



Climate Monitoring and Reporting

Background

Weather and climate describe the condition and variability of the atmosphere in a given place. Weather describes short-term atmospheric conditions—what one experiences at a moment or over a few days. Weather data are instantaneous or short-term observations of current conditions (e.g., the current temperature or cloudiness, today’s maximum temperature, yesterday’s total precipitation). Climate refers generally to long-term analyses of atmospheric conditions. Climate has a prominent influence on the following Sierra Nevada landscape components and processes:

- Vegetation (type, biomass, distribution)
- Water (hydrologic quantity and timing, temperature, and water quality)
- Soils (thickness, stability, nutrient capacity)
- Landforms (rates of formation and loss)
- Fire (location, frequency, seasonal timing, intensity and severity)

The Sierra Nevada Network Inventory & Monitoring Program (SIEN) and park staff selected “weather and climate” and “snowpack” as high-priority vital signs for monitoring because they are major drivers of Sierra Nevada ecosystems and they inform and affect park management and visitor experience.

Sierra Nevada Climate Characteristics

The climate of the southern Sierra Nevada can be characterized as Mediterranean at lower elevations (warm dry summers and wet cool winters) and boreal at high elevations (cold winters). Summers are dry and precipitation



Skier in Giant Forest, Sequoia National Park. In the Sierra Nevada and throughout most of California, water availability is closely tied to the amount of snow received in the mountains and the duration of snowpack into the spring and summer. Photo: Jennie Skancke.

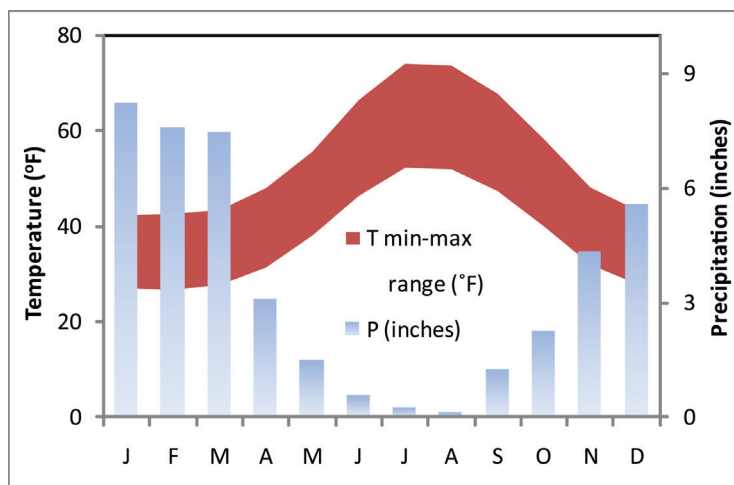


Figure 1. Monthly averages of mean minimum and maximum temperature (T) and precipitation (P, rain + melted snow) for the period 1971-2000 at Grant Cove in Kings Canyon National Park.

predominantly falls in the cool winter season---nearly 70% from December through August (Figure 1).

The majority of the annual precipitation at the middle and high elevations of the parks falls as snow. The rain/snow transition zone ranges from 4,920 to 5,900 feet in the southern Sierra Nevada. More than 85% of the park lands are above 5,900 feet in the snow dominated zone. The snow-dominated zone elevation is expected to rise with climate change and associated warming.

Climate Change

Temperature has varied widely from year to year since instrumental weather records began in 1895, but there have been some notable trends of increasing temperatures. The average air temperature has risen since the mid-1970s, and the average minimum (nighttime) temperature has risen even more

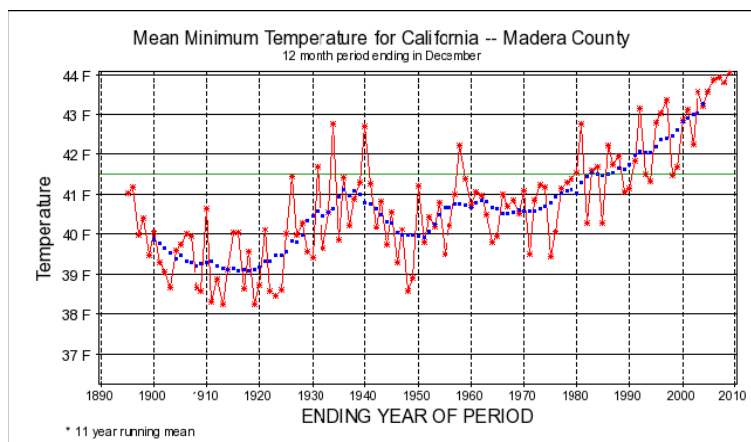


Figure 2. Madera County Mean calendar year minimum temperature (1895-2009). Red: individual years. Blue: 11-year running mean. Green: 1971-2000 mean. Data from PRISM. Source: *Interactive Plots, WRCC/UAirizona Westmap* (from Edwards and Redmond 2011).

dramatically (Figure 2). The annual averages over the last 10 years approach or exceed that of any other decade on record throughout the southern Sierra. Warming temperatures cause the snow to melt earlier in the year and raise the elevation where snow melts and falls as rain; these effects decrease the total winter snow accumulation. When there is less snow accumulation over the winter or snow melts earlier in the season, less water is available for plants, animals, and people through the dry, hot summer season.

Monitoring

Constrained by limited funding, SIEN and park staff decided that it was not logistically or financially feasible to add new weather stations throughout SIEN parks, despite significant gaps in coverage, due to the prohibitive costs of scoping, installing, and maintaining new weather stations. We determined that the best application of our limited budget is to harvest, analyze, and report on data from established weather monitoring programs that provide consistent, long-term, and high-quality climate records for our parks and region. Using existing weather stations, snow courses, stream gages, and gridded data sets that provide modeled estimates of climate parameters at larger spatial scales, SIEN reports on the following five climate measures which are tightly linked with ecological processes:

- **Temperature** – Determine the status and trends in monthly and annual averages of daily minimum and maximum air temperature at the local scale.
- **Precipitation** – Determine the status and trends in monthly and annual accumulated precipitation, including extremes, at the local scale.
- **Drought** – Determine the status, trends, and periodicity in monthly and annual drought at the regional scale.
- **Snowpack** – Determine the status, trend, and periodicity in seasonal snow water equivalent at the local and watershed scale.
- **Streamflow** – Determine the status, trends, and periodicity in daily, monthly, and annual streamflow at the local scale.

Results are shared through annual reports, periodic climate trend reports, resource briefs, newsletter articles, seasonal

training sessions, and presentations. The Sierra Nevada Network website provides a project overview and links to related information, the monitoring protocol, and reports.

Management Applications

Information from the climate monitoring project will:

- Inform fire and air resources management programs, as climate and weather play a major role in influencing fire frequency, severity, and size, as well as daily air quality.
- Inform park operations. Real-time data provide general weather conditions that are of interest to park employees and visitors, and can help inform park managers about events like severe storms and floods.
- Enable managers to better track climate change in Sierra Nevada parks and its effects on park resources.
- Assist with interpretation of changes in other resources that are being monitored by the parks and the SIEN Inventory & Monitoring program.



Installation of a weather monitoring station in Devils Postpile National Monument in 2005 was a collaborative effort among the National Park Service, US Geological Survey, California Department of Water Resources, and Scripps Institution of Oceanography. The station provides the monument with weather data and offers opportunities for interpretation. Photo: Jeff Balmat

More Information

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<http://science.nature.nps.gov/im/units/sien/monitor/climate.cfm>