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United States Environmental Protection Agency

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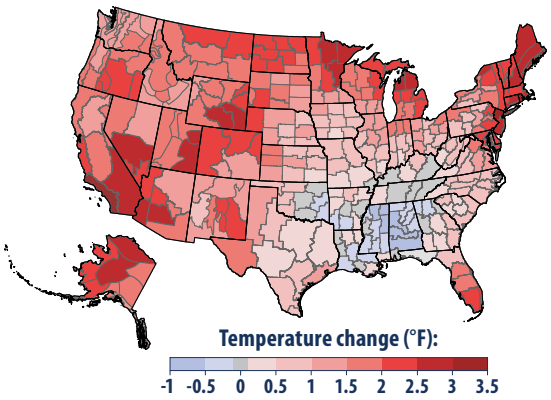
What Climate Change *Means for* Washington

Washington's climate is changing. Over the past century, most of the state has warmed one to two degrees (F). Glaciers are retreating, the snowpack is melting earlier in the year, and the flow of meltwater into streams during summer is declining. In the coming decades, coastal waters will become more acidic, streams will be warmer, populations of several fish species will decline, and wildfires may be more common.

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.



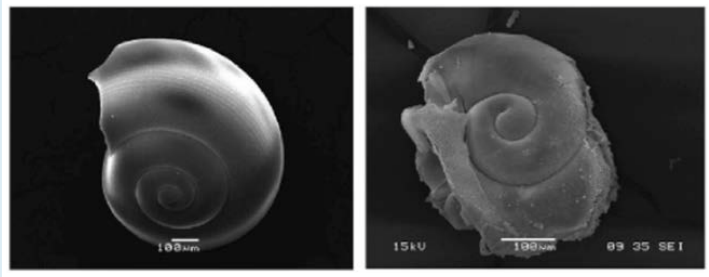
Rising temperatures in the last century. The warming in Washington has been similar to the average warming nationwide. Source: EPA, Climate Change Indicators in the United States.

Marine and Coastal Ecosystems

Rising water temperatures, increasing ocean acidity, and changes in the marine ecosystem will amplify observed losses in commercially and recreationally important fish stocks in the region in the 21st century. Credit: NOAA.

Washington's coastal waters are vulnerable to acidification. The ocean here is more acidic than most of the ocean, because nearby currents bring relatively acidic water from the deep ocean to the surface, especially during spring and summer. Increasing acidity impairs the ability of some types of shellfish to capture minerals in the water to build their shells, which can lead to thinner shells—or even prevent shells from forming. Oyster hatcheries in Washington are becoming less productive, because the water they draw from along the shore has become more acidic and corrosive, partly because of higher atmospheric carbon dioxide. Acidity also thins the exoskeletons of many species of plankton, which could reduce the population of those plankton and the fish that feed on them, and alter the entire marine food web. For example, young salmon eat some of the types of shellfish and plankton that are vulnerable to acidification.

Rising ocean temperatures may also harm marine ecosystems. Warming waters can increase the frequency of toxic algae blooms (such as "red tide") that cause shellfish poisoning and lead to closures of beaches and shellfish beds. Warmer waters also allow invasive species from southern waters to move northward.



Pteropods, or "sea butterflies," are small free-swimming sea snails. They are an important source of food for North Pacific juvenile salmon, as well as whales and other marine species. The left panel shows a shell collected from a live pteropod from a region where acidity is not yet very high. The shell on the right is from a pteropod collected in a region where waters have acidified. Credit: Nina Bednaršek, NOAA.

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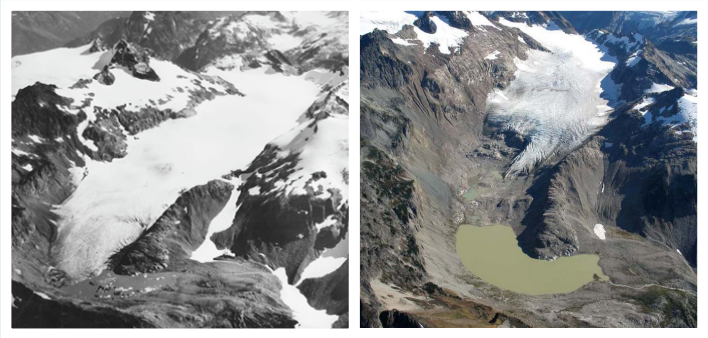
Impacts of Sea Level Rise

Sea level rise will threaten coastal development and ecosystems. Erosion will threaten homes and public property along the shore. Increased flooding could threaten wastewater treatment plants, ferry terminals, highways, and railroads along Puget Sound. Mudflats, marshes, and other tidal wetlands provide habitat for birds and fish. As water levels rise, wetlands may be submerged or squeezed between the rising sea and structures built to protect coastal development.

Glacial Retreat

Three thousand glaciers cover about 170 square miles of mountains in Washington, but that area is decreasing in response to warmer temperatures. For example, South Cascade Glacier has decreased in size since the 1950s, with an accelerated rate of decline in recent years.



Aerial views of South Cascade Glacier in September 1955 (left) and September 2004 (right). Credits: Austin Post, USGS (left); © John Scurlock, used by permission (right).

Snowpack, Streamflows, and Water Availability

The flows of water in rivers and streams are increasing during late winter and early spring but decreasing during summer. Warmer winters have reduced average snowpack in Washington by 20 percent since 1950. The snowpack is now melting a few weeks earlier than during the 20th century, and, by 2050, it is likely to melt three to four weeks earlier. Decreasing snowpack means there will be less water flowing through streams during summer. Moreover, rising temperatures increase the rate at which water evaporates (or transpires) into the air from soils and plants. More evaporation means that less water will drain from the ground into rivers and streams.

Declining snow and streamflow would harm some economic sectors and aquatic ecosystems. Less snow means a shorter season for skiing and other winter recreation. Water temperatures will rise, which would hurt Chinook and sockeye salmon in the interior Columbia River Basin. The combination of warmer water and lower flows would threaten salmon, steelhead, and trout. Lower flows would also mean less hydroelectric power.

Drought and Wildfires

Changing the climate is likely to more than double the area in the Northwest burned by forest fires during an average year by the end of the 21st century. Although drier soils increase the risk of wildfire, other factors also contribute to fires, and forests in the Western Cascades may be less vulnerable to climate change than those in the Eastern Cascades. Higher temperatures and a lack of water can also make trees more susceptible to pests and disease, and trees damaged or killed burn more readily than living trees. Changing climate is likely to increase the area of pine forests in the Northwest infested with mountain pine beetles over the next few decades. Pine beetles and wildfires are each likely to decrease timber harvests. Increasing wildfires also threaten homes and pollute the air.

Agriculture

The changing climate will affect Washington's agricultural sector, particularly fruits and vegetables, which often require irrigation. Because streams rather than ground water provide most of Washington's irrigation water, the expected decline in streamflow would reduce the water available for irrigation. About two-thirds of the nation's apples come from Washington, and most are grown east of the Cascade Mountains where the dry climate requires irrigation. The Washington Department of Ecology is concerned that yields of apples and cherries may decline in the Yakima River Basin as water becomes less available. Alfalfa, potato, and wheat farmers also require substantial irrigation.

Health and Vulnerable People

Climate change is likely to amplify some threats to health in Washington. Certain people are especially vulnerable, including children, the elderly, the sick, and the poor.

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, 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.

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