Protocol Development Summary

Protocol: Monitoring Changes in Climate in Arctic Network Parks

Parks Where Protocol will be Implemented: BELA, CAKR, GAAR, KOVA, NOAT

Justification/Issues Being Addressed

Weather and climate are key drivers in ecosystem structure and function. Global and regional scale climate variations will have tremendous impact on natural systems (Chapin et al. 1996; Hinzman et al, 2005). The Arctic climate is characterized by a distinctive complexity due to numerous nonlinear interactions between and within the atmosphere, cryosphere, ocean, land and ecosystems. Sea ice plays a crucial role in the arctic climate, particularly through its albedo. Reduction of ice extent leads to warming due to increased absorption of solar radiation at the surface. Natural atmospheric patterns of variability on annual and decadal time scales also play an important role in the arctic climate. Such patterns include the North Atlantic Oscillation, the Pacific-North American pattern and the Pacific Decadal Oscillation, which are associated with prominent arctic regional precipitation and temperature anomalies (IPCC, 2007). Average arctic temperatures increased at almost twice the global average rate in the past 100 years and the Arctic is very likely to warm during this century more than the global mean. Warming is projected to be the largest in winter and smallest in summer. Annual arctic precipitation is very likely to increase (IPCC, 2007).

Changes in climate that have already taken place are manifested in the decrease in extent and thickness of Arctic sea ice, permafrost thawing, coastal erosion, changes in ice sheets and ice shelves, and altered distribution of species (IPCC, 2001). With mean annual temperatures in the ARCN typically below freezing and the ground covered by snow more than 6 months per year, any increases in temperature and or changes in precipitation could have great impact on ecosystem structure and dynamics as well as major impacts on the land surface through changes in glaciers and permafrost. Without climate data, it is impossible to understand the causes of a variety of ecosystem changes now underway. Strategic deployment of climate stations in the ARCN will provide data not heretofore available on the climate patterns in the parks. The data generated by these stations will also contribute significantly to the understanding of Alaska's climate and high latitude manifestations of climate change.

Specific Monitoring Questions and Monitoring Objectives to be Addressed by the Protocol:

Monitoring Questions:

1. What are the long-term trends and variations in climate for all ARCN parks?
2. What are the frequencies and patterns of extreme climatic conditions for common weather parameters, including air temperature, soil temperature,

precipitation, wind speed and direction, and snow depth.

Monitoring Objectives:

1. Determine long and short term trends in climate by recording weather parameters at sites that capture the primary climate gradients within ARCN.
2. Using all relevant climate data, analyze, summarize and report on climatic averages and extremes for ARCN.

Basic Approach

There are two networks that have developed climate monitoring protocols in Alaska, the Central Alaska Network (CAKN) and the Southwest Alaska Network (SWAN). The ARCN will use foundation documents drafted by the Western Regional Climate Center (Davey, 2006) and the Central Alaska Network (Sousanes, 2006) to design and develop a strategy that will focus on high latitude climate issues and remote operations. A robust Alaska NPS climate monitoring program that shares resources will be more effective and efficient than a stand-alone program. It will also provide a more complete understanding of the complexities of the high latitude climate system that affects all of the Alaska national parks.

A weather and climate scoping meeting was held in 2006 with climatologists and physical scientists who offered opinions and insight on Arctic climate issues. The product of the meeting was a document that will also be used to guide protocol development. The meeting attendees were asked where they would place additional climate stations in the network; maps of these locations will be used to site new stations in ARCN (Nolan, 2006).

The basic approach will be to 1) ensure that all existing long-term climate and weather stations in and around the network continue to operate and produce high quality data; 2) add new climate stations in areas that are not currently represented that measure and record air temperature, soil temperature, wind speed and direction, snow depth, relative humidity , solar radiation , and year-round precipitation (rain, snow and mixed precipitation); 3) ensure that the maintenance and calibration of the stations and sensors is a priority; 4) engage in partnerships with state and federal agencies involved in climate and weather monitoring in ARCN and work with university researchers interested in high latitude climate changes; 5) ensure that the data produced by the new ARCN stations is available for use by NPS staff, researchers, and the public via the internet, 6) analyze and summarize the data in useful formats to show averages, totals, trends, and extremes; and 6) archive the digital data with the Western Regional Climate Center.

Principal Investigators and NPS Leads

The principal investigator and NPS lead for this project will be the ARCN physical scientist that will be hired in FY 2008. Collaborators on this vital sign will be Rick McClure (Natural Resources Conservation Service), Kelly Redmond (Western Regional Climate Center), Rick Thoman (National Weather Service), Matt Nolan and Martha

Shulski (University of Alaska Fairbanks), and Chris Daly (PRSM Group, Oregon State University).

Development Schedule, Budget, and Expected Interim Products:
The P.I. will produce a draft protocol ready for external peer review by December 1, 2008. After peer review, revision and approval, we hope to implement the protocol in 2009. We have budgeted $75,000 in FY08 for protocol development which will include a comprehensive site evaluation in the five ARCN parks.