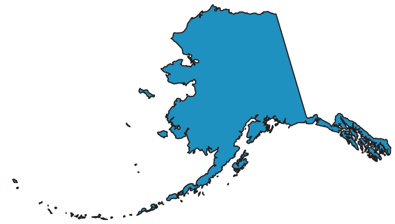
United States Global Change Research Program



Regional Climate Trends and Scenarios: Alaska

This document provides a brief overview of the observed changes in the climate of Alaska as well as possible future climate conditions as simulated by climate models, based on two scenarios of future greenhouse gas emissions. It summarizes the detailed findings presented in one of nine regional and national climate descriptions created by the National Oceanic and Atmospheric Administration (NOAA) in support of the National Climate Assessment (NCA). It is also hoped that these findings are of direct benefit to decision makers and communities seeking to develop adaptation plans. The full Regional Climate Trends and Scenarios report is available at http://scenarios.globalchange.gov/regions/alaska-and-arctic, and should be cited as:

Stewart, B.C., K.E. Kunkel, L.E. Stevens, L. Sun, and J.E. Walsh, 2013: Regional Climate Trends and Scenarios for the U.S. National Climate Assessment. Part 7. Climate of Alaska, NOAA Technical Report NESDIS 142-7, 60 pp.

Observed Regional Climate Trends

This section summarizes the observed climate trends of Alaska, focusing mainly on temperature and precipitation, as well as other climate features, including coastal storms, fires, and sea ice decline. These historical data are primarily from the National Climatic Data Center's first-order surface weather observing stations.

Temperature

- Temperatures across Alaska have generally remained above the 1949-2011 average over the past three decades. Most of the warming has occurred in winter and spring for all regions of Alaska, with the Interior region experiencing the greatest overall warming. It is important to note that warming since 1976 coincides with a shift of the Pacific Decadal Oscillation (PDO) to its positive phase. This climatic feature is known to bring warm air into Alaska during winter.

Precipitation

- Long-term trends in annual precipitation show nearly average amounts from 1949 to 1965, followed by about 15 years of below average totals. In recent decades, precipitation amounts have largely been above average in Alaska.

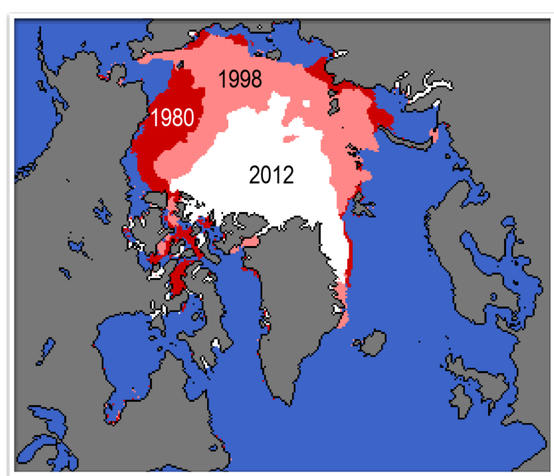
Extremes

- Over the past few decades, the observed decrease in frequency of extreme cold events has become more pronounced, with the greatest decreases occurring in spring. Temporal patterns again coincide with the phase shift of the PDO around 1976.
- As with average precipitation, occurrence of extreme precipitation events is highly variable and both regionally and seasonally dependent.

Additional Climate Features

- No significant change in the overall frequency of strong storm events is detectable, though the northern and northwestern coasts have seen a significant increase in the occurrence of strong storms when a protective sea ice cover is not present during summer and autumn.
- The occurrence of fires in Interior Alaska has increased under the influence of warmer spring temperatures, earlier snow melt, longer growing seasons, and deeper permafrost active layers. The past several years have also seen unprecedented fire occurrence on the tundra of northern and western Alaska associated with sea ice loss.
- Sea ice extent at the end of each summer from 2007 to 2012 was lower than at any time prior to 2007 in the satellite-based sea ice record (1979-2012). This can be seen in the figure, which shows the observed September sea ice extent in 1980, 1998, and 2012.

September Sea Ice Extent



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Future Regional Climate Scenarios

This section describes simulated future climate conditions based on climate models using two emissions scenarios generated by the Intergovernmental Panel on Climate Change: the high (A2) scenario, in which emissions of heat-trapping gases continue to rise, and the low (B1) scenario, where emissions peak in the mid-21st century and decline substantially thereafter. These scenarios were chosen because they incorporate much of the range of potential future human impacts on the climate system, and are used in a large body of literature. These simulations use data from the WCRP's Coupled Model Intercomparison Project 3 (CMIP3), as well as downscaled CMIP3 data.

Temperature

- CMIP3 models simulate an increase in annual mean temperature under both emissions scenarios for all future time periods. Increases are greatest in northwestern Alaska, decreasing southward. The largest simulated warming occurs in the late 21st century under the high emissions scenario. Differences in the two scenarios are especially apparent in winter.
- There is uncertainty within the range of model-simulated temperature changes, but for each model simulation, the warming is unequivocal and large compared to historical temperature variations.
- Growing season is simulated to lengthen by 15 to 25 days for southwestern and south central parts of the state by mid-century under both emissions scenarios.

Precipitation

- CMIP3 models simulate an increase in mean annual precipitation across Alaska, with the greatest increases occurring in northwestern portions of the state. Increases are greatest in the late 21st century under the high emissions scenario.
- The range of model-simulated precipitation changes is considerably larger than the multi-model mean change for both the high and low emissions scenarios, meaning that there is great uncertainty associated with precipitation changes in these scenarios.

Permafrost

- Permafrost degradation is simulated to increase for two future time periods (mid and late 21st century) under both emissions scenarios. Increases cover much of Interior Alaska under the high emissions scenario, while thawing is more discontinuous in the low emissions scenario. This can be seen in the figure, which shows simulated annual average soil temperatures at a depth of one meter.

Sea Ice

- Climate models simulate large declines in sea ice extent in the Alaskan region. Summer sea ice in the Chukchi Sea disappears between 2030 and 2050 in some models, while winter sea ice in the Bering and Chukchi Seas decrease by more than 50% by the end of the century.

Simulated Annual Mean Soil Temperature at 1-Meter Depth