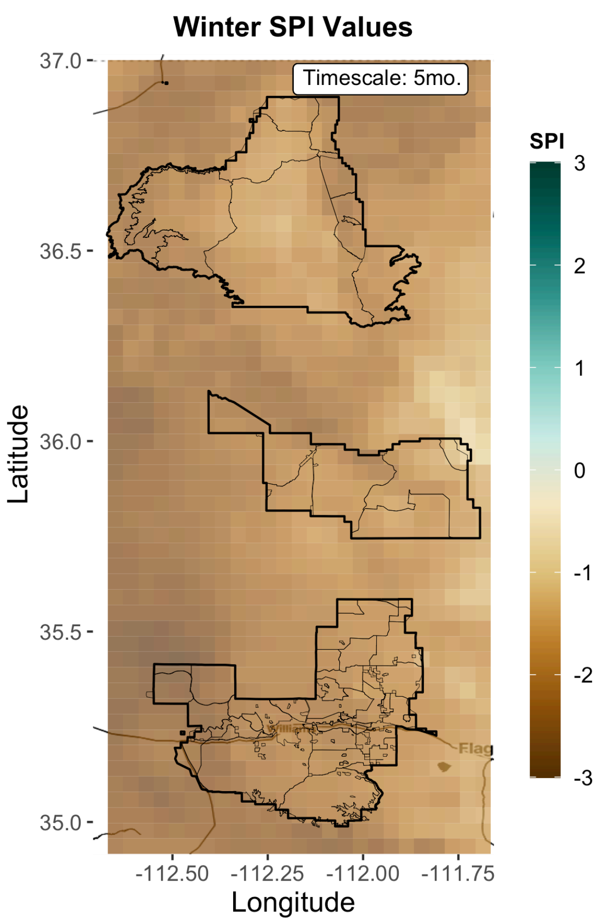
Kaibab National Forest Climate Report: February 2025

Highlights

- The current average 5-month (October-February) Standardized Precipitation Index (SPI) for Kaibab National Forest is **-1.81 (Very Dry)**.
- Average October-February precipitation was 3.01 inches, which was **-4.92 inches** different from the long-term average. This value ranks 126th out of 131 years in total precipitation (Rank 1 is the wettest year).
- Average October-February temperature was 40.5 degrees F, which was **+2.6 degrees F** different from the long-term average. This value ranks 10th out of 131 years in average temperature (Rank 1 is the warmest year).
- The 1-month outlook for March predicts **equal chances of above, below or normal precipitation** and **equal chances of above, below or normal temperatures**. The 3-month seasonal outlook for March-May predicts a **40-50% chance of drier-than-average precipitation** and a **40-50% chance of warmer-than-average temperatures**. (More information at NOAA Climate Prediction Center, https://www.cpc.ncep.noaa.gov/)

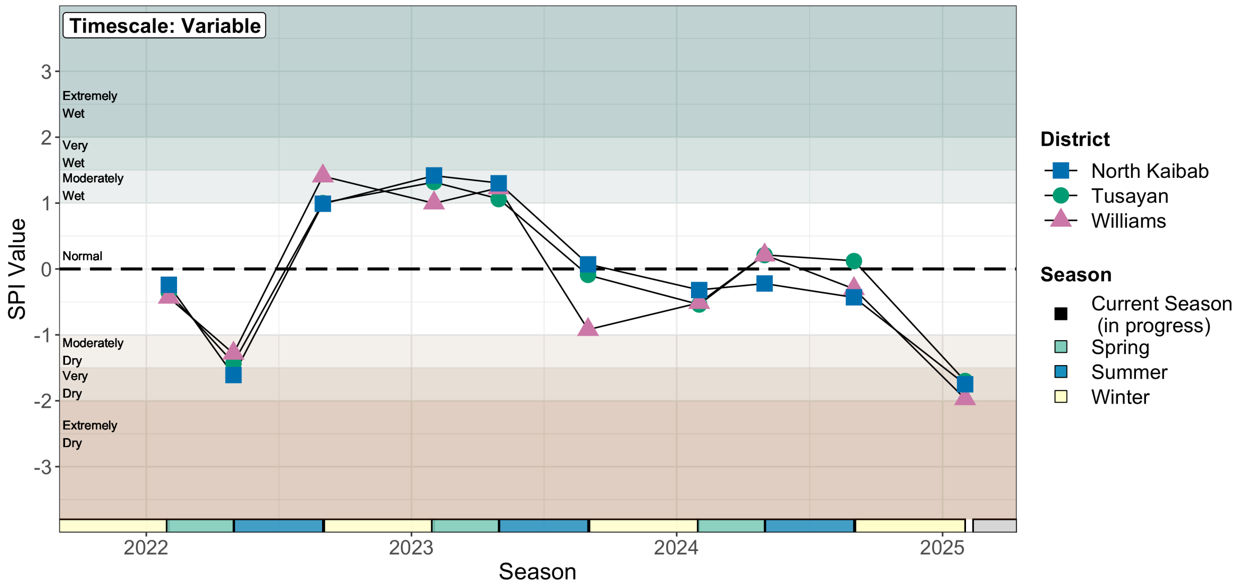


	Total Precip [in.]	Precip Anom [in.]	Temp Anom [F]	SPI	SPI Area < -1 [%]
Kaibab National Forest	3.01	-4.92	2.64	-1.82	99.3
Tusayan	2.35	-3.53	1.98	-1.7	95.3
Williams	2.91	-6.07	2.84	-1.97	100
North Kaibab	3.44	-4.61	2.82	-1.75	100

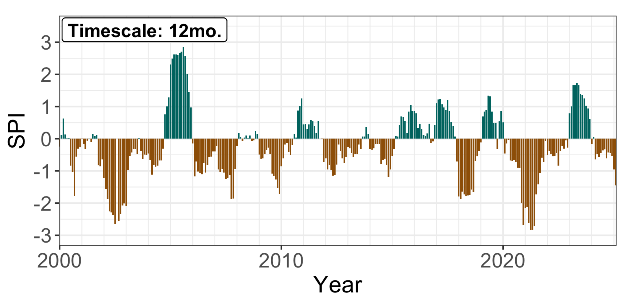
Figure 1: [Left] Kaibab National Forest Standardized Precipitation Index (SPI) values for **Winter 2025 (February 5mo. timescale)**. [Right] Table summarizing climate statistics for **Winter 2025 (October - February).**

Seasonal Progression Summary

This section contains seasonal drought information for the Kaibab National Forest. Season lengths are based on historical climatology and typical land management schedules (see *Climatology and Trends* section). **Season lengths for the Kaibab National Forest are: Winter (Oct-Feb); Spring (Mar-May); Summer (Jun-Sep); Fall (-).** Note: Current season statistics may be partial if season is in progress. Winter 2025 values are currently summarized from Oct-Feb.



	Total Precip [in.]	Precip Anom [in.]	SPI	SPI Area < -1 [%]	Mean Temp [F]	Temp Anom [F]	SPEI
Fall							
Winter*	3.01	-4.92	-1.82	99.7	40.5	2.6	-1.33
Spring	3.62	-0.3	0.03	0	46.3	-0.4	0.45
Summer	5.77	-0.7	-0.26	5.9	69.5	3.8	-1.57
12mo	12.41	-5.91	-1.45	87.2	51.6	2.3	-1.32



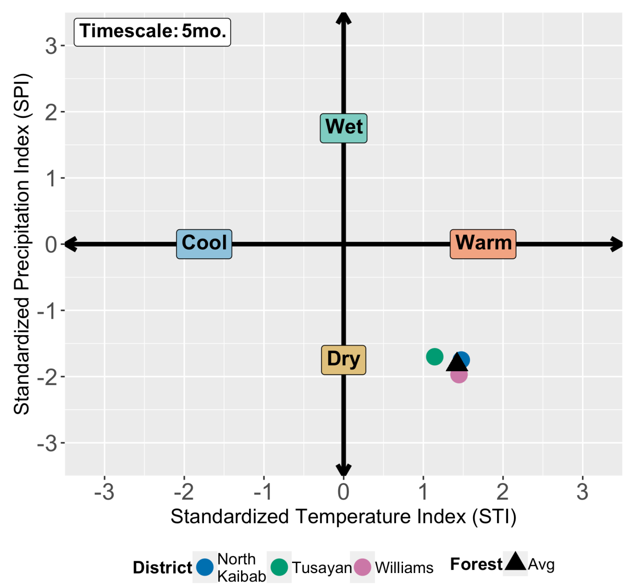
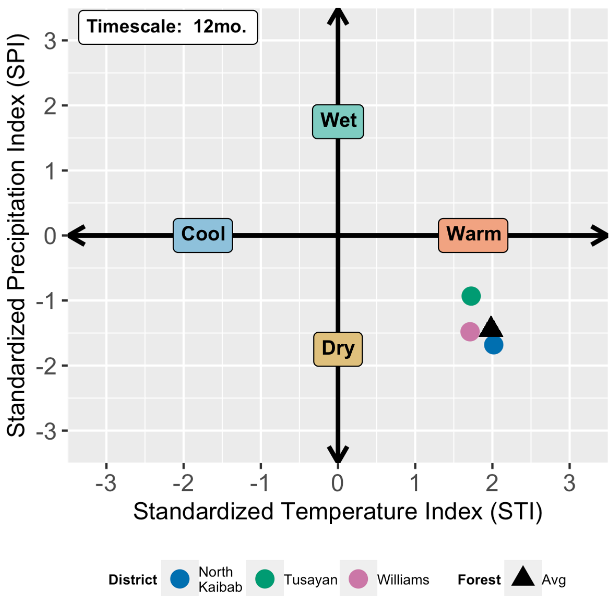


Figure 2: [Top] Variable-timescale seasonal SPI time series from **2022-2025.** Displayed values represent the final SPI value for each season at a timescale equal to the defined season length. [Center-Left] Seasonal and 12-month climate statistics. Asterisk indicates current season. [Bottom-Left] 12mo. SPI time series from **January 2000 - February 2025.** [Bottom-Right] Drought classification quadrant showing standardized precipitation (SPI) vs standardized temperature (STI).

Temperature Impacts on Drought

This section explores the impacts of temperature on drought development for different time length intervals. Figure [A] shows the relationship between the Standardized Precipitation Index (SPI) and Standardized Temperature Index (STI) at a 12-month timescale for the entire Forest and at each District . Table [B] shows precipitation and temperature-based climate statistics at 3-, 6-, and 12-month timescales. Figure [C] shows time series plots of the SPI and Standardized Precipitation-Evapotranspiration Index (SPEI) at 3-, 6-, and 12-month timescales. Note – the Hargreaves method is used to estimate potential evapotranspiration for the SPEI calculation.



	3-Month	6-Month	12-Month
Total Precip [in.]	1.25	3.29	12.41
Precip Anom [in.]	-4.05	-6.18	-5.91
Mean Temp [F]	36.1	44.6	51.6
Temp Anom [F]	3.2	2.8	2.3
SPI	-2.09	-2.34	-1.53
STI	1.27	1.7	1.98
SPEI	-1.53	-1.53	-1.32

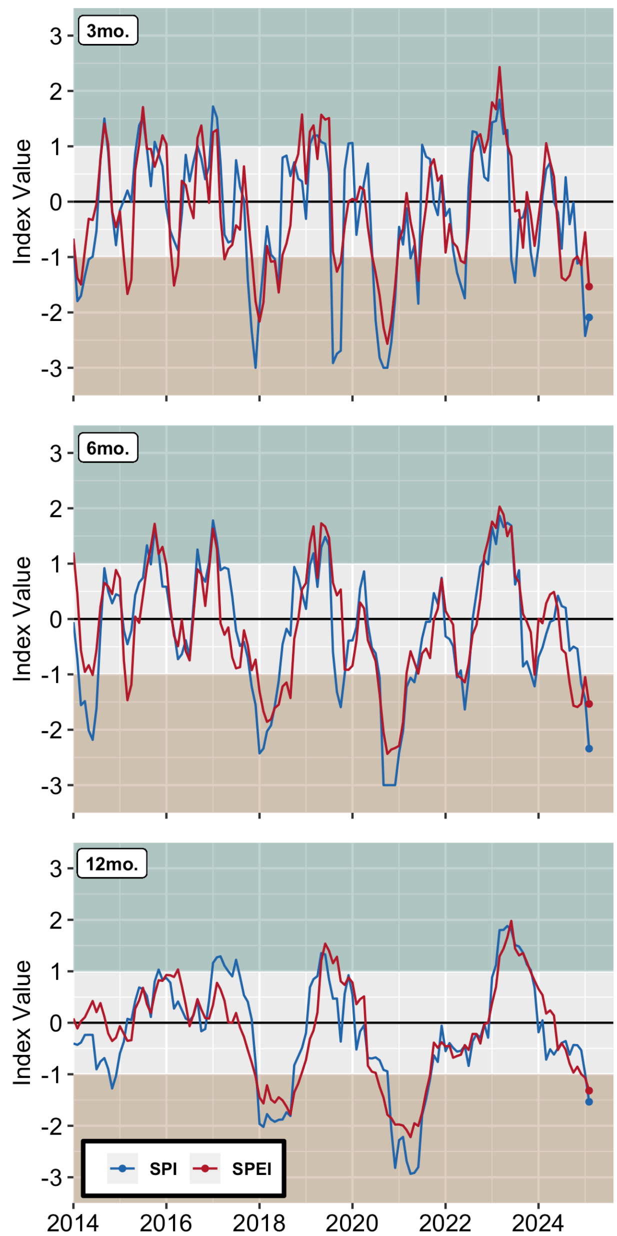
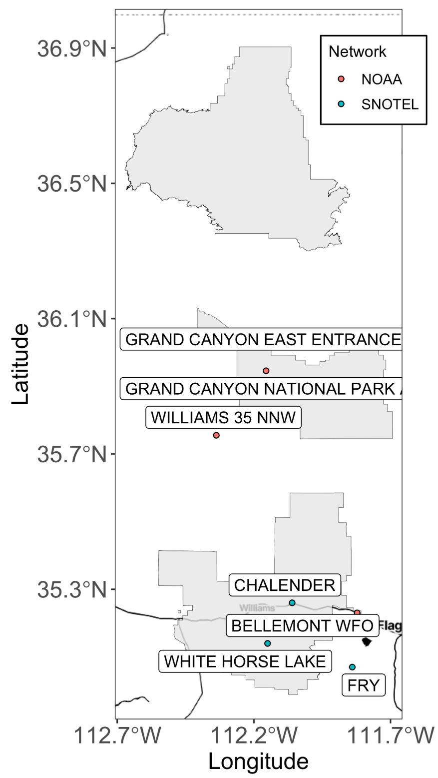


Figure 3: [Top-Left] Drought classification quadrant for the 12-month SPI and STI (Standardized Temperature Index). [Bottom-Left] Table showing 3-, 6-, and 12-month climate statistics for the Kaibab National Forest. [Right] Time series plots of the 3-, 6-, and 12-month SPI and SPEI.

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.



	Elev (ft)	POR	Max SWE (in)	Max SWE Anom (in)	Total Precip (in)	Precip Anom (in)
WHITE HORSE LAKE	7192	1970-2025	1.6	-3.47	3.9	-7.74
FRY	7221	1978-2025	2.6	-4.96	5.19	-7.52
CHALENDER	7021	2009-2025	1	-2.8	2.3	-5.99

	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	2001-2025	3.46	-4.84	13	19.3	35.4	1.94	139
WILLIAMS 35 NNW	5990	2009-2025	1.96	-1.79	8		42.2	1.92	116
GRAND CANYON EAST ENTRANCE	7480	2020-2025	3.2	-1.54	14	12.1	41	2.16	100
GRAND CANYON NATIONAL PARK AP	6540	1999-2025	1.66	-3.07	9		36.5	1.54	134

Figure 4: [Top-Left] Locations of NOAA and SNOTEL station(s) located within the report area boundary. [Top-Right] Table of SNOTEL station(s) statistics from **2024-10-01 to 2025-02-28** [Bottom] Table of NOAA station(s) statistics from **2024-10-01 to 2025-02-28.**

NASA SPoRT Soil Moisture Estimates

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, etc.) 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 can be found at: https://weather.ndc.nasa.gov/sport/modeling/lis.html

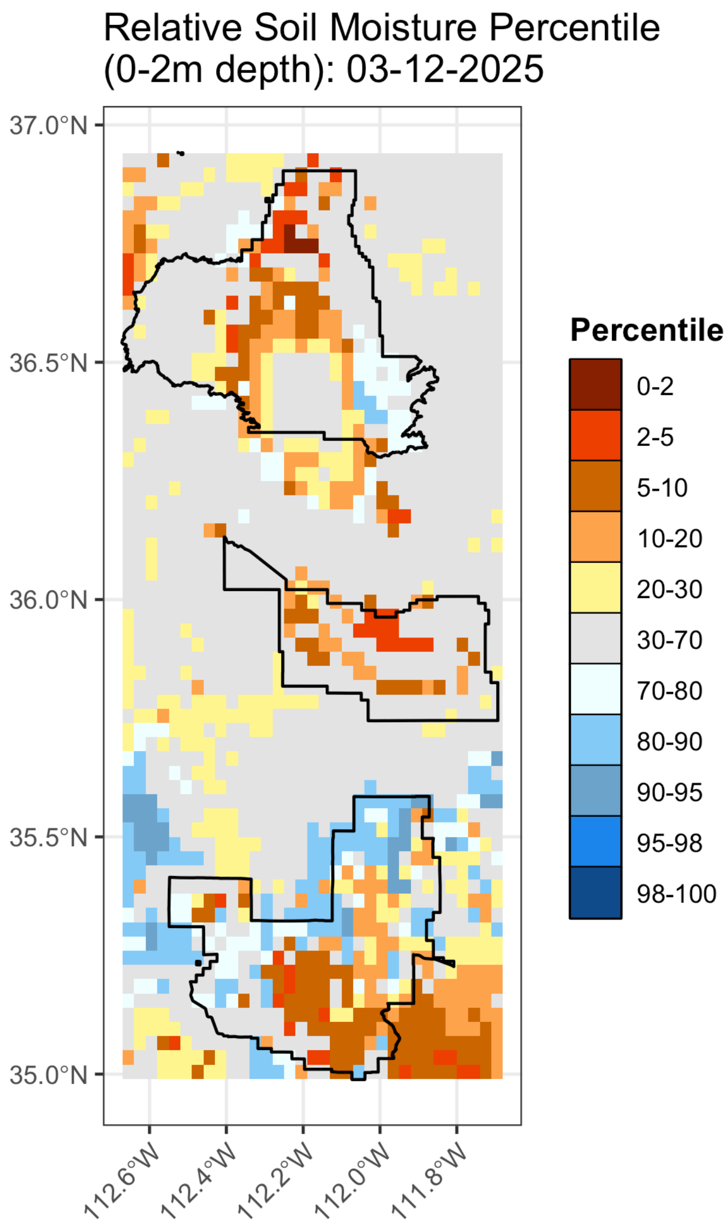


Figure 5: Integrated surface to 2 meter deep relative soil moisture estimate for the Kaibab National Forest.

Climatology and Trends

This section shows local climatology and trends for the Kaibab National Forest. Evaluating local climatology is important for accurately defining an area's season lengths and understanding how local climate has changed over time. By observing historical monthly average precipitation and temperature, along with long-term trend analysis, an area's season lengths can be more accurately determined outside of traditional definitions. These more climatologically-aligned seasons can be used to better summarize climate statistics and portray season-to-season changes. Using this methodology can help land managers more effectively manage resources, aid decision making, and be better prepared for extreme weather events.

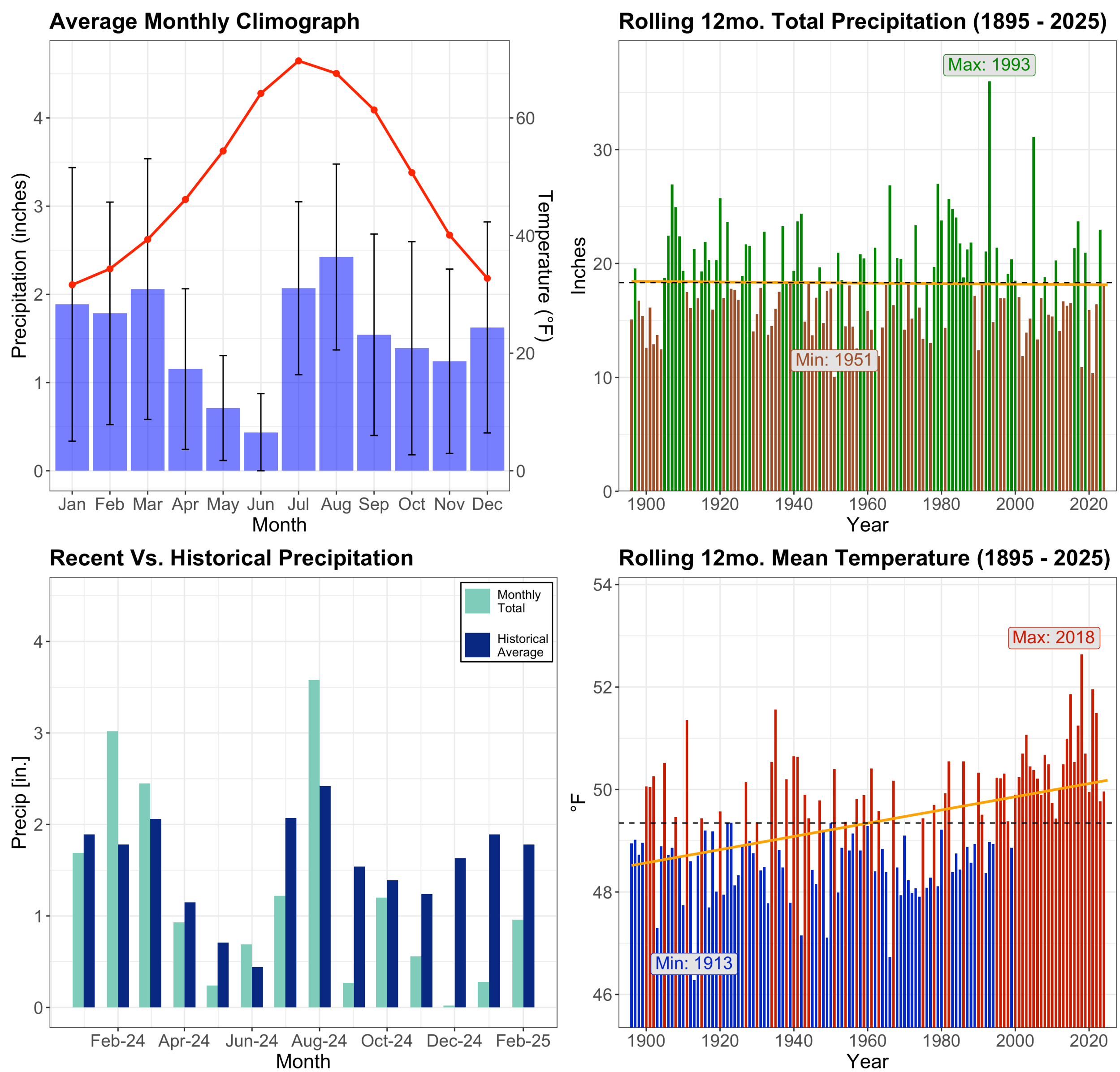


Figure 6: [Top-Left] Local climograph showing monthly average precipitation and temperature **(1895 – 2025)**. Precipitation error bars represent the range of 1 standard deviation based on the full historical record of data for each month. [Bottom-Left] Previous 12-month precipitation totals compared to the monthly average. 12-month rolling total precipitation [Top-Right] and mean temperature [Bottom-Right] from the previous **12-months (March - February) from 1895 - 2025**. The long-term trend line (yellow), and minimum and maximum years are highlighted.

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 1: 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.

Report Information

- This report was generated on 2025-03-12 .
- Past reports can be found at: https://cales.arizona.edu/climatereports/

Contact information

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https://cals.arizona.edu/climate

Appendix A

This appendix contains additional climate statistics for District's within the Kaibab National Forest.

Table 2: Current Drought Conditions

District	Minimum SPI	Mean SPI	Maximum SPI	Total Precip [in.]	Anomaly [in.]
Tusayan	-2.24	-1.7	-0.83	2.35	-3.53
Williams	-2.69	-1.97	-1.34	2.91	-6.07
North Kaibab	-2.22	-1.75	-1.24	3.44	-4.61

Note:

Kaibab National ForestSPI and climate statistics for Winter 2025 (October-February). Statistics are calculated based on the average of all PRISM grid cells lying within a District boundary.

Table 3: District-level Seasonal SPI and Climate Statistics

District	2025 Winter SPI*	2024 Summer SPI	2024 Spring SPI	12mo. SPI	2025 Winter Precip [in.]*	2024 Summer Precip [in.]	2024 Spring Precip [in.]	12mo. Precip [in.]	12mo. Precip Anom [in.]
Tusayan	-1.7	0.12	0.21	-0.93	2.35	6.36	3.10	11.81	-3.49
Williams	-1.97	-0.30	0.21	-1.48	2.91	6.65	3.99	13.55	-6.96
North Kaibab	-1.75	-0.43	-0.22	-1.68	3.44	4.70	3.57	11.70	-6.26

Note:

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

Appendix B

This appendix contains additional 12-month SPI information for the Kaibab National Forest.

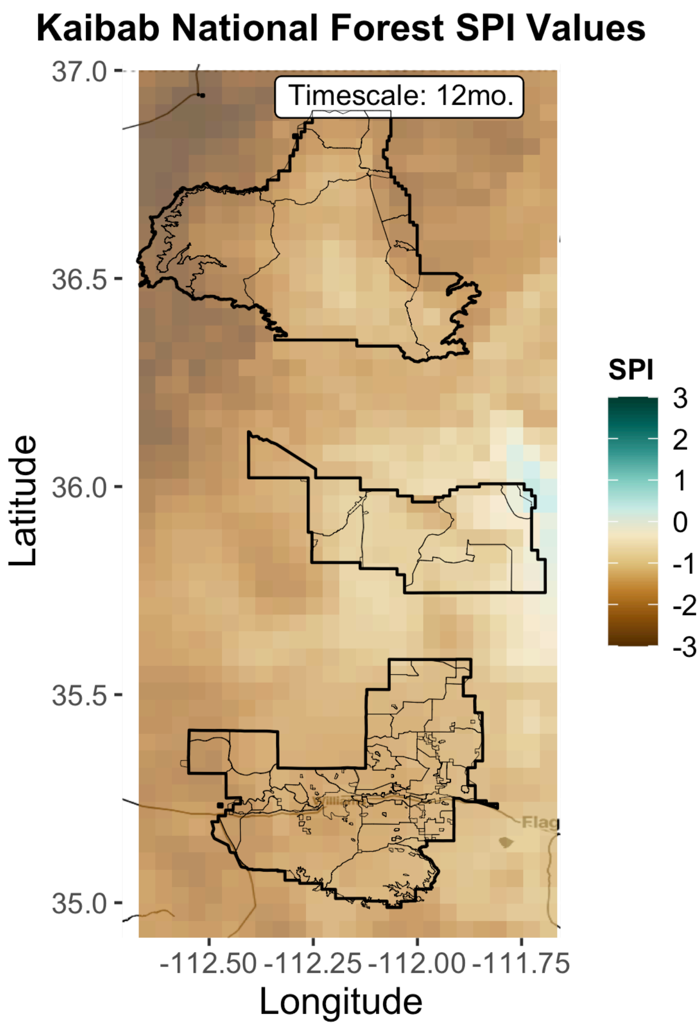

Figure 7: Map of 12-month SPI values for the Kaibab National Forest.