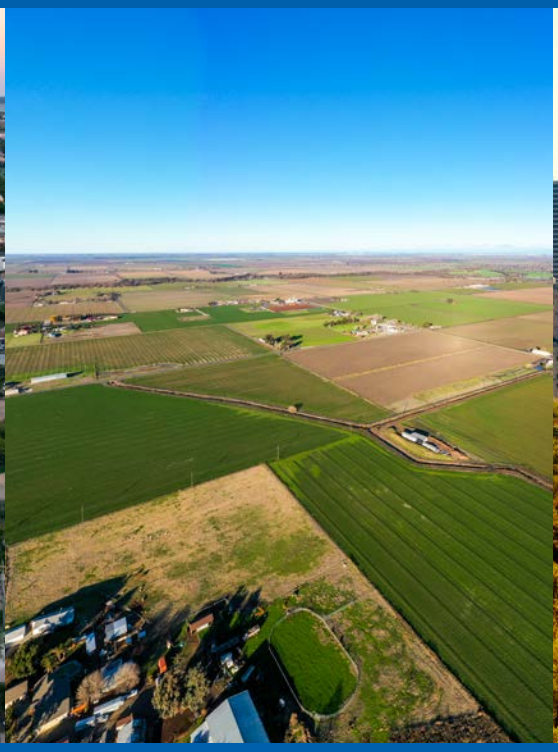
For accessible version go to https://www.cdc.gov/climate-health/php/regions/index.html

PREPARING FOR THE REGIONAL HEALTH IMPACTS OF CLIMATE CHANGE IN THE UNITED STATES



A summary of health effects, resources, and adaptation examples from health departments funded by CDC's Climate and Health Program

2024

CDC

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Contents

Executive Summary

Each region of the United States experiences climate change and its impacts on health differently, due to the regions' location-specific climate exposures and unique societal and demographic characteristics. The Centers for Disease Control and Prevention's (CDC) Climate and Health Program supports states, counties, cities, Tribes, and territories to assess how climate change will affect their community, identify populations more vulnerable to climate change, and implement adaptation and preparedness strategies to reduce the health effects of climate change. This document describes the various health impacts climate change will have on different regions of the United States. Unless otherwise noted, the material in this document is based on the cumulation of information from the U.S. Global Change Research Program, such as the Fifth National Climate Assessment (NCA5), Fourth National Climate Assessment (NCA4), and 2016 Climate and Health Assessment.

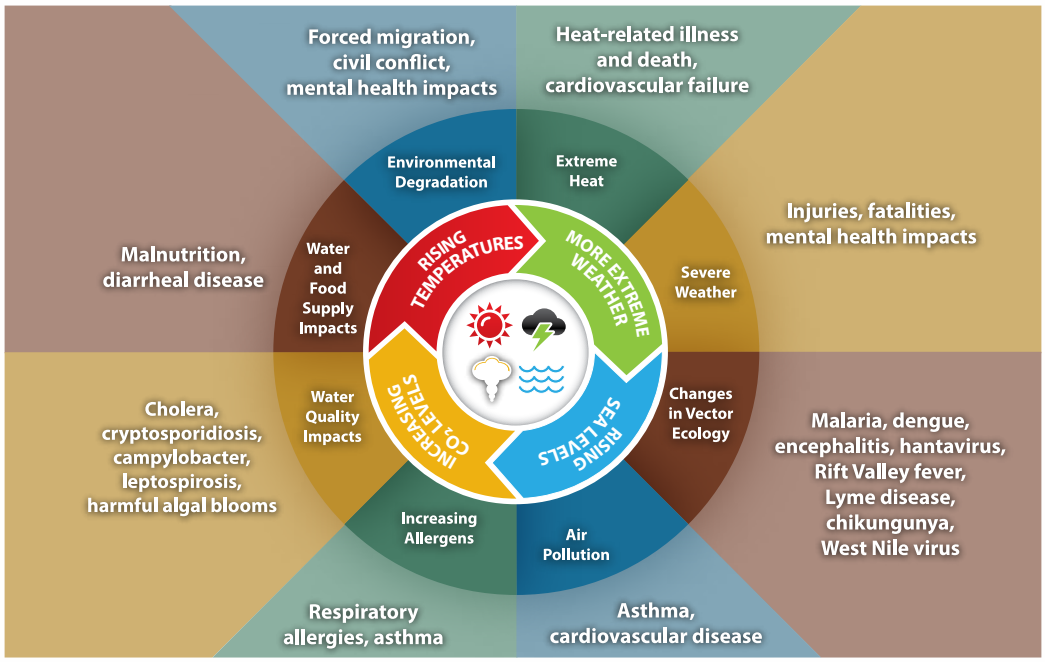
Background

Climate change, together with other natural and human made health stressors, influences human health and disease as some existing health threats will intensify and new health threats will emerge (https://www.cdc.gov/climateandhealth/effects/default.htm). For example, changes in temperature and precipitation are increasing health risks associated with wildfire and ground-level ozone pollution. Rising air and water temperatures and more intense extreme events are expected to increase exposure to waterborne and foodborne diseases, affecting food and water safety. With continued warming, cold-related deaths are projected to decrease, and heat-related deaths are projected to increase, and in most regions, increases in heat-related deaths are expected to outpace reductions in cold-related deaths. The frequency and severity of allergic illnesses, including hay fever, are expected to increase as a result of shorter winters and earlier and longer pollen seasons.

Climate change is also projected to alter the geographic range and distribution of insects and pests, potentially exposing more people to ticks and mosquitoes that carry the agents that cause diseases like Lyme disease, Zika, West Nile, and dengue. Communities in the Southeast, for example, are particularly vulnerable to the combined health impacts from heat and flooding, which can result in large populations of nuisance mosquitoes and potential disease risk. Finally, extreme weather and climate-related events can have lasting mental health consequences in affected communities, particularly if they result in degradation of livelihoods or community relocation. For more information on the health impacts of climate change in the United States, see the health chapter of the fifth National Climate Assessment: https://nca2023.globalchange.gov/chapter/15/.

Impact of Climate Change on Human Health

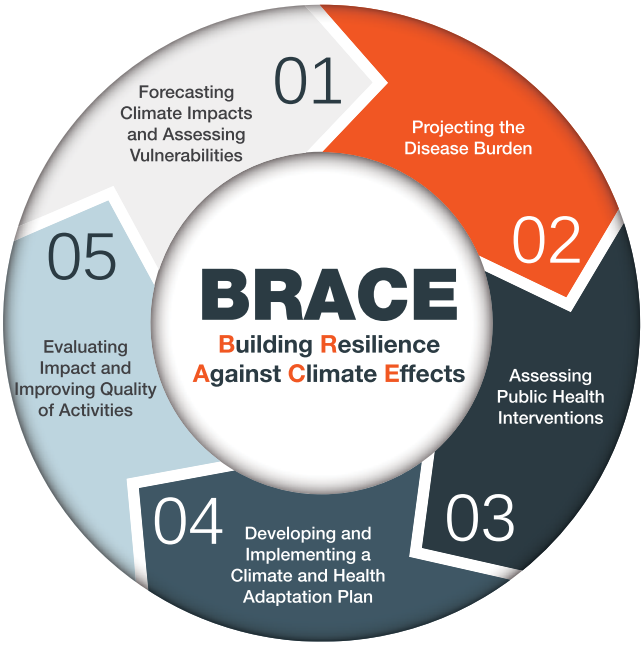
Climate change impacts a wide range of health outcomes. This image illustrates some of the most significant components of climate change (rising temperatures, more extreme weather, rising sea levels, and increasing carbon dioxide levels), their effect on exposures, and the subsequent health outcomes that can result from these changes in exposures. Source: https://www.cdc.gov/climateandhealth/effects/default.htm.



Importantly, not everyone is equally at risk. The impacts on health due to climate change are both place-specific and path-dependent as there are varying degrees of climate exposure and differences in individual and societal characteristics that can either protect you or make you more at risk to the impacts of climate change. For example, those that are overburdened and disproportionately affected by the health impacts of climate change include pregnant people, people other than cisgender straight men, older adults, children, communities with lower socioeconomic status, people with chronic illnesses, people living with disabilities, people experiencing homelessness, and racial and ethnic communities, such as Black, Indigenous, Asian, Latino/Hispanic, and Middle Eastern, commonly referred to communities of color or BIPOC. Adaptation and mitigation policies and programs help individuals, communities, and states prepare for the risks of a changing climate and reduce the number of injuries, illnesses, and deaths from climate-related health outcomes. CDC's Climate and Health Program is the national leader in empowering communities to protect human health from a changing climate. Beginning in 2010, the Climate and Health Program implemented the Climate-ready States and Cities Initiative (CRSCI) to help state and city health departments prepare for and respond to the health effects that a changing climate may bring to their communities. As of 2024, thirteen jurisdictions are directly funded to implement the five-step Building Resilience Against Climate Effects (BRACE) framework to identify likely climate impacts in their communities, potential health effects associated with these impacts, and their most at-risk populations and locations so that they can then develop and implement health adaptation plans and address gaps in critical public health functions and services. For more information see: https://www.cdc.gov/climateandhealth/climate_ready.htm

Five sequential steps comprise the BRACE framework

The Building Resilience Against Climate Effects (BRACE) framework is a five-step process that allows health officials to develop strategies and programs to help communities prepare for the health effects of climate change. Accessibility source: https://www.cdc.gov/climateandhealth/BRACE.htm



Step 1: Anticipate Climate Impacts and Assessing Vulnerabilities

Identify the scope of climate impacts, associated potential health outcomes, and populations and locations vulnerable to these health impacts.

Step 2: Project the Disease Burden

Estimate or quantify the additional burden of health outcomes associated with climate change.

Step 3: Assess Public Health Interventions

Identify the most suitable health interventions for the identified health impacts of greatest concern.

Step 4: Develop and Implement a Climate and Health Adaptation Plan

Develop a written adaptation plan that is regularly updated. Disseminate and oversee implementation of the plan.

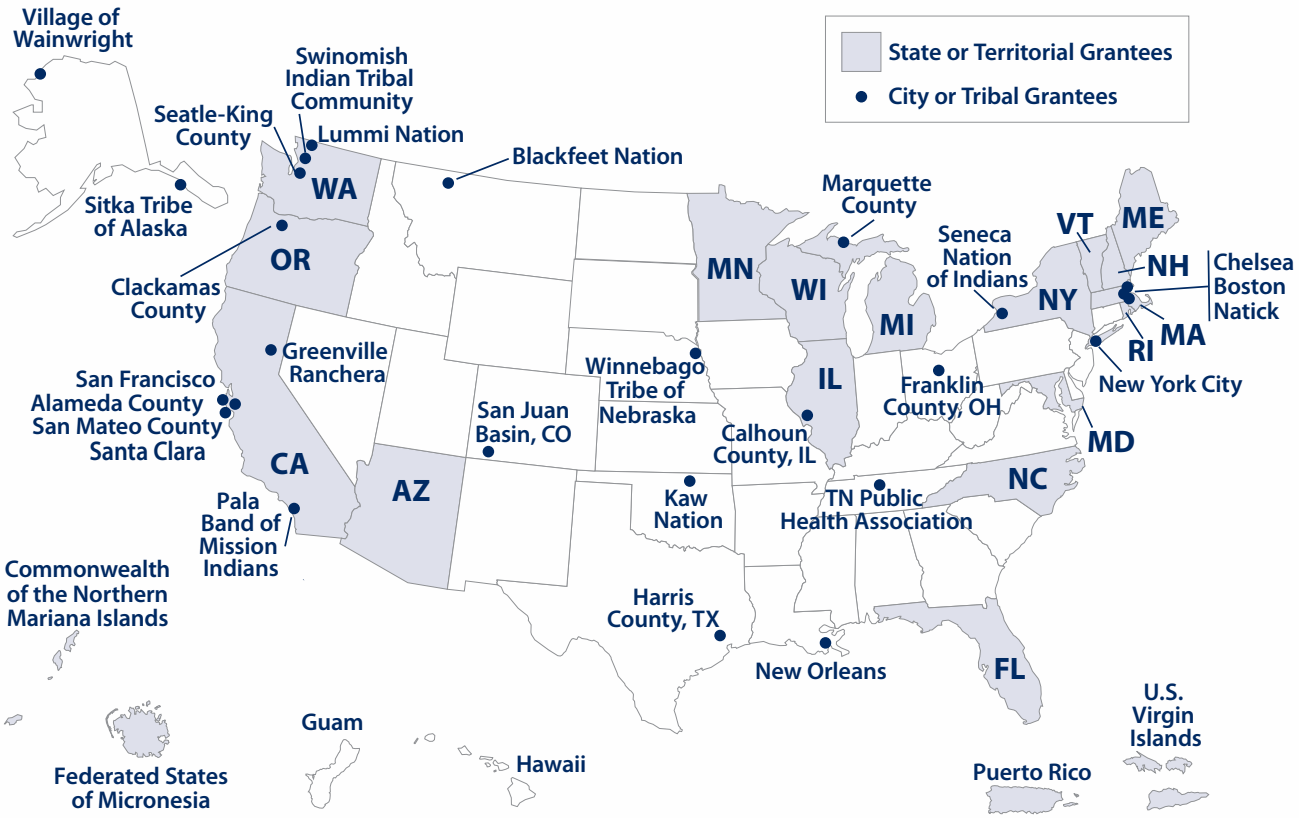
Step 5: Evaluate Impact and Improve Quality of Activities

Evaluate the process. Determine the value of information attained and activities undertaken.

The Climate and Health Program also supports Tribes, territories, and other communities that are not part of the Climate-Ready States and Cities Initiative (CRSCI) through the "Building Capacity of the Public Health System to Improve Population Health through National, Nonprofit Organizations" program managed by CDC's National Center for State, Tribal, Local, and Territorial Public Health Infrastructure and Workforce. Funded partners include the National Indian Health Board (NIHB) Climate-Ready Tribes Initiative; the Association of State and Territorial Health Officials (ASTHO) Climate-Ready Territories Initiative; the Council for State and Territorial Epidemiologists (CSTE); the National Environmental Health Association (NEHA); and the National Association of County and City Health Officials (NACCHO).

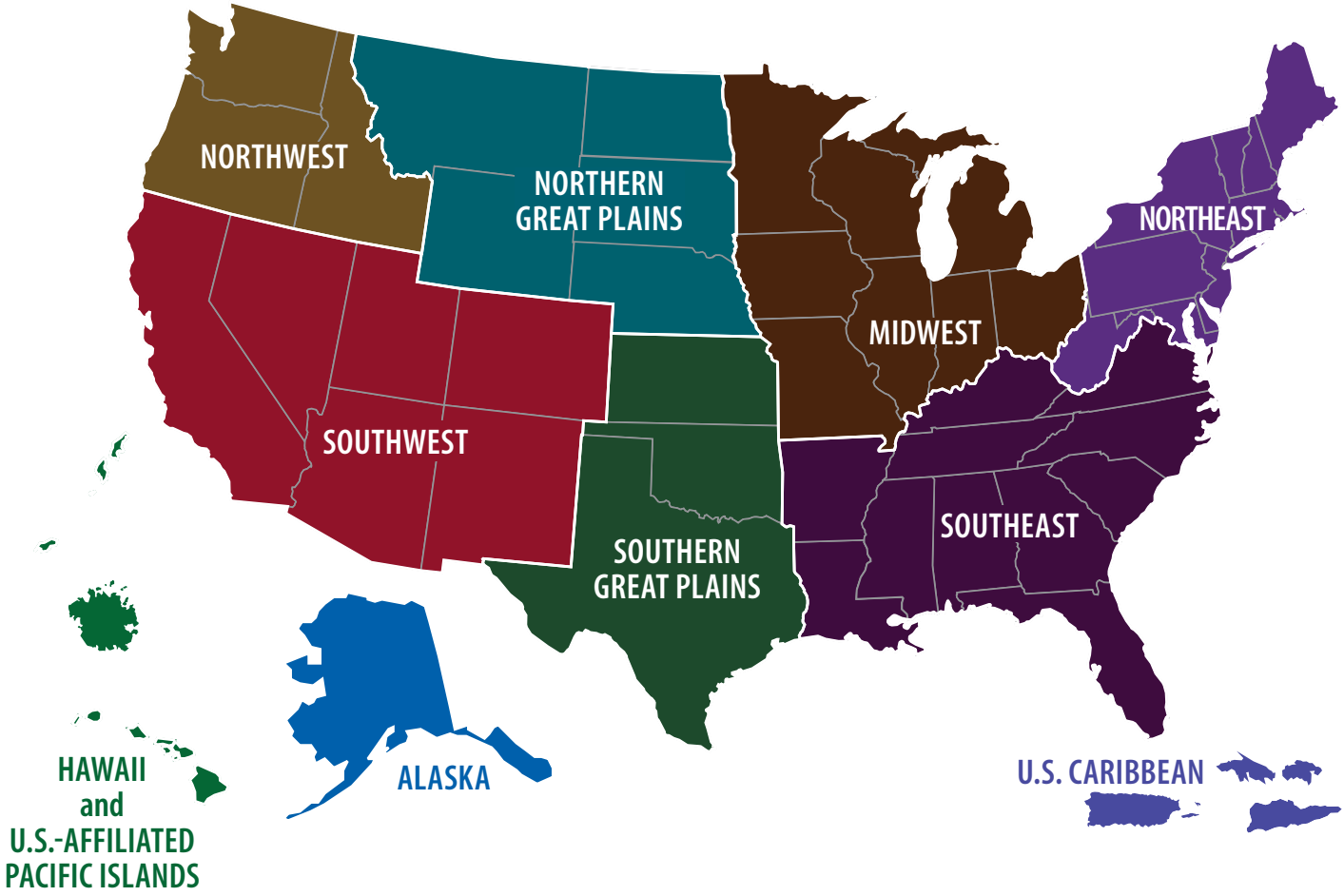
Jurisdictions funded or previously funded by the CDC Climate and Health Program

This map highlights the states, cities, counties, tribes, and territories that have received funding and technical assistance from the CDC Climate and Health Program directly and through partnerships with other organizations.

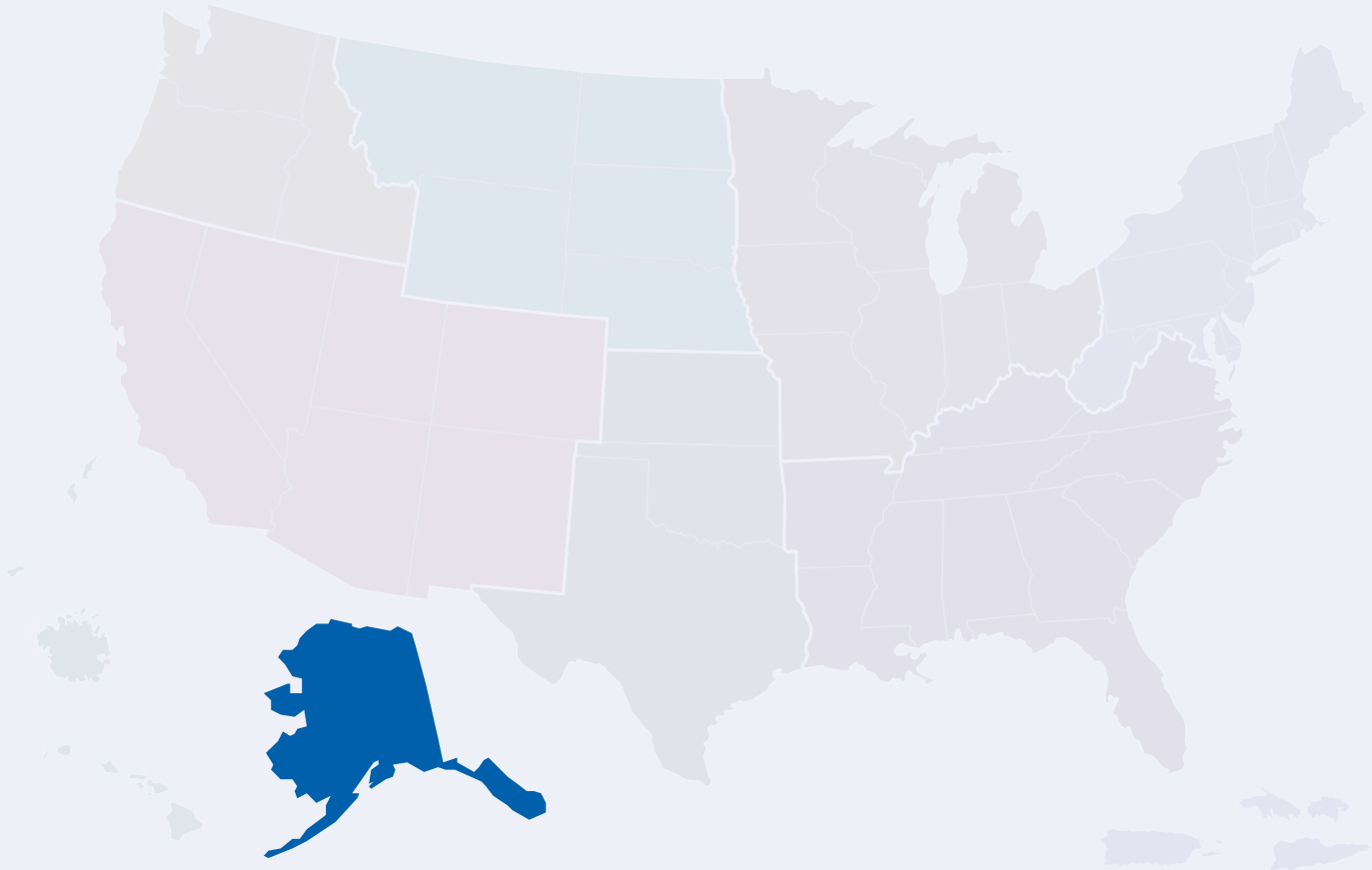


Regions

Outlined on the following pages are the unique climate-related health impacts for each region of the United States (as defined by the Fifth National Climate Assessment) and relevant highlights of actions taken by the CDC Climate and Health Program's health department partners to prepare for and respond to climate change in their communities. Unless otherwise noted, the material in this document is based on the cumulation of information from the U.S. Global Change Research Program, such as the Fifth National Climate Assessment (NCA5), Fourth National Climate Assessment (NCA4), and 2016 Climate and Health Assessment. The climate impacts described in each region of this document are not comprehensive, though provide a high-level overview of key risks. This document synthesizes the impacts that are directly health-relevant but is not meant to be all-encompassing. In addition, a variety of climate-relevant health adaptation activities that are not funded by CDC are taking place across the country and are not reflected in this document.



ALASKA



Health Impacts

Temperature-Related Death and Illness

Winter travel has long been a key feature of subsistence food-gathering activities for rural Alaska communities. Higher winter temperatures and shorter durations of ice seasons may delay or disrupt usual patterns of ice formation on rivers, lakes, and the ocean. For hunters and other travelers, this increases the risk of falling through the ice, having unplanned trip extensions, or attempting dangerous routes, leading to exposure, injury, death, or drowning.

Air Quality Impacts

Climate-driven increases in air pollution in Alaska are primarily linked to the increases in wildfire frequency and intensity. Wildfires threaten individual safety in adjacent communities and pose risks downwind from smoke inhalation, particularly for children and persons with chronic respiratory and cardiovascular conditions. Moreover, wildfire smoke exposure is associated with an increased risk of adverse health outcomes among Alaska Natives and rural residents. This increased risk is thought to be due, in part, to underlying differences in rates of chronic disease, as well as access to healthcare and resources for exposure reduction (e.g., air filters). Common exposure reduction strategies may not be an option for many households. Air conditioning in homes is rare in Alaska, so relief is seldom available for persons disproportionately at risk to escape smoke exposure due to wildfires. Simultaneously, more intense seasonal pollen blooms and mold counts can increase the risk of respiratory allergies and trigger asthma attacks in those who are sensitive. Increased respiratory symptoms have also been reported in communities that are experiencing increased windblown dust

Extreme Events

Extreme weather events such as major storms, floods, and heavy rain have all occurred in Alaska and threaten human health. For coastal areas, the damage from late-fall or winter storms is likely to be compounded by a lack of sea ice cover, high tides, and rising sea levels. These can increase damage to infrastructure such as roads, homes, and buildings, and subsequently threaten lives. Similar events threaten communities on rivers, where flooding due to increased glacial melt or heavy rains can cause extensive structural damage and loss of life.

Vector-Borne Diseases

Changes in insect and arthropod ranges due to climate change have increased human exposure to vector-borne diseases. Tick-borne human illnesses are uncommon in Alaska, but reports of ticks on domestic dogs without travel exposure outside the state raise concerns about tick-range expansion into Alaska and the potential for the introduction of new pathogens, such as Lyme disease. While there have been no known locally acquired human cases of Lyme disease in Alaska, the risk of occurrence is expected to increase, especially for those who spend a lot of time outdoors.

Rabies is another vector-borne disease whose range is shifting with its host species. In Alaska, changes in sea ice and prey availability may have introduced red foxes to rabid Arctic foxes and contributed to the widespread outbreak of rabies in western Alaska during the 2020/21 winter. This event may have contributed to the expansion of rabies along the Alaskan coast and further inland.

Water-Related Illness

In Alaska, climate change has created new challenges to building and supporting sanitation systems and exacerbates inequitable health-related infrastructure. Climate-related environmental changes such as surface water loss, storm surges, river or coastal erosion, saltwater intrusion, and flooding lead to wastewater treatment system damage. Perhaps the biggest threat is permafrost thawing, as shifting soil undermines the integrity of household foundations and wastewater distribution systems. Already, many households lack in-home piped water and sewer services; this lack is associated with multiple adverse health outcomes and contributes to health disparities, especially in rural Alaska.

Simultaneously, the documented northward range expansion of beavers has been postulated to increase the threat of waterborne Giardia infections in humans; however, human Giardia illness reports have been stable in Alaska and show no increasing regional trends.

Food Safety, Nutrition and Distribution

With changes in the habits and habitats of fish, birds, and mammals, traditional subsistence hunters and fishers in Alaska will be particularly impacted by climate change. For example, traditional fishers face an increasing risk of consuming contaminated and toxic wildlife as a result of exposure to harmful algal blooms (HABs). The Chukchi Sea hosts the largest bed of resting HAB cysts, which are primed to hatch as ocean water warms. Thus, there will likely be an increase in HAB-related illnesses in the region, including paralytic shellfish poisoning (PSP), an untreatable and potentially fatal illness caused by a potent neurotoxin in shellfish. Moreover, traditional ice cellars, used in Alaska for storing food, will be disturbed by permafrost thawing and coastal erosion. This could lead to food spoilage or infectious disease outbreaks.

Climate change will have some positive impacts on Alaska's food security, particularly in the agricultural sector. A longer growing season, and increased yields are expected to enhance the share of locally grown foods consumed by Alaskans. On the other hand, pests, flooding, and ground collapse resulting from permafrost thaw will pose challenges.

Mental Health and Well-Being

Climate change is a common concern among Alaskans and is associated with depression, increased rates of suicidality, and other negative mental health effects. In particular, many Alaskan Native populations experience negative mental health impacts and spiritual grief about the potential changes to communities, subsistence foods, culture, traditional knowledge, and the potential of relocation from long-established traditional sites as a result of climate change. Alaska Native populations already experience significantly elevated rates of suicide, especially among youth. The climate-driven mental health crisis is only exacerbated by existing disparities in mental health services.

Populations of Concern

The Alaskans most vulnerable to these climate-related changes are those who are most dependent on subsistence foods, the socioeconomically disadvantaged , the geographically isolated, the very young, the elderly, and those with existing health conditions that require ongoing care, that limit mobility, or that reduce capacity to accommodate changes in diet, family support, or stress.

Native American and Alaska Native communities are particularly vulnerable as the health risks of climate change are expected to compound existing health issues, in part due to the loss of traditional foods and practices, the mental stress from permanent community displacement, increased injuries from lack of permafrost, storm damage and flooding, smoke inhalation, damage to water and sanitation systems, decreased food security, and new infectious diseases.

Additionally, climate impacts have severe socioeconomic consequences for Indigenous peoples, small rural communities, and industries throughout Alaska. For example, a multiyear closure of the subsistence king salmon fishery due to climate change and the overharvesting of ocean king salmon via bycatch has been disastrous to Indigenous peoples' self-sufficiency and financial independence.

CDC Success Stories

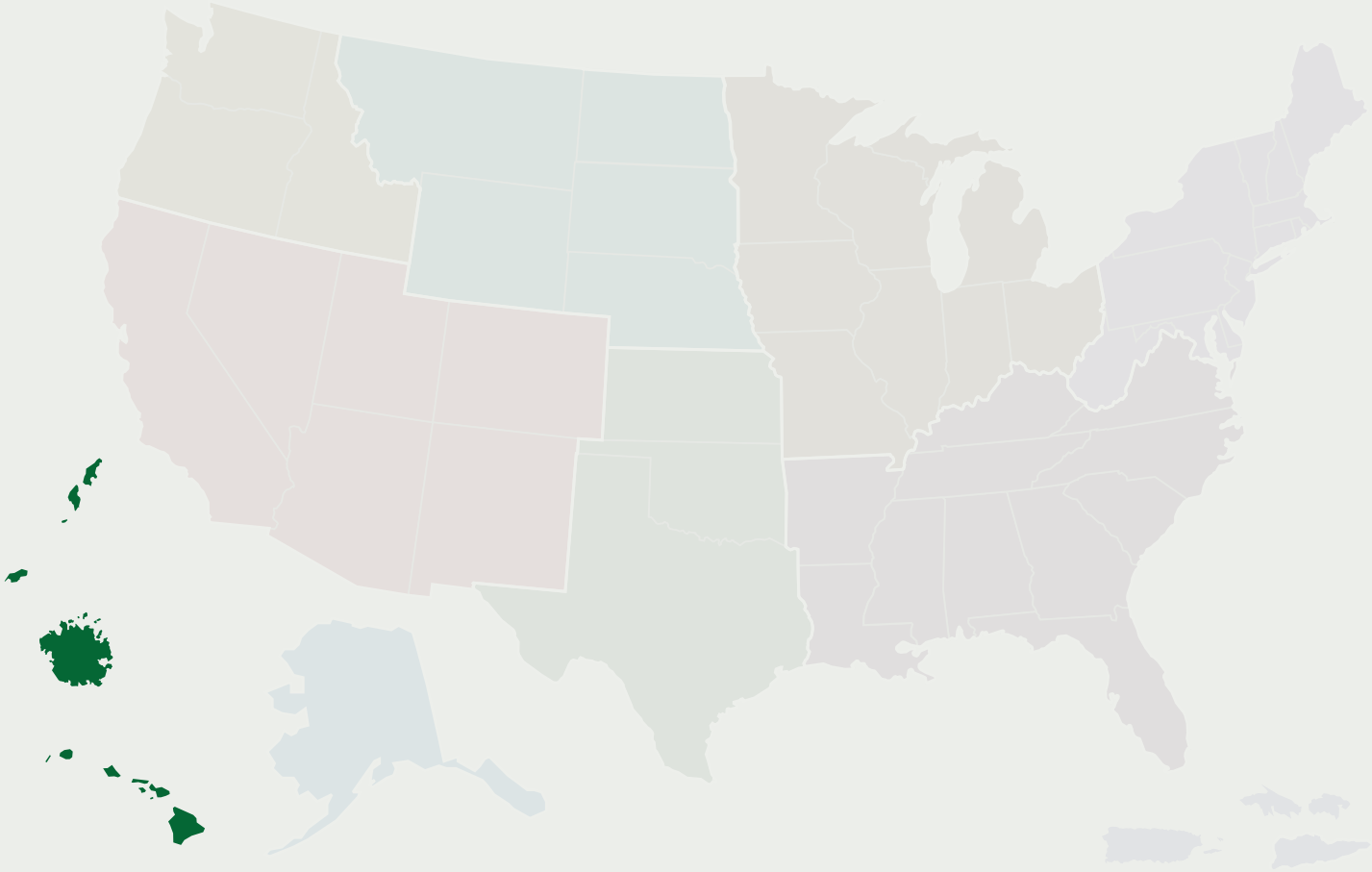
Village of Wainwright

The Tribal Village of Wainwright identified that the effects of climatic changes on sea ice are of particular concern to community members as it creates unstable and hazardous transportation conditions on previously stable routes used by snowmobiles in the spring. In response, a project was implemented that supported existing accident prevention and rescue programs through the promotion of the use of location technology (inReach devices) and developed new community-based programs that increase knowledge of health risks due to climate change to reduce injury and death resulting from subsistence and travel activities. This project was supported by a 2017 mini-grant from the CDC via the National Indian Health Board (NIHB).

Sitka Tribe of Alaska

The Sitka Tribe of Alaska relies heavily on shellfish and seafood for nutrition and cultural purposes. Warming water temperatures threaten the safety of shellfish for human consumption. With a 2019 mini-grant from the CDC via the National Indian Health Board (NIHB), the Tribe coordinated a regional project to monitor shellfish contamination. Through this project, they are building capacity to support testing and notification of threats to traditional shellfish and sea-dependent diets.

HAWAII and U.S.-AFFILIATED PACIFIC ISLANDS



Health Impacts

Temperature-Related Death and Illness

The number of hot days has increased across the Pacific islands. Climate change–driven hot weather causes heat-related illness and increases hospitalizations and deaths; 82% of heat-related deaths in Honolulu are already attributable to climate change. Those more likely to experience heat-related illness include young children, older adults, outdoor workers, those who are economically burdened, and people with little access to cooling or healthcare, military personnel whose duties require heavy gear and vigorous activity, and non-acclimated visitors. Additionally, heat worsens health outcomes for people with noncommunicable diseases (NCDs), such as heart disease, cancer, stroke, and diabetes. Increased temperatures also create challenges for the management of obesity and other diseases because exercise is more difficult to do safely in hot weather. This is of particular concern as overweight and obesity in young children are at a higher prevalence in American Sāmoa, Northern Mariana Islands, and Guam than globally.

Air Quality Impacts

Climate change will likely alter precipitation patterns and potentially increase the wildfire risk for Pacific islands [1]. While wildfires pose an inherent physical risk to citizens, as seen by the impacts of the 2023 Hawaiian wildfires, smoke creates air quality hazards that can be equally deadly. Human exposure to air pollutants in smoke is associated with mortality, asthma, and other respiratory problems, as well as worse outcomes for birth, COVID-19 infection rates, and emotional well-being. Research regarding the respiratory health impacts of the 2023 Hawaiian wildfires is still underway.

Extreme Events

Extreme weather events are expected to increase and continue to aggravate social and geographic inequities. The rate of global average Sea Level Rise (SLR) has accelerated and has become very damaging in the region. Impacts include coastal erosion, episodic flooding, permanent inundation, heightened exposure to marine hazards, and saltwater intrusion to surface water and groundwater systems. Already apparent on many shorelines, these problems endanger human communities by negatively impacting basic societal needs, such as food and freshwater availability, housing, access to healthcare facilities, energy and transportation infrastructure, and access to government services. Given the limited emergency infrastructure and evacuation options, extreme weather events create high risks for the mental and physical health of island populations, with individuals with low income, older adults, children, and persons with disabilities at disproportionately higher risk.

Vector-Borne Diseases

Outbreaks of mosquito-borne diseases such as dengue, chikungunya, and Zika are increasing in frequency, extent, and duration across the Pacific islands, with other vector-borne diseases potentially emerging in the future. In this region, the incidence growth of these vector-borne diseases has been linked to climate variability and is expected to increase further. Primary exacerbating factors include changes in rainfall and temperature, combined with environmental and demographic changes. Presently, resources for vector control and managing outbreaks are limited on small tropical islands, and outbreaks sometimes overwhelm health systems.

Water-Related Illness

Dependable and safe water supplies for Pacific island communities and ecosystems are threatened by rising temperatures, changing rainfall patterns, waterborne pathogenic bacteria, sea level rise, and increased risk of extreme drought and flooding. Islands are already experiencing saltwater contamination due to sea level rise, which is expected to catastrophically impact food and water security, especially on low-lying atolls. Additionally, chronic water shortages are possible as rainfall decreases and both evaporation and the water requirements of a growing human population increase.

Food Safety, Nutrition and Distribution

Away from urban areas, many island communities rely on food gathered from the ocean and land. Rising sea surface temperatures are shifting the location of fisheries further out to sea, increasing the difficulty for traditional fishers. Ocean warming and acidification, coupled with damaging watershed and reef practices, converge on island shores to increasingly limit the food resources gathered from the sea.

In Hawaii, climate change impacts, such as reduced streamflow, sea level rise, saltwater intrusion, and long periods of drought threaten the ongoing cultivation of taro and other traditional crops. These kinds of climate impacts lead to an increased dependence on imported food, which come with complex and sometimes hidden environmental, financial, social, cultural, and nutritional costs. This reliance is a public health concern for Hawaii and the U.S.-Affiliated Pacific islands, as Indigenous Pacific Islanders have the highest rates of obesity and chronic diseases, such as diabetes, in the region.

Mental Health and Well-Being

Climate change directly and indirectly affects the mental health of Pacific Islanders. Firstly, the sea surrounding Pacific island communities continues to rise faster than the global average. As Indigenous People in the Pacific are strongly connected to place, and place is central to conceptions of cultural identity, sudden ecological devastation or gradual change to the environment can create considerable stress. Further, instability caused by voluntary and involuntary migration is expected to be a continuing source of anxiety, although evidence indicates that social cohesion and reducing disparities can counter negative impacts. Across the Pacific region, studies show that rural populations, groups which are socioeconomically disadvantaged, and people with disabilities experience more severe mental health consequences from various climate impacts.

Populations of Concern

Indigenous communities of the Pacific have an inseparable connection to and derive their sense of identity from the lands, territories, and island resources. Climate change threatens this familial relationship with ancestral resources and is disrupting the continuity required for the health and well-being of these communities (this is a common experience to many tribal and Indigenous communities across the United States). Women have also been identified as a population more vulnerable to regional climate risks due to the role they have in terms of economic activities, safety, health, and livelihoods.

CDC Success Stories

Commonwealth of the Northern Mariana Islands

Commonwealth Healthcare Corporation

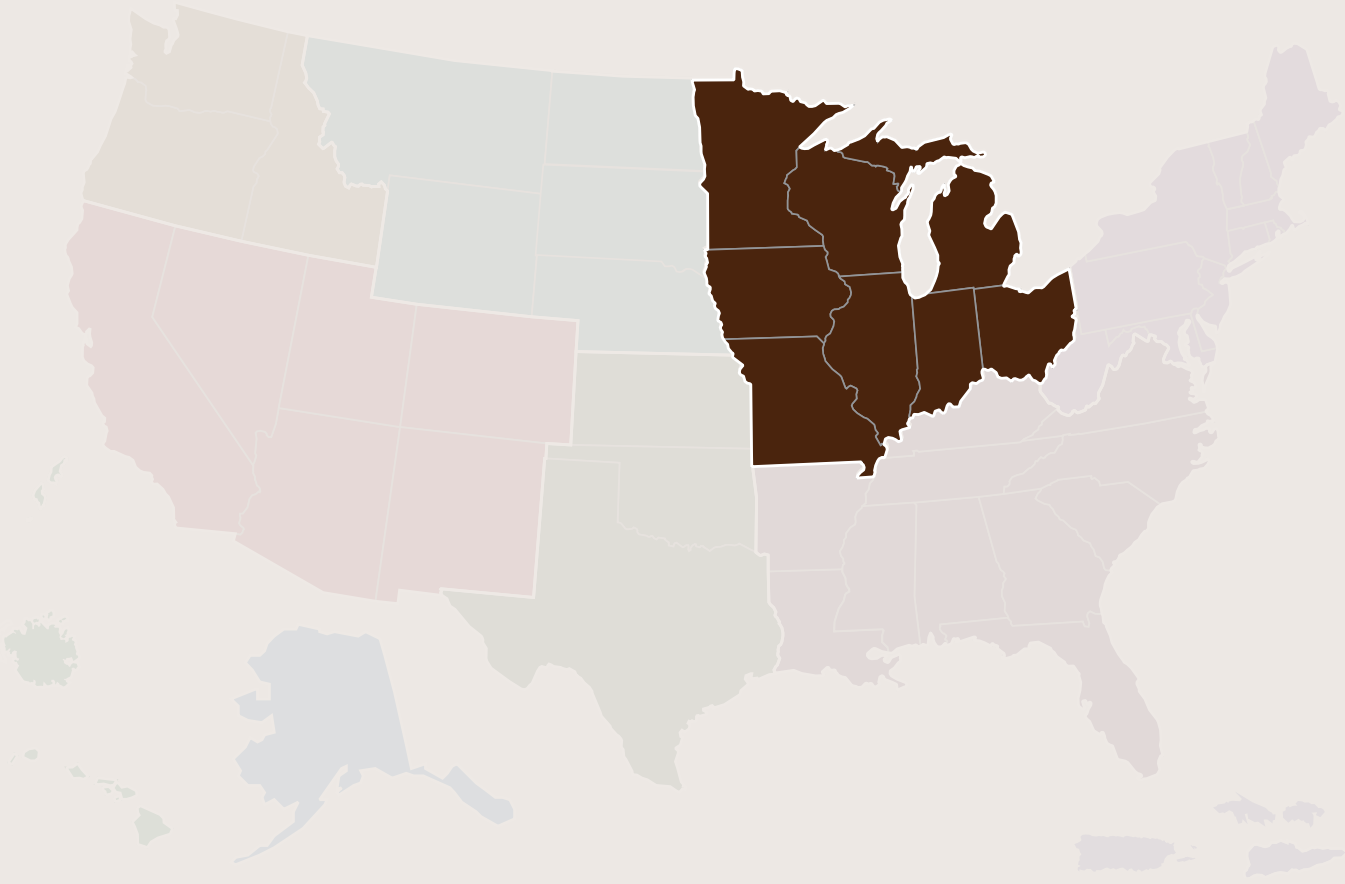
To bolster capacity to address the public health threats associated with climate change, the Commonwealth of the Northern Mariana Islands (CNMI) Commonwealth Health Care Corporation planned and executed a climate change training for staff throughout the agency. This helped to build knowledge and expertise locally. In addition, the project team also developed a CNMI-specific health impact scoping report to assess the local risk of various impacts. Throughout the project, the team also identified and built relationships with key partners outside of public health, including other governmental agencies, who can provide expertise and input on climate and health work across CNMI.

The Federated States of Micronesia

Department of Health and Social Affairs

In 2017, the Federated States of Micronesia-Department of Health and Social Affairs received a mini-grant from the CDC via the Association of State and Territorial Health Officials (ASTHO) to equip the people of the low-lying islands, such as Chuuk and Pohnpei, with knowledge, skills, and techniques to maintain a healthy island diet in a changing environment. The project consisted of educational workshops and hands-on exercises that paired local agricultural and diet-related knowledge and practices with outside technical assistance (i.e., geographic information system training provided by CDC and ASTHO) to empower the communities on the low-lying islands to adapt to the climate impacts on food security and water management.

MIDWEST



Health Impacts

Temperature-Related Death and Illness

Increased daytime and nighttime temperatures are associated with heat-related diseases and death in the Midwest. High rates of heat-related illness also have been observed in rural populations, where occupational exposure to heat and access to care is a concern. A July 2012 extreme heat event in Wisconsin was associated with approximately $290.3 million (in 2022 dollars) in damages due to loss of life, hospitalizations, lost wages, and other health-related costs.

Compared to other regions where worsening heat is also expected to occur, the Midwest is projected to have the largest increase in extreme temperature-related premature deaths under the very high emissions scenario . Climate mitigation strategies would have a great benefit to Midwesterners, as approximately 1,200 deaths related to extreme heat would be avoided by the end of the century under an intermediate emissions scenario compared to a very high emissions scenario . Northern Midwestern communities and populations disproportionately at risk that historically have not experienced high temperatures may be at risk for heat-related disease and death. The risk of death from extremely cold temperatures will decrease under most climate projection scenarios.

Air Quality Impacts

Increases in ground-level ozone and particulate matter are associated with the prevalence of various lung and cardiovascular diseases, which can lead to missed school days, hospitalization, and premature death. Ground-level ozone concentrations are projected to increase across most of the Midwest, resulting in an additional 200 to 550 premature deaths per year by 2050, some of the highest in the United States. Simultaneously, rising temperatures are leading to increased pollen counts, which can worsen allergies and trigger asthma attacks in those who are sensitive, particularly in children. By 2050, increased oak pollen is projected to lead to a 7% annual increase in asthma-related emergency room visits for the Midwest under a very high emissions scenario . Other threats to respiratory health include flooding and wildfires. Flooded buildings can experience mold growth, which can trigger asthma attacks and allergies during cleanup efforts. Further, many Midwest counties will experience increased exposure to wildfire smoke, a known asthma trigger.

Non-Hispanic Black, Hispanic, and Indigenous populations tend to be disproportionately exposed to air pollution and have the highest rates of asthma and asthma-related deaths and hospitalizations in the United States.

Extreme Events

The Ohio River, upper Mississippi River, and lower Missouri River are susceptible to floods and droughts based on projected changes in precipitation, evapotranspiration, and soil moisture. Already, there has been increased flooding in these rivers and their tributaries, which flood surface streets and low-lying areas, resulting in drinking water contamination, evacuations, damage to buildings, injury, and death. Additionally, projected increases in extreme precipitation events have been linked to an increased risk of traffic crashes.

Midwest droughts develop in response to precipitation deficits or extremely high temperatures and evapotranspiration. Groundwater recharge is projected to be variable in the Midwest, with water imbalances resulting from precipitation and evapotranspiration changes. Failure of private wells is expected to increase during droughts as water tables drop with increased irrigation and water usage.

Vector-Borne Diseases

Rising temperatures, particularly in winter, and increasing precipitation contribute to the geographic spread of disease-carrying vectors (e.g., ticks and mosquitoes) into and across the Midwest. Climate-related changes in habitats for disease-carrying insects are associated with higher rates of infection in humans and increased healthcare costs. Warmer temperatures are linked to increased numbers of deer ticks (Ixodes scapularis) in the upper Midwest, leading to earlier and longer seasonal exposure to Lyme disease. Further, northern expansion of the Culex species of mosquito (C. pipiens and C. tarsalis) in the Midwest is expected to result in upwards of 450 additional West Nile virus cases above the 1995 baseline by 2090.

Water-Related Illness

Extreme precipitation events cause dramatic shifts in water quality that can challenge the resilience of drinking water treatment systems. Likewise, large intrusions of precipitation and runoff can overwhelm wastewater treatment systems resulting in release of untreated wastewater into natural bodies of water. These events can allow contaminants to increase in groundwater and surface water sources (i.e., untreated groundwater in private wells, the Mississippi River, and the Great Lakes) eventually impacting drinking water quality. By midcentury, precipitation changes are projected to increase the rate of gastrointestinal illness among children due to contaminated drinking water.

Simultaneously, increasing precipitation may intensify nutrient loads in the Mississippi River system, potentially contributing to harmful algal blooms (HABs). Contact with and consumption of water contaminated with cyanobacteria from HABs has been associated with skin and eye irritation, respiratory illness, gastrointestinal illness, and liver and kidney damage. However, research has been inconsistent about whether HAB severity and magnitude in the Midwest have been increasing, remaining constant, or decreasing.

Food Safety, Nutrition and Distribution

Increasing temperatures and oscillations between extreme droughts and floods threaten field crops, specialty crops, and animal production across the Midwest, which have direct and inequitable impacts on global food supply and security. Temperature increases directly affect crop development, plant physiology, and crop stress during dry conditions, and intense precipitation increases soil erosion and leaches nitrogen fertilizer, thereby affecting water quality. Animal production in the Midwest is also vulnerable to climate change. Livestock impacts include feed shortages, loss of shade structures, nutritional restrictions, disease transmission, and biosecurity concerns. Further, heat stress limits livestock production and impacts dairy quality, while increased precipitation creates muddier paddocks and pastures, which can decrease fetal growth during late gestation.

Evidence suggests that pest distributions have shifted northward since the early 20th century, and projections indicate that increasing temperatures will allow pests (e.g., brown marmorated stink bug, corn earworm, Japanese beetle, Mexican bean beetle, and potato leafhopper) to continue expanding northward across the Midwest.

Mental Health and Well-Being

Stress associated with experiencing climate-related disasters is impacting the mental health of people living in the Midwest and is expected to increase as the frequency of extreme events rises. The trauma caused by a disaster, such as losing one's home, livelihood, or community, can contribute to chronic depression, anxiety, and post-traumatic stress disorder. In addition, people may suffer a loss of social connections, witness traumatic events, see homes destroyed, and confront an uncertain future, any of which can trigger or intensify adverse mental health conditions. Farmers and others dependent on agriculture for their livelihood are particularly at risk. Many rural Midwesterners already experience obstacles to utilizing healthcare services, including mental health services.

Populations of Concern

Tribes in the Midwest have been among the first to feel the effects of climate change as it impacts their culture, sovereignty, health, economies, and ways of life. Simultaneously, an individual's exposure and sensitivity to climate change is influenced by preexisting health conditions, age, gender, race or ethnicity, income, social connectivity, access to resources, and local adaptive capacity. For those who are chronically ill or reliant on electronic medical devices, the increased cost of electricity, which contributes to energy insecurity, may introduce financial and health burdens.

CDC Success Stories

Marquette County Health Department, Michigan

In addition to collaborating with the CDC-funded Michigan Climate and Health Adaptation Program (MICHAP), Marquette County also received a mini-grant from the CDC and the National Association of County and City Health Officials (NACCHO) in 2019 to support local adaptation efforts. The Marquette County Health Department developed a "Public Health Response to Flooding Disasters" plan to protect their community from increasing extreme rain events. This plan is intended to be a step-by-step guide regarding activities conducted by MCHD staff during a flood event. Additionally, local decision-makers are using the resource to assess climate impacts on their communities' health and using built environment design concepts to incorporate health adaptations into community planning.

Minnesota Department of Health

Extreme rainfall can wash contaminants into drinking water resources. This is particularly concerning for Minnesota as one in five Minnesotans use private wells and must maintain water quality themselves. Through multi-agency collaboration, MDPH was able to convey the climate risks to the water quality of private wells so to improve and enhance private well water testing. This was the first time climate knowledge was institutionalized into drinking water programs in the state, and it established new and continuing collaborations. Simultaneously, growing wildfire frequency means more exposure to smoke and other air pollutants. The Minnesota Climate and Health Program engaged in an interagency initiative to launch a new air quality forecast and alert program to ensure consistent messaging and that information reaches those most at-risk and key stakeholders. They also established an ongoing multi-agency relationship to develop climate-related health messaging to protect health and engage new audiences and those sensitive to poor air quality. This work has not only been supported by the CDC's Climate-Ready States & Cities Initiative (CRSCI) but also through a 2019 mini-grant via the National Environmental Health Association (NEHA).

Michigan Department of Health and Human Services

An important climate driver of negative health outcomes in Michigan is extreme precipitation. Extreme rainfall overwhelms sewer systems, impacts drinking water, and causes power outages. The Michigan Climate and Health Adaptation Program (MICHAP) identified risks in rural and urban communities and integrated climate adaptations into community planning. By preparing the built environment now, Michigan residents will be better equipped to face their changing environment in the future.

University of Illinois at Chicago School of Public Health and Illinois Department of Public Health

Illinois experiences increased heat-related illnesses, infectious disease risk related to flooding, and mental health challenges. Despite these clear emerging health challenges, there are gaps in climate and health literacy among health professionals. To help close this knowledge gap, BRACE-Illinois developed climate and health educational materials for physicians and public health professionals. These included a heat toolkit, webinars targeted to family physicians and pediatricians, and graduate courses for public health students. As a result, Illinois has better informed medical and public health professionals who are better prepared for the health impacts of climate change and to discuss risks with their patients.

Wisconsin Division of Public Health

The Wisconsin Climate and Health Program addresses the health effects related to extreme heat, extreme cold, flooding, and vector-borne diseases. One of the adaptation activities that the Wisconsin Heat Health Network is developing is an early warning system in the urban southeastern part of the state and providing heat-health messaging to reduce the health impacts of heat-related illness. The heat health warning system will increase community climate resilience by allowing local decision-makers to implement informed interventions.

Additionally, Wisconsin developed the Flood Resilience Scorecard (FRS) to help local officials identify critical infrastructure risks and social vulnerabilities to improve flood-related health outcomes. This scorecard is a comprehensive checklist that assesses social, institutional, and environmental variables so that local municipalities can better assess their risks of flooding events. It also allows local municipalities to better plan for future flooding events by using the tool's recommendations based on their individual scores. Already, sixteen communities have completed scorecards, considered recommendations, and brought together sectors for collaboration and implementation.

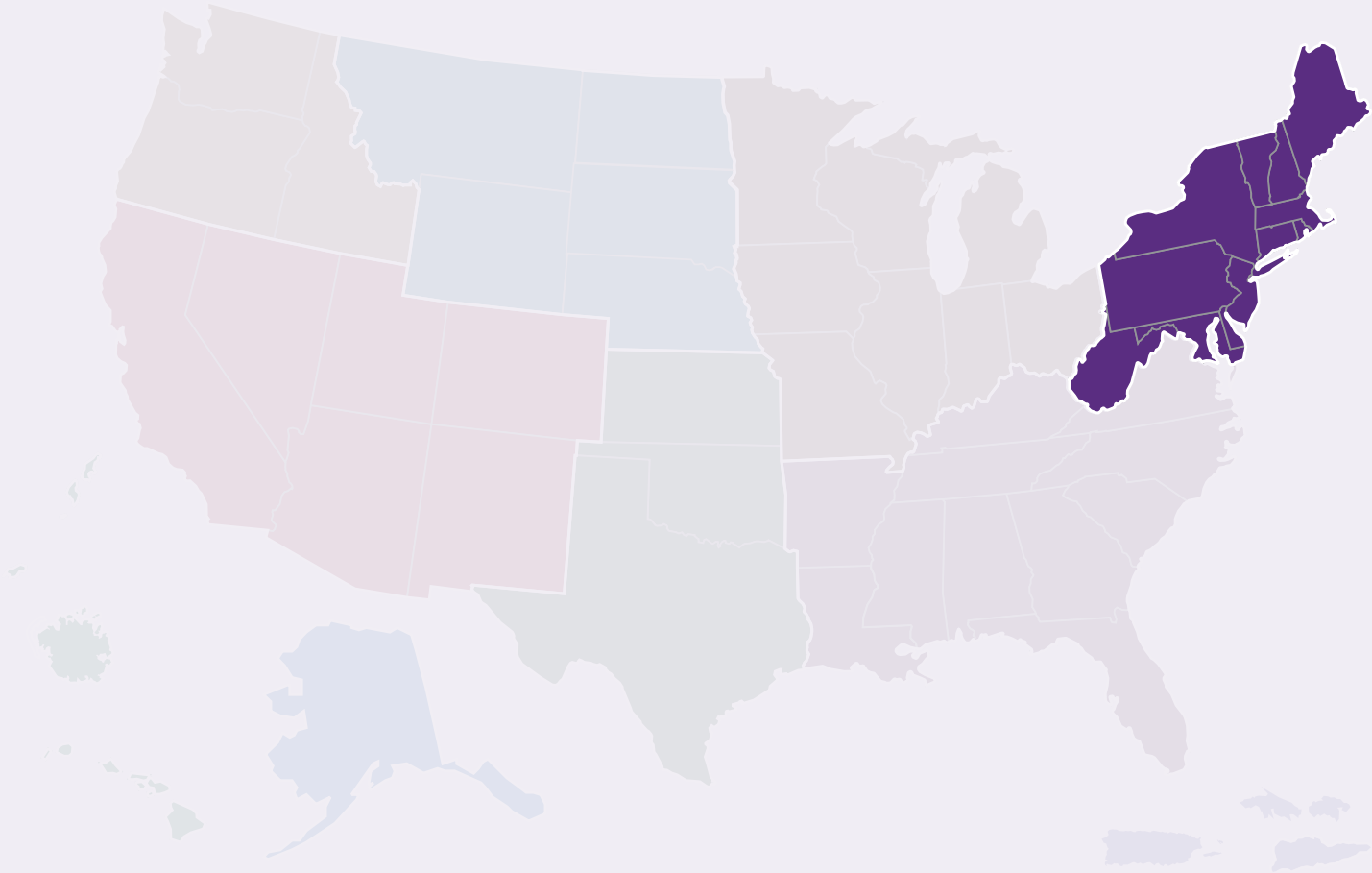
Calhoun County Health Department, Illinois

Climate-driven seasonal flooding disrupts travel, farming, and other daily activities in the community. Supported by a 2022 mini-grant from the CDC via the National Association of County and City Health Officials (NACCHO), the Calhoun County Health Department (CCHD) developed a flood model to understand the speed and scale at which floods can sweep through the area. Utilizing booklets, the flooding information was shared with community members. By raising awareness on the issue, the CCHD aims to give residents the knowledge they need to adapt to their changing environment.

Franklin County Human Service Chamber, Ohio

Local health departments often do not have the resources or staff to manage climate change adaptation or mitigation programs. Using several mini-grant funds from the CDC via the National Association of County and City Health Officials (NACCHO), Franklin County established a health educator position to focus on developing climate change adaptation and mitigation projects, community outreach, and data gathering. Additionally, Franklin County developed indicators for climate health surveillance and is analyzing their metrics with climate science experts from Bird Polar and Climate Research Center. Ultimately, they intend to provide their county climate health data to the public on their existing website.

NORTHEAST



Health Impacts

Temperature-Related Death and Illness

By midcentury, heat index values over 100°F are projected to increase threefold in the Northeast under an intermediate scenario. During extreme heat events, nighttime temperatures in the region's big cities are generally several degrees higher than in surrounding areas, leading to a higher risk of heat-related death. Temperature extremes are related to a larger fraction of cardiorespiratory deaths in the Northeast and industrial Midwest (compared with other regions), particularly in areas with higher urbanization, older people, fewer White residents, and lower socioeconomic status.

Air Quality Impacts

Climate change will potentially lead to higher pollen concentrations and longer pollen seasons, causing more people to suffer more health effects from pollen and other allergens. The health burden of pollen is a particular concern for the Northeast. One study found there is 20% more pollen, and the season is roughly three weeks longer in comparison to the 1990 season [2]. People with respiratory illnesses, like asthma, may be more sensitive to pollen. For those whom pollen is an asthma trigger, exposure to pollen has been linked to asthma attacks and increases in hospital admissions for respiratory illness. Already, the Northeast region has seen some of the largest counts of incremental increases in asthma emergency department visits.

Additionally, air quality in the Northeast can be dramatically worsened by distant wildfires from Canada or the Western United States. This was seen in 2023 when wildfires along the western Canada-U.S. border affected the air quality in the northeastern United States [3]. During this event, New York City saw its worst daily mean PM2.5 concentration in over 50 years [3]. Exposure to wildfire smoke has been shown to lead to several negative health outcomes and is a known asthma trigger. Simultaneously, warmer temperatures will worsen near-surface ozone across the United States and further exacerbate respiratory conditions.

Extreme Events

Much of the historical development of industry and commerce in New England occurred along rivers, canals, coasts, and other bodies of water. These areas often have a higher density of contaminated sites, waste management facilities, and petroleum storage facilities that are potentially vulnerable to flooding. As a result, increases in flood frequency or severity could increase the spread of contaminants into soils and waterways, resulting in increased risks to human health. When coupled with storm surges, sea level rise can pose severe risks of flooding, with consequent physical and mental health impacts on coastal populations .

Vector-Borne Diseases

Increased temperatures make some diseases more prevalent in aquatic organisms (e.g., Vibrio species), which are among the most important causes of seafood-borne diseases. Simultaneously, climate change is predicted to expand the geographic range of many disease-carrying insects, such as ticks. Already, there has been an increase in tick-borne illnesses, such as Lyme disease, in the Northeast with some documented spread northward into Canada [4].

Water-Related Illness

Increased soil erosion and agricultural runoff, including manure, fertilizer, and pesticides, are linked to excess nutrient loading of water bodies and subsequent food safety or public health issues. Indeed, harmful algal blooms (HABs) occur more often in the Northeast compared to other regions and are known to induce illness upon either contact with contaminated water or consumption of exposed shellfish. Simultaneously, warmer winters increase pressure from weeds and pests, driving demand for pesticides, and thus increasing the risk of human health effects from increased chemical exposures.

Food Safety, Nutrition and Distribution

In the Northeast, fish stocks are not only shifting northeastward along the continental shelf into deeper waters, but their distribution is also changing. Warmwater fish remain longer, while cold water species stay for shorter periods. This shift changes when species can be fished. Moreover, there have been documented changes in the life cycle events of the wildlife. For instance, phytoplankton blooms occurred later in recent decades, whereas larval fish occurrence and fish migration are happening earlier.

Simultaneously, the Mid-Atlantic Bight is acidifying faster than other Atlantic coastal regions. Ocean acidification may impact fishery resources, including American lobster, scallops, oysters, clams, and mussels. In the Northeast, scallops are one of the most lucrative fisheries, and acidification will have socio-economic ramifications.

Mental Health and Well-Being

Some Tribal nations and other coastal communities may have to shift their economic or subsistence harvests to new species that are migrating into the region. However, the loss of traditional species or places will likely lead to a loss of cultural practices that will harm physical and mental health and well-being. The loss of access to culturally significant locations and wildlife will harm the physical and mental health of Indigenous peoples.

Populations of Concern

Climate impacts compound the environmental, health, and socioeconomic burdens on some communities. Older adults, those living with disabilities or chronic illness, those persons who lack access to air conditioning, living in older homes, socially isolated, or working outdoors are considered particularly vulnerable to the effects of heat.

Additionally, the combination of heat stress and poor urban air quality can pose a major health risk to vulnerable groups: young children, the elderly, socially or linguistically isolated, those who are economically disadvantaged, and those with preexisting health conditions, including asthma.

Similarly, individuals that are socioeconomically disadvantaged, elderly, historically excluded, linguistically or socially isolated, and recently immigrated individuals, as well as those with existing health disparities are more vulnerable to precipitation events and flooding due to a limited ability to prepare for and cope with such events.

CDC Success Stories

Maine Department of Health and Human Services

Vector-borne diseases and air quality issues are the primary hazards addressed through Maine's Tracking Network. Maine's program has developed a real-time data dashboard to track cases of tick-borne disease, such as Lyme disease, and tick-related emergency department visits, which helps health officials understand the spread of ticks and how a changing climate affects the tick's lifecycle. Simultaneously, they established a pollen monitoring network to provide continuous real-time data on pollen and other airborne allergens. This information is public on their Maine Tracking Network dashboard and allows residents to understand the incidence of vector-borne and aeroallergen in their region.

Massachusetts Department of Health

The Massachusetts Climate Change Adaptation Report identified a need for strengthening public health and healthcare infrastructure to promote climate-resilient communities. To help meet this need, the Massachusetts Department of Public Health (MDPH) awarded grants to local health departments and launched a vulnerability mapping tool to support climate adaptation planning. Local public health departments can assess the need for adaptation efforts, operate municipal warming and cooling centers with emergency preparedness partners, and conduct health impact assessments of climate action strategies.

New York City Department of Health and Mental Hygiene

With temperature increases, some New York City communities face a disproportionate risk of heat-related illness and death. The "Be a Buddy" program was implemented to engage residents and local organizations to check in on residents who are older, disabled, and living alone on hot days. The program strengthened relationships between residents and local organizations to reduce the risk of extreme heat and other weather emergencies in four communities with lower incomes.

New York State Department of Health

New Yorkers experience increased heat and are especially vulnerable, as the built environment is not designed to adapt to warming temperatures. New York promotes social media messaging about specific and protective health behaviors, such as how to find a nearby cooling center and how to sign up for the state's Heating and Cooling Assistance Benefit (HEAP). These messages increased awareness of healthy behaviors during extreme heat, the use of state programs like HEAP, and locations of cooling centers. The messages also increase self-efficacy and access to state and local cooling resources.

Further, despite a lack of resources, local health departments are interested in the climate impacts on health and want to learn more. To support local health departments NYS, BRACE staff launched climate and health workshops that focused on

different climate threats. The workshops increased awareness of the impacts of climate on health, led to the identification of climate change liaisons within local health departments, promoted climate and health resources, and highlighted funding opportunities.

Additionally, NYS BRACE staff have supported the Climate Justice Working Group by providing health outcome data that identifies the communities most disadvantaged. This data has guided investing and directing resources to ensure frontline and underserved communities benefit from the state's clean energy transition.

Maryland Department of Health

There is an increased risk of motor vehicle accidents, asthma hospitalizations, and food-borne diseases following extreme precipitation events in the Chesapeake Bay and Eastern Shore communities. The Maryland Department of Health (MDH) developed education and outreach for school-age youth, minority groups, community health workers, and informal healthcare networks. They also launched the Climate Ambassador Program to provide tools for youth to educate and empower themselves to take climate action. These efforts have improved Marylander's climate literacy and ability to respond to climate threats.

New Hampshire Division of Public Health Services

Rising water temperatures increase the risk of Vibrio cholerae outbreaks in shellfish, which can increase the risk of food poisoning. The New Hampshire Climate and Health Program analyzed the prevalence of Vibrio cholerae along the seacoast and in commercial oyster beds and assessed potential interventions. Interventions were implemented to shade and cool shellfish beds to reduce the risk of food poisoning.

The Northeast Regional Heat Collaborative

Several Northeastern health departments identified that the National Weather Service (NWS) heat advisories were not being issued at times when there were significant heat-related illnesses in the region. The Northeast Regional Heat Collaborative was created in partnership with other Northeastern state health departments to analyze heat, hospitalization, and death data to inform public health policy. The Collaborative successfully changed the NWS Heat Advisory Policy for the New England area. More effective heat alerts can reduce cases of heat-related illness in the region.

Rhode Island Department of Health

In Rhode Island, the economy and culture are tied to the ocean, making the effects of climate change particularly acute. Utilizing CDC Climate and Health Program grants, the Rhode Island Department of Health assessed climate change and health vulnerabilities specific to Rhode Island, produced a Social Vulnerability Index Map, a Climate Change and Health Resiliency Report, and developed a Climate Change and Health Adaptation Plan. These projects have not only produced measurable reductions in the health burdens of climate change but have helped to further address and adapt to the many public health effects of climate change in Rhode Island.

Vermont Department of Health

The Vermont Climate and Health Program addresses many key climate-related health risks, with a particular focus on heat as it is proving to be a growing threat to Vermonters. Many homes and communities are unprepared for extreme heat, resulting in more heat-related illnesses and deaths. To combat heat illness, Vermont increased the resources to Regional Planning Commissions (RPCs) to raise local awareness about heat risks, identify high-risk communities, locate cooling centers, and develop local hot weather emergency response plans. As a result of the RPCs, 19 local heat response plans were developed, dozens of community cooling centers were identified, and awareness about cooling centers was increased. Additionally, Vermont is piloting a "Weatherization + Health Initiative" to modify homes for climate resilience and health promotion. The program prioritizes the delivery of health benefits by including specific health and safety improvements in addition to basic weatherization strategies. The "Weatherization + Health Initiative" enhances home energy efficiency, reduces energy costs, and improves occupant health. This work has not only been supported by the CDC's Climate-ready States & Cities Initiative (CRSCI), but also through a 2020 mini-grant from the CDC via the National Environmental Health Association (NEHA).

Boston Public Health Commission

Increasing temperatures threaten Bostonians and put them at risk of developing heat-related illnesses. In 2015, there were 22 days over 90°F in Boston; by 2030, there could be up to 40 days over 90°F. With the support of a 2019 mini-grant from the CDC via the National Association of County and City Health Officials (NACCHO), the Boston Public Health Commission developed heat awareness materials and translated them into ten languages to reach particularly at-risk populations and reduce health impacts during heat waves.

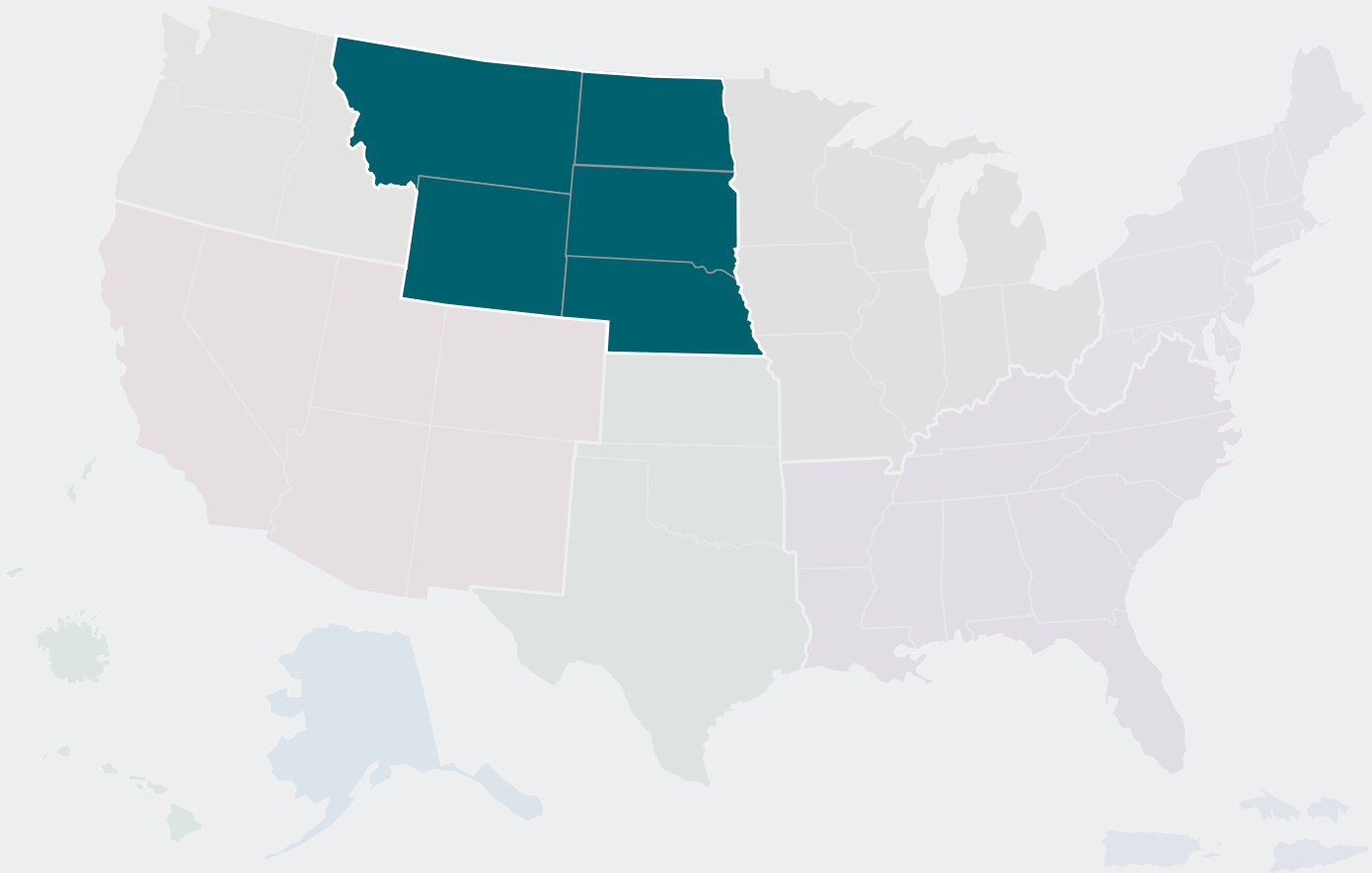
Seneca Nation of Indians

Due to climate change, there is increased flooding, which elevates the risk of vector-borne disease among Indigenous communities. Utilizing a 2020 mini-grant from the CDC via the National Indian Health Board (NIHB), the Seneca Nation of Indians (located in what is now called New York) addressed the impacts of flooding by incorporating health into existing collaborative climate work. The mini-grant project focused on health communication so communities will have a better understanding of the health impacts of flooding, as well as how to prepare and respond to future flooding.

GreenRoots—Chelsea, Massachusetts

Industrial operations generate noise, traffic, and pollution, placing a heavy environmental burden on the residents of Chelsea. In 2022, GreenRoots, a community-based organization (CBO), received a mini-grant from the CDC via the National Association of County and City Health Officials (NACCHO) to distribute 200 air purifiers and collect data from existing outdoor air quality monitors maintained by the state. Through these actions, GreenRoots is not only protecting their community's air quality but also educating residents on its importance for health.

NORTHERN GREAT PLAINS



Health Impacts

Temperature-Related Death and Illness

By midcentury, heat index values over 100°F are projected to increase threefold in the Northeast under an intermediate scenario. During extreme heat events, nighttime temperatures in the region's big cities are generally several degrees higher than in surrounding areas, leading to a higher risk of heat-related death. Temperature extremes are related to a larger fraction of cardiorespiratory deaths in the Northeast and industrial Midwest (compared with other regions), particularly in areas with higher urbanization, older people, fewer White residents, and lower socioeconomic status.

Air Quality Impacts

The Great Plains experience a great deal of dust activity. From Montana to southern Texas, dust from land use, such as agriculture, impacts air quality. These are also regions where climate change is expected to affect drought patterns, worsening this issue.

Further, wildfires are projected to increase in the region with correspondent health implications. One study found that Montana has the highest per capita rate of premature deaths attributable to wildfire smoke.

Extreme Events

The Northern Great Plains region is experiencing unprecedented extremes related to changes in climate, including severe droughts, increased hail frequency and size, floods, and wildfires. Further, climate pressures frequently act simultaneously, leading to compounding health-related outcomes. Earlier snowmelt combined with more intense precipitation events can exacerbate flooding, putting people at risk of water-borne diseases, trauma, increased mental health issues, and economic losses. Wildfires are more common during hotter months when drought is more common, exposing people to compounding risks and stress from smoke, heat, and poor water quality.

Over the last two decades, these unusually extreme events have strained the response capacities of Tribes, and climate change will only increase the need for the ability to fight fires, floods, and droughts. This has widespread impacts on Tribal economies and livelihoods, domestic and municipal water supplies, and health and well-being.

Vector-Borne Diseases

Rising temperatures and precipitation are expected to increase the population of disease-carrying insects, such as mosquitos like Cx. tarsalis. In the northern Great Plains, this is expected to lead to an increased risk of West Nile Virus (WNV). The locations of annual WNV outbreaks vary, but several states have reported consistently high rates of disease over the years, including North Dakota and South Dakota.

Water-Related Illness

IExcess contributions of nutrients, such as nitrogen and phosphorus, from agricultural runoff or wastewater treatment plants can cause water quality issues, which are expected to be exacerbated by climate change. Nutrient runoff spikes after heavy rain and contributes to harmful algal blooms (HABs), which are toxic not only to local wildlife but to humans as well.

Food Safety, Nutrition and Distribution

Agriculture is essential to the economy and culture of the Northern Great Plains region and plays a crucial role in U.S. food security. Although growing seasons and frost-free periods are lengthening due to climate change, other factors may stress crop production. The probability of more days with maximum temperatures above 90°F is expected to increase, potentially impacting agriculture. The net effect of climate change on specific crop yields will depend on the interacting effects of temperature, moisture, carbon dioxide, and ozone, as well as adaptation through shifts in cultivars, crop mix, and management practices. Simultaneously, ranchers face increasing challenges managing livestock health due to heat stress, parasites, and pathogens.

Additionally, Indigenous peoples in the region see many changes to their natural environment and ecosystems. This impacts their livelihoods, health, traditional subsistence on wild foods, and usage of natural resources for ceremonies and medicines.

Mental Health and Well-Being

Some Tribal nations and other coastal communities may have to shift their economic or subsistence harvests to new species that are migrating into the region. However, the loss of traditional species or places will likely lead to a loss of cultural practices that will harm physical and mental health and well-being. The loss of access to culturally significant locations and wildlife will harm the physical and mental health of Indigenous peoples.

Populations of Concern

Because Tribes are among those in the region with the highest rates of poverty and unemployment, and because many are still directly reliant on natural resources, they are among the most at risk of climate change.

Additionally, pregnant people and newborns are uniquely vulnerable to flood health hazards. Flood exposure was associated with adverse birth outcomes (preterm birth, low birth weight) after the 1997 floods in North Dakota and connected to maternal experience of traumatic stress. Homes in floodplains are disproportionately occupied by renters and non-White populations.

CDC Success Stories

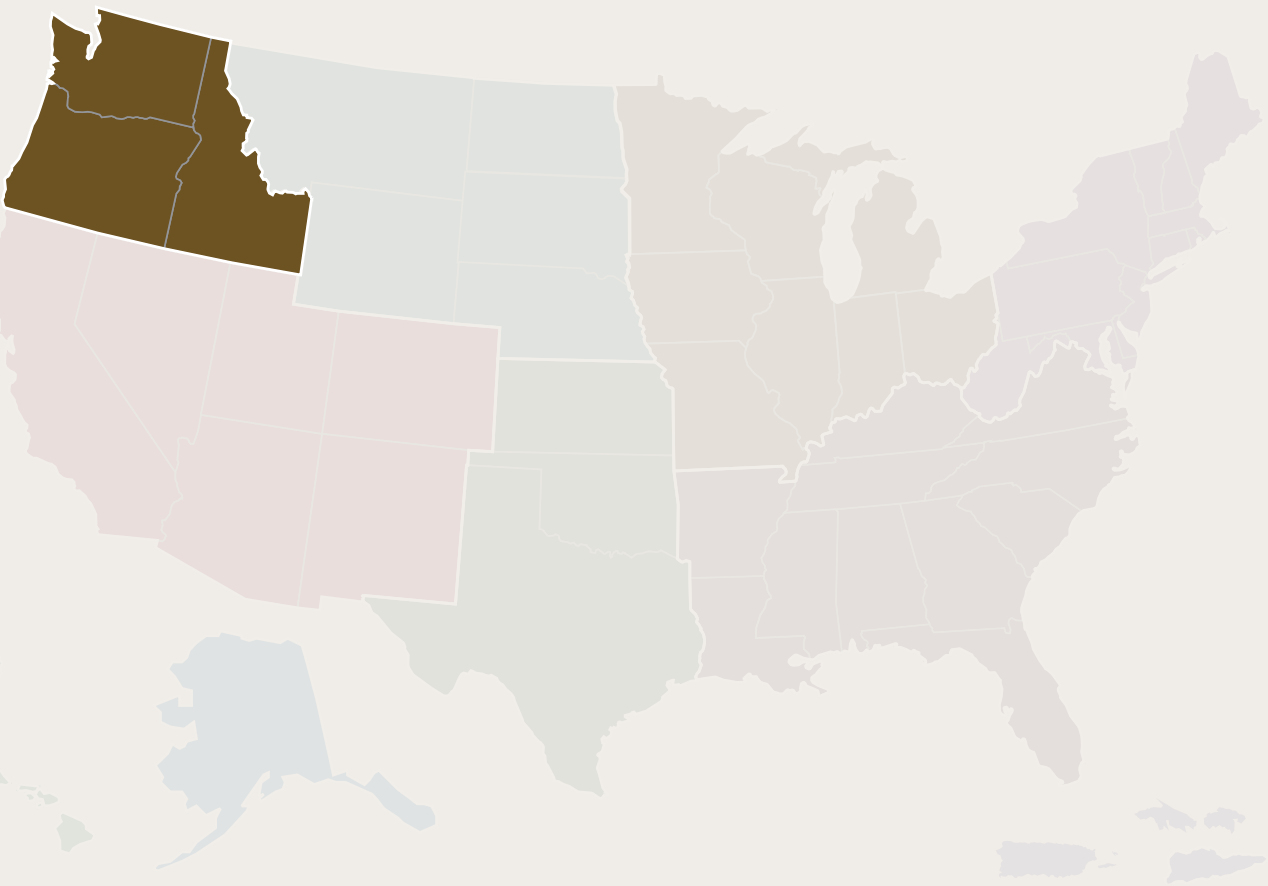
Blackfeet Nation

In 2017, the Blackfeet Nation (located in what is now called Montana) received a mini-grant from the CDC via the National Indian Health Board (NIHB). With these funds, they produced a Blackfeet Community Climate Health Guide that addresses climate impacts and develops activities for engaging tribal community members and leaders in best practices for addressing climate-related health impacts. This collaborative process was community-driven and responsive to local climate and health needs. Community leaders now have a path for building community engagement and awareness surrounding the health impacts of climate change.

Winnebago Tribe of Nebraska

Indigenous peoples of Nebraska observe many climate changes, such as flooding. This not only impacts their traditional subsistence on wildlife but also their ability to be self-sufficient. The Winnebago Tribe of Nebraska is implementing a climate and health communication and preparation strategy to ready community members for future flooding and increase self-reliance. To encourage self-sufficiency, raised garden beds were provided by the Food Sovereignty program, and seeds were given to the community by the Little Priest Tribal College. The project will enhance Tribal resilience, strengthen capabilities for public health preparedness following emergencies, and engage local Tribal members to focus on rural ecosystem and health needs, including climate impacts on agriculture from flooding and drought. The Winnebago Tribe of Nebraska has received several mini-grants from the CDC via the National Indian Health Board (NIHB) to support this work.

NORTHWEST



Health Impacts

Temperature-Related Death and Illness

Heat-related illness and death across the Northwest are expected to increase across all scenarios. Already, heat and wildfire smoke have caused thousands of deaths in the Northwest since 2018. The greatest number of deaths occurred in the summer of 2021, when almost a thousand people perished during an extraordinary heatwave that was partially attributed to climate change.

Extreme heat poses the most consequential health risks for older adults, households with lower incomes , outdoor laborers, people who are unhoused, and others who have limited access to adaptive resources such as affordable cooling options. Further, formerly redlined areas, which are communities with significant Black, Asian, and immigrant populations classified during the New Deal–era as hazardous for financial investment, can be up to 13°F warmer than the city's average surface temperature, disproportionately intensifying some impacts for residents.

Air Quality Impacts

Wildfire smoke can be severe, particularly in communities in the eastern Northwest. During 2004–2009, smoke events were associated with a 7.2% increase in respiratory hospital admissions among adults over 65 in the western United States. In Boise, Idaho, there have been multiple years with smoke levels considered "unhealthy for sensitive groups" (including children) for at least a week during the fire season, causing cancellation of school-related sports activities.

More frequent wildfires and poor air quality are expected to increase excess asthma incidences by the 2050s under a very high emissions scenario . Additionally, projected increases in ground-level ozone (smog), fine particulate matter (PM2.5), and airborne allergens can further complicate respiratory conditions. Young children and older adults are particularly vulnerable, as are those who live in mobile homes , recreational vehicles, or historically disinvested urban areas.

The outdoor tourism and recreation industry in the Northwest supports $51.9 billion (in 2022 dollars) in annual expenditures and employs more than 588,000 individuals. However, more frequent smoke and extreme heat events will increase risks to outdoor summer recreationists, especially for high exertion activities.

Extreme Events

Warming temperatures and decreased summer precipitation over the past four decades have contributed to increases in the size and maximum elevation of wildfires in Northwest forests, and those trends are expected to continue. Because concurrent heat and drought are becoming more common, the volume of dead vegetation is increasing, which builds the fuel load and wildfire risk. Simultaneously, the length of the wildfire season and the potential for human-caused ignitions in all Northwest ecosystems are expected to increase as drought frequency, duration, and intensity increase.

Vector-Borne Diseases

In the last several years, the region has seen an increase in some infectious diseases. A potential increase in Lyme disease cases in some states is associated with rising temperatures and changing tick habitat. The Washington Department of Health's vector surveillance program has observed an earlier onset of West Nile virus-carrying mosquitoes, likely associated with higher temperatures, and an increasing number of human infections, with some resulting in fatalities. Before 1999, Cryptococcus gatti infections were limited to the tropics, but they are now established in Northwest soil, with 76 cases occurring in Oregon in 2015.

Water-Related Illness

Future extreme precipitation events could increase the risk of exposure to water-related illnesses as the runoff introduces contaminants and pathogens (such as Cryptosporidium, Giardia, and viruses) into drinking water. The Oregon Health Authority recorded spikes in cases of Salmonella and E. coli during months of extreme heat in 2015. A large outbreak of Shigellosis (a bacterial diarrheal disease) occurred in late 2015, affecting a large number of people experiencing homelessness in the Portland Metro region; this outbreak was associated with unusually extreme precipitation. Further, rising temperatures are expected to increase the conditions necessary for harmful algal blooms (HABs), increasing threats to marine mammals, fish, shellfish, and the people who may rely on those food sources. Also of concern, wildfires can damage water infrastructure affecting water availability and quality. This was seen in 2020 and 2021 in the Northwest as wildfires damaged physical elements of the water delivery and treatment systems, disrupted electricity systems, and increased the amount of sediment in waterways and reservoirs.

Food Safety, Nutrition and Distribution

Climate change is projected to impact First Foods, or foods that Tribes have historically cultivated for subsistence, economic, and ceremonial purposes. The loss or decline of First Foods is projected to have cascading physical health impacts for Tribes. Changes in drought conditions and increased water temperatures have increased the potential for freshwater harmful algal blooms (HABs) in recreational waters. Toxins from marine HABs can accumulate in shellfish, leading to illnesses for those who eat them.

Mental Health and Well-Being

Climate-driven hardships can also affect mental health, resulting in outcomes ranging from stress to suicide. Oregon, Washington, and Idaho all rank among the top 10 states in terms of prevalence of mental illness and lowest access to mental health care. Children and youth, in general, will likely experience cumulative mental health effects of climate change over their lifetimes.

The cultural practice of harvesting and consuming First Foods is integral to Tribes and Indigenous health. The loss or decline of First Foods is projected to have cascading physical and mental health impacts for Tribes and Indigenous peoples.

Populations of Concern

Urban communities of color with lower incomes face redlining, restrictive housing covenants, and other historical policies, which have reinforced racial and economic discrimination and exacerbated inequitable exposure to contemporary climate impacts. For instance, formerly redlined areas can be up to 13°F warmer than the city's average surface temperature, thereby disproportionately exposing this community to heat effects.

Rural communities fundamentally rely on natural resources and are therefore particularly vulnerable to climate change. Workers in natural resource and outdoor-based industries will experience heightened exposure to heatwaves and wildfire smoke, and outdoor construction workers face higher rates of traumatic injuries when exposed to extreme heat.

Tribes and Indigenous communities experience both physical and cultural threats in the face of climate change. Extreme weather events can prevent Tribal members, especially elders, from participating in Tribal ceremonies. Further, access to ceremonial sites can also be disrupted or damaged by flooding, landslides, and wildfires, exacerbating degradation associated with other land-use decisions.

CDC Success Stories

Oregon Health Authority

Wildfire smoke and water insecurity disproportionately impact people of color, tribal, and communities of lower income. The Oregon Health Authority's (OHA's) Public Health Division identified the power of community partners and recognized CBOs as part of Oregon's public health system. Oregon provided technical assistance, tools, and evaluation to local public health agencies (LPHAs), community-based organizations (CBOs), and Tribes implementing community-led adaptation actions to improve resilience to wildfire smoke and water insecurity. As a result of their work, 38 CBOs and 36 LPHAs have received assistance in advancing climate equity, building community resilience, and implementing climate adaptation actions.

Washington State Department of Health

More frequent wildfires in Washington have led to increased respiratory illness. Smoke events from 2004-2009 were associated with a 7.2% increase in respiratory hospital admission among adults over 65 in the Western United States. Through mini-grants received from the CDC via the Council of State and Territorial Epidemiologists (CSTE), the National Environmental Health Association (NEHA), and the Association of State and Territorial Health Officials (ASTHO), Washington assessed climate change and respiratory health trends and developed best practices for wildfire communications outreach. They also tested the utility of low-cost air quality sensors during wildfires. Overall, Washingtonians are better informed about wildfires through improved communication before, during, and after wildfire events, leading to reduced exposure to wildfire smoke.

Lummi Nation

Rising water temperatures increase the potential for toxic harmful algal blooms (HABs), which can be fatal to both humans and wildlife. The Lummi Nation (located in what is now called Washington State) developed plans to protect their community from HABs and toxins in shellfish. This included hazard communication activities and assessment of local community needs. This work has been supported by several mini-grants from CDC via the National Indian Health Board (NIHB).

Swinomish Indian Tribal Community

Tribal populations are experiencing climate impacts first and worst in the Pacific Northwest. Many have experienced an increase in the effects of climate change, including storm surges, flooding, erosion from wind and wave actions, and impacts on Tribal fisheries resources. In 2017, utilizing mini-grants from CDC via the National Indian Health Board (NIHB), the Swinomish Indian Tribal Community (located in what is now called Washington State) created the "Swinomish Climate Change Health Impact Assessment and Action Plan" by tailoring CDC's BRACE framework using Swinomish-specific health values, definitions, and priorities. They documented and shared the process with other Tribes (i.e., through educational materials) so that they may be better informed to move forward with their impact assessment and action plans.

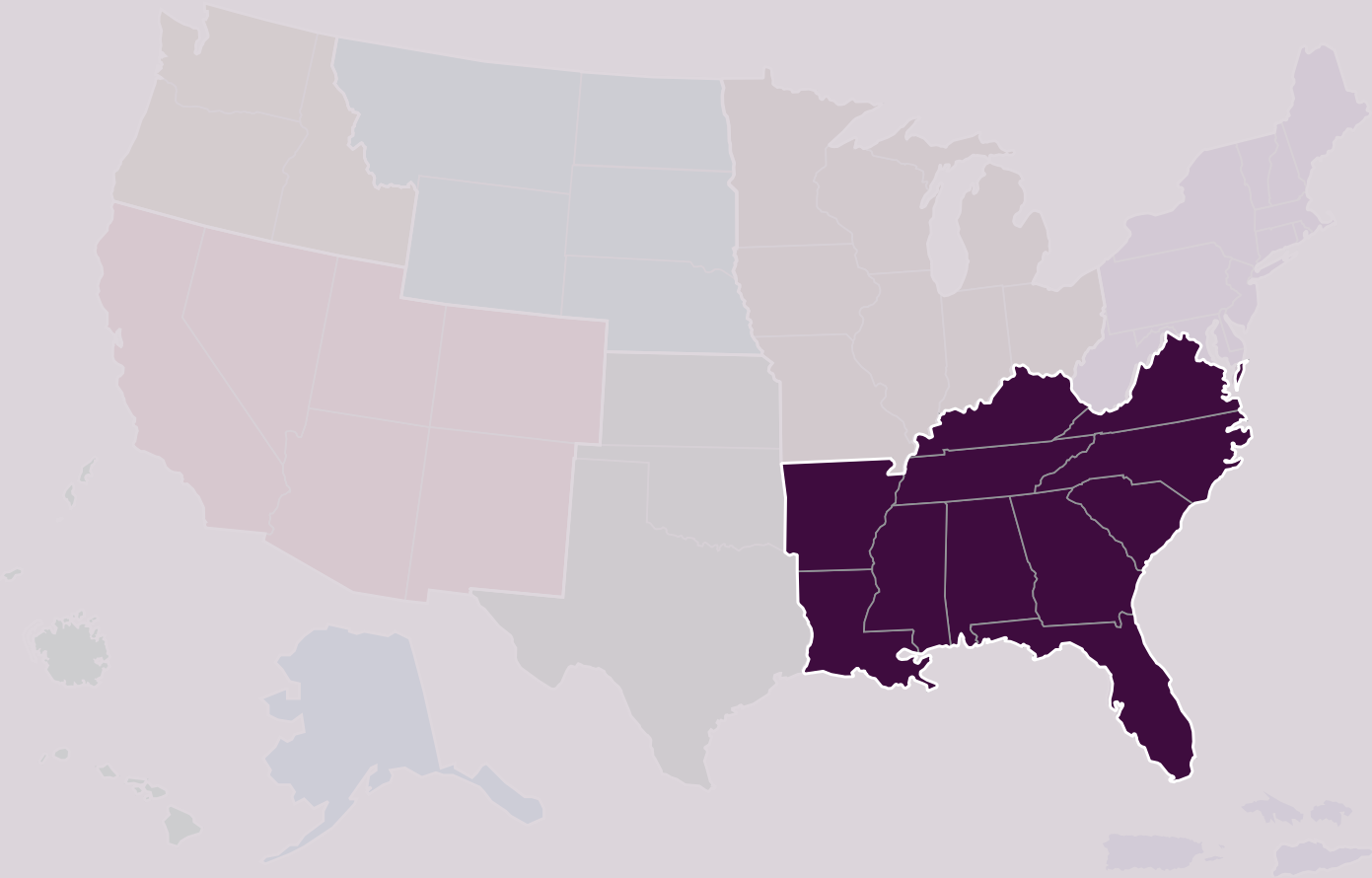
Clackamas County Public Health, Oregon

Clackamas County Public Health partnered with multiple neighboring counties (Multnomah County Health Department and Washington County Public Health) to form a regional collaboration. Together, they developed a comprehensive climate change and health impact assessment report and an accompanying data visualization tool for the Portland metropolitan region. The project involved the engagement of stakeholders to ensure the inclusion of local needs. The assessment data will drive policy efforts related to climate change and highlight how social determinants are the primary driver of climate vulnerability. Clackamas County has been supported with several mini-grants by CDC via the National Environmental Health Association (NEHA), and the National Association of County and City Health Officials (NACCHO).

Seattle-King County, Washington

Wildfire smoke is a routine hazard in the Pacific Northwest that disproportionately affects people with pre-existing health conditions. With support through a 2022 mini-grant from CDC via the National Association of County and City Health Officials (NACCHO), Seattle-King County introduced a pilot program, Clean Air Ambassadors, to educate the community about the importance of indoor air quality. By educating the community, this program reduces health disparities in frontline communities.

SOUTHEAST



Health Impacts

Temperature-Related Death and Illness

Heatwaves in the Southeast are happening more frequently and occurring during longer heat seasons, with some cities also showing increasing trends in their duration and intensity. Sixty-one percent of major Southeast cities are exhibiting some aspects of worsening heat waves, which is a higher percentage than any other region of the country.

Extreme heat affects everyone, but particularly at risk are pregnant people, people with heart or lung conditions, older adults and young children, people with mental health conditions, outdoor workers in construction, agricultural workers, athletes, and populations who lack adequate shelter or are incarcerated.

Air Quality Impacts

In the Southeast, some sources of poor air quality include vehicle or power plant emissions, industrial facilities, wildfires, and airborne allergens. Urban areas have higher concentrations of carbon dioxide which causes allergenic plants, such as ragweed, to grow faster and potentially produce more pollen allergens than in rural areas. Pollen increases pose significant health risks, including aggravating respiratory conditions such as asthma, which has been linked to a loss of school and workdays. The associated health effects of poor air quality are experienced disproportionately by communities of color and populations with lower socioeconomic status. This region has more days with stagnant air masses than other regions of the country (40% of summer days) and higher levels of fine particulate matter (PM2.5). The Southeast is projected to have the highest number of premature deaths due to climate-induced increases in PM2.5 and ozone exposure in the country.

Extreme Events

Growth along the region's coastlines has increased the population exposed to coastal-specific climate threats. An assessment by the Florida Department of Health determined that 590,000 people in south Florida face "extreme" or "high" risk from sea level rise, with 125,000 people living in these areas identified as socially vulnerable and 55,000 classified as medically vulnerable. In addition to causing direct injury, storm surges and related flooding can impact transportation infrastructure by blocking or flooding roads and affecting access to healthcare facilities.

Rising disaster costs negatively impact local and regional economies, some of which are already affected by limited upward economic mobility for their population, as well as by limited administrative, institutional, and social capacity. Financial losses attributed to climate change are expected to increase as rapid development continues to occur in hazardous areas, particularly along coasts.

Vector-Borne Diseases

The Southeast has the most favorable conditions for the Aedes aegypti mosquito and thus faces the greatest threat from diseases the mosquito carries. Warmer conditions may have facilitated the expansion of the geographic range of mosquito populations and could potentially increase their capacity to transmit diseases such as chikungunya, dengue, malaria, West Nile virus, and Zika virus.

For ticks that carry diseases such as Lyme and Rocky Mountain spotted fever, statistical models predict varying shifts in ecosystems suitable for ticks to live in the Southeast depending on the degree of warming, species of tick, land-use changes, and host abundance.

Water-Related Illness

Some wastewater utilities may not have developed plans to assure system resilience in response to heavy precipitation and flood events.

Consequently, future populations may be exposed to untreated wastewater and its associated pathogens due to climate change.

Simultaneously, rising temperatures and precipitation could intensify harmful algal blooms (HABs). HABs have significant negative impacts on human and animal health, as well as broad-reaching environmental and economic effects. Humans may experience various health issues from HAB exposure, such as diarrhea and headache.

Food Safety, Nutrition and Distribution

Extreme weather and coastal stressors are affecting crop production, aquaculture, and livestock in the Southeast. Rising sea levels have increased saltwater intrusion in coastal aquifers, reducing the extent of available forests and farmland and threatening seafood harvesting in estuaries by altering the salinity and turbidity in freshwater streams and marine nurseries.

Further, higher overnight temperatures have reduced crop yields, which is projected to worsen with additional global warming. Hurricanes, tropical storm winds, and increasing rainfall pose unique threats to agriculture in this region.

Mental Health and Well-Being

Mental health is of particular concern in the Southeast, as it is home to 5 out of the 10 highest-ranked states for the prevalence of mental illness, and 8 out of the 10 lowest-ranked states for access to mental healthcare services. Climate change significantly affects mental health as a result of acute disaster events and long-term existential threats of climate change impacts that make people feel less secure in their physical environment.

While extreme weather events commonly occur in the Southeast, climate change has increased their frequency and magnitude, causing residents to face repeated trauma and

displacement at an unprecedented level. This can lead to stress and the onset of new psychiatric disorders or the worsening of preexisting mental health conditions, especially among children and under-resourced and BIPOC residents.

Populations of Concern

Workers in the agriculture, forestry, hunting, and fishing sectors, together with construction and support, waste, and remediation services work are the most highly vulnerable to heat-related deaths in the United States, representing almost 68% of heat-related deaths nationally. Six of the 10 states with the highest occupational heat-related deaths in these sectors are in the Southeast region, accounting for 28.6% of occupational heat-related deaths between 2000 and 2010.

Further, the Southeast has more non-Hispanic Black residents than any other Health and Human Services (HHS) region which face unique health-related barriers. Majority non-Hispanic Black communities have less access to health resources, lower life expectancies, limited opportunities for economic prosperity, and additional barriers to access to quality education —all of which shape health outcomes. As a result, non-Hispanic Black communities in the Southeast will face a disproportionate level of health risk associated with climate change.

CDC Success Stories

North Carolina Department of Health and Human Services

Sea level rise, hurricane intensity, and inland flooding intensify water management challenges in North Carolina. To help protect residents living in flood-prone regions, the North Carolina Department of Health interviewed community members disproportionately at risk about flooding-related knowledge and resources. Additionally, with the National Weather Service, a river monitoring program was established in 2023. The river gauge on the Black River near Tomahawk has already been used to give residents real-time information regarding river flooding following Hurricane Ida in 2023 and will continue to help protect residents.

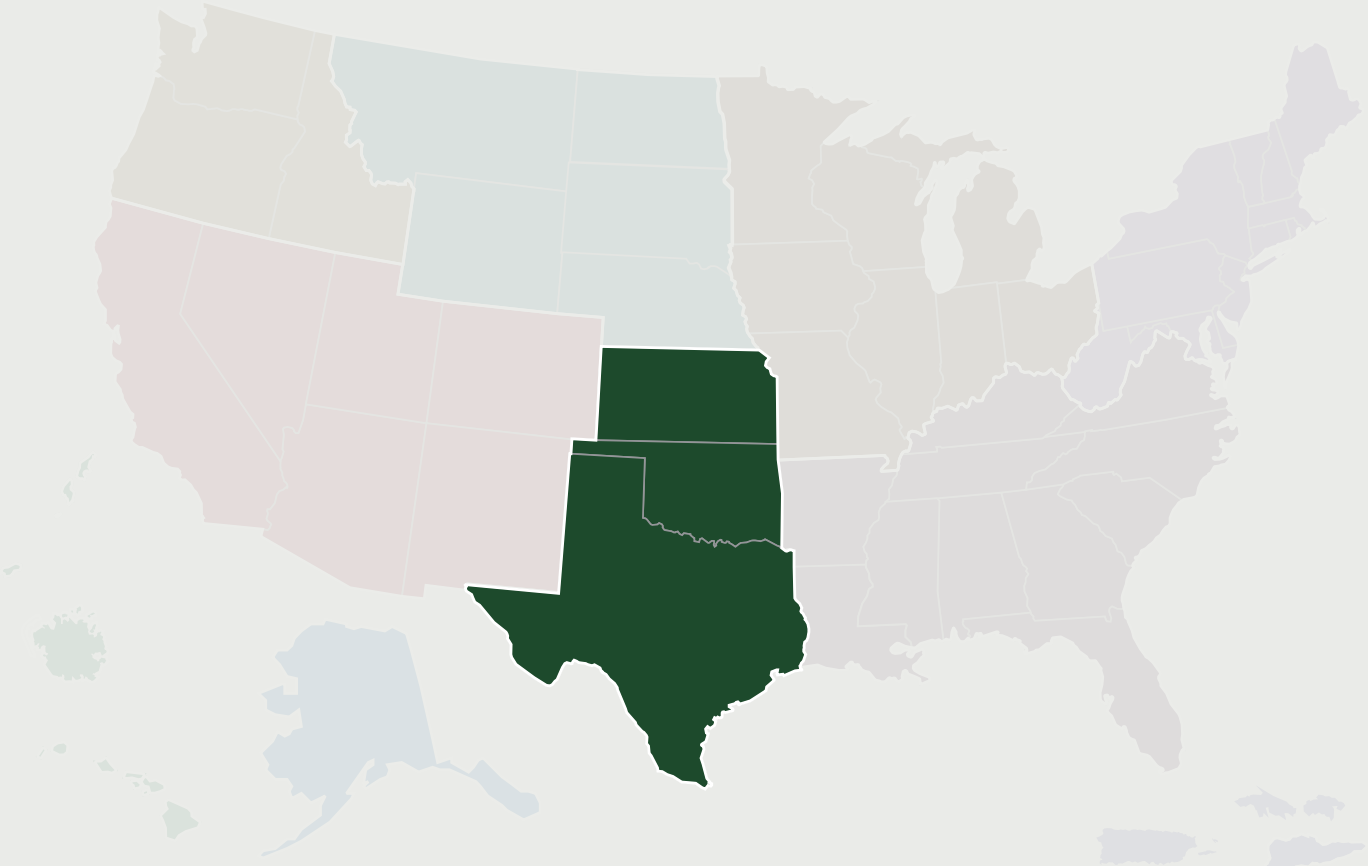
Florida Department of Health

The Florida Building Resilience Against Climate Effects (FLBRACE) Program is working to improve the ability of the public health sector to respond to the health effects of climate variability by incorporating the best available science into routine public health practice. One area of concern for FLBRACE was the accessibility of emergency shelters to vulnerable populations, such as the elderly or residents living in coastal communities, as sea level rise and more intense hurricanes threaten to flood Floridians' homes. The Florida Department of Health and the University of Florida conducted assessments of emergency shelters and made recommendations to improve communication systems and accessible shelter management. Emergency shelters now understand the gaps that need to be addressed to serve their residents at greatest risk.

City of New Orleans Department of Health, Louisiana

The Southeast is experiencing more frequent and intense heat waves. With support through a 2020 mini-grant from CDC via the National Association of County and City Health Officials (NACCHO), New Orleans piloted a heat monitoring program where thermometers were distributed to residents to gather temperature data and develop better outreach about extreme heat and heat-related illnesses. Heat and health messages for New Orleanians with higher risk have been improved, reducing the burden of heat-related illness.

SOUTHERN GREAT PLAINS



Health Impacts

Temperature-Related Death and Illness

Warmer temperatures will likely lead to an increase in heat stress, especially during the summertime. Heat stress is strongly correlated with complications of lung disease, such as asthma, chronic obstructive pulmonary disease (COPD), and emphysema, as well as dehydration and injurious electrolyte abnormalities. People who are male, Black, 65 years or older, diabetic, unmarried, without air-conditioning, or living below the poverty line have been at higher risk of heat-related death.

Athletes of all ages experience decreased performance, do less outdoor physical activity, and are at higher risk of severe or fatal health issues because of extreme heat, air pollution, and weather hazards.

Air Quality Impacts

Dust is a natural phenomenon in the United States but is worsened in the Great Plains by drought or human activities associated with land use, such as agriculture. Exposure to dust can cause respiratory and cardiovascular health problems. These are also regions where climate change is expected to affect drought patterns, thereby worsening dust problems.

Warmer temperatures will also worsen air pollution by increasing near-surface ozone. In 2023, eighteen Texas counties in the Dallas–Fort Worth and Houston–Galveston metropolitan areas exceeded national ozone standards, affecting more than 12 million people.

Extreme Events

Extreme weather events with resultant physical injury and population displacement are a threat to this region. These threats are likely to increase in frequency and distribution and are likely to create significant economic burdens. Hotter temperatures, heavier precipitation, stronger tropical cyclones, and other climate changes have harmed workers' health and productivity, inflated product or building costs, and disrupted supply chains. Extreme events also pose significant health and healthcare burdens. For example, widespread flooding during Hurricane Harvey affected dozens of communities, including those in the Houston and Beaumont metropolitan areas. Immediate effects included deaths from drowning and trauma that claimed the lives of at least 63 individuals. Additionally, more than 30,000 people were evacuated. Displacement of patients from their communities and healthcare providers led to interruptions in medical treatment.

Climate change-related damages to businesses have threatened the continuity of operations, increased insurance costs, disrupted supply chains, and shifted customer demand. Moreover, small businesses owned by women, non-Whites, and veterans have a higher likelihood of closing after experiencing a natural disaster. These closures have negatively affected the economy and well-being of local communities.

Vector-Borne Diseases

In the Southern Great Plains, hantavirus, Rocky Mountain spotted fever, leptospirosis, and West Nile virus are all endemic and could be impacted by climate change. Tropical diseases, such as dengue virus, chikungunya virus, and Zika virus are transmitted by Aedes mosquitoes, which are currently expanding their geographic range in the southern United States. Across western parts of the region, future warmer and drier conditions are projected to support an increased incidence of Valley fever, which is endemic in parts of Texas.

Water-Related Illness

As water evaporates during periods of drought, the remaining water can have higher concentrations of chemicals and solid particles, lower dissolved oxygen levels, and a higher density of pathogens that cause infectious diseases. Drought conditions reduce the number of sources and overall quantity of water available to both humans and animals. Because humans and animals share a reduced supply of water, germ transmission and infectious disease outbreaks become more likely, particularly in unregulated drinking water sources that are not treated. Waterborne diseases linked to drought include amoebiasis, hepatitis A, salmonellosis, schistosomiasis, shigellosis, typhoid, paratyphoid fevers, and infection with E. coli, cholera, and leptospirosis.

Food Safety, Nutrition and Distribution

Agriculture is an essential industry in the region. However, increases in carbon dioxide are changing the nutritional composition of food crops. Elevated carbon dioxide levels have been shown to reduce the protein composition of grains, tubers, rice, wheat, and barley. Micronutrient contents are also affected by rising carbon dioxide levels, with atmospheric carbon dioxide concentrations of 550 parts per million being associated with reductions in zinc, iron, phosphorus, potassium, calcium, sulfur, magnesium, copper, and manganese across a wide range of crops. High temperatures also pose risks to animal health and have been responsible for mass cattle deaths in Kansas. Overall, agricultural producers are experiencing loss of livestock and crops, reduced income, and negative public health outcomes as climate extremes increase in magnitude and frequency.

Mental Health and Well-Being

A changing environment and subsequent disconnect from the natural region and local customs will likely lead to an increase in negative mental health outcomes for individuals. Children who are BIPOC and from families with lower incomes have less access to high-quality, sizeable urban parks, putting them at higher risk of heat illness, negative physical outcomes, and mental health problems.

Populations of Concern

Climate change does not affect all people in the same ways. Those most impacted by climate injustices include people with low incomes, rural residents, persons with disabilities, older adults, BIPOC, those who identify as other than cisgender, straight men, immigrants, those living in colonias (Texas-border housing developments lacking basic infrastructure and services), and individuals experiencing homelessness. These communities often lack access to adequate flood infrastructure, sufficient weatherization or air-conditioning, and appropriate shade or green spaces. This increases their risk to heatwaves, flooding, and other extreme weather events. Further, Tribal and Indigenous communities are particularly vulnerable to climate change due to water resource constraints, extreme weather events, higher temperatures, and other public health issues.

CDC Success Stories

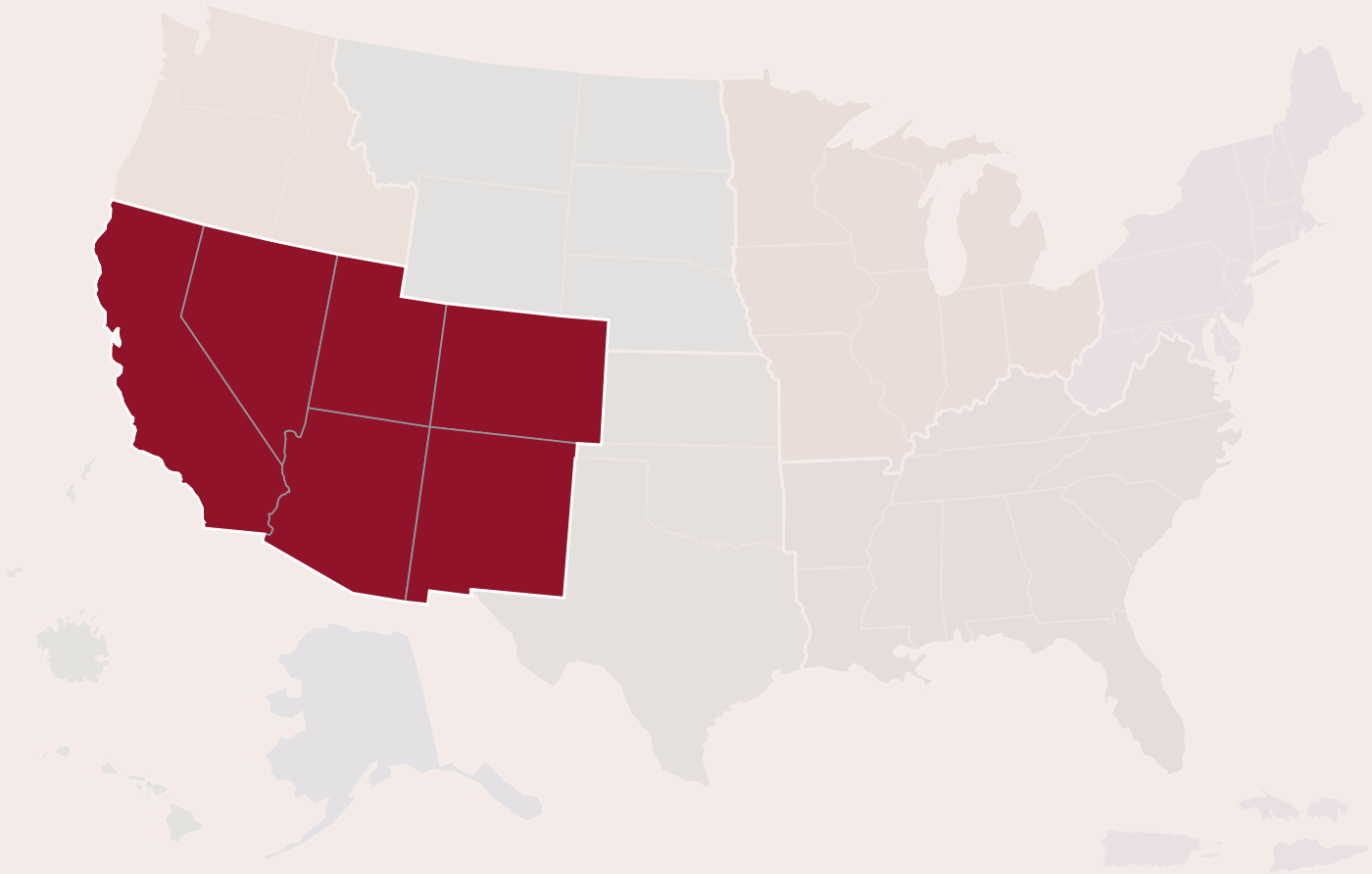
Kaw Nation

Indigenous communities face health effects from climate change, ranging from limited water resources, extreme weather events, and higher temperatures. The Kaw Nation (located in what is now called Oklahoma) received a one-time mini-grant from CDC and the National Indian Health Board (NIHB) in 2019 for a project focused on local community education and outreach related to climate and health. They created fact sheets and other communications materials to help inform community members of potential climate-related threats and steps to protect health. A major focus was the health impacts of heat.

Harris County Public Health, Texas

Communities disproportionately impacted by climate change struggle to make their voices heard among policymakers and can receive resources to increase resilience. With support from a 2021 mini-grant from CDC via the National Association of County and City Health Officials (NACCHO), Harris County Public Health (HCPH) began integrating a two-way communication platform into their existing climate program. Here, they can both advise about climate risks and members can share their stories and needs. This plan intends to enhance climate and health knowledge within the county, as well as strengthen the HCPH's outreach to communities most at risk.

SOUTHWEST



Health Impacts

Temperature-Related Death and Illness

Under continued climate change, projected increases in hot days and extreme heat events in the Southwest will increase the risk of heat-associated deaths. Under the higher emissions scenario , the Southwest would experience the highest increase in annual premature deaths due to extreme heat in the country, with an estimated 850 additional deaths per year by 2050. By 2090, deaths and economic losses would more than double from 2050 under all emissions scenarios. Heat and other environmental exposures particularly affect outdoor workers.

Air Quality Impacts

Respiratory and cardiovascular disease is associated with exposure to various air pollutants, including ground-level ozone air pollution, dust storms, particulate air pollution (such as from wildfires and dust storms), and aeroallergens (airborne proteins that trigger allergic reactions). These exposures are only expected to worsen with climate change. For instance, intensified aridity from higher temperatures and drought is expected to lead to more dust storms. Consequently, the number of deaths attributed to fine dust is expected to more than double by 2080–2099 under a very high emissions scenario , with increasing exposures for outdoor workers during the warm season. Additionally, drier conditions can also increase the reproduction of a fungus found in soils, potentially leading to the disease coccidioidomycosis or Valley fever. Wildfires are also a growing source of PM2.5, and the costs of adverse respiratory and cardiovascular health outcomes can exceed the billions spent on wildfire suppression.

Extreme Events

Climate change negatively impacts human health and well-being, cultural heritage, property, built infrastructure, economic prosperity, natural capital, and ecosystem services across the Southwest. Impacts include rising air temperatures and sea surface temperatures, both attributable in part to human activities; changes to the timing, form, and amount of precipitation; sea level rise and associated flooding events; increases in extreme heat events; summertime heat stress and heat-related mortality; surface and groundwater reductions; increased wildfire risks; and changes to ocean chemistry. These impacts pose heightened risks to overburdened and frontline communities and to Indigenous peoples.

Vector-Borne Diseases

Infectious diseases like plague and hantavirus pulmonary syndrome disproportionately affect the Southwest region and could be impacted by climate change. Heat extremes and changes in precipitation may influence the distribution and occurrence of vector-borne diseases like West Nile virus and may lead to the emergence of new diseases. The incidence of coccidioidomycosis (Valley fever) in the region has increased and is associated with higher air temperatures and drier soils, with greater risk to those whose job requires dirt disruption.

Water-Related Illness

Climate change has reduced surface water and groundwater availability for people and the natural environment in the Southwest, and there are inequities in how these impacts are experienced. Indigenous communities, in particular, experience a lack of clean water and sanitation services. A major impediment to water access is the cost of water infrastructure, which averages $600 per acre-foot of water for non-Indigenous families with piped delivery, compared to $43,000 per acre-foot of water for Navajo families relying on hauled water. Further, greater variability in streamflow threatens the region's ability to consistently produce and use hydropower, impacting a typically reliable and low-carbon source of energy.

Food Safety, Nutrition and Distribution

Food production in the Southwest is vulnerable to water shortages. Increased drought, heat waves, and reduction of winter chill hours can harm crops and livestock; exacerbate competition for water among agriculture, energy generation, and municipal uses; and increase future food insecurity. Droughts and wildfires in the Southwest have contributed to declines in traditional Indigenous staple foods, including fish, wildlife, acorns, corn, and pine nuts. Additionally, ocean warming and acidification, as well as sea level rise, increase risks to shellfish beds (which reduces access for traditional harvesting), pathogens that cause shellfish poisoning, and damage to shellfish populations, which can cause cascading effects in food and ecological systems upon which some Tribes depend.

Mental Health and Well-Being

Climate change may weigh heavily on mental health in the general population and those already struggling with mental health disorders. One impact of rising temperatures, especially in combination with environmental and socioeconomic stresses, is violence towards others and towards self. Slow-moving disasters, such as drought, may affect mental health over many years. Communities that rely especially on well-functioning natural and agricultural systems in specific locations may be especially vulnerable to mental health effects when those systems fail. Indeed, mental health risks are also increasing as farmers and ranchers report moderate to severe levels of anxiety about climate change and the need to adapt. Simultaneously, the loss of stability and certainty in natural systems may affect the physical, mental, and spiritual health of Indigenous peoples with close ties to the land.

Populations of Concern

With 1.5 million Native Americans, 182 federally recognized Tribes, and many state-recognized and non-federally recognized Tribes, the Southwest has the largest population of Indigenous peoples in the country. Yet, Native Americans are among the most at risk from climate change, often experiencing the worst effects because of higher exposure, higher sensitivity, and lower adaptive capacity due to historical, socioeconomic, and ecological reasons. Simultaneously, other frontline communities, such as Hispanic populations, women farmers, and migrant farmworkers, face challenges to water access in their homes as well as food security and health. Specifically, women farmers tend to have fewer resources and are given less compensation than their male counterparts [5]. Additionally, strong evidence indicates that extreme heat disproportionately impacts the health of people experiencing homelessness, outdoor workers, migrant farmworkers, those with low income, and older adults.

CDC Success Stories

Arizona Department of Health Services

Arizonans experience more than 100 days over 100°F per year. Yet, some populations are disproportionately impacted by extreme heat including people experiencing homelessness, older adults, and people without access to air conditioning. Maricopa and Pima counties assessed how to improve the visitor experience for cooling centers, developing best practices, and increasing awareness of locations. As a result of their efforts, new cooling center locations were identified using geospatial analysis; locations are chosen by their ability to best meet demand and support populations at higher risk. Additionally, heat alerts reach nearly 29,000 people on extreme heat days.

San Francisco Department of Health, California

San Francisco is particularly at risk to the health impacts of extreme heat. A study of a 2006 California heat wave found that during extreme heat events, San Francisco's emergency department visits increased more than almost anywhere else in the state. The San Francisco Department of Public Health's Climate and Health Program analyzed surface temperature data alongside 21 social and environmental risks to create the city's first heat vulnerability index. This will help prepare the city for future extreme heat events by informing its extreme heat emergency response plan, developing extreme heat preparedness training specifically for older adults, and engaging local clinicians about how to discuss extreme heat preparedness with their patients.

California Department of Public Health

In the past decade, California experienced more frequent and intense heat events, wildfires and droughts, and reduced air quality that outpaced historic records. Aligned with the Building Resilience Against Climate Effects (BRACE) Framework, the California Building Resilience Against Climate Effects (CalBRACE) maintains web-based tools and resources for adaptation planning, including consultation and engagement, hazard, vulnerability, disease burden assessments, and strategies for implementation and evaluation. Some online resources include CDPH syndromic surveillance, the Climate Change and Health Vulnerability Indicators (CCHVIz) interactive data platform, and digital stories narrated by community residents about adverse social, economic, and health impacts from extreme heat events.

San Mateo County, California

Worsening air quality from increased pollen, wildfire smoke, and ground-level ozone exacerbate respiratory conditions such as asthma. San Mateo County assessed the magnitude and trends of asthma burden and adapted the Community Health Vulnerability Index for their jurisdiction. This allowed them to address specific local climate and respiratory health issues, especially among populations disproportionately at risk.

Alameda County, California

Often, populations at increased risk to the health impacts of climate change do not receive adequate communications about air quality alerts during wildfire smoke events. In 2020, Alameda County received a mini-grant from CDC via the National Association of County and City Health Officials (NACCHO). With this support, Alameda County engaged community stakeholders through focus groups to develop preferred methods of communication regarding air quality levels and protective action. Using this information, they aim to develop an informed governmental communication protocol to send smoke alerts and information to communities which are disadvantaged and those vulnerable to smoke impacts. Community members at higher risk will receive more prompt and relevant messages to take preventive actions, potentially reducing asthma attacks and other respiratory problems.

Pala Band of Mission Indians

The Southwest has the largest population of Indigenous peoples in the country, and they are often experiencing the worst effects of climate change due to high exposure, sensitivity, and lower adaptive capacity stemming from historical and social factors. The Pala Band of Mission Indians (located in what is now called Southern California) developed climate and health communication and outreach materials tailored to the specific needs of the Pala community, including a plan highlighting the importance of culture-based psychosocial resilience strategies.

By creating culturally competent climate resilience communications, not only will the materials reach more people, but those people are more likely to use the strategies. This work has been supported through several mini-grants from CDC via the National Indian Health Board (NIHB).

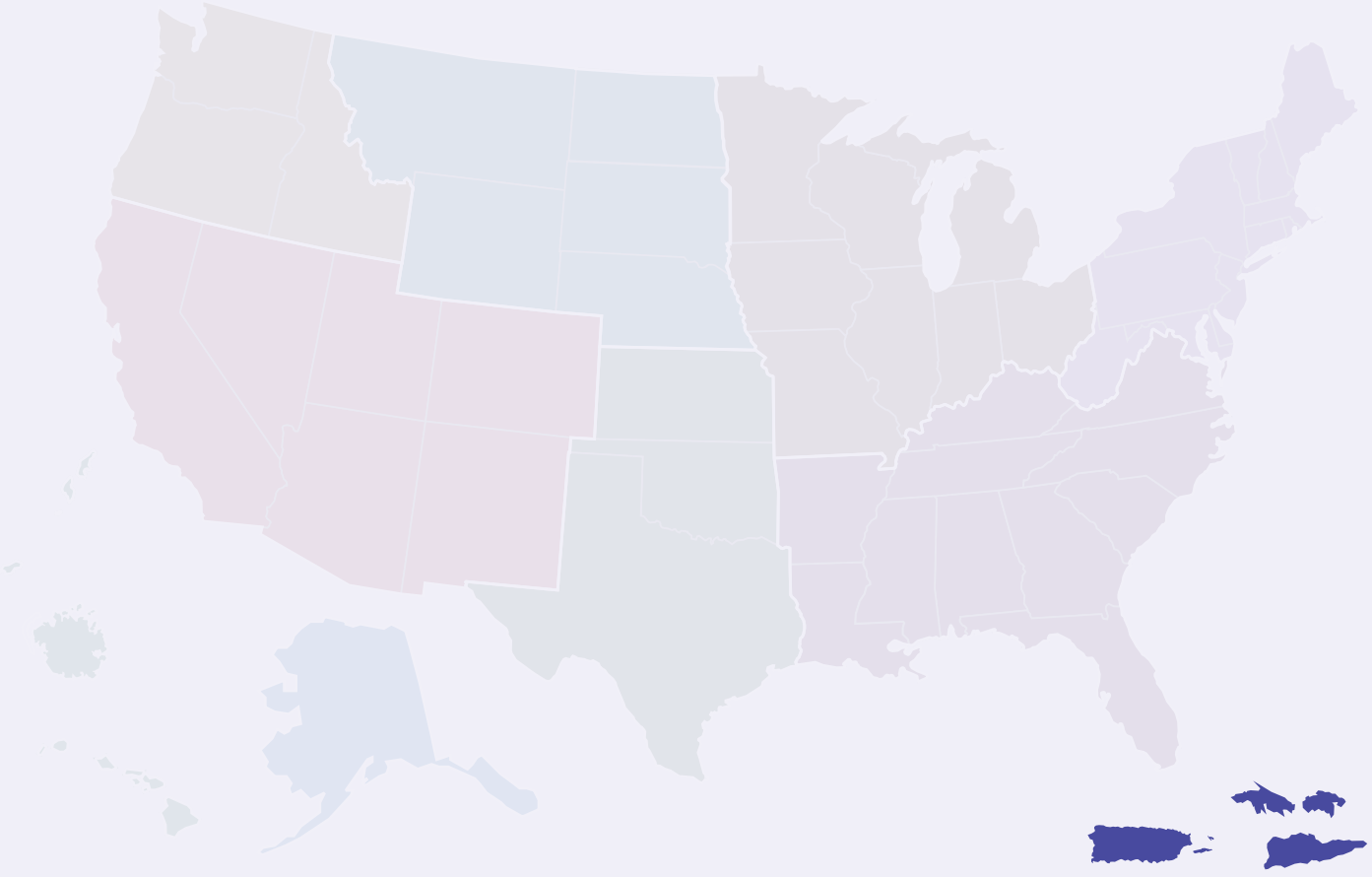
Greenville Rancheria

Extreme events like wildfires are causing power outages in rural Indigenous communities. This not only disturbs daily life but can also significantly impact those who need electricity to power medical equipment. In 2019, Greenville Rancheria (located in what is now called California), received a mini-grant from CDC via the National Indian Health Board (NIHB) to help protect their citizens by enhancing local capacity to respond to wildfires and resulting power outages. They are improving the local health department's ability to anticipate areas that will experience blackouts, as well as developing materials to inform citizens on how to safely operate generators during power outages. Overall, improved communication about wildfires gives rural communities more time to prepare for potential power outages and help mitigate some of the health consequences.

Santa Clara County, California

Existing community-based organizations (CBOs) provide an opportunity to enhance individual and community climate resilience when residents seek services (i.e., food, health, etc.). Santa Clara County is launching a Climate Resilience Leadership Academy for CBOs to increase their knowledge of climate and health, build skills for developing climate action plans, and strengthen self-efficacy through capacity-building projects. These actions will reduce the risks of extreme heat and poor air quality among the community members at risk that the CBOs serve.

U.S. CARIBBEAN



Health Impacts

Temperature-Related Death and Illness

Weather stations indicate that the annual number of days with temperatures above 90°F has increased over the last four and a half decades. A number of extreme temperature events occurred in Puerto Rico during the summers of 2012–2014, when most days exceeded 90°F. During San Juan's record heat episode in 2012, stroke and cardiovascular disease were the primary causes of death due, in part, to the elevated summer temperatures in the municipalities of San Juan and Bayamón.

Several factors contribute to heat risk and sensitivity, including age, pregnancy, poverty, disability, chronic health conditions, and outdoor labor. Cooling indoor environments helps to lessen the impact of heatwaves, but energy demands on a crumbling power infrastructure, as well as rising costs of living, create climate risks associated with inequality, as only a section of society will be able to afford cooling equipment.

Air Quality Impacts

In the U.S. Caribbean, dust particles carried across the Atlantic from the Sahara, mostly during summer, affect climate, weather, and ecosystems, including coral reefs, forests, and human populations. While vital for the ecosystem, the dust is associated with increased cardiovascular and respiratory risks. It also has been linked to an increased risk of emergency room visits and hospitalizations related to asthma in children in Trinidad and Tobago, Guadeloupe, and Grenada. As humidity and temperatures rise, the abundance of mold and spores impacts air quality and, thus, respiratory non-communicable diseases.

Extreme Events

Extreme events pose significant risks to life, property, conservation, agriculture, and the economy in the Caribbean. Further, some extreme events, such as flooding and droughts, are projected to increase in frequency and intensity as climate change worsens. This is particularly concerning for the U.S. Caribbean as there is a high concentration of population and critical infrastructure in low-lying coastal areas, which increases vulnerability to sea level rise and storm surge and magnifies the effects of coastal flooding and beach erosion.

The health impacts across the Caribbean Small Island Developing States (SIDS) span a large range, including physical injury from wind and water during hurricane passage and during post-event rescue and cleanup efforts, heat-related injury due to loss of access to air conditioning and fans, inability to manage chronic disease due to loss of access to electrical power or medical services, and increased exposure to vector-borne diseases and diseases from contaminated water. Mental health impacts are also notable, as most survivors experience a high degree of psychological trauma during and after hurricane events.

Vector-Borne Diseases

Vector-borne diseases in the Caribbean, such as dengue, Zika, and chikungunya, are mostly transmitted by the Aedes aegypti, Aedes albopictus, and Culex mosquitoes. Warmer conditions facilitate the expansion of mosquito populations and potentially increase their capacity to transmit diseases.

There are also emerging vector-borne diseases, such as leptospirosis, whose spread has been associated with flood-prone areas, heavy rainfall, and higher temperatures. Extreme weather events such as tropical storms, heavy rainfall, and floods are expected to result in an upsurge in the number and magnitude of leptospirosis outbreaks.

Factors in the U.S. Caribbean that favor vector-borne outbreaks include climate change, inequality, poverty, serotype profile (virus variation), immunity, deficient water and waste management, and lack of community awareness.

Water-Related Illness

Coastal communities' water supplies are threatened by rising temperatures, sea level rise, saltwater intrusion, extreme drought, and flooding. Moreover, traditional rainwater catchment systems are becoming unreliable and threatened as precipitation patterns are changing. Studies conducted after hurricanes have found water pollution, disease vectors, and bacteria in the drinking water supply, all of which are expected to worsen with the expected impacts of climate change, thus affecting livelihood security. Puerto Rico and the USVI are projected to lose 3.6% and 4.6% of their total coastal land area, respectively. Were such a rise to take place, Puerto Rico's critical infrastructure near the coast would be negatively impacted, including drinking water pipelines, pump stations, sanitary pipelines, and one wastewater treatment plant. In the USVI, infrastructure and historical buildings in the inundation zone include pipelines for water and sewage.

Food Safety, Nutrition and Distribution

Studies show that major shifts in fisheries distribution, coupled with changes in marine habitats such as coral reefs, adversely affect food security, shoreline protection, and economies throughout the Caribbean.

Additionally, increases in average temperature and extreme heat events will likely have detrimental effects on agricultural operations throughout the U.S. Caribbean region. Climate change affects cattle ranchers and dairy farmers in the U.S. Caribbean by reducing rangeland productivity, causing a shortage of nutritional feed, increasing heat stress on animals, and increasing energy costs for cooling.

Mental Health and Well-Being

Mental health impacts are also notable in the Caribbean Small Island Developing States (SIDS), as most survivors experience a high degree of psychological trauma during and after hurricane events. In the aftermath of Hurricane Maria, many older adults in Puerto Rico experienced unmet needs that contributed to declining physical and emotional health, inadequate management of noncommunicable diseases, social isolation, financial strain, environmental health issues, and excess mortality. High levels of post-traumatic stress disorder (PTSD), depressive symptoms, and disaster-related stressors were also evident.

Populations of Concern

U.S. Caribbean societies, with their multiethnic and multiracial makeup of high proportions of people of African and Indigenous descent, are more vulnerable to climate-related risks due to economic policies and social systems, varying levels of educational attainment, unemployment, poverty, out-migration, older-age demographics, food insecurity, colonialism, and unjust historical treatment.

Urban areas are particularly vulnerable to extreme heat events, given the concentration of built structures, traffic, and other factors that drive the urban heat island (UHI) effect. Since the middle of the last century, urbanization and population growth have increased the UHI effects in San Juan, Puerto Rico. Such effects are becoming even more life-threatening with a growing and more vulnerable aging population.

CDC Success Stories

University of the Virgin Islands, U.S. Virgin Islands

The U.S. Virgin Islands are projected to lose 4.6% of their total coastal land area due to rising sea levels. These losses could negatively impact drinking water supplies, sewage systems, and historical infrastructure. In 2017, the University of the Virgin Islands received a mini-grant from CDC via the Association of State and Territorial Health Officials (ASTHO) to strengthen their community resilience. Through informal community focus groups and surveys, this project captured community-level knowledge and perceptions of climate change and water safety. Families residing in communities with lower incomes in St. Thomas, St. John, and St Croix were invited to participate in educational focus groups wherein they discussed climate change, food and water safety, as well as extreme weather. Participants were then surveyed to assess their knowledge and perceptions of those topics leading to a better understanding of where future education should be offered. These new climate actions will help communities better adapt to rising sea levels, which can protect water quality and infrastructure.

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