Past, Current and Future Climate Trends

Abstract
Nebraska has experienced a warming trend, which is expected to continue in the future. The rate of change going forward will be greater than the historical trend. Precipitation has seen an overall increase, and this trend is also expected to continue. There will also be an increase in heavy rain events, increased variability and more precipitation during the winter and spring with less during the summer. Impacts of these changes include

Nebraska's climate has warmed over the last century. On average, temperatures have increased about 1.6°F since 1895 (a rate of 0.15 degrees per decade). The rate of warming has generally increased over the last 30 years (0.3 degrees per decade), most notably for summer and fall. One exception to the warming in recent years is a cooling trend for the winter months, where temperatures have cooled about one degree since 1987.

Overall, the rise of minimum temperatures is outpacing the rise in maximum temperatures by a factor of two. Lows have warmed 2.2 degrees while highs have warmed 1.1 degrees. Portions of Nebraska have experienced a slight long-term cooling trend in maximum temperatures during summer and fall. However, since 1987, the trend for summer and fall has been warming trend of one degree.

Climate models project the overall warming trend will continue through the century. The rate of warming will accelerate in the coming decades. By mid-century, average temperatures in Nebraska are expected to be 2 to 5 degrees warmer than they are now, increasing at a rate of 0.5 to 1.25 degrees per decade.

Nebraska experiences, on average, 10 to 20 days annually with a high temperature greater than 95°F. By mid-century, this number will likely double, impacting forage growth and development. Conversely, the number of extreme cold days will be reduced by about half.

The length of the growing season (number of days between the last spring and first fall freeze) can be quite variable in Nebraska – on the order of 60 days, in fact. On average, it is about 150 days. By mid-century, the length of the growing season is expected to increase by several weeks. Currently, modified growing degree days (base of 50°F) is 3,000 to 4,000 units. An increase of about 20% can be expected by mid-century.

Nebraska's precipitation patterns can generally be defined by high year to year variability and a strong west to east gradient where annual totals increase by 50%. Through the 20th century our climate generally became slightly wetter, with a precipitation increase of 1.3 inches. Much of this is a result of more precipitation in spring. Trends over the last 30 years are amplified with an increase of 2 inches in the annual average, half of which occurs during spring. Portions of Nebraska have experienced a recent drying trend during the summer, fall and winter.

Climate model projections for precipitation point to a persistence of the wetting trend for the annual average total. We can expect our historical trend to continue with an increase in precipitation. There are changes expected in when this precipitation falls, however. Winter and spring totals will be about 20% higher than current conditions. Fall will be slightly wetter (5%) and summer will be about 10% drier than present climate, impacting summer irrigation demand.

Daily rainfall greater than one inch is generally not too common (less than 5 days per year), but we have experienced an increase for central and northeast Nebraska. Days with heavy precipitation will increase by about 20% by mid-century. Furthermore, multi-day extreme precipitation events will increase in severity. Soil cover and structure will be critical to reduce runoff and increase infiltration of excess precipitation.

Implications

Projected effects of Nebraska's changing climate include longer growing season, warmer summers, more heat extremes, wetter winter and spring, more extreme rain events, more frequent large hail. These shifts impact evaporative demand, water requirements, livestock stress, field work days and runoff and soil erosion.

The severity of large scale events, such as the March flood of 2019, generally are determined by a combination of multiple factors and timing. They are not expected to be the norm due to climate change, rather an increased likelihood of occurrence.

There is inherent variability in Nebraska's climate and the potential for back to back flood to drought years. As such, reservoir and groundwater storage are expected to become even more important to mitigate enhanced risk to future precipitation variability that lies outside of the range of past experience. Sustainable water management is therefore paramount.