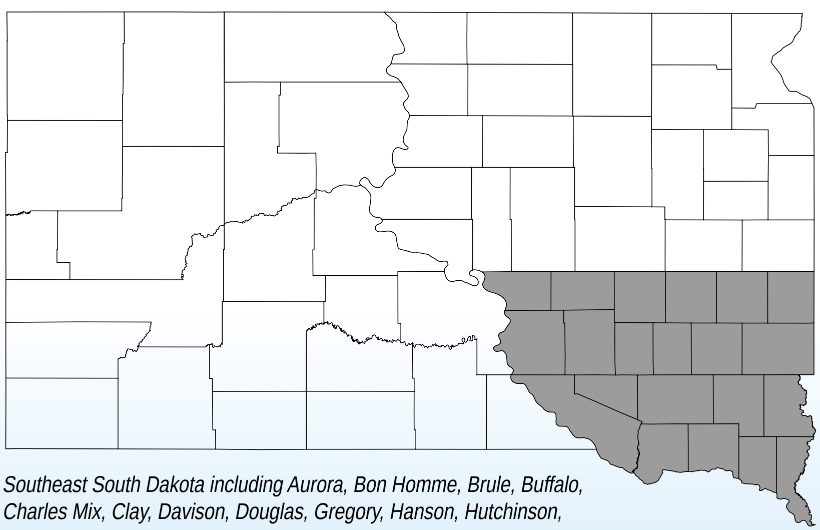
# AGRICULTURE AND WEATHER VARIABILITY IN THE CORN BELT: SOUTHEAST SOUTH DAKOTA

Corn is currently grown on more than 20 percent of total U.S. cropland and is the dominant crop in the Midwest region, most often in rotation with soybean. The highly versatile crop is an economic powerhouse, employing millions and producing food, feed and fuel for use by every citizen. With demand at an all-time high, success for farmers and industry relies on a profitable cropping system while also employing measures which will protect the environment for future generations.

The Midwest is a highly productive agricultural region. This is due in part to a favorable environment, which includes deep soils, timely rainfall, and ample solar radiation, among many other factors. However, the region has experienced more volatile and variable weather events and conditions, including increased spring rainfall, more frequent 100-year floods, increasing dew points and humidity, and the accumulation of more growing degree days (www.globalchange.gov/usimpacts). Midwestern farmers are increasingly uncertain how these long-term climate trends are impacting corn-based cropping systems and are seeking ways to ensure continued crop productivity while minimizing environmental impact.

The United States Department of Agriculture (USDA) has identified the U.S. agricultural base as potentially susceptible to changes occurring in the climate. In fact, farmers have independently begun adjusting hybrid and management decisions either directly or indirectly to adjust to the changing climate. To address this need, the USDA has funded teams such as the Climate and Corn-based Cropping Systems Coordinated Agricultural Project to research potential climate impacts and help strengthen the resilience of U.S. agriculture. Research-driven recommendations can offer farmers and agribusiness a suite of tools to better equip them in meeting this challenge with strategies for adaptation and mitigation.



*Southeast South Dakota including Aurora, Bon Homme, Brule, Buffalo, Charles Mix, Clay, Davison, Douglas, Gregory, Hanson, Hutchinson, Jerauld, Lake, Lincoln, McCook, Miner, Minnehaha, Moody, Sanborn, Turner, Union, and Yankton counties*

## WHO

The Climate and Corn-based Cropping Systems Coordinated Agricultural Project is a transdisciplinary partnership among 11 institutions: Iowa State University; Lincoln University; Michigan State University; The Ohio State University; Purdue University; South Dakota State University; University of Illinois; University of Minnesota; University of Missouri; University of Wisconsin; USDA Agricultural Research Service – Columbus, Ohio; and USDA National Institute of Food and Agriculture (USDA-NIFA).

## WHAT

The team's goal is to promote long-term sustainability and productivity of U.S. corn-based cropping systems against recent climate trends and future uncertainty. Environmental, economic and social impacts are assessed within Midwest agricultural systems to sustainably increase resilience and adaptation capacity while meeting crop demand.

## WHEN

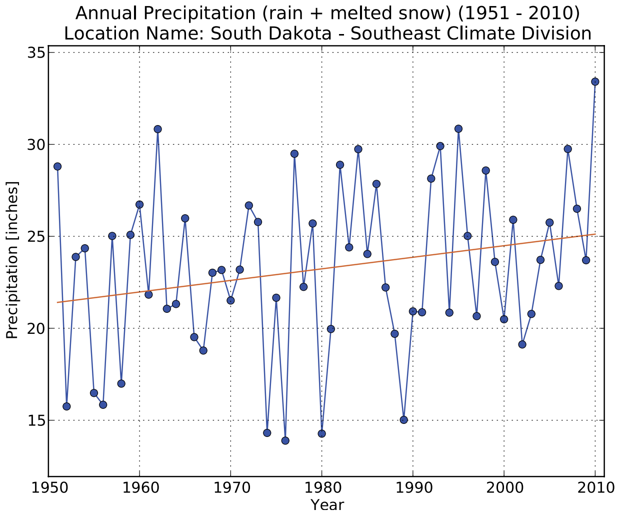
2011-2016

## WHERE

Twenty-six field sites; participating institutions represent nine Midwestern states.

## HOW

1. Develop standardized methodologies and perform baseline monitoring of carbon, nitrogen and water footprints at agricultural test sites across the Midwest.
2. Evaluate how crop management practices impact carbon, nitrogen and water footprints at test sites.
3. Apply models to research data and climate scenarios to identify impacts and outcomes that could affect the sustainability and economic vitality of corn-based cropping systems.
4. Gain knowledge of farmer beliefs and concerns about climate change, attitudes toward adaptive and mitigative strategies and practices, and decision support needs to inform the development of tools and practices that support long-term sustainability of crop production.
5. Promote extension, outreach and stakeholder learning and participation across all aspects of the program.
6. Train the next generation of scientists, develop science education curricula and promote learning opportunities for high school teachers and students.



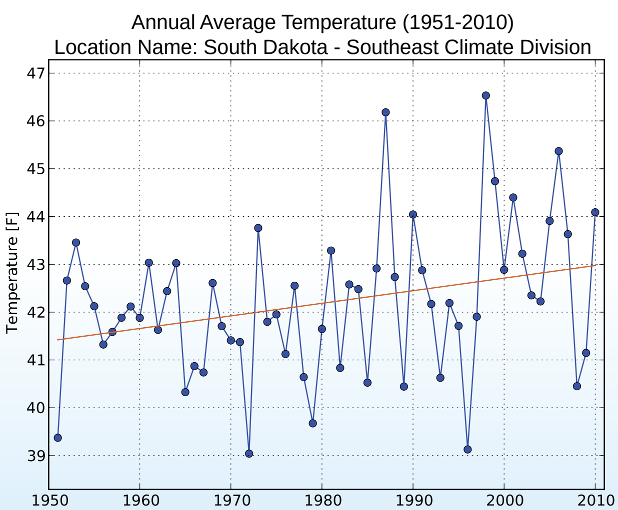

## Average Annual Precipitation

Variability in annual precipitation is observed in Southeast South Dakota throughout the 1951-2010 time period. Increases in spring rainfall may result in waterlogged soils and later planting dates.

*Figure 1 - Average annual precipitation across Southeast South Dakota from 1951 to 2010*

*Saturated soils and excess rain (W. Boyer)*

*Drought stressed corn (J. McGuire)*




## Average Annual Temperature

The average annual temperature in Southeast South Dakota from 1951 to 2010 has also fluctuated. However, after 1975, increases in temperature variability are observed.

*Figure 2 - Annual average temperature across Southeast South Dakota from 1951 to 2010*

This research is part of a regional collaborative project supported by the USDA-NIFA,
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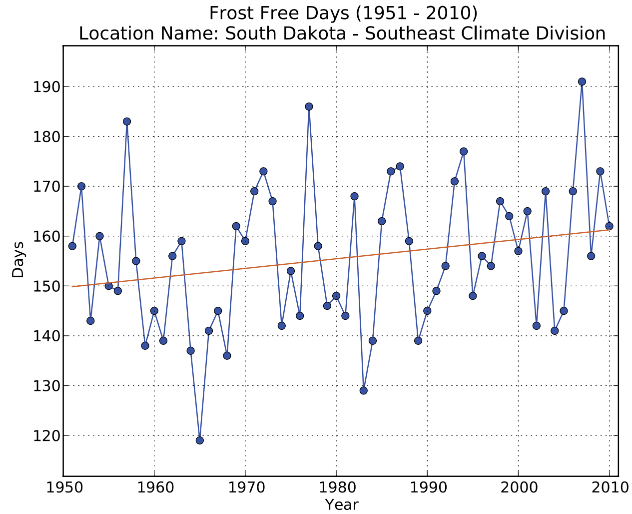
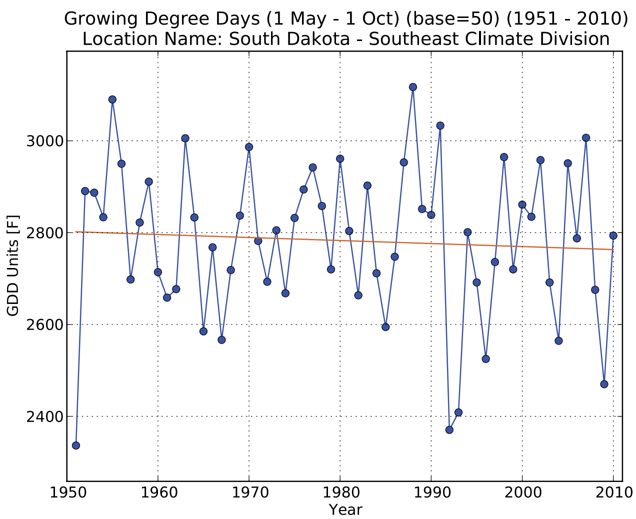
Project website: sustainablecorn.org




## Frost-Free Days

The number of frost free days has varied since 1951. Frost free days could begin earlier in the year compared to past decades and last later into the fall.

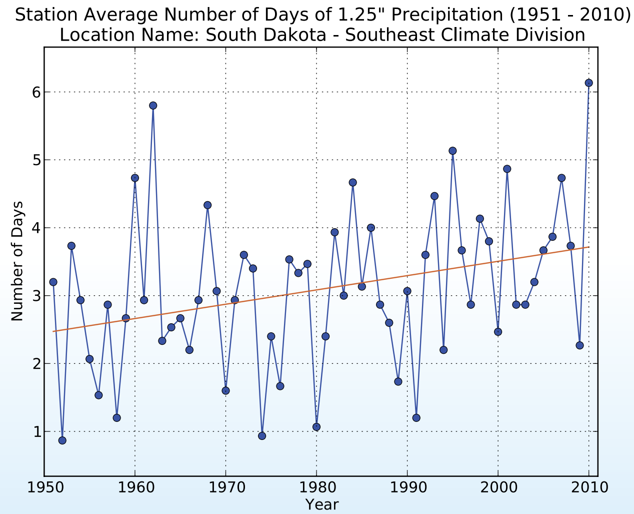
*Figure 3 - Number of frost-free days across Southeast South Dakota from 1951 to 2010*




## Growing Degree Days

Growing degree days have fluctuated across Southeast South Dakota from 1951 to 2010. Growing degree days (GDD) are calculated by subtracting the base temperature needed for growth (50°F) from the mean daily air temperature. For this calculation, 86 degrees Fahrenheit is used as the maximum temperature (Tmax) and 50 degrees Fahrenheit as the minimum temperature (Tmin); GDD=[(Tmin+Tmax)/2]-50 = GDD. For example, if the minimum and maximum temperatures are 54 and 87 degrees, respectively, the daily GDD is 21. The sum of all GDD during the growing season, May 1- October 1 for this publication, are calculated and used for tracking crop and insect development.

*Figure 4 - Number of growing degree days from May 1 to October 1 across Southeast South Dakota from 1951 to 2010*




## Increasing Extreme Rain Events

The number of days when precipitation exceeded 1.25 inches across Southeast South Dakota has varied since 1951. Extreme precipitation events have large implications on agricultural conditions. Increased soil erosion, delayed field operations, and increased flooding are challenges facing farmers when heavy rainfall events occur.

*Figure 5 - Number of annual days when total precipitation exceeded 1.25 inches (3 cm) across Southeast South Dakota from 1951 to 2010*

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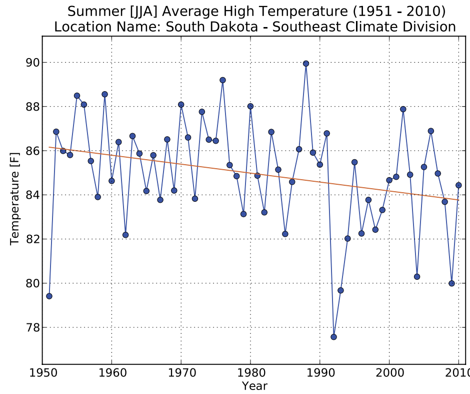
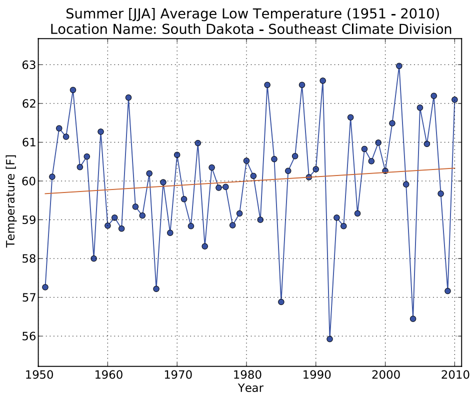
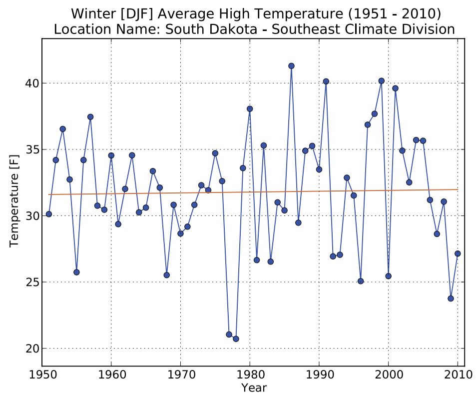
## Changing Temperature Patterns

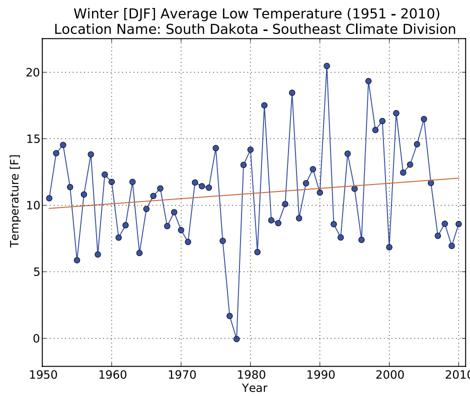
The summer average high and summer average low temperatures across Southeast South Dakota began to increase in variability in the 1980s. Winter average high and winter average low temperatures began to increase in variability in the mid-1970s.

*Figure 6. Region-wide temperature trends across Southeast South Dakota from 1951 to 2010 for summer daily maximum temperature (right), summer daily minimum temperature (below left), winter daily maximum temperature (below center), and winter daily minimum temperature (below right)*




## Summary

This project is continually gathering information and resources to understand the environmental, economic, and social impacts of long-term shifting weather patterns on agricultural production in the Midwest. The project will provide information and connect farmers with decision support tools and resources to help them make agricultural management decisions. It will be important for farmers in the Midwest to continuously evaluate their current farming practices and implement strategies that protect their productivity and the environment in the face of increasingly volatile and uncertain weather events.

**For More Information:** sustainablecorn.org

## References and Climate Data Source

The National Climate Data Center's Daily Climate Cooperative archives were used to compile state and regional data (http://gis.ncdc.noaa.gov/map/daily/). Although weather data have been collected for more than 100 years, the figures in this bulletin begin in 1950 and continue to present because these data are generally more rigorously evaluated and of higher quality.

Global Climate Change Impacts in the United States (www.globalchange.gov/usimpacts)

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