ALASKA

Key Messages

Arctic summer sea ice is receding faster than previously projected and is expected to virtually disappear before mid-century. This is altering marine ecosystems and leading to greater ship access, offshore development opportunity, and increased community vulnerability to coastal erosion.

Most glaciers in Alaska and British Columbia are shrinking substantially. This trend is expected to continue and has implications for hydropower production, ocean circulation patterns, fisheries, and global sea level rise.

Permafrost temperatures in Alaska are rising, a thawing trend that is expected to continue, causing multiple vulnerabilities through drier landscapes, more wildfire, altered wildlife habitat, increased cost of maintaining infrastructure, and the release of heat-trapping gases that increase climate warming.

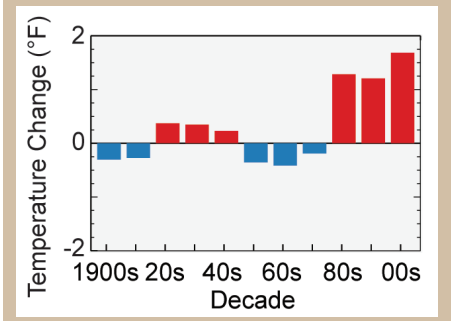
Current and projected increases in Alaska's ocean temperatures and changes in ocean chemistry are expected to alter the distribution and productivity of Alaska's marine fisheries, which lead the U.S. in commercial value.

The cumulative effects of climate change in Alaska strongly affect Native communities, which are highly vulnerable to these rapid changes but have a deep cultural history of adapting to change.

Over the past 60 years, Alaska has warmed more than twice as rapidly as the rest of the U.S., with average annual air temperature increasing by 3°F and average winter temperature by 6°F, with substantial year-to-year and regional variability.[1] Most of the warming occurred around 1976 during a shift in a long-lived climate pattern (the Pacific Decadal Oscillation) from a cooler pattern to a warmer one. The underlying long-term warming trend has moderated the effects of the more recent shift of the Pacific Decadal Oscillation to its cooler phase in the early 2000s.[2] Alaska's warming involves more extremely hot days and fewer extremely cold days.[1,3] Because of its cold-adapted features and rapid warming, climate change impacts on Alaska are already pronounced, including earlier spring snowmelt, reduced sea ice, widespread glacier retreat, warmer permafrost, drier landscapes, and more extensive insect outbreaks and wildfire.

Inupiaq seal hunter on the Chukchi Sea. Reductions in sea ice alter food availability for many species from polar bear to walrus, and make hunting less safe for Alaska Native hunters.

Rising Temperatures



Bars show Alaska average temperature changes by decade for 1901-2012 relative to the 1901-1960 average. The far right bar (2000s decade) includes 2011 and 2012. (Figure source: NOAA NCDC / CICS-NC).

The state's largest industries, energy production, mining, and fishing, are all affected by climate change. Continuing pressure for oil, gas, and mineral development on land and offshore in ice-covered waters increases the demand for infrastructure, placing additional stresses on ecosystems. Land-based energy exploration will be affected by a shorter season when ice roads are viable, yet reduced sea ice extent may create more opportunity for offshore development.

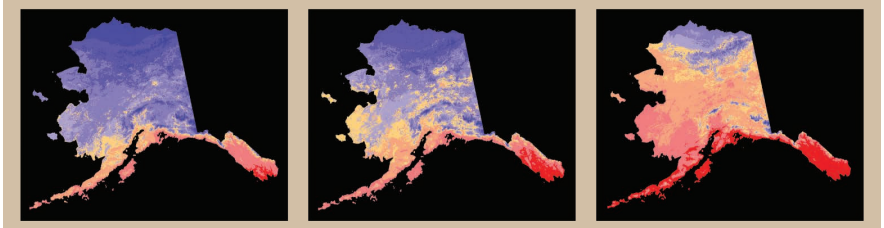
Alaska is home to 40% of the federally recognized tribes in the United States.[4] The small number of jobs, high cost of living, and rapid social change make rural, predominantly Native, communities highly vulnerable to climate change through impacts on traditional hunting and fishing and cultural connection to the land and sea.

Arctic sea ice extent and thickness have declined substantially, especially in late summer (September), when there is now only about half as much sea ice as at the beginning of the satellite record in 1979.[5,6] The seven Septembers with the lowest ice extent all occurred in the past seven years. Sea ice has also become thinner, with less ice lasting over multiple years, and is therefore more vulnerable to further melting.[6] Models that best match historical trends project that northern waters will be virtually ice-free in late summer by the 2030s.[7]

Reductions in sea ice increase the amount of the sun's energy absorbed by the ocean. This melts more ice, leaving more dark open water that gains even more heat, leading to a self-reinforcing cycle that increases warming.

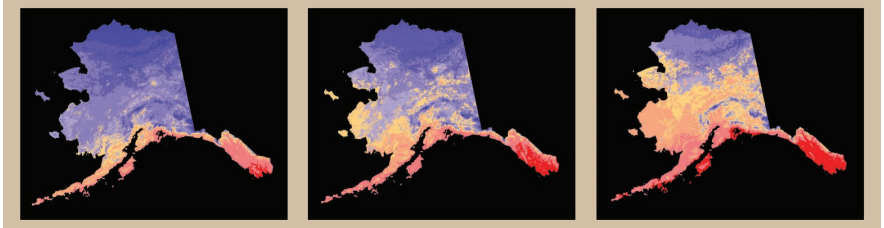
The Big Thaw

Higher Emissions Scenario (A2)



2001-2010 2041-2050 2091-2100

Lower Emissions Scenario (B1)



Soil Temperature (°F)

As temperatures rise, permafrost thawing increases. Maps show projections of average annual ground temperature at a depth of 3.3 feet for three time periods if emissions of heat-trapping gases continue to grow (higher scenario, A2), and if they are substantially reduced (lower scenario, B1). (Figure source: Permafrost Lab, Geophysical Institute, University of Alaska Fairbanks).

In Alaska, 80% of land is underlain by permafrost – frozen ground that restricts water drainage and therefore strongly influences landscape water balance and the design and maintenance of infrastructure. More than 70% of this area is vulnerable to subsidence (land sinking) upon thawing because of its ice content.[8] Permafrost near the Alaskan Arctic coast has warmed 6°F to 8°F at 3.3 foot depth since the mid-1980s.[9] Thawing is already occurring in interior and southern Alaska, where permafrost temperatures are near the thaw point.[10] Permafrost will continue to thaw,[11] and some models project that near-surface permafrost will be lost entirely from large parts of Alaska by the end of this century.[12]

Selected Responses

Local governments and tribes throughout Alaska are planting native vegetation, moving inland or away from rivers, and building riprap walls, seawalls, or groins, which are shore-protection structures built perpendicular to the shoreline.[13] Top photo shows a Homer seawall battered by waves while still under construction.

Villages including Newtok, Shishmaref (bottom), and Kivalina are facing relocation because of sea level rise and coastal erosion. Storm surges that used to be buffered by ice are now causing more shoreline and infrastructure damage. Residents of these villages face thawing permafrost, tilting houses, and sinking boardwalks along with aging fuel tanks and other infrastructure. Newtok has worked for a generation to move to a safer location, but current federal legislation does not authorize federal or state agencies to assist communities in relocating, or the use of public funds to repair or upgrade storm-damaged infrastructure in flood-prone locations.[14] Shishmaref and Kivalina are also seeking to relocate but have been similarly unsuccessful.