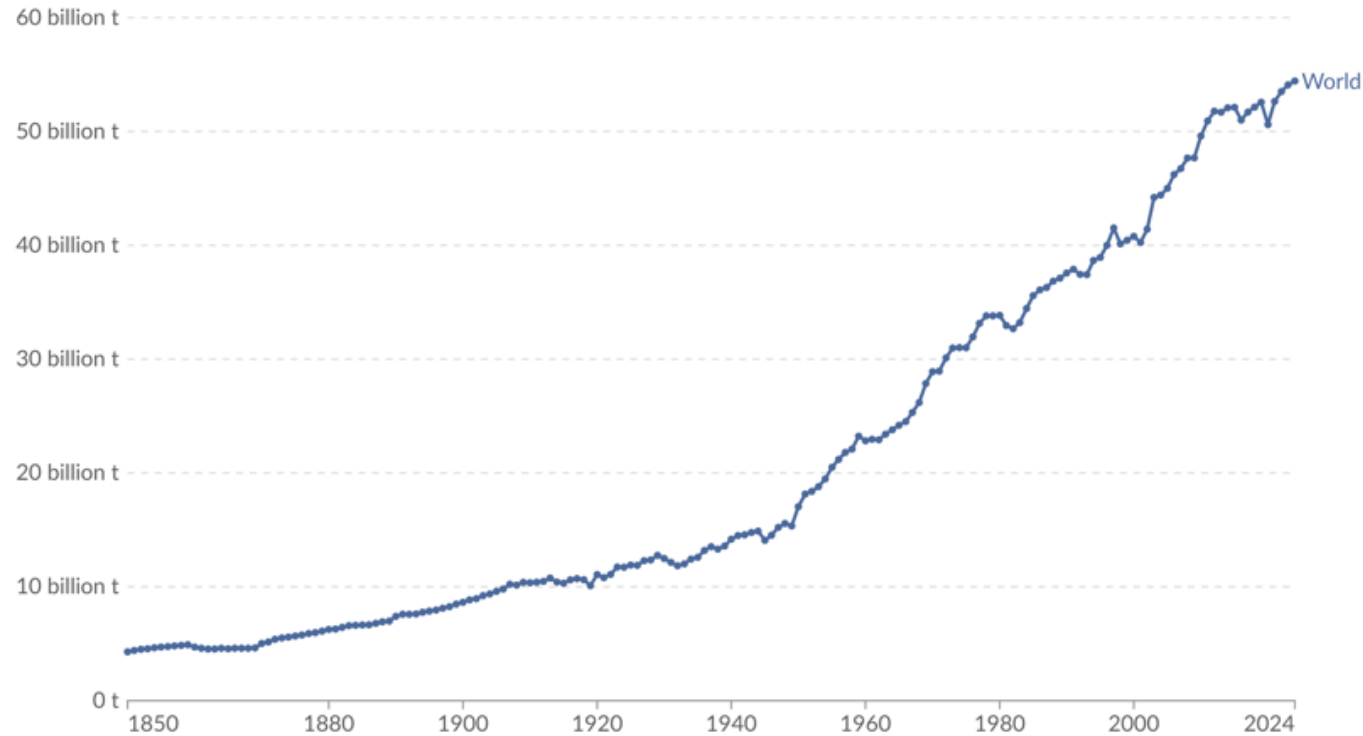


Estimated methane emissions since 1850

Greenhouse gas emissions

Our World
in Data

Greenhouse gas emissions¹ include carbon dioxide, methane and nitrous oxide from all sources, including land-use change². They are measured in tonnes of carbon dioxide-equivalents³ over a 100-year timescale.



Data source: Jones et al. (2025)

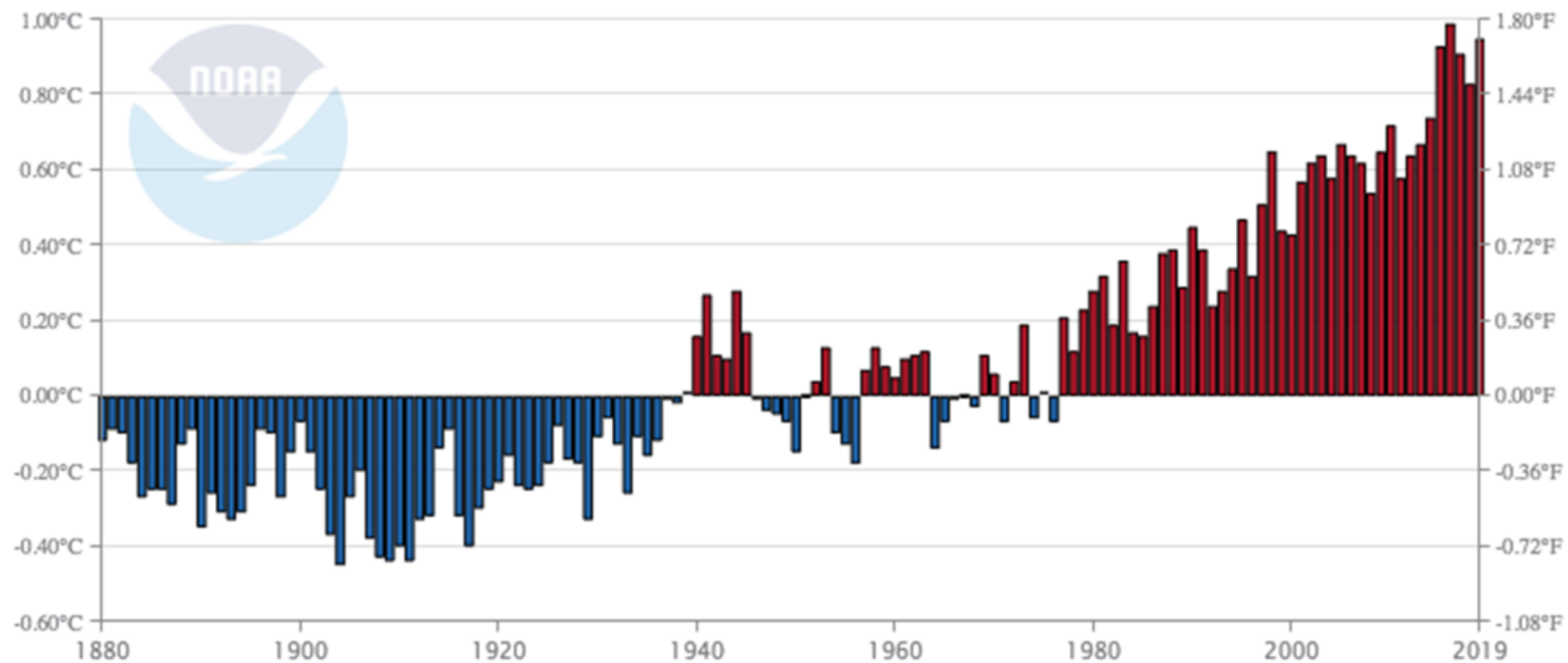
OurWorldinData.org/co2-and-greenhouse-gas-emissions | CC BY

Note: Land-use change emissions can be negative.

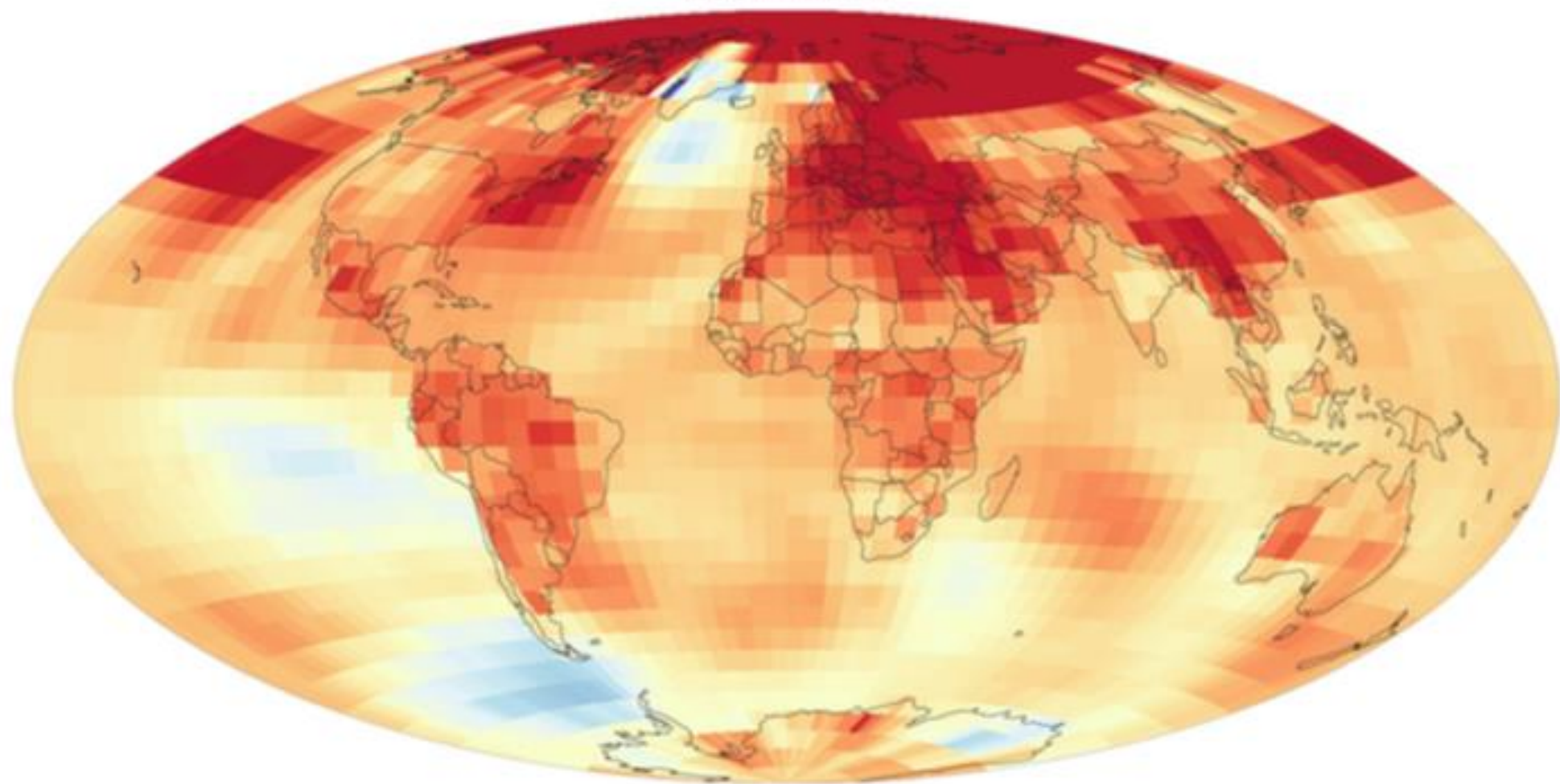


Global Temperatures 1880-2019

Global Land and Ocean
January–December Temperature Anomalies



1994-2024



Change in temperature ($^{\circ}\text{F}/\text{decade}$)

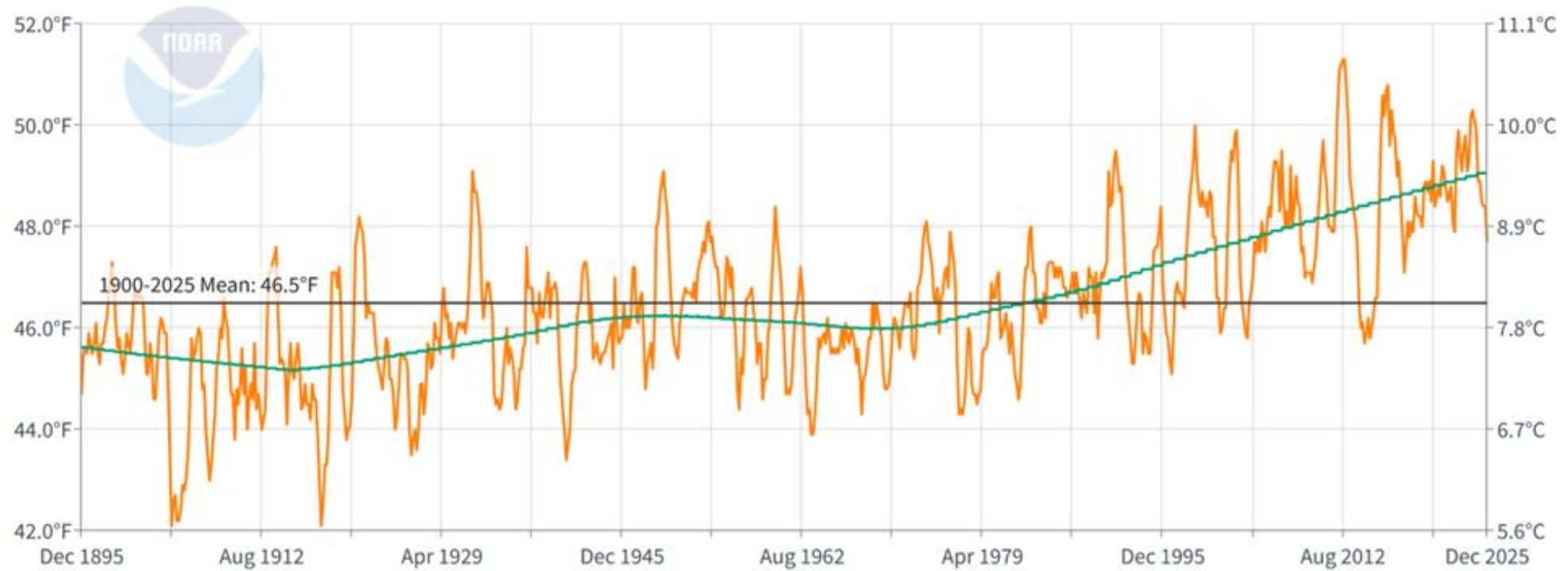


NOAA Climate.gov
Data: NCEI

Local temperature changes

Monroe County, Pennsylvania Average Temperature

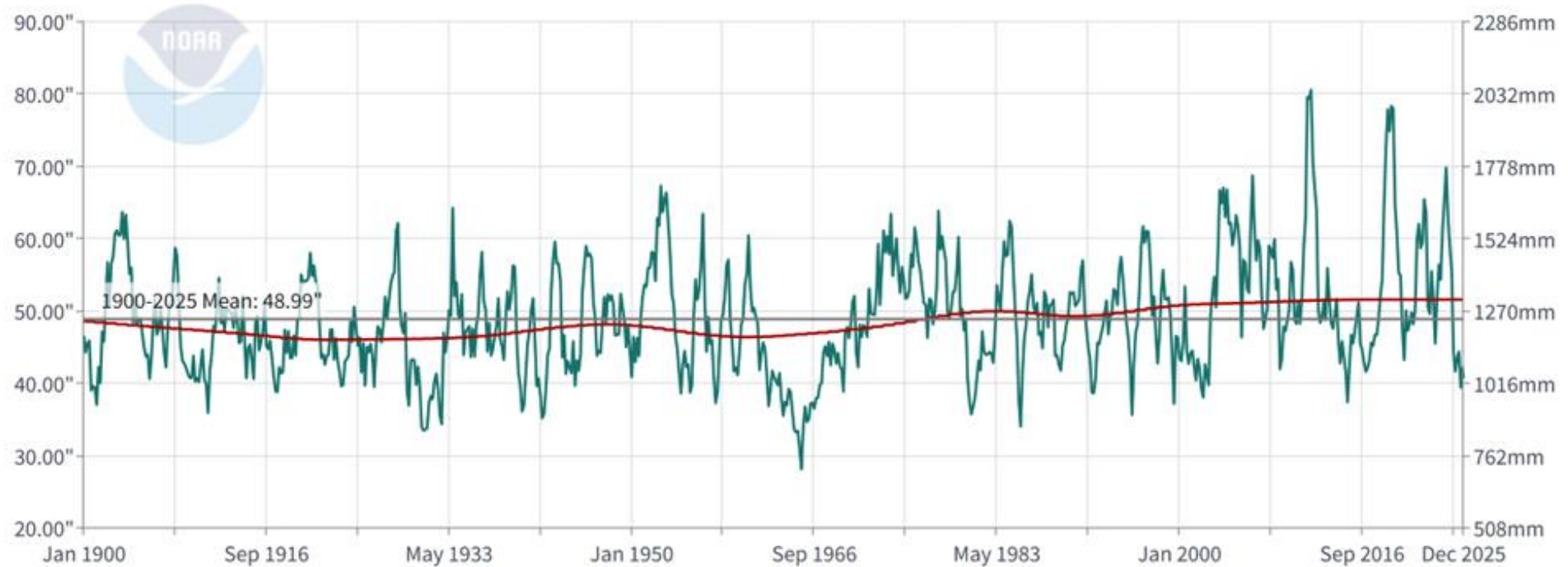
12-Month Period



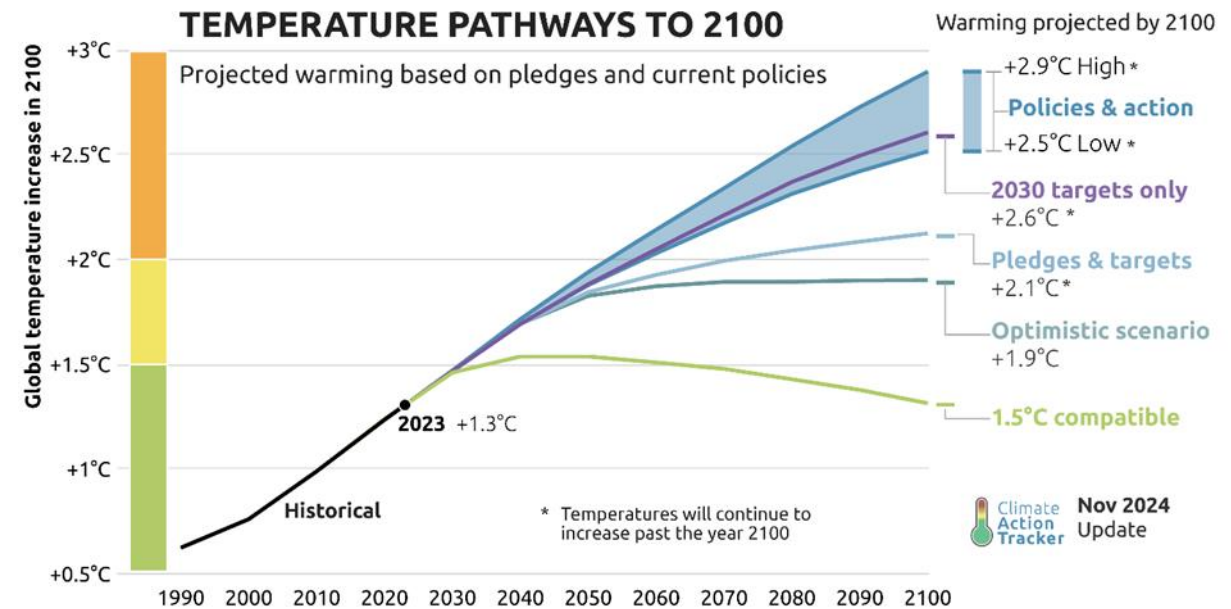
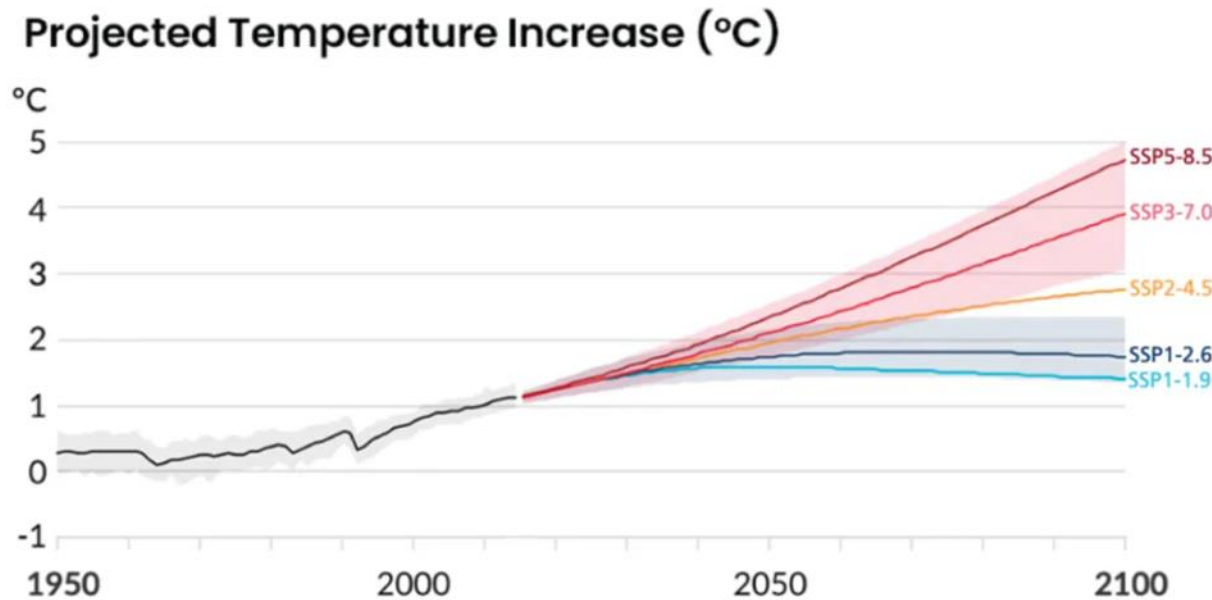
Increasing temperatures result in more moisture in the atmosphere

Monroe County, Pennsylvania Precipitation

12-Month Period

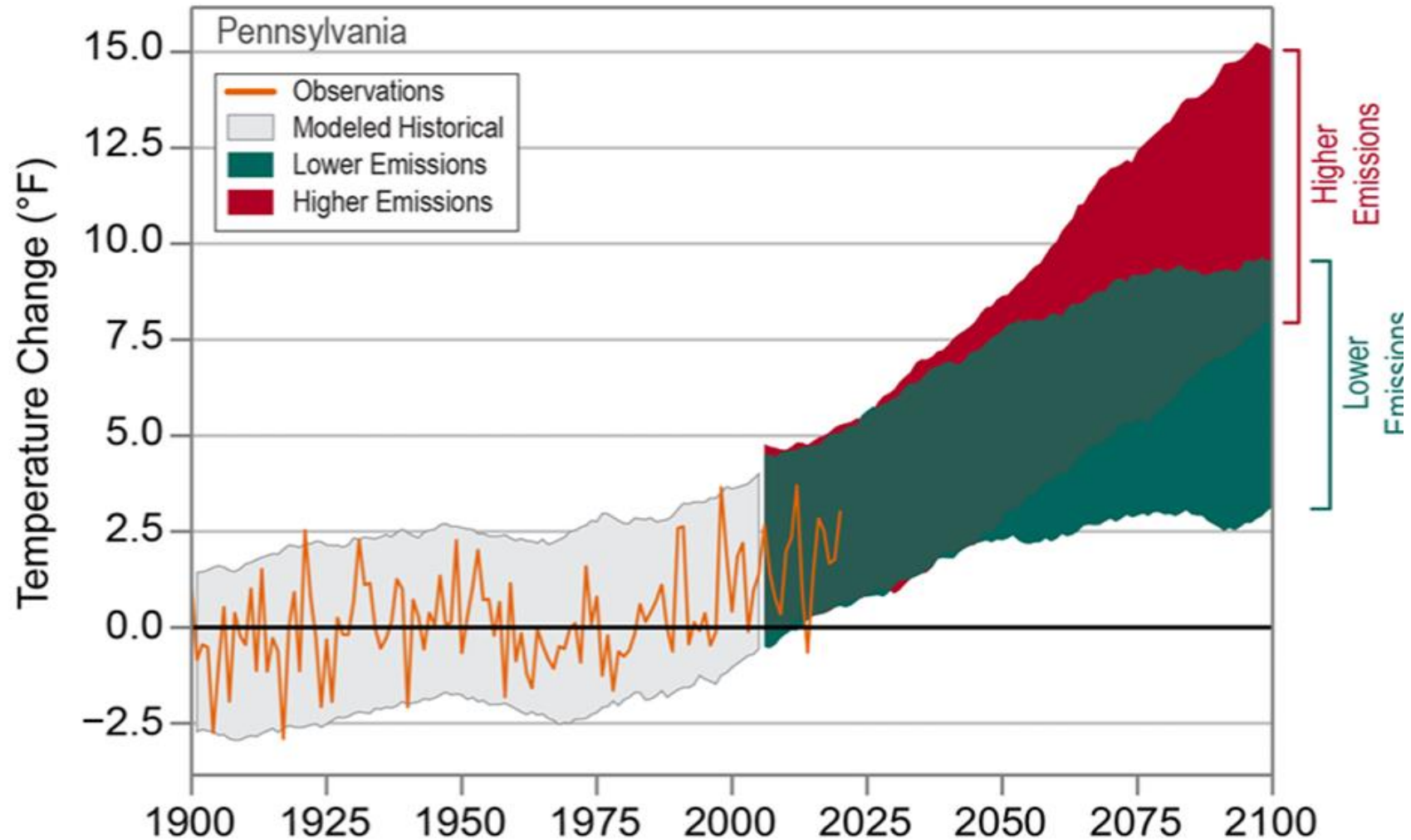


Where are global temperatures headed?



Increases of 2-2.5° C are expected to have broad impacts on ecosystems and human society

Changes for PA (NOAA, 2022)



1° C =
1.8° F

Modeled Estimates for East Stroudsburg

- Based on most pessimistic emissions rates to 2100
- Our climate will be similar to Georgia/South Carolina
- Many days over 100° F; warmer nights
- Increases in precipitation (5%)

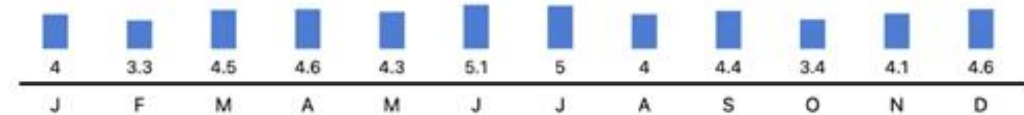
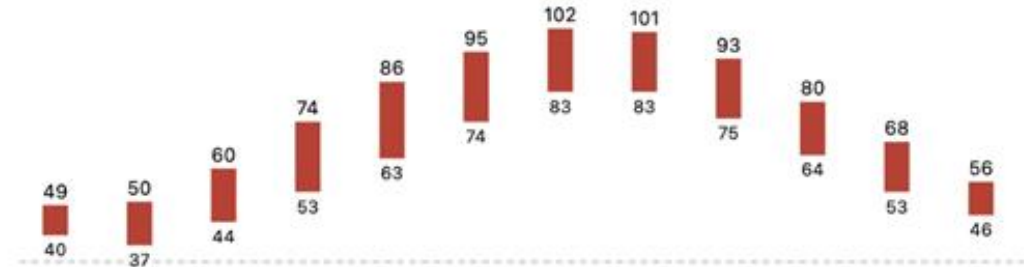


East Stroudsburg, Pennsylvania

2071 - 2100 normals

Köppen Classification: Cfa (humid subtropical)

Dickinson Classification: Chz1 (subtropical humid with scorching hot summer)



■ Average max. and min. temperatures in °F

■ Precipitation totals in inches

Data sources: Baseline climate conditions are derived from CHELSA v2.1 climatological normals (1981–2010). Future projections use CHELSA-downscaled UKESM1-0-LL SSP5-8.5 projection normals for 2011–2040, 2041–2070, and 2071–2100. SSP5-8.5 represents a high-growth, energy-intensive future dominated by fossil fuel use, resulting in very high greenhouse gas emissions—making it a widely used analogue for present-day trajectories under minimal mitigation efforts. UKESM1-0-LL was selected due to its higher climate sensitivity and stronger land–atmosphere coupling, which makes it useful for bounding upper-risk habitability outcomes.

What we can do to minimize impacts of rising temperatures

- Increase vegetative shading
 - tree plantings in urban areas to increase shade and cooling effects of evapotranspiration, protect public health and livability of urbanized areas
 - increase riparian buffers to allow more cooling of surface and groundwaters, this protects stream health and cooling of waters (100-200 feet are inadequate)
- Enhanced stormwater mgmt in critical trout/cold-water streams
 - hotter temps will mean hotter stormwater to streams in summer months
 - retention/detention
- Increase programs that provide cooling equipment for people, esp those most susceptible; (aka like home fuel assistance) new building standards, designs, siting
- Increased energy supplies for warmer periods so cooling demands can be met



What we can do to minimize impacts of rising temperatures - continued

- Enhance public health monitoring for heat stroke, invasive warm climate pests and diseases and other hotter climate health issues
- Plant more southern species of trees/shrubs (landscaping) and crops (agriculture)
- Plan for appropriate land and water resources in a sub-tropical climate; what are the fish and wildlife of the near future we need to protect and manage for
- Increased fire risk education/controls for forests/grasslands
- Other actions as identified in communication with others

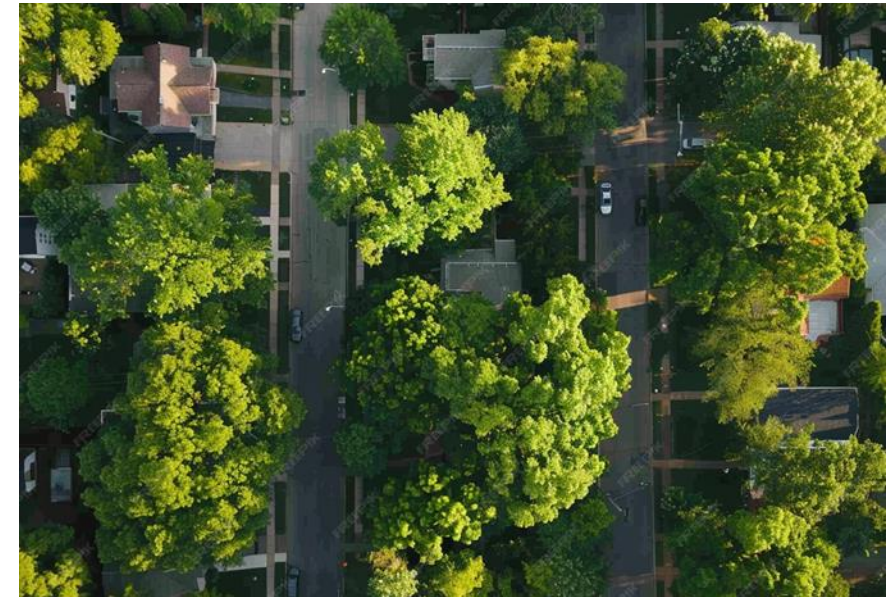


Making our urban area less hot

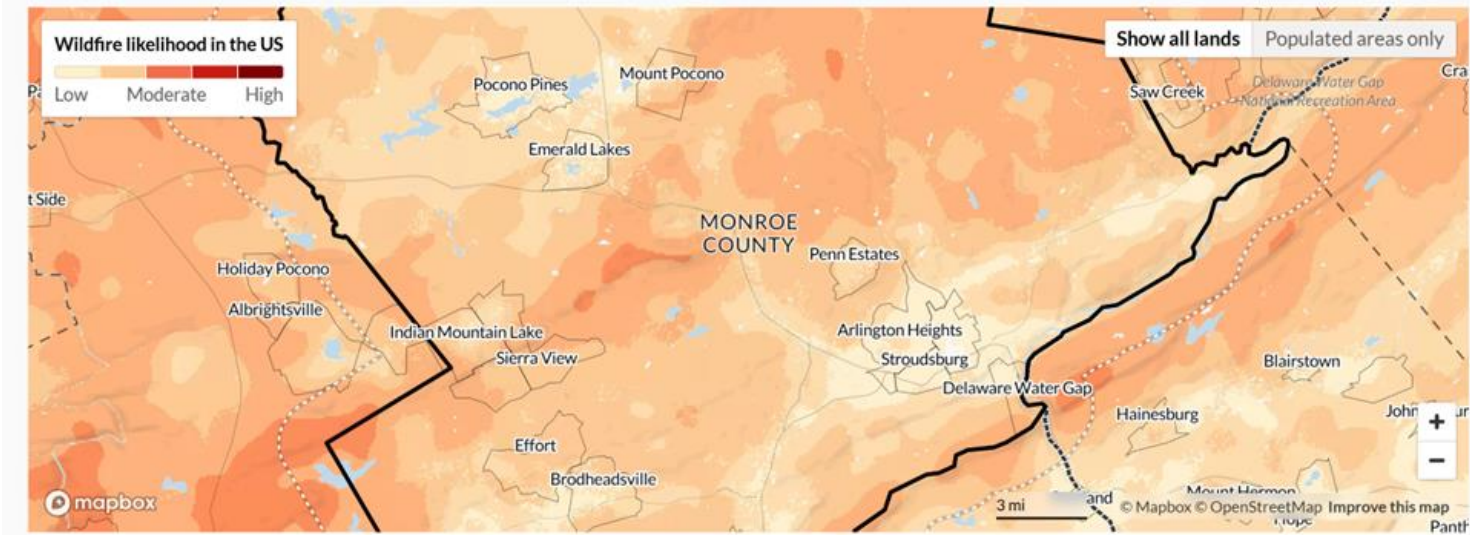


Urban heat island intensity (°F) by census tract.
Climate Central analysis based on Sengupta (2020) and Demuzere (2020).

CLIMATE CENTRAL



Identifying wildfire risks

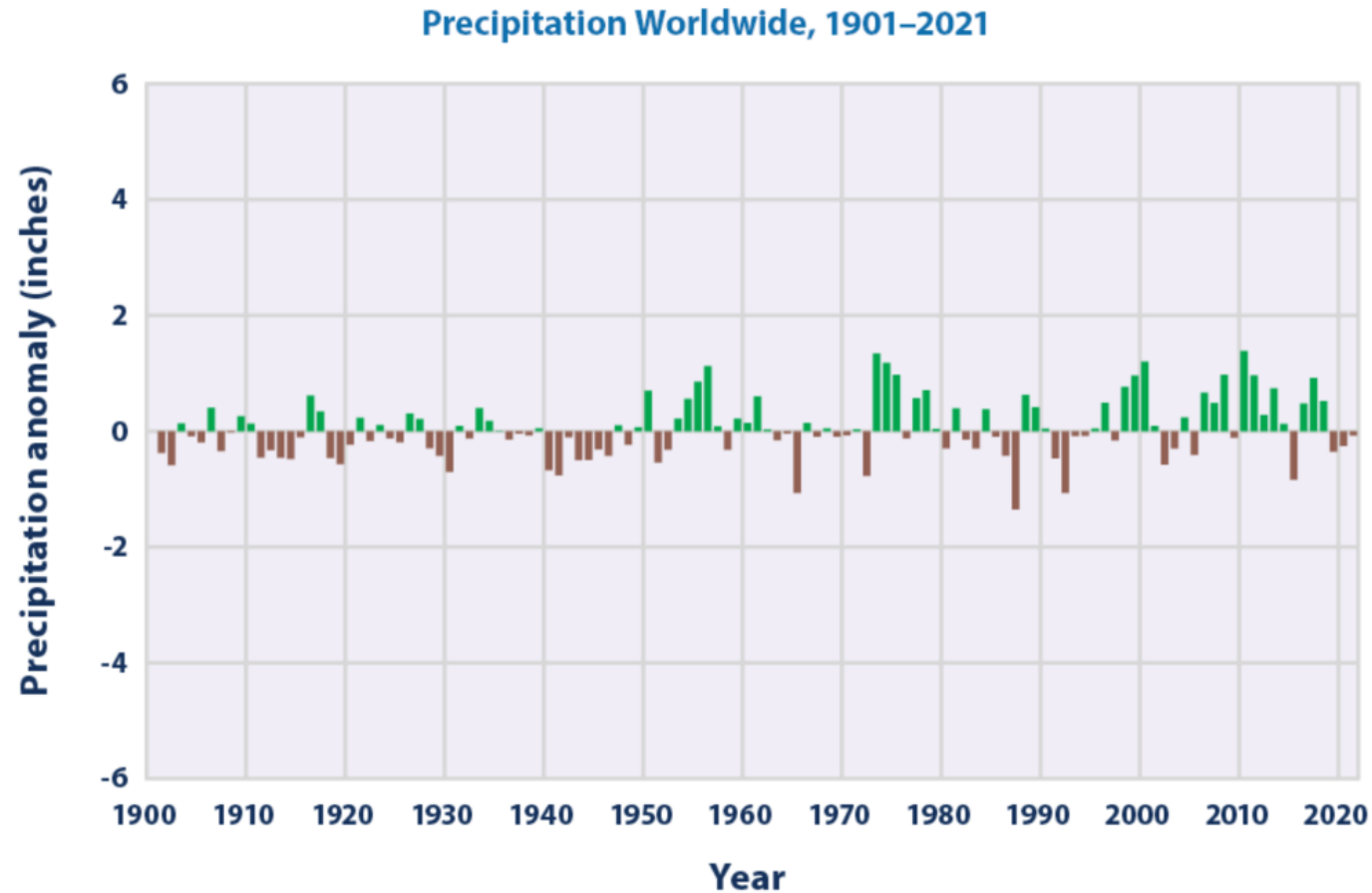


Wildfire risk map for a portion of Monroe County Source: <https://apps.wildfirerisk.org/explore/wildfire-likelihood/42/42089/>



Dead ash trees from emerald ash tree borer

Global Precipitation

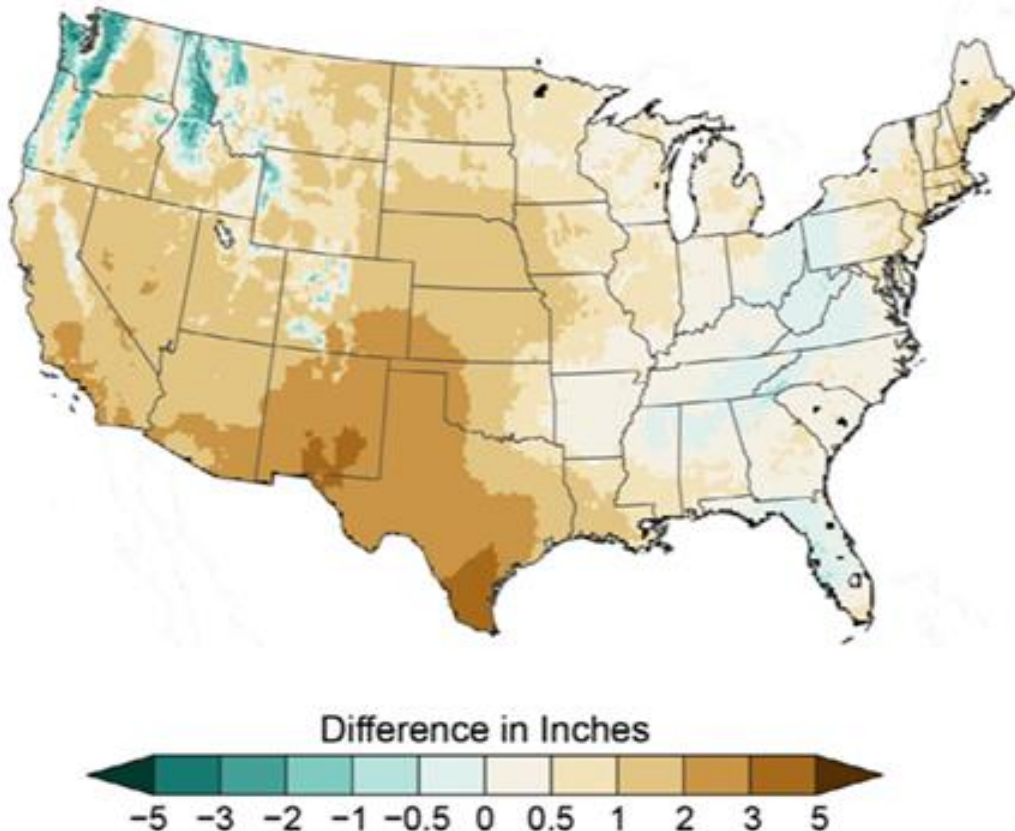
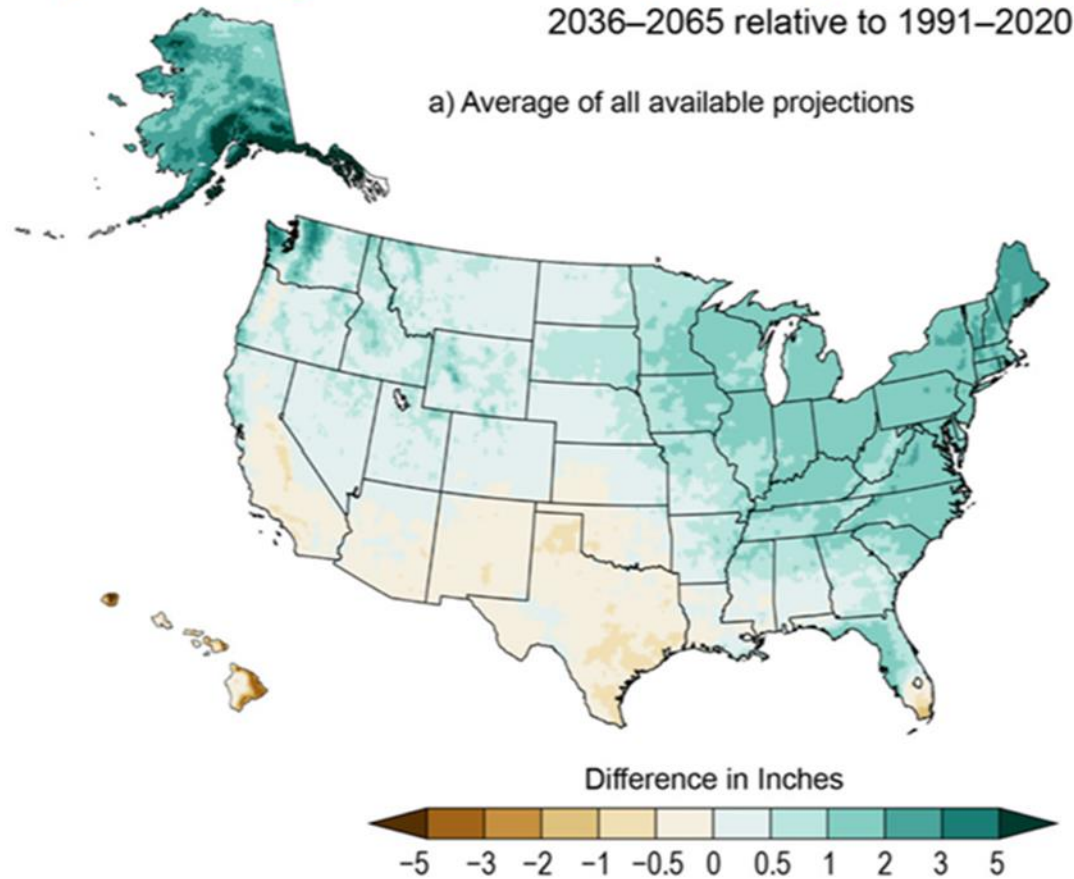


Data source: NOAA (National Oceanic and Atmospheric Administration). 2022. Extended version of GPCC dataset originally published in: Blunden, J., and T. Boyer (eds.). 2021. State of the climate in 2020. B. Am. Meteorol. Soc. 102(8):Si-S475. <https://doi.org/10.1175/2021BAMSStateoftheClimate.1>.

Projected Changes in Annual Precipitation by Midcentury

2036–2065 relative to 1991–2020

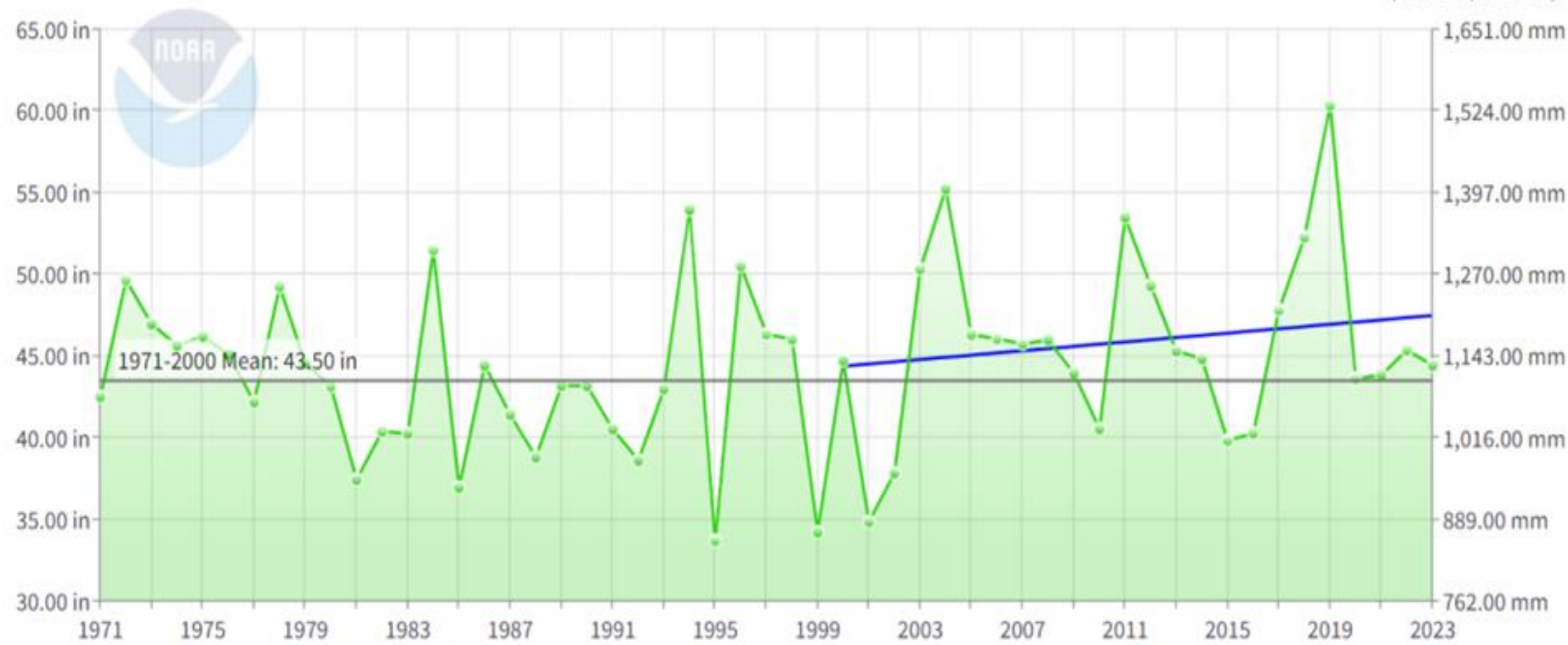
a) Average of all available projections



Projected Changes in Annual Climatic Water Deficit by Midcentury

Pennsylvania Precipitation

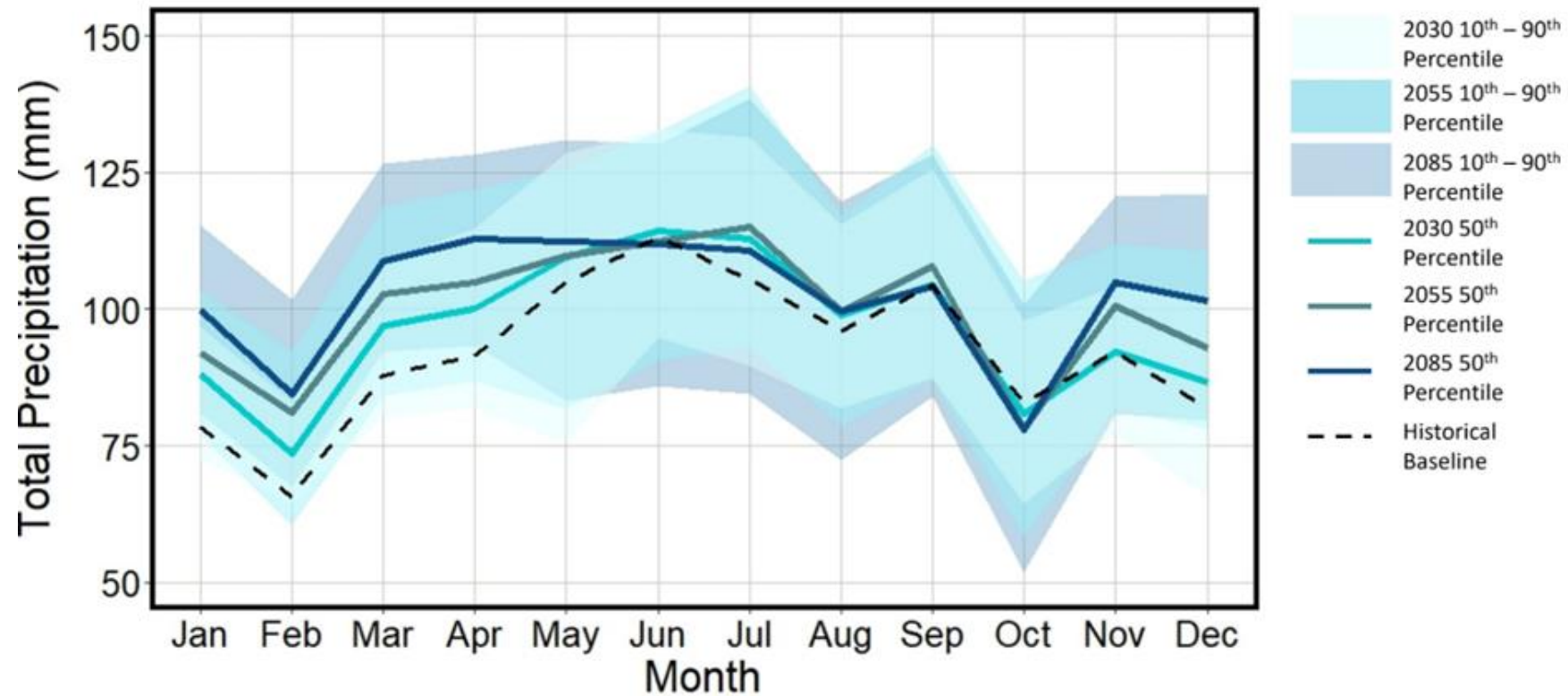
September-August



The 1971-2000 mean of 42.5 inches is shown in addition to the trend from 2000 to 2023. Source: National Centers for Environmental Information. Climate at a Glance – Statewide Time Series.



Past and projected average monthly precipitation for PA (PADEP, 2024)



Changing Precipitation and Water Resources

- Greater overall precipitation
- More intense precipitation events as atmosphere warms
- Greater possibilities for extended dry periods and droughts between precipitation, especially in summer and fall periods (short-term/flash droughts)
- Less snowfall and earlier melting of snow
- Increased evapotranspiration due to longer growing seasons and warmer temperatures.
- Availability of water resources will be impacted



What we can do to minimize impacts of changing precipitation

- We need to better assess how precipitation is changing and impacts on our water resources
 - We need new water management plans in light of climate change.
- Identify current and future water supplies in relation to societal needs, aquatic life needs; identify water stress areas/watersheds
 - What areas/watersheds are now experiencing water stress from overuse, what are projections for future water needs, and how will these water needs be met in the future
- Predict increasing flood potential to areas
 - Create new flood hazard maps and population/critical infrastructure at risk
- Plan how to save rain and snowmelt
 - We may need to be saving streamflows during wet periods to have water for dry periods. How much do we need to save and how do we accomplish it?



What we can do to minimize impacts of changing precipitation - continued

- Manage increased pollutant amounts during extreme rainfall and snowmelt and drought
 - We need to reassess how we can achieve water-quality goals
 - More storage of sediments/other pollutants from runoff on the land (low-lying areas, wetlands)
 - Water quality will get worse as drought periods become more common and severe
- Presence of new water threats
 - Harmful algal blooms, new waterborne diseases and pests will occur in a warming climate; need to begin to monitor and have plans on how to control



Showing water stressed areas

Source: World Resource Institute



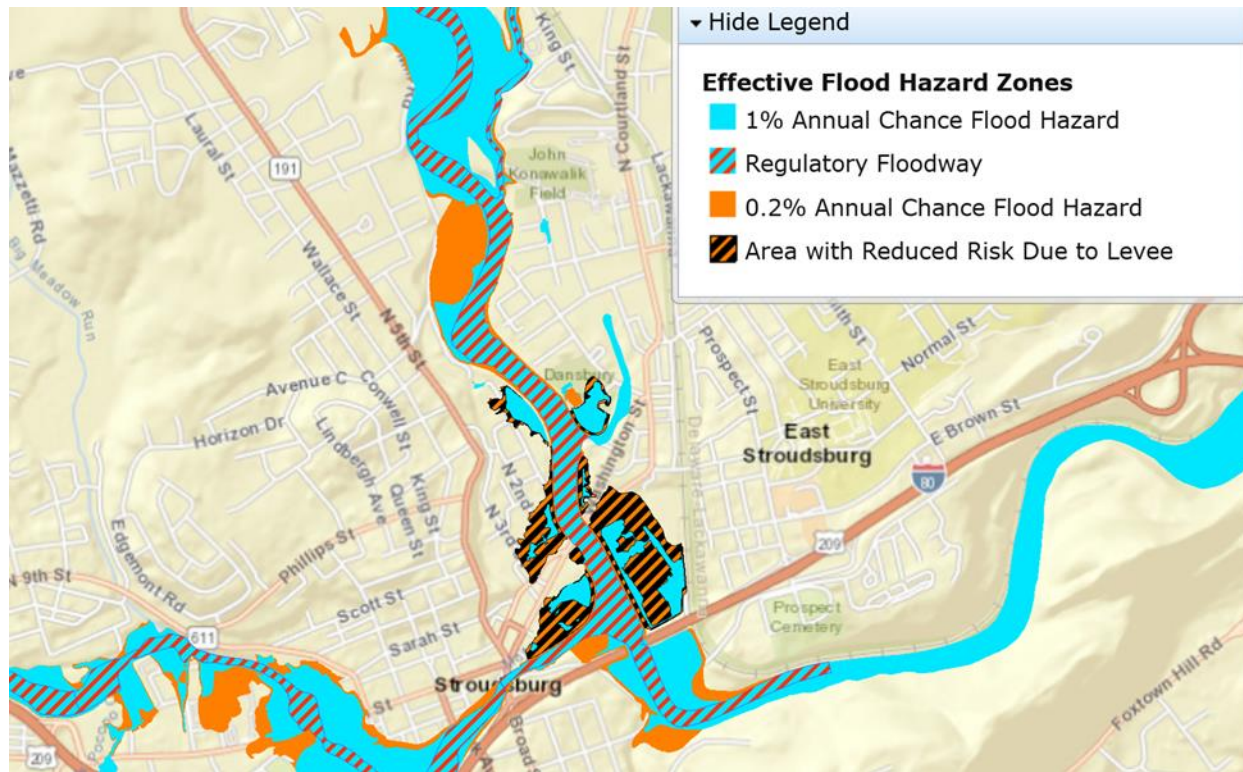
Flood mapping, prediction and preparedness



**Photo by
Albert Koster**

Flood mapping, prediction and preparedness

Existing flood risk maps

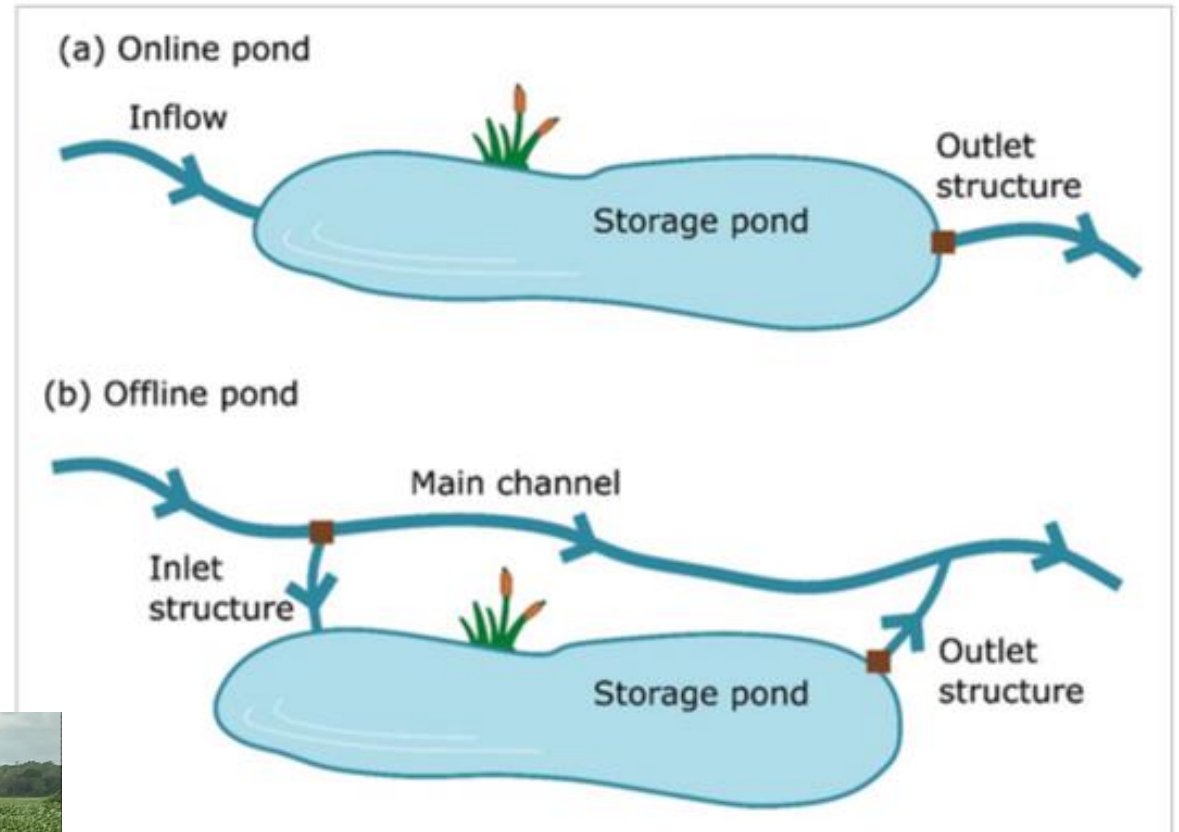


Flood inundation maps



Water storage ponds

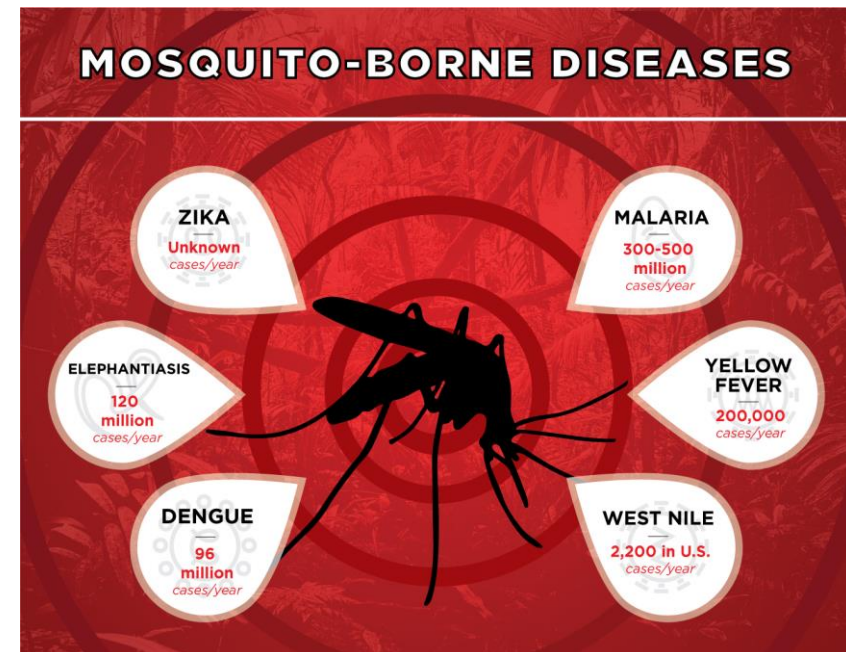
Designed to store extra water during wet periods so we have enough water in dry periods



Using agricultural lands and wetlands to store excess water

Human Health and Safety

- Provide cooling resources
 - air conditioners, shading, group facilities
- Monitoring of those at risks
 - visiting monitors to check on folks,
 - digital monitors for temp and health
- Enhanced public health programs to deal with the changing climate
 - heat related activities
 - new diseases and pests



Human Health and Safety

- Revise our engineering standards to incorporate climate scenarios
 - roads/culverts
 - water treatment
- Better building standards to enhance cooling, less needs for heating
- Improve electric grid to handle increase cooling loads, increase electrification of everyday life



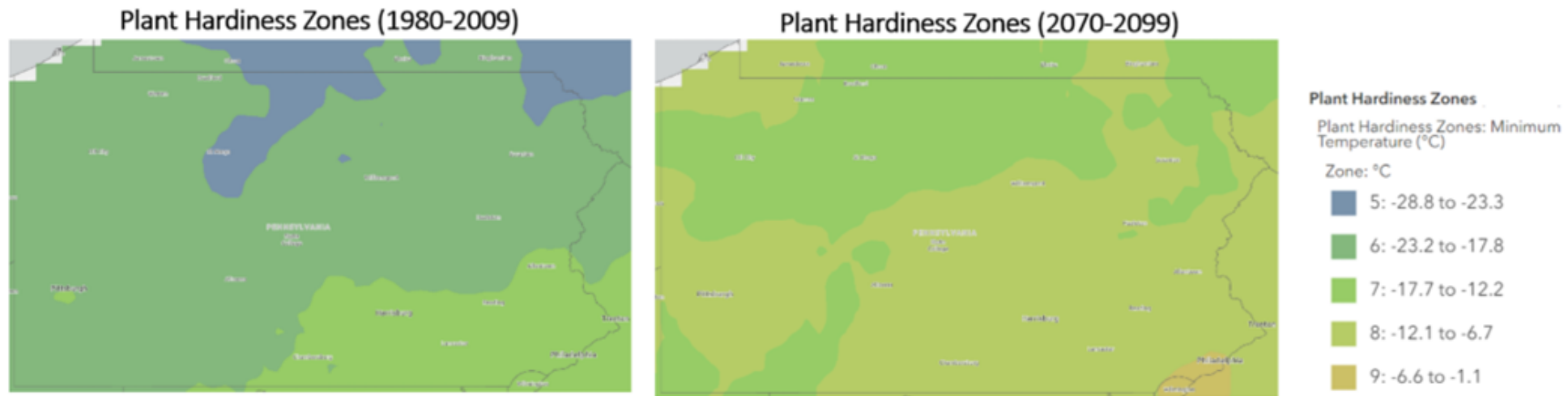
Maintaining our Natural Resources

- Re-think what is doable for natural resource goals
 - water quality and uses
 - define critical species to manage/enhance for the future
 - forest management programs/wildfire control
- Protect remaining wetlands, build more
- Initiate actions soon – can take 50 years to change



Future of Agriculture/Gardening

- Longer and hotter growing seasons
- Increased water demand for irrigation
- New pests/diseases
- Cooling for livestock
- Adaptive management of fields for runoff control



Source: USDA Plant Hardiness Zones – Office of Sustainability and Climate Zones

Us – how we can adapt

- Acknowledge and spread the word
-be a messenger of change; become examples for others
- Minimize our own impacts
-go electric, solar, renewables
- Consume less, make due with what we have, buy used
- Promote local products/businesses
- Promote/demand change with politicians, organizations, local communities
- Get folks to work together



Next Steps in this Climate Action Plan

- The plan needs more work....
- Brodhead Watershed Association direction
- Publicize and communicate esp with community partners, governments, experts, those that need to act
- See if we can get towns to work together
- Build interest and a constituency
- Prioritize actions, find funding, begin the actual work
- Update the plan if there's interest
- Maintain commitment to deal with our changing climate





Thank you!

