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July Southwest Climate Outlook

Precipitation and Temperature: June precipitation ranged from record driest to near average in Arizona, while in New Mexico, precipitation ranged from much-below to much-above average (Fig. 1a). This difference reflects the seasonal progression of monsoon activity in the Southwest—it typically starts earlier in New Mexico and progresses westward—as well as the relatively late start to monsoon activity observed in much of Arizona this year. June temperatures ranged from much-above average to record warmest in Arizona and from above average to much-above average in New Mexico (Fig. 1b). A region-wide heat wave that struck in mid-to-late June helped drag up the averages, setting a number of daily high records across Arizona. Year-to-date precipitation ranks reveal average to above-average precipitation in all of New Mexico and much of Arizona, with a pocket of below-average precipitation in southeast Arizona (Fig. 2a). Year-to-date temperatures reveal much-above-average to record-warmest conditions in both Arizona and New Mexico (Fig. 2b).

Monsoon Tracker: The official start of the monsoon was June 15, but widespread activity started relatively late this year (see monsoon discussion on p. 4-5), especially in southern Arizona. There, numerous storms in mid-July brought widespread and frequent precipitation activity, boosting the percent normal monsoon precipitation in several locations (See Figs. 1a-b on p. 4). New Mexico had a comparatively earlier start to monsoon activity, which is expected given the typical spatiotemporal progression of the monsoon (Fig. 3), and has seen more steady and widespread monsoon activity, as evidenced by the percent of days with rain (see Figs. 2a-b on p. 4).

Drought & Water Supply: Drought conditions on the U.S. drought monitor have expanded in the past few weeks, with most of Arizona recording either D0 (abnormally dry) or D1 (moderate drought) conditions. This reflects short-term precipitation deficits in the upper two-thirds of Arizona, as well as short- and long-term deficits in the lower third, a pattern that also extends to the southwestern corner of New Mexico. Most of the rest of New Mexico has no drought designation (Fig. 4).

Wildfire: Arizona is experiencing an active fire season in 2017, with nearly 350,000 acres of wildfire across the state. A number of factors contributed to the increased activity in Arizona this year, including abundant fine fuels, below-average winter precipitation, above-average temperatures, and a later-than-average start to the monsoon and its increased precipitation and relative humidity. New Mexico has had less fire activity, with approximately 123,000 acres burned, largely attributed to the earlier arrival of monsoon conditions.

El Niño Southern Oscillation: Most models and forecasts continue to suggest the most likely outcome for 2017 is ENSO neutral conditions through winter 2017-2018 (50-55 percent chance). The chances of an El Niño event do remain elevated (35-45 percent chance) compared to long-term averages, however, effectively reducing the chance of a La Niña event to near zero.

Precipitation and Temperature Forecast: The July 20 NOAA Climate Prediction Center's outlook for August calls for increased chance of above-average precipitation in Arizona and New Mexico, and equal chances of above- or below -average temperatures in most of Arizona and New Mexico. The three-month outlook for August through October calls for increased chance of above-average precipitation in Arizona and New Mexico (Fig. 5, top). Increased chances of above-normal temperatures are forecast for the entire United States (Fig. 5, bottom).

Tweet July SW Climate Outlook CLICK TO TWEET

JUL2017 @CLIMAS_UA Climate Outlook, ENSO Tracker, Monsoon Tracker, Reservoir vol. http://bit.ly/2uf7Lag #SWclimate #AZWX #NMWX #SWCO

Online Resources

Figures 1-2
National Center for Environmental Information
http://www.ncdc.noaa.gov

Figure 3
Earth Systems Research Lab
http://www.esrl.noaa.gov

Figure 4
U.S. Drought Monitor
http://droughtmonitor.unl.edu/

Figure 5
NOAA - Climate Prediction Center
http://www.cpc.ncep.noaa.gov/

CLIMAS YouTube Channel

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www.youtube.com/user/UACLIMAS/

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www.climas.arizona.edu/media/podcasts

July 2017 Southwest Climate Outlook

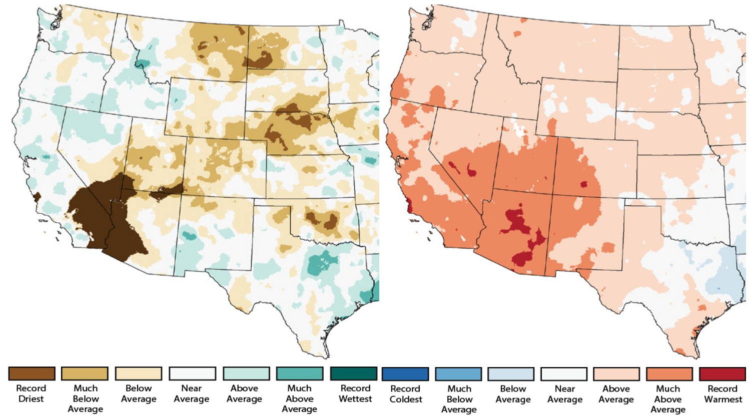


Figure 1: June 2017 Precipitation (a) & Temperature Ranks (b)

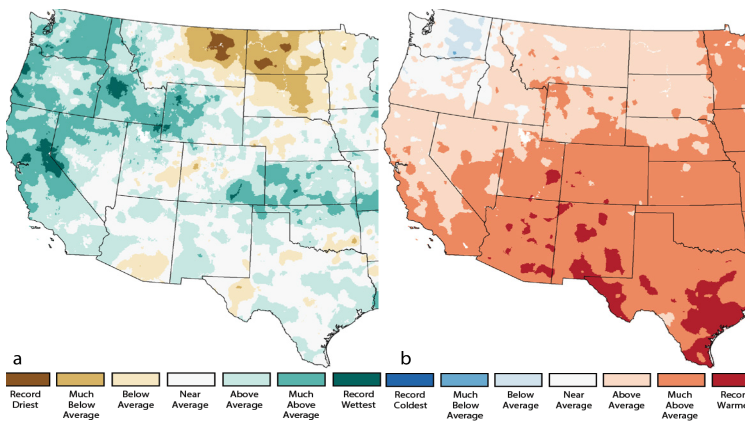


Figure 2: Jan-Jun 2017 Precipitation (a) & Temperature Ranks (b)

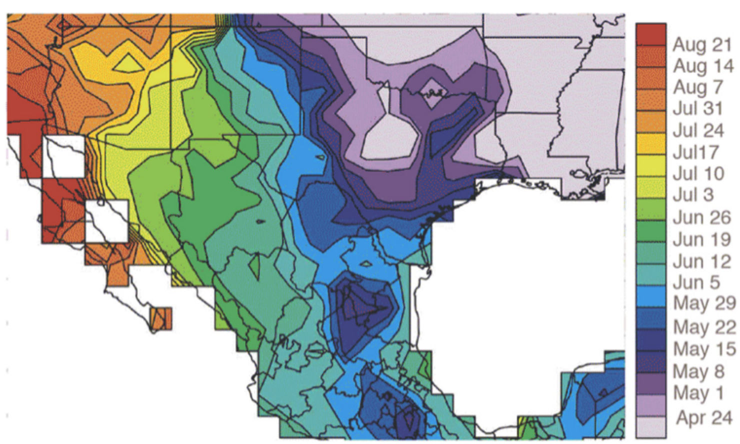


Figure 3: Historical Monsoon Onset Date

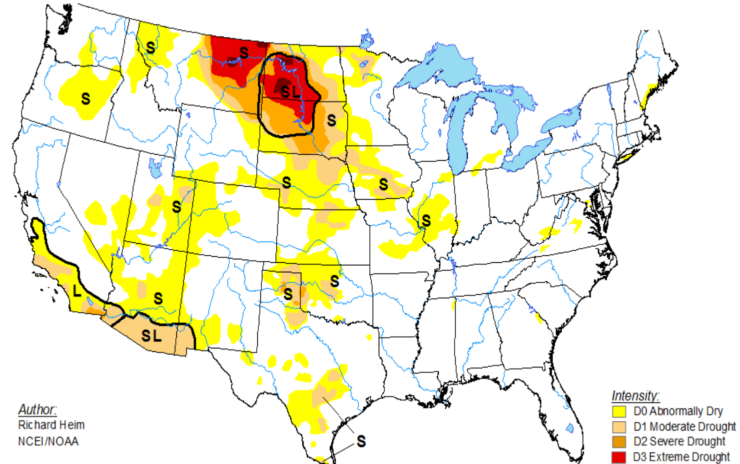


Figure 4: US Drought Monitor - Jul 18, 2017

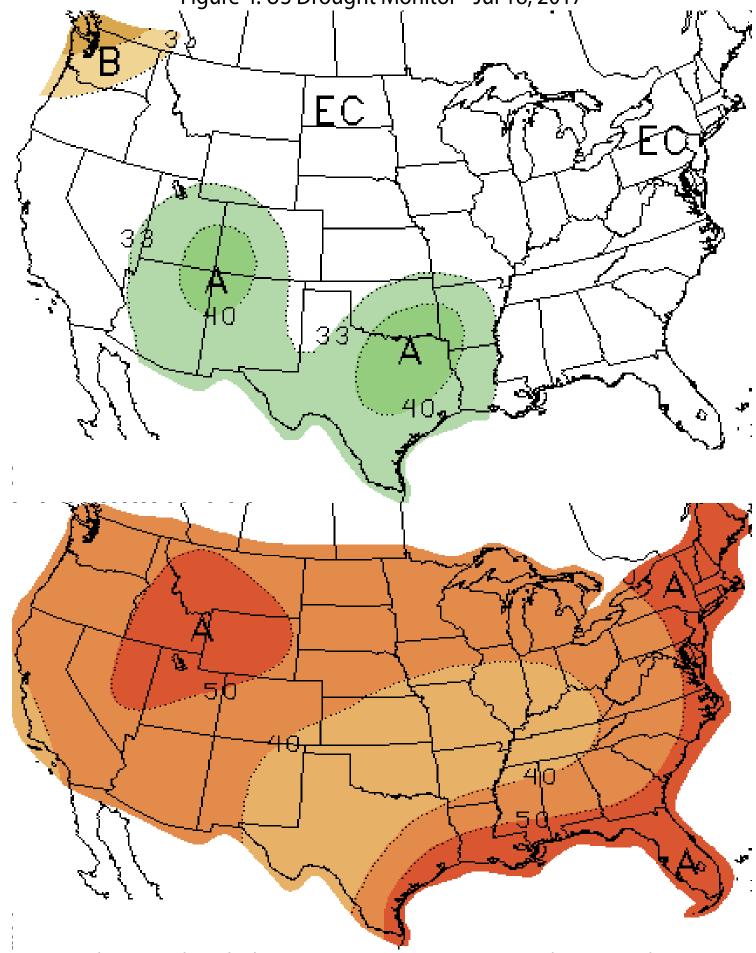


Figure 5: Three-Month Outlook - Precipitation (top) & Temperature (bottom) - Jul 20, 2017

Online Resources

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

Figure 2
NOAA - Climate Prediction Center
http://www.cpc.ncep.noaa.gov/

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

Figure 4
NOAA - Climate Prediction Center
http://www.cpc.ncep.noaa.gov/

International Research Institute for Climate and Society
http://iri.columbia.edu - #IRIforecast

El Niño / La Niña

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

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

El Niño-Southern Oscillation (ENSO) - Tracker

Oceanic and atmospheric indicators are still within the range of neutral (Figs. 1-2), although sea-surface temperatures have hinted at borderline El Niño conditions. Seasonal outlooks and forecasts generally agree that ENSO-neutral conditions are the most likely outcome for the remainder of 2017, albeit with a lingering possibility of an El Niño event by winter 2017-2018.

On July 10, the Japanese Meteorological Agency (JMA) identified a continuation of ENSO-neutral conditions with an 80-percent chance of them extending through fall 2017. On July 13, the NOAA Climate Prediction Center (CPC) observed that oceanic and atmospheric conditions were consistent with ENSO-neutral conditions, maintaining a 50-55-percent chance of ENSO-neutral conditions in 2017 and a 35-45-percent chance of an El Niño. On July 18, the Australian Bureau of Meteorology effectively ended their El Niño watch, citing little evidence for anything other than neutral conditions at this point. On July 20, the International Research Institute for Climate and Society (IRI) and CPC identified a 35-40-percent chance of an El Niño in 2017 (Fig. 3) with "ENSO-neutral as the most likely condition during 2017." The North American Multi-Model Ensemble (NMME) is ENSO-neutral as of July 2017. The model spread indicates a range of outcomes for the rest of 2017 (Fig. 4), but the ensemble mean indicates ENSO-neutral as the most likely outcome, yet allowing that a weak El Niño event is plausible.

Summary: The lack of atmospheric indicators of El Niño and the borderline status of sea-surface temperature anomalies have further contributed to forecaster consensus that ENSO-neutral conditions are the most likely outcome for 2017. An El Niño event remains possible but looks increasingly unlikely. As with last month, two key conclusions can be drawn from the current outlooks and forecasts. One, the probability of a La Niña event in 2017 is near zero, which is good news considering La Niña winters are often warmer and drier than normal in the Southwest. Two, given the relatively weak correlation between cool-season precipitation and weak El Niño events, it doesn't really matter whether this winter ultimately turns out as ENSO-neutral or weak El Niño, as the winter seasonal precipitation outlook for the Southwest will encompass a wide range of possible outcomes, including both wetter and drier than normal conditions.

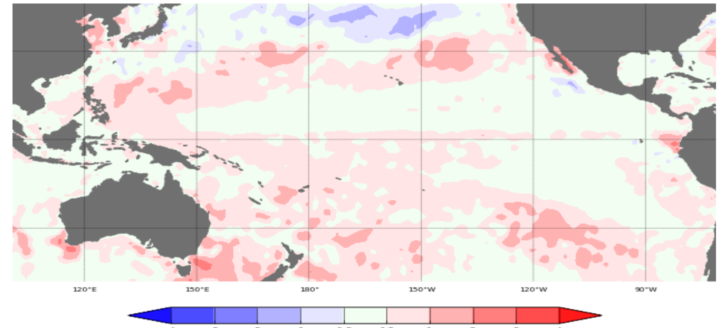


Figure 1: June 2017 Sea Surface Temperature (SST) Anomalies

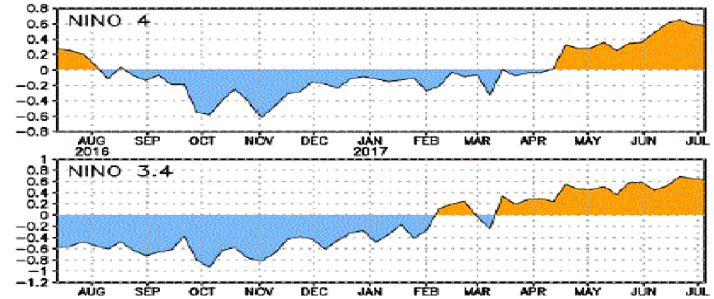


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

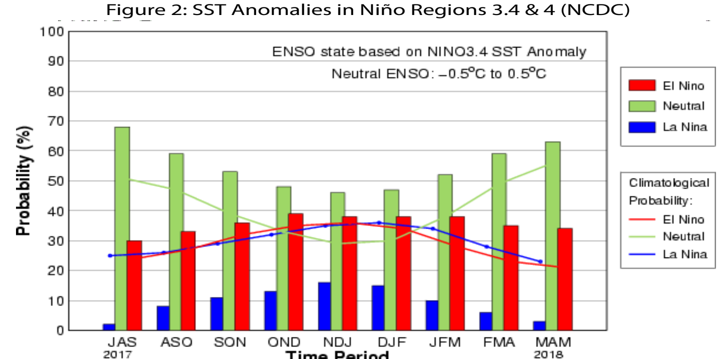


Figure 3: Mid-July IRI/CPC Model-Based Probabilistic ENSO Forecast

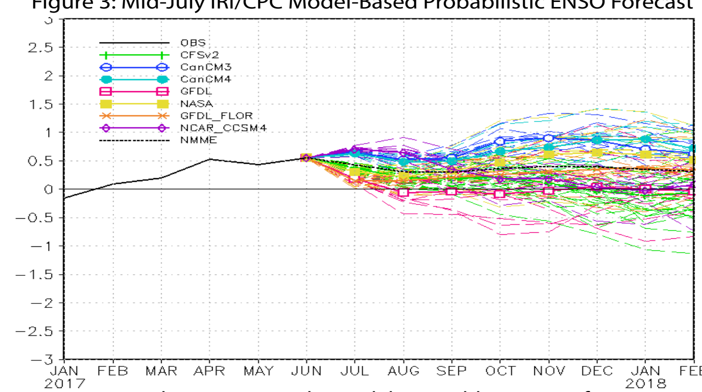


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

Figures 1-2
Climate Science Applications Program
cals.arizona.edu/climate/

CLIMAS Monsoon Hub

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

www.climas.arizona.edu/sw-climate/monsoon

Southwestern Monsoon Tracker

The official start date of the monsoon (June 15) was overshadowed by a Southwest-wide extreme heatwave that set numerous records. Heatwaves in June are a typical feature of the seasonal climate, especially as the subtropical ridge builds north, but these record temperatures also increased the anticipation for the relief that the monsoon can provide. Much of southern and central Arizona have recorded pockets of above-average precipitation, while New Mexico has seen more widely distributed precipitation since June 15 (Fig. 1a-b). The maps highlight the extreme spatial variability of monsoon precipitation and the difficulty of scoring or grading the monsoon performance using single stations or summary maps (not that we don't continue to try!). Another useful metric is the percent of days with rain, which, when used with the precipitation maps, distinguishes areas that have received more frequent and moderate precipitation from those in which just a few extreme events boosted seasonal totals. In Arizona, the southeastern corner and a swath across the higher-elevation areas of the central part of the state have received the most consistent precipitation, with significant variability across other areas (Fig. 2a). In contrast, precipitation frequency is relatively uniform across most of New Mexico, reflecting an earlier start to the monsoon as well as more overall precipitation activity (Fig. 2b).

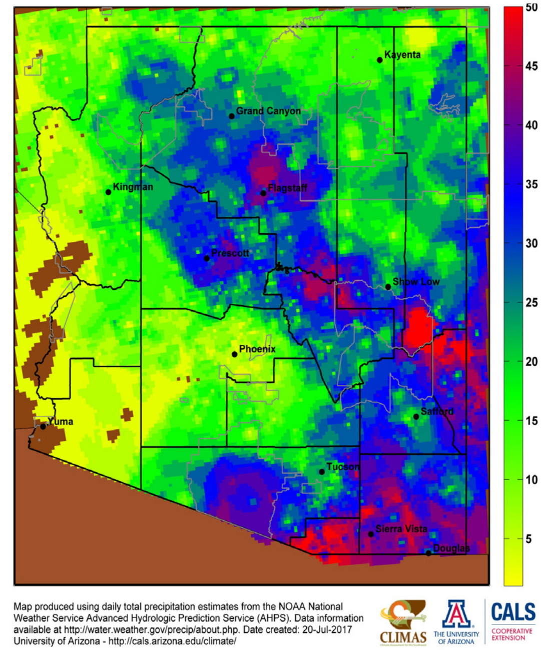


Figure 2a: Percent of Days With Rain (>0.01") - Jun 15 - Jul 19

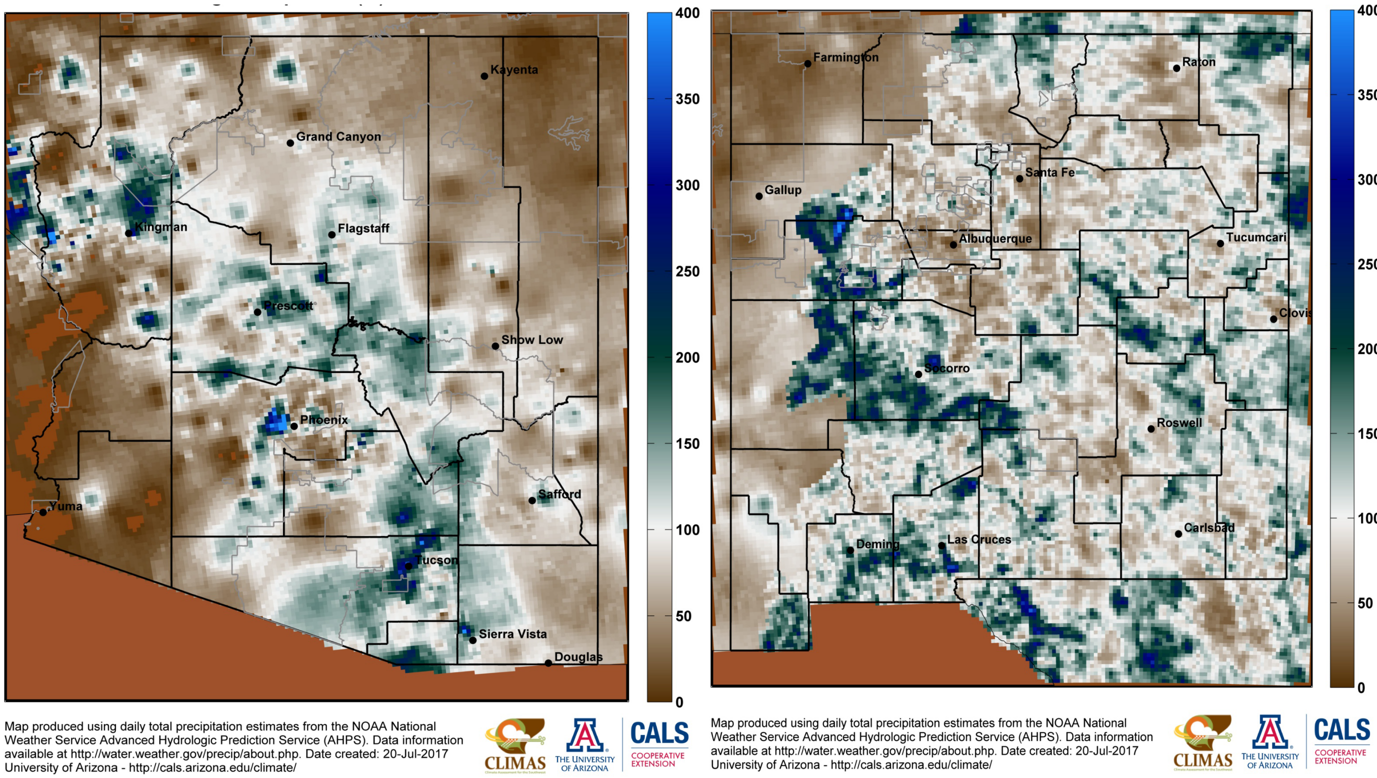


Figure 1a-b: Percent of Average Precipitation - Jun 15 - Jul 19, 2017

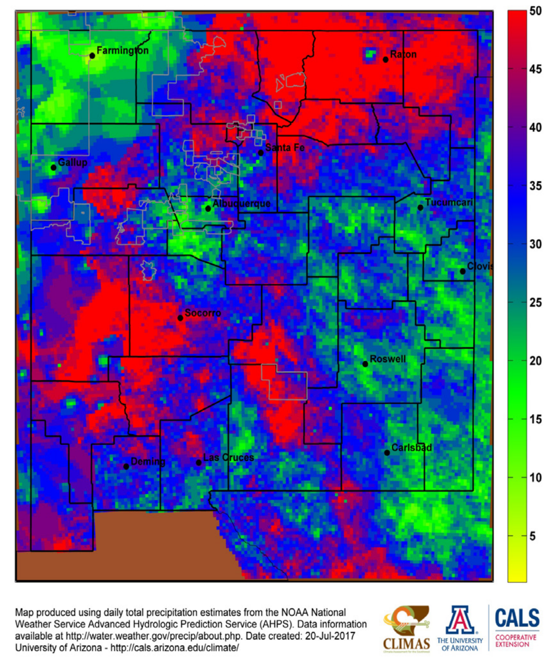


Figure 2b: Percent of Days With Rain (>0.01") - Jun 15 - Jul 19

Online Resources

Figures 3
CLIMAS: Climate Assessment for the Southwest
climas.arizona.edu

CLIMAS Monsoon Hub

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

www.climas.arizona.edu/sw-climate/monsoon

Southwestern Monsoon Tracker (cont.)

Case Study - Tucson: The onset of monsoon activity seemed to arrive late in Tucson this year, although residents have been rewarded for their patience by a surge of almost daily storms in the region since July 10. Coincidentally, July 10 was also the third straight day of average daily dewpoint temperatures at or above 54 degrees, thereby meeting the monsoon threshold used by NWS Tucson prior to 2008. The average start date by the former definition is around July 3, although in 2015 and 2016 Tucson met this threshold on June 25. By the dewpoint criteria—and given the absence of any measurable precipitation in Tucson in June and early July, the monsoon did start late, but as was discussed in the most recent episode of the CLIMAS Southwest Climate Podcast, the relatively short length of the monsoon and the desire for relief from the extreme heat of June means any delay to the onset feels like an eternity, even if the first big storm day is only a few days or a week after we might normally expect it.

The recent surge of precipitation in southern Arizona has dramatically boosted seasonal totals: the recording station at the Tucson International Airport jumped from zero percent of normal on July 9 to nearly 200 percent of normal by July 19 (Fig. 3). This example illustrates two important points about monsoon-related data:

1) The temporal variability of the monsoon means that daily or weekly tracking can be deceptive, and over the 108 days of the official season, there will be bursts and breaks of activity, with greater chances occurring during the height of the season from early- to mid-July through mid- to late August;

2) Single stations do not capture the spatial variability of the monsoon – a quick visit to rainlog.org on any given storm day will demonstrate the high degree of variability across relatively short distances.

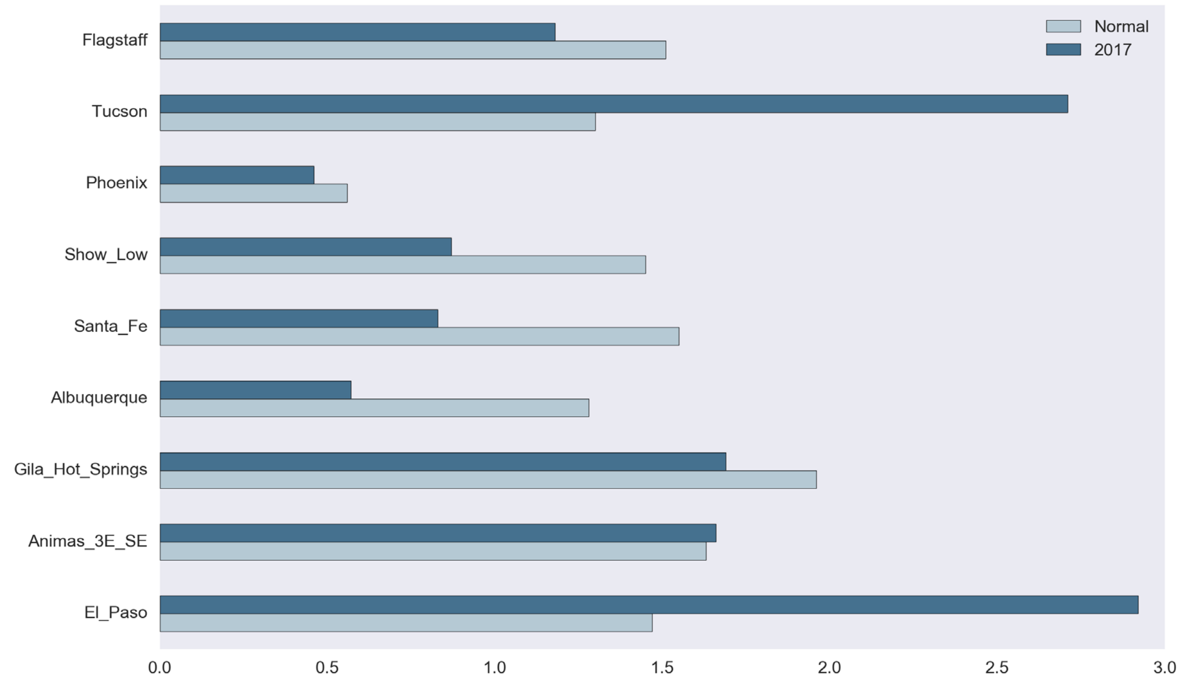


Figure 3: Normal vs. 2017 Precipitation - June 15 - July 19, 2017

Online Resources

Portions of the information provided in this figure can be accessed at the Natural Resources Conservation Service

Arizona: http://1.usa.gov/19e2BdJ

New Mexico: http://www.wcc.nrcs.usda.gov/cgibin/resv_rpt.pl?state=new_mexico

Contact Ben McMahan with any questions or comments about these or any other suggested revisions.

Notes

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).

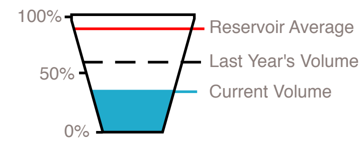
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). 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.

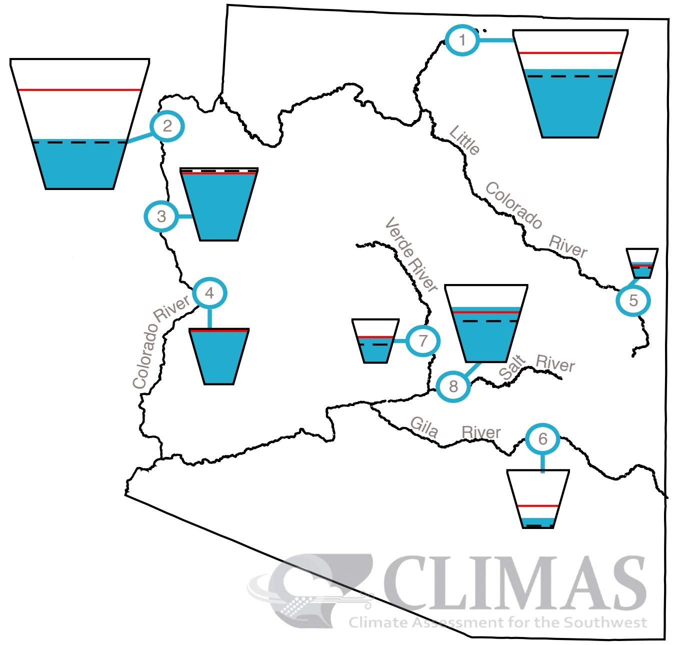
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

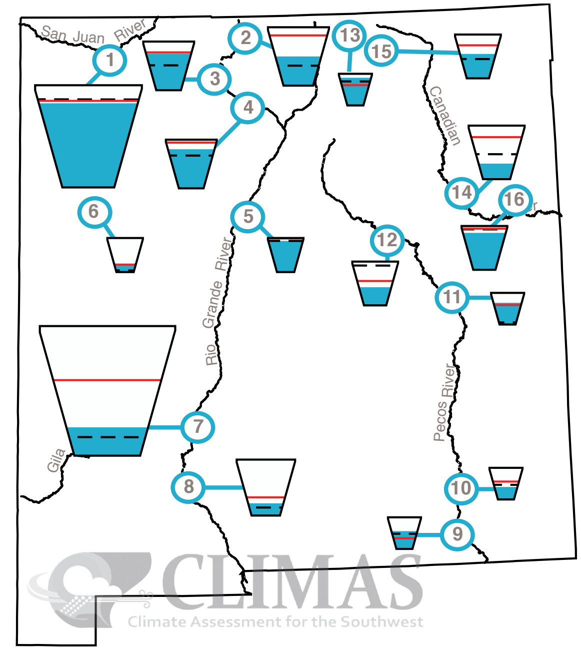
Reservoir Volumes

DATA THROUGH JUNE 30, 2017

Data Source: National Water and Climate Center, Natural Resources Conservation Service







Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Lake Powell	63%	15,407.7	24,322.0	1740.7
2. Lake Mead	38%	9,974.0	26,159.0	-167.0
3. Lake Mohave	94%	1,700.0	1,810.0	-18.0
4. Lake Havasu	95%	590.1	619.0	1.2
5. Lyman	54%	16.3	30.0	-1.9
6. San Carlos	17%	152.3	875.0	-40.7
7. Verde River System	61%	174.8	287.4	-26.8
8. Salt River System	71%	1,435.3	2,025.8	-44.4

*KAF: thousands of acre-feet

* in KAF = thousands of acre-feet
**Reservoirs with updated "Max Storage"

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	82%	1,398.2	1,696.0	-137.8
2. Heron	49%	194.9	400.0	35.9
3. El Vado	74%	141.3	190.3	25.2
4. Abiquiu	79%	147.7	186.8**	5.7
5. Cochiti	92%	46.0	50.0**	-1.1
6. Bluewater	24%	9.3	38.5	-1.3
7. Elephant Butte	21%	469.9	2,195.0	-31.2
8. Caballo	21%	70.9	332.0	3.8
9. Lake Avalon	56%	2.5	4.5**	1.4
10. Brantley	39%	16.6	42.2**	-3.8
11. Sumner	68%	24.3	102.0**	-1.3
12. Santa Rosa	41%	43.4	105.9**	-28.9
13. Costilla	88%	14.0	16.0	2.3
14. Conchas	29%	73.1	254.2	-6.1
15. Eagle Nest	55%	43.2	79.0	0.0
16. Ute Reservoir	84%	167	200	-5.0

Online Resources

Figure 1
Climate Program Office
http://cpo.noaa.gov/

RISA Program Homepage

http://cpo.noaa.gov/ClimateDivisions/ClimateandSocietalInteractions/RISAProgram.aspx

UA Institute of the Environment

http://www.environment.arizona.edu/

New Mexico Climate Center

http://weather.nmsu.edu/

CLIMAS Research & Activities

CLIMAS Research

www.climas.arizona.edu/research/

CLIMAS Outreach

www.climas.arizona.edu/outreach

Climate Services

www.climas.arizona.edu/climate-services

CLIMAS
Climate Assessment for the Southwest
A NOAA RISA TEAM

What is CLIMAS?

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.

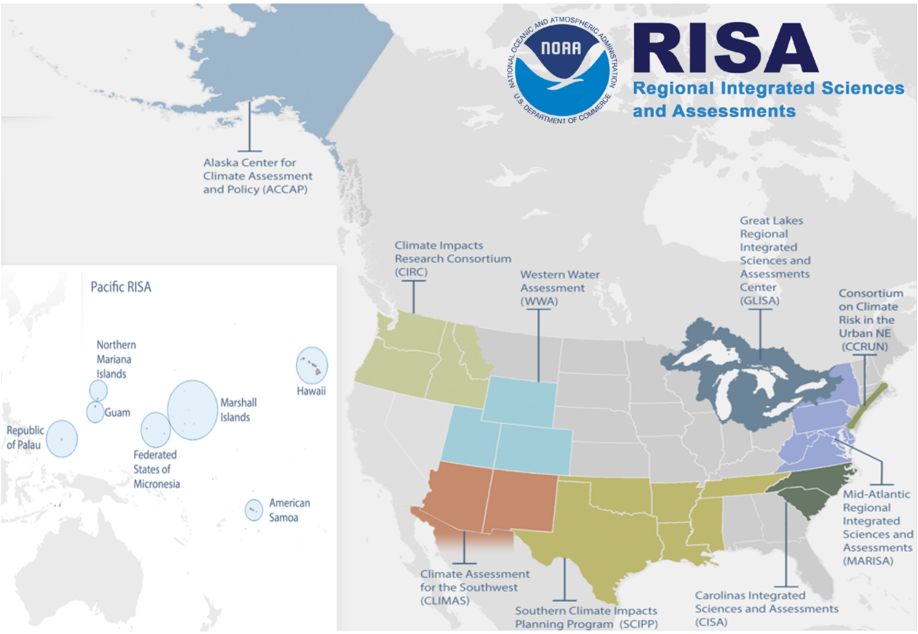


Figure 1: NOAA Regional Integrated Sciences and Assessments Regions

What does CLIMAS do?

The CLIMAS team and our 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.

Why is this work important?

Climate variability and the long-term warming trend affect social phenomena such as population growth, economic development, and vulnerable populations, as well as natural systems. This creates a complex environment for decision making in the semi-arid and arid southwestern United States. For example, natural resource managers focused on maintaining the health of ecosystems face serious climate-related challenges, including severe sustained drought, dramatic seasonal and interannual variations in precipitation, and steadily rising temperatures. Similarly, local, state, federal, and tribal governments strive to maintain vital economic growth and quality of life within the context of drought, population growth, vector-born disease, and variable water supplies. Uncertainties surrounding the interactions between climate and society are prompting decision-makers to seek out teams of natural and social scientists—like those that comprise CLIMAS—for collaborations to help reduce risk and enhance resilience in the face of climate variability and change.