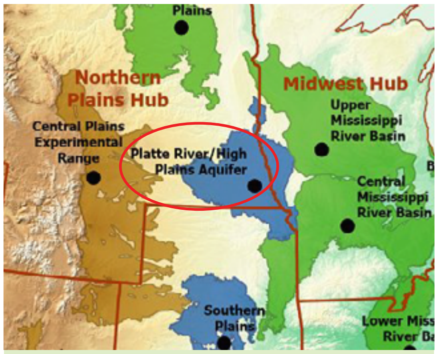
THE PLATTE RIVER HIGH PLAINS AQUIFER (PRHPA)



Location and Climate

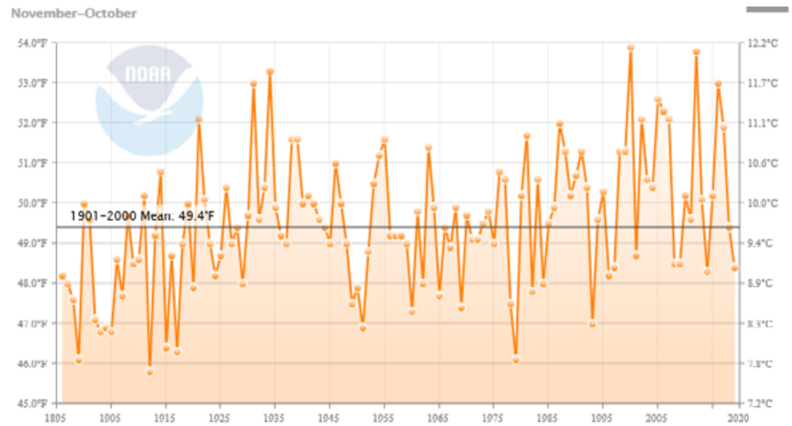
The Platte River High Plains Aquifer (PRHPA) Long-Term Agroecosystem Research (LTAR) conducts a majority of its research at the UNL's Eastern Nebraska Research and Extension Center. The irrigated and rainfed croplands as well as the pasture sites are located within 41.18° N latitude and -96.44° W longitude, 360 asl). These sites support aspirational research targeted towards adapting to emerging challenges that face Nebraska's agro-ecosystems including corn, soybean and livestock farming production systems.

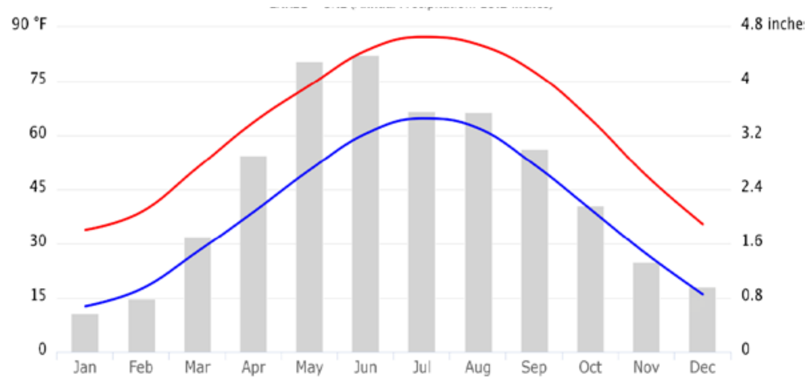
Historic Precipitation

The PRHPA experiences a continental climate characterized by mean annual precipitation of 760 mm and annual temperature is 10°C. Most of the precipitation falls during the growing season (April to September). Highest temperatures are experienced in July (average of 31°C) and lowest temperatures are experienced in February (average -9°C). Duration for frost-free growing season is around 161 days.

LTAR Network and USDA Climate Hubs are working to develop knowledge and technology for sound resource management **via research with partners.** The goal is to ensure **sustained crop and livestock production and ecosystem services** from agroecosystems, and to forecast and verify the effects of environmental changes, public policies, and emerging technologies.

Average annual temperature variation as compared to mean temperature 1901-2000 (credit: NOAA).





Maximum (red line) and Minimum (blue line) temperature and mean precipitation (gray bars) 1981-2010 (credit: Climate Toolbox).

Measuring Weather and Climate

Nebraska and other states in the Plains are generally showing warming in the winter and springs. Nighttime lows have increased compared to daytime highs. In Nebraska, temperatures have risen about 1°F since 1895. The positive trend in both low temperatures and high temperatures is notable with the low temperatures being greater. Minimum temperatures have increased by 2.0- 4.0°F per century while maximum temperatures have increased by 1.0-2.5°F over the same duration. Frost-free season has increased 5-25 days since 1895. There is no discernable trend in mean annual precipitation in Nebraska however the rate of very heavy precipitation events in the Great Plains Region has increased by 16%.

Impacts to Agriculture

Evidence has shown that agriculture in Nebraska and elsewhere is already being impacted by climate variability and change as well as weather extremes. These include diseases, pests and invasive species shifts; strains on water resources to meet agricultural, community and natural resource needs; and extremes in precipitation and temperature impacting the economic sustainability of all sectors of agriculture.

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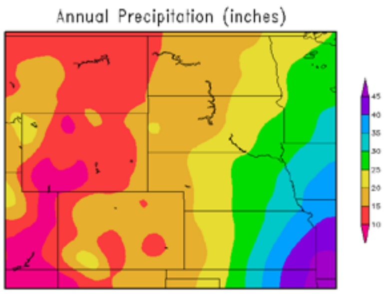
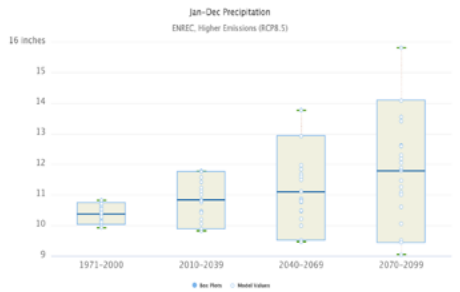
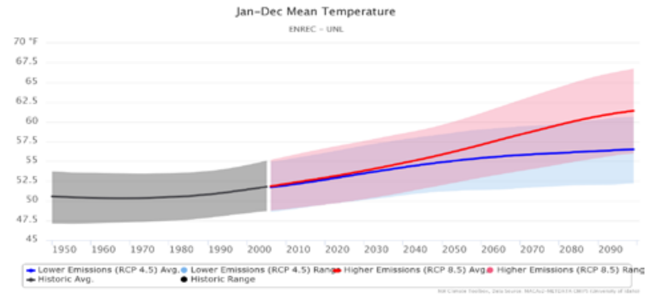


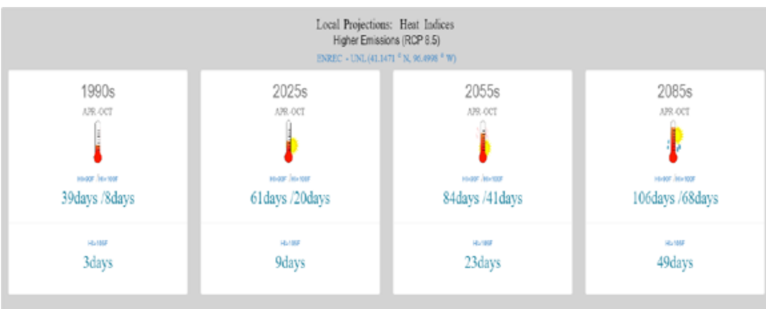
Annual Precipitation (inches), 1981-2010 (credit: HPRCC)



1971- 2099: Historical and Projected Annual Precipitation at ENREC, UNL ((credit: Climate Toolbox).



Mean temperature projections (credit: Climate Toolbox).



Future climate projections dashboard for ENREC (credit: Climate Toolbox).

Climate and Climate Change

It is projected that by 2100, temperatures will increase by 4-5°F under the low emissions scenario while projected temperatures under a high emissions scenario will increase by 8-9°F. Additionally projected summer of 2100 will have 13-25 days over 100°F and the number of nights over 70°F will increase by 20-40 days. Soil moisture is projected to decrease by 5-10% while streamflows in Nebraska's rivers such as the Platte River will experience flow volume reductions due in part to the reduced snowpack in Rocky Mountains in Colorado. Heavy precipitation events, increased flooding magnitudes, drought frequency and severity are all projected to increase.

To manage land sustainably, consider weather and climate.

Crop production

Climate change is anticipated increase plant stresses during crucial plant development (Wienhold et al., 2018). Steps to maximize resiliency of soils, mitigate weather extremes, and improve water and nutrient use efficiencies of crops, through crop rotations, cover cropping increased cropping intensity, reducing tillage among other practices have been tested and promoted (BlancoCanqui et al., 2015, Wienhold et al., 2018). Selection of improved and tolerant plant hybrids that can withstand either or both abiotic and biotic stresses is underway using biotechnology and/or conventional breeding (e.g. Werle et al., 2017; Blecha et al., 2019).

Livestock production

Livestock are valuable to Nebraska's economy. However, they contribute to large amounts of greenhouse gases (Holley and Liska, 2020). Weather extremes, especially in the summer, can result in livestock deaths. Limited land resources and the encroachment of invasive species also pose threats to feed availability. The use of shade and water have been used to help livestock adapt during extreme weather events (Mader et al. 1999). Integrated croplivestock systems which include the utilization of crop residues, perennial forages, and/or failed crops are currently encouraged and have been found to be beneficial in enhancing biological biodiversity and increasing both the quality and quantity of animal protein (Wienhold et al., 2018, Kumar et al. 2019).

Invasive Species

New improved breeds as well as diversification of cropping systems are important in addressing increased occurrence of pests and diseases and decrease the risks of total losses (Bathke et al. 2014).

Water Resources

Nebraska ranks first in the quantity of water and irrigated acreage (Johnson et al., 2011). Conservation practices such as deficit irrigation have been found to be economical (Rudnick et al., 2019). The need to increase water productivity continues to be explored through the application of different management practices (Mekonnen, 2020). Fertilizer costs eutrophication effects due to heavy leaching from heavy rain event, are being addressed through the implementation of in-season variable N fertilizer rate applications while using reactive N fertilizer (Thompson et al., 2015).

Decision Support Tools

Projected changes pose several challenges to the timing of field operations (e.g. planting, harvesting). Delays in field operations due to reduced workability of the cropland affect production resulting in severe losses. Modelling tools have been applied to assist farmers to select hybrids while simulating several different climatic scenarios to maximize profits (Yang et al, 2015).

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