Resource Brief
Alaska

National Park Service
U.S. Department of the Interior

Inventory and Monitoring Program
Alaska Region

Arctic Network Central Alaska Network Southeast Alaska Network Southwest Alaska Network

Glaciers and Climate Change

Background

Approximately one fourth (4.6 million acres) of Alaska's glaciers occur within the boundaries of national parks. Most of Alaska's glaciers have been receding over the last century. Recent findings suggest the rate of recession has significantly increased in recent years (Arendt, Walsh, Harrison, 2009). The effects of melting glaciers are not yet fully understood; however, given the tremendous amount of water stored in glaciers, the impacts on fresh water flow, vegetation and coastal marine ecosystems will likely be of great significance.

As part of the Climate Change Response Strategy developed by the National Park Service in September of 2010, the Alaska Region is currently enhancing existing glacier monitoring efforts. These enhanced efforts are outlined here and include extent mapping and volume change analysis for glaciers within all Alaska Inventory and Monitoring networks. In addition, the project will include detailed descriptions and analyses of a select group of focus glaciers within each network and a series of briefing documents communicating status and trends.

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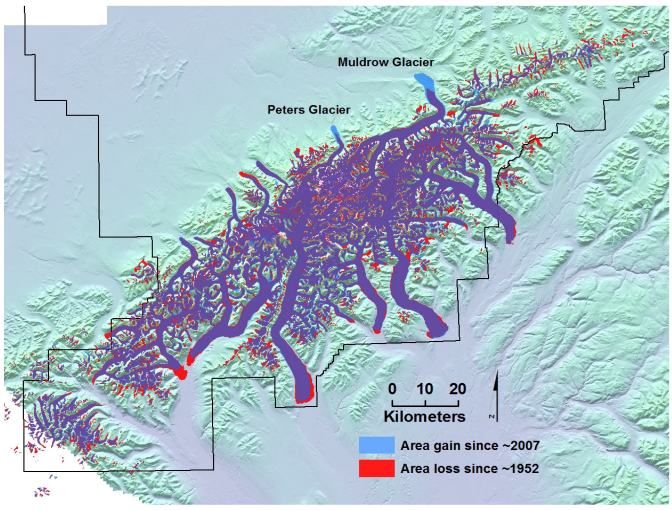


Image: University of Alaska Fairbanks

Glacier change in Denali National Park between 1952 and 2007. Maps similar to this one will be created for each park as part of the enhancements to the ongoing monitoring program.

Photo: Luke Rosier/NPS

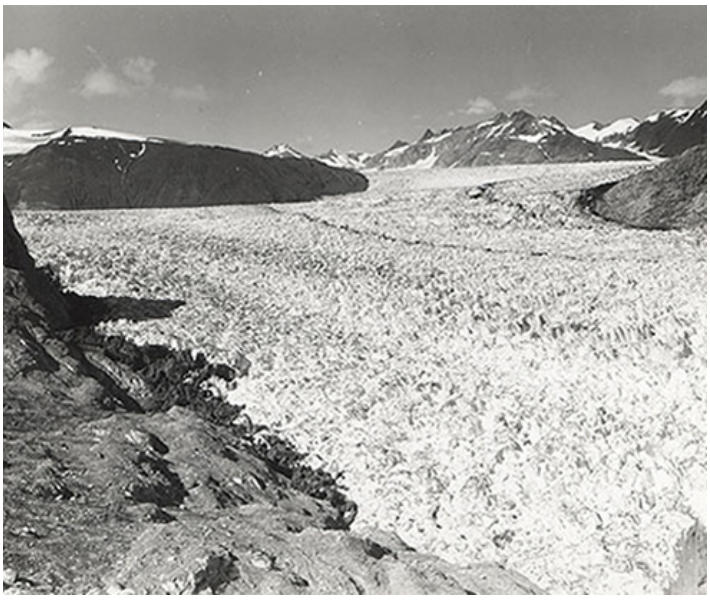
An NPS researcher measures a GPS waypoint at an exposed mass balance stake on the Harding Icefield in Kenai Fjords National Park.

Enhanced Monitoring

Long-term monitoring of glaciers is a multi-tiered approach involving partners at individual parks, the Geophysical Institute at University of Alaska Fairbanks and Alaska Pacific University. This initial cycle of monitoring will take place over 2011 - 2013. Extent mapping is being conducted over two time periods (1950 and current) using aerial photography and latest available satellite imagery (Landsat). Maps containing the two outlines will be created and compared for each glacier. Data sets describing the physical characteristics of each glacier (length, width, slope, area, elevation) will also be developed. This extensive data set describing glaciers within Alaska's national parks is unique and will have widespread applications.

Volume change analysis is being conducted on glaciers within parks using existing altimetry data. The altimetry data provides elevation profiles, which are accurate to ± 30 cm, along the center flowline of glaciers. Elevation for the entire surface of the glacier is then projected using the best available Digital Elevation Models (DEM).Volume change will be calculated for glaciers with multiple elevation profiles, which have been obtained at various times from 1950 to current. By comparing physical characters of glaciers collected during the extent mapping component of this project, volume change for specific groups of glaciers will also be projected to estimate regional volume change.

Photos: GLBA/NPS (1950 image), Bruce Molnia/USGS (2004 image)



Muir Glacier in Glacier Bay National Park is one of approximately 20 focus glaciers being analyzed and described as part of the enhancements to glacier monitoring in Alaska's national parks. The two images show Muir Glacier in 1950 (l) and in 2004 (r).

Putting it All Together

As a result of this study, glaciers within all of Alaska's national parks will be mapped and have physical characteristics, including average length, width, slope and elevation, described. Volume change will be calculated for glaciers with multiple altimetry data sets over time. The focus glaciers, of which there are approximately 20 located throughout the parks, have been studied extensively over time and are collectively representative of the diversity of glacier types in Alaska's national parks. Researchers will combine existing data with new analyses to provide detailed time lines and summaries of focus glacier status and trends. The detailed discussions of focus glaciers will provide information to be used in understanding climate trends and variations between parks and regions within Alaska. Project findings and focus glacier discussions will be summarized in a technical report. This information will also be developed into an interpretive publication that will take the form of a detailed, illustrated guide to glaciers in Alaska's national parks.

Data collected and analyzed as part of this project will be made available via several online data sources for use by the scientific community, including the National Snow and Ice Data Center (NSIDC), Global Land Ice Measurements from Space (GLIMS) and the Geographic Information Network of Alaska (GINA).

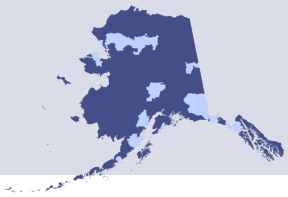
Plans to repeat this project are currently being developed and will likely occur every few years. As part of the science arm of the Climate Change Response Strategy, enhancements are also being made to existing permafrost, seasonal patterns and alpine vegetation monitoring efforts within the Alaska Inventory and Monitoring Program.

Glacier Activity in Alaska's Parks

More than 98 % of Alaska's large, lower elevation glaciers are in retreat, thinning or stagnating (USGS, 2008). Glacier ice is the largest reservoir of fresh water on earth. The effects of melting glaciers are only partially understood but may include changes in hydrology, terrestrial and aquatic ecosystems and further changes in climate.

This project is using multiple data analyzing methods and building on partnerships to strengthen the quality of findings. Extent mapping, physical characteristics profiles and volume change analysis results will be compiled into both a technical report and an illustrative interpretive guide. The enhanced understanding of status and trends on glaciers in Alaska can be applied to park and natural resource management as well as future scientific research.

Arendt, A., Walsh, J., Harrison, J. (2009). Changes of Glaciers and Climate in Northwestern North America During the late Twentieth Century. Journal of Climate, 22, 4117 - 4134. doi:10.1175/2009JCLI2784.1

Molnia, B.F., 2008, Glaciers of North America -- Glaciers of Alaska, in Williams, R.S., Jr., and Ferrigno, J.G., eds., Satellite image atlas of glaciers of the world: U.S. Geological Survey Professional Paper 1386-K, 525 p.

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