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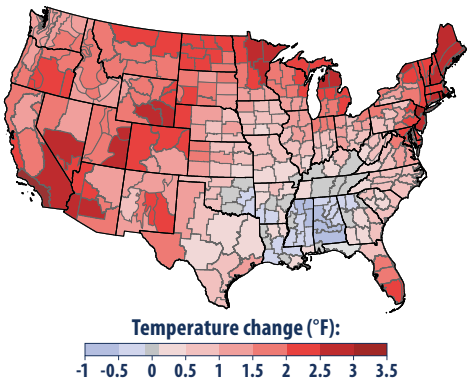
What Climate Change *Means for* North Dakota

North Dakota's climate is changing. In the past century, most of the state has warmed about two degrees (F). Rainstorms are becoming more intense, and annual rainfall is increasing. In the coming decades, longer growing seasons are likely to create opportunities for farmers, and increasing rainfall may benefit some farms but increase the risk of flooding.

Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree during the last 50 years. Evaporation increases as the atmo-sphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others.

Greenhouse gases are also changing the world's oceans and ice cover. Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed about one degree during the last 80 years, and sea level is rising at an increasing rate. Warming is causing snow to melt earlier in spring.



Rising temperatures in the last century. North Dakota has warmed more than most of the United States. Source: EPA, Climate Change Indicators in the United States.

Precipitation and Water Resources

Changing the climate is likely to increase the demand for water and make it more available. Rising temperatures increase evaporation and water use by plants. But rainfall is also likely to increase, so soil moisture is likely to increase slightly or remain about the same as today. More water is likely to run off into the upper Missouri River and its tributaries.

The resulting increase in river flows could benefit recreational boating, public water supplies, and electric power generation. During droughts, decreased river flows can lower the water level in lakes and reservoirs, which may limit water supplies and impair swimming, fishing, and other recreational activities. But if more water flows through the rivers before or during a drought, these problems will become less likely. Higher water flows also increase hydropower production, which accounts for about 5 percent of all energy produced in North Dakota. Nevertheless, droughts are likely to become more severe in downstream states. When droughts lower water levels enough to impair navigation, the U.S. Army Corps of Engineers releases water from the upstream dams, making less water available to North Dakota.

Increased Flooding

Greater river flows, increasing precipitation, and more severe storms are each likely to increase the risk of flooding. The year 2011 was one of the wettest years on record: the Souris River near Minot crested at four feet above its previous record, with a flow five times greater than any in the past 30 years, and flooding occurred throughout the state. In the Red River watershed, river flows during the worst flood of the year have been increasing about 10 percent per decade since the 1920s.

Flooding of the Red River at Grand Forks in 1997. Flood magnitudes have been increasing since the 1920s in the Red River watershed. Credit: Tony Mutzenberger, USGS.

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Heavy Storms

Warmer air tends to have more water vapor, so more water can be potentially released in a storm. During the last 50 years, the amount of rain falling during the wettest four days of the year has increased about 15 percent in the Great Plains. Over the next several decades, heavy downpours are likely to account for an increasing fraction of all precipitation.

Agriculture

Changing the climate is likely to have both positive and negative effects on agriculture in North Dakota. Warmer temperatures have extended the growing season by about 30 days since the beginning of the 20th century. Corn and soybeans are now grown in areas that were previously too cold for those crops, and warmer temperatures are likely to increase corn yields in the future. The fertilizing effect of increased concentrations of carbon dioxide is likely to further increase yields of corn and substantially increase yields of wheat and soybeans. The extended growing season might allow two crops per year instead of one in some instances. Increased precipitation at the beginning of the growing season is likely to help ensure that soils are sufficiently moist for the growing season.

Although the longer growing season benefits most crops, planting dates might be delayed if increased winter and spring precipitation leaves some fields too wet to plant. Rising temperatures may also reduce yields of wheat, partly offsetting the fertilizing effect of carbon dioxide. Warmer winters may promote the growth of weeds and pests. During drought years, hotter summers will dry the soil more than would otherwise occur. Over the next 70 years, the number of days above 100°F is likely to double, which could further stress crops during drought years.

Ecosystems

Rising carbon dioxide concentrations are likely to increase the productivity of grasslands. Although ecosystems generally benefit from higher productivity, several impacts of a changing climate may harm ecosystems. Changes in temperature and the length of the growing season may disrupt natural ecological processes and shift species' ranges. Many species of birds are shifting northward as temperatures rise, and warmer temperatures are causing flowers in North Dakota to bloom earlier in spring. Even small changes in the timing of plant development or animal migration can disrupt predator-prey relationships, mating behavior, or availability of food.

Human Health

Extremely hot and cold days can be unhealthy—even dangerous. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. The elderly may be particularly prone to heat stress and other heat-related health problems, including dehydration, cardiovascular strain, and respiratory problems. Those with low incomes may be particularly vulnerable due to a lack of air conditioning. Power failures due to severe weather can also present risks, especially in lightly populated areas where access to the necessary support services may be limited. While these risks will increase as the climate becomes warmer, illnesses and deaths due to cold weather and snow are likely to decline.

Climate change may also increase the length and severity of the pollen season for allergy sufferers. For example, the ragweed season in Fargo has grown 19 days longer since 1995, because the first frost in fall is later.

A photo of a ragweed plant, a common source of allergens in North Dakota. Like many crops and pollen sources, ragweed will have a longer growing season as temperatures rise. Stock photo.

The sources of information about climate and the impacts of climate change in this publication are: the national climate assessments by the U.S. Global Change Research Program, synthesis and assessment products by the U.S. Climate Change Science Program, assessment reports by the Intergovernmental Panel on Climate Change, and EPA's *Climate Change Indicators in the United States*. Mention of a particular season, location, species, or any other aspect of an impact does not imply anything about the likelihood or importance of aspects that are not mentioned. For more information about climate change science, impacts, responses, and what you can do, visit EPA's Climate Change website at www.epa.gov/climatechange.

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