

# Climate of Michigan

## 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Unpublished climatological summaries have been prepared for a wide variety of users to fit specific applications.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.

**State and Station Normals are available at:**

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## **Climate of Michigan**

Topographic Features- Michigan is located in the heart of the Great Lakes Region and is composed of two large peninsulas. Many smaller peninsulas jut from these two peninsulas into the world's largest bodies of fresh water to give most of Michigan a quasi-marine type climate in spite of its mid-continent location.

The Upper Peninsula is long and narrow, lying primarily between 45 and 47° North latitude. It averages only 75 miles in width and extends from northern Wisconsin eastward over 300 miles into northern Lake Huron. Lake Superior lies to the north while the northern portion of Lake Michigan forms the boundary to the southeast. Isle Royale is located in Lake Superior about 50 miles northwest of the tip of the Keweenaw Peninsula. Isle Royale, about 10 miles wide and 25 miles long, is a national park popular during the summer months.

The Lower Peninsula, shaped like a left-handed mitten and occupying about 70 percent of Michigan's total land area, extends northward nearly 300 miles from the Indiana-Ohio border or from about 42° North latitude to the eastern end of the Upper Peninsula. The Mackinaw Bridge, which spans the Straits of Mackinac, joins the two large peninsulas where Lake Michigan flows into Lake Huron. Lake Michigan extends the entire length of the Lower Peninsula on the west while lakes Huron, St. Clair and Erie form the eastern boundary. The total coastline for the State exceeds 3,100 miles.

In addition, Michigan has over 11,000 smaller lakes for a total surface area of over 1,000 square miles. These lakes are scattered throughout nearly every county, while more than 36,000 miles of streams wind their way across the State.

While latitude, by determining the amount of solar insolation received, is the major climatic control, the Great Lakes and variations in elevation play important roles in determining Michigan's climate. Due to its mid-latitude location, prevailing winds are from a westerly direction. During the summer months, winds are predominately from the southwest when the semi-permanent Bermuda High Pressure Center is located over the southeastern United States. During the winter months, the prevailing winds are west to northwest, but change quite frequently for short periods as migrating cyclones and anticyclones move through the area. One exception occurs in the eastern portion of the Upper Peninsula where easterly winds prevail during the late fall and early winter months. This is the result of early winter anticyclones moving eastward across Canada and the major storm track beginning to push southward.

The eastern half of the Upper Peninsula varies from level to gently rolling hills with elevations generally between 600 and 1,000 feet above sea level. The gently rolling hills located along the Lake Superior shoreline contain the famous Pictured Rocks and Tahquamenon Falls areas. The western tablelands rise to elevations generally between 1,400 and 1,600 feet with Porcupine Mountain, located in Ontonagon County, overlooking Lake Superior. The rugged hills extend

northeastward from Ontonagon County through the center of the Keweenaw Peninsula and play an important role in the larger precipitation amounts received in this area. The Lower Peninsula features range from quite level terrain in the southeast to gently rolling hills in the southwest, with elevations generally 800 to 1,000 feet. A series of sand dunes along the Lake Michigan shoreline rises to heights of nearly 400 feet above lake level. These are the result of the prevailing westerly winds which blow across the lake. Tablelands cover the northern part of the Lower Peninsula and reach a maximum elevation of 1,700 feet near Cadillac. In the northwestern section of the Lower Peninsula, a number of finger-like projections extend into Grand Traverse Bay and Lake Michigan.

Temperature- The lake effect imparts many interesting departures to Michigan's climates which one would not ordinarily expect to find at a mid-latitude location. Due to the lake waters' slow response to temperature changes and the dominating westerly winds, the arrival of both summer and winter are retarded. In the spring, the cooler temperatures slow the development of vegetation until the danger of frost is past. In the fall, the warmer lake waters temper the first outbreaks of cold air, allowing additional time for crops to mature or reach a stage which is free from damage by frost. This modification in temperature extremes by the lakes enables Michigan to produce successfully a variety of crops more ideally suited to the climate of states much further south.

With the first cold outbreaks in the fall, Michigan experiences a considerable increase in cloudiness. When cold air passes over the warmer lake water, a shallow layer of unstable, moisture-laden air develops in the lower levels of the atmosphere. This air, when forced to rise, produces the increased cloudiness and frequent snow flurry activity observed in the fall and early winter months. A comparison of percent of possible sunshine in December showed Lansing receiving 27 percent, while Madison, Wisconsin received 42 percent. The difference decreases slowly as the lake waters cool, but does not completely disappear until the latter part of February.

The length of Michigan's growing or freeze-free period does not decrease in the normal manner from south to north. Instead, isolines for the length of the growing season follow closely the contours of the lakeshores. The shortest average growing season, about 60 days, occurs in the interior section of the western Upper Peninsula. The growing season increases to between 140 and 160 days towards the lakeshores. A similar pattern exists in the Lower Peninsula where the growing season in small areas of the northern tablelands averages only 70 days, but increases rapidly to near 140 days near the largest lakes. Michigan's maximum average growing season, 170 - 185 days, is found in the southwest and southeastern corners of the State.

Precipitation- Michigan averages about 31 inches of precipitation per year. About 55 - 60 percent of the annual total is recorded during the normal growing season. Summer precipitation falls primarily in the form of showers and thunderstorms, while more steady lighter intensity precipitation dominates during the winter months. The annual number of thunderstorms observed decreases from about 40 in the south to around 25 in the Upper Peninsula area with nearly 50 percent of these recorded during June, July and August. A number of stations in southern and central Michigan have recorded no measurable rainfall during some of the late summer or early fall months. The frequency of floods is quite low in Michigan, with the greatest likelihood occurring in late winter or early spring when sudden warming and rain combine with

snowmelt. Mild meteorological drought conditions are not uncommon in Michigan, but meteorological droughts reaching severe conditions are infrequent and generally of short duration. The rather even distribution of precipitation and higher humidities observed across the State help reduce the drought episodes that are experienced in other areas of the upper Midwest. Portions of Michigan receive some of the heaviest snowfall totals east of the Rockies. The maximum average annual snowfall amounts of over 180 inches occur along the escarpment which rises abruptly to an elevation of over 1,400 above Lake Superior at the western end of the Upper Peninsula. An area with amounts exceeding 150 inches is centered in the western section of the tableland region of the Lower Peninsula. The prevailing westerlies, passing over the Great Lakes, become moisture-laden in the lower levels and when forced upward by the landmasses, drop much of their excessive moisture in the form of snow squalls in these areas.

Precipitation frequencies show large variations from one side of the lake to the other. For example, in January, Milwaukee, Wisconsin experiences measurable precipitation about 20 percent of the time or, on average once every five days, while Muskegon, with 45 percent, can expect, on average, measurable precipitation every other day. In June this trend is reversed with Milwaukee's frequency of measurable precipitation almost 25 percent and Muskegon's frequency down to less than 15 percent. This difference in precipitation frequency decreases inland from the lakes.

On warm summer days when prevailing winds are generally light, the lake's shore area frequently develops a localized wind pattern which may extend inland for only a few miles. This frequently referred to as the "lake breeze". It develops when the much warmer air over the land begins to rise, allowing the cooler air over the lakes to move inland. At night this pattern may be reversed creating what is known as a "land breeze". A wind of this type may also be observed on a much smaller scale along the shores of the larger inland lakes.

Damaging or dangerous storms do not occur as frequently in Michigan as in states to the south and west. On average, 16 tornadoes are reported in the State annually, with the vast majority occurring in the southern half of the Lower Peninsula. A destructive series of tornadoes was observed on Palm Sunday, April 11, 1965, causing over \$51 million (1965 figure) in damages to southern Michigan. Severe wind storms and blizzards occur infrequently, but cause considerable damage from time to time. Hail is most frequently observed in the spring, but the total damage caused by hail tends to be small. A higher frequency of hail is noted in the fall months over the northwestern section of the Lower Peninsula. This is attributed mainly to the strong lake influence in this region.

Climate and the Economy- Michigan is particularly fortunate in its supply of both surface and ground water. Surface water supplies are constantly replenished by rainfall that is well distributed throughout the year and with little annual variation. Because of the moderately high humidities, evaporation rates are quite low so that less water is lost in this manner. Heavy industrial demands are made upon the water supply of Michigan. Aside from the availability of lake water, industry can normally meet its water demands from wells averaging from 50 to 400 feet deep. There is, of course, an abundance of water to meet the needs of cities and individuals. Due to its climate, soils and nearby consumers, a large range in agricultural practices and many kinds of crops are found in the State. Primary crops are hay and pasture, corn, wheat, field

beans, oats, truck crops, potatoes, sour cherries, apples, sugar beets and peaches. Oats, hay and pasture are grown throughout Michigan. Corn production generally occurs in the southern half of the Lower Peninsula. Field bean and sugar beet production is concentrated in the Saginaw Valley and “Thumb” areas.

The fruit belt of Michigan is located in the southwestern and western border areas of the Lower Peninsula along the shores of Lake Michigan where, because of the prevailing westerly winds, the tempering influence of the lake water is strongest. Apple orchards extend northward along the western shore line to the Grand Traverse area, which is also known for its sour cherry production. Cherry growing is best adapted to areas having relatively short, cool growing seasons free from extremely low winter temperatures and free from frosts at blossom time. A number of finger-like peninsulas extend into Grand Traverse Bay with further amelioration of the climate, and cherry growing is heavily concentrated on these peninsulas.

Due to the Great Lakes’ influence on Michigan’s climate, the changing topographic features, and thousands of miles of lakeshore, the State enjoys a year-round tourist business. The cooler temperatures and abundant natural beauty provide an excellent summertime vacation attraction. The topography and tempered wintertime temperatures in the heavy snowfall areas are ideally for skiing and tobogganing.