Climate of Virginia

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Unpublished climatological summaries have been prepared for a wide variety of users to fit specific applications.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- Virginia's climate results from global-scale weather patterns that are modified by the diverse landscape of the Commonwealth. While detailed discussion of the global-scale contribution is beyond the scope of this review, the State's landscape provides local controls primarily in three ways. First, the Atlantic Ocean and its "river" of warm water, commonly called the Gulf Stream, play a dominant role in differentiating Virginia's precipitation climate. Winter storms generally move or "track" from west to east and, in the vicinity of the East Coast, move northeastward paralleling the coast and the Gulf Stream. This shift, to a northeast track, results in part from the tendency of the storm to follow the boundary between the cold land and the warm Gulf Stream waters. These storms grow rapidly as they cross the coast; and as they move northeastward, moisture-laden air from the storm crosses Virginia from the east and northeast. The eastern slopes and foothills of the Blue Ridge Mountains are the prime recipients of this moisture. The great coastal storms of 1962, which are remembered primarily because of the high surf and storm surges along Virginia's coast, also produced record snowfalls along the northern section of the Blue Ridge Mountains.

The high relief of the Appalachian and Blue Ridge Mountain systems also helps to control Virginia's climate. The influence here originates with the well-developed rainfall pattern that is evident along the great mountains of the western margin of North America. Great quantities of rain fall on these western slopes as moist air from the Pacific Ocean flows eastward, rises, condenses and precipitates. As the air flows down over the eastern slopes, however, little rain falls and a "rain shadow" pattern results. Along the Appalachian and Blue Ridge Mountains of western Virginia, this airflow is sometimes from the west and sometimes from the east. When the flow is from the west, the New River and Shenandoah River valleys are in the rain shadow of the Appalachian Mountains; when the airflow is from the east, they are in the shadow of the Blue Ridge Mountains. As a result, both the New River and the Shenandoah River valleys are the driest portions of the State. Regions of equally low rainfall are rare in the eastern United States (although common along the eastern margins of the great plains of the central United States).

The third important local control on climate is the State's complex pattern of rivers and streams, which drain the precipitation that falls and modify the pattern of moist airflow from which the precipitation falls. These river systems drain the Commonwealth's terrain in all four geographical directions. In far southwestern Virginia, the Clinch and Holston rivers drain south into Tennessee. The New River drains westward into the Ohio River, while the Shenandoah River drains northward into the Potomac. Finally, the Roanoke, James, York and Rappahannock rivers drain eastward through the Piedmont and into the Tidewater area. The air that flows across Virginia flows either up these river valleys or over the crests of the mountains and down into the valleys. With a southerly flow of air, for example, moist air would move up the Holston River drainage, and rainfall would increase up valley with increasing elevation. However, this same southerly airflow would be downhill into the New River drainage, and on toward the Ohio River basin. This downward flow of air is not conducive to rainfall.

Virginia temperature and precipitation averages:

Virginia Long-Term Average Temperature and Precipitation (1895-1998)

Month	Maximum °F	Minimum °F	Average °F	Precipitation (Inches)
Jan	45.8	26.0	35.9	3.13
Feb	47.7	26.7	37.2	3.08
Mar	56.9	34.1	45.5	3.86
Apr	67.1	42.7	54.9	3.29
May	75.8	52.2	64.0	3.99
Jun	82.9	60.2	71.5	3.69
Jul	86.1	64.3	75.2	4.31
Aug	84.6	63.2	73.9	4.14
Sep	79.2	57.0	68.1	3.50
Oct	69.2	45.0	57.1	3.36
Nov	57.8	35.4	46.6	3.21
Dec	47.8	28.0	37.9	3.18
Annual	66.7	44.6	55.7	42.70

Much of Virginia's rainfall results from storms associated with warm and cold fronts. As already noted these storms generally move from west to east and, in the vicinity of the East Coast, move northeastward. While a very large number of specific storm histories and storm tracks can occur and a great diversity of precipitation patterns can result, not all are equally common. Storms are most frequently observed to move parallel to the Appalachian or the Blue Ridge Mountains, the coastal zone and the Gulf Stream, all of which have a northeast trend, or to move parallel to the Great Lakes and the Ohio River Valley. When storms cross the east coast well to the south of Virginia and move offshore, the heaviest rain usually falls in southeastern Virginia. When these storms become very intense or when they closely skirt the coastline, the strong upslope winds result in heavy rainfalls on the Blue Ridge. Frequently, frontal storms tracking along the Ohio Valley move across southern Pennsylvania and off the New Jersey coast; as such storms approach the coast, great quantities of moist air flow inland and then southward into Virginia.

When sufficient cold air invades Virginia from the west and northwest, frontal storms may cause heavy snowfalls. Two of the State's most dramatic frontal snowstorms occurred during the Christmas holidays of 1966 and 1969. In both cases, the storm tracked along the Gulf, the east coasts and crossed over Tidewater Virginia; a strong east and northeast flow brought moist air across the State, overriding cold air from the west. While heavy snows are common in the Piedmont region, the average winter does not have a major coastal snowstorm, and heavy winter snows usually are confined to the mountainous areas of the State. As remarkable as it may seem,

some of the heaviest snowfalls in the eastern United States occur in the Appalachians of West Virginia, just a few miles west of Highland County, Virginia. More than 100 inches fall annually in this area; but Virginia, being in West Virginia's snow shadow, receives only a fraction of this amount.

While heavy snowfalls usually result from frontal storms, hurricanes are created by a different weather pattern. Hurricanes and tropical storms are intense cyclones formed within the deep, moist layers of air over warm, tropical waters. Unlike frontal storms, which derive much of their energy from the great temperature contrasts on either side of fronts, hurricanes and tropical storms derive most of their energy from the warm ocean surface. Tropical systems over the low-latitude oceans generally move from east to west. As they move westward, they are displaced farther and farther to the north. Eventually, they enter the westerly airstreams of the mid-latitudes, and then recurve north and eastward. In the vicinity of Virginia, these tropical systems move in a general northeasterly track, like frontal storms. Those storms that reach an intensity indicated by sustained winds of at least 74 mph are classified as hurricanes.

Hurricanes and tropical storms that cross Virginia, including immediately offshore, occur most frequently in early August and September and rarely appear before June or after November. During the month of September, anywhere from 10 to 40 percent of Virginia's rainfall comes from tropical systems or their remnants. When Hurricane Camille, passed through the State in 1969, upwards of 33 inches of rain fell on the eastern slopes of the Blue Ridge in Nelson County and caused record floods along the James River.

Before 1900, hurricane and tropical storm passages across Virginia were relatively common, averaging one per year. From 1905 to 1920, however, a hurricane struck, on the average, only one year in every five. The frequency then increased to about three hurricanes in a five-year period before decreasing again in the 1960s and 1970s. Beginning in the late 1990s, there was an increase in the number of tropical systems affecting the Commonwealth.

Thunderstorms, which occur in all months of the year, are most common in the deep, moist, warm air of tropical origin that is typical of summer. The State has averaged one thunderstorm day a decade in January, compared with nine thunderstorm days a month in July. Thunderstorm days are most frequent in southern Virginia, particularly in the far southwestern section, while northern Virginia experiences the least number of such storms. Thunderstorms are also most likely to occur during the warmest part of the day, with 4:00 p.m. the most probable time of occurrence. In Roanoke, for example, thunderstorms occur 10 times more frequently at 4:00 p.m. than at 10:00 a.m. and five times more frequently at 4:30 p.m. than at 7:00 p.m. At Norfolk, thunderstorms are also most frequent at 4:00 p.m., remaining common there until about midnight. Thunderstorms produce complex patterns of rainfall, such that areas of heavy rain may be next to areas with little or no rain.

Climate and the Economy- Few states have a more diverse climate than that of Virginia. The State has five different climate regions: the Tidewater, Piedmont, Northern Virginia, Western Mountain and Southwestern Mountain regions. Some localities-Charlottesville, Lynchburg and Warrenton, for example, have climate amenities such as long growing seasons and infrequent subzero temperature minimums, while winters on the northern Blue Ridge frequently produce

bitterly cold temperatures like those of Chicago. Similarly, annual rainfall totals can vary from a sparse thirty-three inches typical of the Shenandoah Valley to more than sixty inches in the mountains of southwestern Virginia.

Virginia's wide variety of agricultural products marks the economic benefits of its climate diversity. The close quarters of dissimilar climatic zones also have their costs, however, because the boundaries between zones are not fixed and the year-to-year constancy of conditions is rare. A climate condition typical of one region might in a given year extend outward into another area. As an example, low rainfall levels typical of the Shenandoah Valley's 33 inches per year may extend eastward across the Blue Ridge, out across the Piedmont, and into the Tidewater region. In such a case, drought, crop failure, and economic losses may be extensive.