Monitoring Responses to Climate Change in Southwest Alaska

Climate change is expected to result in large-scale changes to the Southwest Alaska Network. Many of the metrics we are monitoring are specifically geared toward detecting changes resulting from climate change. Mean annual winter temperatures in Southwest Alaska Network parks hover near the freezing point. Therefore, small increases in temperature will likely have enormous impacts on snow pack, winter survival of moose, and hydrologic factors that govern these landscapes. Below are some of the specific Vital Signs that SWAN has identified to inform managers and the public about how climate change is impacting ecosystems of the parks.

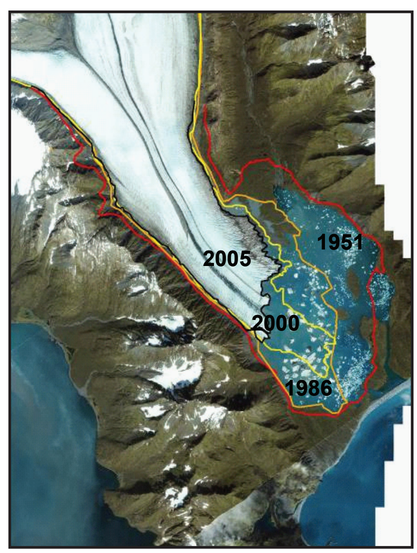
Weather and Climate

SWAN installed nine remote automated weather stations to address the scarcity of climate information for its park units. These strategically-placed stations form a network documenting a wide range of climate conditions (elevation and ecosystem gradients) that are present within SWAN. These data will provide a more detailed understanding of short-term weather conditions and long-term climate trends across the diverse landscape of SWAN.

SWAN staff install RAWS climate station at Hickerson Lake, a high elevation inland site (LACL).

Glacial Extent

Although about one-fifth of the landmass of this Network is covered by ice or permanent snowfield, widespread reductions in glacial volume and extent over the last 100 years are evident. Landsat imagery and historic aerial photography are being used to map glacial extent on a decadal scale in SWAN. Glacial mapping indicates a 7.7% loss of glacial extent in KATM since 1974 and a 1.6% loss in KEFJ since 1951. Mapping work is ongoing for LACL.



Bear Glacier, Kenai Fjords National Park. Glacier terminus positions are shown for 1951, 1986, 2000, and 2005. Terminus positions were digitized from LANDSAT and IKONOS imagery.

Landscape Processes

Impacts of global climate change are expected to result in greater variation in the seasonality of snowpack, lake ice, and vegetation dynamics in southwest Alaska. All have wide-reaching physical and biological effects in the region. SWAN is using MODIS satellite data to monitor landscape metrics such as snow cover duration and timing, and lake ice onset and duration on several large lakes across the region. Annual vegetation growth (NDVI) differences are also being monitored.

Vegetation

Vegetation is integral to ecosystem function and element cycling, and is a sensitive indicator of environmental conditions. Vegetation composition and structure are expected to respond to increasing variability in climate. Remotely-sensed data are used to detect broad-scale changes in vegetation and landscape features. Ground-based monitoring will target fine-scale changes in vegetation composition and structure. Sensitive plant communities are targeted for additional monitoring, including salt marshes and nunataks (alpine ridges surrounded by ice). Vegetation plots have been established to monitor these targeted plant communities in KATM, KEFJ and LACL. Additional alpine monitoring is planned as part of the international GLORIA monitoring network.

SWAN plant ecologist and biological technician collect frequency data on non-vascular and vascular plants during plot establishment in spruce woodlands (KATM).

Moose

Moose are an integral component of terrestrial systems. Moose browsing can influence the structure and function of vegetation communities during periods of high moose abundance. Conversely, as climate changes, vegetation communities previously utilized by moose may change into something less desirable. Aerial surveys will be used in portions of KATM and LACL to monitor moose abundance and bull:cow ratios.

Surface Hydrology and Freshwater Chemistry

Many factors contribute to the impacts of climate change on SWAN freshwater systems, including altered hydrology, precipitation and primary productivity. Change may be experienced through gradual shifts in water quality or through abrupt shifts as climatic variables cross threshold points. These changes will have impacts on aquatic process, such as lake productivity and fish reproductive success. Water level, water temperature and water quality parameters are being measured across the large lakes and rivers of KATM, KEFJ and LACL.

Aquatic ecologists use a multi-parameter sonde to collect water quality data in Lake Clark.

Marine Nearshore

The marine coastline of SWAN spans 1,900 km (1180 mi) and encompasses some of the most biologically productive nearshore ecosystems in the Gulf of Alaska. These nearshore systems are susceptible to the effects of sea level rise, increased storm activity, ocean acidification, and temperature changes associated with climate change. A suite of physical, chemical and biological metrics are being monitored in KATM, KEFJ, and LACL to assess the impacts of climate change on key nearshore species.

USGS and contract biologists measure clams as part of invertebrate density and abundance monitoring on the KATM coast.

For more information
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