Historical Weather Observations and Potential Future Climate Trends for the Summit Lake, Nevada Region

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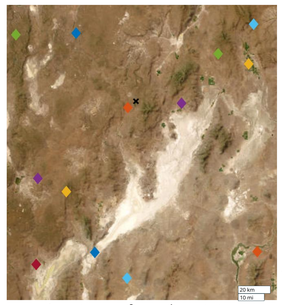
Introduction

Photograph of Summit Lake

In order to plan for climate adaptation, the Summit Lake Paiute Tribe in Northern Nevada wanted an assessment of recent climate changes over the last few decades as well as expected changes between now and 2100. The complex basin and range topography of Northern Nevada are smoothed in weather and climate models making forecasting for this region less reliable than for the gentler terrain of the eastern US.

US Topographic Map

Summit Lake in Northern Nevada has an elevation of 5,910ft (1,800m) above sea level and is situated in the Great Basin Desert Region



Locations of weather stations in the region

GHCN Weather Station
- DISASTER PEAK
- CATNIP MOUNTAIN NEVADA
- BARREL SPRINGS NEVADA
- TEXAS SPRINGS NEVADA
- KINGS RVR VLY – OROVADA 26 NW
- LEONARD CREEK RCH – DENIO 33S
- DRY CANYON NEVADA
- JUNIPER SPRINGS NEVADA
- FOX MOUNTAIN NEVADA
- IMLAY
- GERLACH
- BUFFALO CREEK NEVADA
- BLUE WING MOUNTAIN NEVADA

Locations
- Summit Lake

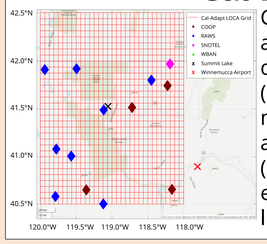
Data and Methods

We examine key climate indicators that impact the environment, ecology, and people:
- Daily Minimum Temperature
- Daily Maximum Temperature
- Daily Precipitation

Summit Lake Paiute Reservation Weather Station
Source: summitlaketribe.org

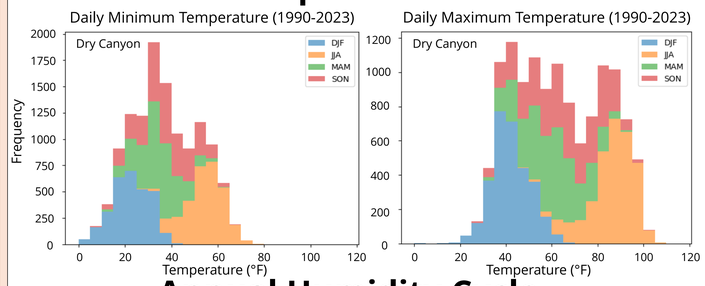
Data for historical analysis is obtained from Global Historical Climatology Network (GHCN) weather stations in the region. Thirteen weather stations in Northern Nevada have nearly complete temperature records for 1990-2023 and five measure precipitation. A data set is considered representative for a given 3-month season if it records at least 90% of days for each variable. Median absolute deviation (MAD) is used to assess variability. A permutation test is used to determine the significance (<5% chance of being random) of seasonal linear trends.

Cal-Adapt LOCA Climate Models

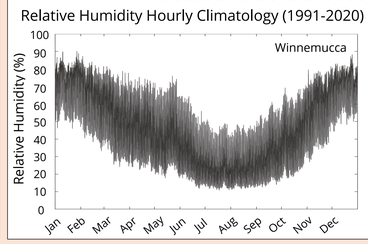


Cal-adapt.org, run by the California Energy Commission, provides accessible downscaled (~6km x ~6km) climate model projection data derived from the Climate Model Intercomparison Project 5 (CMIP5) for the California and Nevada region. Analysis showed minor differences in predictions for the northern Nevada region among the 32 models. We focus on the CanESM2 "average" model (Pierce et al., 2018). We consider the more likely future CO_2 emission scenario (RCP 4.5, 650 ppm CO_2 in 2100) and the less likely CO_2 high emission scenario (RCP 8.5, 1370 ppm CO_2 in 2100).

Seasonal Temperature Distribution

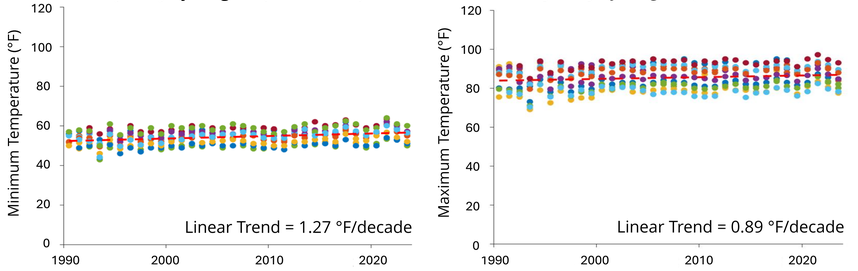


Annual Humidity Cycle



Relative humidity is a common measure of moisture content of the air. At the closest airport in Winnemucca, NV, the summer months are the least humid, and the winter months are the most humid. Lower humidity increases wildfire risk, dries out vegetation, and reduces soil moisture.

Summit Lake Region Temperature Observations



Colored dots representing median minimum and maximum seasonal temperatures for the historical period (1990-2023) are from the 13 weather stations in the region with daily temperature records.

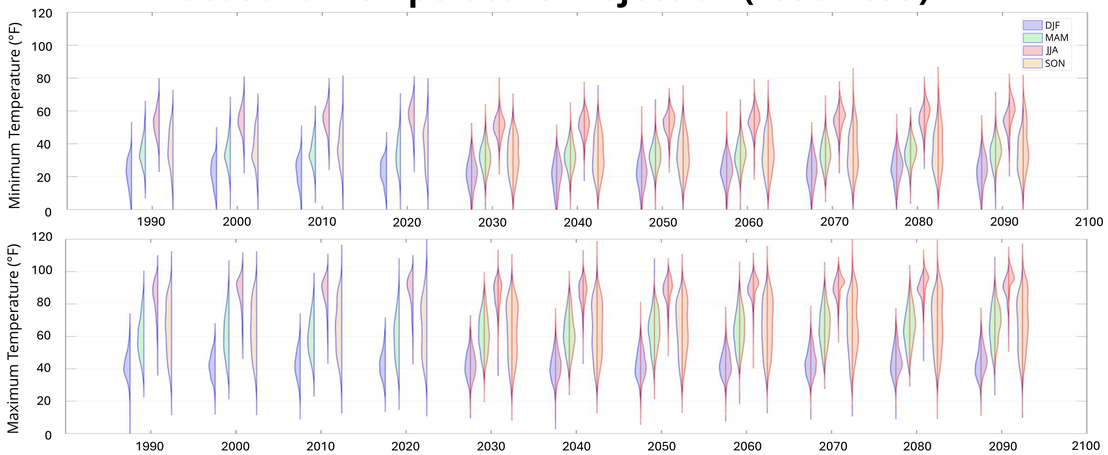
Minimum Temperature

Season	Mean	Median	MAD
DJF	23.5	24.1	2.2
MAM	34.2	34.0	2.0
JJA	54.5	55.0	2.5
SON	37.8	37.9	2.5

Maximum Temperature

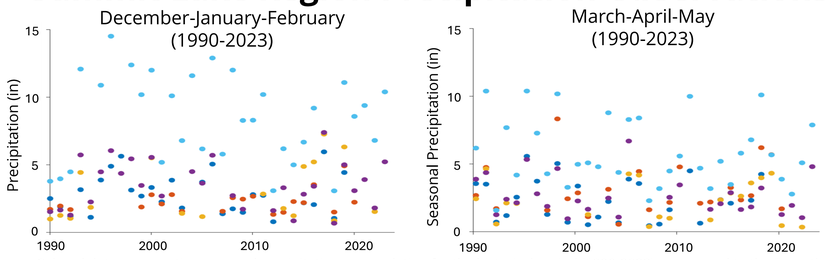
Season	Mean	Median	MAD
DJF	41.1	41.0	3.3
MAM	57.8	57.9	5.9
JJA	85.4	86.0	5.0
SON	63.5	64.0	4.9

Seasonal Temperature Projection (1990-2099)



Distributions of minimum and maximum daily temperatures by season and by decade. For 1990-2023, the observations are from Dry Canyon, NV and for the CanESM2 projection period (2030-2099) data are from the model grid cell corresponding to Dry Canyon. Distributions (~ 900 samples for each) of historical values (1990-2023) are shown as half-violin plots and future values (2030-2099) are shown as violin plots with the left side indicating the more likely climate scenario (RCP 4.5) and the right side indicating the low probability very hot climate scenario (RCP 8.5).

Summit Lake Region Precipitation Observations

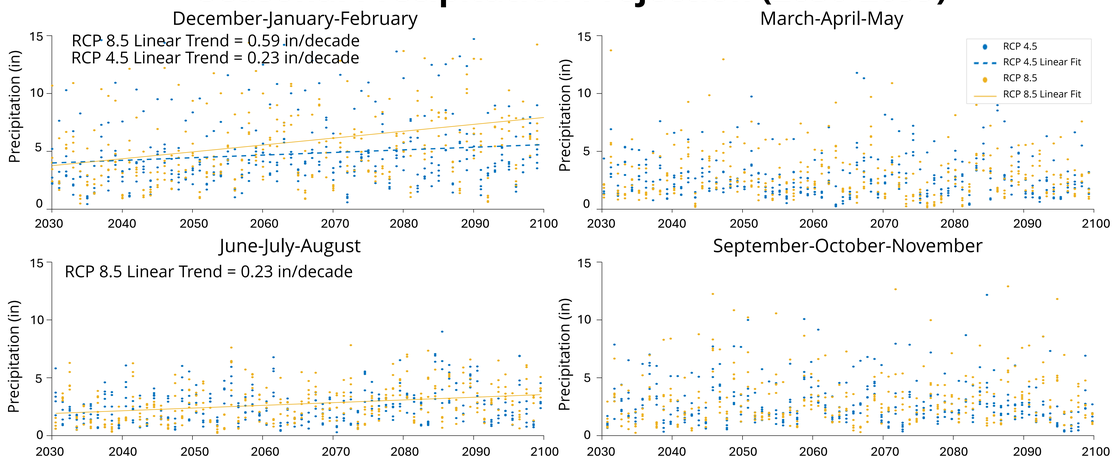


Colored dots representing seasonal precipitation accumulation for the historical period (1990-2023) correspond to the 5 weather stations with daily precipitation records: Disaster Peak, Kings River Valley, Leonard Creek Ranch, Imlay, and Gerlach.

Precipitation Variability Comparison

Season	MAD (1990-2023)	RCP 4.5 MAD (2030-2065)	RCP 4.5 MAD (2066-2099)	RCP 8.5 MAD (2030-2065)	RCP 8.5 MAD (2066-2099)
DJF	1.74	1.20	1.34	1.63	2.44
MAM	1.44	0.82	1.20	1.06	1.06
JJA	0.65	0.93	1.01	0.92	1.01
SON	0.83	1.02	0.79	1.10	1.11

Seasonal Precipitation Projection (2030-2099)



Seasonal precipitation accumulations for the CanESM2 projection period (2030-2099) are from the 5 model grid cells corresponding to weather stations with daily precipitation data.

Summary of Key Findings

Historical period (1990-2023)
- June-July-August minimum temperatures have increased by ~1.3°F/decade and maximum temperatures have increased by ~0.9 °F/decade. There were no notable trends for the other seasons.
- There are no notable trends for seasonal precipitation accumulations. The December-January-February months receive the most precipitation and have the largest year-to-year variation. Annual precipitation accumulation varies from over 10 inches in a wet year to less than 1.3 inches in a dry year.

Climate Model Projections (2030-2099)
- June-July-August temperatures are likely to continue increasing more than the other seasons. The more likely scenario shows a June-July-August temperature increase of ~0.5 °F/decade as compared to the low probability, worst case scenario of ~1.6 °F/decade.
- Notable precipitation accumulation trends are only present in December-January-February and June-July-August. For RCP 4.5, a significant trend is present in December-January-February of ~0.23 in/decade. For RCP 8.5, December-January-February has an increase of ~0.59 in/decade and June-July-August has an increase of ~0.23 in/decade. There is likely to be continued large variation in seasonal precipitations year-to-year.

References

Pierce, D. W., J. F. Kalansky, and D. R. Cayan, 2018: Climate, drought, and sea level rise scenarios for California's fourth climate change assessment. Tech. Rep. CCCA4-CEC-2018-006, California Energy Commission and California Natural Resources Agency, 71 pp.

Acknowledgements

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