Climate of Minnesota

Introduction

This publication consists of a narrative that describes some of the principal climatic features and a number of climatological summaries for stations in various geographic regions of the State. The detailed information presented should be sufficient for general use; however, some users may require additional information.

The National Climatic Data Center (NCDC) located in Asheville, North Carolina is authorized to perform special services for other government agencies and for private clients at the expense of the requester. The amount charged in all cases is intended to solely defray the expenses incurred by the government in satisfying such specific requests to the best of its ability. It is essential that requesters furnish the NCDC with a precise statement describing the problem so that a mutual understanding of the specifications is reached.

Unpublished climatological summaries have been prepared for a wide variety of users to fit specific applications. These include wind and temperature studies at airports, heating and cooling degree day information for energy studies, and many others. Tabulations produced as by-products of major products often contain information useful for unrelated special problems.

The Means and Extremes of meteorological variables in the Climatography of the U.S. No.20 series are recorded by observers in the cooperative network. The Normals, Means and Extremes in the Local Climatological Data, annuals are computed from observations taken primarily at airports.

The editor of this publication expresses his thanks to those State Climatologists, who, over the years, have made significant and lasting contributions toward the development of this very useful series.

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Climate of Minnesota

Topographic Features- The State of Minnesota covers 84,068 square miles. There are 11,842 lakes greater than 10 acres. The State's jurisdiction covers 2,546 square miles of Lake Superior. Minnesota extends about 400 miles south to north between latitudes 43.5 and 49° North, and averages 275 miles east to west between longitudes 89.5 and 97° West.

Elevations are less than 1,200 feet near each of the three major rivers, the: Red, Minnesota and Mississippi (except in the northern part). There are three areas where elevations are greater than 1,600 feet: the Iron Range, paralleling the north shore of Lake Superior; the Coteau Des Prairies (also known as Buffalo Ridge), extending out of South Dakota across the southwest portion of the State; and a small area in the Lake Itasca region. The highest point above sea level, Eagle Mountain, in the extreme northeast portion of the State, is 2,301 feet, and the lowest is 602 feet along the shores of Lake Superior. Minnesota can be considered to have a continental divide in three directions: drainage is toward Hudson Bay to the north; toward the Atlantic Ocean to the east; and toward the Gulf of Mexico to the south.

Temperature- Minnesota has a continental-type climate and is subject to frequent outbreaks of continental polar air throughout the year, with occasional Arctic outbreaks during the cold season. Occasional periods of prolonged heat occur during summer, particularly in the southern portion of Minnesota, when warm air pushes northward from the Gulf of Mexico and the southwestern United States. Pacific Ocean air masses that move across the Western United States produce comparatively mild and dry weather at all seasons.

Mean annual temperatures range from 36 degrees Fahrenheit (° F) in the extreme north to 49 degrees along the Mississippi River in the southeast. State temperature extremes range from -60 to 114° F.

Monthly mean temperatures vary from 85 in the southwest to -11° F in the northwest. Mean temperatures during January in the northern portions of the State average near 4° F; this is 10 degrees colder than temperatures recorded at stations near Lake Superior and in southern Minnesota.

The mean temperature in July for the State averages about 70° F in most places but this is five to 10 degrees warmer than at stations near Lake Superior. Thus, Lake Superior stations are cool in summer and relatively warm in winter.

Dew point temperatures in most areas range from a high of 70° F in July to a low of 6 in January. However, the dew point temperatures average about five to 10 degrees lower in the extreme northern portion of the State at all seasons.

Precipitation- Although the total precipitation is important, its distribution during the growing season is even more significant. For the most part, native vegetation grows for seven months (April to October) and row crops grow for five months (May through September). During the latter five-month period, approximately two-thirds of the annual precipitation occurs. Mean annual precipitation is 35 inches in extreme southeast Minnesota, an amount that gradually decreases to 19 inches in the extreme northwest portion of the State. At most locations there have been months with no precipitation recorded. Statewide, two of the driest years were 1910 and 1976, while two of the wettest were 1965 and 1977.

Seasonal snowfall averages near 70 inches in the highlands along the north shore of Lake Superior in northeast Minnesota, gradually decreases to 40 inches along the Iowa border in the south, and is around 40 inches along the North Dakota and South Dakota borders in the west. Snow cover of one inch or more over the State occurs on an average of about 110 days annually, ranging from 85 days in the south to 140 days in the north.

Heavy snowfalls of greater than 4 inches are common any time from mid-November through mid-April. Heavy snowfalls with blizzard conditions affect the State on the average about two times each winter. The most devastating blizzards were those of January 11 - 13, 1888, and of November 11 - 12, 1940, which resulted in the loss of many lives and a heavy toll of livestock. Blizzard conditions are when visibilities are reduced to less than ¼ mile for several hours due to falling and/or blowing snow. The wind must be at least 35 mph. Another memorable blizzard occurred on October 31, 1991 and is known as the “Halloween Blizzard”. The Twin Cities received 28.4 inches of snow from this storm which lasted until November 3.

Conditions of severe drought with an annual Palmer Drought Index of -3 or lower are expected on the average about once in 10 years in southwest and west central Minnesota, to about once in 25 years over eastern Minnesota. The northeast part of the state experiences severe drought about once in 50 years.

Thunderstorms generally cause more damage to property in Minnesota than any other weather factor. The annual frequency of thunderstorm days is about 45 days in southern Minnesota, decreasing to about 30 days along the Canadian border. Generally, 80 percent or more of these storms occur during the heavier rainfall months--from May through September. Damaging local windstorms, tornadoes, hail, and heavy rains sometimes occur with better-developed thunderstorms.

The “tornado month” in the State is June, with July next, and then May. During these three months, over 75 percent of all tornadoes occur; May has about 17 percent, June around 33 percent, and July approximately 28 percent. Tornadoes have never been reported in the State during December, January and February. The average number reported annually is 35. The southern half of Minnesota has three to four times as many tornadoes as the northern half of the State. The deadliest Minnesota tornado of record was the Saint Cloud-Sauk Rapids tornado on April 14, 1886, when 74 lives were lost. The most damaging tornadoes were those occurring in the northern part of Minneapolis in the late afternoon of May 6, 1965, causing about $280 million (2001 figure) in damage.

The frequency of hail shows a high of three to four days annually in southwestern Minnesota, decreasing to near two days in the northern portion of the State. The month with the most hail is June, with May next, and then July. During these three months, about 60 percent of the hail occurs; June has 24 percent, May has 20 percent and July has 16 percent. The size of the hail reported is generally in the pea to dime-sized category, with several reports annually of baseball-size and larger.

Freezing rain and glaze storms are not numerous, but do coat the roads several times each season in Minnesota. The more severe ice storms cause extensive damage to utility lines and trees; such storms are not as common in the northern part of the State as they are in the south and southeast portions.

Local flash flooding can be very destructive along the steep bluffs of Lake Superior and the hilly terrain and narrow valleys of southeast Minnesota; however, flash flooding can occur anywhere in Minnesota. Flash flooding (defined as a six inches or more rain in 24 hours) occurs on average, three times a year somewhere in the state.

The agricultural areas of Minnesota can be divided into three approximately equal parts: national and State forest land, farmlands for row crops, and farmlands for pasture and hay. Corn is the major crop by acreage, followed by about equal acreages of: hay, oats and soybeans. Farm income from marketing shows that about two-thirds of the total comes from livestock and with one-third from field crops.

The freeze-free (air temperatures greater than 32° F) growing season generally starts about the second week of May in the south and the first of June in the north and ends about mid-September in the north and during the first week of October in the south. The area in southeast Minnesota along the Mississippi River has the longest growing season, approximately 160 days. The southern one-third of the State averages from 140 to 150 days. The North Central Division and the ridges of the Iron Range average a growing season of only about 90 to 100 days. There are bog areas in northern Minnesota that have reported freezing temperatures every month of the year.

The average number of Growing Degree Days (GDD) over the freeze-free growing season for agricultural areas is less than 2,000 in the north, but ranges to near 2,700 GDD in the south (The GDD is derived from the excess of daily mean temperatures over 50° F; minimum temperatures cannot fall below 50 nor can maximum temperatures rise above 86 for computational purposes.)

Annual lake evaporation varies from 35 inches in a year in the Southwest to about 20 inches in Northeast Division. Annual pan evaporation varies from about 50 inches in a year in the southwest to less than 30 inches in the northeast. The actual daily evapotranspiration (evaporation from land and plant surfaces) or ET averages about 0.15 inch of water during the months of June, July and August for all of the State except the North Central and Northeast Divisions. Row crops average approximately 20 inches of ET in a year; however, the average annual potential ET (adequate soil moisture at all times) is near 24 inches.
Solar radiation varies from an average of about 120 langleys a day in December to near 570 langleys a day in July. (The langley is a unit of energy per unit area commonly employed in

radiation theory; it is equal to one gram-calorie per square centimeter.) Sunshine amounts vary from a low in November of nearly 40 percent of possible sunshine hours to a high of about 70 percent in July, with an annual average of 58 percent. The daylight length varies from about 8.5 hours in December to 16 hours in June.
The soil freezes about the first week of December and thaws about mid-April. Average maximum freeze depth in the State ranges from three to four feet in the south to five to six feet in the north, exclusive of forested regions where the freezing depth is ordinarily much shallower.

Climate and the Economy- Minnesota climate, in conjunction with some 15,000 lakes interspersed in forests and wooded areas, produces an almost ideal environment for variety of recreational activities. The summer season (May through August), with its warm days and cool nights, attracts summer vacationers.

Common activities are camping, fishing, swimming, boating, canoeing and hiking. The recreational activity in the fall season (September through November) is dominated by the hunters. Deer, moose, pheasant, duck, geese, grouse and occasionally bear are the principal targets. For the non-hunters, autumn is beautiful for the annual change of the summer leaves to hues of yellow, orange and red.

The winter season (December through March) has sufficient snowfalls and low temperatures to maintain conditions for skiing, snowmobiling, skating (hockey) and ice fishing. The transition season is the month of April when the snow and ice melt.

A special recreational area in northern Minnesota has been set aside and regulated for canoeing only. This area: known as the Boundary Water Canoe Area, is a 110-mile canoe region that extends along the Canadian border and into Canada. There are also 72 state parks and numerous other camping facilities that offer camping and recreation.

For more information, please contact:

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www.climate.umn.edu