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August Southwest Climate Outlook

Precipitation and Temperature: Precipitation in July ranged from below average to much-above average in Arizona and New Mexico (Fig. 1a), illustrating the extent to which monsoon precipitation varies across the region. July temperatures were warmer than average in nearly all of Arizona and New Mexico (Fig. 1b), and since July 1, most of the daily temperature anomalies (deviations above or below the average temperature) have been warmer across the region (Fig. 2). Year-to-date precipitation is above average to record driest while year-to-date temperatures have been much-above average to record warmest (Fig. 3a-b).

Monsoon Tracker: The monsoon is going strong with prevailing conditions favorable to storm activity. Arizona and New Mexico have had nearly daily storms since early July, but as is typical this time of year, the actual precipitation totals vary considerably across the Southwest at regional and even local scales due to the intense but localized nature of monsoon events (see Monsoon Tracker for details).

Drought: Water-year precipitation to date reveals persistent cumulative deficits across nearly all of Arizona and much of New Mexico (Fig. 4). The Aug. 14 USDM responded to recent precipitation and scaled back some of the drought designations in southern Arizona and New Mexico (Fig. 5), although the Four Corners region remains in exceptional drought (D4). Drought experts continue to discuss the extent to which short-term upticks in summer precipitation can truly reverse months of deficit. This is our annual conundrum: How much does monsoon precipitation mitigate drought conditions in the Southwest? High-intensity precipitation is subject to loss via runoff and evaporation, yet it can help quickly recharge reservoir storage and irrigate summer forage crops that are dependent on the timing of the precipitation, thus the answer depends on what type of drought you are tracking. Furthermore, the spatial variability of monsoon events can lead to a sense of winners and losers for monthly and seasonal totals during the monsoon, even while both are still subject to the longer-term, cool-season precipitation deficits.

Wildfire: Widespread moisture and monsoon activity helped tamp down fire risk in July and August (so far). The period of highest wildfire risk is over for the Southwest, but convective activity associated with the monsoon does bring additional ignition sources for wildfire, and wildfire totals in Arizona and New Mexico as of Aug. 7 saw modest increases in lightning-caused fires over the last month (see Fig. 6 for a seasonal summary).

El Niño Tracker: Neutral conditions are present in oceanic and atmospheric indicators and are expected to remain neutral through summer. Seasonal outlooks indicate increasing chances of an El Niño event in 2018, with El Niño conditions likely to emerge by fall or winter (see ENSO Tracker for details). Above-average winter precipitation is one characteristic of El Niño in the Southwest, but if the event develops earlier rather than later this fall, it also could help enhance eastern Pacific tropical storm activity. This in turn could promote increased precipitation in the Southwest this fall, especially if these tropical storms bend back into the Southwest and drive moisture into the region. By way of comparison, last year—a La Niña year—brought little tropical storm activity to augment precipitation totals for either the monsoon or the fall season.

Precipitation and Temperature Forecast: The three-month outlook for August through November calls for increased chances of above-normal precipitation in Arizona and most of New Mexico (Fig. 7, top), and increased chances of above-average temperatures for the entire western United States (Fig. 7, bottom).

Tweet August 2018 SW Climate Outlook CLICK TO TWEET

AUG2018 @CLIMAS_UA SW Climate Outlook, ENSO Tracker, Monsoon Tracker, AZ & NM Reservoir volumes https://bit.ly/2PfUkAU #SWclimate #AZWX #NMWX #SWCO

August 2018 SW Climate Outlook

Online Resources

Figures 1,3
National Centers for Environmental Information
ncei.noaa.gov

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

Figure 4
Western Regional Climate Center
wrcc.dri.edu

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

Figure 7
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

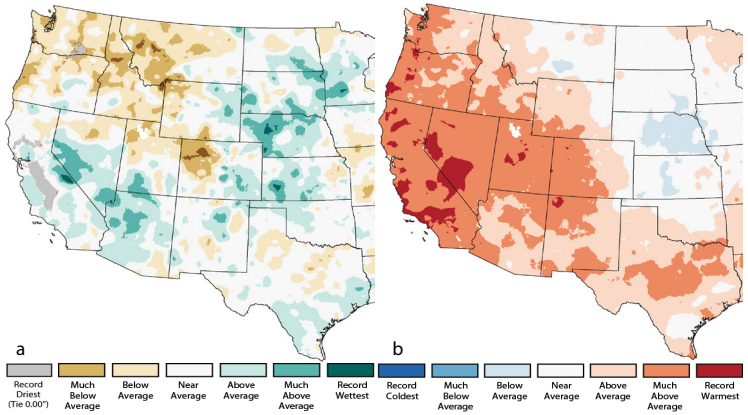


Figure 1: July 2018 Precipitation (a) & Temperature Ranks (b)

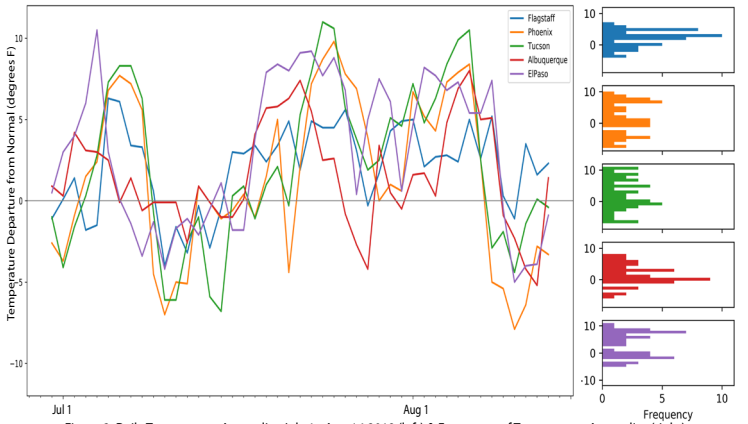


Figure 2: Daily Temperature Anomalies July 1 - Aug 14 2018 (left) & Frequency of Temperature Anomalies (right)

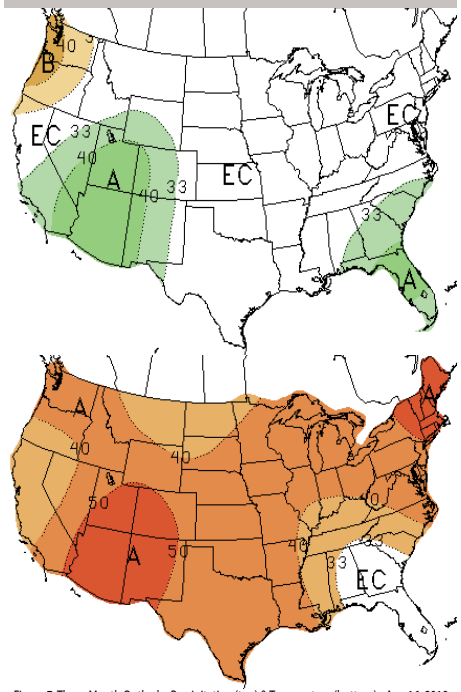


Figure 7: Three-Month Outlook - Precipitation (top) & Temperature (bottom) - Aug 16, 2018

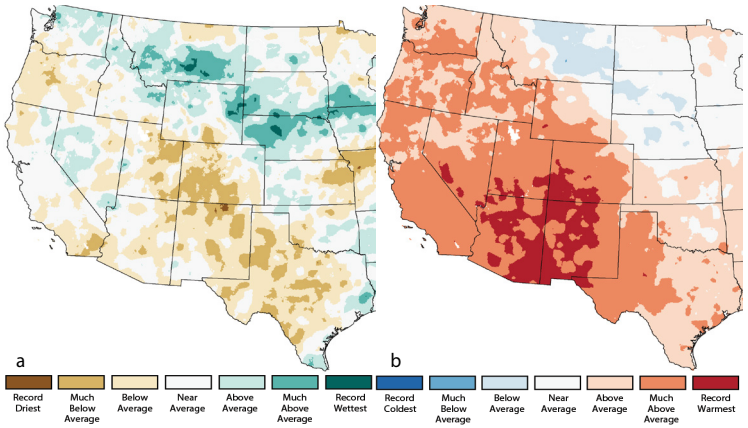


Figure 3: Jan - Jul 2018 Precipitation (a) & Temperature Ranks (b)

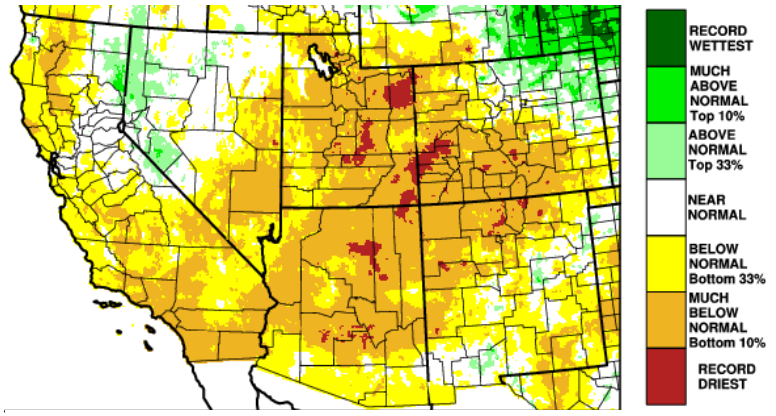


Figure 4: Water Year (Oct 2017 - Jul 2018) Precipitation Rankings

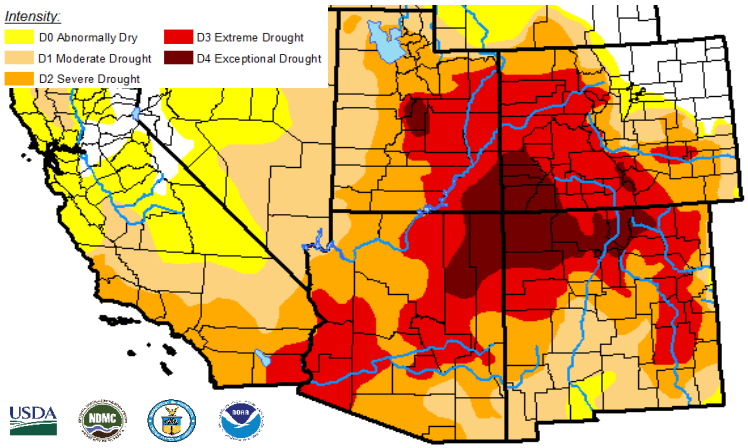


Figure 5: US Drought Monitor - Aug 14, 2018

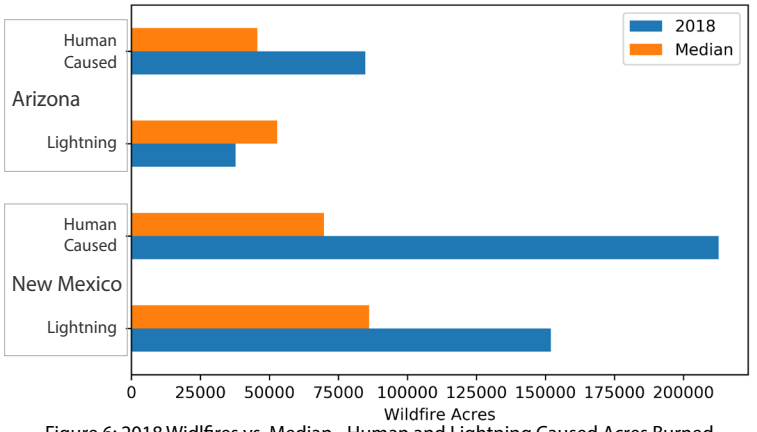


Figure 6: 2018 Widlfires vs. Median - Human and Lightning Caused Acres Burned
Data as of Aug 7, 2018

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

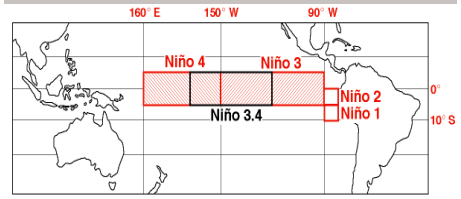
Figure 4
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

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

The Southwest remains in an ENSO holding pattern, with oceanic and atmospheric conditions still within the range of ENSO neutral over the last month (Figs. 1-2), and the forecasts and outlooks reflect that. On Aug. 9, the NOAA Climate Prediction Center (CPC) continued its El Niño watch, identifying persistent neutral conditions at present but with seasonal outlooks and models picking up on an increased likelihood of El Niño later this year despite a recent decrease in equatorial sea surface temperatures (see Niño 3.4 plot in Fig. 2 & sidebar for more information). CPC's outlook indicates a 60-percent chance of an El Niño event developing this fall and a 70-percent chance of El Niño conditions this winter. On Aug. 9, the International Research Institute (IRI) issued an ENSO Quick Look noting neutral conditions in the oceans and atmosphere now but with warming subsurface oceanic waters pushing forecast probabilities for an El Niño event to just over 70 percent by the end of 2018 (Fig. 3). On Aug. 10, the Japanese Meteorological Agency (JMA) also identified neutral conditions in oceanic and atmospheric indicators and a 60-percent chance of El Niño by this fall. On Aug. 14, the Australian Bureau of Meteorology maintained its "El Niño Watch," although most indicators were within the range of neutral. They, too, noted the warm subsurface waters in the Pacific Ocean despite recent cooling of surface waters and predicted a 50-percent chance of El Niño formation by the end of 2018. The North American Multi-Model Ensemble (NMME) is demonstrating the steady trend in observations and forecasts towards warmer-than-average ocean temperatures and is zeroing in on a weak to borderline-moderate El Niño event by the end of 2018 (Fig. 4).

Summary: Despite a recent dip in surface temperatures in the Pacific Ocean, most outlooks have maintained an increased chance of a weak to borderline-moderate El Niño forming in 2018 with virtually no chance of a La Niña. Warm subsurface waters persist, and the forecasts suggest a return to warming sea-surface temperatures in the coming months along with a transition to atmospheric patterns more indicative of El Niño. However, the formation of an El Niño event is still far from certain; the probabilities for neutral conditions range from 30 to 50 percent, depending on the agency and the timeframe, but are near zero for a La Niña event (see Fig. 3 for an example). Presuming an El Niño event does form in 2018, the onset timing and intensity of the event will play a role in how much it affects tropical storm activity this fall and cool-season precipitation this winter and spring.

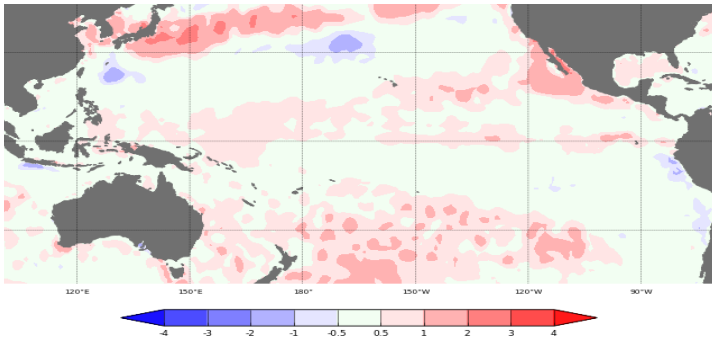


Figure 1: July 2018 Sea Surface Temperature (SST) Anomalies

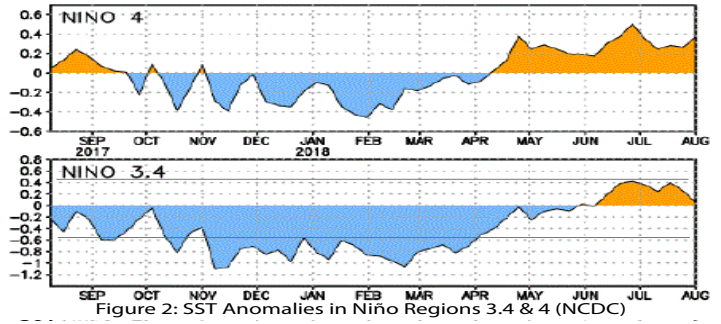


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

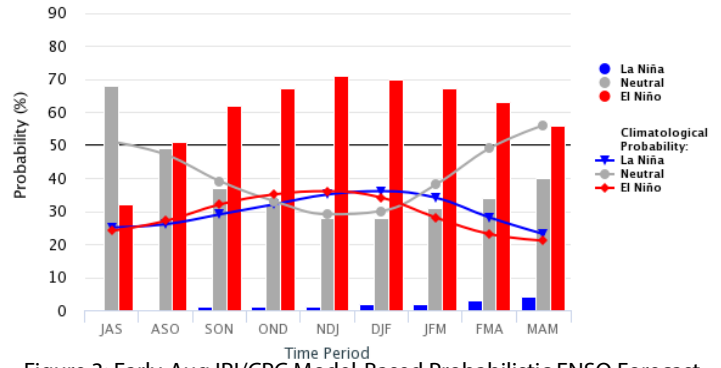


Figure 3: Early-Aug IRI/CPC Model-Based Probabilistic ENSO Forecast

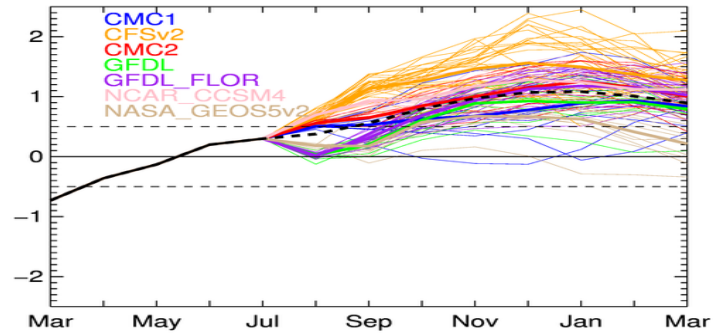


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

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

Figure 1 Data: wrh.noaa.gov/twc/monsoon/monsoon_elp.php

Figure 2 Data: mesowest.utah.edu/

Regional Monsoon Maps

On the following page, seasonal totals to date (Fig. 3), the percent of normal precipitation (Fig. 4) and percent of days with rain (Fig. 5) all help characterize the spatial variability and intensity of the monsoon thus far.

Monsoon Tracker

Monsoon precipitation totals vary considerably across the Southwest. Monthly totals for select locations reveal near or below-average amounts compared to long-term averages (Fig. 1). There are widespread regions with above-average totals as well (see p. 5), revealing the challenge of characterizing monsoon performance using single stations. The monthly breakdown illustrates the sporadic nature of monsoon activity that affects how each locale reaches its seasonal totals and demonstrates how particular events can boost monthly totals in some locations but not others—such as how TS Bud in June affected Tucson but not Phoenix. Daily precipitation plots for the same stations (Fig. 2) further demonstrates the intermittent nature of monsoon precipitation and distinguishes areas that have had frequent events (e.g. Tucson, Flagstaff) from those with fewer ones (e.g. Phoenix, El Paso).

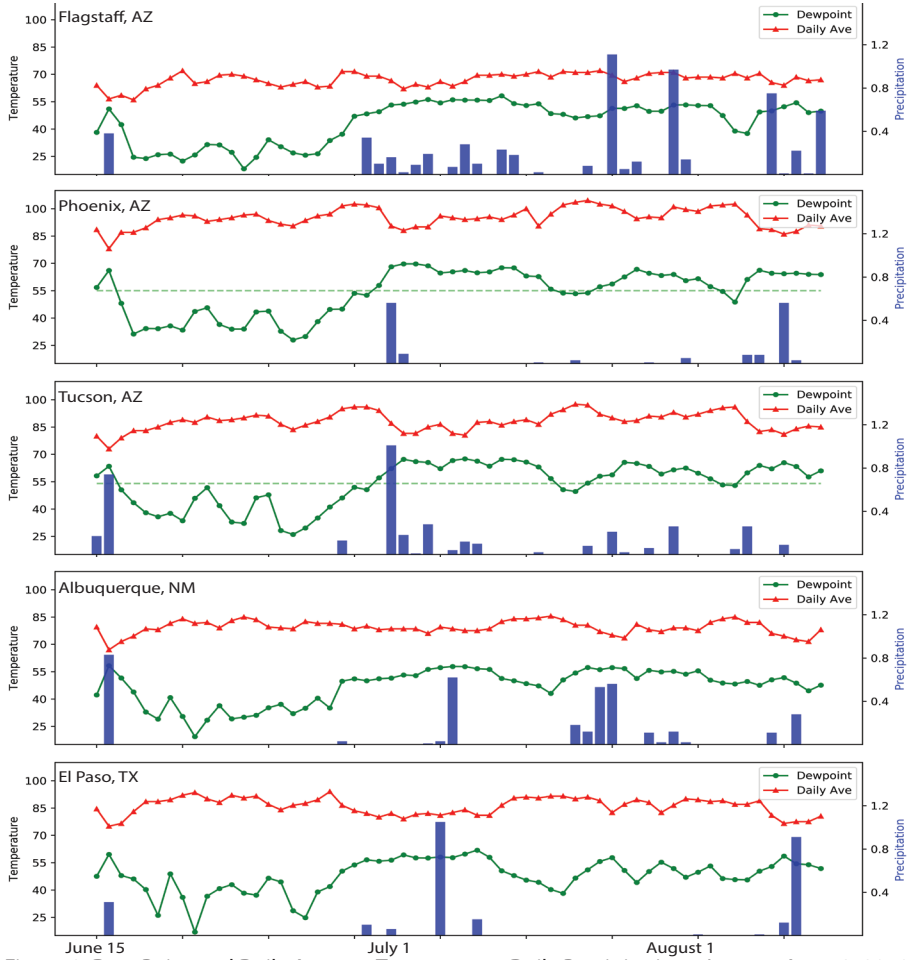


Figure 2: Dew Point and Daily Average Temperature, Daily Precipitation - Jun 15 - Aug 13, 2018

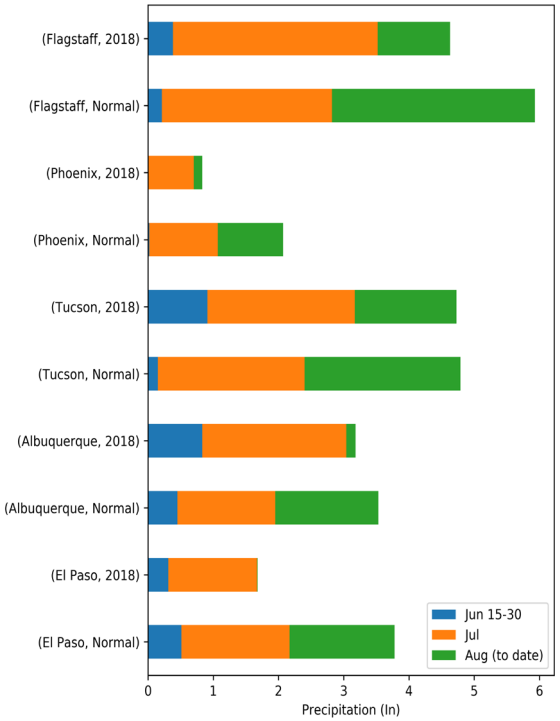


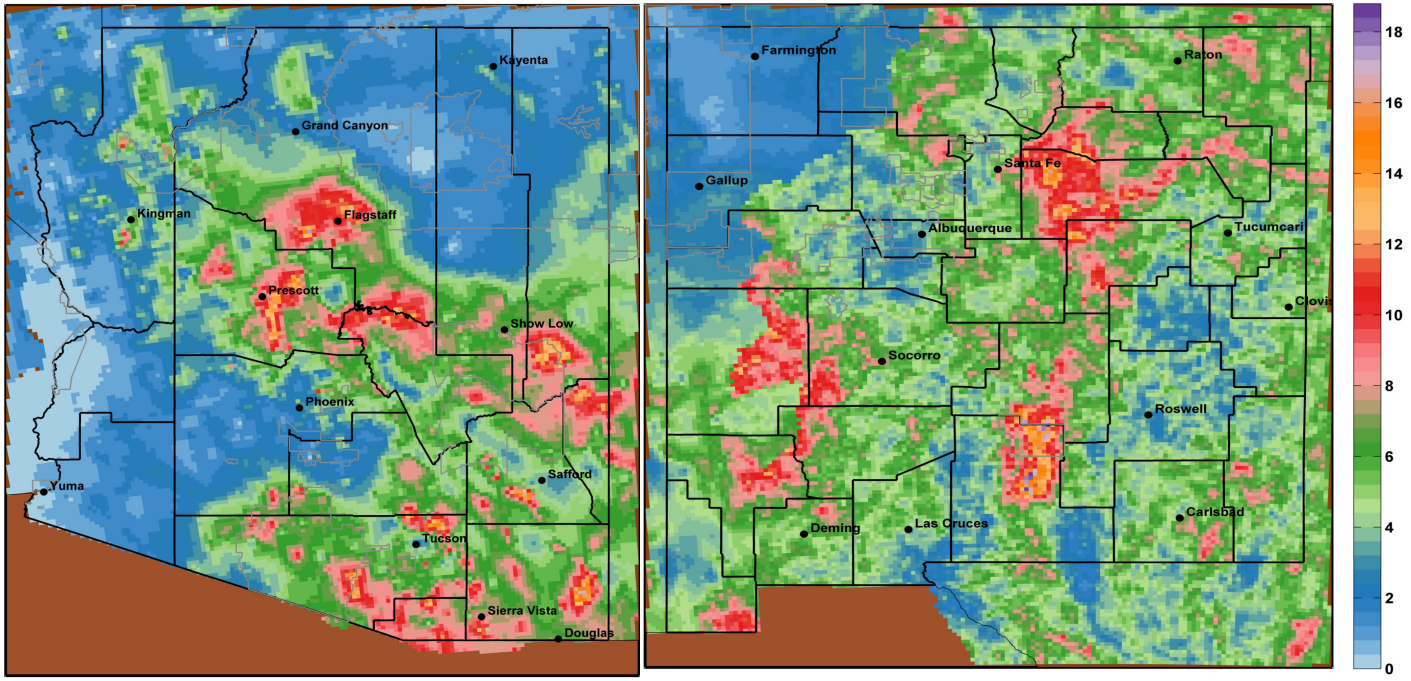
Figure 1: Monthly Monsoon Precipitation Totals - 2018 vs. Average

As discussed last month, increasing dewpoint temperature was the old metric by which monsoon onset was determined. This year, the onset of monsoon precipitation was relatively closely aligned with increasing dewpoint temperatures in early July, but the precipitation/dewpoint relationship since then illustrates why elevated dewpoint is an imperfect measure of likely precipitation. Although dewpoint temperatures were elevated for much of the last month, precipitation was not consistent. In fact, sustained periods of high dewpoints without precipitation led to extreme heat warnings in the region, with heat indices over 110 degrees in some locations, and persistent warm overnight temperatures. Without storm-induced cooling, elevated dewpoint temperatures can be downright miserable, especially for households that rely on evaporative coolers for interior climate control.

Online Resources

Figures 3-5
UA Climate Science Application Program
cals.arizona.edu/climate

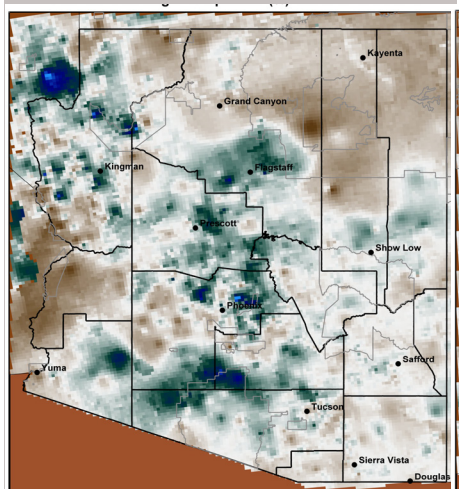
Monsoon Tracker

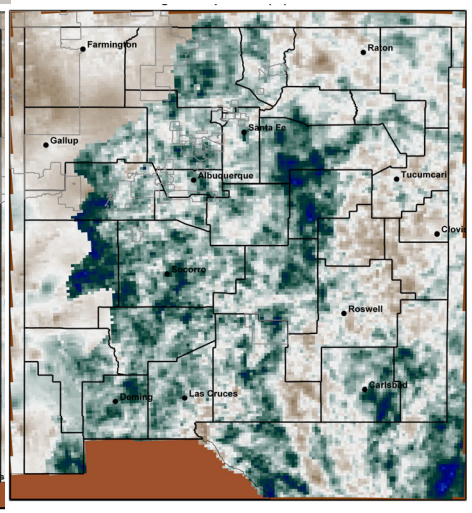


Map produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at http://water.weather.gov/precip/about.php. Date created: 15-Aug-2018 University of Arizona - http://cals.arizona.edu/climate/

Map produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at http://water.weather.gov/precip/about.php. Date created: 15-Aug-2018 University of Arizona - http://cals.arizona.edu/climate/

Figure 3a-b: Total Precipitation - Jun 15 - Aug 14, 2018

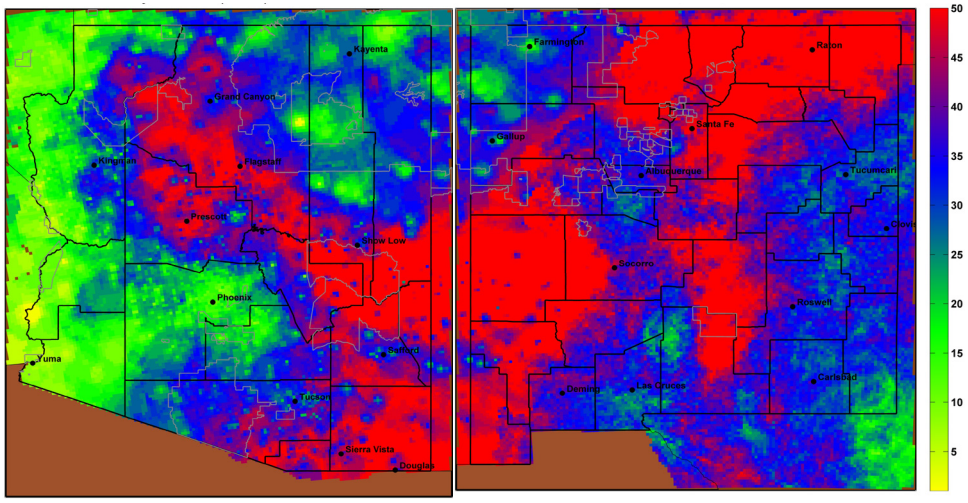




Map produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at http://water.weather.gov/precip/about.php. Date created: 15-Aug-2018 University of Arizona - http://cals.arizona.edu/climate/

Map produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at http://water.weather.gov/precip/about.php. Date created: 15-Aug-2018 University of Arizona - http://cals.arizona.edu/climate/

Figure 4a-b: Percent of Normal Precipitation - Jun 15 - Aug 14, 2018



Map produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at http://water.weather.gov/precip/about.php. Date created: 15-Aug-2018 University of Arizona - http://cals.arizona.edu/climate/

Map produced using daily total precipitation estimates from the NOAA National Weather Service Advanced Hydrologic Prediction Service (AHPS). Data information available at http://water.weather.gov/precip/about.php. Date created: 15-Aug-2018 University of Arizona - http://cals.arizona.edu/climate/

Figure 5a-b: Percent of Days With Precipitation (>0.01") - Jun 15 - Aug 14, 2018

Online Resources

Figures 6-7
CLIMAS: Climate Assessment for the Southwest
climas.arizona.edu

Data: RainLog.org & Pima County Flood Control District

CLIMAS has a new project in collaboration with the National Weather Service in Tucson exploring how to integrate citizen science rainfall observations into monsoon analysis and visualizations, and to compare these observations to official stations and radar derived estimates of precipitation. If you have any questions or want more infomation, contact Ben McMahan at bmcmahan@email.arizona.edu

RainLog: rainlog.org
CoCoRaHs: cocorahs.org

Monsoon Tracker (cont)

A look at monsoon precipitation across the Tucson metropolitan area illustrates the spatial heterogeneity of monsoon events. Some areas receive frequent and/or abundant precipitation, while others–often nearby–do not (Figs. 6-7). Individual stations (e.g. the Tucson Airport) track long-term comparisons to normal at that single location, but cannot capture this variability. Higher elevation areas are expected to receive more precipitation, but the range found in lower elevation locations highlights how daily and cumulative totals can vary across a remarkably short distance.

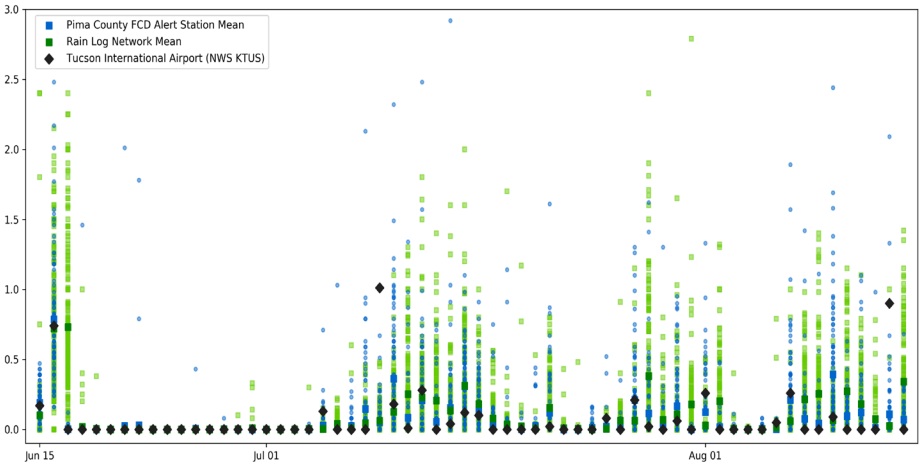


Figure 6: Monsoon Precipitation Jun 15 - Aug 15 (Pima County FCD, Rain Log, and Tucson Int. Aiport)

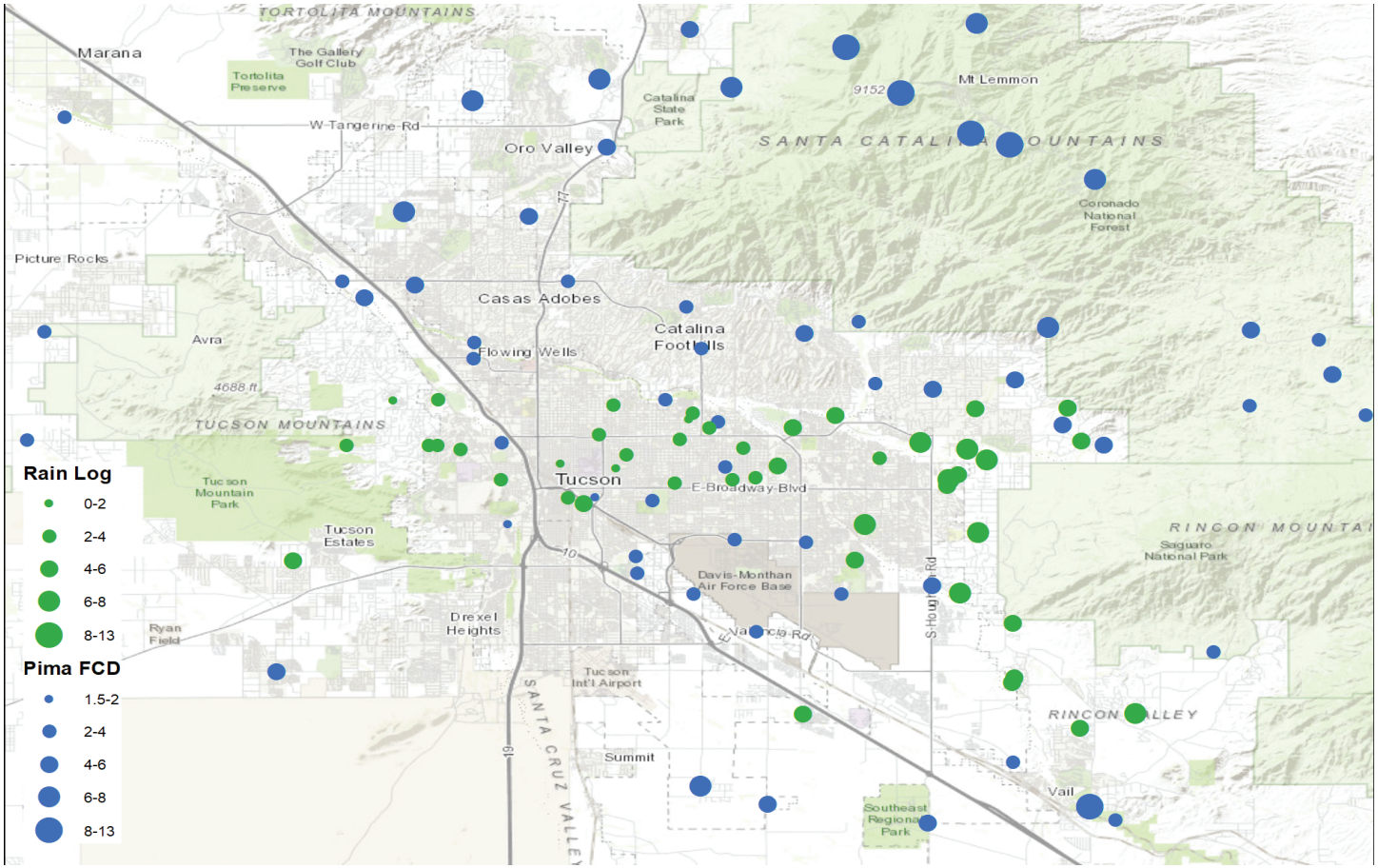


Figure 7: Cumulative Precipitation Jun 15 - Aug 15, 2018 (Rainlog & Pima FCD Networks)

Online Resources

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

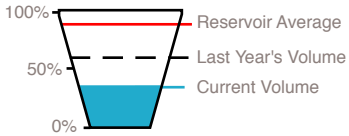
www.wcc.nrcs.usda.gov/BOR/basin.html

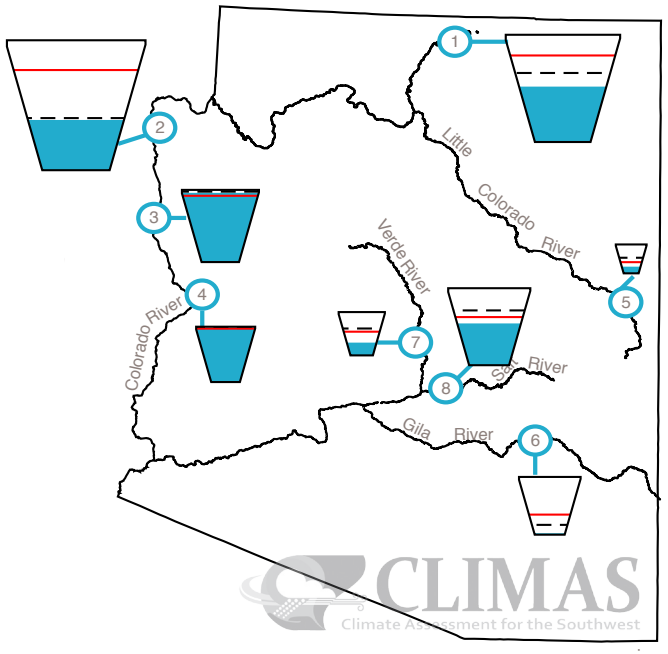
Contact Ben McMahan with any questions or comments about these or any other suggested revisions.

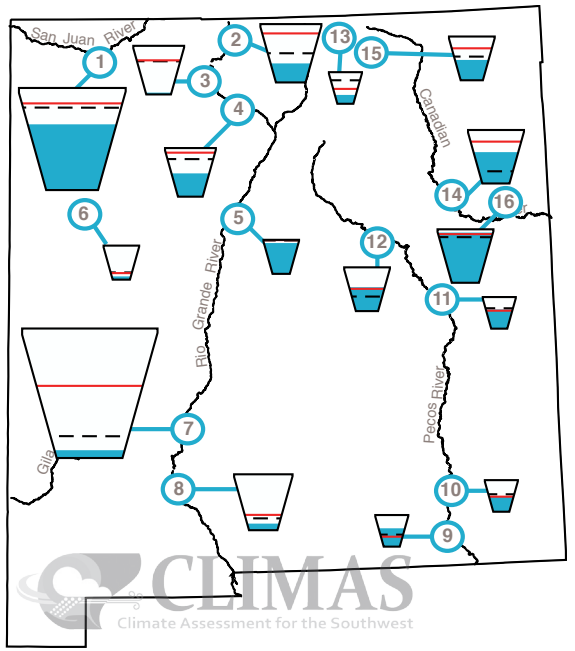
Reservoir Volumes

DATA THROUGH JULY 31, 2018

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	50%	12,116.4	24,322.0	-611.9
2. Lake Mead	37%	9,799.0	26,159.0	51.0
3. Lake Mohave	94%	1,703.0	1,810.0	-31.0
4. Lake Havasu	94%	581.9	619.0	-8.4
5. Lyman	21%	6.4	30.0	-0.8
6. San Carlos	0%	0.4	875.0	-234.6
7. Verde River System	28%	80.2	287.4	-0.1
8. Salt River System	52%	1,053.6	2,025.8	-67.0

*KAF: thousands of acre-feet

* in KAF = thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	64%	1,080.2	1,696.0	-79.2
2. Heron	33%	133.1	400.0	-31.2
3. El Vado	4%	7.9	190.3	-8.4
4. Abiquiu	48%	89.7	186.8	-6.3
5. Cochiti	91%	45.3	50.0	-1.1
6. Bluewater	9%	3.6	38.5	-0.7
7. Elephant Butte	6%	128.9	2,195.0	-98.8
8. Caballo	11%	36.5	332.0	2.5
9. Lake Avalon	58%	2.6	4.5	0.1
10. Brantley	48%	20.2	42.2	8.2
11. Sumner	61%	21.8	35.9	-1.1
12. Santa Rosa	55%	58.7	105.9	-30.7
13. Costilla	28%	4.4	16.0	-2.7
14. Conchas	58%	147.3	254.2	-21.4
15. Eagle Nest	47%	37.0	79.0	-1.0
16. Ute Reservoir	94%	187	200	-4.0

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).

Online Resources

Figure 1
Climate Program Office
cpo.noaa.gov

RISA Program Homepage

http://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

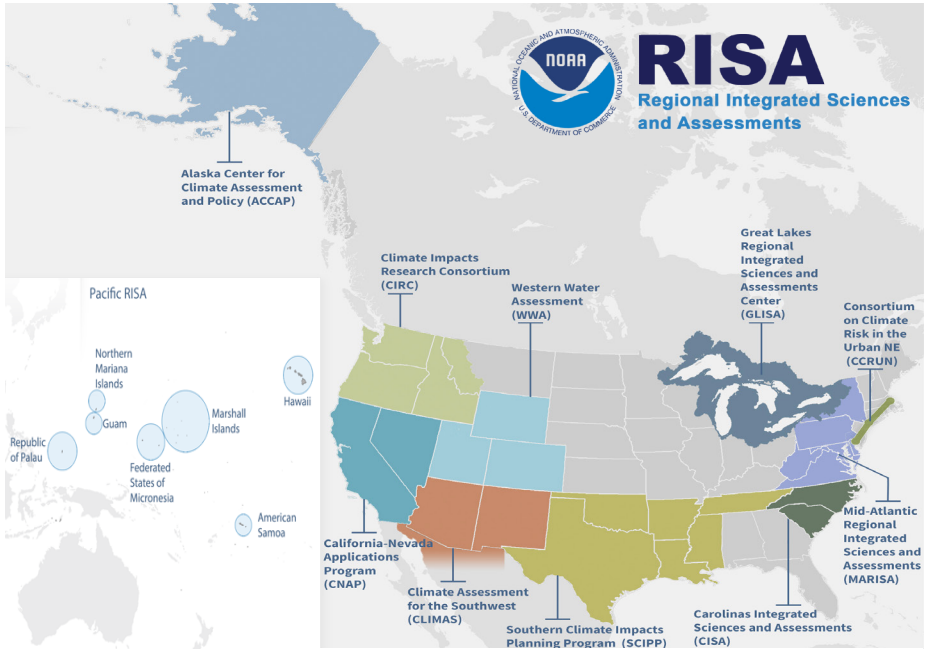
climas.arizona.edu/climate-services

CLIMAS
Climate Assessment for the Southwest
A NOAA RISA TEAM

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.



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.

July 2018 SW Climate Podcast

A Little Better than Climatology - A Fast Start to "Monsoon" Precip and Optimism for the Season

The monsoon is back! In the July edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido kick off with a recap of the role that Hurricane Bud played in driving storms and moisture into the Southwest on June 15-16, with a focus on the tropical moisture incursion that occurred during the transitional season. They even take a moment to discuss whether that event *was* the monsoon, or just–in Mike's words–"monsoon-y." Next, they turn to the onset of the actual monsoon in terms of a few different metrics (precipitation, dewpoint, precipitable water), the atmospheric patterns that affect this onset, and how this shift has affected recent temperatures, wildfire activity, and where and how precipitation is falling. They briefly discuss El Niño, as well as the seasonal outlooks that forecast a relatively rosy picture (i.e. wet) for Arizona and parts of New Mexico over the next few weeks and months.

https://bit.ly/2LgS8H0