



Nebraska Elder Climate Legacy Initiative¹

Fact Sheet: Climate Change and Its Implications for Nebraska

What we know

- Climates have changed in the past and will continue to change in the future in response to both natural and anthropogenic or human induced forces. Recent changes in climate have been confirmed globally from many data sources and are the result of human actions. There is a strong scientific basis for this conclusion, as confirmed in the 2018 4th National Climate Assessment report issued by the U.S. government. This Congressionally mandated report concluded that the effects of global warming are intensifying and getting costlier.
- Natural forces or forcings that affect our climate occur on long timescales, i.e., thousands of years. These forcings would include solar variability, such as changes in the earth's orbit or changes in solar energy the earth receives. These changes in natural forcings have always occurred and continue today but *natural forces cannot explain recent changes in the earth's climate*, e.g., increasing temperatures, the increased occurrence and severity of extreme events. Massive volcanic eruptions, a natural forcing, can alter the earth climate but they normally have a short-term cooling effect, i.e., 12-18 months, on the earth's climate.
- Anthropogenic forces that are affecting our climate include emissions of greenhouse gases (GHG) through the burning of fossil fuels, changes in land use and aerosol production. In recent decades, these human-induced forcings have affected and are continuing to affect the global

“Climate change poses many challenges that affect society and the natural world. With these challenges, however, come opportunities to respond. By taking steps to adapt to and mitigate climate change, the risks to society and the impacts of continued climate change can be lessened.” (4th

National Climate Assessment report, 2018)

¹ Prepared by: Nebraska Elder Climate Legacy Initiative, <http://elderclimatelegacy.org>

climate system and at an accelerating rate. Changes in temperature and other associated changes in the climate, as well as projected changes in climate, are the direct result of the rapid increase in GHG concentrations. These recent observed changes in our climate are occurring on short timescales, i.e., decades.

- Atmospheric CO₂ concentrations have increased from 280 parts/million (ppm) at the beginning of the Industrial Revolution to more than 415 ppm, measured recently (May 13, 2019). Atmospheric CO₂ levels are increasing at approximately 2.5 ppm/year and are expected to reach 500 ppm by the end of the 21st Century. CO₂ levels are now at their highest level in the past 3 million years. CO₂ levels in the atmosphere have increased from 315 ppm in 1960 to 415 ppm today.
- GHGs, including carbon dioxide (CO₂), nitrous oxide and methane, are the heat regulators for the Earth. Their concentration in the atmosphere control the heat balance for the Earth by trapping heat emitted from the Earth's surface. GHGs are the thermostat for the planet. When CO₂ and other GHGs concentrations are high, the Earth's temperature is high. Likewise, when CO₂ and other GHG concentration are low, the Earth's temperature is lower.
- Based on a review of peer reviewed research publications globally, 99% of climate scientists agree that our climate is changing and human actions are the primary cause for these changes.
- According to NOAA, the globally averaged land surface temperature for 2019 was 2.56°F above the 20th Century average.
- 2019 marks the 43rd consecutive year (dating back to 1977) with global land and ocean temperatures above the 20th Century average.
- The five warmest years on record globally have occurred since 2015.
- Globally, December 2019 represents the 420th consecutive month with above average temperatures based on the 30-year average.
- Since 1981, the average rate of temperature increase has been .32°F per decade.
- The amount of temperature increase varies regionally due to different climatic controls such as proximity to large water bodies, mountain ranges, latitude and prevailing winds.
- Since 1980, average U.S. temperatures have increased by 2.5°F, leading to more hot days (>90 ° F) and fewer extremely cold days.
- During the 21st century and beyond, one of the many effects of climate change will be its impact on global food prices and food security. This will lead to an increasing number of climate refugees fleeing areas of food shortages for resettlement in Europe, the United States, Canada and other developed nations.
- A United Nations report in May 2019 on biodiversity concluded that 1 million species of plants and animals will be extinct in the near future due to climate change, loss of habitat, overfishing of oceans, pollution, invasive species and other factors.
- All nations must work together to *adapt* to observed and projected changes in climate and *mitigate* as much future warming and other disruptions to the

“Among the future trends that will impact our national security is climate change. Rising global temperatures, changing precipitation patterns, climbing sea levels, and more extreme weather events will intensify the challenges of global stability, hunger, poverty and conflict. They will likely lead to food and water shortages, pandemic disease, disputes over refugees and resources, and destruction by natural disasters in regions across the globe.” (Chuck Hagel, former Secretary of Defense and former U.S. Senator from Nebraska, 2014)

climate system by reducing GHG emissions. Adaptation is associated with adjustments in natural or human systems in a new or changing environment that exploits beneficial opportunities or moderates negative effects (4th National Climate Assessment, 2018)

Nebraska's Changing Climate

- Climate change, largely due to human actions, is real and a threat to Nebraska's economy, economic development, the environment, and public health. Nebraska's economy is especially vulnerable to a changing climate due to its reliance on agriculture, the most sensitive sector to the vagaries of climate.
- Since 1970, temperature records for Nebraska indicate that average temperatures have increased by 2°F. Lincoln's average temperature has increased by 1.8°F since 1970.
- Lincoln's average winter temperature has increased by 3.5°F since 1970. Lincoln is also experiencing less extreme cold when you plot the lowest recorded winter temperature during the period from 1970 to 2018. The trend shows minimum temperatures have increased by 7.5°F since 1970. Average annual snowfall has declined sharply during this same period.
- On average, the growing season in Nebraska has increased by one week in recent decades. Precipitation trends across Nebraska have been variable with some areas experiencing a slight increase while other areas have experienced a slight decrease in recent decades.
- The occurrence of very heavy precipitation events has increased by an average of 29% in the Northern Great Plains during the past 50 years. Heavy precipitation events increase soil erosion, runoff and flood potential. This change in heavy precipitation events has serious implications for agriculture, ecosystems, transportation, urban areas and the public health sector.

Key Messages from the 4th National Climate Assessment Report (2018²): Northern Great Plains Region (Nebraska, North Dakota, South Dakota, Montana and Wyoming)

Key Message 1: Water

Water is the lifeblood of the Northern Great Plains, and effective water management is critical to the region's people, crops and livestock, ecosystems, and energy industry. Even small changes in annual precipitation can have large effects downstream; when coupled with the variability from extreme events, these changes make managing these resources a challenge. Future changes in precipitation patterns, warmer temperatures, and the potential for more extreme rainfall events are very likely to exacerbate these challenges.

Key Message 2: Agriculture

Agriculture is an integral component of the economy, the history, and the culture of the Northern Great Plains. Recently, agriculture has benefited from longer growing seasons and other recent climatic changes. Some additional production and conservation benefits are expected in the next two to three

² **Fourth National Climate Assessment (NCA4) 2017/2018** is a 1,500 page two-part congressionally mandated report by the [U.S. Global Change Research Program](#) (USGCRP)^[1]—the first of its kind by the [Trump administration](#), who released the report on November 23, 2018. The climate assessment process, with a report to be submitted to Congress every four years, is mandated by law through the [Global Change Research Act of 1990](#).

decades as land managers employ innovative adaptation strategies, but rising temperatures and changes in extreme weather events are very likely to have negative impacts on parts of the region. Adaptation to extremes and to longer-term, persistent climate changes will likely require transformative changes in agricultural management, including regional shifts of agricultural practices and enterprises.

“Climate change will bring hotter temperatures, changing rainfall patterns and more frequent natural disasters. These effects could slow the growth of food production by 2% each decade for the rest of the century. Farmers everywhere will be affected. If these challenges are not addressed, consumers will need to be prepared for higher food prices and potential food shortages.”

(Doug Bereuter, Member of Congress from Nebraska, 1979-2004)

Key Message 3: Recreation and Tourism

Ecosystems across the Northern Great Plains provide recreational opportunities and other valuable goods and services that are at risk in a changing climate. Rising temperatures have already resulted in shorter snow seasons, lower summer streamflows, and higher stream temperatures and have negatively affected high elevation ecosystems and riparian areas, with important consequences for local economies that depend on winter or river-based recreational activities. Climate-induced land-use changes in agriculture can have cascading effects on closely entwined natural ecosystems, such as wetlands, and the diverse species and recreational amenities they support. Federal, tribal, state, and private organizations are undertaking preparedness and adaptation activities, such as scenario planning, transboundary collaboration, and development of market-based tools.

Key Message 4: Energy

Fossil fuel and renewable energy production and distribution infrastructure is expanding within the Northern Great Plains. Climate change and extreme weather events put this infrastructure at risk, as well as the supply of energy it contributes to support individuals, communities, and the U.S. economy as a whole. The energy sector is also a significant source of greenhouse gases and volatile organic compounds that contribute to climate change and ground level ozone pollution.

Key Message 5: Indigenous Peoples

Indigenous peoples of the Northern Great Plains are at high risk from a variety of climate change impacts, especially those resulting from hydrological changes, including changes in snowpack, seasonality and timing of precipitation events, and extreme flooding and droughts as well as melting glaciers and reduction in streamflows. These changes are already resulting in harmful impacts to tribal economies, livelihoods, and sacred waters and plants used for ceremonies, medicine, and subsistence. At the same time, many tribes have been very proactive in adaptation and strategic climate change planning.

Projections for Nebraska’s Climate (Summarized from *Understanding and Assessing Climate Change: Implications for Nebraska*, UNL 2014 report, and the *4th National Climate Assessment Report*, 2018)

- Projected temperature changes for Nebraska by the 4th quarter of the 21st Century range from 4-5°F (low CO₂ emissions scenario) to 8-9°F (high CO₂ emissions scenario). This range in projected temperature is due to uncertainties regarding future emissions of CO₂ into the atmosphere, not because of computer model inaccuracies. Globally, we are on the high emissions scenario. The number of high temperature stress days (days over 90°F) is expected to increase

substantially by 2041-2070 under both the high (35-45 additional days) and low (25-35 additional days) emissions scenarios. These changes are roughly equivalent to the temperatures observed in Nebraska during the 2012 drought.

- Warm nights (temperatures above 60°F for the northern Great Plains) are expected to increase by 20-25 nights for the lower emissions scenario and by 25-40 nights for the high emissions scenario.
- The length of the frost-free season is expected to increase by an additional 2 weeks by the mid-21st Century.
- Annual and winter precipitation is not expected to change substantially. Spring precipitation is expected to increase while changes in summer precipitation is expected to be small with a protracted drying likely in the central Great Plains due to projected temperature increases.
- The trend toward a decline in snowpack in the Rocky Mountains will continue with serious implications for streamflow on the Platte and Missouri Rivers.

Implications for Nebraska

- Increasing temperatures, both daytime and nighttime, high temperature stress days, the rising incidence of weather extremes and more variable precipitation will:
 - increase evaporation and transpiration rates;
 - increase the frequency, duration and severity of drought events;
 - reduce soil moisture and groundwater recharge;
 - increase the frequency of excessive rainfall events, flood frequency, and soil erosion.
 - have a profound negative effect on crop productivity in Nebraska through its impact on yield and nutrient quality;
 - have a profound negative effect on livestock production in Nebraska through its impact on (1) feed-grain production, availability and price; (2) pastures and forage crop production and quality; (3) animal health, growth and reproduction; and (4) disease and pest distributions;
 - require adoption of new crop and water management practices and technological innovations in order to keep pace with more rapid changes in climate over the next several decades;
 - increase irrigation demand in agricultural and urban areas, as occurred during the severe drought in 2012 that depleted groundwater levels in parts of the state by 5 to 20 feet and increased energy costs for irrigated agriculture;
 - threaten human health through increased exposure to extreme weather events, wildfire, decreased air quality, threats to mental health and illnesses transmitted by food, water and disease carriers such as mosquitoes and ticks;
 - continue to have significant impacts on species and ecosystems by changing species distribution, altering the timing of annual life-cycle events and disrupting ecological relationships. Climate change will exacerbate the effects of non-climatic stressors such as habitat loss and fragmentation, pollution and the spread of invasive species, pests and pathogens.
 - lead to substantial and negative impacts on the state's tree and forest resources through the increased incidence and severity of drought and severe weather events, higher day

“We are sleepwalking toward a climate catastrophe and need to wake up and take urgent action”
(Alden Meyer, Union of Concerned Scientists, NYTimes, 11/26/19).

and nighttime temperatures that are leading to the reduced health, vitality and resilience of urban and rural forest ecosystems and forest and wildfires.

Building Resilience to a Changing Climate: The Need for a Nebraska Climate Action Plan

It is clear that the development and implementation of a climate action plan by the State of Nebraska could facilitate the process of adapting to and mitigating the effects of current and projected changes in climate. The majority of rural Nebraskans support such an action, as noted by a poll of rural Nebraskans (University of Nebraska, 2015) that found 61% of those responding agreed that the State of Nebraska should develop a climate action plan. LB 283 was introduced in the Nebraska legislature in 2019 but failed to move out of the Executive Committee.

Increases in extreme weather and climate events is occurring throughout the U.S. and globally. For example, in 2017, 16 weather and climate related disaster resulted in losses of \$1 billion dollars or more—total losses in 2017 exceeded \$400 billion.

The 2019 flooding event in Nebraska and the Midwest is indicative of the trend for more climate-related disasters and the associated economic, environmental and social losses that were the result of these events. Losses in Nebraska in 2019 from the floods exceeded \$3.4 billion. Nebraska Governor Pete Ricketts recently noted that the flooding event of 2019 was one of the greatest natural disaster events to affect Nebraska.

Given the dependence of Nebraska’s economy on agriculture and the sensitivity of this sector to weather and climate conditions, a climate action plan would provide substantial economic development opportunities and increase climate resiliency. Nebraska could play a prominent leadership role in addressing this important issue in the key agricultural states of the Great Plains and Midwest states.

“My message today is one of hope, not of despair. Hope, unfortunately, is not a plan” (UN Secretary-General Antonio Guterres at the beginning of the Madrid Climate Change Summit as reported by the Washington Post, 12/3/19).

A climate action plan would be prepared in consultation with key stakeholders with the goal of assisting local and state government, businesses and private citizens prepare for current and projected changes in climate. Many of these actions are ‘no-regrets’ adaptation and mitigation actions that focus on sustainability, e.g., increased water and energy efficiency, adopting new crop and livestock management strategies, improved soil management practices, increased soil health, and accelerating the shift to renewable energy sources that will take advantage of Nebraska’s wind and solar potential and stimulate economic development in rural Nebraska. As noted in the report on climate change produced by the University of Nebraska-Lincoln in 2014, ‘action now is preferable and more cost effective than reaction later.’ Nearly 350 stakeholders who attended the eight sector-based roundtables that met in 2015 to discuss adaptation and mitigation measures appropriate for their sector also reinforced the importance of taking action now. These reports are available at <http://go.unl.edu/climatechange>.

