Climate of Kentucky

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Unpublished climatological summaries have been prepared for a wide variety of users to fit specific applications.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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Topographic Features- Site and situation are keys to understanding Kentucky's climate and its role in the State's economy. Kentucky is centrally situated in the eastern half of the United States. It lies midway between the Gulf of Mexico to the south and the Great Lakes to the north and between the Atlantic Coast to the east and the Great Plains to the west. Kentucky site is characterized by a physical landscape covering more than 40,000 square miles and extending more than 400 miles from the Mississippi River in the west toward the Appalachian Mountains in the east. It is about 175 miles at its greatest extent from north to south, and it narrows to the west. Elevation increases from less than 400 feet above sea level along the Mississippi River to higher than 4,000 feet in the southeast. However, 75 percent of the State lies below 1,000 feet above sea level, and 99 percent is less than 2,000 feet in elevation. With the exception of a small area along the western margin of Kentucky that drains directly into the Mississippi, Kentucky's nearly 90,000 miles of streams and rivers drain to the north and west into the Ohio River.

Kentucky is a State of diverse regional landscapes. Physical processes have shaped distinctive landforms, and people have used these in a variety of ways to make a living. The influence and importance of climate varies with the physical and economic character of these regional landscapes.

The Jackson Purchase Region of far western Kentucky includes alluvial plains and small hills. Low lying areas stretching south and east from the Ohio and Mississippi rivers are nearly flat and thus poorly drained. Lakes, ponds and other wetlands are common. Local relief is generally less than 100 feet. The soil is fertile, and agriculture helps to sustain the region's small rural communities. Corn, soybeans and winter wheat are the dominant crops. Paducah, situated along the Ohio River, is the region's largest industrial and commercial center.

The Western Kentucky Coal Field Region lies east of the Jackson Purchase. It is part of a basin that reaches southward from Illinois and Indiana and is endowed with coal and oil resources. Relief increases toward the margin of the basin, and much of this area is forested. Alluvial deposits become prominent in proximity to the Ohio River. As in the Jackson Purchase, the nearly flat land is poorly drained and wetlands are evident. Fertile soils support extensive production of corn and soybeans. Agriculture and mining have supported the growth of many rural communities. The cities of Owensboro and Henderson, both located along the Ohio River, are the primary centers of business and industry.

Kentucky is perhaps best known for its Bluegrass Region. Located in north central Kentucky, the core of the Bluegrass is a gently rolling karst plain characterized by sinkholes, sinking streams and springs. The region's limestone-purified water is recognized as a key location factor for Kentucky's distilleries. Weathering of limestone has produced the State's most fertile soil, and the horse farms sprawling across rich pasturelands are a Kentucky icon. Relief increases gradually and the soil becomes less fertile toward the margin of the Bluegrass. Tobacco is also

an important source of income for farmers throughout much of the region. The Knobs Region, identified by dispersed, often conical hills that have steep slopes but rise only about 500 feet above the surrounding plain, surrounds the Bluegrass. The city of Lexington lies in the heart of the Bluegrass, while the outer Bluegrass includes the Ohio River cities of Louisville and Covington. This is the most highly urbanized and industrialized region in Kentucky.

Farther to the east, the Eastern Kentucky Coal Field Region is distinguished by its more rugged terrain. Most of the region lies on the Appalachian Plateau that rises gradually from the west toward the Appalachian Mountains. The plateau has been carved by water to form a landscape distinguished by a maze of hills, valleys and hollows. The hills are less than 2,000 feet in elevation, and local relief is several hundred feet. Pine Mountain trends across the southeastern margin of Kentucky where the plateau reaches the Appalachian Mountains. Kentucky's highest point, 4,139 feet, is the peak of Black Mountain along the border with Virginia. The Eastern Kentucky Coal Field is well endowed with natural resources, including abundant coal deposits, natural gas and extensive forests that support the region's economy. Strip mining has significantly altered the landscape in some areas. Forests include a mixture of hardwood and softwood species. Agriculture includes a mix of tobacco, corn, hay, and pasture but is practiced on a very limited scale. Soils are not particularly fertile, and only small areas of flat land are available for cultivation. This region is also the least industrialized. Ashland, the largest city in the region, is located along the Ohio River. Cities located throughout the region are small and largely confined to narrow valleys and more gently sloping hillsides.

The Pennyroyal Region stretches across southern Kentucky from the Jackson Purchase to the Bluegrass and Eastern Kentucky Coal Field. The Dripping Springs Escarpment of the Pennyroyal encircles much of the Western Kentucky Coal Field and falls onto a karst plain. Sinkholes, sinking streams and springs are characteristic of the rolling landscape. Mammoth Cave, the world's longest cave system is located in the region. Much of the escarpment is forested, while the karst plain supports a variety of agricultural uses. In its western and southern extent, corn, soybeans and winter wheat are grown. Farther east and north, pastureland and hay become more common, and significantly less land is devoted to grain production. Tobacco is an important cash crop throughout much of the region. Bowling Green, a diversified city that capitalizes on its location between Louisville and Nashville, Tennessee, is the Pennyroyal's largest city. Hopkinsville and a number of other smaller cities are dispersed throughout the region. Tourism is important in the Mammoth Cave area. The Land between the Lakes region is located at the western extent of the region, and Lake Cumberland is located near the eastern extent.

The climate of Kentucky reflects the interplay of several locational influences. Kentucky's inland location contributes to a continental influence which acting alone tends to produce a large seasonal temperature range between summer and winter. Meanwhile, its position north of the Gulf of Mexico contributes a tropical marine influence that moderates temperatures and yields ample precipitation. Kentucky's mid-latitude position places it in a region where weather can be highly variable. While prevailing surface winds are southerly and light, upper level westerly winds steer frontal systems across the State. These systems bring warm, moist air from the south, followed by cooler and drier air from the north. At a broader scale, Kentucky's climate is influenced by interactions involving the oceans and atmosphere. While these influences

originate thousands of miles away, they may contribute to significant variations in Kentucky's climate on a seasonal or annual timeframe.

Temperature- Mean annual temperature ranges from 53 degrees Fahrenheit (° F) in the northeast to 59 in the southwest, but there is significant seasonal variation in temperature. Summer days are typically sunny, warm and humid. Most areas of the State receive more than 60 percent of available sunshine during summer. The average daily high temperature for July increases from about 86 in the east to 90° F in the west. High temperatures exceed 90° F an average of 20 days per year in the north and east and 40 or more days in the south and west. Temperatures occasionally exceed 100° F. The passage of frontal systems is less frequent during summer, so weather patterns are typically more persistent. But when they do arrive, cold fronts bring pleasant conditions that may persist for a few days. Winters are rarely harsh. In January, average daily high temperatures increase from 38 in the north to 44° F in the south. Cloudy skies are more frequent in winter, as most areas receive near 40 percent of available sunshine. Polar air masses occasionally affect Kentucky for short periods. Temperatures dip below 0° F an average of about five days in the north and two days in the south. Spring and fall are generally pleasant seasons, though temperatures can change dramatically with the passage of frontal systems. The diurnal temperature range is about 20° F during the summer and winter but increases to near 25° F during the spring and fall, when warm days and cool nights are prevalent.

Kentucky's growing season varies across the State. The average date of the last spring freeze ranges from early April in the southwest to early May in the northeast. Meanwhile, the average date of the first fall freeze extends from early October in the northeast to late October in the southwest. The average length of the frost-free period varies from about 165 days in the northeast to 200 days in the southwest, but the average can vary with local topography.

Precipitation- Precipitation is generally plentiful enough to meet agricultural needs and the needs of municipalities that serve industrial, commercial and residential users. Average annual precipitation ranges from 42 inches in the north to 52 inches in the south. Much of the range is due to a strong precipitation gradient during the winter season. Summer precipitation patterns are less pronounced. Fall is normally Kentucky's dry season, while the spring season is typically the wettest. But, precipitation is well distributed throughout the year. Thunderstorms are responsible for much of the rainfall during summer, and they often bring intense rainfall that may be highly localized. Rainfall intensities generally increase toward the southwest. Rates exceeding one inch per hour are not unusual and 24-hour totals of five inches or more occur an average of about one in ten years at a given location. Meanwhile, it is common for a location to go for a period of two weeks or more without measurable precipitation in the summer or fall. Snowfall is most likely from December to March, but it occasionally occurs as early as October or as late as April. Seasonal amounts average from near 10 inches in the south to more than 20 inches in the north. Amounts are highly variable from year to year. In some years, a single heavy snowfall event may represent a large percentage of the seasonal total. Across southern Kentucky, seasonal totals of less than five inches are fairly common, while totals of more than 20 inches are infrequent. Northern areas rarely receive less than 10 inches of snow and occasionally receive as much as 40 inches or more. Snowcover seldom persists for more than a week in the south or more than two weeks in the north.

Kentucky's climate is a valuable natural resource. However, like other states, Kentucky is vulnerable to a variety of hazards associated with its climate. These hazards pose threats to life and property, and they can disrupt economic activity.

Thunderstorms are an important element of Kentucky's climate. They can occur throughout the year but are most common in the warmer months. The number of thunderstorm days averages about 55 in the west and closer to 40 in the east. While thunderstorms are a vital source of rainfall in the summer season, they can also bring severe weather, including damaging winds, hail and tornadoes. Fewer than 10 tornadoes are recorded in most years. Tornadoes are most frequent in April, but they can occur in any month.

Winter storms producing heavy snow occasionally affect Kentucky. Heavy snow is normally associated with storm systems that originate in the southwest, are fueled by Gulf of Mexico moisture, and track toward the northeast. Instead of snow, a winter storm may bring freezing rain that produces significant icing, but such events are infrequent. Intense winter storms are sometimes followed by cold waves that bring temperatures of 0° F or colder.

Flooding can be widespread or highly localized across Kentucky. Widespread flooding is most common in the winter and spring seasons when moisture-laden frontal systems can drop heavy rains over large areas. Flooding in the late summer and early fall can occur due to the remnants of a tropical system that tracks over or close to the State. Intense thunderstorm precipitation can cause flash flooding. While flash floods can occur anywhere across the State, they are a greater threat in areas of rough terrain and narrow stream valleys.

Droughts are a recurrent feature of Kentucky's climate. They occur on an average of about one year in 10 and usually become evident during the growing season when temperatures are warm and the demand for water is high. Since fall is normally a dry season, recovery usually does not occur until winter, and in some cases a drought may persist for more than a year. Droughts often intensify during the summer due to a strong Bermuda High, which blocks the movement of frontal systems across the State, inhibits the development of thunderstorms, and contributes to the intensity of heat waves.

Climate and the Economy- The effects of climate on the economy are multifaceted. Seasonal norms of temperature and precipitation help to shape the structure of many activities, such as agriculture, forestry, recreation and tourism, which draw directly from elements of the physical environment. Meanwhile, other aspects of climate, such as the frequency and intensity of thunderstorms, snow and ice storms, droughts, heat waves and cold waves, have more pervasive effects on daily operations of business and industry.

Agriculture is the historical foundation of rural communities across much of the State. Slightly over one-half of Kentucky's land is used for agriculture. Prime farmland is concentrated in the alluvial soils of Kentucky's river and stream valleys, and the soils formed from limestone in karst regions are also fertile. Harvested cropland accounts for slightly over one-third of agricultural land, while pastureland and woodlands account for progressively smaller portions. Warm temperatures and precipitation that is spread throughout the growing season favor plant growth. Only a small percentage of cropland is irrigated. The choice of crops largely reflects

soils and topography, though climate and markets are also factors. The largest percentage of harvested cropland is used for hay, about equal amounts are used for corn and soybeans, and a smaller amount is planted in winter wheat. Kentucky's most valuable crop, tobacco, is grown on small plots. Pastureland and some harvested crops are used to feed beef and dairy cattle and hogs. The State's richest pastureland is home to Kentucky's famous horse farms. Farm operations are directly impacted by storms that can cause localized crop damage or limit access to fields for planting or harvesting. Likewise, drought and extreme temperature variations can adversely affect both crops and livestock.

Forests cover nearly half of Kentucky. But forestland is much more extensive in eastern Kentucky where there is little cleared land except in river and stream valleys. The composition of Kentucky's forests is a reflection of the State's moderate climate. Species associated with both northern and southern latitudes are found in abundance, and the microclimates that vary with slope and aspect in the eastern mountains contribute to diverse forest ecosystems. Commercially valuable species include red oak, white oak and yellow poplar, along with less abundant species such as cedar, ash, maple, hickory and walnut. Kentucky's timber resources support sawmills and a variety of industries, including furniture and hardwood flooring, across the State. Forests tend to be resilient to short-term climatic variations, but prolonged periods of drought can stress timber stands and increase the threat of forest fires.

Natural resources contribute to Kentucky's economic development. Agricultural and timber resources provide inputs for related food products and wood products industries. Meanwhile, abundant coal reserves, along with smaller reserves of oil and natural gas, fuel energy production. Low energy rates are important in the chemical and metals industries, including aluminum and steel. Combined with only moderate energy needs for heating and cooling, Kentucky's low energy rates contribute to a low cost of living. Kentucky's rivers and reservoirs are used to generate electricity in parts of the State, and surface water is relied upon heavily to meet the needs of communities, large and small across the State. Providers of water and electricity must be able to cope with natural fluctuations in supply and demand tied to climatic variability.

Kentucky's location is advantageous for manufacturing. Not only does it possess a central geographic location in the eastern United States, net migration into the South has increased its centrality with respect to the distribution of population. Motor vehicles manufactured in Kentucky's many assembly plants are shipped to widely distributed markets. The adoption of just-in-time inventory systems makes the reliability of transportation services critical for delivering parts to manufacturers and distributing products to market. Kentucky benefits from a lower frequency of snow days and shorter duration of cold waves than more northern locations, while having a lower frequency of thunderstorms that can disrupt transportation schedules than areas farther south. This combination of location and climate contributes to making Kentucky an important node for transportation services.

Service industries form a vital component of Kentucky's economy. Traditional service industries that derive value from the physical environment, including tourism and recreation, prosper in Kentucky's climate. Outdoor activities, such as golf, hiking, hunting, fishing and water sports, can be enjoyed throughout much of the year. Other business and consumer services are

distributed with respect to local demand. A few examples are Kentucky's prominent health services industry, along with legal services, education services and retailing. While these are much less sensitive to climate, consumer behavior is known to be affected by variations in climate. Innovations in communications technology make it increasingly possible for firms to deliver services electronically, without great concern for transportation access to their markets. Kentucky's ability to attract service providers that depend on information technology is more dependent on quality of life issues, of which climate is an integral part.

Climate plays an integral role in Kentucky's economy. In a competitive economic environment, the ability of business and industry to respond to both short and long term climatic variability can be critical.