



Alagnak

Aniakchak

Katmai

Kenai Fjords

Lake Clark

Climate

Climate monitoring efforts supplement knowledge of patterns in remote areas

Four years of weather observations (2008-2012) support the following general observations. Weather stations across the SWAN region capture synoptic-scale weather events, but the magnitude of these events (temperature swings, precipitation intensity, and wind speed) are typically greater at more remote, higher-elevation SWAN stations. Average temperatures are typically below freezing November

to April. Winter temperatures are more variable than summer temperatures, with long cold-snaps that are punctuated by several (2-5/yr) warm air advection events with above-freezing temperatures, strong wind, and rain. Most precipitation occurs in the fall, and the winter snowpack develops through discrete events. Winds are persistent with several (5-30/yr) events (typically in winter) exceeding 100 km/hr.



Importance

Climate is considered the most important broad-scale factor influencing ecosystems. Because global climate models indicate that climate change and variability will be greatest at high latitudes, climate monitoring is critical to understanding the changing conditions of park ecosystems. Potential effects in SWAN park units include a reduced snowpack, earlier lake ice break-up, warmer winters, and wetter summers. These changes may affect the distribution, abundance, growth, and productivity of plants and animals.

Biological science technician Bob Peterson sets up a remote automated weather station at Three Forks, near the Valley of 10,000 Smokes in Katmai.

SWAN Climate Overview

The weather and climatic conditions of the SWAN region are largely influenced by the region's high latitude, proximity to oceans, complex topography, and the interaction of these features with global atmospheric circulation. Much of the seasonal variation in the timing of maximum precipitation is explained by the location and intensity of the Aleutian Low. Annual to decadal climate variability is primarily influenced by large-scale changes in atmospheric and oceanic circulation (ENSO, PDO). Temperature data from long-term stations show a significant increase in both mean winter temperatures (Homer +5.4 F or +3.0 C, King Salmon +8.0 F or +4.4 C) and

mean annual temperatures (Homer +3.4 F or +1.9 C, King Salmon +3.4 F or +1.9 C) for 1949-2011. Climate projections based on an intermediate climate change scenario suggest that mean annual temperatures for SWAN parks will increase by 0.9-1.1 F or 0.5-0.6 C per decade. Precipitation is also generally projected to increase with 11-26% more snowfall in winter and 10-12% more rain in summer. It appears that the most severe environmental stresses in Alaska at present are climate related. Accurate, long-term climate data sets are fundamental to understanding the effects.

Monitoring Approach

In order to address the scarcity of climate information from national parks in southwestern Alaska, SWAN operates 10 remote automated weather stations in three network parks. The objective is to record and archive weather observations in locations that are characteristic of the diverse landscape and topography within these parks. This effort will support real-time needs, identify natural variability in weather patterns and long-term climate trends, provide reliable climate data to researchers, and help interpret ecosystem changes.

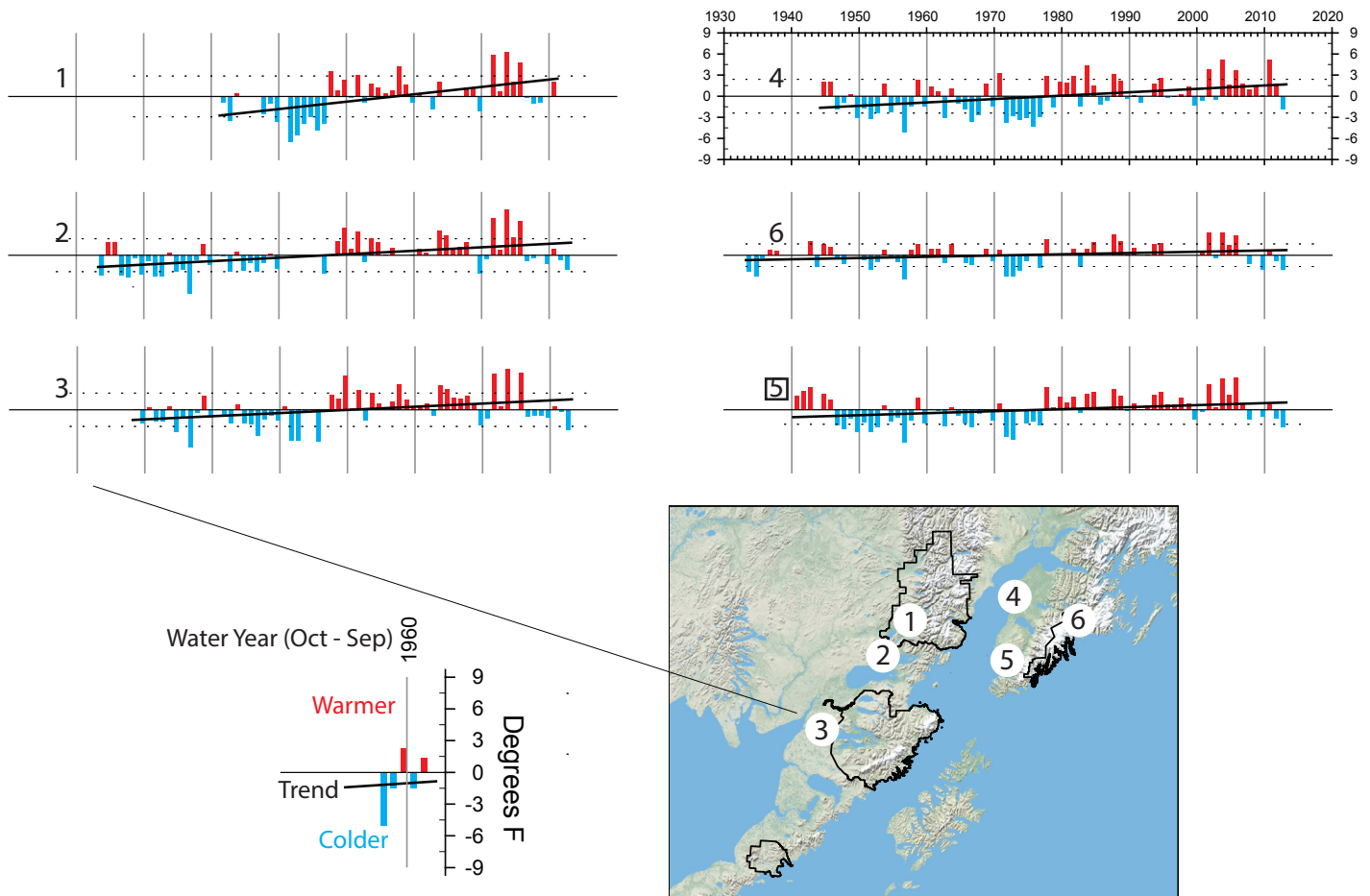
New Developments in Monitoring Efforts

A new weather station was installed on the west side of Cook Inlet near Silver Salmon Lakes in Lake Clark, and another weather station in Katmai was moved from Contact Creek to the Three Forks cabin near the Valley of Ten Thousand Smokes. Both weather stations are fully automated and powered by solar panels and large capacity deep-cycle batteries. Weather observations are transmitted every hour to a weather satellite and are publicly available on the internet at <http://mesowest.utah.edu/cgi-bin/droman/mesomap>.

[cgi?state=AFC&rawsflag=290](http://mesowest.utah.edu/cgi?state=AFC&rawsflag=290). Weather observations include: temperature, relative humidity, wind speed and direction, precipitation, snow depth, and solar radiation. A time lapse camera is also present at Silver Salmon Lakes, taking daily photographs that document vegetation and snow pack conditions.

The Silver Salmon Lakes weather station will eventually replace a weather station that was installed in 2008 at Hickerson Lake (located nearby at a higher elevation).

This weather station has proven difficult to access and will be removed in 2014 after both stations have operated for one year. The Three Forks weather station was moved from a location at Contact Creek (located in southwestern Katmai) where a weather station was installed in 2008. This original weather station was replaced with a Climate Reference Network (CRN) Station that was installed by the National Oceanic and Atmospheric Administration (NOAA) in September 2012.



In addition to operating and maintaining 10 remote weather stations in network parks, SWAN also obtains climate data from long-term weather stations throughout the region. Temperature anomalies (annual departures from long-term average) are shown for: 1) Port Alsworth, 2) Iliamna, 3) King Salmon, 4) Kenai, 5) Homer, and 6) Seward. Long-term warming is evident; however, it is clear that this trend is non-linear. The step-wise shift in the late 1970s corresponds with a shift in the Pacific Decadal Oscillation.

Recent Reports

Lindsay, C. 2013. Climate monitoring in the Southwest Alaska Network: Annual report for the 2012 hydrologic year. Natural Resource Technical Report NPS/SWAN/NRTR-2013/716. National Park Service, Fort Collins, Colorado.

Lindsay, C. 2011. Climate monitoring in the Southwest Alaska Network: Annual report for the 2011 hydrologic year. Natural Resource Technical Report NPS/SWAN/NRTR-2011/517. National Park Service, Fort Collins, Colorado.

Lindsay, C. 2011. Climate monitoring in the Southwest Alaska Network: Annual report for the 2010 hydrologic year. Natural Resource Technical Report NPS/SWAN/NRTR-2011/463. National Park Service, Fort Collins, Colorado.

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Weather data are available from the SWAN website at: <http://science.nature.nps.gov/im/units/swan/monitor/weather.cfm>