Kaibab National Forest Climate Report: January 2024

Highlights

- The current average 4-month (October-January) Standardized Precipitation Index (SPI) for Kaibab National Forest is **-1.15 (Moderately Dry)**.
- Average October-January precipitation was 3.19 inches, which was **-2.99 inches** different from the long-term average. This value ranks 115th out of 130 years in total precipitation (Rank 1 is the wettest year).
- Average October-January temperature was 41.2 degrees F, which was **+2.5 degrees F** different from the long-term average. This value ranks 14th out of 130 years in average temperature (Rank 1 is the warmest year).
- The 1-month outlook for March predicts a 33-40% chance of wetter-than-average precipitation and equal chances of above, below or normal temperatures. The 3-month seasonal outlook for March-May predicts equal chances of above, below or normal precipitation and equal chances of above, below or normal temperatures. (More information at NOAA Climate Prediction Center, https://www.cpc.ncep.noaa.gov/)

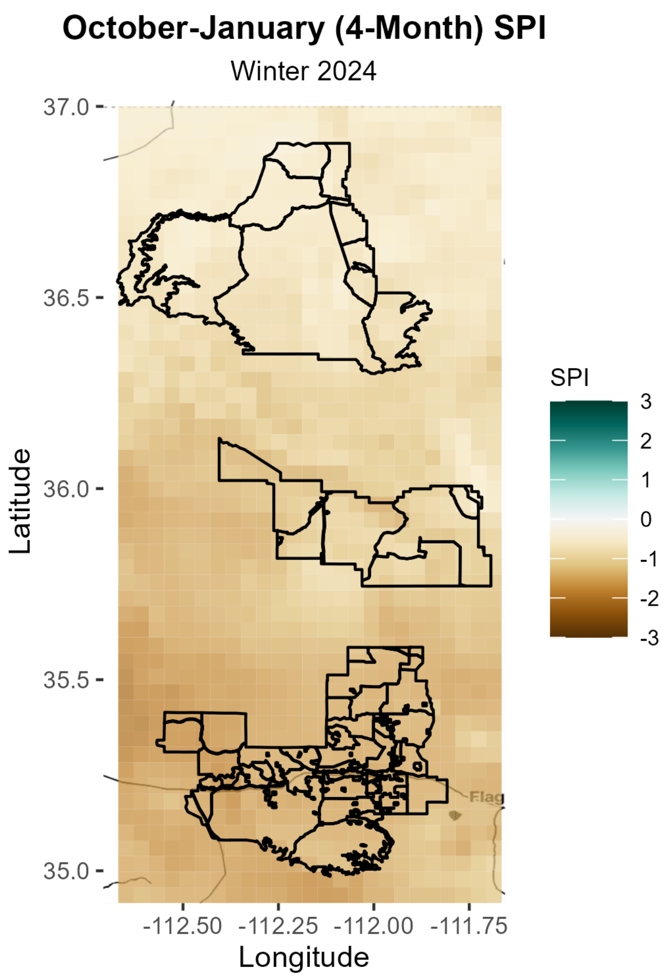

Figure 1: Kaibab National Forest drought status for Winter 2024 (January 2024 4-Mo. SPI)

Table 1: Current Drought Conditions

District	Minimum SPI	Mean SPI	Maximum SPI	Total Precip [in.]	Anomaly [in.]
Tusayan	-1.51	-1.16	-0.54	2.37	-2.27
Williams	-1.86	-1.54	-1.28	2.67	-4.27
North Kaibab	-1.13	-0.75	-0.43	4.07	-2.23

Note:

Kaibab National ForestSPI and climate statistics for Winter 2024 (October-January). Statistics are calculated based on the average of all PRISM grid cells lying within a District boundary.

Seasonal Drought Progression

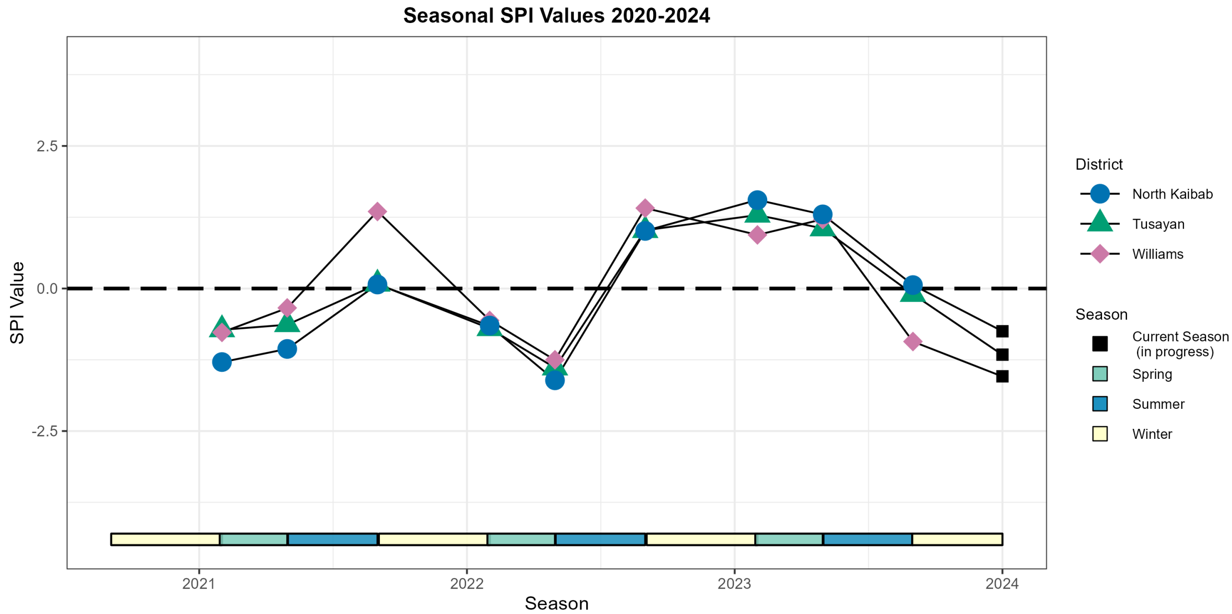

Figure 2: Kaibab National Forest seasonal SPI values (2021-2024). Seasonal monthly definitions are as follows: Winter (Oct-Feb); Spring (Mar-May); Summer (Jun-Sep); Fall (-).The displayed SPI value represents the final month within each season at a timescale of the number of months within that season. Current seasonal SPI values (black dots) are not final since the season is still in progress.

Table 2: District-level Seasonal SPI and Climate Statistics

District	2024 Winter SPI*	2024 Fall SPI	2024 Summer SPI	2024 Spring SPI	12mo. SPI	2024 Winter Precip [in.]*	2024 Fall Precip [in.]	2024 Summer Precip [in.]	2024 Spring Precip [in.]	12mo. Precip [in.]	12mo. Precip Anom [in.]
Tusayan	-1.16	NA	-0.10	1.05	-0.21	2.37	NA	5.90	4.59	14.25	-1.07
Williams	-1.54	NA	-0.93	1.21	-0.69	2.67	NA	5.37	6.68	17.23	-3.31
North Kaibab	-0.75	NA	0.06	1.30	0.31	4.07	NA	5.44	7.38	19.16	1.15

Note:

Kaibab National Forest seasonal SPI and climate statistics by District. Asterisk (*) signifies season in progress - currently Winter (Oct-Jan). Values are calculated based on the average of all PRISM grid cells lying within a District boundary.

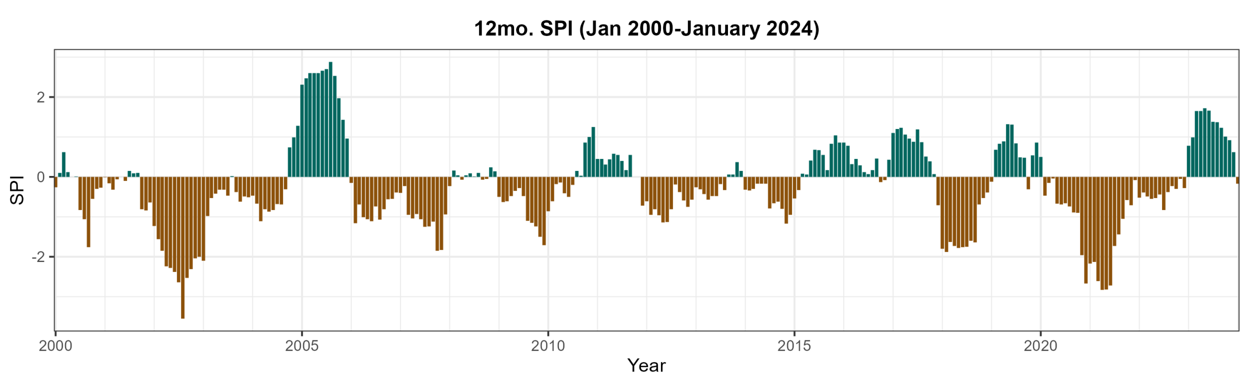

Figure 3: 12mo. SPI for Kaibab National Forest (2000-2024)

Station Climate Summaries

Summaries from climate stations with relatively long periods of record, minimal missing data (<10% of days), and within the area boundary are presented in the following tables (5 and 6) as reference locations. These stations are a select subset of stations that contribute to the gridded climate maps. Red circles on map indicate locations of NOAA Global Historical Climate Network stations.

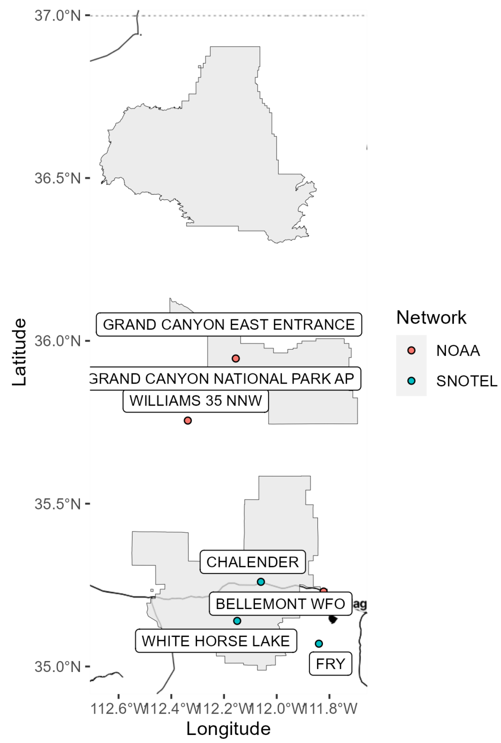

Figure 4: NOAA station(s) located within the report area boundary.

Table 3: NOAA Climate Station Observations (2023-10-01 to 2024-01-31)

Station	Elev (ft)	POR	Total Precip (in)	Precip Anom (in)	Days with Precip	Total Snow (in)	Avg Temp (F)	Temp Anom (F)	Freeze Days
BELLEMONT WFO	7152	2001-2024	2.75	-3.91	18	25.8	36.0	1.83	114
WILLIAMS 35 NNW	5990	2009-2024	1.77	-1.35	18	0.0	42.2	1.23	79
GRAND CANYON EAST ENTRANCE	7480	2019-2024	3.19	-1.39	20	14.8	40.6	1.06	75
GRAND CANYON NATIONAL PARK AP	6540	1999-2024	2.42	-1.47	20	0.0	38.1	2.41	105

Note:

Kaibab National Forest summary statistics of select NOAA stations within the Forest boundary for October-January 2024

Table 4: USDA NRCS SNOTEL Station Observations (2023-10-01 to 2024-01-31)

Station	Elev (ft)	POR	Max SWE (in)	Max SWE Anom (in)	Total Precip (in)	Precip Anom (in)
WHITE HORSE LAKE	7201	1970-2024	1.5	-2.48	3.20	-5.47
FRY	7238	1978-2024	2.8	-2.64	4.88	-4.8
CHALENDER	7034	2009-2024	1.1	-2.05	2.70	-4.09

Note:

Kaibab National Forest summary statistics of select USDA NRCS Snow Telemetry (SNOTEL) stations within the Forest boundary for October-January 2024

Vegetation Condition – NDVI Greenness Rank

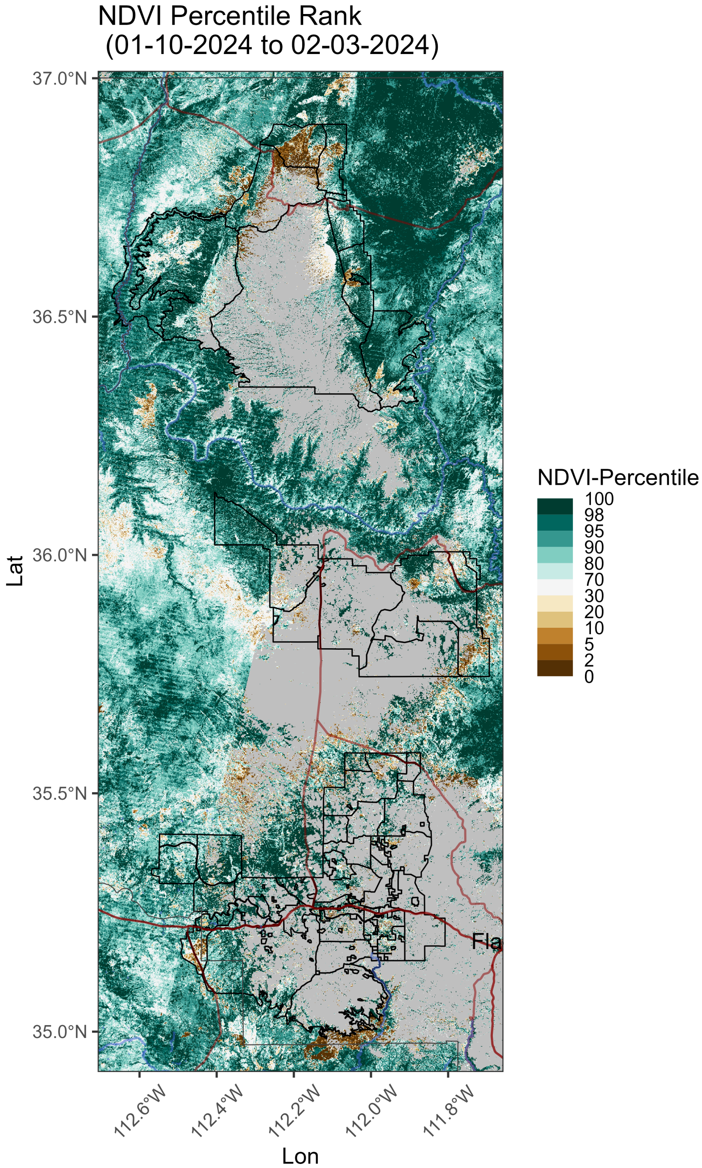

Figure 5: Percentile rank of NDVI Greenness values for specified period

A satellite-based measurements of vegetation ‘greenness’ (Normalized Difference Vegetation Index, NDVI) can be used to monitor changes in ecosystem conditions. The values in the map above indicate the percentile rank of NDVI values over the specified period relative the 1991-2020 historical period. High values indicate that conditions are much greener than typical for this period, while low values indicate lack of greenness. Values near the 50th percentile can be considered average for this time of year. Gray areas indicate missing values due to clouds or snow. (NDVI values are calculated using Landsat 5/7/8/9 Surface Reflectance data averaged over a 30-day period, ranked relative to the 1991-2020 period and then resampled to a 120m resolution. More information on the dataset can be found here. Use https://app.climateengine.org/climateEngine to access and interact with the most recent data).

Rangeland Production

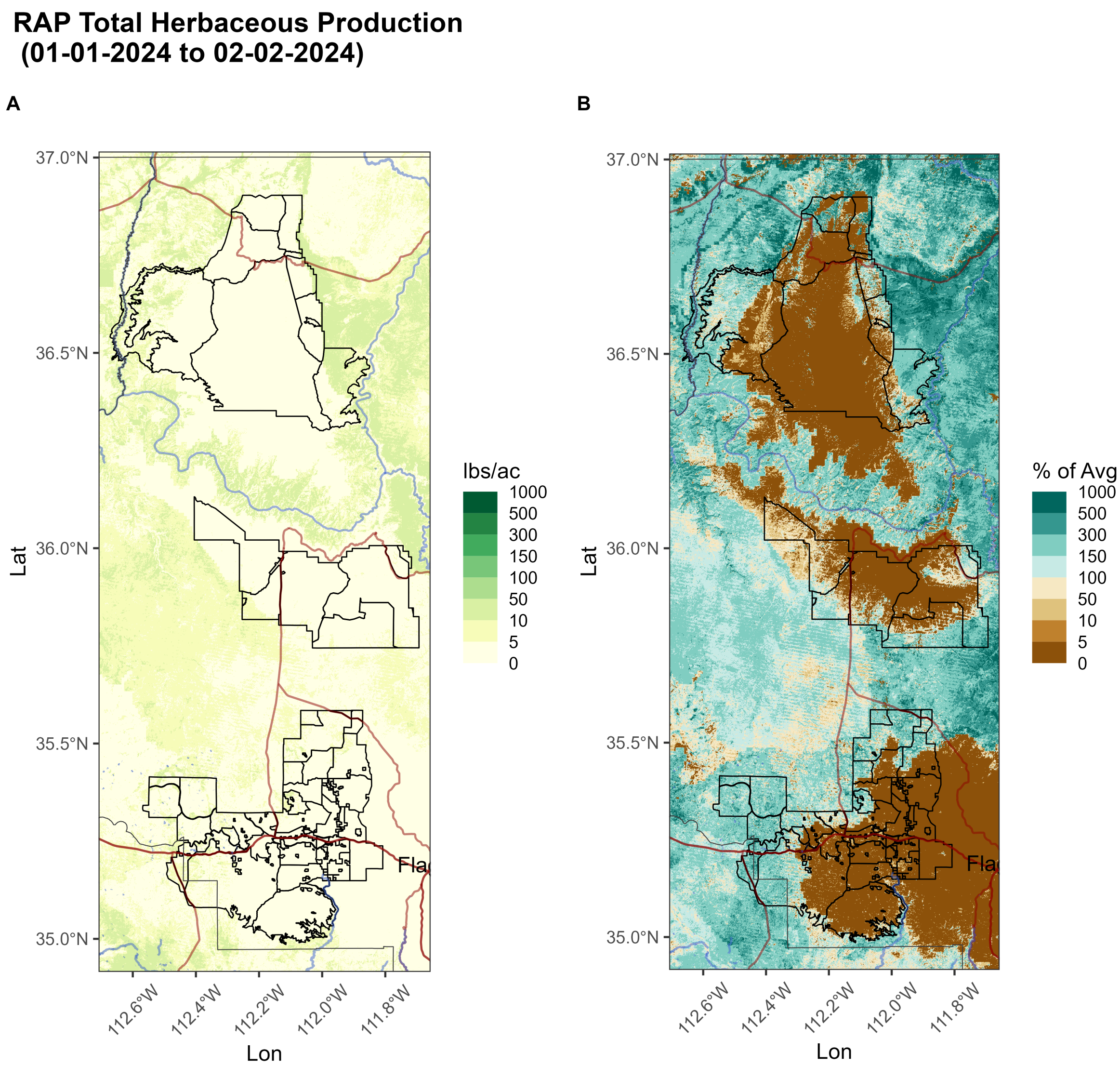

Figure 6: Modeled cumulative total herbaceous production (lbs/ac) since Jan-1st (A) and percent of average production to date (B)

The USDA Rangeland Analysis Program (RAP) uses satellite data and a process based model to estimate total new aboveground rangeland production every two weeks throughout the year (more information on methodology available here). The maps above present the cumulative total production estimate since January 1st (figure A) and the percent of average relative to the 1986-present historical period (figure B). Total production values will be low early in the year and increase throughout the year. These data are experimental estimates and only suitable to for rangeland applications. (Data are resampled from a native 30m resolution and presented at 120m pixel size. Use https://app.climateengine.org/climateEngine to access and interact with the most recent data)

NASA SPoRT Soil Moisture Estimates

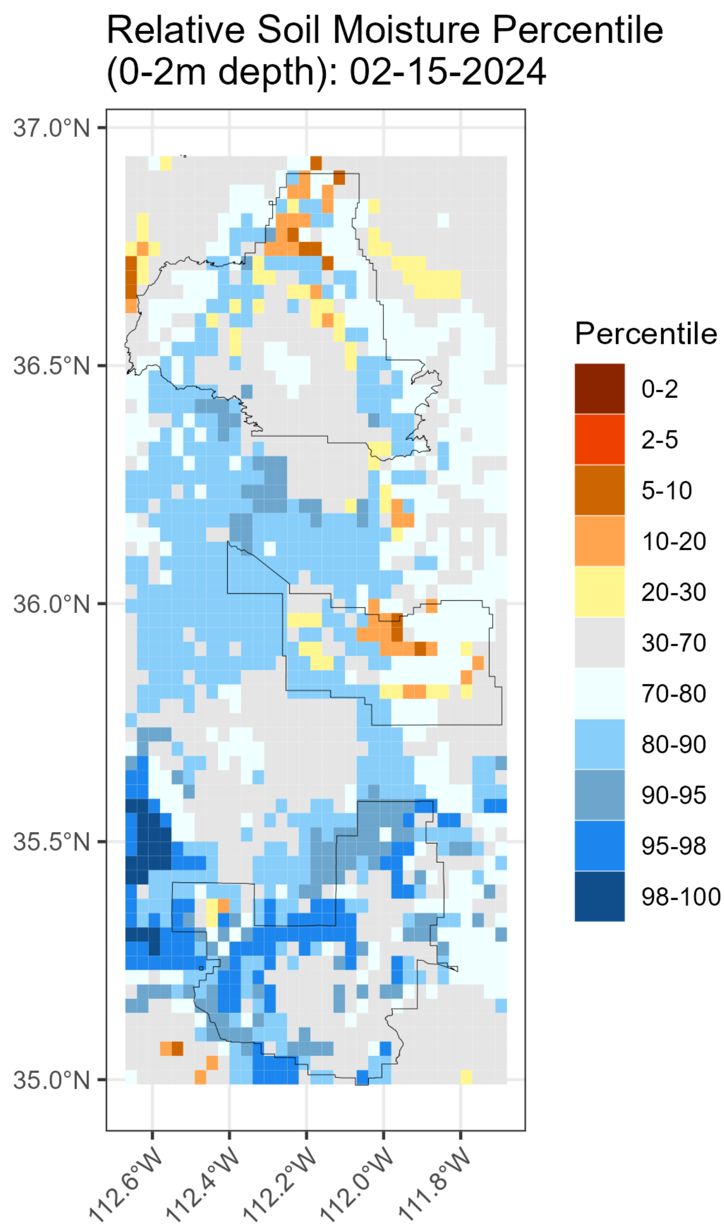

Figure 7: Integrated surface to 2 meter deep relative soil moisture estimate

Modeled soil moisture estimates are provided by the NASA Short-term Prediction Research and Transition Center. This program uses a land surface model to integrate surface weather conditions (e.g. precipitation, temperature, wind…) with surface and soil properties like vegetation cover, soil depth and type to track and make near real-time estimates of soil moisture on a 3km by 3km grid. This map displays how unusually wet or dry the relative soil moisture (based on local soil properties) is for the integrated amount from the surface to 2 meters deep. (more information at https://weather.ndc.nasa.gov/sport/modeling/lis.html)

Mechanics Behind the Standardized Precipitation Index (SPI)

The SPI is a meteorological drought index which use monthly precipitation sums to calculate a time series of z-score values. The SPI uses z-score values to represent the number of standard deviations a monthly precipitation total is from the long-term mean. The sign (positive or negative) of a z-score value represents if the monthly total precipitation is above (+, water surplus) or below (-, water deficit) the long-term mean for *all other instances of that month on record*. Furthermore, the size of the z-score value represents the frequency of drought conditions (Table . Smaller SPI values (i.e. falling near zero) represent more frequent drought events while larger SPI values (positive or negative) are less frequent drought events.

Table 5: SPI Drought Categories

SPI Value	SPI Category
≥ 2	Extremely Wet
1.5 to 1.99	Very Wet
1 to 1.49	Moderately Wet
-0.99 to 0.99	Near Average
-1 to -1.49	Moderately Dry
-1.5 to -1.99	Very Dry
$\leq$ -2	Extremely Dry

Note:

Table adapted from https://drought.unl.edu/Monitoring/SPI/MapInterpretation.aspx

An important feature of the SPI is the ability to be calculated at a variety of monthly timescales. This flexibility allows the SPI to evaluate drought conditions for different time periods. For example, a 3-month SPI calculation compares total precipitation from the 3 months with all other instances of those same 3 months on record. Land managers can assess SPI values of different timescales to interpret short and long-term drought conditions on their land.

About the data used in this report

- PRISM Climate: The gridded used in mapping and forest and district level climate summaries is provided by the PRISM (Parameter elevation Regression on Independent Slopes Model) statistical mapping system. This system uses a weighted regression scheme to interpolate station data while accounting complexities like topography and rain shadows. The PRISM mapping system relies on a high density of stations to account for small variations in temperature and precipitation. Use caution in interpreting fine-scale patterns (or lack thereof) in regions with low station density. More information on PRISM can be found at https://prism.oregonstate.edu/ and https://climatedataguide.ucar.edu/climate-data/prism-high-resolution-spatial-climate-data-united-states-maxmin-temp-dewpoint.
- Climate Stations: Station-level data used in this report consist of NOAA Global Historical Climatology Network(NOAA-GHCN) stations and USDA NRCS Snow Telemetry sites which include Cooperative Observer sites, Airports, and CoCoRAHS volunteer observations and also USDA NRCS Snow Telemetry(SNOTEL) sites. NOAA-GHCN stations consist of Cooperative Observer sites, Airports, and CoCoRAHS volunteer precipitation observations. SNOTEL sites are automated stations located in key snow monitoring locations, often in forested locations. NOAA-GHCN data were accessed through the Regional Climate Center-Applied Climate Information System(RCC-ACIS) and SNOTEL data were downloaded using the ‘snotelr’ package.

Contact information

Direct any questions, comments, or suggestions to:

- Mike Crimmins, Professor and Extension Specialist (crimmins@arizona.edu)
- Trevor McKellar, Post-doctoral Researcher (tmckella@arizona.edu)

https://cals.arizona.edu/climate