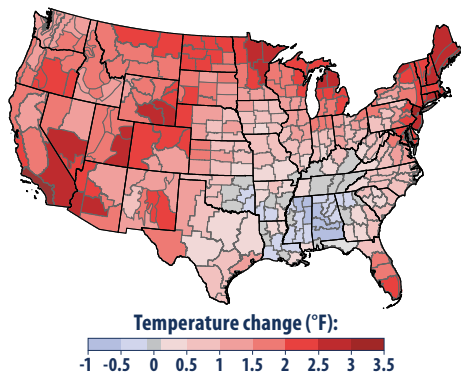


What Climate Change Means for Virginia

Virginia's climate is changing. Most of the state has warmed about one degree (F) in the last century, and the sea is rising one to two inches every decade. Higher water levels are eroding beaches, submerging low lands, exacerbating coastal flooding, and increasing the salinity of estuaries and aquifers. The southeastern United States has warmed less than most of the nation. But in the coming decades, the region's changing climate is likely to reduce crop yields, harm livestock, increase the number of unpleasantly hot days, and increase the risk of heat stroke and other heat-related illnesses.

Our climate is changing because the earth is warming. People have increased the amount of carbon dioxide in the air by 40 percent since the late 1700s. Other heat-trapping greenhouse gases are also increasing. These gases have warmed the surface and lower atmosphere of our planet about one degree during the last 50 years. Evaporation increases as the atmosphere warms, which increases humidity, average rainfall, and the frequency of heavy rainstorms in many places—but contributes to drought in others.

Greenhouse gases are also changing the world's oceans and ice cover. Carbon dioxide reacts with water to form carbonic acid, so the oceans are becoming more acidic. The surface of the ocean has warmed about one degree during the last 80 years. Warming is causing snow to melt earlier in spring, and mountain glaciers are retreating. Even the great ice sheets on Greenland and Antarctica are shrinking. Thus the sea is rising at an increasing rate.



Rising temperatures in the last century. The eastern half of Virginia has warmed more than the western half. Source: EPA, *Climate Change Indicators in the United States*.

Rising Seas and Retreating Shores

Sea level is rising more rapidly along Virginia's shores than in most coastal areas because the land is sinking. If the oceans and atmosphere continue to warm, sea level along the Virginia coast is likely to rise sixteen inches to four feet in the next century.



Oceanfront houses in Virginia Beach are vulnerable to severe storms, flooding, and coastal erosion. © James G. Titus; used by permission.

As sea level rises, the lowest dry lands are submerged and become either tidal wetland or open water. The freshwater wetlands in the upper tidal portions of the Potomac, Rappahannock, York, and James rivers build their own land by capturing floating sediments, and they are likely to keep pace with the rising sea during the next century. But most salt marshes along the brackish portions of those rivers and along Chesapeake Bay are unlikely to keep pace if sea level rises three feet. The wetlands of Back Bay and the North Landing River are even more vulnerable and may be lost if the sea rises two feet.

Beaches also erode as sea level rises. A higher ocean level makes it more likely that storm waters will wash over a barrier island or open new inlets. The United States Geological Survey estimates that Virginia's barrier islands could be broken up by new inlets or lost to erosion if sea level rises two feet by the year 2100. Beach erosion will threaten the oceanfront portion of Virginia Beach, unless people take measures to offset the erosion. Rising sea level also threatens bay beaches and tidal flats.

Saltwater Intrusion

As sea level rises, salt water can mix farther inland or upstream in bays, rivers, and wetlands. Because water on the surface is connected to ground water, salt water can also intrude into aquifers near the coast. Soils may become too salty for farms or forests. For example, some of the freshwater swamps along the York River's tidal tributaries have standing dead trees that were killed by saltwater intrusion made possible by rising sea level.

Storms, Homes, and Infrastructure

Tropical storms and hurricanes have become more intense during the past 20 years. Although warming oceans provide these storms with more potential energy, scientists are not sure whether the recent intensification reflects a long-term trend. Nevertheless, hurricane wind speeds and rainfall rates are likely to increase as the climate continues to warm.

Whether or not storms become more intense, coastal homes and infrastructure will flood more often as sea level rises, because storm surges will become higher as well. Many roads, railways, and ports are vulnerable to the impacts of storms and sea level rise, and most of the heavily populated Hampton Roads area could be flooded by a major hurricane. Poquoson and a few other communities along Chesapeake Bay are so low that water in roadside ditches rises and falls with the tides. As sea level rises and storms possibly become more severe, homes and infrastructure in these communities will flood more frequently. As a result, rising sea level is likely to increase flood insurance rates, while more frequent storms could increase the deductible for wind damage in homeowner insurance policies.

Increased rainfall could further exacerbate flooding in both coastal and inland areas. The amount of precipitation during very heavy storms increased by 27 percent between 1958 and 2012 in the Southeast, and the trend toward increasingly severe rainstorms is likely to continue.



The rising sea threatens low-lying coastal towns such as Tangier, which is less than five feet above sea level. © James G. Titus; used by permission.

Coastal Ecosystems

The loss of tidal marshes could harm fish and birds that depend on a marsh for food or shelter. Marine organisms and small insects that feed in marshes are key sources of food for crabs, rockfish, and other commercially important fisheries. Striped bass, bluefish, sea trout, and summer flounder move into and out of marshes for food and shelter. Many birds inhabit the most vulnerable marshes along Chesapeake Bay, including great blue heron, bald eagle, American black duck, and snowy egret.

Marshes along the Atlantic coast provide forage for shorebirds, such as sandpipers and plovers, and several species of ducks and geese spend the winter in these marshes.

The loss of bay beaches would remove key habitat for diamond-back terrapin, which nest on these beaches. Other species that depend on bay beaches include horseshoe crabs, tiger beetles, sand fleas, snails, and several crab species. The loss of those species would remove important sources of food for birds.

Changing temperatures could also disrupt ecosystems. If water temperatures exceed 86°F during summer, eelgrass could be lost, which would remove habitat for summer flounder, blue crab, and bay scallop. Brants, canvasback ducks, and American black ducks would also lose a food source.

Agriculture

Changing the climate will have both harmful and beneficial effects on farming. Higher temperatures are likely to reduce livestock productivity, because heat stress disrupts the animals' metabolism. In the next few decades, hotter summers are likely to reduce yields of corn. But higher concentrations of atmospheric carbon dioxide increase crop yields, and that fertilizing effect is likely to offset the harmful effects of heat on cotton, soybeans, wheat, and peanuts—assuming that adequate water is available. Rising temperatures are likely to increase the need for irrigation, and where water is scarce, increasingly severe droughts are likely to reduce crop yields.

Energy

Seventy years from now, temperatures are likely to rise above 95°F approximately 20 to 40 days per year in the southeastern half of Virginia, compared with about 10 days per year today. Warmer temperatures will increase the use of air-conditioning, which will increase electricity consumption.

Human Health

Hot days can be unhealthy—even dangerous. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. High air temperatures can cause heat stroke and dehydration, and affect people's cardiovascular and nervous systems. Warmer temperatures can also increase the formation of ground-level ozone, a key component of smog. Because ozone has a variety of health effects, aggravates lung diseases such as asthma, and increases the risk of premature death from heart or lung disease, EPA and the Virginia Department of Environmental Quality have been working to reduce ozone concentrations. As the climate changes, continued progress toward clean air will be more difficult.

The sources of information about climate and the impacts of climate change in this publication are: the national climate assessments by the U.S. Global Change Research Program, synthesis and assessment products by the U.S. Climate Change Science Program, assessment reports by the Intergovernmental Panel on Climate Change, and EPA's *Climate Change Indicators in the United States*. Mention of a particular season, location, species, or any other aspect of an impact does not imply anything about the likelihood or importance of aspects that are not mentioned. For more information about climate change science, impacts, responses, and what you can do, visit EPA's Climate Change website at www.epa.gov/climatechange.