



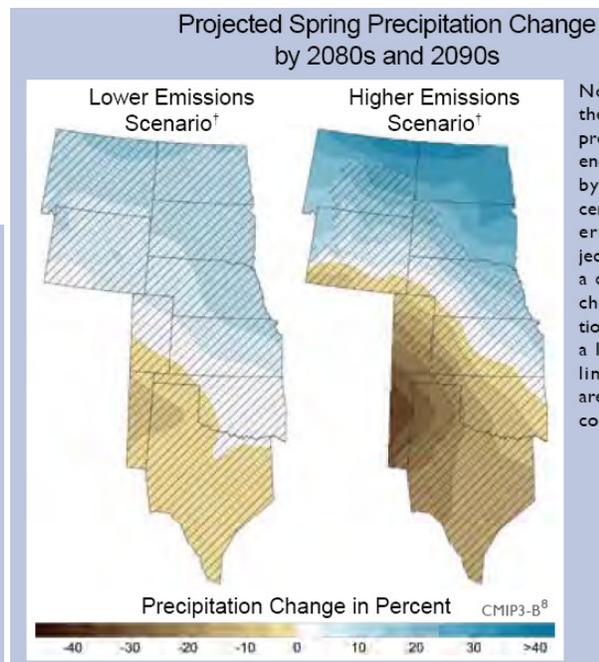
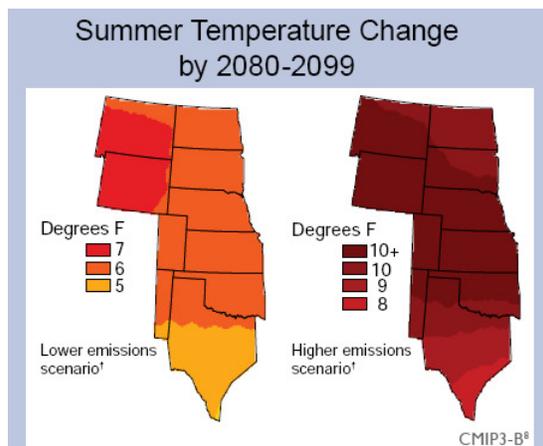
All information in this summary is entirely based on "Global Climate Change Impacts in the United States" (USGCRP, 2009). To enhance clarity, slight modifications were made that maintain the intended meaning of the report.

Great Plains

Kansas, Montana, Nebraska, North Dakota, Oklahoma, South Dakota, Texas – Central, Wyoming

Average temperatures have increased throughout the region, with more than 6 degrees Fahrenheit (°F) increase over the last 30 years occurring in winter months and over the northern states. Relatively cold days are becoming less frequent and relatively hot days more frequent. Precipitation also has increased over most of the area and there has been a reduction in drought frequency.

Temperatures are projected to continue to increase over this century, with larger changes expected under scenarios of higher heat-trapping emissions as compared to lower heat-trapping emissions. Precipitation is also projected to change, particularly in winter and spring. Conditions are anticipated to become wetter in the north and drier in the south. Projected changes in long-term climate and more frequent extreme events such as heat waves, droughts, and heavy rainfall risk affecting many aspects of life in the Great Plains. These include the region's already threatened water resources, essential agricultural and ranching activities, unique natural and protected areas, and the health and prosperity of its inhabitants.



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WATER RESOURCES

Projected increases in temperature, evaporation, and drought frequency add to concerns about the region's declining water resources. Projections of increasing temperatures, faster evaporation rates, and more sustained droughts, especially in the southern region, brought on by climate change will only add more stress to overtaxed water sources. Current water use on the Great Plains is unsustainable, as the High Plains aquifer continues to be tapped faster than the rate of recharge. Projected increases in precipitation are unlikely to be sufficient to offset decreasing soil moisture and water availability in the Great Plains due to rising temperatures and aquifer depletion. The largest

impacts are expected in heavily irrigated areas in the southern Great Plains, already plagued by unsustainable water use and greater frequency of extreme heat.

Water is a major factor affecting activities on the Great Plains. Most of the water used in the Great Plains comes from the High Plains aquifer (sometimes referred to by the name of its largest formation, the Ogallala aquifer), which stretches from South Dakota to Texas. The aquifer holds both current recharge from precipitation and so-called “ancient” water, water trapped by silt and soil washed down from the Rocky Mountains during the last ice age.

As population increased in the Great Plains and irrigation became widespread, annual withdrawals began to outpace natural recharge. Today, an average of 19 billion gallons of groundwater are pumped from the aquifer each day. This water irrigates 13 million acres of land and provides drinking water to over 80 percent of the region’s population. Since 1950, aquifer water levels have dropped an average of 13 feet, equivalent to a 9 percent decrease in aquifer storage. In heavily irrigated parts of Texas, Oklahoma, and Kansas, reductions are much larger, from 100 feet to over 250 feet.

AGRICULTURE

Agriculture, ranching, and natural lands, already under pressure due to an increasingly limited water supply, are very likely to also be stressed by rising temperatures. Agricultural, range, and croplands cover more than 70 percent of the Great Plains, producing wheat, hay, corn, barley, cattle, and cotton. Agriculture is fundamentally sensitive to climate. Heat and water stress from droughts and heat waves can decrease yields and wither crops. The influence of long-term trends in temperature and precipitation can be just as great.

As temperatures increase over the coming century, optimal zones for growing particular crops will shift. Pests that were historically unable to survive in the Great Plains’ cooler areas are expected to spread northward. Milder winters and earlier springs also will encourage greater numbers and earlier emergence of insects. Rising carbon dioxide levels in the atmosphere can increase crop growth, but also make some types of weeds grow even faster.

With limited water supply comes an increased vulnerability of agriculture to climate change. Further stresses on water supply for agriculture and ranching are likely as the region’s cities continue to grow, increasing competition between urban and rural users. The largest impacts are expected in heavily irrigated areas in the southern Great Plains, already plagued by unsustainable water use and greater frequency of extreme heat. Successful adaptation will require diversification of crops and livestock, as well as transitions from irrigated to rain-fed agriculture. Producers who can adapt to changing climate conditions are likely to see their businesses survive; some might even thrive. Others, without resources or ability to adapt effectively, could lose out.

Even crop species that are well-adapted to warmth, such as tomatoes, can have reduced yield and/or quality when daytime maximum temperatures exceed 90°F for even short periods during critical reproductive stages. For many high-value crops, just hours or days of moderate heat stress at critical growth stages can reduce grower profits by negatively affecting visual or flavor quality, even when total yield is not reduced. Water deficits are detrimental for all crops. Drought frequency and severity are projected to increase particularly under higher emissions scenarios in the southern Great Plains. Increased drought will be occurring at a time when crop water requirements also are increasing due to rising temperatures increasing the likelihood for higher irrigation costs and further depletion of the Ogallala aquifer..

Like human beings, cows, pigs, and poultry are warm-blooded animals that are sensitive to heat. In terms of production efficiency, studies show that the negative effects of hotter summers will likely outweigh the positive effects of warmer winters. For example, an analysis of warming in the range of 9 to 11°F (as projected under higher emissions scenarios) projected a 10 percent decline in livestock yields in cow/calf and dairy operations in southern Plains regions, Appalachia, and the Southeast (including the Mississippi Delta), while a warming of 2.7°F caused less than a 1 percent decline. Temperature and humidity interact to cause stress in animals, just as in humans; the higher the heat and humidity, the greater the stress and discomfort, and the larger the reduction in the animals’ ability to produce milk, gain weight, and reproduce. Milk production declines in dairy operations, the number of days it takes for cows to reach their target weight grows longer in meat operations, conception rate in cattle falls, and swine growth rates decline due to heat. As a result, swine, beef, and milk production are all projected to decline in a warmer world.

Increases in air temperatures are projected to negatively affect confined animal operations (dairy, beef, and swine) located in the central United States, increasing production costs as a result of reductions in performance associated with lower feed

intake and increased requirements for energy to maintain healthy livestock. These costs do not account for the increased death of livestock associated with extreme weather events such as heat waves. Nighttime recovery is an essential element of survival when livestock are stressed by extreme heat. A feature of recent heat waves is the lack of nighttime relief. Large numbers of deaths have occurred in recent heat waves, with individual states reporting losses of 5,000 head of cattle in a single heat wave in one summer.

CLIMATE CHANGE SOLUTIONS

There is growing recognition that the enormous wind power potential of the Great Plains could provide new avenues for future employment and land use. Texas already produces the most wind power of any state. Wind energy production also is prominent in Oklahoma. North and South Dakota have rich wind potential.

ECOSYSTEMS

Climate change is likely to affect native plant and animal species by altering key habitats such as the wetland ecosystems known as prairie potholes or playa lakes.

Ten percent of the Great Plains is protected lands, home to unique ecosystems and wildlife. The region is a haven for hunters and anglers, with its ample supplies of wild game such as moose, elk, and deer; birds such as goose, quail, and duck; and fish such as walleye and bass. Urban sprawl, agriculture, and ranching practices already threaten the Great Plains' distinctive wetlands. Many of these are home to endangered and iconic species. In particular, prairie wetland ecosystems provide crucial habitat for migratory waterfowl and shorebirds.

Climate-driven changes are likely to combine with human stresses to further increase the vulnerability of natural ecosystems to pests, invasive species, and loss of native species. Changes in temperature and precipitation affect the composition and diversity of native animals and plants through altering their breeding patterns, water and food supply, and habitat availability. In a changing climate, populations of some pests such as red fire ants and rodents, better adapted to a warmer climate, are projected to increase. Grassland and plains birds, already besieged by habitat fragmentation, could experience significant shifts and reductions in their range.

Shallow ephemeral lakes dot the Great Plains, anomalies of water in the arid landscape. In the north they are known as prairie potholes; in the south, playa lakes. Playa lakes create unique microclimates that support diverse wildlife and plant communities. A playa can lie with little or no water for long periods, or have several wet/dry cycles each year. When it rains, what appeared to be only a few clumps of short, dry grasses just a few days earlier suddenly teems with frogs, toads, clam shrimp, and aquatic plants.

The playas provide a perfect home for migrating birds to feed, mate, and raise their young. Millions of shorebirds and waterfowl, including Canada geese, mallard ducks, and Sandhill cranes, depend on the playas for their breeding grounds. From the prairie potholes of North Dakota to the playa lakes of West Texas, the abundance and diversity of native bird species directly depends on these lakes.

Despite their small size, playa lakes and prairie potholes also play a critical role in supplying water to the Great Plains. The contribution of the playa lakes to this sensitively balanced ecosystem needs to be monitored and maintained in order to avoid unforeseen impacts on our natural resources.

Before cultivation, water from these lakes was the primary source of the recharge to the High Plains aquifer. But many playas are disappearing and others are threatened by growing urban populations, extensive agriculture, and other filling and tilling practices. In recent years, agricultural demands have drawn down the playas to irrigate crops. Agricultural waste and fertilizer residues drain into playas, decreasing the quality of the water, or clogging them so the water cannot trickle down to refill the aquifer. Climate change is expected to add to these stresses, with increasing temperatures and changing rainfall patterns altering rates of evaporation, recharge, and runoff to the playa lake systems.

DUST BOWL LESSONS

The Dust Bowl of the 1930s epitomizes what can happen as a result of interactions between climate and human activity. In the 1920s, increasing demand for food encouraged poor agricultural practices. Small-scale producers ploughed under native

grasses to plant wheat, removing the protective cover the land required to retain its moisture. Variations in ocean temperature contributed to a slight increase in air temperatures, just enough to disrupt the winds that typically draw moisture from the south into the Great Plains. As the intensively tilled soils dried up, topsoil from an estimated 100 million acres of the Great Plains blew across the continent.

The Dust Bowl dramatically demonstrated the potentially devastating effects of poor land-use practices combined with climate variability and change. A similar trend is apparent today. Water is being pumped from the Ogallala aquifer faster than it can recharge.

In many areas, playa lakes are poorly managed. Existing stresses on water resources in the Great Plains due to unsustainable water usage are likely to be exacerbated by future changes in temperature and precipitation, this time largely due to human-induced climate change.

NATIVE AMERICANS

The Great Plains region is home to 65 Native American tribes. Native populations on rural tribal lands often have limited resources to respond to climate change. Many reservations already face severe problems with both water quantity and quality—problems likely to be exacerbated by climate change and other human-induced stresses.