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September Southwest Climate Outlook

Monthly Precipitation and Temperature: August precipitation was much below average in most of Arizona, while most of New Mexico ranged from above average to much below average, and both states saw small pockets of record driest conditions (Fig. 1a). August temperatures were much above average to record warmest in Arizona and New Mexico (Fig. 1b). The daily average temperature anomalies for Aug 1 – Sep 17 highlight the fluctuations at select stations around the region (Fig. 2).

Seasonal Precipitation and Temperature: Total precipitation for the last three months (June-August) was below average to record driest in Arizona, with a wide range of above and below average totals in New Mexico (Fig. 3a). Mean temperatures for the same three-month period were above average to much above average across the region (Fig. 3b).

Drought: Water year precipitation to date includes wetter than normal winter conditions, and only pockets of Arizona, and much of western and southern New Mexico recorded below normal precipitation in the Southwest (Fig. 4). The recent downturn in precipitation activity is reflected in the Sept 10 U.S. Drought Monitor (USDM), which has seen a return of widespread drought designations in Arizona and western New Mexico (Fig. 5).

Water Supply: Most of the reservoirs in the region are at or above the values recorded at this time last year, but most also remain below their long-term average (see reservoir storage on p. 7). There have been improvements over the last year, but concerns remain about the recent below average precipitation, along with the accumulated water resource deficits associated with multiple years of drought.

Wildfire, Health, and Safety: The National Interagency Fire Center outlooks for September, October, and November all call for average fire risk across the region. With the declining monsoon activity and cooling temperatures, the Southwest should be on the wane for fire activity. Current seasonal statistics for wildfire acres burned show that lightning and human caused fires are above median in Arizona, and below median in New Mexico (Fig. 6).

ENSO Tracker: Oceanic and atmospheric conditions are generally consistent with an ENSO-neutral outlook for 2019 and into 2020 (see ENSO-tracker on p. 3 for details).

Precipitation and Temperature Forecast: The three-month outlook for October through December calls for increased chances of above-normal precipitation in much of New Mexico, eastern Arizona, and north Texas, while equal chances of above- or below-normal precipitation are prominent in western Arizona, west Texas, and most of northern Mexico (Fig. 7, top). The three-month temperature outlook calls for increased chances of above-normal temperatures across the U.S. Southwest and northern Mexico (Fig. 7, bottom).

Tweet Sept 2019 SW Climate Outlook

SEP2019 @CLIMAS_UA SW Climate Outlook, Monsoon Tracker, ENSO Tracker, AZ & NM Reservoir volumes, bit.ly/2kqJMnX #SWclimate #AZWX #NMWX

September 2019 SW Climate Outlook

Online Resources

Figure 1
National Centers for Environmental Information
ncei.noaa.gov

Figures 2,6
Climate Assessment for the Southwest
climas.arizona.edu

Figures 3,4
Western Regional Climate Center
wrcc.dri.edu

Figure 5
U.S. Drought Monitor
droughtmonitor.unl.edu

Figure 7
International Research Institute for Climate and Society
iri.columbia.edu

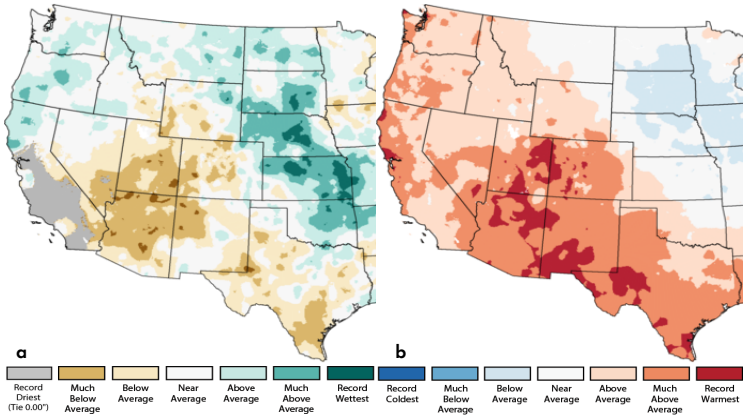


Figure 1: Aug 2019 Precipitation (a) & Temperature Ranks (b)

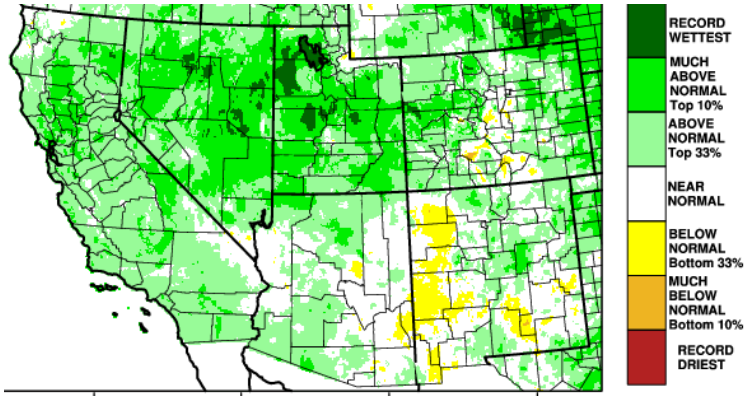


Figure 4: Oct 2018 - Aug 2019 - Precipitation Percentile Ranking

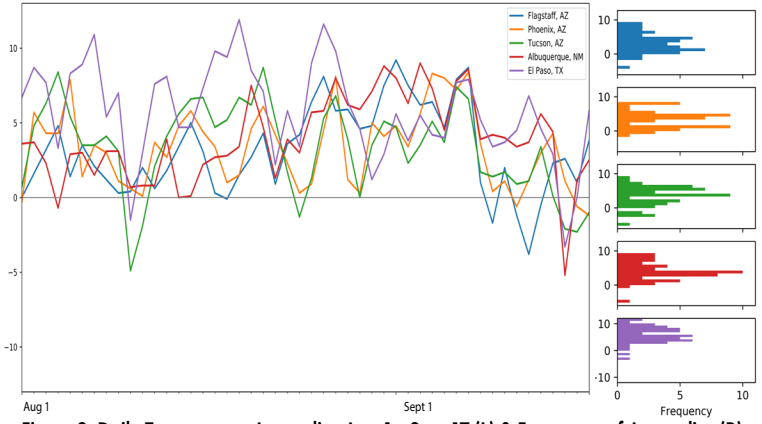


Figure 2: Daily Temperature Anomalies Aug 1 - Sept 17 (L) & Frequency of Anomalies (R)

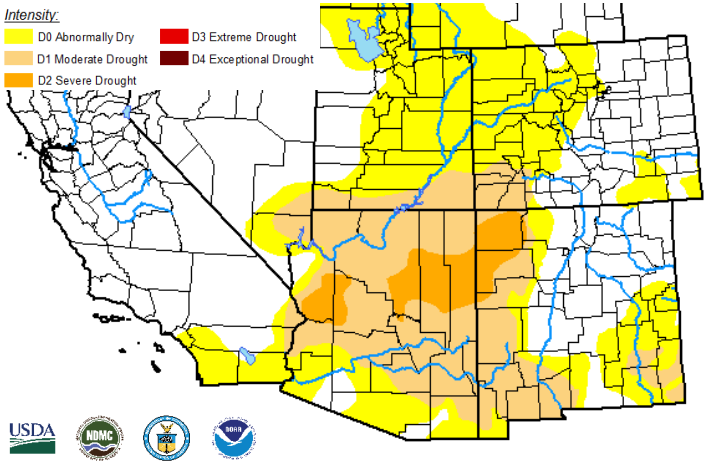


Figure 5: US Drought Monitor - Sep 10, 2019

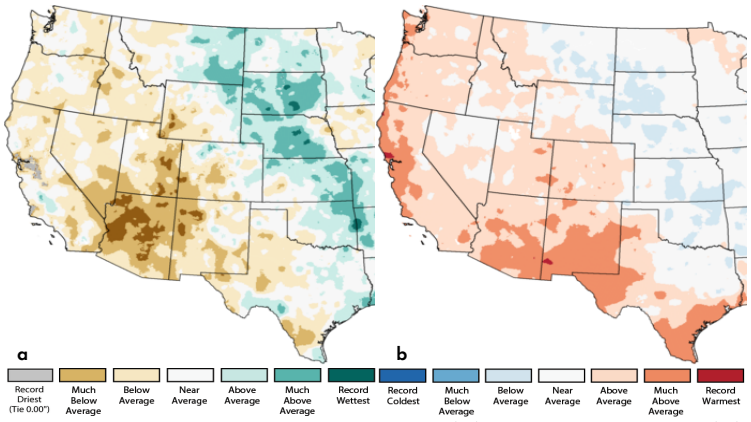


Figure 3: June-July-Aug 2019 Precipitation (a) & Temperature Ranks (b)

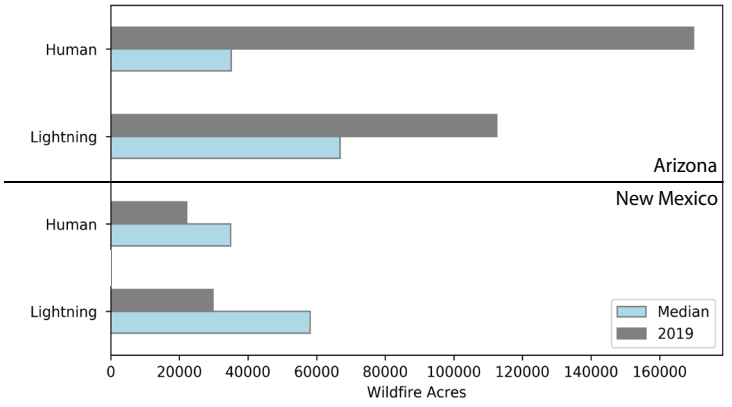


Figure 6: Wildfire Acres Burned to Date

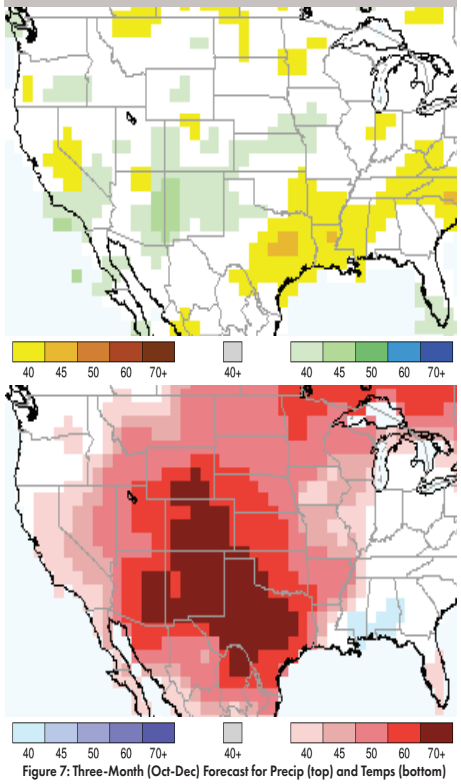


Figure 7: Three-Month (Oct-Dec) Forecast for Precip (top) and Temps (bottom)

Online Resources

Figure 1
Australian Bureau of Meteorology
bom.gov.au/climate/enso

Figure 2
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

Figure 3
International Research Institute for Climate and Society
iri.columbia.edu

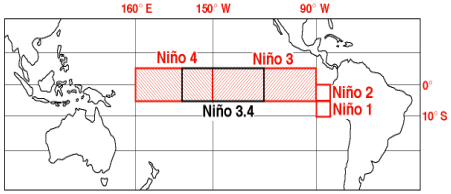
Figure 4
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

El Niño / La Niña

Information on this page is also found on the CLIMAS website:

climas.arizona.edu/sw-climate/el-niño-southern-oscillation

Equatorial Niño Regions



For more information: ncdc.noaa.gov/teleconnections/enso/indicators/sst/

Image source: aoml.noaa.gov/

ENSO Tracker

Forecast Roundup: Seasonal outlooks and forecasts based on sea surface temperature (SST) anomalies (Figs. 1-2) and other oceanic and atmospheric indicators all point towards ENSO-neutral conditions lasting through 2019 and into 2020. On Sep 10, the Japanese Meteorological Agency (JMA) highlighted dissipating warmer-than-normal SSTs and maintained their call for a 60-percent chance of ENSO-neutral conditions to continue until winter 2019-2020. On Sep 12, the NOAA Climate Prediction Center (CPC) issued their ENSO diagnostic discussion, which focused on neutral conditions across the oceans and atmosphere. They called for a 75-percent chance of ENSO-neutral conditions persisting through fall 2019. On Sep 12, the International Research Institute (IRI) issued an ENSO Quick Look (Fig. 3), emphasizing neutral conditions in both oceanic and atmospheric ENSO indicators. Their models see ENSO-neutral as the most likely outcome, but with "slightly higher chances for El Niño than La Niña". On Sep 17, the Australian Bureau of Meteorology maintained their ENSO Outlook at 'inactive' with most oceanic and atmospheric conditions in the range of neutral. The North American Multi-Model Ensemble (NMME) is within the range of ENSO-neutral and is forecast to remain neutral through 2019, with more variability and uncertainty into 2020 (Fig. 4).

Summary & Outlook: ENSO-neutral remains the most likely outcome for 2019 extending into winter 2020. Oceanic and atmospheric conditions returned to within the range of ENSO-neutral, and the ENSO outlooks generally reflect these conditions. In terms of the Southwest, seasonal outlooks had been calling for above average precipitation in late summer and early fall, presumably linked to the increased chance of enhanced tropical storm activity in the eastern pacific associated with El Niño. With a return to ENSO-neutral, the role that El Niño might play in enhancing those pacific tropical storms is no longer in play, but warmer and (mostly) wetter than normal conditions remain in the seasonal outlooks thus far (see Fig. 7 on p. 2). Despite El Niño's decline to ENSO-neutral, tropical storm activity has picked up in the eastern Pacific Ocean. At the time of this writing, two named storms (TS Lorena and TS Mario), depending on their eventual storm track, are poised to help direct moisture into the Southwest. This could amplify precipitation activity even as the monsoon is on the wane and might even help make up some of the accumulated precipitation deficit of a mostly below average monsoon.

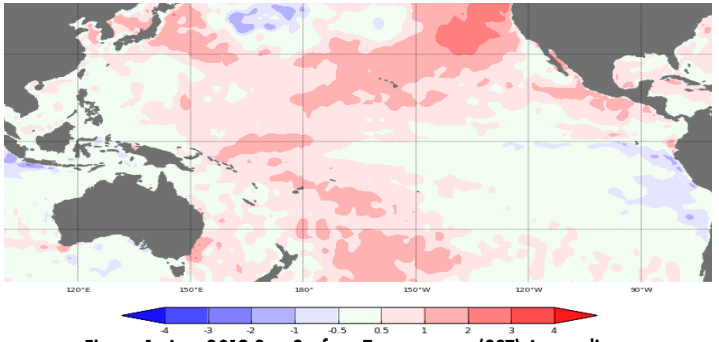


Figure 1: Aug 2019 Sea Surface Temperature (SST) Anomalies

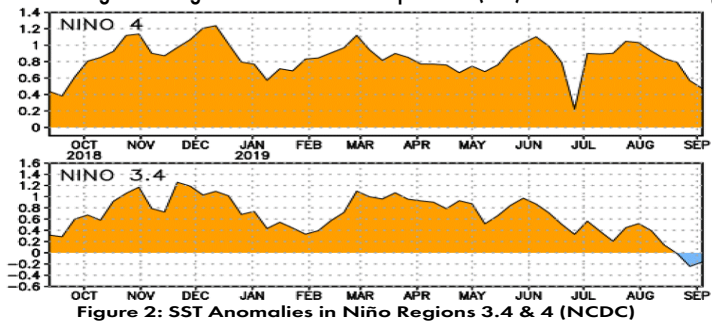


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

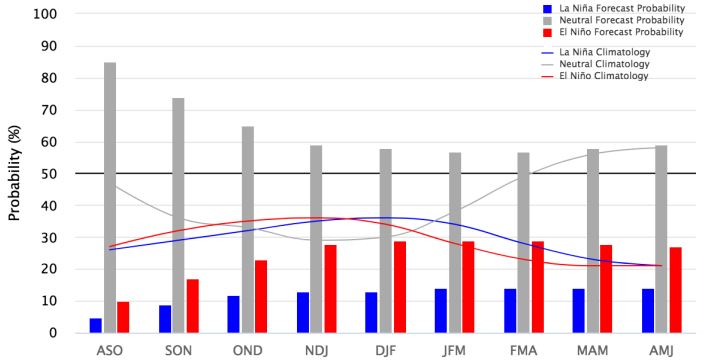


Figure 3: Early-Sep IRI/CPC Model-Based Probabilistic ENSO Forecast

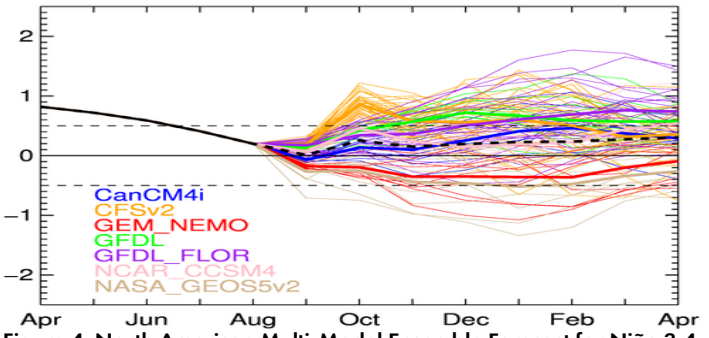


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

Figures 1-2
Climate Assessment for the Southwest
climas.arizona.edu

Southwest Climate Podcast

Aug 2019 - Tracking The Nonsoon - Nobody Really Wins

In the full August 2019 edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido deconstruct the monsoon to-date, including recent history, what the forecasts and outlooks have to say, and what this means for the monsoon fantasy game.

Monsoon MiniPod - Rogue Storm Late Start Edition

In the this "mini" episode - Mike Crimmins and Zack Guido deconstruct the relative lack of monsoon activity across much of the region, as well as a few places that are receiving more precipitation than expected. They recap some of the totals through Aug 7 and dive into the mechanics that have been driving this (relative lack of) activity. They also check the 1-2 week forecasts to see whether there is any hope for recovery in the latter half of the monsoon.
climas.arizona.edu/media/podcasts

Monsoon Tracker

Single weather stations are an imperfect measure of monsoon spatial variability, but they do provide an opportunity to track long term averages compared to the current year. Figure 1 compares 2019 precipitation to date with 2018 and climatology. This reveals 2019 is lagging behind average in terms of precipitation and is also a significant departure from 2018's widespread activity that continued into September.

Plots of daily average and dewpoint temperatures, along with daily precipitation (Fig. 2) illustrate that while increased dewpoint temperatures do not guarantee monsoon precipitation, it is rare to see monsoon precipitation in the absence of these elevated dewpoint temperatures.

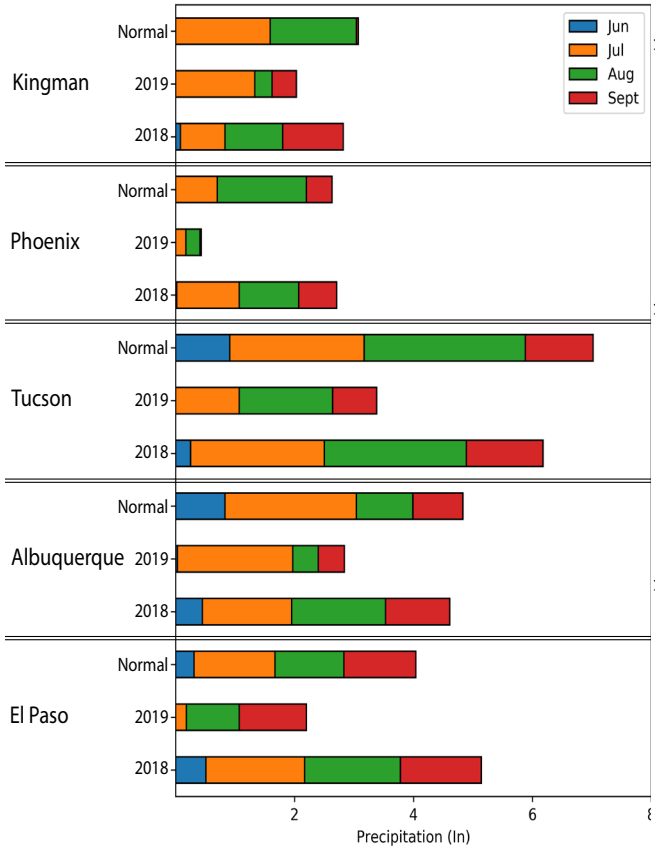


Figure 1: Monthly Monsoon Precipitation Totals - 2018, 2019 & Average

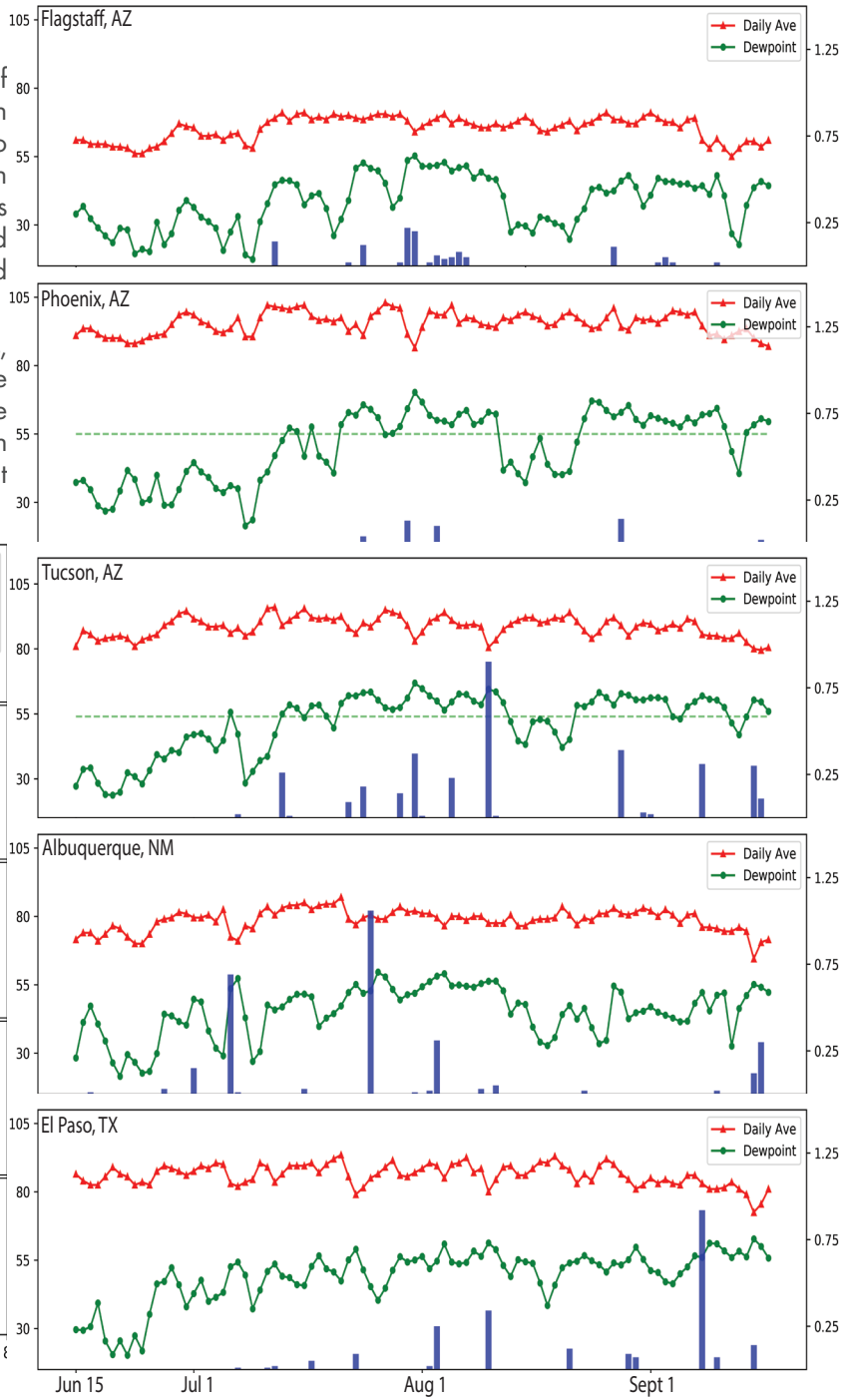


Figure 2: Average Dewpoint & Daily Temperature, Daily Precipitation - Jun 15 - Sept 17 2019

Online Resources

Figures 3-5
Climate Science Applications Program
cals.arizona.edu/climate/misc/SWMonsoonMaps/current/swus_monsoon.html

Contact Mike Crimmins with questions and/or suggestions on how to improve these plots, or ideas for additional variables

* The Southwest U.S. Monsoon Technical Summaries contain a wealth of information about different locations across the Southwest, including current vs. average accumulated precipitation, seasonal midpoints, and analog years. cals.arizona.edu/climate/misc/monsoon/monsoon_summaries.html

Monsoon Tracker (cont.)

Total monsoon precipitation (Fig. 3) is variable in the Southwest, with much of the region lagging behind average through mid-September (Fig. 4). Percent of days with rain highlight areas with more (or less) regular rainfall events (Fig. 5). 2019 is shaping up to be one of the drier monsoons for much of the region, and some locations may be in the running for driest monsoon on record. A late September tropical storm could boost precipitation totals, but time is quickly running out.

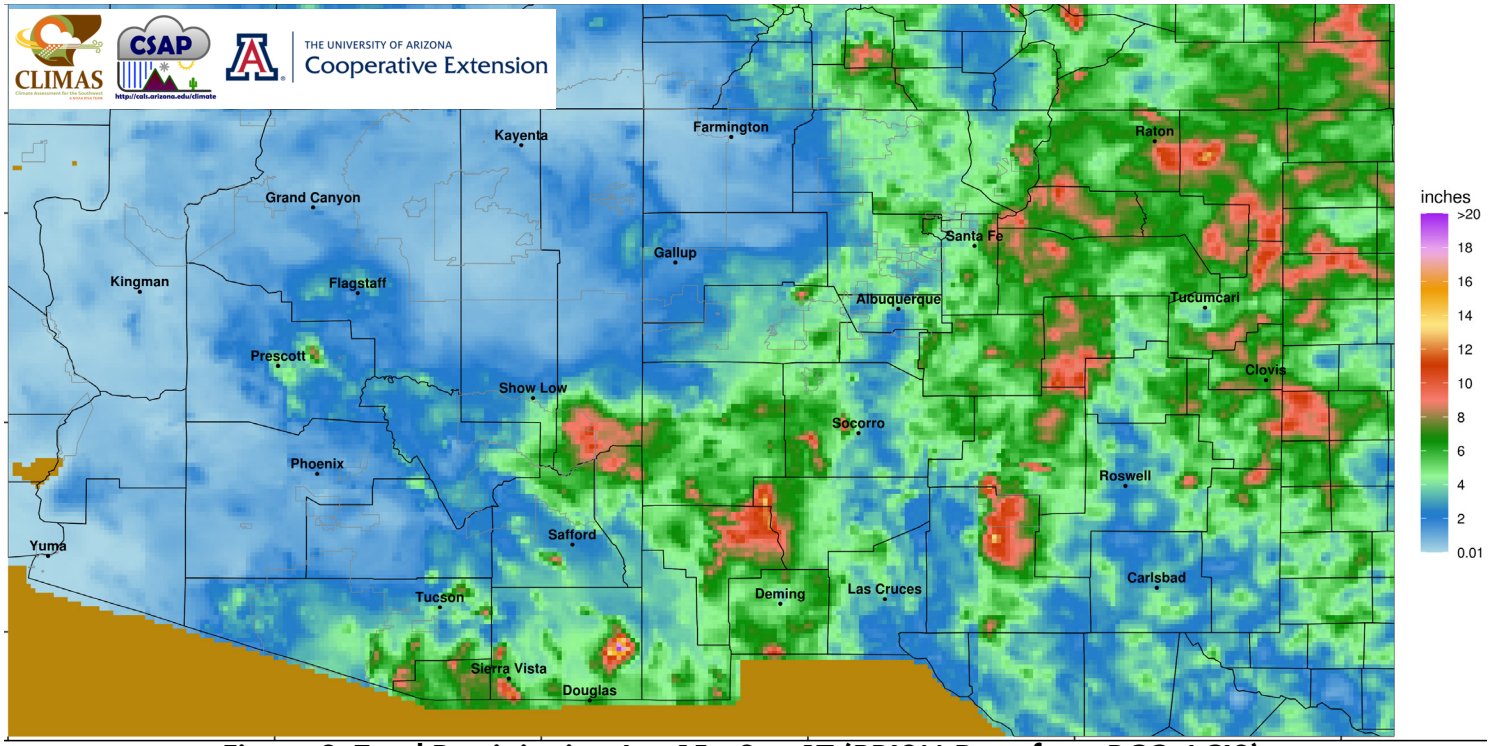


Figure 3: Total Precipitation Jun 15 - Sep 17 (PRISM Data from RCC-ACIS)

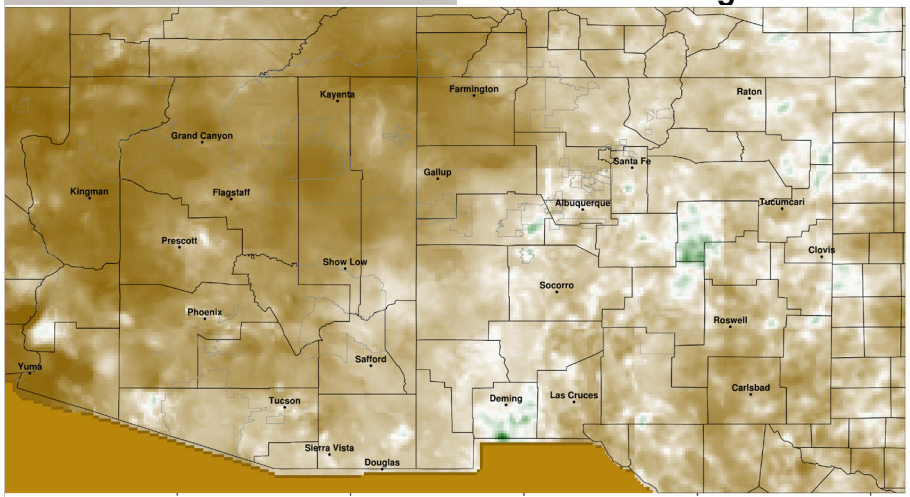


Figure 4: Precipitation percent of Normal Jun 15 - Sept 17 (PRISM Data from RCC-ACIS)

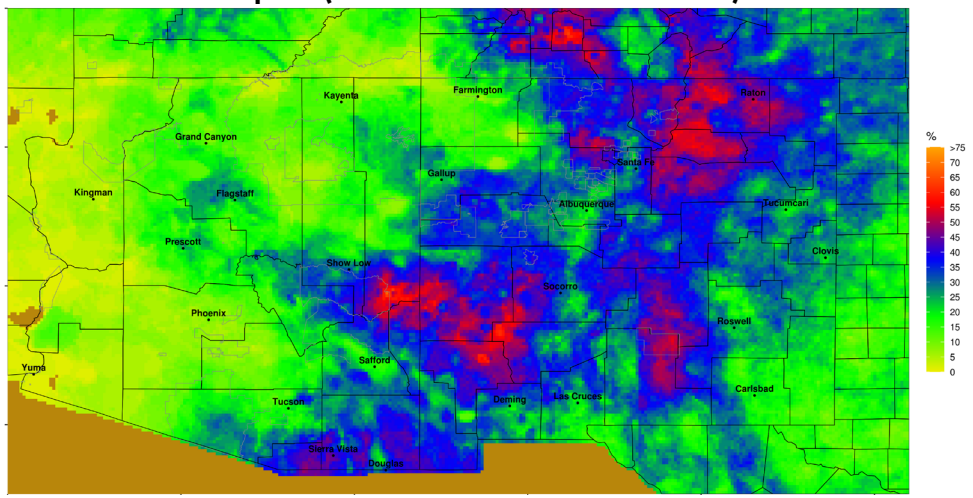


Figure 5: Percent of days with rain Jun 15 - Sept 17 (PRISM Data from RCC-ACIS)

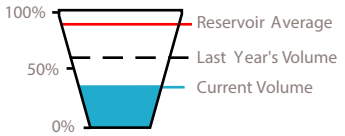
Online Resources

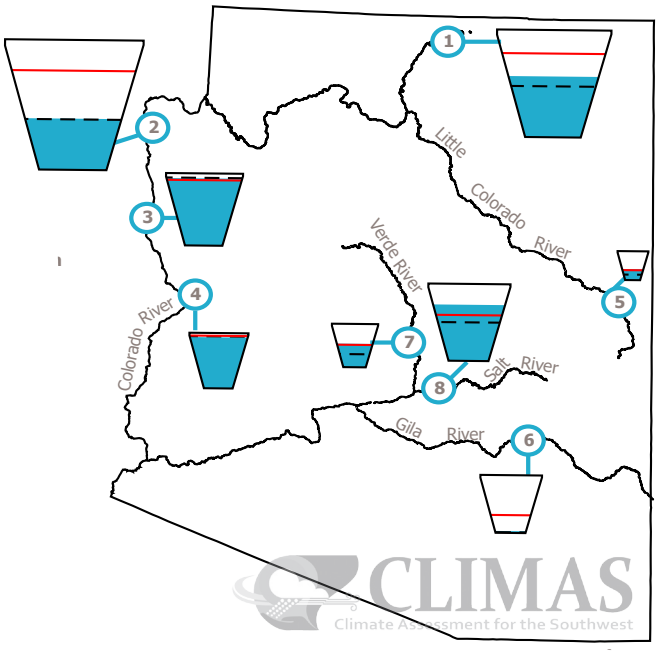
Portions of the information provided in this figure is available at the Natural Resources Conservation Service
www.wcc.nrcs.usda.gov/BOR/basin.html

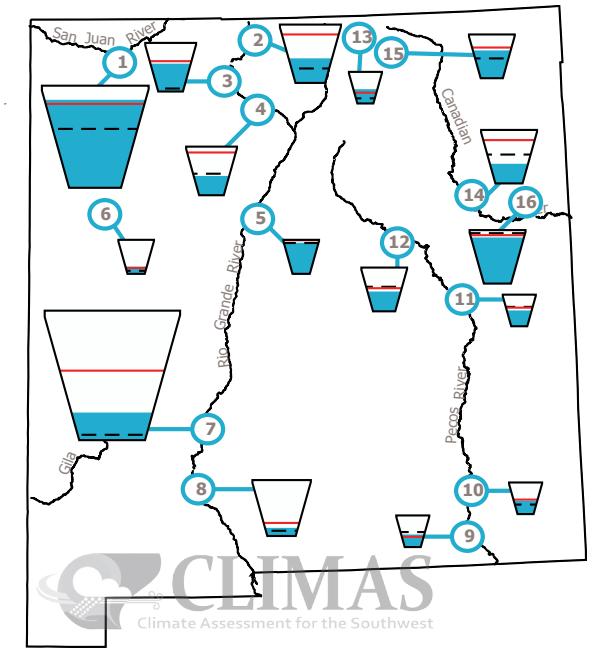
Contact Ben McMahan with questions/comments.

Reservoir Volumes

DATA THROUGH SEPT 1, 2019
Data Source: National Water and Climate Center, Natural Resources Conservation Service







* in KAF = thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Lake Powell	56%	13,610.2	24,322.0	-323.3
2. Lake Mead	39%	10,304.0	26,159.0	59.0
3. Lake Mohave	93%	1,678.0	1,810.0	-33.0
4. Lake Havasu	92%	567.9	619.0	-17.0
5. Lyman	38%	11.5	30.0	-1.9
6. San Carlos	3%	27.9	875.0	-31.4
7. Verde River System	54%	156.3	287.4	-5.2
8. Salt River System	72%	1,454.5	2,025.8	-74.0

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	86%	1458.5	1,696.0	-72.0
2. Heron	42%	168.7	400.0	-24.3
3. El Vado	57%	108.5	190.3	5.8
4. Abiquiu	39%	71.9	186.8	13.8
5. Cochiti	91%	45.6	50.0	-1.0
6. Bluewater	21%	7.9	38.5	-0.8
7. Elephant Butte	21%	458.9	2,195.0	-84.3
8. Caballo	14%	47.6	332.0	6.2
9. Lake Avalon	40%	1.8	4.5	0.1
10. Brantley	42%	17.9	42.2	-12.8
11. Sumner	50%	17.8	35.9	-3.9
12. Santa Rosa	45%	47.3	105.9	-0.2
13. Costilla	45%	7.2	16.0	-1.8
14. Conchas	37%	94.8	254.2	-16.0
15. Eagle Nest	63%*	50.0	79.0	*
16. Ute Reservoir	86%	175	200	-4.0

The map gives a representation of current storage for reservoirs in Arizona and New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage (blue fill) as a percent of total capacity. Note that while the size of each cup varies with the size of the reservoir, these are representational and not to scale. Each cup also represents last year's storage (dotted line) and the 1981–2010 reservoir average (red line).

The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of four people for a year. The last column of the table lists an increase or decrease in storage since last month. A line indicates no change.

These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Online Resources

Figure 1
Climate Program Office
cpo.noaa.gov

RISA Program Homepage
cpo.noaa.gov/Meet-the-Divisions/Climate-and-Societal-Interactions/RISA

UA Institute of the Environment
environment.arizona.edu

New Mexico Climate Center
weather.nmsu.edu

CLIMAS Research & Activities

CLIMAS Research
climas.arizona.edu/research

CLIMAS Outreach
climas.arizona.edu/outreach

Climate Services
climas.arizona.edu/climate-services

CLIMAS
Climate Assessment for the Southwest
A NOAA RISA TEAM

The Climate Assessment for the Southwest (CLIMAS) program was established in 1998 as part of the National Oceanic and Atmospheric Administration's Regional Integrated Sciences and Assessments program. CLIMAS—housed at the University of Arizona's (UA) Institute of the Environment—is a collaboration between UA and New Mexico State University. The CLIMAS team is made up of experts from a variety of social, physical, and natural sciences who work with partners across the Southwest to develop sustainable answers to regional climate challenges

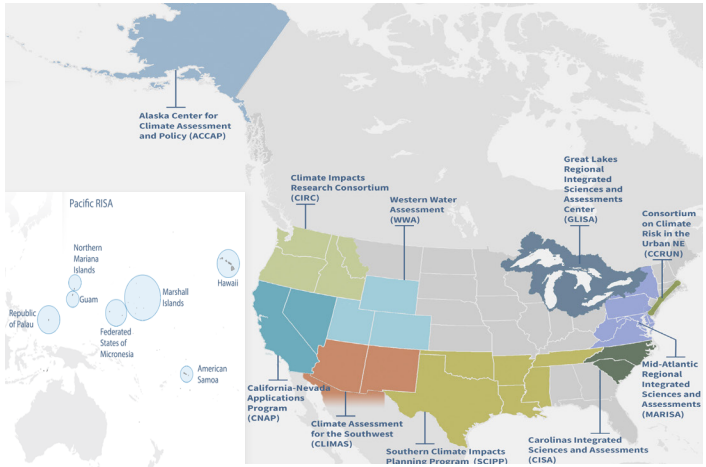


Figure 1: NOAA Regional Integrated Sciences and Assessments Regions

What does CLIMAS do?

The CLIMAS team and its partners work to improve the ability of the region's social and ecological systems to respond to and thrive in a variable and changing climate. The program promotes collaborative research involving scientists, decision makers, resource managers and users, educators, and others who need more and better information about climate and its impacts. Current CLIMAS work falls into six closely related areas: 1) decision-relevant questions about the physical climate of the region; 2) planning for regional water sustainability in the face of persistent drought and warming; 3) the effects of climate on human health; 4) economic trade-offs and opportunities that arise from the impacts of climate on water security in a warming and drying Southwest; 5) building adaptive capacity in socially vulnerable populations; and 6) regional climate service options to support communities working to adapt to climate change.

2020 CLIMAS Environment & Society Graduate Fellows

Applications Due: Thursday, October 17, 2019

The Climate Assessment for the Southwest (CLIMAS) program is currently accepting applications for the 2020 Environment & Society Graduate Fellows Program. This fellowship supports currently enrolled University of Arizona graduate students from any degree-granting program whose work is focused on the nexus of environmental research and decision making. Up to four fellowships in the amount of $4,750 each will be awarded for projects occurring between January–December 2020. The Environment & Society Fellows Program is made possible by the University of Arizona Office of Research, Development, & Innovation and CLIMAS.

The Environment & Society Fellowship provides an opportunity for graduate students to develop their knowledge, training, and experience in applied environmental science and outreach. Projects should incorporate a use-inspired research approach meaning that the project meets a need expressed by a stakeholder (an organization, community, or person affected by your research outcomes). Competitive proposals will include a component of stakeholder engagement or collaboration. Projects can fall under one or more of the following categories: scoping research, dissertation/thesis work, a discrete 1-year project, outreach, and/or network building.

For more information and to apply:

climas.arizona.edu/content/environment-society-graduate-fellows-program