Contributors

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October Southwest Climate Outlook

Precipitation & Temperature: September precipitation was much-below average to below average across central and southeastern Arizona and southwestern New Mexico, while northeastern New Mexico recorded above-average to much-above-average precipitation for the month (Fig. 1a). September temperatures were average to much-above average in New Mexico, and below average to much-above average in Arizona (Fig. 1b). October temperatures to date have been quite warm, especially in the southern portions of Arizona and New Mexico. Year-to-date precipitation ranges widely from much-below average in southeastern Arizona to much-above average to record wettest in northeastern New Mexico (Fig. 2a). January through September temperatures have been consistently warmer than average, with nearly all of Arizona and New Mexico recording much-above average temperatures, including small pockets of record-warmest conditions in both states (Fig. 2b).

Monsoon Tracker: Persistent dry conditions in September meant 2017 monsoon precipitation totals saw little change in the last weeks of the monsoon, especially in Arizona. New Mexico recorded a late-season surge, with heavy rainfall observed in a number of locales just in time to be counted in the seasonal totals (Figs. 3, 5a; see Monsoon Tracker on p.3 for more details).

Drought & Water Supply: Arizona has seen a return to short-term drought designation (D0: abnormally dry) in eastern and southeastern regions. This designation, in addition to the long-term drought designations (D0: abnormally dry and D1: moderate drought) that are persisting along the U.S.-Mexico border in southwest Arizona, mean that well over 50 percent of Arizona had some form of drought designation as of October 2017. New Mexico is nearly free of drought designation, with just one small area of D0 (abnormally dry) in the western part of the state (Fig. 4; for details on reservoir storage and water supply, see the diagrams on p.7).

Water Year 2017: Water-year (Oct 2016 – Sept 2017) precipitation was normal to above normal in most of New Mexico, while Arizona ranged from well-below normal in southern and eastern areas to above normal in the northwest part of the state (Fig. 5b). Notably, the pattern of below-normal precipitation extended into the Upper Basin of the Colorado River (in Utah and Colorado), an important fact to monitor going into this next winter and water year given the strong influence that drought in the Upper Basin can have on Lower Basin water availability and management.

El Niño Southern Oscillation: Current conditions are generally in the range of ENSO-neutral, while seasonal outlooks and forecast models continue to suggest La Niña as the most likely outcome this winter (See ENSO Tracker on p.6).

Tropical Storms: The eastern Pacific tropical storm season has been active in 2017 with 17 named storms, including nine hurricanes of which four were major (greater than category 3), and the season is not yet over. This is in line with the seasonal outlook for 2017, which predicted 14-20 named storms, 6-11 hurricanes and 3-7 major hurricanes. Despite an average to above-average number of storms, they have not been active in driving moisture into the Southwest. This is one factor that has contributed to the drier-than-average conditions observed in late August and most of September, which often sees increased precipitation linked to tropical storm activity.

Precipitation & Temperature Forecast: The three-month outlook for October through December calls for increased chances of below-average precipitation for most of Arizona and New Mexico (Fig. 6, top), and increased chances of above-normal temperatures for the entire southwestern United States (Fig. 6, bottom).

Tweet Oct SW Climate Outlook

CLICK TO TWEET

OCT2017 @CLIMAS_UA SW Climate Outlook, Monsoon Recap, ENSO Tracker, Reservoir vol. http://bit.ly/2yVDPFi #SWclimate #AZWX #NMWX #SWCO

October 2017 SW Climate Outlook

Online Resources

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

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

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

Figures 5a-b
West Wide Drought Tracker
wrcc.dri.edu/wwdt/

Figure 6
NOAA - Climate Prediction Center
www.cpc.ncep.noaa.gov/

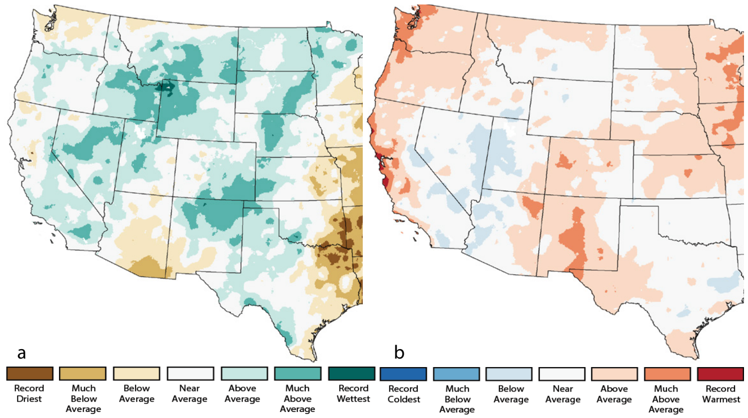


Figure 1: Sept 2017 Precipitation (a) & Temperature Ranks (b)

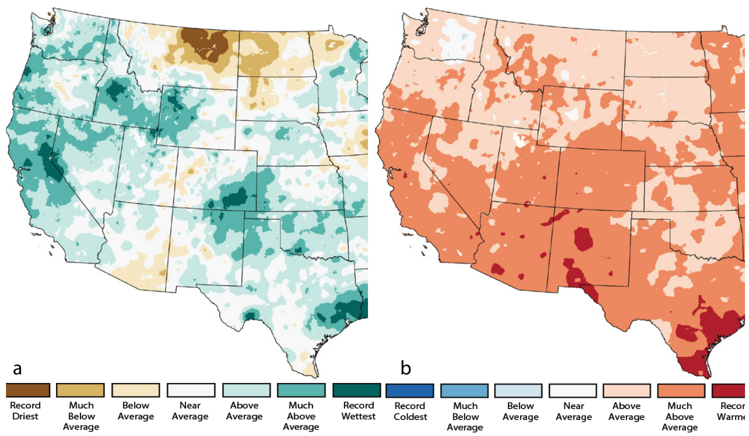


Figure 2: 2017 (Jan - Sept) Precipitation (a) & Temperature Ranks (b)

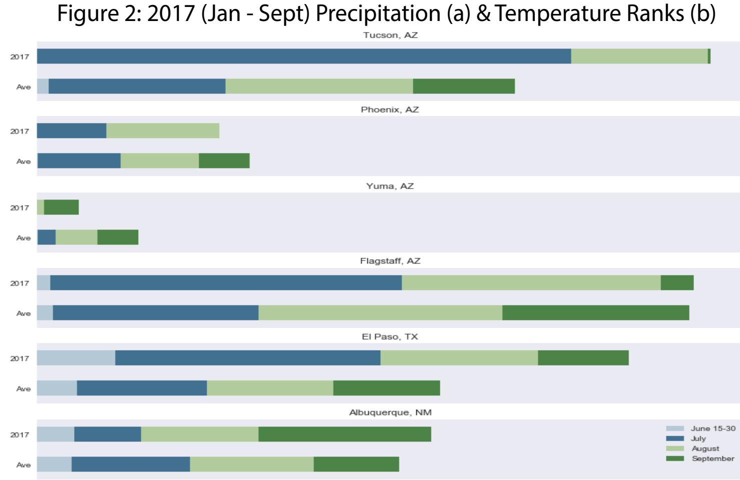


Figure 3: Monsoon Precip by Month - 2017 vs. Average (Source: NWS Tucson)

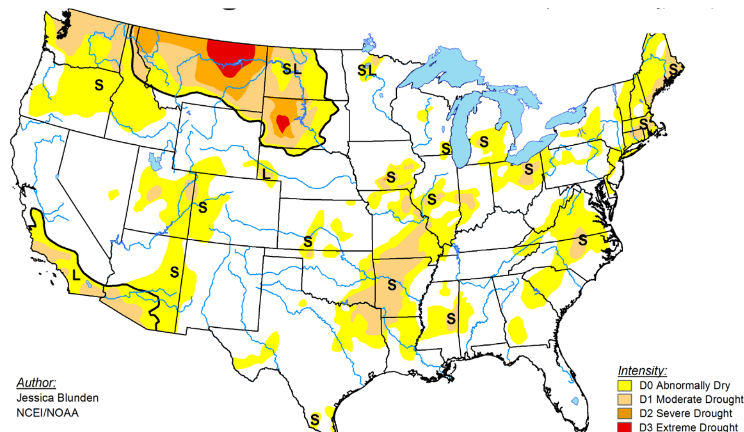


Figure 4: US Drought Monitor - Oct 17, 2017

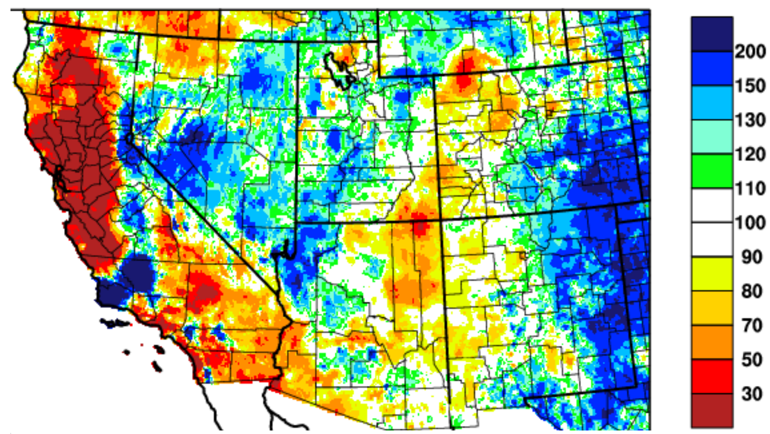


Figure 5a: Jul-Aug-Sept (2017) Precipitation Percent of 1981-2010 Normal

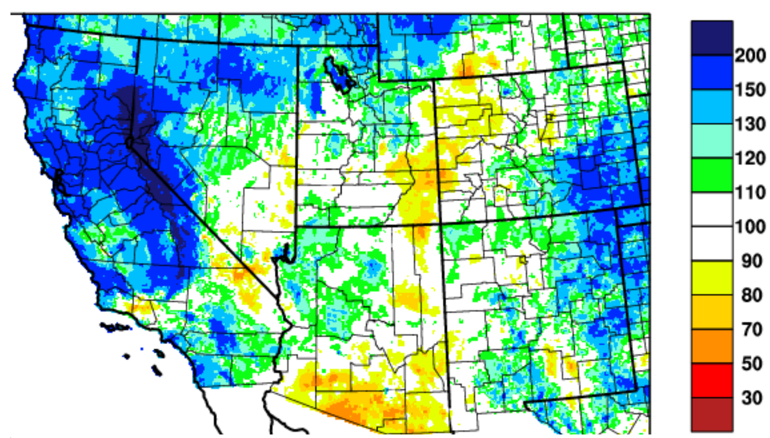


Figure 5b: Oct 2016 - Sept 2017 Precipitation Percent of 1981-2010 Normal

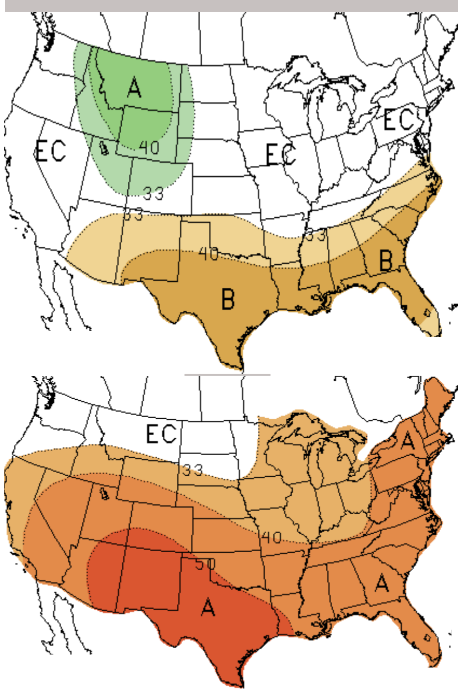


Figure 6: Three-Month Outlook - Precipitation (top) & Temperature (bottom) -Oct 19, 2017

Online Resources

Figure 1
Climate Science Applications Program
cals.arizona.edu/climate/

Figures 2-4
West Wide Drought Tracker
wrcc.dri.edu/wwdt/

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 North American Monsoon was quiet for much of the Southwest through early July. The rest of July was active and numerous locations approached or set single-month precipitation records. August saw a widespread shutdown of monsoon activity across much of Arizona, which lasted for the rest of the official season. During the same period, New Mexico saw more consistent precipitation activity, including a last gasp in late September when a cluster of storms hit both central and far southern parts of the state. Weather stations in regional metropolitan areas recorded mostly average to above-average totals (Fig. 3 on p.2), with the larger anomalies in Tucson and El Paso attributed to near-record July precipitation. Conversely, Yuma and Albuquerque had been lagging behind their seasonal averages but received late-season boosts to their seasonal totals. Precipitation rank maps reveal July was mostly above normal (top 33 percent) and much-above normal (top 10 percent) across nearly all of Arizona and much of western and northern New Mexico (Fig. 1). August flipped that script, with most of Arizona and western New Mexico recording below-normal or much-below-normal precipitation, and with a large pocket of dry conditions centered over the Four Corners region even while eastern New Mexico was much-above normal to record wettest (Fig. 2). September was a variation on that theme, with most of Arizona and southwestern New Mexico recording below-normal or much-below-normal precipitation while northwestern Arizona and northern and eastern New Mexico recorded above-normal to much-above-normal precipitation (Fig. 3). The cumulative seasonal precipitation totals diminish the more extreme monthly variations (Fig. 4), with percent of total and days with rain revealing a high degree of spatial heterogeneity of precipitation totals and frequency across the region (Figs. 5-6 on p.4).

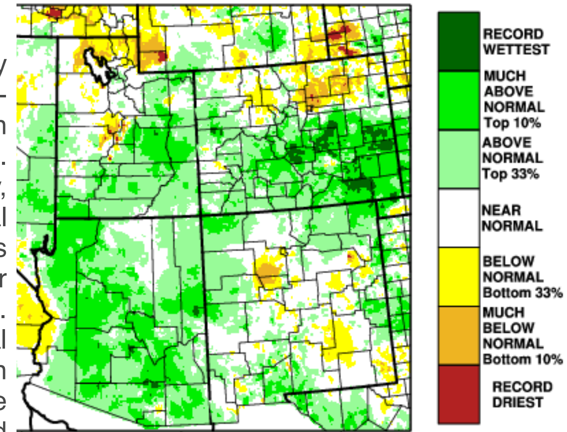


Figure 1: July 2017 Precipitation Percentile

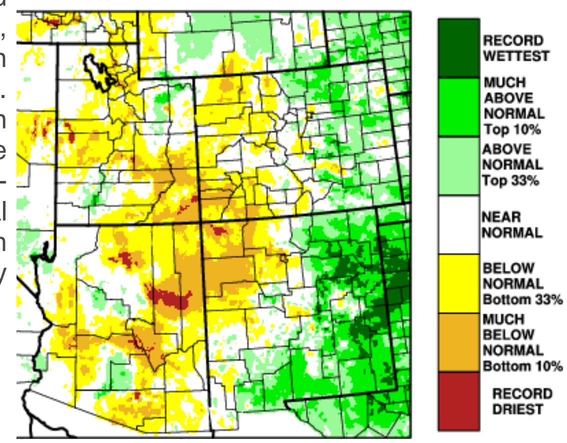


Figure 2: August 2017 Precipitation Percentile

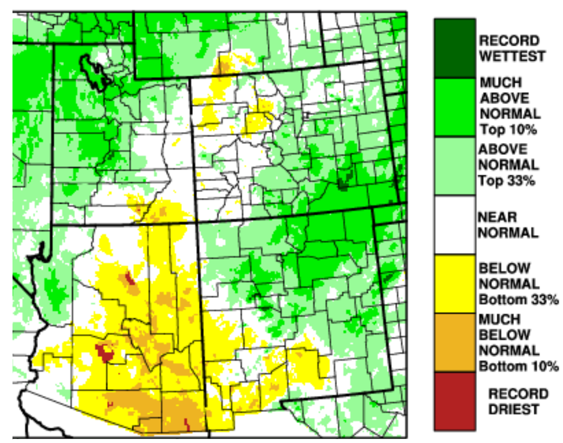


Figure 3: Sept 2017 Precipitation Percentile

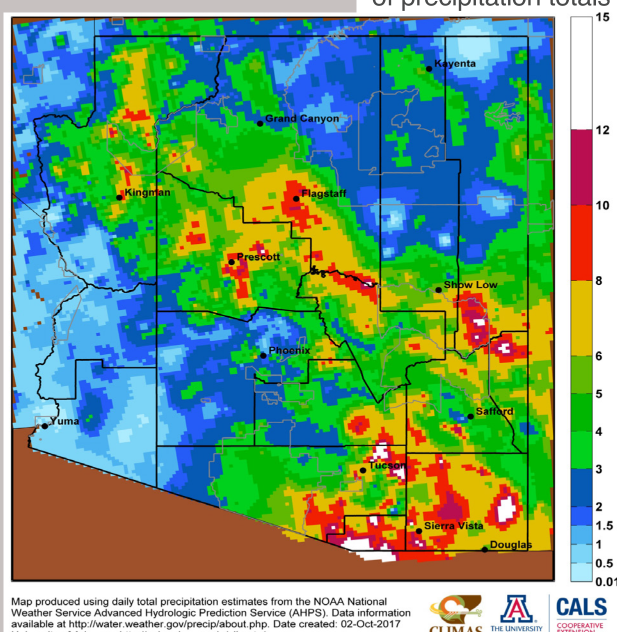


Figure 4a: Total Monsoon Rainfall (AZ) - Jun 15 - Sep 30

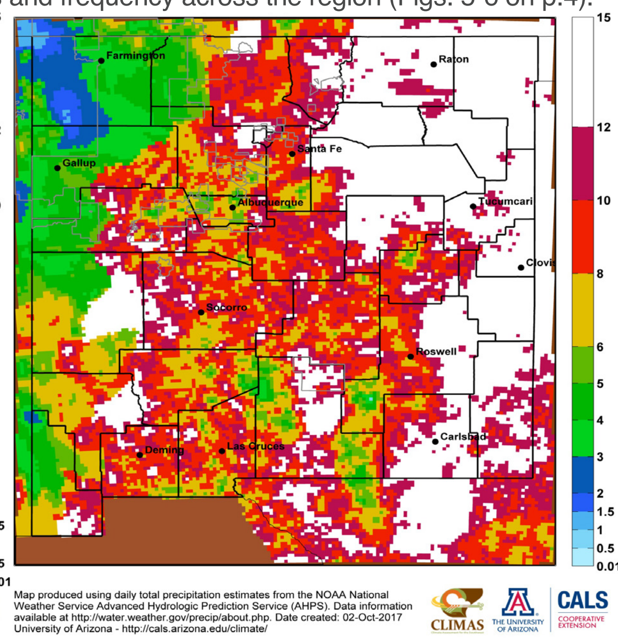


Figure 4b: Total Monsoon Rainfall (NM) - Jun 15 - Sep 30

Southwestern Monsoon Tracker

Online Resources

Figures 5-6
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

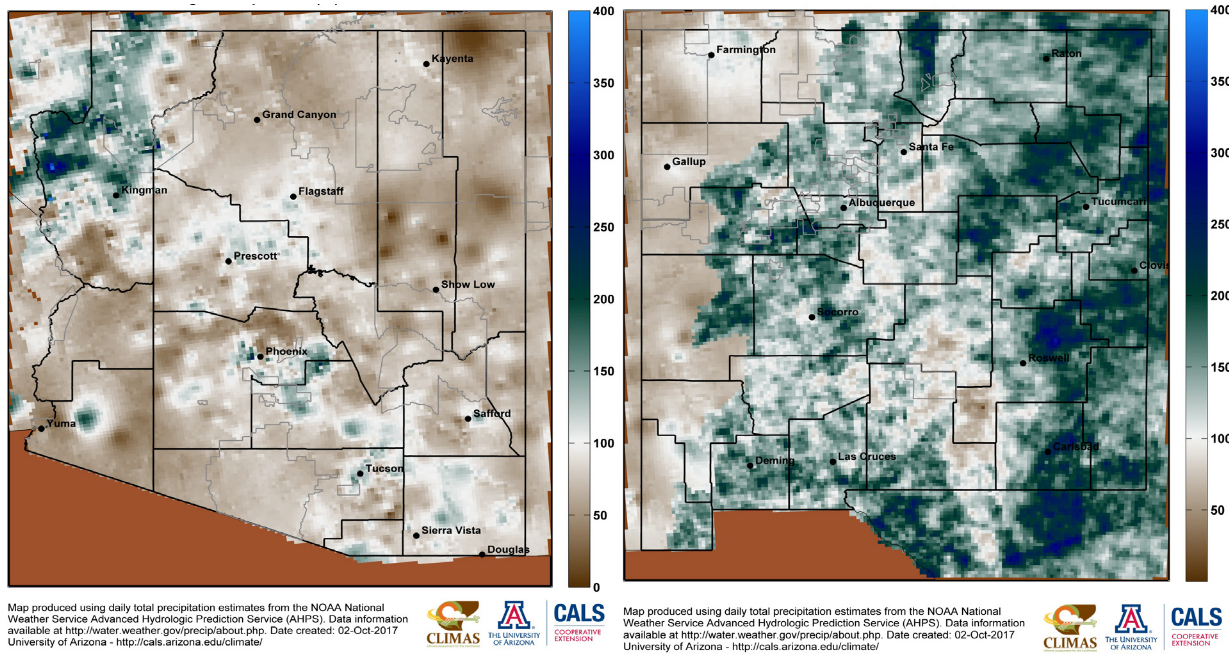


Figure 5a-b: Percent of Average Precipitation - Jun 15 - Sept 30, 2017

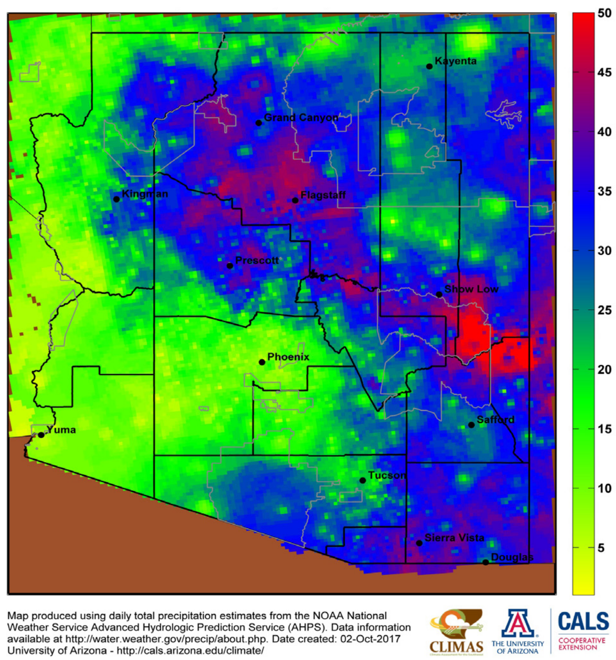


Figure 6a: AZ Percent of Days With Rain (>0.01") - Jun 15 - Sep 30

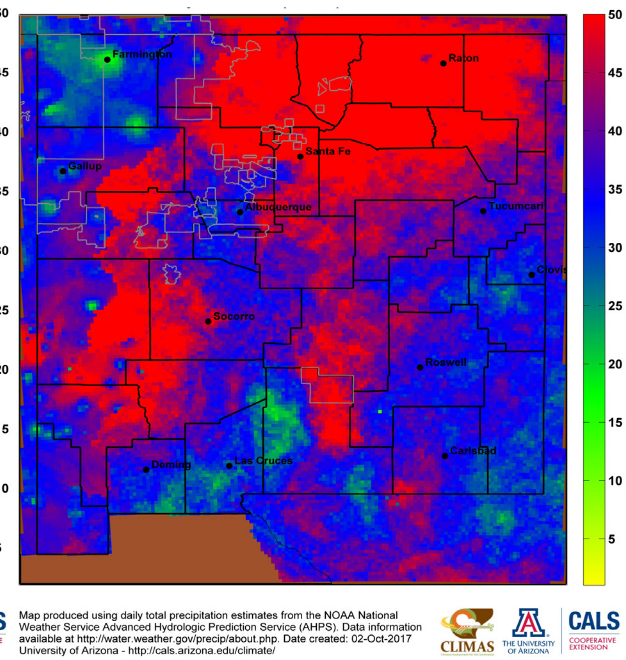


Figure 6b: NM Percent of Days With Rain (>0.01") - Jun 15 - Sep 30

Online Resources

Figures 7a-c
Climate Science Applications Program
cals.arizona.edu/climate/

Figure 8
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.)

Cumulative precipitation maps help illustrate where monsoon precipitation fell, and the monthly maps on p.3 narrow down when it fell, but a closer look at individual stations reveals the variety of ways the monsoon can progress. The cumulative plot for Tucson (KTUS: Fig. 7a) shows the slightly-behind-normal start, the strong series of storms from mid-July to early August, and the complete shutdown of monsoon activity after mid-August. Albuquerque, on the other hand, had an early event but then lagged behind the seasonal total for most of the monsoon before a run of storms pushed the city just over its seasonal average at the end of September (KABQ: Fig. 7b). El Paso looks to be the best of both worlds, with an early start, a strong set of storms in the middle, and a season-ending event that pushed the total even further past the seasonal average (KELP: Fig. 7c). A closer look at the daily rainfall totals reveals a vast majority of El Paso's monsoon rainfall fell during a small number of intense rainfall events. Each of the three cities had similar overall results – above-average monsoon totals – but each followed a different pattern to reach those totals.

CLIMAS developed an experimental product using the Pima County ALERT network data that further reveals the range of precipitation totals that occur during monsoon events. Figure 8 plots the daily precipitation totals from the KTUS NWS station used for Figure 7a, along with the range of precipitation totals recorded at the various network stations around Pima county.

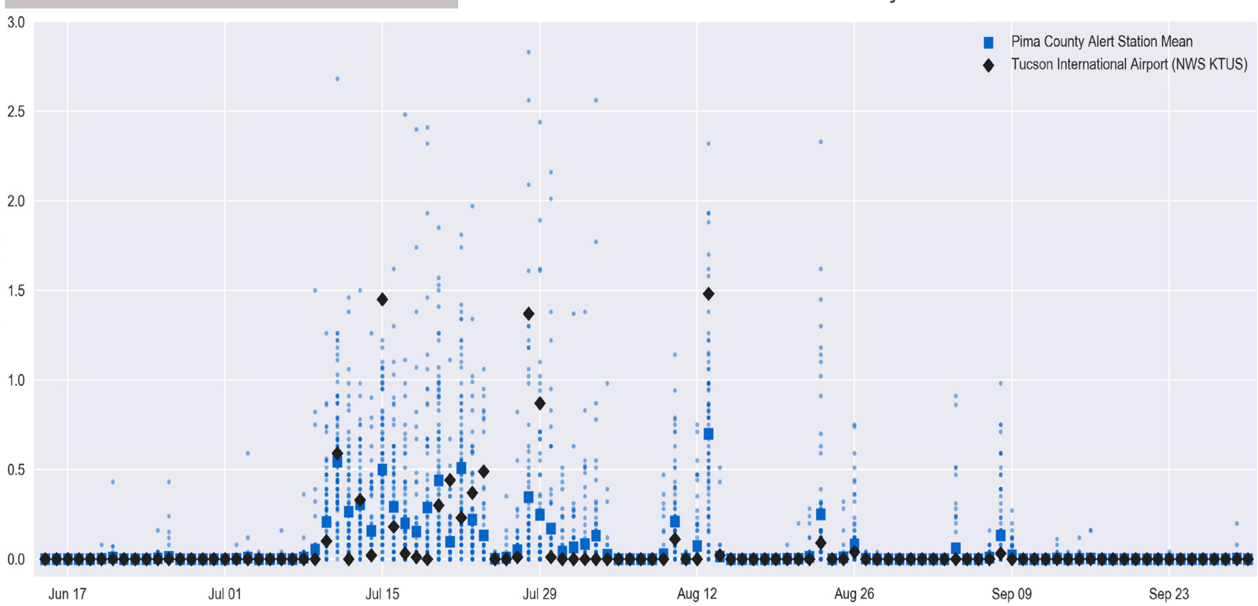


Figure 8: Daily Monsoon Precipitation - Pima County ALERT Network (Blue) & Tucson International Airport (Black)

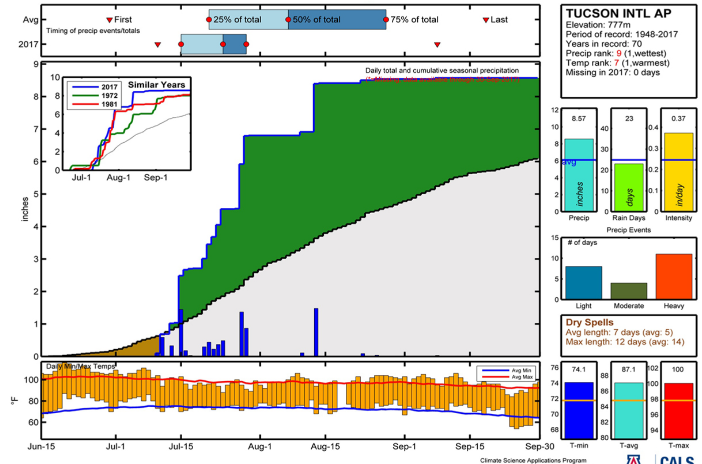


Figure 7a: Tucson (KTUS) 2017 Monsoon Summary

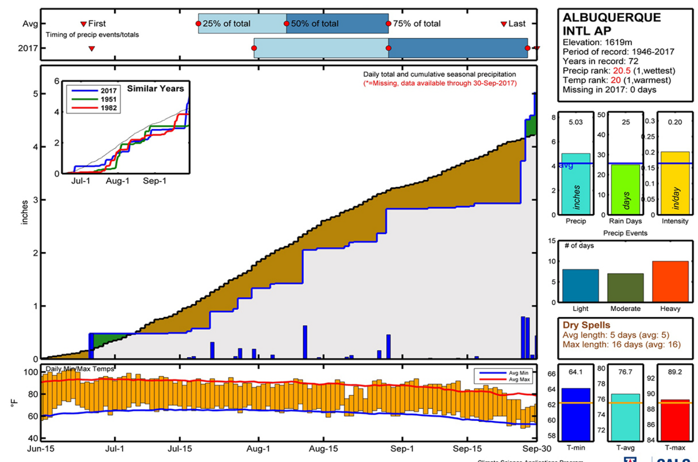


Figure 7b: Albuquerque (KABQ) Monsoon Summary

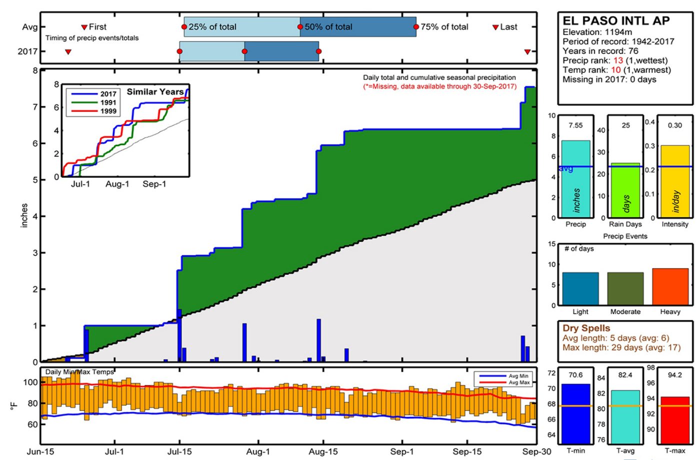


Figure 7c: El Paso (KELP) 2017 Monsoon Summary

Online Resources

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

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

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

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

International Research Institute for Climate and Society
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 remain generally within the range of ENSO-neutral but have shifted more towards La Niña conditions in the past month (Figs. 1-2). Most seasonal outlooks and forecasts reflect these changes, and continue to call for the formation of a La Niña event as the most likely outcome by the end of fall and continuing into this winter. On Oct. 10, the Australian Bureau of Meteorology noted that all oceanic and atmospheric indicators remained ENSO-neutral, and highlighted recent short-term warming of sea surface temperatures in the tropical Pacific after a longer period of cooling. On Oct. 11, the Japanese Meteorological Agency (JMA) forecast a 50-50 chance of either ENSO-neutral conditions persisting through winter or La Niña conditions developing in fall or winter. On Oct. 12, the NOAA Climate Prediction Center (CPC) observed that while oceanic and atmospheric conditions remained ENSO-neutral, they had "edged closer to La Niña conditions," with a 55- to 65-percent chance of a La Niña event this winter. On Oct. 19, the International Research Institute for Climate and Society (IRI) and CPC briefing noted further short-term cooling in sea surface temperatures, and forecast a 70-percent chance of La Niña by the end of 2017. The North American Multi-Model Ensemble (NMME) is borderline weak La Niña as of October 2017 (Fig. 4), with a majority of the models predicting a weak La Niña this winter.

Summary: The seasonal outlooks have turned more bullish on a weak La Niña event developing this fall, if you can call tentative forecasts that hint at the possibility of a short and weak La Niña "bullish." Despite the fact that many ENSO indicators have remained within the range of neutral, forecasters are seeing enough evidence in the data to be relatively certain that a La Niña event is the most likely outcome this winter. It is late in the forecast window for so much uncertainty about the upcoming winter; the signal is usually clearer by mid-October. Last year, the sea surface temperature anomalies had already consolidated into weak La Niña status by October, whereas this year there is still quite a bit of movement around the boundary between ENSO-neutral and weak La Niña. Given the warmer- and drier-than-average winter conditions associated with La Niña in the Southwest, the possibility of a La Niña forming might generate concern regarding winter precipitation and persistent drought in the Southwest. However, it may not ultimately make much difference whether the conditions resolve into weak La Niña or borderline weak ENSO-neutral: southwestern winters are relatively dry and neither scenario is likely to bring much precipitation.

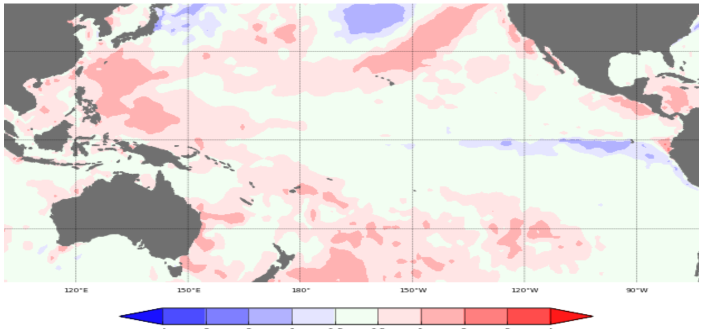


Figure 1: Sept 2017 Sea Surface Temperature (SST) Anomalies

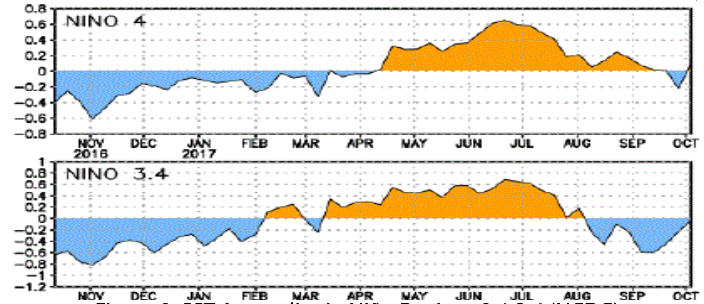


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

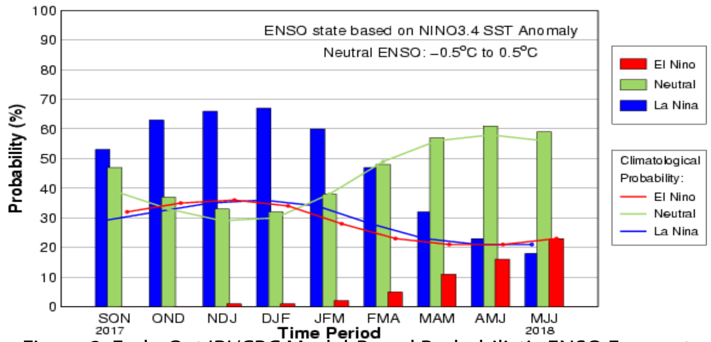


Figure 3: Early-Oct IRI/CPC Model-Based Probabilistic ENSO Forecast

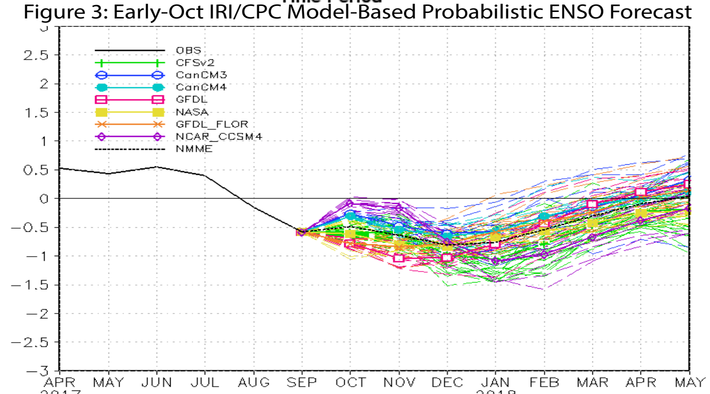


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

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

Arizona: usa.gov/19e2BdJ

New Mexico: 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).

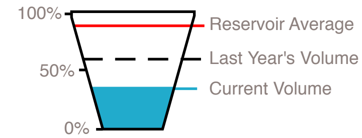
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons).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

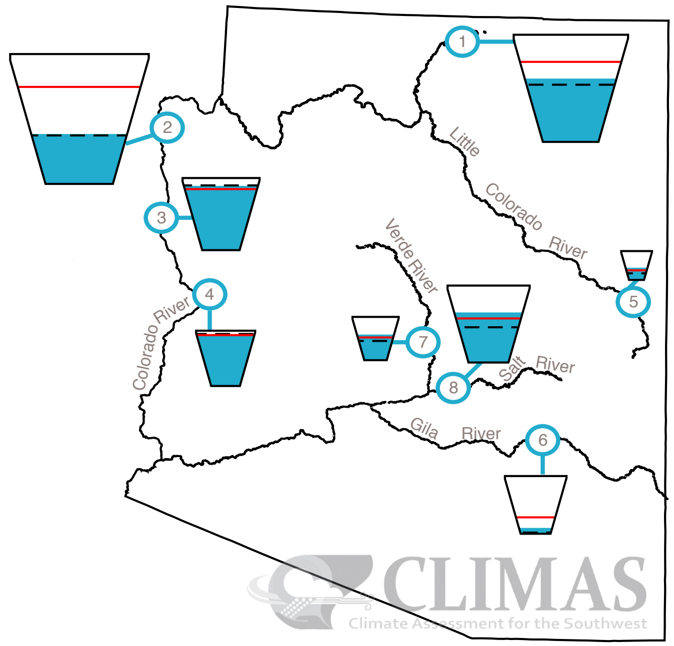
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

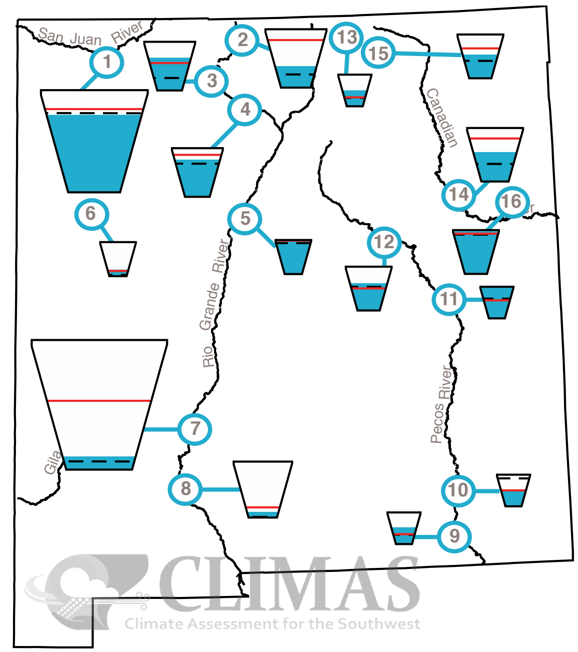
Reservoir Volumes

DATA THROUGH SEPTEMBER 30, 2017

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	60%	14,664.4	24,322.0	-287.2
2. Lake Mead	39%	10,190.0	26,159.0	59.0
3. Lake Mohave	89%	1,602.0	1,810.0	-90.0
4. Lake Havasu	91%	566.2	619.0	-21.4
5. Lyman	43%	13.0	30.0	-1.5
6. San Carlos	10%	83.9	875.0	-27.4
7. Verde River System	59%	170.7	287.4	-5.1
8. Salt River System	65%	1,315.1	2,025.8	-59.9

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	76%	1,288.9	1,696.0	-34.6
2. Heron	37%	148.4	400.0	-25.7
3. El Vado	67%	127.6	190.3	-7.6
4. Abiquiu	77%	143.8	186.8	1.5
5. Cochiti	95%	47.5	50.0	-0.2
6. Bluewater	19%	7.2	38.5	-0.3
7. Elephant Butte	10%	227.3	2,195.0	-57.9
8. Caballo	10%	34.5	332.0	-26.5
9. Lake Avalon	53%	2.4	4.5	0.3
10. Brantley	48%	20.2	42.2	-6.4
11. Sumner	100%	49.8	102.0	28.5
12. Santa Rosa	63%	66.6	105.9	16.7
13. Costilla	51%	8.2	16.0	8.2
14. Conchas	41%	137.0	254.2	32.1
15. Eagle Nest	54%	41.8	79.0	0.8
16. Ute Reservoir	90%	182	200	16.0

CLIMAS
Research & Activities

CLIMAS Research

climas.arizona.edu/research/

CLIMAS Outreach

climas.arizona.edu/outreach

Climate Services

climas.arizona.edu/climate-services

CLIMAS YouTube Channel

youtube.com/user/UACLIMAS

CLIMAS New Project Showcase

Archived presentation videos now on YouTube

Videos of the presentations (slides + audio) for the CLIMAS new project showcases (Sept 15 and 29) are now available on the CLIMAS YouTube channel.

youtube.com/user/UACLIMAS

CLIMAS
Climate Assessment for the Southwest
A NOAA RISA TEAM

Sept 15

Michael Crimmins: Evaluating Existing and Developing New Drought Indices Using Modeled Soil Moisture Time Series

https://www.youtube.com/watch?v=Tz2QFp2frek

George Frisvold: A Colorado River Shortage Declaration: Planning, Responses, and Consequences

https://www.youtube.com/watch?v=2fOUL9ZEZ7o

Stephanie C. Rainie: Southwest Tribal Data Summit: Partnering with Southwest Indigenous Communities to Identify Data and Information Needs, Issues, and Opportunities to Support Climate Resilience

https://www.youtube.com/watch?v=ndb94ITHjNU

Jeremy Weiss: Improved Understanding of Climate Variability and Change Relevant to Orchards and Vineyards in Arizona and New Mexico

https://www.youtube.com/watch?v=gfO1XlprMjY

Sept 29

Dave Dubois - Impacts of Climate Extremes to Interstate and Local Trucking Industry Across NM and AZ

https://www.youtube.com/watch?v=ljEAlwaaHu0

Ladd Keith - Evaluating the Use of Urban Heat Island and Heat Increase Modeling in Land Use Planning and Decision-Making

https://www.youtube.com/watch?v=6SgY3fhvhJw

Alison Meadow - Community Climate Profiles to Support Adaptation Planning

https://www.youtube.com/watch?v=6fnHPYQjF5I

Connie Woodhouse - Engagement-Driven Climate Science in the Lower Colorado River Basin (LCRB)

https://www.youtube.com/watch?v=HLSX-9YsMlA

Presentation audio was captured from the webinar stream using room microphones. These microphones make it easier to hear audience questions and discussion, but their automatic leveling results in occasional garbling of the audio during crosstalk, and the webinar stream is best listened to using headphones.

Online Resources

Figure 1
Climate Program Office
cpo.noaa.gov/

RISA Program Homepage
cpo.noaa.gov/ClimateDivisions/ClimateandSocietalInteractions/RISAProgram.aspx

UA Institute of the Environment
www.environment.arizona.edu/

New Mexico Climate Center
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.

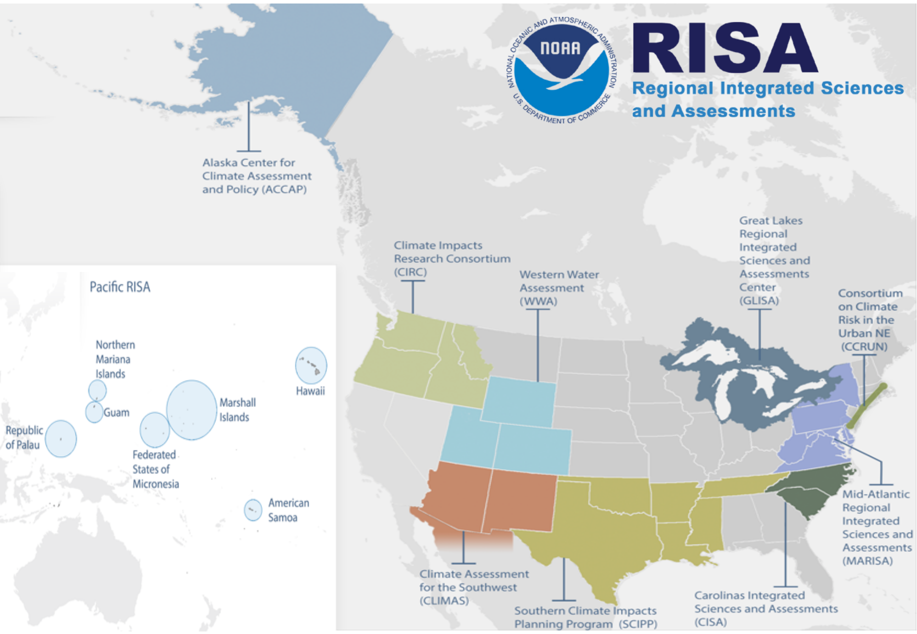


Figure 1: NOAA Regional Integrated Sciences and Assessments Regions

What does CLIMAS do?

The CLIMAS team and 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.

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 collaborations with natural and social scientists—like those that comprise CLIMAS—to help reduce risk and enhance resilience in the face of climate variability and change.