EPA United States Environmental Protection Agency

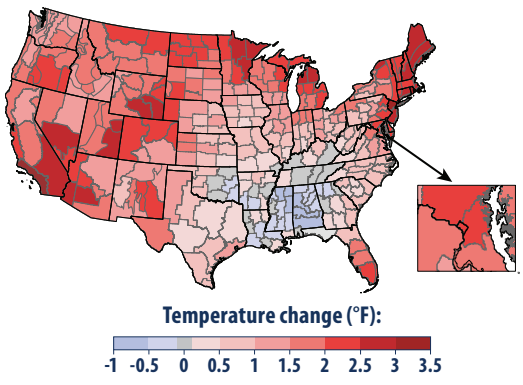
November 2016
EPA 430-F-16-064

What Climate Change *Means for the* District of Columbia

The **District of Columbia**'s climate is changing. The region has warmed by more than two degrees (F) in the last century, hot days and heavy rainstorms are more frequent, and the tidal Potomac is rising about one inch every eight years. In the coming decades, changing climate is likely to increase tidal flooding, cause more heavy rainstorms and sewer overflows, and increase some risks to human health.

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 District of Columbia has warmed more than most of the nation. Source: EPA, Climate Change Indicators in the United States.

Increasing Temperature and Changing Precipitation Patterns

Summer, fall, winter, and spring have all become warmer since the 1940s in the District of Columbia. Five of the six hottest summers on record have occurred since 2010. This trend is very likely to continue.

Rising temperatures and shifting rainfall patterns are likely to increase the intensity of both floods and droughts. Average annual precipitation in the DC area has increased by 5 to 10 percent in the last century, but precipitation from extremely heavy storms has increased by more than 25 percent across the eastern United States since 1958. Over the next century, average annual precipitation and the frequency of heavy downpours are likely to keep rising. During winter and spring, average precipitation is likely to increase. During summer and fall, precipitation is unlikely to change significantly, but rising temperatures will increase evaporation and thereby dry the soil. As a result, changing climate is likely to intensify flooding during winter and spring, and intensify drought during summer and fall.

Severe Storms, Flooding, and Wind Damage

As severe rainstorms become more frequent, flood damage to homes and other buildings is likely to increase. Most homes along the north side of Watts Branch—as well as Mayfair on the south side—are in the 100-year floodplain, and several homes and businesses along Oxon Run are also vulnerable to flash flooding. Almost all of the land in and adjacent to Federal Triangle is low-lying and vulnerable to flooding from severe rainstorms or high water levels in the Potomac River. During June 2006, a severe rainstorm flooded several federal buildings and museums around Federal Triangle and caused $10 million in damage across the region.

More heavy storms could also harm wastewater and other types of infrastructure. One-third of the District is served by a combined sewer system designed before 1900, which carries both sewage and stormwater in the same system of pipes. Heavy rainfall can overwhelm the system, forcing it to discharge raw sewage into the Anacostia River, Rock Creek, or the Potomac River. DC Water's Clean Rivers project is building wastewater treatment and stormwater storage facilities to reduce these sewer overflows. But capturing or treating all of this water will become more difficult if heavier storms release more water onto the city's streets, rooftops, and other impermeable surfaces. Storms can also harm transportation systems: for example, flash flooding temporarily closed the Cleveland Park Metro station in June 2016.

The changing climate may also increase damage caused by winds. Hurricanes and other tropical storms 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, wind speeds and rainfall rates during hurricanes are likely to increase as the climate continues to warm. These storms can damage homes and disrupt power supplies and transportation networks. In 2003, Hurricane Isabel knocked down many trees throughout the District, and half of PEPCO's customers lost electric power—some for as long as a week. Downed power lines made many roads impassable in adjacent counties in Maryland. In 2011, Hurricane Irene also left hundreds of thousands of people without electric power in the Washington area.

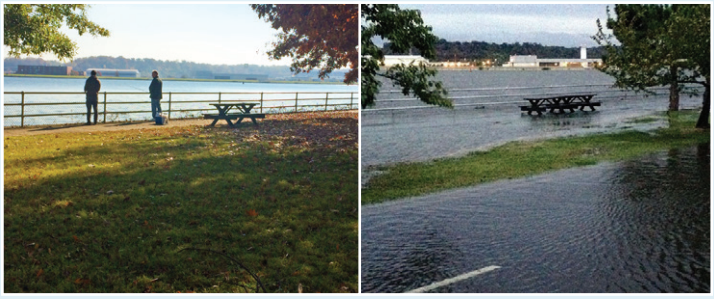
Rising Sea Level and Tidal Inundation

Sea level is rising more rapidly along the shores of the Potomac and Anacostia rivers than along most shores because the land here is sinking. At the official tide gauge along the Southwest Waterfront, sea level has risen six or seven inches during the last 50 years. If the oceans and atmosphere continue to warm, sea level in the District is likely to rise sixteen inches to four feet in the next century.

As sea level rises, the lowest dry lands are submerged and become either tidal wetland or open water, while lands that are rarely flooded by the tides become flooded more frequently. The District has between one and two square miles of land within about three feet of the average high tide. These areas include most of Kenilworth Aquatic Gardens, the northern portion of Joint Base Anacostia-Bolling, and about half of East Potomac Park.

As sea level rises, occasional extreme high tides are able to reach farther inland. Most of the sidewalks along the Tidal Basin and part of the road to Hains Point in East Potomac Park, for example, are about one foot above the average daily high tide. This water level was only reached about six times per year during the 1950s, but now it is exceeded more than 30 times per year. By the time sea level rises one foot, these areas will be flooded during half the days of the year.

Although few homes in the District are close enough to sea level to be permanently submerged, sea level rise can exacerbate damage caused by storm surges and river flooding. A higher average water level in the Potomac and Anacostia provides a higher base for storm surges and river surges, which means that water pushed inland by storm winds could penetrate farther into adjacent dry land, as could flood waters from upstream. A higher water level also makes storm drains less effective.



Fishing at Hains Point in East Potomac Park (left) and flooding in the same area in September 2015 (right). Hains Point is one of several areas along the Potomac that could be regularly inundated at high tide as sea level rises. Credit: (left) James G. Titus, EPA; (right) NOAA.

Ecosystems

The tidal wetlands in the Washington area build their own land by capturing floating sediments, and they are generally likely to keep pace with the rising sea during the next century. Nonetheless, rising sea level could alter wetland habitat and harm fish and birds that depend on it for food or shelter. Areas at risk include freshwater marshes along tidal portions of the Anacostia River, where surveys have found nearly 200 bird species; marshes on Roosevelt Island; and other marshes downstream along the Potomac. The rise in sea level may also submerge parts of the swamp forest on Roosevelt Island.

Flooding at the Tidal Basin during cherry blossom season. As the climate changes, tidal flooding is occurring more often, while Washington's famous cherry trees are blooming earlier in the spring. Credit: National Park Service.

Rising temperatures are lengthening the growing season in the Mid-Atlantic region, and they could change the composition of woodlands and the timing of ecological processes. In many parts of our nation, wildflowers and woody perennials are blooming—and migratory birds are arriving—sooner in spring. Not all species adjust in the same way, however, so the food that one species needs may no longer be available when that species arrives on its migration. Washington's cherry trees are blooming earlier: since 1921, peak bloom dates have shifted earlier by approximately five days. The timing of the peak bloom is important to tourism and the local economy because the cherry blossoms draw more than one million people each year, many of whom are from out of town.

Human Health

Hot days can be unhealthy—even dangerous. Rising temperatures will increase the frequency of hot days and warm nights. High air temperatures can cause heat stroke and dehydration and affect people's cardiovascular and nervous systems. Warm nights are especially dangerous because they prevent the human body from cooling off after a hot day. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor. Because the District of Columbia is warmer than surrounding areas, Washingtonians face a greater risk of heat-related illnesses—especially residents without air conditioning.

Warmer temperatures can increase the formation of ground-level ozone, a component of smog that can contribute to respiratory problems. Rising temperatures may also increase the length and severity of the pollen season for plants such as ragweed, which has already been observed in other regions.

The risk of some diseases may also increase. West Nile virus, transmitted by mosquitoes, could become more common due to rising temperatures, which speed up the mosquito life cycle and increase biting rates, as well as dry periods, which benefit the type of mosquito that transmits West Nile. But the effects are still uncertain and likely to vary by region. Increased flooding from more intense storms could lead to more indoor dampness and mold, which contribute to asthma, allergies, and respiratory infections.

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.