Future of Drought in the U.S: View from the Southwest

Public Information Gathering Session
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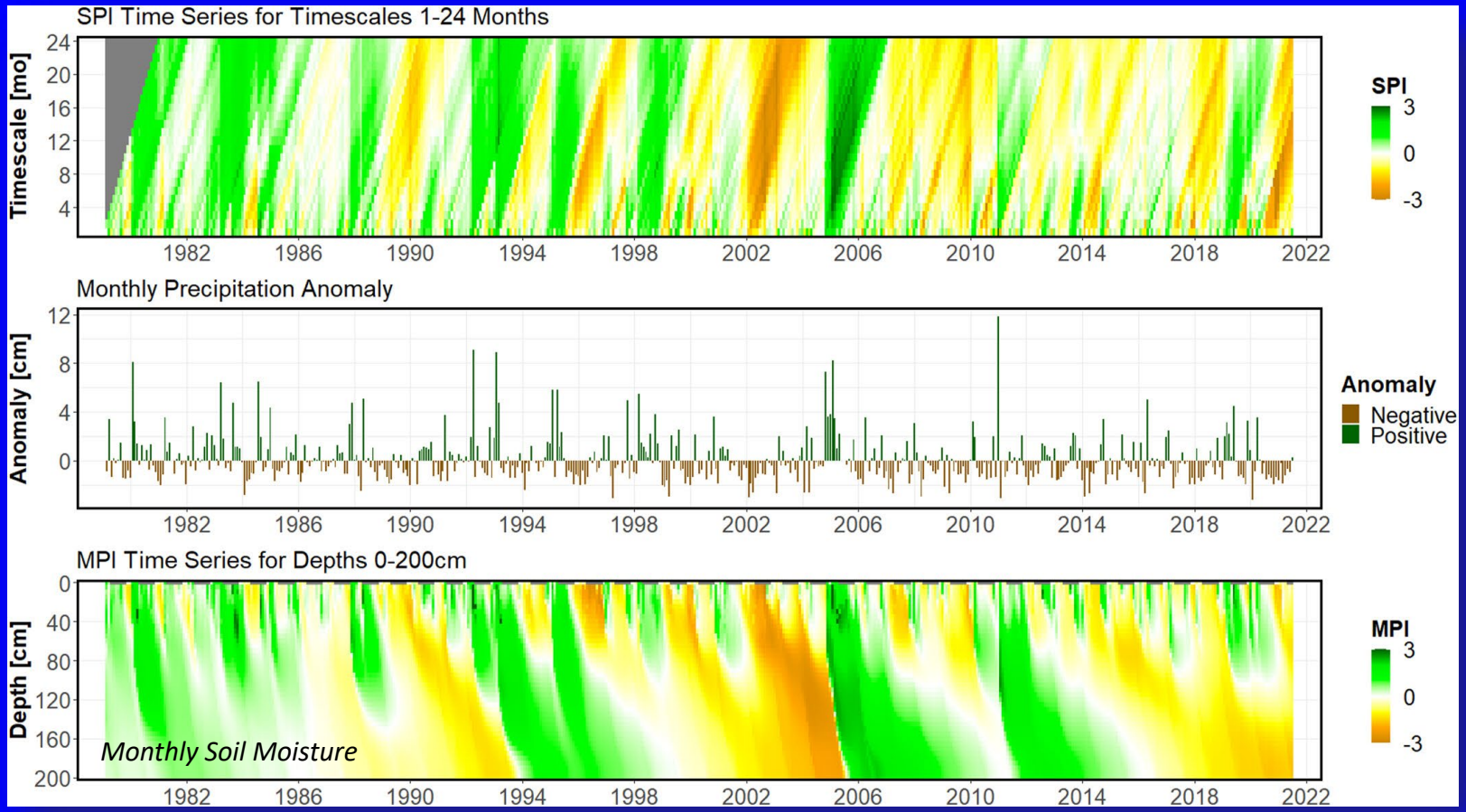
Who We Serve and What We Provide

- My extension program (climate science) and connection with Climate Assessment for the Southwest (NOAA-CAP) focuses on supporting land management
  - Ranching and livestock production
  - Federal/State/Local/Tribal agency land management (Range, Wildfire, Invasive Species, Wildlife…)
- Applied research, assessment, training, outreach and tool development in support of better weather and climate services
- Climatic context: *Arid to semi-arid climate, water limited ecosystems, precipitation seasonality*
- https://cales.arizona.edu/climate/ and https://climas.arizona.edu/

Do Our Products Reflect Local Drought Conditions?

- Widespread use and comfort in using gridded climate products and drought indices (e.g. Westwide Drought Tracker and Standardized Precipitation Index (SPI))
- Challenge in choosing, interpreting and applying different drought indices and timescales for management decisions



Conceptual figure demonstrating the alignment of linear Standardized Precipitation Index (SPI) timescales (top) with non-linear depths of the matric potential index (MPI) (bottom) for a loam soil (example from model run 121 of 240; Major Land Resource Area 30).

McKellar, T., M.A. Crimmins, M. Schaap and C. Rasmussen. 2023. Defining the Multiscalar Index Timescale – Soil Water Depth Continuum for the Southwestern United States. Journal of Geophysical Research – Atmospheres. http://doi.org/10.1029/2023JD039348.

Meeting Managers where they Work – Custom Climate Reports

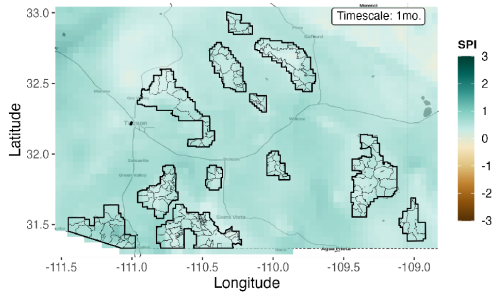
- Reports co-developed with USFS land managers
- Custom management season definitions for each land management unit
- Monthly PRISM Temp and Precip from RCC-ACIS
- Quasi-automated report generation, email lists for all National Forests in AZ and NM
- Evaluating additional products to add based on feedback (remote sensing products, wildfire…)

Coronado National Forest Climate Report: June 2025

Highlights

- The current average 1-month (June) Standardized Precipitation Index (SPI) for Coronado National Forest is **0.64** (Near Normal).
- Average June precipitation was 0.81 inches, which was **+0.21 inches** different from the long-term average. This value ranks 42nd out of 131 years in total precipitation (Rank 1 is the wettest year).
- Average June temperature was 76.8 degrees F, which was **+3.4 degrees F** different from the long-term average. This value ranks 13th out of 131 years in average temperature (Rank 1 is the warmest year).
- The 1-month outlook for July predicts a **40-50% chance of wetter-than-average precipitation** and a **33-40% chance of warmer-than-average temperatures**. The 3-month seasonal outlook for July-September predicts **equal chances of above, below or normal precipitation** and a **40-50% chance of warmer-than-average temperatures**. (More information at NOAA Climate Prediction Center, https://www.cpc.ncep.noaa.gov/)

Current Summer SPI Values

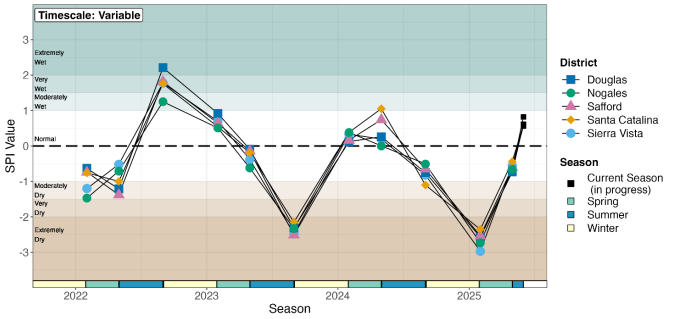


	Coronado National Forest	Sierra Vista	Douglas	Safford	Santa Catalina	Nogales
Total Precip [in.]	0.81	0.87	0.93	0.64	0.58	0.94
Precip Anom [in.]	0.21	0.18	0.22	0.12	0.14	0.36
Temp Anom [F]	3.38	3.38	3.44	3.86	2.59	3.38
Summer SPI [1mo.]	0.64	0.59	0.61	0.56	0.6	0.82
% Area in Moderate Drought	0	0	0	0	0	0

Figure 1: [Left] Coronado National Forest Standardized Precipitation Index (SPI) values for **Summer 2025 (June 1mo. timescale)**. [Right] Table summarizing climate statistics for **Summer 2025 (June - June).** Note: Season in progress - partial statistics being reported.

Seasonal Progression Summary

This section contains seasonal drought information for the Coronado National Forest. Season lengths are based on historical climatology and typical land management schedules (see *Climatology and Trends* section). **Season lengths for the Coronado 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. Summer 2025 values are currently summarized from Jun-Jun.



	Total Precip [in.]	Precip Anom [in.]	SPI	% Area in Mod Drought	Mean Temp [F]	Temp Anom [F]	SPEI
Fall							
Winter	1.04	-5.87	-2.64	100	53.1	4.3	-1.94
Spring	0.98	-1.05	-0.61	3.1	58.5	1.6	0.16
Summer*	0.81	0.21	0.64	0	76.8	3.4	0.65
12mo	9.88	-9.68	-2.26	100	62.3	3.5	-1.31

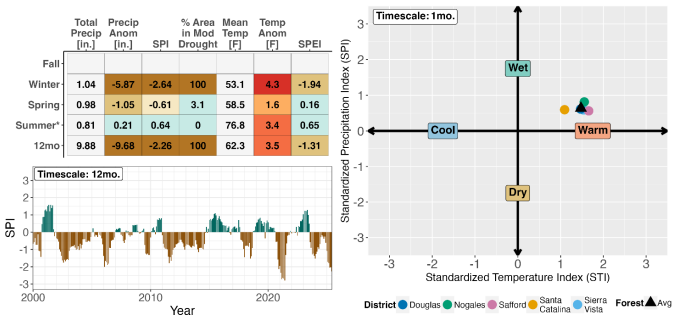
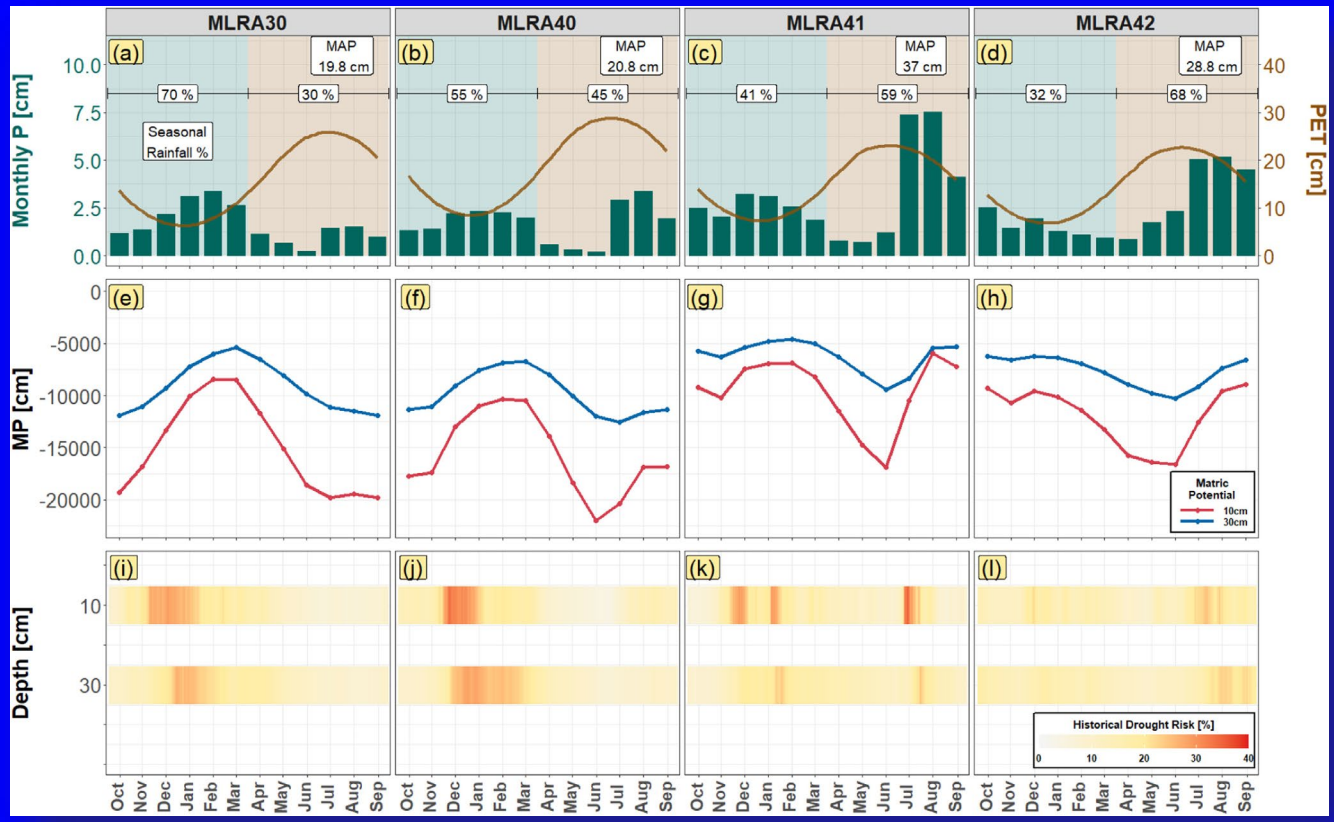


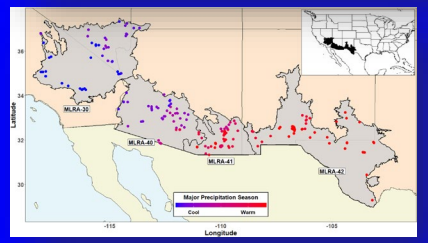
Figure 2: [Top] Variable-timescale seasonal SPI time series from **2022-2025.** Displayed values represent the final SPI value for each season at a timescale equal to the defined season length. [Center-Left] Seasonal and 12-month climate statistics. Asterisk indicates current season. [Bottom-Left] 12mo.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

https://cales.arizona.edu/climatereports/

Non-stationarity and drought monitoring in SW US

- Land management decisions are tied to multiple timescales of drought – challenge in matching timescales to decisions (weeks to months vs seasons to years)
- Water limited system makes it challenging to discern the impacts of shifts in temp, ET and timing of precipitation – looking at soil moisture as an integrating variable
- Actively evaluating how best to connect SPI and SPEI (Precip-ET) timescales to management decisions, ecosystem responses (e.g. rangeland condition)





Climatology of MLRA modeling sites, including seasonal rainfall percentages (a-d); historical monthly mean matric potential values at 10 cm and 30 cm (e-h); and the historical drought risk percentage during each DOY (i-l).

McKellar, T. T., and M. A. Crimmins, 2025: Seasonal precipitation variability controls shallow soil water drought events across the southwestern United States. Agricultural and Forest Meteorology, 363, 110403, https://doi.org/10.1016/j.agrformet.2025.110403.

Tools and Resources

- SPI Explorer Tool (https://uaclimateextension.shinyapps.io/SPItool/)
- SDI Visualization Tool (https://uaclimateextension.shinyapps.io/SDIViz/)
- AZ Station-based Drought Tracker (https://cales.arizona.edu/climate/AZdrought/)
- Multiscale SPI Time Series Plots (https://cales.arizona.edu/climate/misc/spi/spi_contour.html)
- Climate Reports for Natural Resource Management and Planning (https://cales.arizona.edu/climatereports/)
- UA Climate Science Applications Program (https://cales.arizona.edu/climate/)