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# November Southwest Climate Outlook

**Precipitation & Temperature:** October precipitation was below average to record driest in Arizona, with the driest conditions occurring in the southwestern corner of the state (Fig. 1a). In New Mexico, precipitation was average to above average in the eastern half of the state, and average to below average in the western half (Fig 1a). October temperatures were above average to much-above average across both Arizona and New Mexico (Fig. 1b) except for small regions in the north and in eastern New Mexico. Thus far, November has been mostly dry in the Southwest (Fig. 2), while temperatures have mostly been above average (Fig. 3). Year-to-date precipitation ranges widely from much-below average in southeastern Arizona to much-above average in northeastern New Mexico (Fig. 4a). Year-to-date temperatures have been consistently warmer than average, with nearly all of Arizona and New Mexico recording much-above average temperatures, including pockets of record-warmest conditions in both states (Fig. 4b).

**Snowpack & Water Supply:** Snow water equivalent (SWE) is mostly below average across the Southwest, whereas the opposite has occurred in the Pacific Northwest (Fig. 5). Our dry conditions are partially attributable to persistent warm temperatures and relatively dry conditions in October and November. With the emergent weak La Niña event – and its associated warmer and drier conditions in the Southwest – the potential implications for drought and water resource management are something to watch over the winter season.

**Drought:** The trend of relatively widespread drought conditions in most of Arizona and western New Mexico continued this past month. The southern third of Arizona is mostly classified as D1 (moderate drought) with a small pocket of D2 (severe drought), while the northern two-thirds is mostly classified as D0 (abnormally dry) with pockets of D1. New Mexico is free of drought designation except for the western edge, which is classified as a mix of D0 and D1 (Fig. 6).

**ENSO & La Niña:** October saw the onset of a La Niña event that is expected to continue through at least winter 2018. However, the current forecast also suggests this will remain a weak La Niña event, for which correlations to below-average winter precipitation in the Southwest are not as evident (see La Niña Tracker on p. 3-4 for more details).

**Tropical Storms:** The 2017 eastern Pacific tropical storm season is winding down, and as of Nov. 16, 2017, there have been 18 named storms, including nine hurricanes and four major hurricanes – totals that fell within the expected range of the May 25 NOAA seasonal forecast for 14-20 named storms, including 6-11 hurricanes and 3-7 major hurricanes. Notably, while the eastern Pacific basin was active, very little of the mid-to-late season activity (September-October) reached the Southwest this year. In a typical year, the Southwest often sees a few mid-to-late season tropical storms curve back into the region. Those that arrive prior to Sept. 30 can help boost monsoon seasonal totals, while those that arrive after Oct. 1 can jumpstart water-year precipitation.

**Precipitation & Temperature Forecast:** The three-month outlook for December through February calls for increased chances of below-average precipitation for nearly all of Arizona and New Mexico (Fig. 7, top), and increased chances of above-normal temperatures for the entire southwestern United States (Fig. 7, bottom).

## Tweet Nov SW Climate Outlook

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NOV2017 @CLIMAS_UA SW Climate Outlook, La Niña Tracker, Reservoir volumes http://bit.ly/2hymRID #SWclimate #AZWX #NMWX #SWCO

# November 2017 SW Climate Outlook

## Online Resources

**Figures 1,4**
**National Center for Environmental Information**
www.ncdc.noaa.gov

**Figures 2-3**
**High Plains Regional Climate Center**
www.hprcc.unl.edu

**Figure 5**
**Western Regional Climate Center**
wrcc.dri.edu

**Figure 6**
**U.S. Drought Monitor**
droughtmonitor.unl.edu/

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

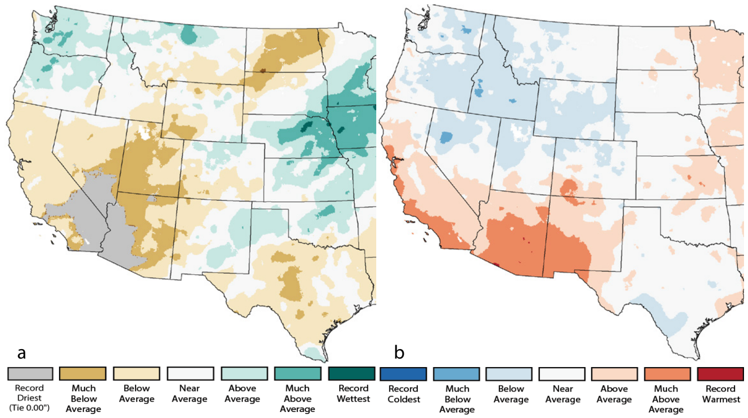



Figure 1: Oct 2017 Precipitation (a) & Temperature Ranks (b)

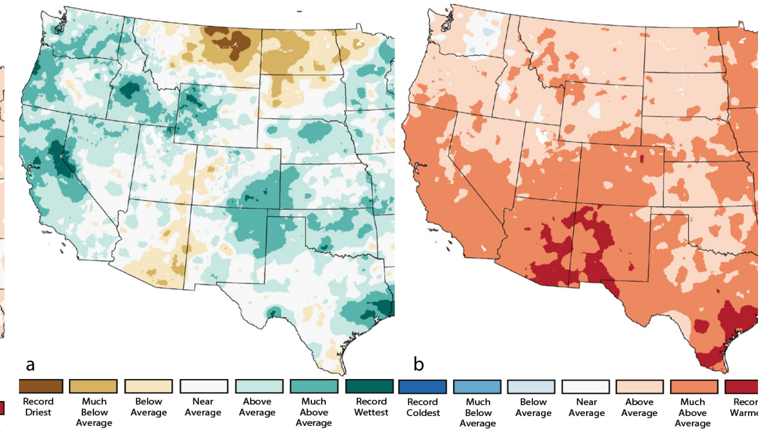



Figure 4: 2017 (Jan - Oct) Precipitation (a) & Temperature Ranks (b)

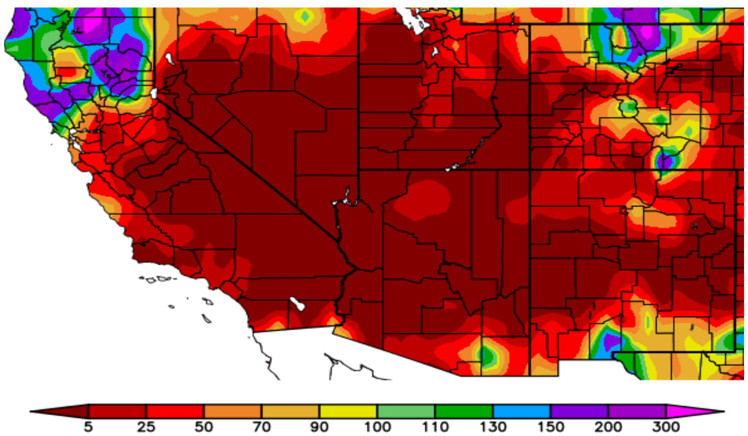



Figure 2: Nov 1 - Nov 14, 2017 - Precipitation Percent of Normal

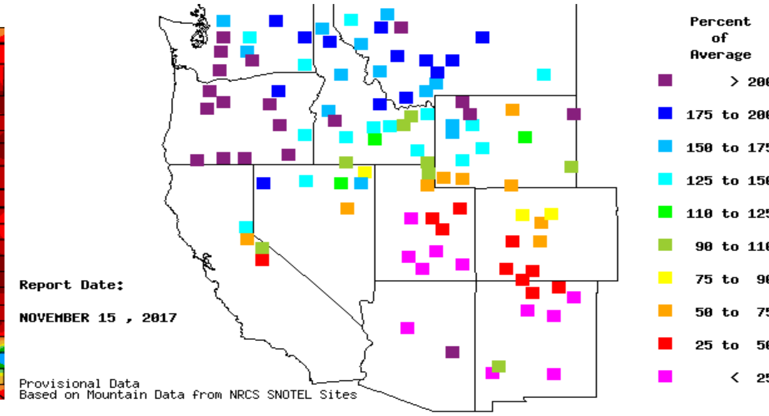



Figure 5: Basin Percent of Average Snow Water Content

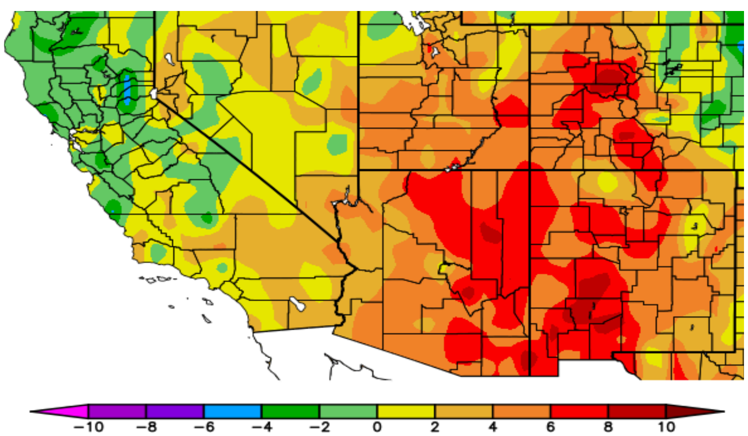



Figure 3: Nov 1 - Nov 14, 2017 - Temperature Departure from Normal

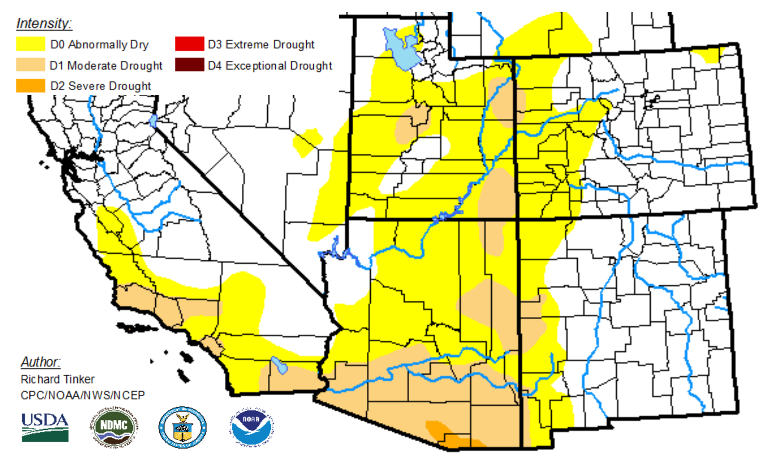



Figure 6: US Drought Monitor - Nov 14, 2017

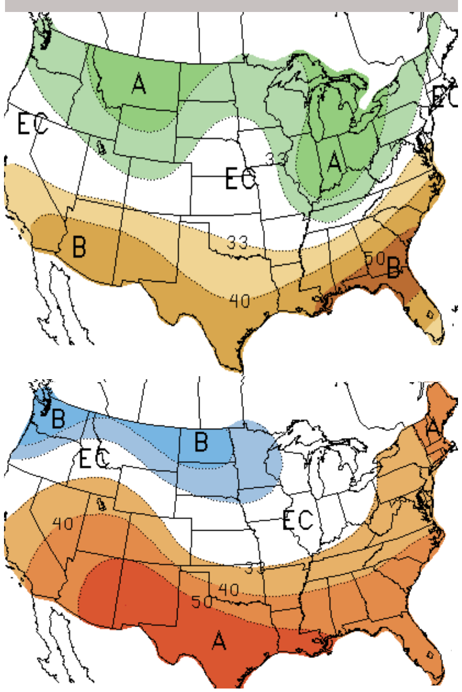



Figure 7: Three-Month Outlook - Precipitation (top) & Temperature (bottom) - Nov 16, 2017

## 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

# La Niña Tracker

Most models now suggest that a weak La Niña event has emerged (Figs. 1-2) and is likely to last through this winter. On Nov. 8, the Australian Bureau of Meteorology called for a 50-percent chance of La Niña forming in 2017, noting that while sea-surface temperatures had cooled, the cooling had stalled, whereas atmospheric indicators had shifted slightly toward weak La Niña. On Nov. 9, the NOAA Climate Prediction Center (CPC) took a stronger stance, identifying the emergence of La Niña conditions in October and calling for a 65- to 75-percent chance of the event lasting through the winter. The CPC forecast consensus took into account below-average sea-surface and sub-surface temperatures as well as atmospheric indicators of La Niña conditions. On Nov. 10, the Japanese Meteorological Agency (JMA) also determined that La Niña conditions had emerged, and called for a 60-percent chance of these conditions lasting long enough to meet the JMA criteria for a La Niña event. The North American Multi-Model Ensemble (NMME) nudged back toward borderline ENSO-neutral conditions in October 2017 (Fig. 4), but a majority of the models predict a swing into weak La Niña this winter while some even veer into moderate La Niña. Notably, very few of the models in the ensemble predict an ENSO-neutral event this winter.

**Summary**: The seasonal outlooks have mostly converged on a weak La Niña event having formed, and most predict these conditions will persist through February 2018. As noted in last month's Tracker, the signal is usually clearer by mid-October, but this year there was quite a bit of movement around the boundary between ENSO-neutral and weak La Niña well into the fall. Given the warmer- and drier-than-average winter conditions associated with La Niña in the Southwest, its likely presence may heighten ongoing concerns regarding winter precipitation and persistent drought. Southwestern winters are already relatively dry, however, so the emergence of a weak La Niña doesn't necessarily ensure an exceptionally dry winter, it just takes wetter-than-average winters off the table, based on past La Niña events (see following page for a few examples).

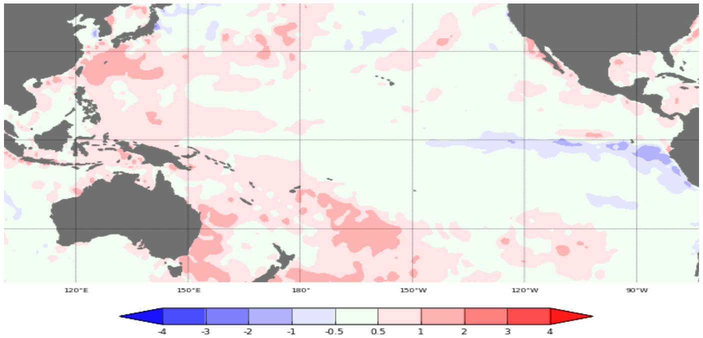


Figure 1: Oct 2017 Sea Surface Temperature (SST) Anomalies

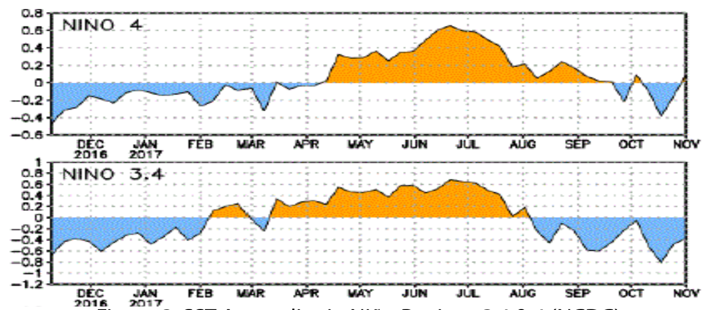


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

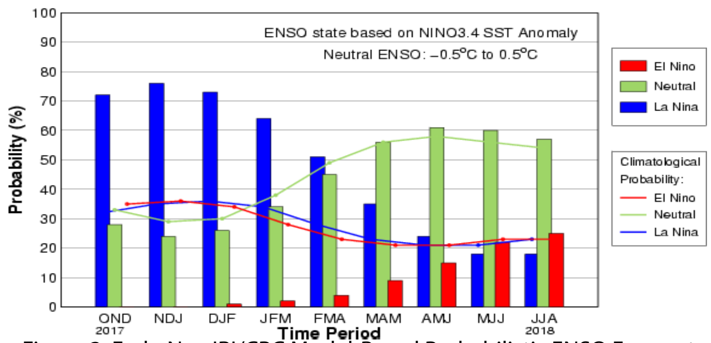


Figure 3: Early-Nov IRI/CPC Model-Based Probabilistic ENSO Forecast

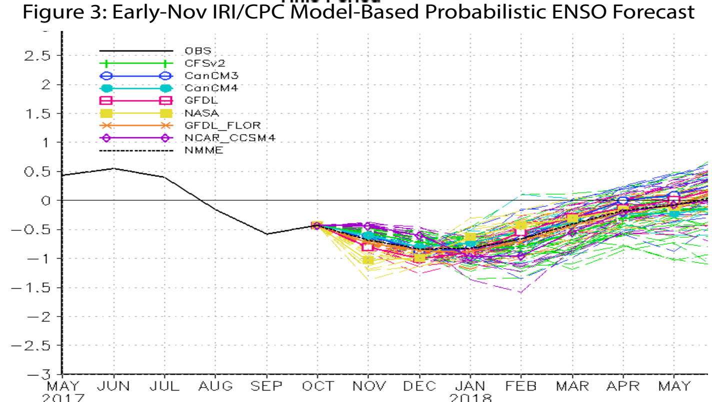


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

# Online Resources

**Figures 5-6**
**UA Climate Science Applications Program**
cals.arizona.edu/climate/

**Figure 7-8**
**CLIMAS: Climate Assessment for the Southwest**
climas.arizona.edu

# 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

# La Niña Tracker (cont.)

Looking more closely at winter Dec-Feb (DJF) precipitation, most weak La Niña events (ENSO Index Value between -0.5 and -1.0) recorded below-average precipitation, although a few years (1968, 1985) are notable outliers (Figs. 5-6). Looking at the monthly breakdown of weak La Niña events reveals that while the DJF totals for Tucson, AZ and Las Cruces, NM are mostly below average (Figs. 7-8), there have been some individual months that recorded precipitation above the monthly average (represented by black lines on the plots). The most likely outcome is below-average precipitation totals for the winter season, but the way that these events unfold will have an impact on how residents of the Southwest perceive and experience this La Niña event.

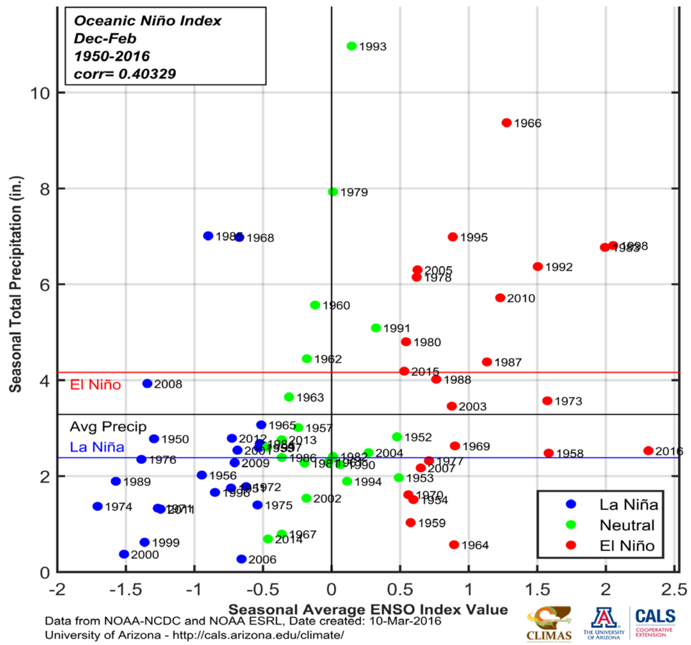



Figure 5: Arizona Climate Division 7 - ENSO vs. Winter (DJF) Precipitation

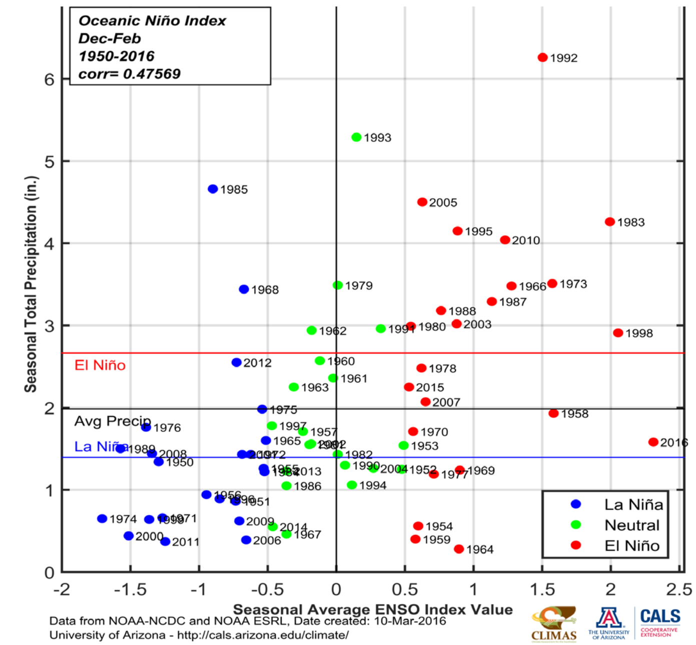



Figure 6: New Mexico Climate Division 8 - ENSO vs. Winter (DJF) Precip

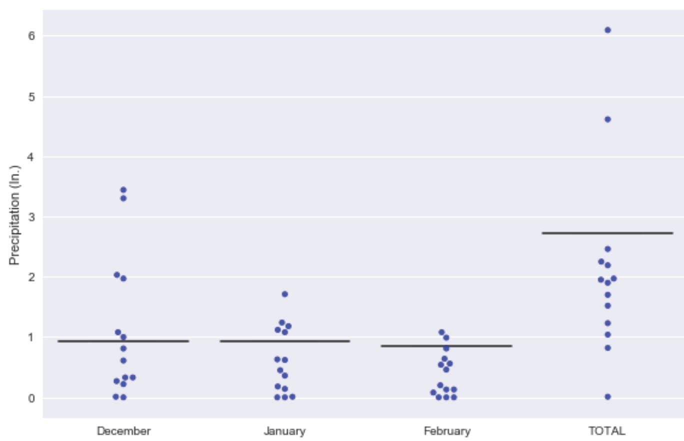



Figure 7 - Weak La Niña Winter (DJF) Precipitation - Tucson, AZ

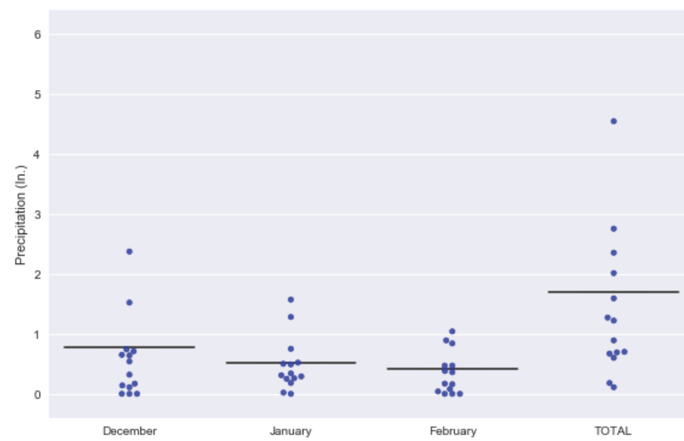



Figure 8 - Weak La Niña Winter (DJF) Precipitation - Las Cruces, NM

## 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).

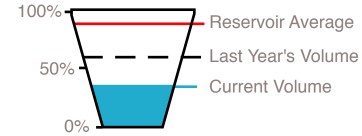
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons).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

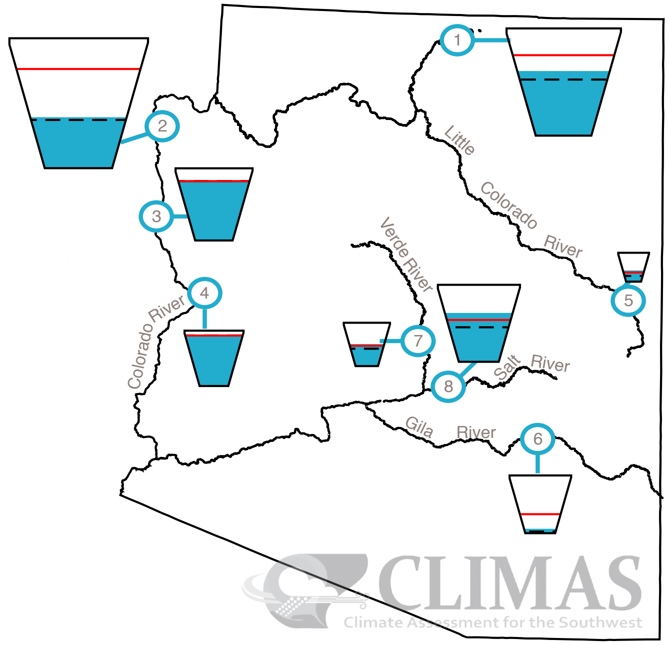
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

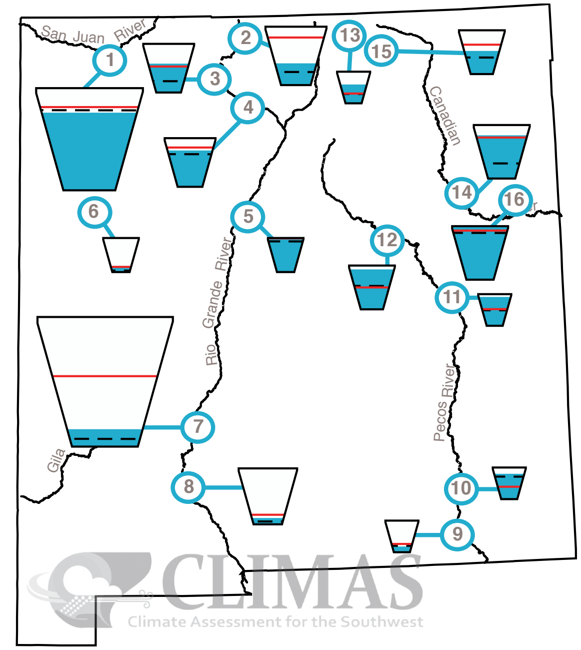
# Reservoir Volumes

DATA THROUGH OCTOBER 31, 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% | 14,529.5 | 24,322.0 | -134.9 |
| 2. Lake Mead | 39% | 10,202.0 | 26,159.0 | 12.0 |
| 3. Lake Mohave | 83% | 1,506.0 | 1,810.0 | -96.0 |
| 4. Lake Havasu | 89% | 549.9 | 619.0 | -16.3 |
| 5. Lyman | 39% | 11.8 | 30.0 | -1.2 |
| 6. San Carlos | 8% | 68.7 | 875.0 | -15.2 |
| 7. Verde River System | 51% | 146.3 | 287.4 | -24.4 |
| 8. Salt River System | 63% | 1,283.7 | 2,025.8 | -31.4 |

*KAF: thousands of acre-feet

| Reservoir | Capacity | Current Storage* | Max Storage* | One-Month Change in Storage* |
|---|---|---|---|---|
| 1. Navajo | 76% | 1,296.4 | 1,696.0 | 7.5 |
| 2. Heron | 37% | 149.4 | 400.0 | 1.0 |
| 3. El Vado | 59% | 111.4 | 190.3 | -16.2 |
| 4. Abiquiu | 75% | 139.3 | 186.8 | -4.5 |
| 5. Cochiti | 96% | 47.8 | 50.0 | 0.3 |
| 6. Bluewater | 18% | 6.9 | 38.5 | -0.3 |
| 7. Elephant Butte | 14% | 297.9 | 2,195.0 | 70.6 |
| 8. Caballo | 11% | 35.6 | 332.0 | 1.1 |
| 9. Lake Avalon | 18% | 0.8 | 4.5 | -1.6 |
| 10. Brantley | 80% | 33.9 | 42.2 | 13.7 |
| 11. Sumner | 91% | 32.7 | 102.0 | -17.1 |
| 12. Santa Rosa | 91% | 96.2 | 105.9 | 29.6 |
| 13. Costilla | 59% | 9.5 | 16.0 | 1.2 |
| 14. Conchas | 80% | 204.5 | 254.2 | 67.5 |
| 15. Eagle Nest | 53% | 42.1 | 79.0 | 0.3 |
| 16. Ute Reservoir | 100% | 206 | 200 | 13.0 |

# 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.

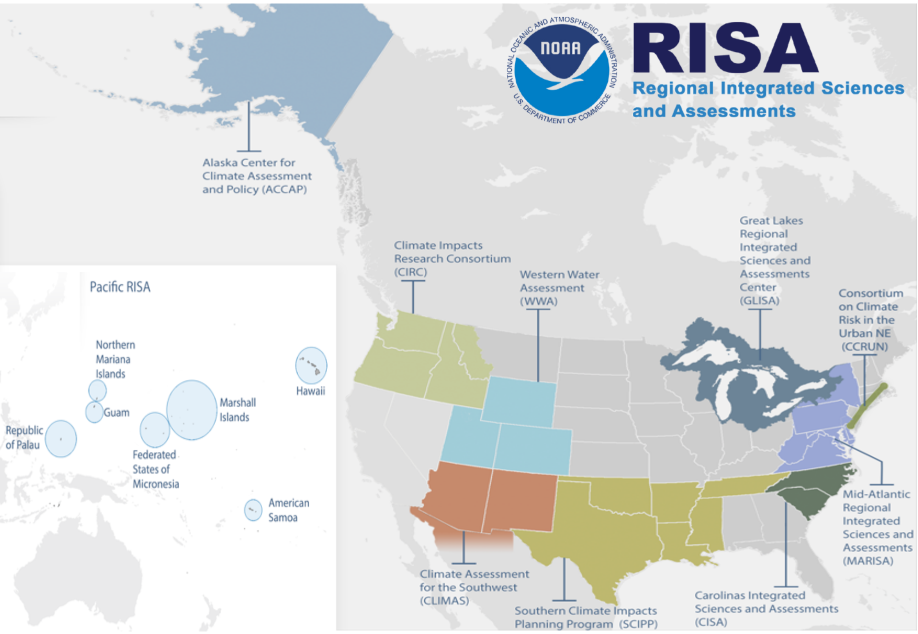



Figure 1: NOAA Regional Integrated Sciences and Assessments Regions

## 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.