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United States Environmental Protection Agency

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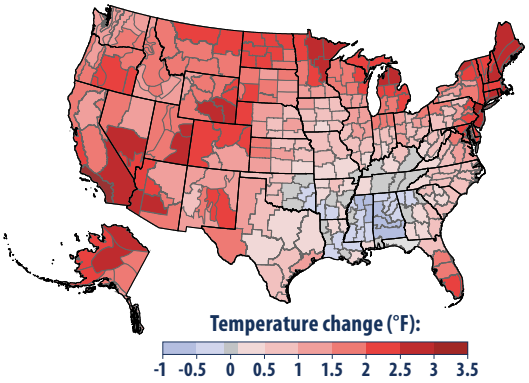
What Climate Change *Means for* Alaska

Alaska's climate is changing. Over the past 60 years, most of the state has warmed three degrees (F) on average and six degrees during winter. As a result, Arctic sea ice is retreating, shores are eroding, glaciers are shrinking, permafrost is thawing, and insect outbreaks and wildfires are becoming more common. In the coming decades, these effects are likely to accelerate.

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

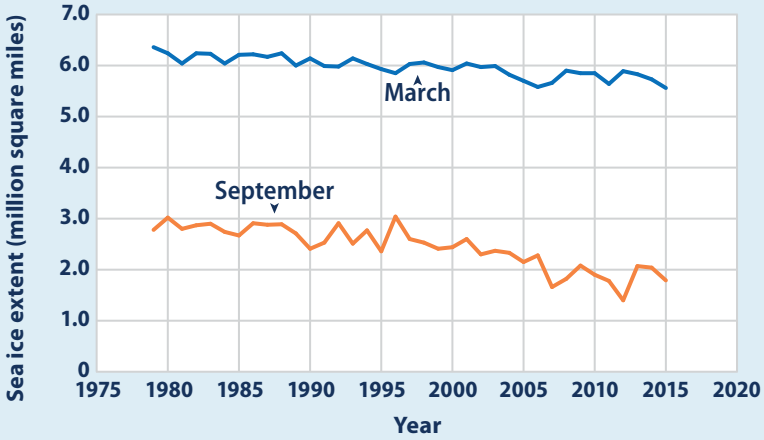
Glaciers and Sea Ice

Rising temperatures have reduced the area of land covered by glaciers and water covered by sea ice, and will continue to do so. Glaciers have retreated dramatically during the last century in southeast Alaska, in the Alaska Range, and along the south central coast. In Glacier Bay National Park, for example, Muir Glacier has retreated more than 31 miles since it was first observed in the late 19th century.

Toboggan Glacier near Prince William Sound in August 1905 (top) and August 2008 (bottom). The glacier has thinned by nearly 500 feet and retreated by about 0.3 miles. Credits: Sidney Paige, USGS (top); Bruce F. Molnia, USGS (bottom).

Sea ice covers almost all of the Arctic Ocean in winter, and, until recently, ice covered most of this ocean during summer as well. During the last few decades, the ice has retreated. The area covered by ice at the end of summer 2012 was nearly 50 percent smaller than the historical average. The ice is likely to melt entirely most summers within a few decades.

Sea ice provides habitat for polar bears, walruses, and other animals; hunting grounds for Alaska Native communities; and a buffer against storm damage. But all of that is threatened by rising temperatures.



Average Arctic sea ice coverage has declined since 1979. Source: EPA.

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Permafrost, Infrastructure, and Energy Production

Permafrost soil lies beneath about 80 percent of Alaska's land surface. Much of this land could shift or sink if rising temperatures thaw the permafrost. That can damage pipelines, buildings, roads and other transportation infrastructure, water supplies, and sewer systems. Thawing permafrost is likely to increase the cost of maintaining public infrastructure by 10 to 20 percent in the next 20 years.

Energy production depends on vehicles that must drive on frozen tundra and ice roadways to support oil and gas exploration activities in areas without conventional highways. Because of melting, the travel season has shrunk from more than 200 days in 1970 to around 100 days in 2002. Energy production and transportation could benefit from warming in other ways, though. For example, less sea ice could allow more ship travel and oil and gas exploration in the Arctic Ocean.

Fisheries and Wildlife

Increasing ocean acidity threatens fishing, which is Alaska's third largest industry and a key source of food for many native communities. Higher acidity harms shellfish and certain types of plankton that depend on minerals in the water to build their skeletons and shells. Less plankton means less food available to support populations of salmon and other fish.

Climate change is likely to affect Alaska's animal biodiversity. Declining Arctic sea ice can harm polar bear populations, by reducing their ability to hunting seals. Polar bear, walrus, and seal populations are expected to decline further, due to loss of snow and ice cover—especially walrus, which bear and nurse their calves on summer sea ice. Higher evaporation, permafrost thaw, and other factors have decreased the area of lakes in the past half-century, particularly in southern Alaska. Continued loss of lake and wetland areas in Alaska is likely to reduce habitat for the millions of migratory birds that rely on these areas for breeding.

Forests and Tundra

Rising temperatures in interior Alaska have increased the length of the growing season by 45 percent during the last century, and the growing season will continue to lengthen. While a longer growing season could boost agriculture and plant growth, other changes could harm Alaska's forest and tundra plants. Wetland drying; warmer, drier summers; and more frequent thunderstorms have led to more large forest and tundra fires in the last 10 years than in any decade since recordkeeping began in the 1940s. The number of acres burned each year is likely to double by 2050 and triple by 2100.

"Drunken forests" occur when the permafrost under trees thaws, causing them to lean. Credit: NOAA.

In south-central Alaska, during the 1990s, milder winters and warmer temperatures increased the winter survival of the spruce bark beetle and allowed it to complete its life cycle in one year instead of the normal two years. Nine years of drought stress weakened spruce trees' normal defense mechanisms against the beetles. This combination of ecological factors—all related to climate change—led to the largest reported outbreak of spruce bark beetles in the world, which killed many trees.

Alaska Native Communities

Many of Alaska's native communities are vulnerable to climate change, because their travel, hunting, food, and infrastructure depend on a landscape that is frozen for at least part of the year. The loss of sea ice restricts the subsistence lifestyle of groups such as the Yup'ik, Iñupiat, and Inuit by limiting hunting grounds and reducing habitat for traditional food sources such as walrus. Erosion and thawing permafrost are forcing some coastal communities to consider relocating to more stable land. Jobs in the general economy are scarce in these villages, so threats to the resources on which Alaska Natives rely make them particularly vulnerable to the impacts of climate change.

Health and Vulnerable People

Climate change is likely to amplify some threats to health in Alaska. 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, 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.

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