



## Climate of Illinois Narrative

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### Introduction

Illinois lies midway between the Continental Divide and the Atlantic Ocean, and the state's southern tip is 500 miles north of the Gulf of Mexico. Illinois' climate is typically continental with cold winters, warm summers, and frequent short fluctuations in temperature, humidity, cloudiness, and wind direction. Many consider the more moderate temperatures of spring and fall to be the most pleasant.

Major businesses in Illinois are highly climate sensitive. Crop yields are dependent upon climate conditions because irrigation generally is not used. Illinois serves as the nation's center for air and surface transportation. With both the nation's busiest airport (O'Hare) and the rail hub of the nation at Chicago, Illinois also is the heart of the nation's trucking industry. Each form of transportation is influenced by weather and climate extremes, and resulting delays in shipments are also a major problem for manufacturers in Illinois. However, many Illinois businesses sometimes profit from climate extremes. For example, Illinois retailers received an estimated \$0.9 billion in additional revenue after shoppers took advantage of the unusually warm winter weather resulting from the 1997-1998 El Niño. Home sales also increased during this period.

Climate conditions have effects on human health and safety. Temperature extremes and storms are responsible for deaths and health problems. Each year, 20 to 30 deaths in Illinois are attributed to floods, winter storms, tornadoes, and lightning.

Heat and cold waves are other climate hazards associated with high death tolls. Illinois experienced two of its most deadly heat waves during the 1990s. The 1995 heat wave, the deadliest on record, led to 753 Illinois deaths. That heat wave and another one in 1999 caused major power outages in the Chicago metropolitan area. Annually, 74 deaths are attributed to heat, and 18 deaths are attributed to cold, far exceeding deaths due to tornadoes, lightning, and floods.

Flooding is the single most damaging weather hazard in Illinois. Ever-increasing heavy precipitation since the 1940s has led to increased flood peaks on Illinois rivers. Flood losses in Illinois, \$257 million annually since 1983, are the third highest in the nation. Within Illinois and the Midwest, flood losses have been increasing at a greater rate than elsewhere in the nation. Over a 45-year period (1955-1999), Illinois had \$5.195 billion in flood losses; 74% of these losses have occurred since 1985.

### Climatic controls

Five factors control the continental climate of Illinois: 1) the sun, 2) weather systems, 3) topography, 4) urban areas, and 5) Lake Michigan. Two major controls are latitude (reflecting the amount of solar input) and weather systems (air masses and cyclonic storms). The effects of topography, Lake Michigan, and urban areas are of lesser significance because they influence local climate conditions, rather than conditions statewide.



The sun, primary energy source for virtually all weather phenomena, in large part determines air temperatures and seasonal variations. Solar energy is three to four times greater in early summer than in early winter at Illinois' mid-latitude location; which results in warm summers and cold winters when combined with the state's inland location.

Weather systems, the second major factor affecting the state's climate, create the wide variety of weather conditions that occur almost daily as a result of varying air masses and passing storm systems. The polar jet stream often is located near or over Illinois, especially in fall, winter, and spring, and is the focal point for the creation and movement of low-pressure storm systems characterized by clouds, winds, and precipitation. The settled weather associated with high pressure systems is generally ended every few days by the passage of low-pressure systems.

Topography, urban areas, and Lake Michigan are the three local influences with effects on Illinois climate. The Shawnee Hills extend across southern Illinois and have elevations 500 to 900 feet higher than the surrounding terrain. This change in elevation is enough to increase annual precipitation by about 10 to 15 percent.

The second local feature is the urban climate found in many cities. Buildings, parking lots, roads, and industrial activities make the urban climate noticeably different than that of surrounding rural areas. For example, Chicago tends to be warmer by 2°F, on average, especially at night. Urban areas also enhance summertime precipitation downwind of the city and cause changes in humidity, cloudiness, wind speeds and directions.

Lake Michigan influences the climate of northeastern Illinois, especially Chicago. The large thermal mass of the lake tends to moderate temperatures, causing cooler summers and warmer winters. One of the major benefits is cool lake breezes that provide some relief from summer heat. The lake also tends to increase cloudiness in the area and suppress summer precipitation. Winter precipitation is enhanced by lake-effect snows that occur when winds blow from the north or northeast. These winds allow air to pass over the relatively warm lake, boosting storm system energy and water content, and leading to increased snowfall.

## Temperature

Average annual temperatures ranges from 48°F (north) to 58°F (south), with highs ranging from 57°F (north) to 67°F (south). Average winter highs range from the 30s (north) to the mid-40s (south), while average lows range from the teens (north) to the upper 20s (south). Average summer highs are in the 80s, while lows are in the 60s across the state. Both spring and fall have more moderate temperatures. Average spring highs range from 57°F (north) to 67°F (south), while average lows range from 36°F (north) to 48°F (south). Average fall highs range from 60°F (north) to 70°F (south), while average lows range from 40°F (north) to 48°F (south).

Illinois averages 10 days at or above 90°F (north) compared to just over 40 days (south). Days at or above 100°F are quite rare, occurring about every other year (north) and 2 days annually (south). Illinois averages 140 days at or below 32°F (north) but only 80 such days (south). Days at or below 0°F range from 16 days annually (north) to 2 days (south).



Average annual heating-degree days range from 7000 days (north) to 4000 days (south). Average annual cooling-degree days range from 800 days (north) to 1600 days (south). The base temperature used for both heating-degree and cooling degree days is the same (65°F).

The average length of the frost-free growing season in Illinois ranges from 160 days (north) to more than 190 days (south). Average dates of the last occurrence of 32°F in spring range from April 28 (north) to April 7 (south), while the average dates of the first occurrence of this temperature in fall range from October 7 (north) to October 21 (south), and about October 14 near Lake Michigan, including the Chicago area, due to relatively warm waters of the lake.

The highest and lowest temperatures ever reported in Illinois were 117°F in East St. Louis on July 14, 1954, and -36°F in Congerville on January 5, 1999.

## Precipitation

Average precipitation exceeds 48 inches a year (south), compared to less than 32 inches (north). Snowfall distribution is just the opposite, with averages of 36 inches a year in the north to less than 10 inches in extreme southern Illinois. Winter snowfall is heaviest in the Chicago area, enhanced by lake-effect snows from Lake Michigan.

Variability in precipitation also extends over time. There have been major multi-year droughts in the 1930s and 1950s and major prolonged wet periods during the 1970s and 1980s. May and June are typically the wettest months, and January and February are the driest. Each year, Illinois has rainstorms producing 40 or more flash-floods each with 4 to 8 inches of rainfall in a few hours in localized areas.

The average number of days with measurable precipitation ranges from 110 days (north) to just under 100 days (south). The number of days with an inch or more of precipitation ranges from 8 days (north) to 13 days (south), and the number of days with an inch or more of snow ranges from 12 days (north) to 4 days (south). Days with 6 inches or more of snow are infrequent, ranging from once per year (north) to once in three years (south). Typical dates of the first inch of snow range from November 20th (Chicago area) to December 20th (south). Typical dates of the last inch of snow range from March 26 (north) to March 5 (south). The average number of days with a measurable snow depth (1 inch or more) ranges from 60 days (northwest) to only 10 days (southwest).

The following is a list of precipitation records for Illinois. The greatest 24-hour rainfall was 16.94 inches at Aurora on July 17-18, 1996. The greatest one-year precipitation was 74.58 inches at New Burnside in 1950. The greatest 24-hour snowfall was 37.8 inches at Astoria on February 27-28, 1900. The greatest winter snowfall was 105.1 inches at Antioch in 1978-1979.

## Severe Weather

Illinois experiences about 29 tornadoes annually. Peak months are April-June (63 percent of the total), but tornadoes have occurred in all months. Although Illinois averages four tornado-related fatalities per year, the number varies widely from year to year.



Thunderstorms account for 50-60 percent of annual precipitation and are quite common in Illinois with an average of 60 storms (far northeast) to 80 storms (southwest). Nearly half of all thunderstorm days occur during the June-August period. Similarly, the average number of cloud-to-ground lightning strikes per square mile ranges from 5 strikes (northeast) to more than 11 strikes (southwest). Some thunderstorms produce hail, and annual average hail-days vary from 3.3 days (southwest) to less than 1.8 days (northeast).

## Summary

The climate of Illinois has five unique features:

- Four distinct seasons, each with different conditions
- Major north-south temperature contrasts
- An extremely wide variety of types and amounts of precipitation with moderate variations between monthly and seasonal average values.
- Extreme variability of weather conditions in different parts of the state and, certainly, between years.
- A large number of storms during all seasons.

**Source:** Illinois Climate Atlas. S. A. Changnon, J. R. Angel, and K. E. Kunkel. Illinois State Water Survey, Champaign, Illinois.

## About the State Climatologist

The Illinois State Climatologist is located in Champaign, Illinois, at the Illinois State Water Survey (ISWS), at the Prairie Research Institute on the campus of the University of Illinois. The Illinois State Water Survey is the primary agency in Illinois for research and information on surface water, groundwater, and the atmosphere.

The State Climatologist promotes the use of climate information in areas crucial to the economic and environmental benefit of Illinois by disseminating climate information, monitoring climate events, conducting applied research, and making presentations to community organizations, individuals, and the media.

Additionally, the State Climatologist conveys information to the public on the impacts of climate change and variability on climate-sensitive systems such as agriculture and water resources, and on the characteristics and impacts of severe events (heavy rainstorms, tornadoes, ice storms, and snowstorms).

**Legislation:** In 2008, the Illinois General Assembly voted into law the University of Illinois Scientific Surveys Act. As a result the Illinois State Water Survey was transferred from the Illinois Department of Natural Resources to the newly formed Prairie Research Institute on the campus of the University of Illinois at Urbana-Champaign. See

<http://www.ilga.gov/legislation/ilcs/ilcs3.asp?ActID=2983&ChapterID=18>



In 2014, additional legislation was passed, establishing Illinois State Scientists, including the State Climatologist, and how they will be appointed. See <http://www.prairie.illinois.edu/state-scientists/index.shtml>

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