Southwest Alaska Network
Inventory & Monitoring Program

National Park Service
U.S. Department of the Interior

Alagnak Aniakchak Katmai Kenai Fjords Lake Clark

Glacial Extent

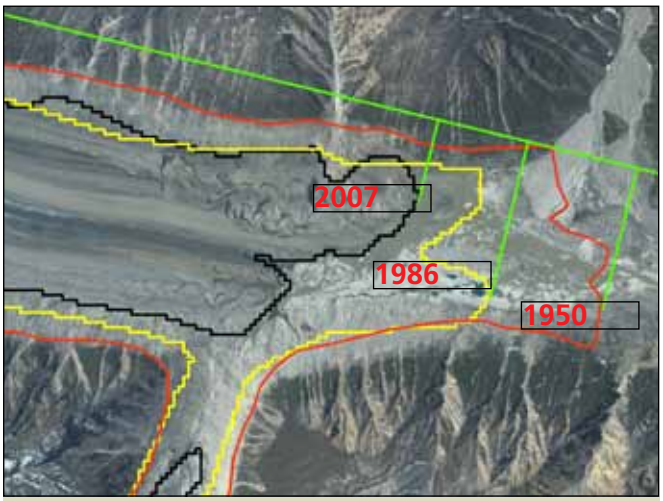
Resource Brief
October 2011

Importance

Glaciers are a significant feature in several SWAN park units, including Katmai NPP (KATM), Kenai Fjords NP (KEFJ) and Lake Clark NPP (LACL), where glaciers/ permanent snowfields comprise approximately 5%, 50% and 13% of the landscape, respectively. Alaska's glaciers have been retreating since the waning of the Little Ice Age (~100 years ago). Although historically ice loss occurred at varying rates, current evidence suggests that the rate has increased in recent decades. This widespread glacial recession is largely responsible for substantial landscape changes in SWAN park units that are visible today. Glaciers act as huge ice reservoirs for many of the large freshwater systems in the Network, and as such, glacial extent directly affects the character of the Network's watersheds and is suggestive of potential shifts in aquatic communities.

Long-term Monitoring

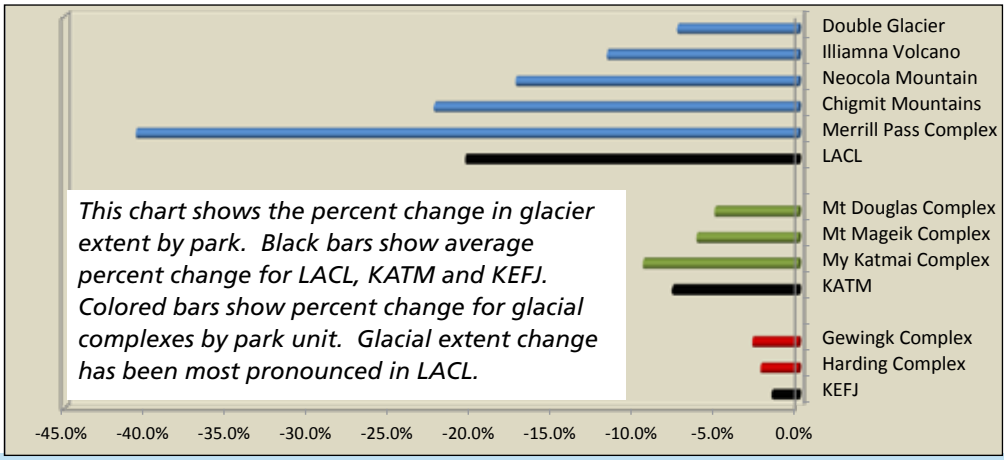
Late-season (August/September), cloud-free Landsat satellite imagery is used to map glacier extent on a decadal scale in KATM, KEFJ and LACL. Glacier extent is estimated using a combination of automated image classification techniques enhanced with manual correction in miss-classified areas. Minimizing the presence of seasonal snow cover in the imagery is critical to ensure repeatable and comparable glacial extent estimates over time. Other factors that affect the accuracy of delineating glacier boundaries include debris cover on glaciers, shadowed glaciers due to extreme topography and cloud cover. All classification and analysis are conducted using Geographic Information System (GIS). Glacier extent mapping shows that a large portion of the observed glacier change occurs at the terminus position. Change in glacier terminus position is determined by measuring the difference between the furthest down valley extent of glacier ice for a specific date (1950, 1986/87 and 2007). Analysis of glacier extent and terminus position data can help identify where and how rapidly changes in glacier cover are occurring throughout the Park.



2007 Ikonos image of an unnamed glacier at the head of the Neocola River (LACL). Glacier terminus positions shown in red (1950), yellow (1986) and black (2007). The green lines demonstrate how the change in down-valley terminus position is measured.

Discussion

Glacial extent mapping was completed for KATM and KEFJ in 2009 and for LACL in 2011 using imagery from 1986/87 and 2007. LACL lost 20% of its glacier ice between 1986/87 and 2007. Some of this estimated loss is due to a strong snow melt season and slight under-represention of glacier ice in the 2007 mapping effort, especially in areas of debris-covered ice. These combined factors over estimate LACL-wide glacier loss by up to 5%.



This chart shows the percent change in glacier extent by park. Black bars show average percent change for LACL, KATM and KEFJ. Colored bars show percent change for glacial complexes by park unit. Glacial extent change has been most pronounced in LACL.

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Discussion (continued)

The rate of retreat appears to have increased between 1986/87-2007 as compared with 1950-1986/8. For example, the Merrill Pass region, composed of many small isolated cirque and valley glaciers, has lost up to 40% of its glacier cover during the study period, whereas the Double Glacier region, has lost only 7% , likely due to the fact that this area is composed of one large source area with only a few outlying glaciers.

Eighty-seven glaciers were sampled to estimate changes in glacier terminus position in LACL. Three timeframes were evaluated: 1950 (based on USGS quadrangle maps), 1986/87 and 2007 (based on Landsat). Although the rate of retreat between 1950 and 2007 was similar to that estimated for the 1950 – 1986/87 timeframe, the rate of retreat appears to have increased between 1986/87 and 2007. As with glacial extent, the rate of terminus change appears to be regional. The Neocola Mountain region with its large, long valley glaciers, exhibits the largest rate of glacier terminus retreat in the park. The Merrill Pass region exhibits one of the slowest rates of terminus change, largely due to the fact that the glaciers are small in this region of the park.

These paired views show a satellite image and corresponding photo of glaciers in Lake Clark NPP. The upper pair shows Double Glacier - note the nunatak (an isolated mountain peak surrounded by glacial ice) in the center of the photo with trim lines (areas where glacial ice has receded) well above the current ice surface indicating significant thinning of the glacier. The lower pair shows a glacier in the Neocola Mountains where two large valley glaciers merge together.