National Park Service
U.S. Department of the Interior
Inventory and Monitoring Program
Research Project Summary November 2008

Weather and Climate Station Inventory for the San Francisco Bay Area Network

Importance: *Climate is a dominant factor driving the physical and ecologic processes affecting the environment of the San Francisco Bay Area. Weather and climate data from area monitoring stations can provide critical information to park staff for improved resource management.*



Weather patterns such as the fog common throughout the San Francisco Bay Area affect entire ecosystems.

"Weather" generally refers to current or near-real-time atmospheric conditions, while "climate" comprises long-term atmospheric behavior. Climate and weather phenomena shade gradually into each other and are ultimately inseparable.

Weather and climate can have long-lasting effects on: plant and animal populations including endangered or threatened species; air and water quality; and drought and flood cycles, fires, and landslides.

Long-term weather data can also contribute to the understanding of global climate change and its local effects. Potential impacts on sensitive ecosystems, endemic species, and threatened or endangered species are of particular concern. Changes in sea level and precipitation patterns around the Bay Area could cause accelerated shoreline erosion and other problems for coastal environments. Future climate changes could also affect the frequency, intensity, and duration of regional climatic patterns such as El Niño, which strongly influences ocean temperature and precipitation in the area.

Inventory Methods: *The National Park Service (NPS) worked with the Western Regional Climate Center (WRCC) to catalog and evaluate weather and climate stations in and near park units of the San Francisco Bay Area Network (SFAN).*

In order to properly utilize weather and climate information, NPS must first know what is available and reliable. WRCC conducted a weather station inventory by searching national databases and making inquiries to NPS staff. Inventory information from stations included items such as location, elevation, parameters measured, measurement frequency, and managing individual or agency. Information about measured data values included completeness and data gaps, seasonality, and how special circumstances in the data record are denoted. The WRCC evaluated whether the spatial and temporal coverage of the stations adequately represents network weather and climate.



Weather monitoring stations take many different forms and measure parameters such as temperature, precipitation, humidity, and wind speed.

Inventory Findings: *NPS identified 31 weather and climate stations within SFAN park units and hundreds nearby. Most of the weather and climate stations identified have metadata and data records that are sufficiently complete and satisfactory in quality for at least the recent past.*

Weather and climate data are collected through a variety of different networks, many of which have been identified in or near SFAN (Table 1). Each network has slightly different goals, and many are run by different agencies. Some network stations are automated while others are dependent on volunteer observers (e.g., CWOP and COOP); some collect fire weather data (e.g., RAWS) while others also collect air quality measures (e.g., CASTnet and NADP). Stations were identified within 40 km of both Pinnacles National Monument and Point Reyes National Seashore and 20 km of the other SFAN parks.

Table 1. Weather and climate networks represented by many different types of stations within SFAN.

Network Acronym	Network Name
BAMI	Bay Area Mesoscale Initiative network
CARB	California Air Resources Board network
CASTNet	Clean Air Status and Trends Network
CIMIS	California Irrigation Management Information System
COOP	NWS Cooperative Observer Program
CWOP	Citizen Weather Observer Program
DRI	Desert Research Institute network
GPMP	NPS Gaseous Pollutant Monitoring Program
GPS-MET	NOAA ground-based GPS Meteorology network
NADP	National Atmospheric Deposition Program
RAWS	Remote Automated Weather Station network
SAO	NWS/FAA Surface Airways Observation network

Although many SFAN parks host weather stations with useful short-term records, with the exception of Pinnacles, no SFAN park units have reliable long-term climate records within their boundaries. In general, park units depend on outside sources for this data (see Figure 1 for an example of a long-term climate record). Some long-term records in the San Francisco metropolitan area provide reliable data, but the data likely are influenced by urbanization effects that obscure background climate variability and change such as temperature increases over the years. SFAN park units containing more pristine locations could potentially help determine the impacts of climate change. For this reason, in 2006 WRCC established two new stations in Point Reyes as part of a 25 year climate change project.

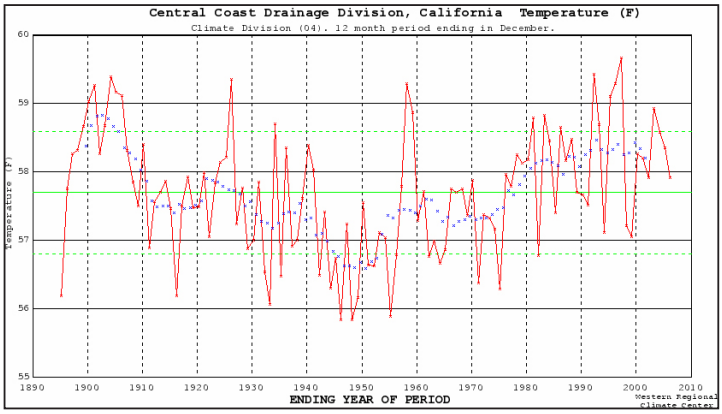

Figure 1. Temperature time series, 1895-2005, for the SFAN region. These include twelve-month average temperature (ending in December) (red), 10-year running mean (blue), mean (green), and plus/minus one standard deviation (green dashed).

Standard climate information is accessible through http://www.wrcc.dri.edu/summary. These summaries are generally for COOP stations and feature monthly and daily extremes and averages for common parameters such as temperature, precipitation, and snowfall.

WRCC, under the RAWS program, has been steadily developing software to summarize more extensive data from hourly sites. These tools include time series graphs, hourly frequency distributions, and wind stability graphs and tables. The WRCC RAWS web page is located at http://www.raws.dri.edu. An access code, available to park personnel by request, is needed for data listings, but the summary tools are available without restriction.

Web pages providing historic and ongoing climate data and information from SFAN park units can be accessed at http://www.wrcc.dri.edu/nps**.** This site will provide information on the design of climate observing networks, the development of protocols, and network inventories as they become available. The site also provides links to nationwide sources of weather and climate data.

Additional Resources:

Davey, C.A., K.T. Redmond, and D.B. Simeral. 2007. Weather and Climate Inventory National Park Service San Francisco Bay Area Network. Natural Resource Technical Report NPS/PWR/SFAN/NRTR—2007/041. WRCC Report 2007-16. National Park Service, Fort Collins, CO. Online: http://science.nature.nps.gov/im/units/sfan/Inventory/FinalInventoryReports/2007_05_03_sfaninventory_final.pdf.

Summary written by Alison Williams. For more information contact Marcus Koenen, I&M Coordinator, San Francisco Bay Area Network Inventory and Monitoring Program, 415-331-5734.