



Climate Monitoring in the Mediterranean Coast Network 2014

Santa Monica Mountains National Recreation Area

Natural Resource Report NPS/MEDN/NRR—2015/1063



ON THE COVER

Fog shrouds the hillsides of the Santa Monica Mountains. View from Stunt Road.
Photograph courtesy of the National Park Service.

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Michael T. Tercek, Ph.D. and Allison Klein
Walking Shadow Ecology
PO Box 1085
Gardiner, Montana 59030

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Executive Summary

This report details the climate (temperature, precipitation, drought, and streamflow) of Santa Monica Mountains National Recreation Area (NRA) during 2014. Gridded GIS maps are used to present broad-brush conditions across the region for each month. This regional presentation is compared to detailed data from Remote Automated Weather Stations (RAWS), weather stations in Global Historical Climatology Network (GHCN), and data from USGS stream gages. Prior to analysis, a set of data quality control checks were performed by the authors in accordance with an established National Park Service protocol (Rocky Mountain Climate Working Group 2010). Key points summarizing calendar year 2014 are presented as bullets in the Conclusion section at the end of the report. The region entered into drought conditions in April 2012 (Tercek 2013) and became progressively drier throughout 2013 and 2014. By the end of 2014, the area in and near Santa Monica Mountains NRA was classified as “D4 - Exceptional Drought” by the US Drought Monitor, which is the most severe classification on this scale. The average annual temperatures for 2014 at UCLA (74.8 degrees (F) for average daily maximum (Tmax) and 59.4 degrees (F) for average daily minimum (Tmin)) were the warmest since 1933. Total annual precipitation during 2014 (9.8 inches) was only 53% of the 1981 – 2010 average. At the UCLA station, 7 out of the last 8 years have had below average precipitation. Monthly data from the UCLA station show that December 2014 had 158% of the 1981 – 2010 average precipitation while all other months of the year had below average precipitation. Every month of 2014 had above average temperatures at UCLA. January was particularly warm, with average daytime highs 6.7 degrees above the 1981 – 2010 average and average night-time lows 4.8 degrees above average. There was significant spatial and month to month variability in the data that provided exceptions to these generalizations, so an examination of the regional maps are key to understanding the climatic patterns for 2014. Readers can download the data used in this report and make custom climate graphs and tables of their own by visiting www.ClimateAnalyzer.org

Acknowledgments

Funding for this report was provided by National Park Service Mediterranean Coast Network Inventory and Monitoring Program.

Glossary

GHCN – Global Historical Climatology Network.

RAWS – Remote Automated Weather Station

PRISM - Parameter-elevation Regression on Independent Slopes Model. See <http://www.prism.oregonstate.edu/>

US Drought Monitor - A broad brush assessment of drought conditions. See <http://drought.unl.edu/dm/monitor.html>

B-91 Forms – Paper data sheets that are used to record climate data at weather stations

Tmax / Tmin – mean daily Maximum / Minimum Temperatures

NOAA - National Oceanic and Atmospheric Administration

30-year average or “normal” – Official 30-year averages for each weather station are issued every 10 years by NOAA. Prior to 2011, the official reference period was 1971 – 2000.

Introduction

This report details the climate (temperature, precipitation, drought, streamflow) of Santa Monica Mountain National Recreation Area during 2014. Climatic events are presented both from a local perspective, with data from individual weather stations, and from a regional perspective, with maps that depict broad-scale conditions across southern California during each month of the year. The climatic conditions of 2014 are also compared to a historical context, based on a 30-year average or “normal” period calculated over the years 1981 – 2010, and to data from the UCLA weather station that spans 1933 - present.

Typically, when a weather report states that a particular month was “warmer than average” or “cooler than normal,” the comparison is to a set of averages calculated over an agreed upon time period. These averages, which are known as “climatological normals,” are updated every 10 years by the National Oceanic and Atmospheric Administration (NOAA). From 1991 – 2000, meteorological measurements were compared to 1961 – 1990 averages; from 2001 – 2010 the reference period was 1971 – 2000; and starting in calendar year 2011, most weather data has been compared to 1981 – 2010 averages. NOAA further defines climatological normals as follows:

“In the strictest sense, a “normal” of a particular variable (e.g., temperature) is defined as the 30-year average. For example, the minimum temperature normal in January for a station in Chicago, Illinois, would be computed by taking the average of the 30 January values of monthly-averaged minimum temperatures from 1981 to 2010. Each of the 30 monthly values was in turn derived from averaging the daily observations of minimum temperature for the station. In practice, however, much more goes into NCDC’s Normals product than simple 30-year averages. Procedures are put in place to deal with missing and suspect data values. In addition, Normals include quantities other than averages such as degree days, probabilities, standard deviations, etc. Normals are a large suite of data products that provide users with many tools to understand typical climate conditions for thousands of locations across the United States.” (Source:

<http://www.ncdc.noaa.gov/oa/climate/normals/usnormals.html#WHATARENORMALS>)

Those interested in additional climate-related information for Santa Monica Mountain National Recreation Area and the surrounding areas should seek:

The ClimateAnalyzer: www.ClimateAnalyzer.org. This web site allows you to create custom graphs and tables from both “official,” unedited data and from the corrected datasets used in this report. You can also download all the data from the weather stations in the area as spreadsheets.

Western Regional Climate Center (<http://www.wrcc.dri.edu/>)

Drought Monitor (<http://drought.unl.edu/dm/monitor.html>)

NOAA (National Oceanic Atmospheric Administration) National Weather Service
(<http://www.cpc.ncep.noaa.gov/>)

USGS (U.S. Geological Survey) Water National Information System
(<http://waterdata.usgs.gov/nwis>)

Approach and Methods

Selection of Datasets

In order to place Santa Monica Mountains National Recreation Area within a regional context, grid-based estimates of precipitation and temperature were used to provide a broad overview of climatic conditions in the area. These estimates were generated with a statistical modeling technique that interpolates precipitation and temperature values between actual climate stations while also accounting for the effects of aspect and elevation. Known as the Parameter-elevation Regression on Independent Slopes Model (PRISM; <http://www.prism.oregonstate.edu/>), this approach has a long history of use in the western United States, and it has been shown to provide robust products in a wide variety of studies (Daly et al. 2008). In this report, PRISM data from calendar year 2014 are compared to 1981 – 2010 PRISM averages for each month by calculating the percent of normal precipitation (2014 precipitation divided by 1981 – 2010 precipitation) or the temperature departure (2014 temperature minus 1981 – 2010 average temperature) for each grid cell on the map of southern California.

Records from individual precipitation and temperature observing stations were included as a way to highlight intra-regional variability. The process of selecting specific stations included in this report is described in the Rocky Mountain Climate Protocol (Rocky Mountain Climate Working Group 2010). Generally, the selection criteria were:

1. Stations provide good spatial coverage within and near the parks of interest. In the case of Santa Monica Mountains NRA, RAWs stations were chosen because they are located within the administrative boundaries of the recreation area (Fig. 1) and are routinely consulted by NPS staff. In addition, National Weather Service (NWS) stations were chosen from nearby locations. Data from the NWS stations are available through the Global Historical Climatology Network (GHCN). GHCN stations have several advantages, including their relatively long period of record (Appendix 1), and the availability of established 30-year averages that can be used to quantify the difference between the current year and “normal” conditions. The weather stations used in this report are shown in Figure 1.
2. Stations provide a sufficient length of record to provide historical context for current observations. For this report, GHCN stations were not considered if they had not been in operation during the period 1981 – 2010 at a minimum.
3. Instrumentation at individual stations is relatively consistent over the life of the record.
4. Instrumentation and siting standards used in selected networks are suitable for providing consistent, continuous, and long-duration records of climate and streamflow.

As a way of presenting the integrated effects of temperature and precipitation, maps from the US Drought Monitor (<http://drought.unl.edu/dm/monitor.html>) were used to depict broad-brush conditions across the region. Even though the watercourses in the region are human-controlled and not directly tied to rainfall, USGS stream gage data (<http://waterdata.usgs.gov/nwis>) were used to

contrast streamflow during the 2014 water year, which ran from October 2013 to September 2014, with historical conditions. The locations of weather stations cited in this report are shown in Figure 1. Metadata for these stations can be accessed from the internet links provided in Appendix 1.

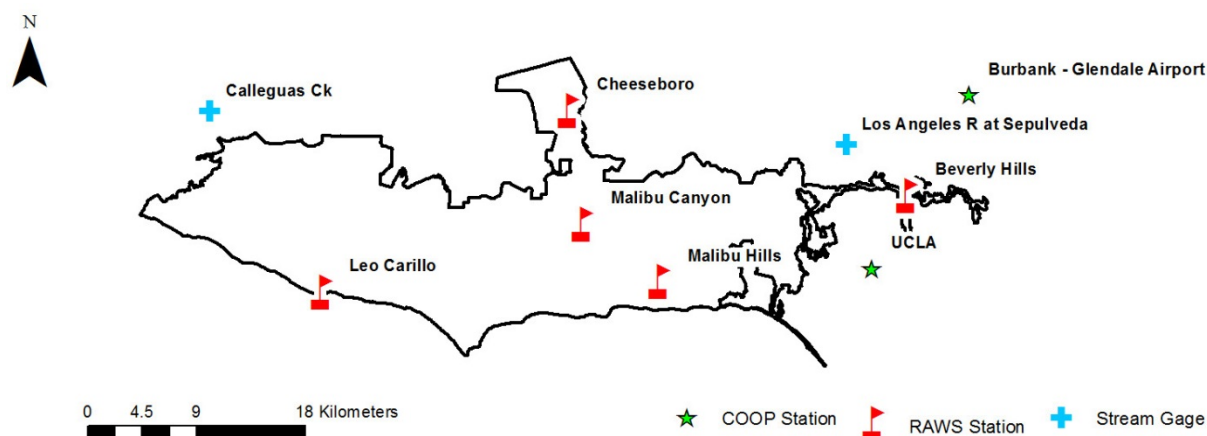


Figure 1. Map showing key climate stations and stream gauges in and near Santa Monica Mountains National Recreation Area. Cooperative Observer (COOP) stations are accessed through the Global Historical Climatology Network (see text).

Quality Control of Global Historical Climatology Network Data (GHCN)

All of the GHCN stations used in this report are operated by the National Weather Service (NWS). These stations are sometimes referred to as “Cooperative Observer” (COOP) stations because in most cases their measurements are recorded by volunteer human observers and submitted to NWS for aggregation and error checking.

Data from these weather stations undergo quality control and error-checking by NWS, and as part of this process many of the observations in the data files are assigned “flags” (letter or number codes) that indicate potential problems or other factors that should be taken into consideration when interpreting the data. Consequently, the author of this report has created software tools that assist in the interpretation of the data flags and diagnostic plotting of the data. Following guidelines from Kittel (2008), Kittel et al. (2009), and Rocky Mountain Climate Working Group (2010), the Qa/Qc employed by these software tools involved graphing and visual inspection of each time series, evaluation of the data quality flags that accompany each observation, comparison with historical observations and observations from surrounding sites, and logical consistency tests (e.g., confirming that minimum daily temperatures were lower than the daily maximum temperatures). Point observations provided by the GHCN stations were also compared to corresponding estimates from the PRISM datasets and to the original datasheets (B-91 forms) used by weather station staff. When possible, data missing in the electronic records were recovered from the original datasheets and hand entered by the author of this report. If more than 3 days of precipitation data were missing for a particular month, a monthly total was not calculated, and the entire month was instead considered missing. Similarly, if more than 5 days of mean daily maximum temperature (Tmax) or mean daily minimum temperature (Tmin) were missing, monthly average temperatures were not calculated. The data handling was conservative, i.e., no data points were changed unless it was very clear that an

erroneous value, for example a precipitation measurement with a missing decimal point that could be verified on the original station records, was found. Readers can download the data used in this report and make custom climate graphs and tables of their own by visiting www.ClimateAnalyzer.org

Quality Control of RAWS Station Data

Because RAWS data are collected hourly, daily Tmax, Tmin, and precipitation values must be derived from the automated data stream. Furthermore, precipitation is recorded as a running total that must be translated into daily measurements. If any particular day in a record was missing more than six hours of measurements, the entire day was considered missing. In addition, if the temperature during any day varied by less than 2 degrees Fahrenheit, data for the entire day was considered invalid due to instrumental error and replaced with missing values. Once daily statistics had been calculated, diagnostic plots were used to screen for physically impossible measurements (e.g. 500 degrees Fahrenheit), which were ascribed to instrumental error and considered missing; and the missing data criteria just described for GHCN stations were used to calculate monthly statistics.

Results

Temperature, Precipitation, and Drought Status During Calendar Year 2014

The patterns described in this section are often stated as broad generalizations. In most cases there was significant variability across the region and exceptions to the patterns described here were common. In order to appreciate this variability, it is important to examine the PRISM maps (Figures 5 – 7) and compare them to the weather station data presented in Figures 3 – 4 and Tables 1 – 2.

Broader Picture – The Ongoing Drought Became More Severe

The region entered into drought conditions in April 2012 (Tercek 2013) and became progressively drier throughout 2013 and 2014. By the end of 2014, the area in and near Santa Monica Mountains NRA was classified as “D4 - Exceptional Drought” by the US Drought Monitor, which is the most severe classification on this scale (Figure 2).

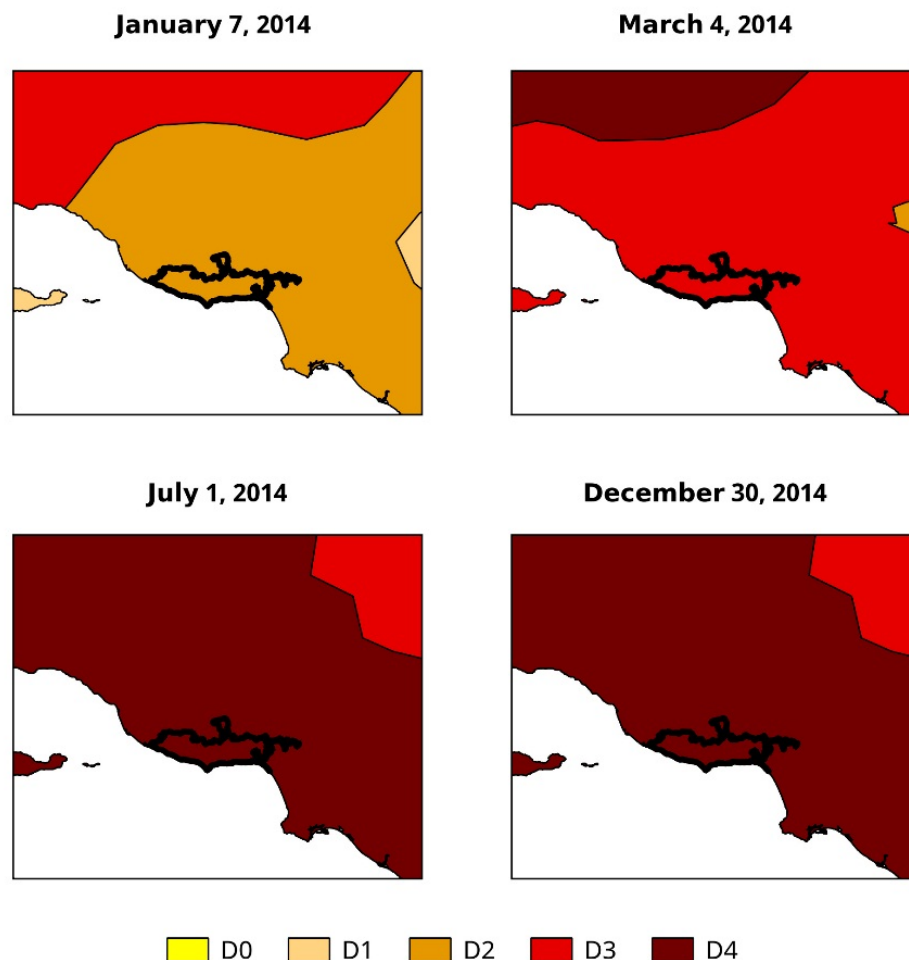


Figure 2. U.S. Drought Monitor maps for Santa Monica Mountains NRA during 2014. Santa Monica Mountains NRA is outlined in black on the coast. For more information visit: www.drought.unl.edu/dm/monitor.html

Weather Station Temperature and Precipitation Data

Generally speaking, there are two components to drought: high temperatures, which increase evapotranspiration, exacerbating drought; and precipitation, or the lack thereof. Calendar year 2014 was both hot and dry, unlike the two previous years in the current drought, which had more moderate temperatures. As shown in Figure 3, the average annual temperatures for 2014 at UCLA (74.8 degrees (F) for average daily maximum (Tmax) and 59.4 degrees (F) for average daily minimum (Tmin)) were the warmest since 1933 (Figures 4,5; Tables 1,2). Total annual precipitation during 2014 (9.8 inches) was only 53% of the 1981 – 2010 average (Figure 4). ***At the UCLA station, 7 out of the last 8 years have had below average precipitation (Figure 4).***

Monthly data from the UCLA station show that December 2014 had 158% of the 1981 – 2010 average precipitation while all other months of the year had below average precipitation. Every month of 2014 had above average temperatures at UCLA. January was particularly warm, with average daytime highs 6.7 degrees above the 1981 – 2010 average and average night-time lows 4.8 degrees above average (Figure 4; Tables 1,2).

RAWS stations in and near Santa Monica Mountains NRA do not have established 30-year averages, but they recorded similarly warm temperatures and low precipitation (Tables 1 – 3).

El Nino – La Nina Status

The El Nino – Southern Oscillation (ENSO) is an oscillation of the ocean – atmosphere climate system centered over the tropical Pacific Ocean that follows a rough cycle of approximately 2 – 7 years. When ENSO is in its “El Nino phase,” sea surface temperatures in the central and eastern tropical Pacific are warmer than average, and this generally produces warmer, drier conditions in the northern continental United States and cooler, wetter conditions in the southern United States, particularly the southwest. In contrast, the opposite conditions prevail when ENSO is in its “La Nina phase.” More information on ENSO can be found on the NOAA web site located here:

<http://www.pmel.noaa.gov/tao/elnino/el-nino-story.html>

ENSO remained in the neutral state between La Nina and El Nino throughout 2014. Normally, La Nina conditions produce drier conditions in southern California while El Nino produces wetter conditions. Given its transitional state, predicting the effects of ENSO on regional is difficult. For long-term El Nino patterns, consult NOAA here:

http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml

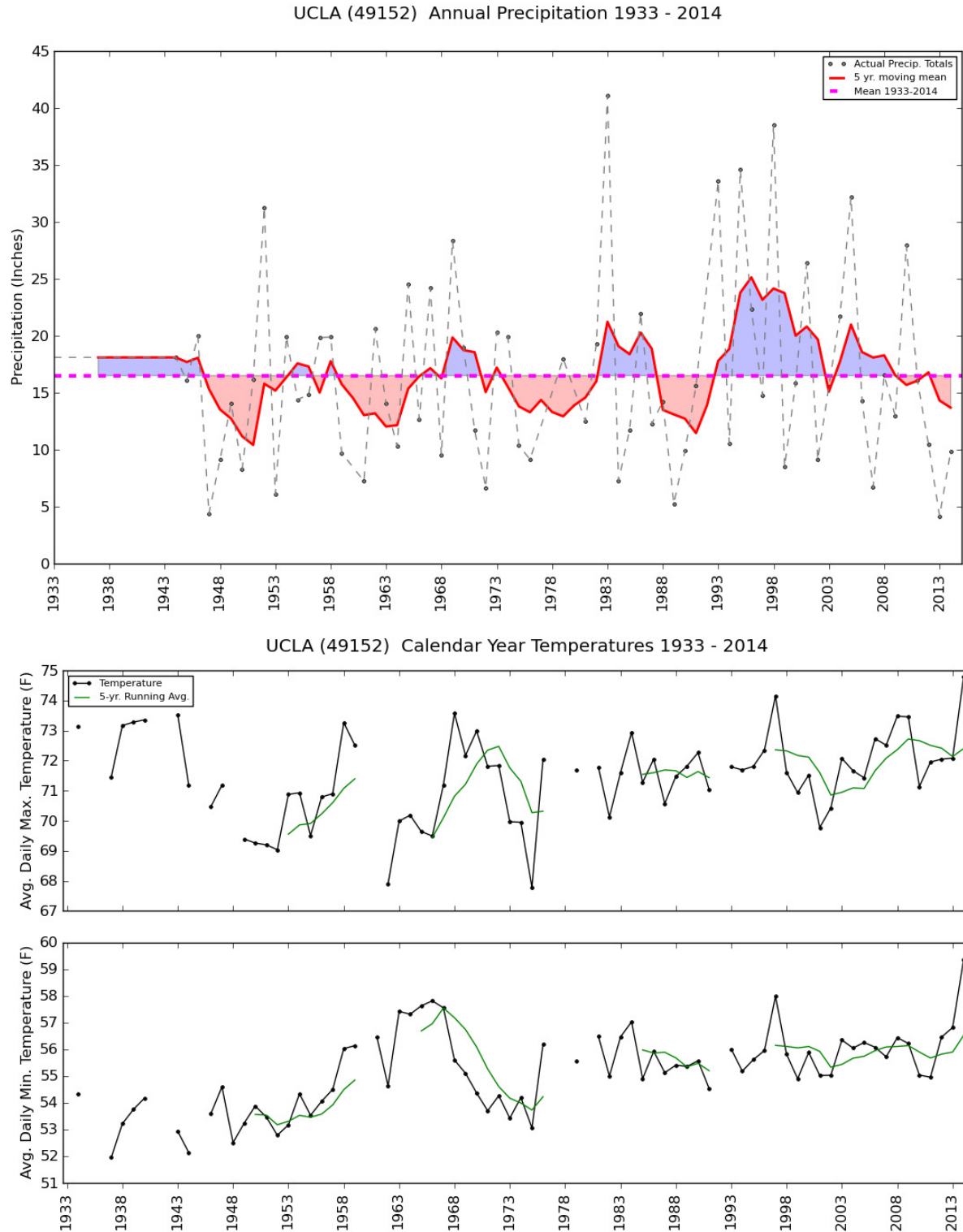
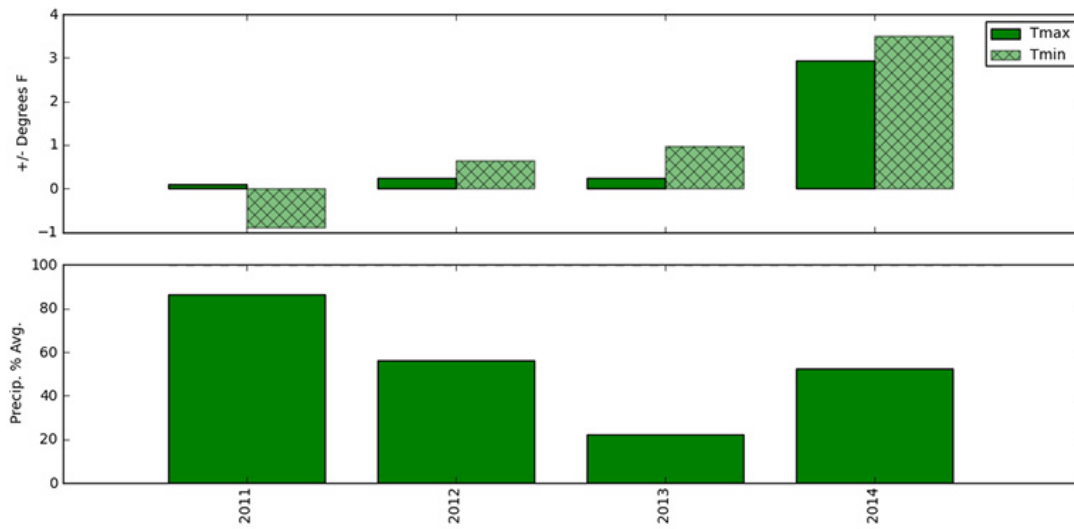


Figure 3. Top: total annual precipitation (dots) at UCLA 1933 – 2014. Red-shaded areas = years when the running mean is below the long-term average (dashed red line). Blue-shaded areas = running mean above the long-term average. Bottom: Annual averages for daily maximum temperature and daily minimum temperature 1933 – 2014. Green line = 5 year running average of temperatures. Running averages include the current year and the previous 4 years.

UCLA (49152) 2011-2014: Departure from 1981 - 2010 Avgs.



UCLA (49152) - 2014 - Departure from 1981 - 2010 Avgs.

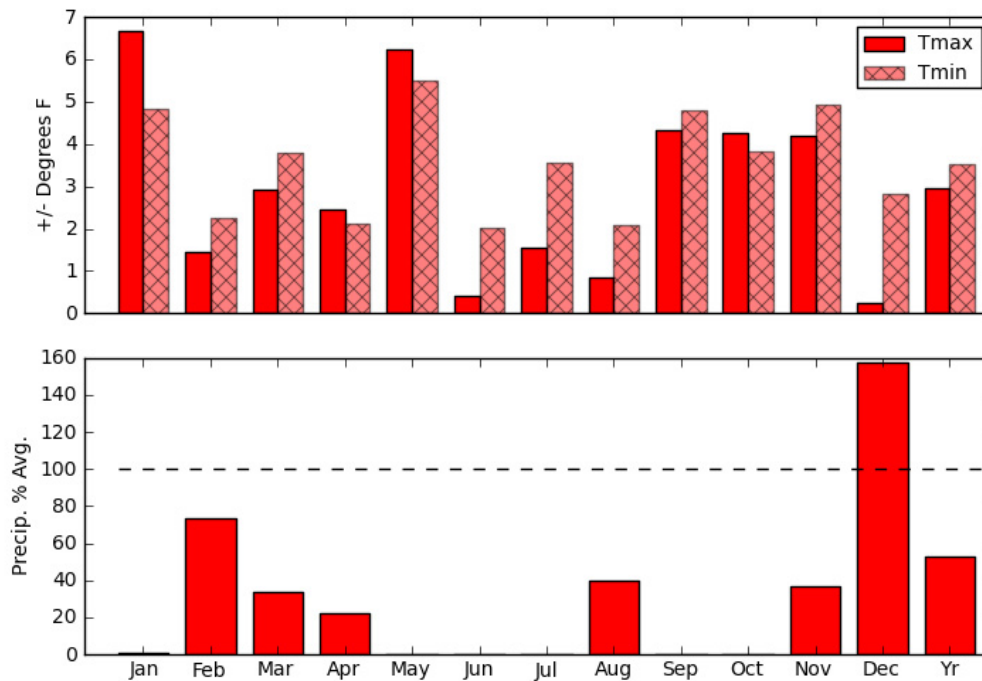


Figure 4. Top: Departure of 2011 - 2014 annual precipitation, annual average daily maximum temperature (Tmax), and annual average daily minimum temperature (Tmin) from 1981 - 2010 averages at UCLA. Bottom: Monthly departures of precipitation, Tmax, and Tmin from 1981 - 2010 averages during 2014. May - August often have less than 0.2 inches average precipitation, so 0% average precipitation during those months may be a small absolute difference.

Table 1. Total Monthly Precipitation in inches during 2014 and percent of 1981 – 2010 averages at key weather stations in and near Santa Monica Mountains National Recreation Area.

	UCLA	UCLA	Burbank Glendale Airport	Beverly Hills	Malibu Canyon	Leo Carrillo	Cheeseboro	Malibu Hills
Month	2014 Precip. (in)	% average	2014 Precip. (in)	2014 Precip. (in)	2014 Precip. (in)	2014 Precip. (in)	2014 Precip. (in)	2014 Precip. (in)
1	0.04	1.09	0.00	0.02	0.00	0.00	0.01	0.03
2	3.74	73.69	4.06	0.84	1.60	0.00	3.74	1.64
3	0.95	33.41	0.81	0.56	0.13	6.16	1.28	0.16
4	0.22	22.32	0.04	0.19	0.26	0.20	0.15	0.31
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.02	39.37*	0.04	0.03	N/A	0.03	0.03	0.00
9	0.00	0.00	0.00	0.00	0.07	0.00	0.00	N/A
10	0.00	0.00	0.34	0.03	0.35	0.31	0.22	N/A
11	0.50	37.05	0.80	1.52	1.17	0.53	0.86	1.44
12	4.34	157.77	3.36	4.57	4.42	3.09	3.95	3.98
YR	9.81	52.66	9.45	7.76	8.02	10.32	10.24	N/A

* Precipitation is so low during summer months that departure calculations can be misleading.

(-) Insufficient data for an accurate calculation.

RAWS do not have 30-year averages.

No 1981 - 2010 averages are available for the Burbank station.

Table 2. Average daily maximum temperatures (Tmax), Average Daily Minimum Temperatures (Tmin) during 2014 and departure from 1981 – 2010 averages expressed as +/- Degrees F.

	UCLA	UCLA	Burbank Glendale Airport	Beverly Hills	Malibu Canyon	Leo Carrillo	Cheeseboro	Malibu Hills
Month	2014 Tmax (F)	Tmax Departure (+/- F)	2014 Tmax (F)	2014 Tmax (F)	2014 Tmax (F)	2014 Tmax (F)	2014 Tmax (F)	2014 Tmax (F)
1	73.8	6.7	77.7	80.0	76.8	72.0	74.3	74.4
2	68.4	1.5	72.8	77.0	71.3	67.6	70.5	69.3
3	70.4	2.9	73.0	79.7	74.5	70.0	72.2	71.2
4	71.9	2.4	76.7	83.4	77.2	70.4	75.4	74.9
5	76.5	6.2	81.4	88.3	81.4	75.0	81.9	78.7
6	73.2	0.4	81.5	87.6	78.0	72.5	86.6	77.8
7	78.7	1.6	87.9	93.9	85.3	76.8	91.7	85.4
8	79.5	0.9	88.0	94.4	N/A	77.1	91.0	85.1
9	82.6	4.3	89.6	97.1	90.6	79.1	91.4	N/A
10	79.7	4.3	83.8	91.6	83.5	77.7	85.3	N/A
11	75.4	4.2	76.2	81.5	77.5	74.3	73.7	73.6
12	66.9	0.2	66.3	69.6	68.0	67.7	62.9	65.0
YR	74.8	3.0	79.6	85.4	79.1	73.4	79.8	N/A

	UCLA	UCLA	Burbank Glendale Airport	Beverly Hills	Malibu Canyon	Leo Carrillo	Cheeseboro	Malibu Hills
Month	2014 Tmin (F)	Tmin Departure (+/- F)	2014 Tmin (F)	2014 Tmin (F)	2014 Tmin (F)	2014 Tmin (F)	2014 Tmin (F)	2014 Tmin (F)
1	55.7	4.8	50.0	55.4	37.0	54.7	51.2	57.9
2	52.8	2.2	50.4	51.1	39.1	50.5	57.2	51.6
3	55.0	3.8	52.0	51.8	42.8	53.2	51.4	52.2
4	55.1	2.1	53.4	52.6	42.5	52.3	52.1	54.2
5	61.1	5.5	59.7	57.3	48.2	57.3	53.0	58.5
6	60.4	2.0	60.5	56.3	51.9	56.9	58.0	56.1
7	65.3	3.6	66.4	61.9	58.5	62.3	56.4	63.0
8	64.4	2.1	65.1	61.5	N/A	60.9	63.1	63.1
9	66.3	4.8	66.3	64.4	55.8	62.6	63.5	N/A
10	62.6	3.8	59.4	60.4	47.1	60.0	66.0	N/A
11	59.4	4.9	52.5	55.8	41.9	58.5	62.4	58.8
12	53.5	2.8	47.9	50.4	42.5	53.9	58.0	52.9
YR	59.4	3.6	57.0	56.7	46.9	57.0	57.8	N/A

PRISM maps depicting spatial patterns in departure from 1981 – 2010 averages

The regional precipitation and temperature patterns seen in the PRISM maps (Figures 5 - 7) are similar to the patterns seen in the weather station data. January was notably warm, and December was the only month with uniformly above average precipitation.

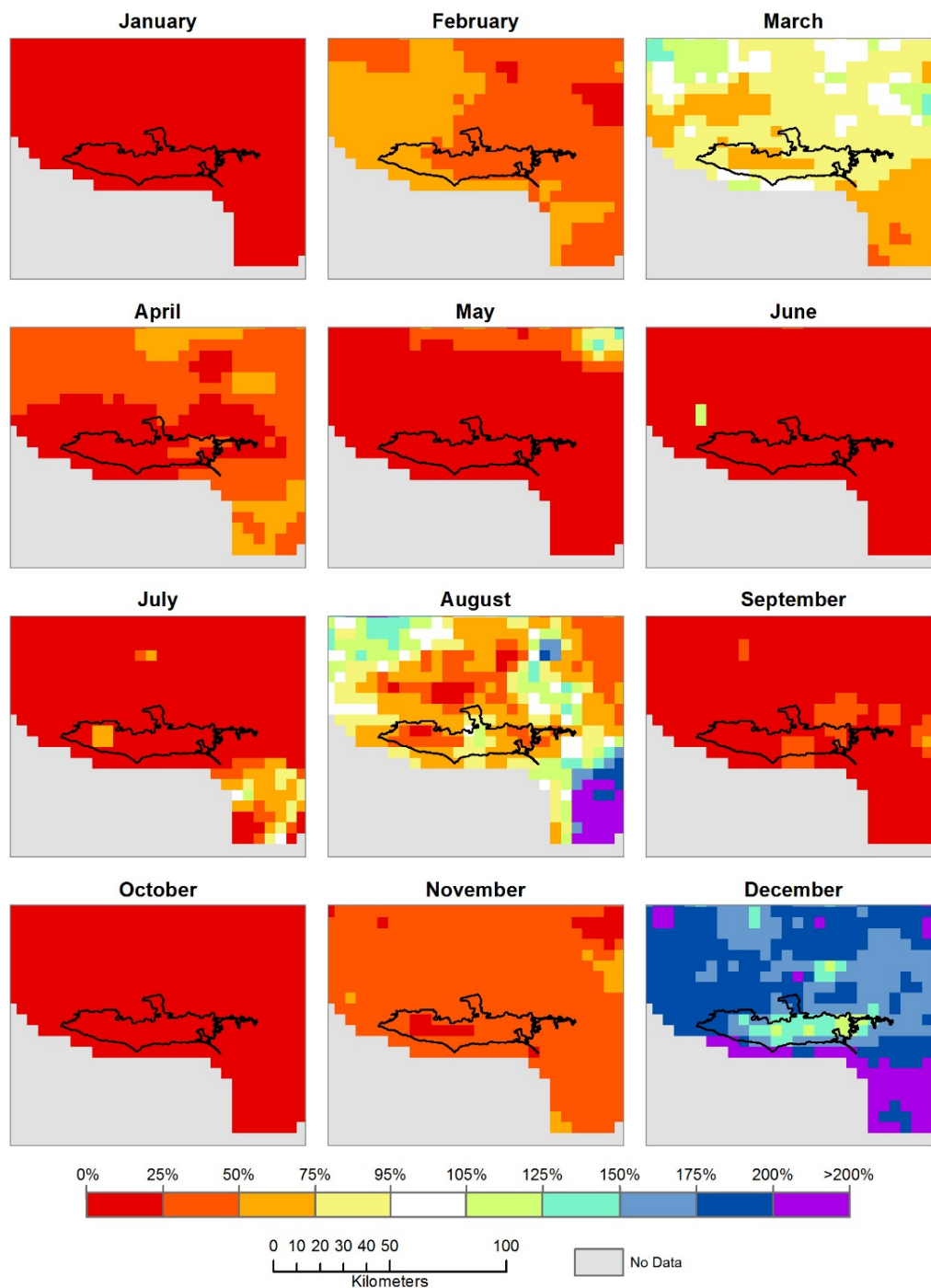


Figure 5. Parameter-elevation Regressions on Independent Slopes Model (PRISM) data showing 2014 monthly precipitation as a percentage of 1981 – 2010 averages. Gray areas = Pacific Ocean. For more information, see <http://www.prism.oregonstate.edu/>.

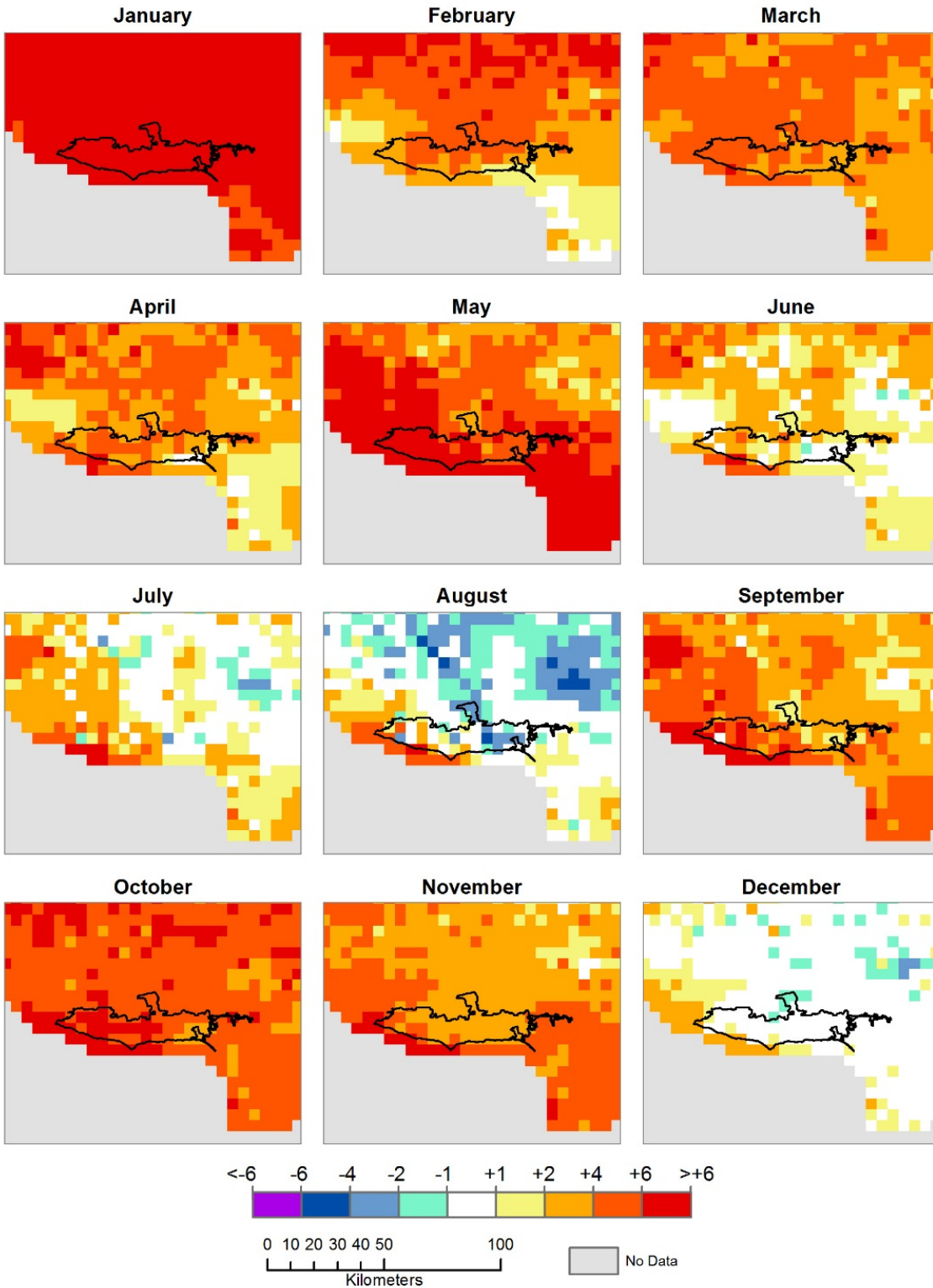


Figure 6. Parameter-elevation Regressions on Independent Slopes Model (PRISM) data showing 2014 monthly average daily maximum temperature (Tmax) departure from 1981 – 2010 averages in degrees Fahrenheit. Gray areas = Pacific Ocean. For more information, see <http://www.prism.oregonstate.edu/>.

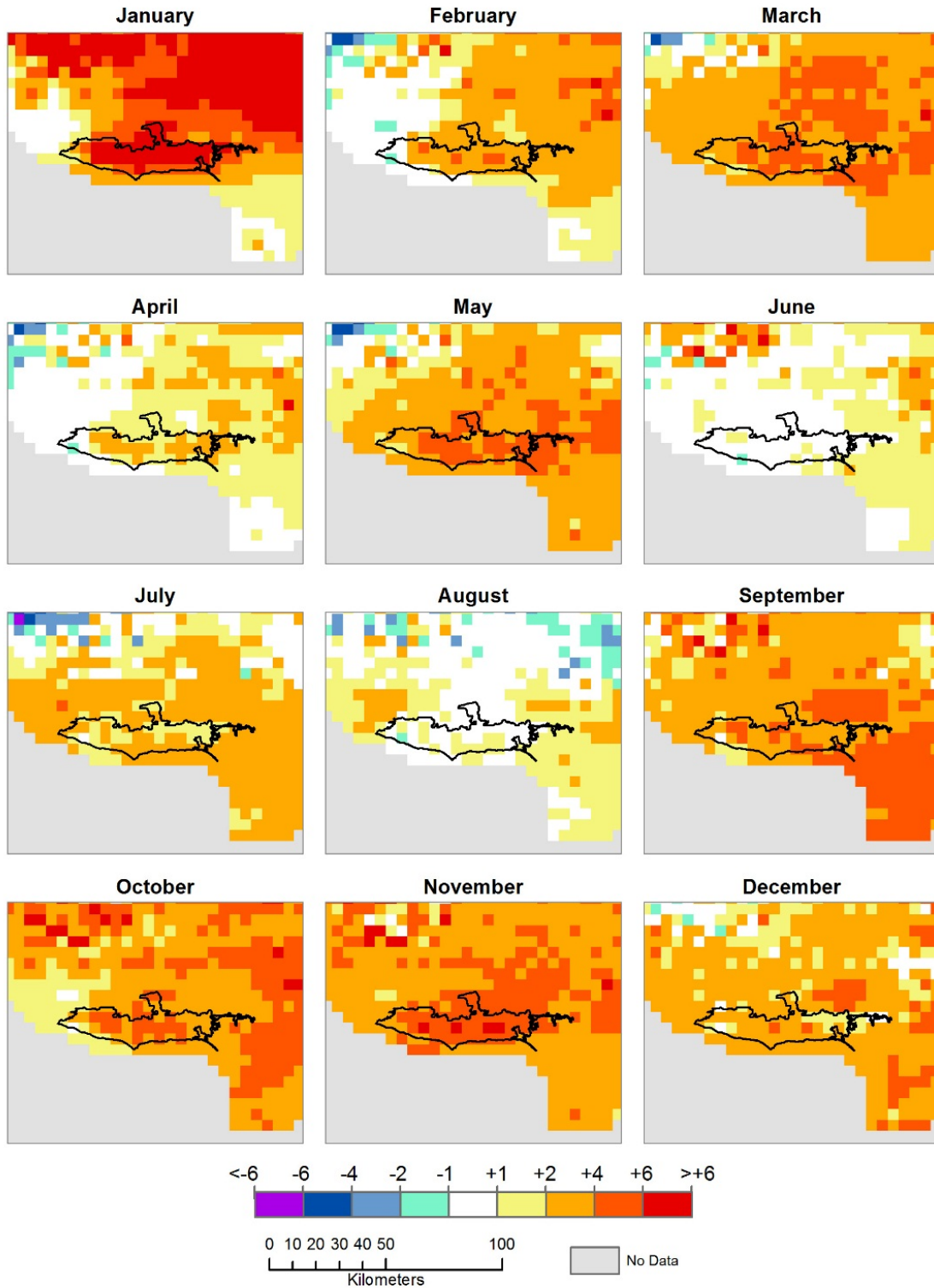


Figure 7. Parameter-elevation Regressions on Independent Slopes Model (PRISM) data showing 2014 monthly average daily minimum temperature (Tmin) departure from 1981 – 2010 averages in degrees Fahrenheit. Gray areas = Pacific Ocean. For more information, see <http://www.prism.oregonstate.edu/>.

Streamflow

Since the rivers in and near Santa Monica Mountains NRA are all heavily influenced by human activity, streamflow is as much a result of management priorities as annual climatic events. Nevertheless, the above average precipitation during December 2014 (Table 1; Figures 4,5) manifested as a spike in the hydrograph during that month (Figure 8).

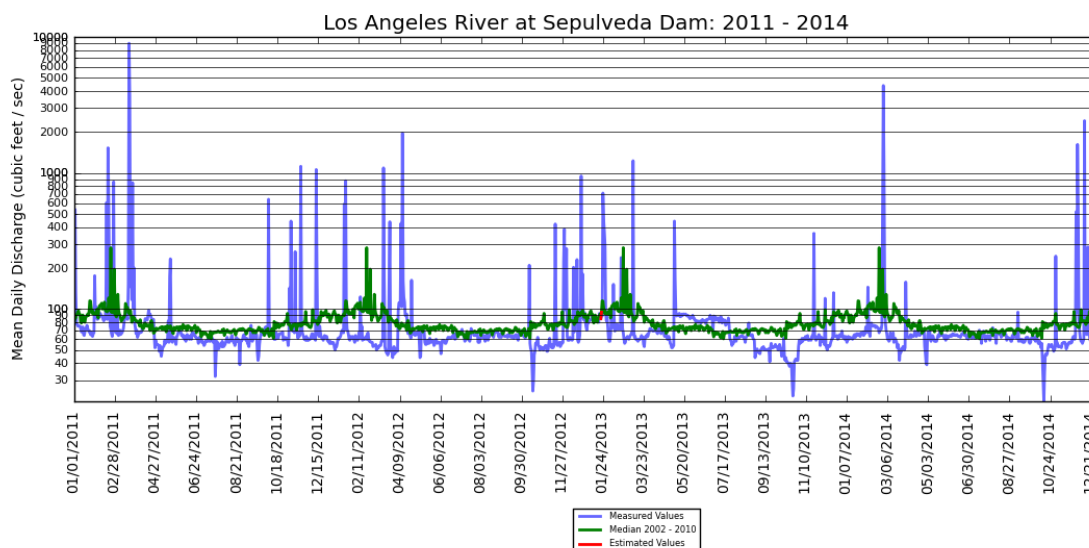


Figure 8. Stream discharge on the Los Angeles River at Sepulveda Dam 2011 – 2014.

Accumulated Growing Degree Days, an Index of Growing Season Length

Accumulated Growing Degree Days (AGDD) are often used as an index of growing season length. They are calculated as the sum of the differences between the average temperature for each day of the year and a base temperature. This base temperature is often chosen as the threshold below which plants are thought to be metabolically inactive. In the case of AGDD 40, the base temperature is 40 degrees Fahrenheit. Consequently, 40 is subtracted from the mean temperature for each day, and these differences are added up for the entire year, giving a single number. Similarly, AGDD 50 is calculated with a base temperature of 50 (F).

When viewed from the perspective of growing season length, calendar-year 2014 was above average. At UCLA, AGDD 40 was 117% the 1981 – 2010 average and AGDD 50 was 129% (Table 3).

Table 3. Accumulated Growing Degree Days (AGDD) and days above or below critical temperature thresholds during 2014. (-) = Insufficient data for an accurate calculation.

Station Name	Time Period	AGDD40	AGDD50	# days >= 80 F	# days >= 90 F	# days <= 32F
UCLA	2014 Value	9880.25	6230.25	91	11	0
	1981 - 2010 Avg.	8479	4842	N/A	9.1	0.1
Burbank - Glendale Airport	2014 Value	10332.95	6689.97	191	48	0
	1981 - 2010 Avg.	(-)	(-)	(-)	(-)	(-)
Beverly Hills	2014 Value	11273.5	7653.5	252	138	1
Malibu Canyon	2014 Value	8135.5	4621	160	47	13
Leo Carrillo	2014 Value	9150.5	5520.5	44	8	0
Cheeseboro	2014 Value	10483.5	6853	195	87	0
Malibu Hills	2014 Value	N/A	N/A	N/A	N/A	N/A

Conclusions

- The region entered into drought conditions in April 2012 (Tercek 2013) and became progressively drier throughout 2013 and 2014. By the end of 2014, the area in and near Santa Monica Mountains NRA was classified as “D4 - Exceptional Drought” by the US Drought Monitor, which is the most severe classification on this scale.
- The average annual temperatures for 2014 at UCLA (74.8 degrees (F) for average daily maximum (Tmax) and 59.4 degrees (F) for average daily minimum (Tmin)) were the warmest since 1933. Total annual precipitation during 2014 (9.8 inches) was only 53% of the 1981 – 2010 average. At the UCLA station, 7 out of the last 8 years have had below average precipitation.
- Monthly data from the UCLA station show that December 2014 had 158% of the 1981 – 2010 average precipitation while all other months of the year had below average precipitation. Every month of 2014 had above average temperatures at UCLA. January was particularly warm, with average daytime highs 6.7 degrees above the 1981 – 2010 average and average night-time lows 4.8 degrees above average.

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Appendix 1

Table of climate stations in and near Santa Monica Mountains. You can make custom graphs and tables based on all these weather stations by visiting www.ClimateAnalyzer.org. Detailed histories, period of record, and 30-year averages can be accessed from the links provided below.

Name	Stn type	ID	Metadata
Burbank Valley Pump Plant AKA Burbank Glendale Airport	GHCN	41194	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca1194
UCLA	GHCN	49152	http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca9152
Beverly Hills	RAWS		http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCBEV
Leo Carrillo	RAWS		http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCLEO
Malibu Hills	RAWS		http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCMAL
Malibu Canyon	RAWS		http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCMCN
Cheeseboro	RAWS		http://www.wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCCHB
Calleguas Creek nr Camarillo	USGS Stream Gage	11106550	http://waterdata.usgs.gov/nwis/dv/?site_no=11106550&agency_cd=USGS&referred_module=sw
Malibu Creek at Malibu California	USGS Stream Gage	11105510	http://waterdata.usgs.gov/nwis/dvstat/?format=sites_selection_links&search_site_no=11105510&agency_cd=USGS&referred_module=sw
Los Angeles River a Sepulveda Dam	USGS Stream Gage	11092450	http://waterdata.usgs.gov/nwis/dvstat/?format=sites_selection_links&search_site_no=11092450&agency_cd=USGS&referred_module=sw

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Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

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