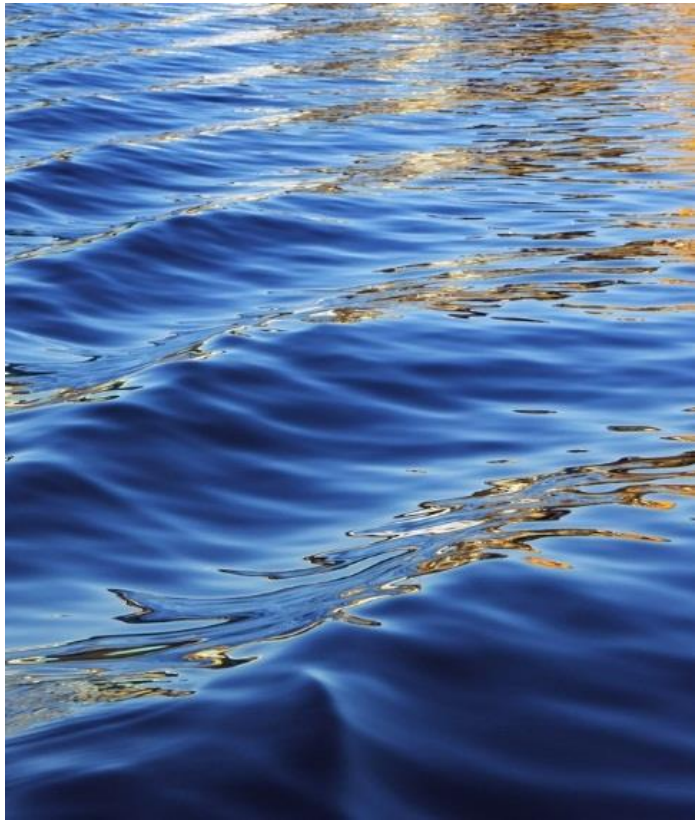
Changing Climate Exposures and Impacts; Temperature Extremes

Tribal Climate and Health Adaptation Webinar #3



Since Last Webinar

Suggested Reading

- Pick one chapter (2-8) of Impacts of Climate Change on Human Health in the United States

Climate Sensitivity: long-term change that would result from a doubling of carbon dioxide in the atmosphere relative to preindustrial levels

Did you complete Section 1 of your Workshop Companion?

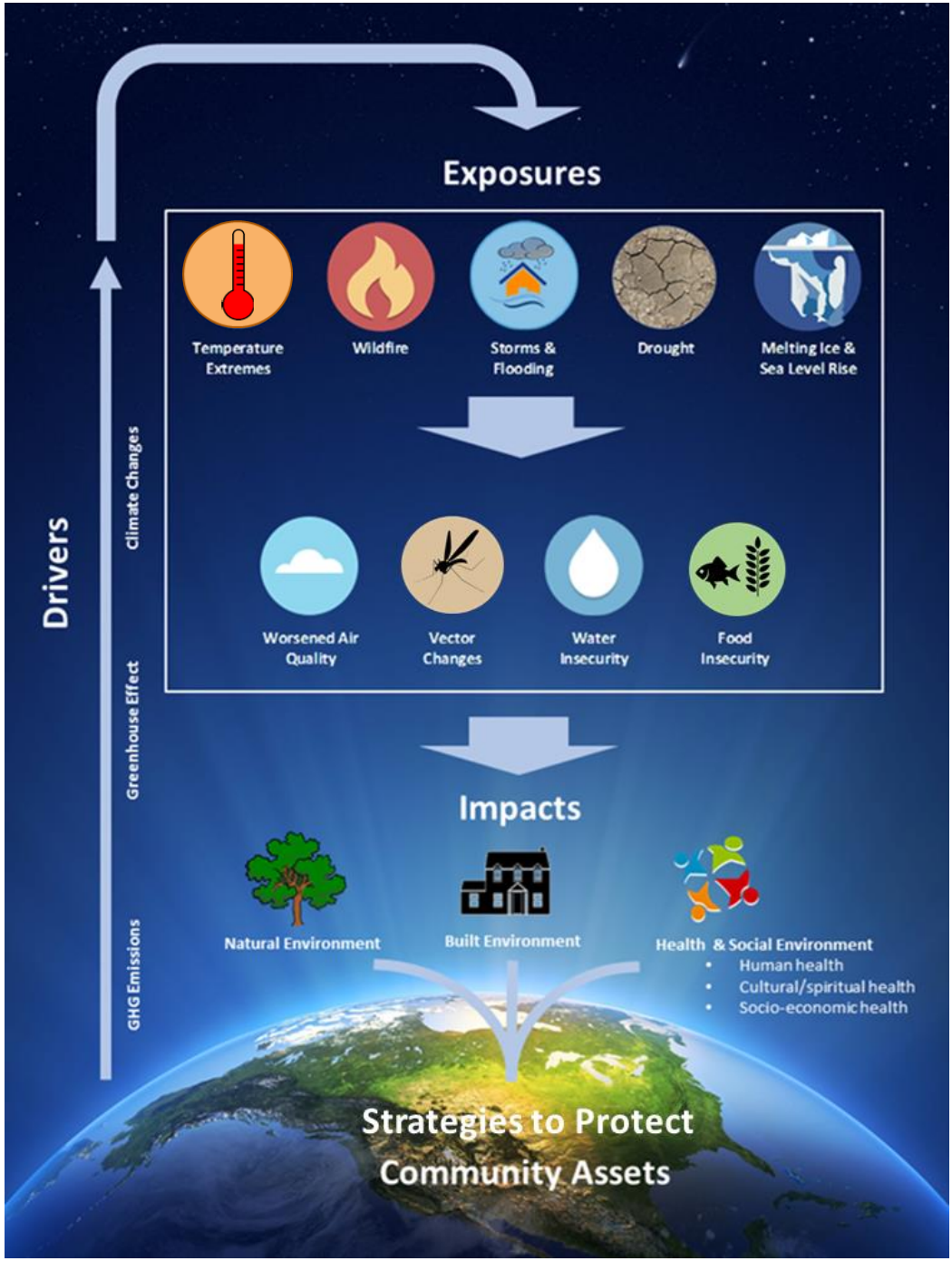
	Climate Driver	Exposure	Health Outcome	Impact
Extreme Heat	More frequent, severe, prolonged heat events	Elevated temperatures	Heat-related death and illness	Rising temperatures will lead to an increase in heat-related deaths and illnesses.
Outdoor Air Quality	Increasing temperatures and changing precipitation patterns	Worsened air quality (ozone, particulate matter, and higher pollen counts)	Premature death, acute and chronic cardiovascular and respiratory illnesses	Rising temperatures and wildfires and decreasing precipitation will lead to increases in ozone and particulate matter, elevating the risks of cardiovascular and respiratory illnesses and death.
Flooding	Rising sea level and more frequent or intense extreme precipitation, hurricanes, and storm surge events	Contaminated water, debris, and disruptions to essential infrastructure	Drowning, injuries, mental health consequences, gastrointestinal and other illness	Increased coastal and inland flooding exposes populations to a range of negative health impacts before, during, and after events.
Vector-Borne Infection (Lyme Disease)	Changes in temperature extremes and seasonal weather patterns	Earlier and geographically expanded tick activity	Lyme disease	Ticks will show earlier seasonal activity and a generally northward range expansion, increasing risk of human exposure to Lyme disease-causing bacteria.
Water-Related Infection (*Vibrio vulnificus*)	Rising sea surface temperature, changes in precipitation and runoff affecting coastal salinity	Recreational water or shellfish contaminated with *Vibrio vulnificus*	*Vibrio vulnificus* induced diarrhea & intestinal illness, wound and bloodstream infections, death	Increases in water temperatures will alter timing and location of *Vibrio vulnificus* growth, increasing exposure and risk of waterborne illness.
Food-Related Infection (*Salmonella*)	Increases in temperature, humidity, and season length	Increased growth of pathogens, seasonal shifts in incidence of *Salmonella* exposure	*Salmonella* infection, gastrointestinal outbreaks	Rising temperatures increase *Salmonella* prevalence in food; longer seasons and warming winters increase risk of exposure and infection.
Mental Health and Well-Being	Climate change impacts, especially extreme weather	Level of exposure to traumatic events, like disasters	Distress, grief, behavioral health disorders, social impacts, resilience	Changes in exposure to climate- or weather-related disasters cause or exacerbate stress and mental health consequences, with greater risk for certain populations.

Chat Discussion:

What did you read about that surprised you?

TCHP Framework

- Illustrates the cascading effects of climate change and how communities can protect assets against harmful impacts (basis for training)
- For example, communities that expect greater levels of flooding may look out for contaminated water and indoor mold spores.
- Not every exposure is applicable to every community, or to the same extent



TCHP Framework

Secondary exposures

Worsened Air Quality

- Ozone
- Smoke/Particulate matter
- Dust/Fungus
- Allergens
- Indoor mold

Vector Changes

- Disease-carrying ticks
- Disease-carrying mosquitos
- Disease carrying mice
- Forest Pests

Water Insecurity

- Contamination
- Supply shortage
- Distribution disruption

Food Insecurity

- Supply shortage
- Distribution disruption

Spotlight on Water and Food Insecurity

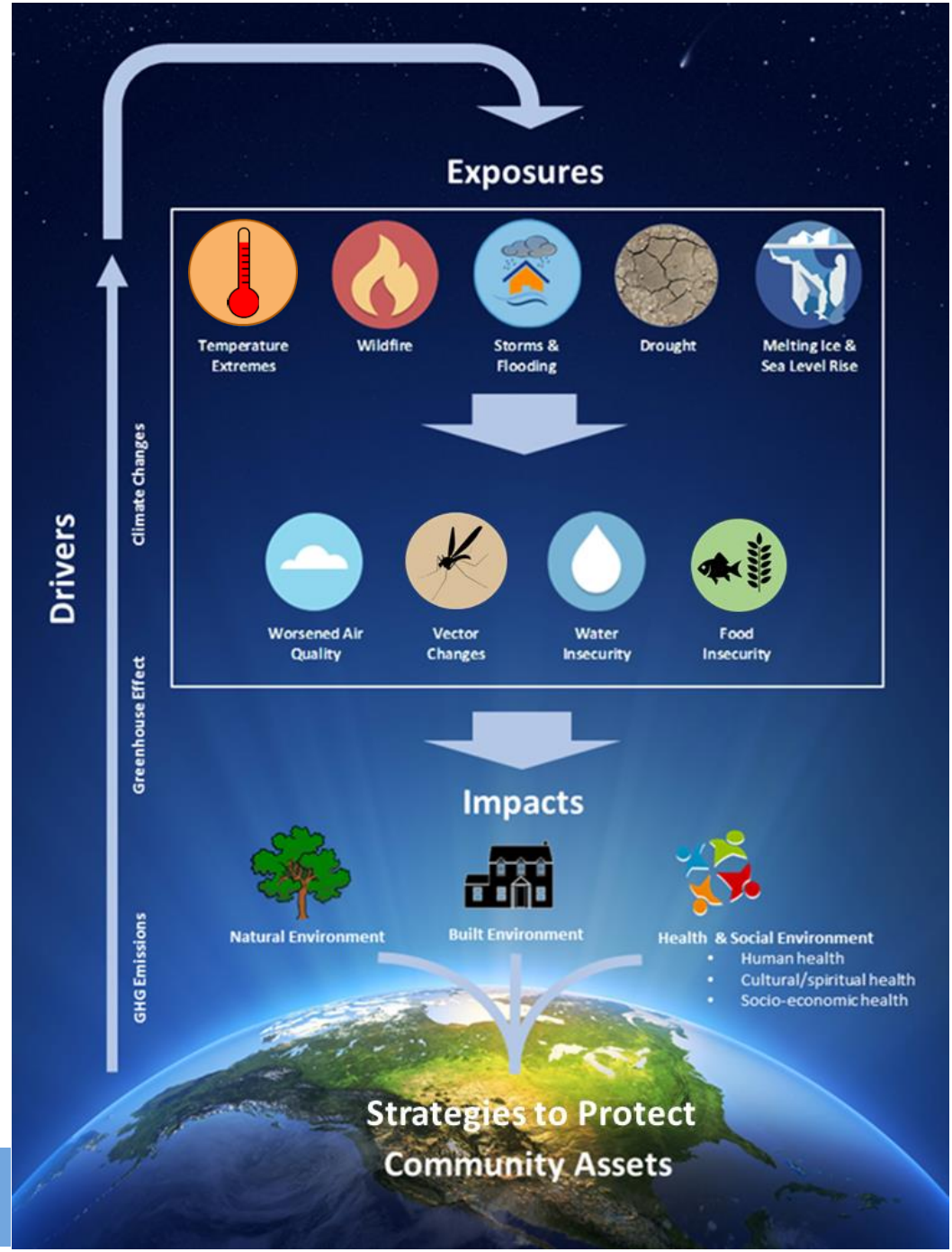
At Suquamish (WA)

TCHP Framework

- While a specific impact may be projected to be a risk for a specific region, it is up to the community to determine what is important
- Interventions or adaptation strategies occur at the point where impacts meet assets

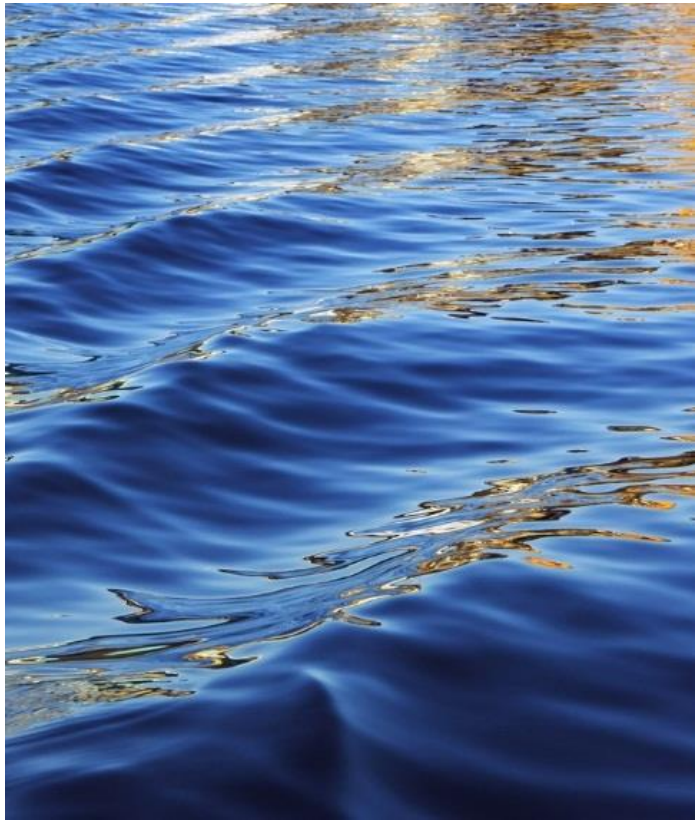
- An example:

  An increase in GHGs triggers temperature rise (driver) results in more intense heat waves for a tribe in Arizona (exposure), which leads to an increase in pathogen growth in a nearby source of drinking water (secondary exposure), which leads to a rise in gastrointestinal illnesses (impact), that threatens the physiological health of tribal elders and children (assets).



Group Poll

Temperature Extremes



EXPOSURES

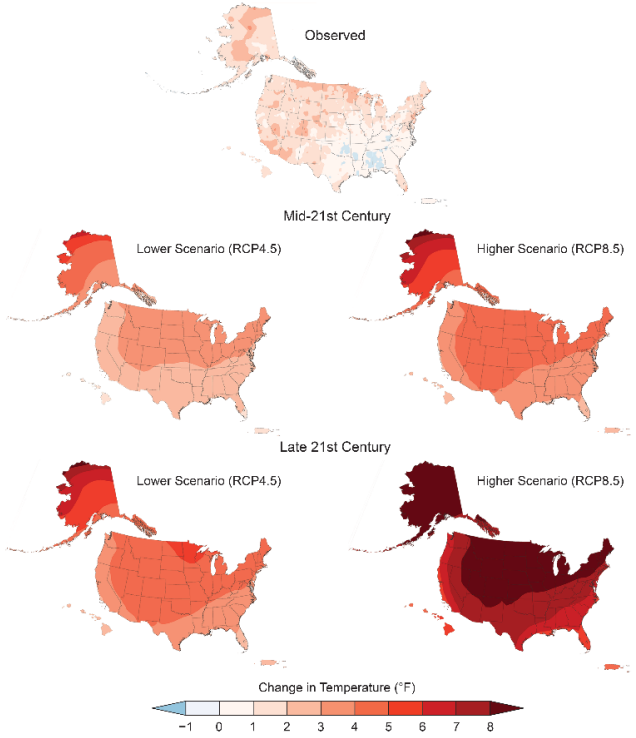
Temperature Extremes

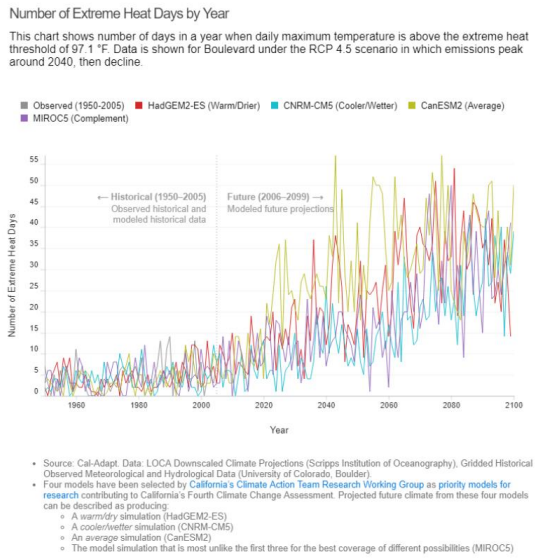
Key Climate Exposure Facts

- Increased **1.8 degrees F** from 1895 - 2016
- Projected to increase **2.8 – 7.3 degrees F** by 2071 – 2100
- Season shifts, more extreme heat and extreme cold events, sea temperatures

Regions Affected

All – Southwest particularly vulnerable to extreme heat





Group Discussion:

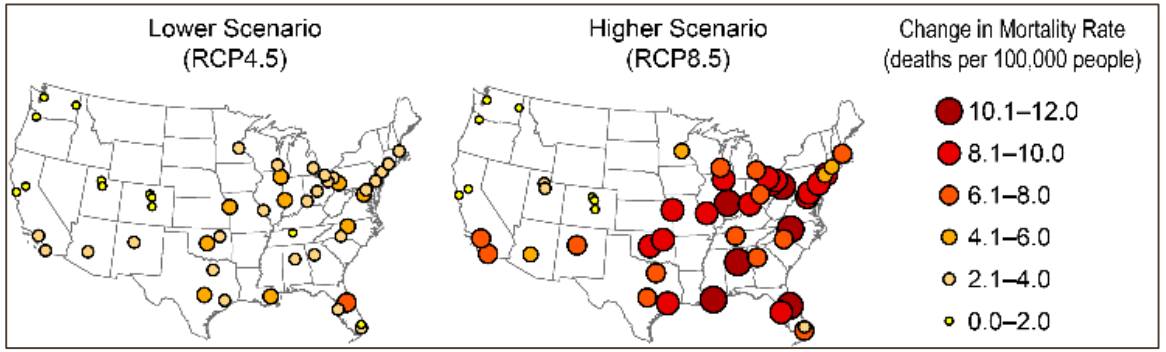
What health impacts can you anticipate?

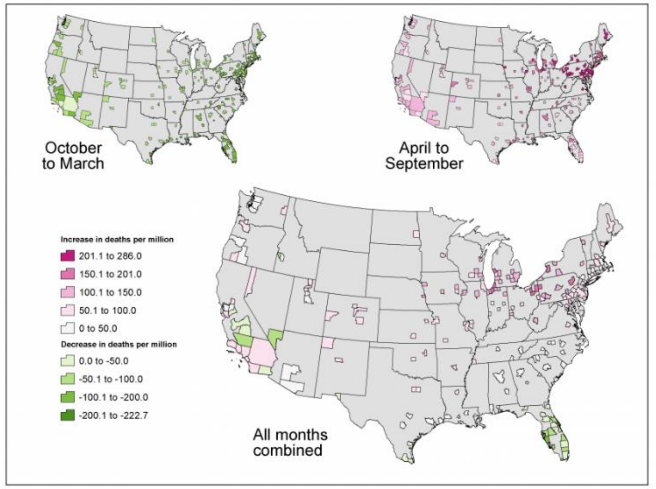
Temperature Extremes

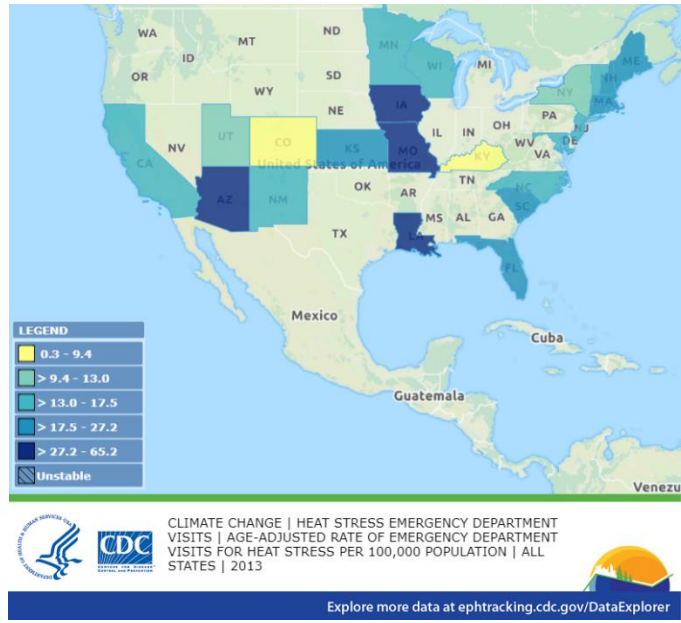
IMPACTS

Possible Health Impacts

- Heat-related illness and death
- Decrease in fitness activity level
- Mental, behavioral and cognitive wellbeing
  - Increased conflict violence and aggression



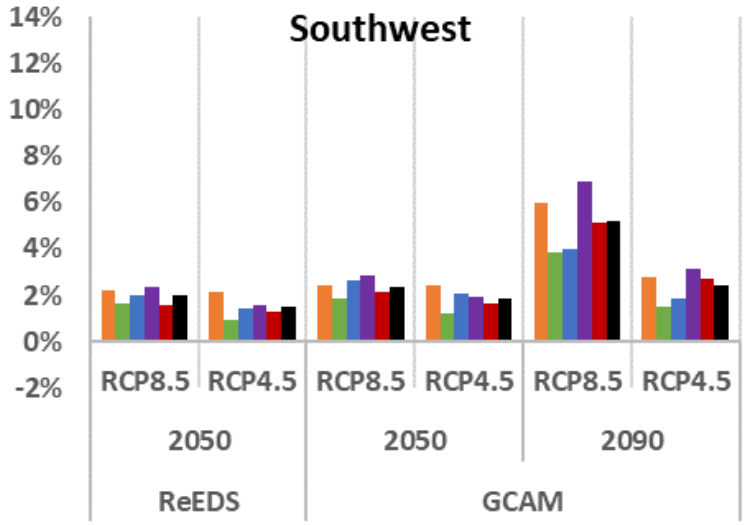


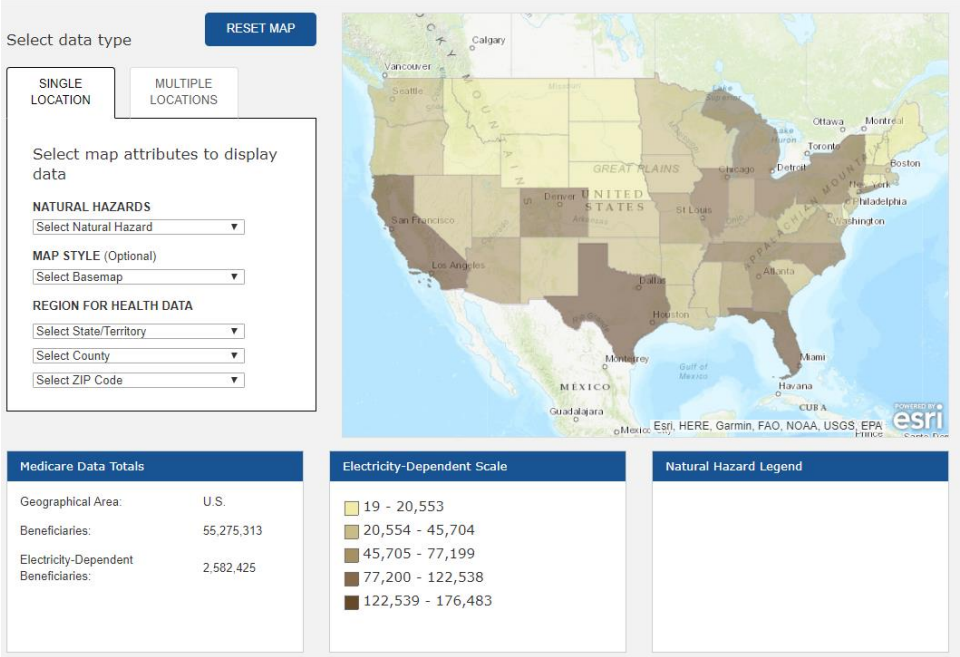


Temperature Extremes

Possible Health Impacts

- Power outages limit access to health services, can result in carbon monoxide poisoning
  - E.g. Those that rely on electricity-dependent medical equipment (e.g. ventilator, dialysis) are especially vulnerable





IMPACTS

EXPOSURES

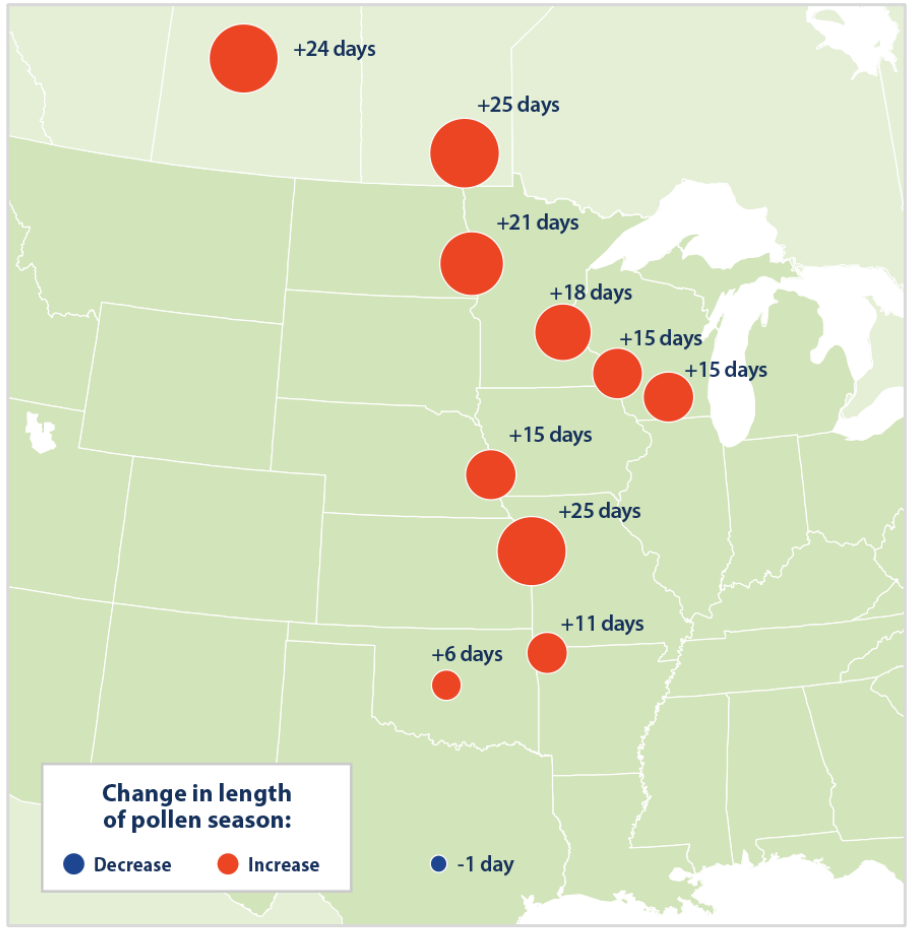
Temperature Extremes

Related Exposures

- Contributes to wildfire and drought
- Triggers the following **secondary exposures**:

- Ozone
- Allergens
- Ticks, Mosquitos
- Water contamination and supply disruption
- Food contamination and supply disruption

Change in Ragweed Pollen Season, 1995–2015



Data source: Ziska, L., K. Knowlton, C. Rogers, National Allergy Bureau, Aerobiology Research Laboratories, Canada. 2016 update to data originally published in: Ziska, L., K. Knowlton, C. Rogers, D. Dalan, N. Tierney, M. Elder, W. Filley, J. Shropshire, L.B. Ford, C. Hedberg, P. Fleetwood, K.T. Hovanky, T. Kavanaugh, G. Fulford, R.F. Vrtis, J.A. Patz, J. Portnoy, F. Coates, L. Bielory, and D. Frenz. 2011. Recent warming by latitude associated with increased length of ragweed pollen season in central North America. P Natl. Acad. Sci. USA 108:4248–4251.

For more information, visit U.S. EPA's "Climate Change Indicators in the United States" at www.epa.gov/climate-indicators.

Chat Discussion:

What health impacts can you anticipate?

IMPACTS

Temperature Extremes

Possible Health Impacts

- Respiratory illness
- Allergic symptoms from pollen

Figure 3.2. Change in Ozone-Related Premature Deaths

Maps show county-level estimates for the average change in ozone-related premature deaths over the summer months in 2050 (2045-2055) and 2090 (2085-2095) compared to 2000 (1995-2005).

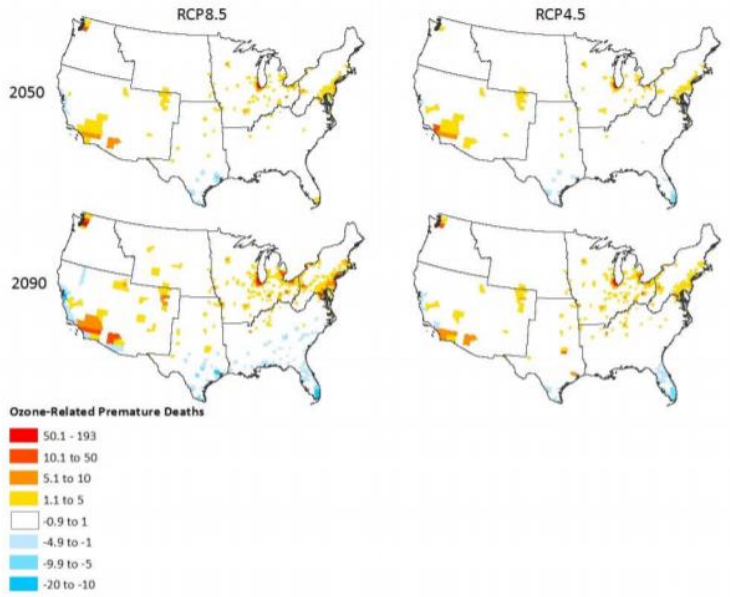
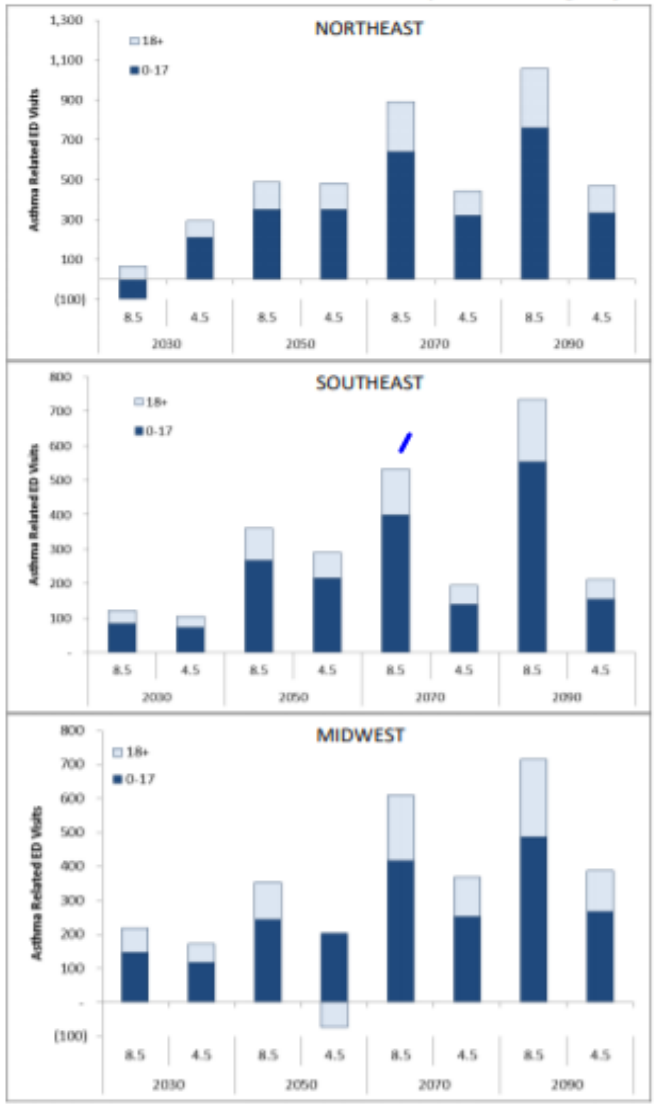


Figure 4.2. Change in Asthma-Related Emergency Department Visits

The graphs show change from the reference period (1994-2010) by age groups for the three regions studied under RCP8.5 and RCP4.5. Results represent averages of the five GCMs.



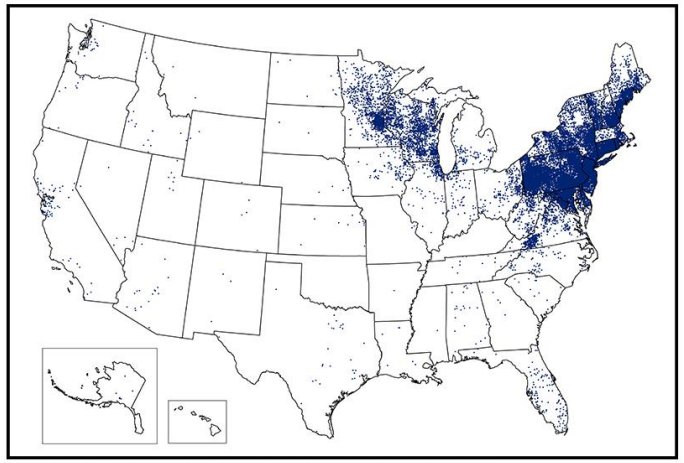
IMPACTS

Temperature Extremes

Possible Health Impacts

Vector-borne disease (e.g. Lyme, West-Nile, Zika, Dengue)

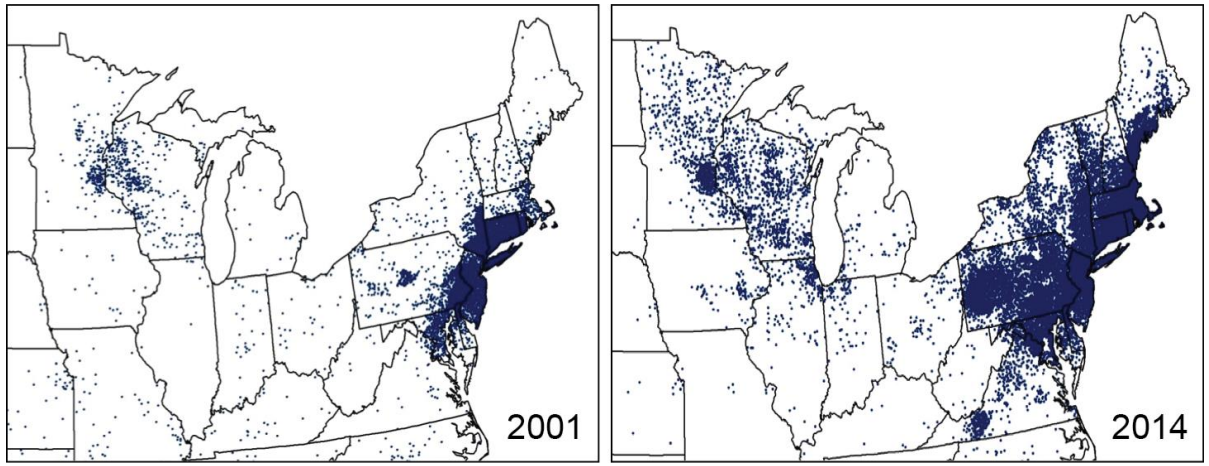
Reported Cases of Lyme Disease — United States, 2017



1 dot placed randomly within county of residence for each confirmed case

In 2016, Massachusetts transitioned to a surveillance method that relies primarily on laboratory reports. This method does not currently align with the national surveillance case definition as set by the Council of State and Territorial Epidemiologists (CSTE). Therefore, information on most Lyme disease cases occurring in Massachusetts is not sent to CDC. Please contact the MA Department of Public Health for case numbers.

Changes in Lyme Disease Case Report Distribution



Temperature Extremes

IMPACTS

Possible Health Impacts

- Infections and illness from contaminated water and food (e.g. algal blooms)
- Lack of nutritional and medicinal abundance

> "Climate change is very likely to affect global, regional, and local food security by disrupting food supply availability, decreasing access to food, and making utilization more difficult."

Figure 21.1. Projected Percent Change in National Crop Yields

Results shown represent the average of the five GCMs under RCP8.5 and RCP4.5 compared to the reference period (1986-2005). Results are weighted averages of the individual irrigated and rainfed values from the EPIC model.

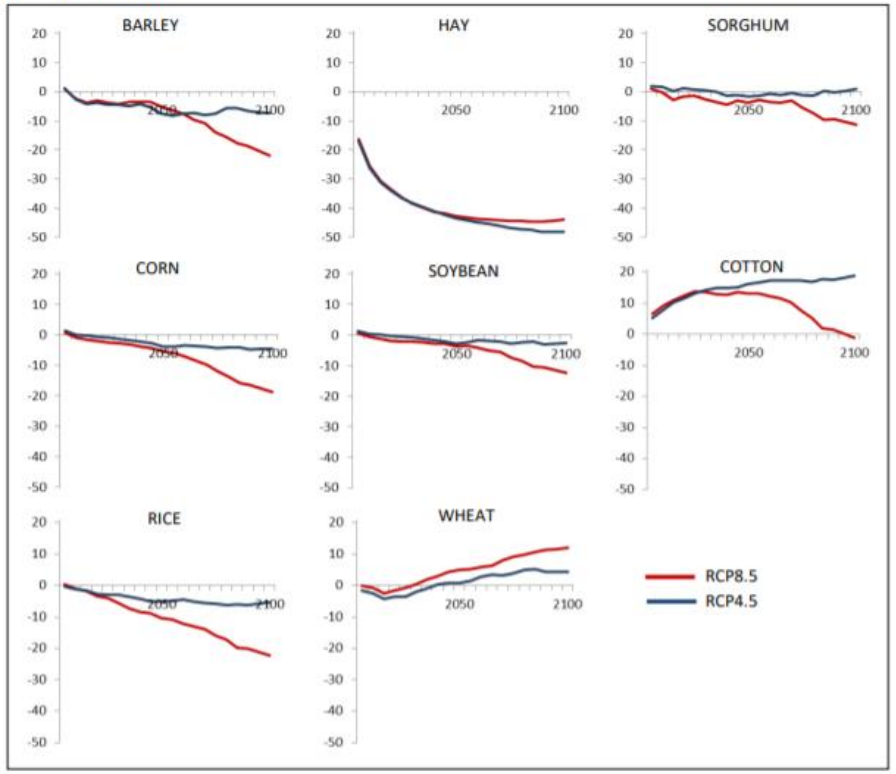


Figure 21.2 shows the projected change in national yield under RCP8.5 for the three largest U.S. crops (by area and production volume, not including hay) under the five different climate models, along with the ensemble average. In general, there is agreement in the direction of yield effects across the GCMs, although the magnitude of change varies by climate model and crop. In addition, the magnitude of change, whether positive or negative, increases over time in almost all cases. The largest change from reference yields is projected under the HadGEM2-ES model, which is the hottest model used in this analysis, with the exception of wheat where yield changes under this GCM are the most positive.

Group Poll

Temperature Extremes

IMPACTS

Vulnerable Populations

- Children and elders
- Neighborhoods lacking green space
- People susceptible to health impacts from poor air quality
- People with mental, behavioral, and cognitive disorders
- Populations lacking access to AC
- Residents living in older homes
- Electricity-dependent populations
- Outdoor workers

Sample of Population Sensitivity and Adaptive Capacity Factors

- Urban heat island
- Tree canopy
- Households with air-conditioning
- Population size of vulnerable individuals

IMPACTS

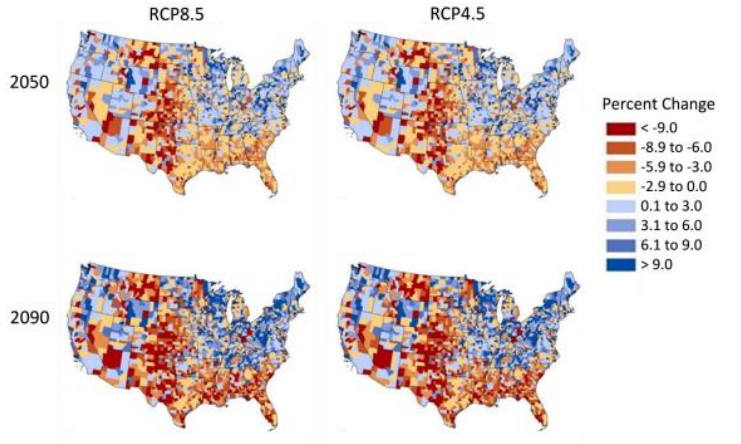
Temperature Extremes

Possible Impacts to Social, Economic and Cultural Health

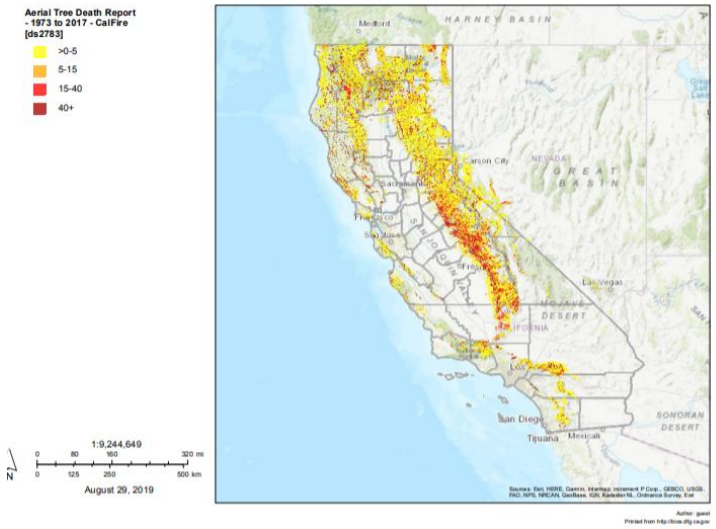
- Displacement
- Lost school days and business revenues
- Disruptions to culturally important activities and species (e.g. outdoor traditional events, Oak loss)
- Economic damage
  - E.g. In CA by 2050
    - $50 billion/year associated with human mortality from high temperatures
    - Increased electricity demand = $200M/year

Figure 9.1. Climate Change-Induced Domestic Migration

Relative net differences in county-level population projections by RCP and year. Values represent the average percentage change across the five GCMs compared to a "no climate change" control scenario.



Map of Project Area



Chat Discussion:

How might cultural wellbeing and traditional ways of life be disrupted by temperature extremes?

IMPACTS

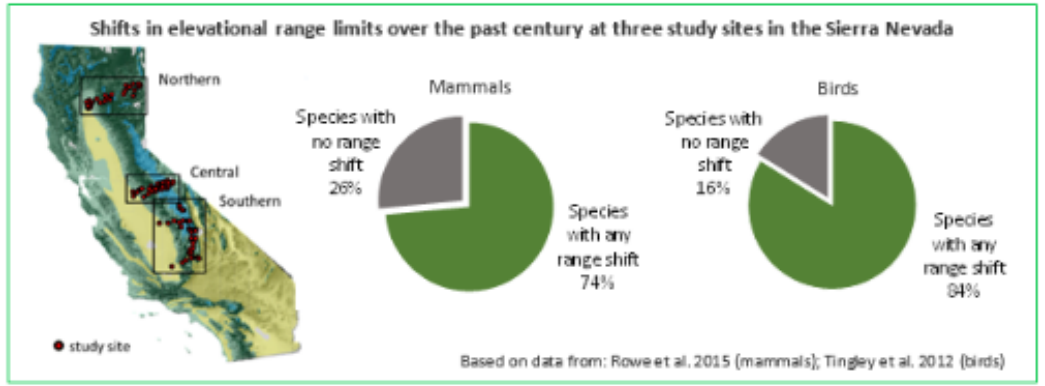
Temperature Extremes

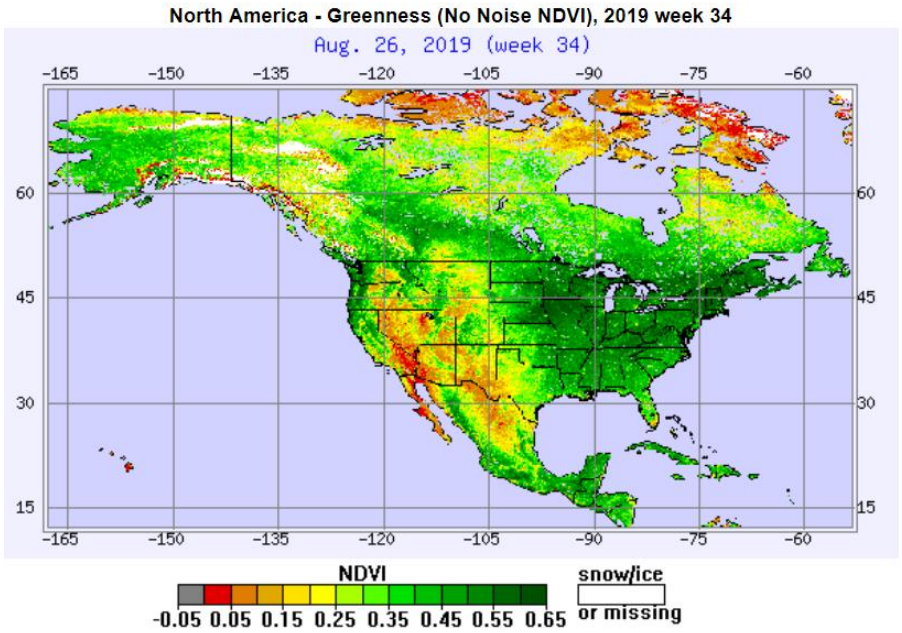
Possible Natural Environment Impacts

- Heat or season shift related disruptions, declines and stresses to habitats, waterways, and important or sensitive plant and wildlife species
  - E.g. tree mortality, global vegetative health, range shifts, algal blooms, increases in the presence and prevalence of invasive species)

Possible Built Environment Impacts

- Disruption to public services and infrastructure (e.g. power outages)
- Disruption to agricultural operations





Chat Discussion:

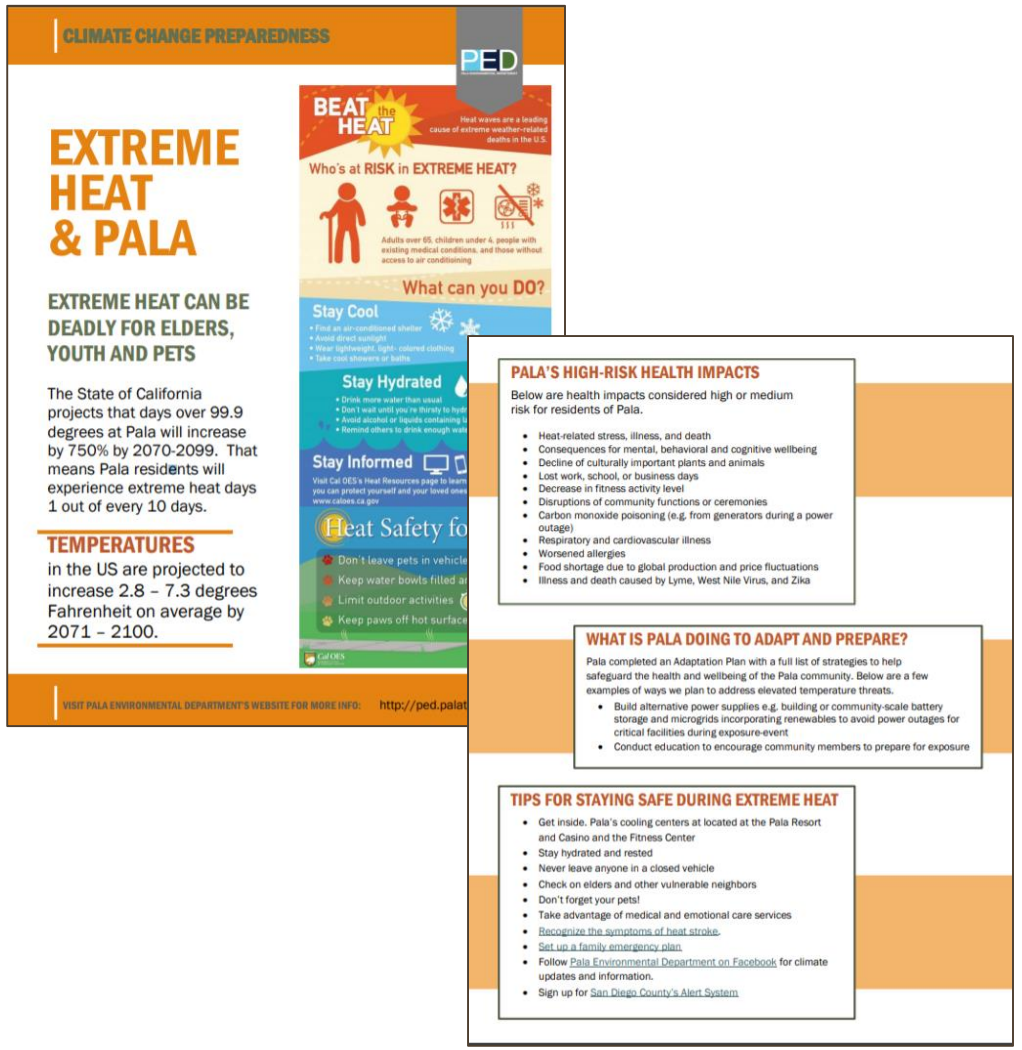
What adaptation strategies may be able to reduce negative impacts to your community?

STRATEGIES

Temperature Extremes

Sample Strategies to Address Impacts

- Develop an emergency or heat health management plan to anticipate and prepare public services for heat risks.
- Notify community about heat events, heat-related illness systems, cooling centers and tips
- Promote food sovereignty and resilience through tribal food cooperatives, seed banks, and protected gardens
- Stress test facilities for heat tolerance
- Increase urban forestry and green infrastructure
- Implement advanced surveillance of air and water quality
- Improve energy resilience to avoid power outages (e.g. microgrid)



Temperature Extremes

Tribal Case Study

Mescalero Apache Tribe (New Mexico)

- Some of the highest temperatures ever recorded in the region all occurred since 2011.
- Working with a range of federal, state, and local government agencies and academia to maintain forest health and resiliency.
- Constructed hoop houses and greenhouses to protect produce from climate extremes and solar systems at the fish hatchery

Temperature Extremes

Trainee Examples

Wrapping Up

Thank you for being part of our training community!

Suggested reading (complete before next webinar)

- APEN: "Mapping Resilience: A Blueprint for Thriving in the Face of Climate Disasters"

Next webinar:

September 17, 2019 (9AM PST / Noon EST)

Wildfire, Drought (Module 2)

Announcement:

Sept 4 National Tribal Air Association will be Hosting a Webinar on US Senate request for Climate Change Recommendations from Tribes

Questions?