

Climate of North Carolina

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.

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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- North Carolina lies between 33.5 and 37° North latitude and between 75 and 84.5° West longitude. The extreme length from east to west is 503 miles: greater than any other state east of the Mississippi and its extreme breadth from north to south is 187 miles. The total area of the State is 52,712 square miles, of which 49,142 square miles are land and 3,570 squares miles are water.

The range of altitude is also the greatest of any state east of the Mississippi River, ranging from sea level along the Atlantic coast to 6,684 feet at the summit of Mount Mitchell, the highest peak in the eastern United States. Mount Mitchell is in the heart of the Blue Ridge; this mountain range, along with the Great Smokies which lie partly in North Carolina and partly in Tennessee, form the highest part of the Appalachian Mountains.

The three principal physiographic divisions of the eastern United States are particularly well developed in North Carolina. From east to west, they are the: Coastal Plain, Piedmont and Mountains.

The land and water areas of the Coastal Plain comprise nearly half the area of the State. It may be divided roughly into two sections: the tidewater area, which is in large part flat and swampy, and the interior portion, which is gently sloping and, for the most part, naturally well drained. Throughout both sections of the Coastal Plain, the soils consist of soft sediment, with little or no underlying hard rock near the surface. The average slope is from about 200 feet at the "fall line", or western boundary, to generally less than 50 feet over the tidewater subdivision.

The fall line is the dividing line between the Coastal Plain and the Piedmont. It may have at one time been the shoreline, since most of the soil to the east is sedimentary. Over the Piedmont, however, there is a great deal of hard rock near the surface. This area, comprising about one-third of the State, rises gently from about 200 feet at the fall line to near 1,500 feet at the base of the mountains. Although most of the Piedmont is gently rolling, there are several ranges of rather steep hills within its area, mainly in the Uwharrie Range around Randolph County and the Kings Mountain Range in Cleveland and Gaston counties.

The westernmost, or Mountain Division of North Carolina is the smallest of the three, comprising a little more than one-fifth of the total area of the State. Its elevation range, however, is by far the greatest; it stretches upward from around 1,500 feet along the eastern boundary to 6,684 feet at the summit of Mount Mitchell. Some of the valleys drop to 1,000 feet above sea level while some 125 peaks exceed 5,000 feet and 43 tower above 6,000 feet. The surface of the Mountain Division is rocky; the soils are mainly weathered and eroded rocky materials.

With its nearly 6,700-foot range in elevation and 300-mile range from the ocean, North Carolina has one of the most varied climates of any eastern state. Latitude accounts for some climatic variations, as do soils, plant cover and inland bodies of water. The Gulf Stream has some direct

effect on North Carolina temperatures, especially on the immediate coast. Though the Gulf Stream lies some 50 miles offshore, warm water eddies spin off from it and moderate the winter air temperatures along the Outer Banks. Coastal fronts are common during the winter months, and can push inland, bringing warmer than expected temperatures to coastal areas. However, the southern reaches of the cold Labrador Current pass between the Gulf Stream and the North Carolina coast, offsetting most of the general warming effect the Gulf Stream might otherwise have on coastal temperatures. The meeting of the two opposing currents provides a breeding ground for rough weather. Strong low-pressure systems having their origin there develop into major storms, causing rain along the North Carolina coast and over states to the north as well.

The rivers of North Carolina fall into two groups; those that flow into the Atlantic Ocean, and those that drain westward via the French Broad and the Tennessee rivers into the Mississippi River system.

By far the greater portion of the State drains into the Atlantic Ocean. The principal rivers draining into the Atlantic are the: Roanoke, Tar, Neuse, Cape Fear, Yadkin and Catawba. The Roanoke River rises in the Allegheny Mountains west of Roanoke, Virginia, and flows in a southeasterly direction through Virginia and North Carolina for a distance of 400 miles, 150 miles of which is in North Carolina. The Tar, Neuse and Cape Fear rivers rise in the Piedmont Plateau in North Carolina and flow in a general southeasterly direction to the Atlantic Ocean. The Yadkin and Catawba rivers rise in the Blue Ridge Mountains of western North Carolina and flow first easterly, then southeasterly into the Pee Dee and Santee rivers, respectively.

The main stream draining the extreme western portion of the State is the French Broad River. This river rises in the mountains southwest of Asheville, flows first in a northerly direction then westward through the Great Smoky Mountains, into the Holston River just east of Knoxville, Tennessee. Intense rainstorms occur in this precipitous terrain and the streams rise quickly to flood stage.

All North Carolina's rivers commonly have a maximum flow in late spring, with low flow in fall. It is rare for any but the very smallest streams to be dry at any time. However, all are likely to flood. Flash floods on small streams in the mountains, connected with heavy rains falling onto saturated or frozen soil, are most common in spring. Floods covering a wider area and extending into the Piedmont are most likely in winter, when traveling weather systems bring prolonged rain to a large portion of the state. The most severe floods, however, are those during autumn which are associated with tropical systems or their remnants. Rarely will a single hurricane cause major flood damage, but two in succession, or one coming after a very wet spell, can be very destructive, causing several river basins to flood at the same time. Although this is most likely to affect the coastal plain, such major floods have been recorded in all parts of the state, including the mountains. Dams have been constructed on most major rivers in North Carolina. Although some have been primarily for hydroelectric generation or water supply, they all serve as flood control structures. As a consequence, the frequency of severe flooding has decreased. Nevertheless, there are still situations where the climate of North Carolina will provide sufficient rain to ensure that floods continue to occur in the future.

Temperature- The most important single influence contributing to the variability of North Carolina climate is altitude. In all seasons of the year, the average temperature varies more than 20 degrees Fahrenheit (° F) from the lower coast to the highest elevations. The average annual temperature at Southport on the lower coast is nearly as high as that of interior northern Florida, while the average on the summit of Mount Mitchell is lower than that of Buffalo, New York.

In winter, the greater part of North Carolina is partially protected by the mountain ranges from the frequent outbreaks of cold air which move southeastward across the central states. Such outbreaks often move southward all the way to the Gulf of Mexico without attaining sufficient strength and depth to traverse the heights of the Appalachian Range. When cold waves do break across, they are usually modified by the crossing and the descent on the eastern slopes. The temperature drops to 10 to 12° F about once during an average winter over central North Carolina, ranging some 10 degrees warmer the coast and 10 degrees colder in the mountains. Temperatures as low as 0° F are rare outside the mountains, but these temperatures have occurred throughout the western part of the State. The lowest temperature of record is -34° F recorded January 21, 1985, at Mount Mitchell. Winter temperatures in the eastern sections are modified by the Atlantic Ocean which raises the average winter temperature and decreases the average day-to-night range.

In spring, the storm systems that bring cold weather southward reach North Carolina less often and less forcefully, and temperatures begin to modify. The rise in average temperatures is greater in May than in any other month.

Occasional invasions of cool, dry air from the north continue during the summer, but their effect on temperatures is slight and of short duration.

The increase in sunshine which follows usually brings temperatures back up quickly. When the dryness of the air is sufficient to keep cloudiness at a minimum for several days, temperatures may occasionally reach 100° F or higher in the interior at elevations below 1,500 feet. Ordinarily, however, summer cloudiness develops to limit the sun's heating while temperatures are still in the 90° F range. Rarely, an entire summer passes without a high of 100 being recorded in the State. The average daily maximum reading in mid-summer is below 90° F for most localities.

Differences in temperatures over the various parts of the State are no less pronounced in summer than in winter. The warmest days are found in the interior rather than near the coast in summer. The average daily maximum temperature at mid-summer exceeds 92 at Goldsboro and Fayetteville, for example, while on the southernmost part of the coast it is 89° F. The mid-July average afternoon high temperature atop Mount Mitchell is only 68, while over widely populated areas in the Mountain Division the figure is around 85° F. Morning temperatures average about 20° F degrees lower than those in the afternoon except along the immediate coast, where the daily range is only 10 to 15 degrees.

Autumn is the season of most rapidly changing temperature, the daily downward trend being greater than the corresponding rise in spring. The drop-off is greatest during October, and

continues at a rapid pace in November, so that average daily temperatures by the end of that month are within about five degrees of the lowest point of the year.

Precipitation- While there are no distinct wet and dry seasons in North Carolina, average rainfall does vary around the year. Summer precipitation is normally the greatest, and July is the wettest month. Summer rainfall is also the most variable, occurring mostly in connection with showers and thunderstorms. Daily showers are not uncommon, nor are periods of one to two weeks without rain. Autumn is the driest season, and November the driest month. Precipitation during winter and spring occurs mostly in connection with migratory low pressure storms, which appear with greater regularity and in a more even distribution than summer showers. In southwestern North Carolina, where moist southerly winds are forced upward in passing over the mountain barrier, the annual average is more than 90 inches. This region is the rainiest in the eastern United States. Less than 50 miles to the north, in the valley of the French Broad River, sheltered by mountain ranges on all sides, is the driest point south of Virginia and east of the Mississippi River. Here the average annual precipitation is only 37 inches. East of the Mountains, average annual rainfall ranges mostly between 40 and 55 inches.

Winter-type precipitation usually occurs with southerly through easterly winds, and is seldom associated with very cold weather. Snow and sleet occur on an average once or twice a year near the coast, and not much more often over the southeastern half of the State. Such occurrences are nearly always connected with northeasterly winds, generated when a high pressure system over the interior, or northeastern United States, causes a southward flow of cold dry air down the coastline, while offshore a low pressure system brings in warmer, moist air from the North Atlantic. Farther inland, over the mountains and western Piedmont, frozen precipitation sometimes occurs in connection with low pressure storms, and in the extreme west with cold front passages from the northwest. Average winter snowfall over the State ranges from about inch per year on the Outer Banks and along the lower coast to about 10 inches in the northern Piedmont and 16 inches in the southern Mountains. Some of the higher mountain peaks and upper slopes receive an average of nearly 50 inches a year.

The average relative humidity does not vary greatly from season to season but is generally the highest in winter and lowest in spring. The lowest relative humidities are found over the southern Piedmont, where the year around average is about 65 percent. The highest are along the immediate coast, averaging around 75 percent. The least amount of actual moisture is found in the higher mountains. The lower temperatures, however, result in relative humidities that are about the same as elsewhere in the State.

Sunshine is relatively abundant. The average annual percent of possible sunshine ranges between 58 to 65 percent. On average, 26 days per year are clear, 117 partly cloudy and 122 cloudy, while measurable rain falls on 120 days. The prevailing winds are generally from the southwest for 10 months of the year, and from the northeast during September and October. The average wind speed is about eight to 10 mph; however, winds along the coast can exceed 100 mph when hurricanes strike.

In most years the greatest economic loss entailed in North Carolina from severe weather is probably due to summer thunderstorms. These storms usually affect only limited areas, but hail

and wind occurring with some of them account for an average yearly loss of over \$5 million. In any given locality, 40 or 50 thunderstorms may be expected in a year.

North Carolina is outside the principal tornado area of the United States, but still averages 13 per year. They occur mostly east of the Mountains during early spring.

Hurricanes come close enough to influence North Carolina weather about twice in an average year. Less frequently, these storms strike a part of the State with sufficient force to do much damage to inland property. Coastal properties occasionally suffer severe damage from associated high tides.

Climate and the Economy- The variety of climate in North Carolina produces a wide range of vegetation. Along the southern coast the warm ocean currents stimulate vegetation often associated with Florida while north of Cape Hatteras the cooler ocean waters lead to vegetation often akin to that of New England. Similarly, the Great Smoky Mountains are a meeting ground for northern and southern forest species. The range of opportunities for agriculture reflect this climatic and vegetation diversity. The average annual freeze-free period ("growing season") lasts from about 130 days in the highest mountain areas to around 290 days on the Outer Banks. At Hatteras, entire seasons often pass without either frost or freezing temperature occurring and tropical fruits can be grown in sheltered spots.

The traditional agricultural cash crops of North Carolina are tobacco and cotton. Soils and climate combine to provide optimum conditions for the former, with acreage scattered throughout the State. For cotton, the State is near the northern limit for cultivation, but the plant is grown across the Coastal Plain.

The Coastal Plain is the major area for extensive agricultural crops, including soybeans, peanuts, potatoes, sweet potatoes, corn for seed, wheat and several other small grains. This is the area with deep soils, abundant flat land and long growing seasons. In most years, precipitation is sufficient for crop growth, but much of the area is irrigated. This not only ensures optimum yields, but also allows some crops to obtain two harvests per year.

North Carolina is a national leader in the production of hogs, turkeys and chickens. Many are reared in climate-controlled buildings, with the State's climate minimizing the need for winter heating, while fans are sufficient to provide summer cooling. Again, the eastern part of the State leads in production, although a considerable number of chickens are raised on the Piedmont.

The Piedmont is the center of population for the State, and is the major area for hay and cattle production. This is also an area where agricultural products destined for the local urban centers, ranging from turf for lawns to grapes for wine, are produced. The sandy soils of the Sandhills region warm rapidly in spring and allow the production of early peaches, destined for not only the local market but also for shipment to areas further north.

Although agricultural production is much smaller in the mountain region, given the rugged topography and cooler climate, there have always been areas of specialized agriculture. There has been a long tradition of apple production in the area known as the "Thermal Belts". In the

19th century, pioneer horticulturalists discovered that in the southern mountains of the State the growing season was longer on the hill slopes than on the mountain tops or in the valley bottoms. Apples thrived in the thermal belts. Eventually the name was applied to the whole area, which still is a major apple growing region in the mountains.

More recently the northwestern part of the State has been able to utilize its cool climate and well-drained land to specialize in the production of Christmas trees. Other mountain areas produce high quality, high value crops, especially soft-fruits and out-of-season vegetables, by using black plastic mulches and drip irrigation to control the microclimate of crops growing in the fertile valley bottom soils.

Throughout the State abundant moisture, fertile soils and high temperatures encourage tree growth. Forests, ranging in size from woodlots of less than an acre to the million acre national forests of the far west, cover over 50 percent of the State's land area. Pulp and paper production facilities are an important part of the economy in several locations scattered over the State.

In most summers North Carolina's weather is dominated by the "Bermuda High" pressure system. This gives calm, virtually cloudless conditions where any pollution placed into the atmosphere remains suspended for an extended period of time. Compared to many other states, North Carolina does not support activities which emit great quantities of pollution. But automobile traffic in the major cities, along with some paper producing and energy generation plants can cause local problems for short periods of time. Additionally, with winds coming predominantly from a westerly direction, North Carolina also receives pollution from a suite of upwind states. On occasion this can severely reduce visibility in the western mountains, and has been regarded as a major contributor to the presence of acid rain on some of the highest peaks.

North Carolina is a major tourist destination and a popular center for retirement. These activities are concentrated in three areas: mountains, beaches, and Sandhills. Climate plays a major role in all of them.

The mountains, because of their mild summer temperatures, have always provided a welcome escape from the heat at lower elevations. Midsummer afternoon temperatures average less than 80° F at elevations of 3,000 feet or higher; nights are crisp and cool, but seldom too cold for outdoor activities or light camping. At the same time, mountain streams and forests furnish plenty of space and opportunity for hiking, climbing, fishing or hunting, while there are many lakes with boating facilities and resorts with golf or similar opportunities.

The summer mountain resorts are also winter ski resorts. Although some snowfall is likely most years, resorts use snowmaking equipment to ensure a reliable supply. Large snow amounts and severe low temperatures are rare in the mountains away from the highest peaks. January daytime averages in the valleys where people live are commonly around 45° F, with overnight lows reaching down to 20. So the climate is not extreme, even compared to lower-altitude areas farther north, and fosters year round activity. Retirement communities have developed in response.

Year-round vacation and retirement communities have also developed along the North Carolina beaches. Summer air temperatures along the immediate coastline are considerably lower than

those even a few miles inland. Midsummer ocean water temperatures are around 80° F along the entire coast, practically all of which is suitable for ocean recreation. Opposite the ocean, across the narrow barrier islands behind most beaches are the "Sounds". These protected inland waters, calm, quiet and sheltered even from the sea breezes, are bordered on both sides by cool forests and productive swamps with unique vegetation and wildlife. Fishing, ranging from deep sea to soundside to inland lake and stream, is one of the most popular of sports.

This North Carolina beach country, especially the southern portion, is popular for year-round vacationing. Both air and water temperatures are generally mild; the average ocean water temperature at Southport in January is higher than along the northern coast of Maine in July.

The third of North Carolina's resort and retirement areas is the "Sandhills" section of the southern Piedmont. Here, due to the sandy character of the soils, the average winter daytime temperature is higher and the relative humidity lower than in any other similarly exposed section of the State. Winter rains are readily absorbed by the sandy soils so conditions underfoot remain dry, while snow is a rarity. Horse racing, golf and other outdoor sports are widely enjoyed. Pinehurst and Southern Pines, in the center of this area, have become popular places for the retirement of those seeking a moderate climate.