Contributors

Ben McMahan
SWCO Editor; Research, Outreach & Assessment Specialist (CLIMAS)

Mike Crimmins
UA Extension Specialist

Stephanie Doster
Institute of the Environment Editor

Dave Dubois
New Mexico State Climatologist

Gregg Garfin
Founding Editor and Deputy Director of Outreach, Institute of the Environment

Nancy J. Selover
Arizona State Climatologist

Published by the Climate Assessment for the Southwest (CLIMAS), with support from University of Arizona Cooperative Extension, the Arizona State Climate Office, and the New Mexico State Climate office.

December Southwest Climate Outlook

Precipitation & Temperature: November precipitation totals were average to above average in Arizona's climate divisions, and above average to much above average in New Mexico's climate divisions (Fig. 1a). November temperatures were much above average across most of Arizona and all of New Mexico (Fig. 1b). This continued a trend of warm temperatures this fall, with parts of Arizona and New Mexico recording record warm temperatures in October and November (Fig. 2). Very little precipitation has fallen in December. This is not unexpected, as the Southwest generally receives limited precipitation between the end of the monsoon and early fall tropical storm activity and the uptick in precipitation in mid-winter into spring (when much of the cool season precipitation falls in the region). Temperatures in December have been mostly above normal in Arizona and western New Mexico, with cooler-than-normal temperatures in eastern New Mexico (Fig. 3). The upcoming polar vortex in the upper midwestern and eastern U.S., in addition to atmospheric river activity off the U.S. Pacific Coast, should shift this pattern in the latter half of December.

Snowpack & Water Supply: Warm temperatures continue to limit early season snowpack across the West, and snow water equivalent (SWE) values are below average across much of the region. As of December 14, most of the stations in Arizona and New Mexico were at or below 50–75 percent of normal, while stations in Colorado and Utah recorded 50–90 percent of normal and 90–125 percent of normal, respectively (Fig. 4). There is ongoing concern that continued drought conditions may lead to water supply restrictions (see Reservoir Volumes on page 5).

Drought: Long-term drought conditions persist across the Southwest (Fig. 5). According to the December 13 U.S. Drought Monitor, most of Arizona is designated as abnormally dry (D0) or experiencing moderate drought (D1). The far southwestern corner of the state is designated as experiencing severe drought (D2), reflecting the persistent multi-year drought conditions extending from central and Southern California. In New Mexico, most of the northern half of the state and pockets along the U.S.-Mexico border are designated as abnormally dry (D0).

ENSO & La Niña: Borderline weak La Niña conditions are present but are declining, with a likely return of neutral conditions during winter 2016–2017. The decline that most models and forecasts identify could limit the influence of La Niña on weather in the Southwest, although weak La Niña events have been less reliably dry compared to moderate and strong La Niña events. Regardless of the ENSO signal, the climate of the Southwest is inherently dry. The cool season already receives relatively low precipitation totals in a normal year, so La Niña conditions—weak or otherwise—are more likely than not to increase the chances of a drier-than-average winter. This is a concern, given the multi-year drought currently underway in the Southwest, along with the looming possibility of water restrictions in coming years if Lake Mead levels are forecast to drop below the 1,075-foot elevation threshold.

Precipitation & Temperature Forecasts: The December 15 NOAA Climate Prediction Center's outlook for January calls for increased chances of below-average precipitation and above-average temperatures. The three-month outlook for January through March also calls for increased chances of below-average precipitation (Fig. 6, top) and above-average temperatures (Fig. 6, bottom).

Tweet Dec SW Climate Outlook CLICK TO TWEET

DEC2016 @CLIMAS_UA SW Climate Outlook - SW Climate Summary, La Niña Tracker, Reservoir Volumes - http://bit.ly/2hyCdrE #SWclimate #AZWX #NMWX

ARIZONA CLIMAS Climate Assessment for the Southwest A NOAA RISA TEAM THE UNIVERSITY OF ARIZONA College of Agriculture & Life Sciences Cooperative Extension NM STATE UNIVERSITY

December Southwest Climate Outlook

Online Resources

Figure 1
National Center for Environmental Information
https://www.ncdc.noaa.gov

Figure 2
High Plains Regional Climate Center
http://www.hprcc.unl.edu/

Figures 3-4
Western Regional Climate Center
http://www.wrcc.dri.edu/

Figure 5
U.S. Drought Monitor
http://droughtmonitor.unl.edu/

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

CLIMAS YouTube Channel

Visit our YouTube channel for videos of content pulled from the podcast.

www.youtube.com/user/UACLIMAS/

Podcasts

Visit our website or iTunes to subscribe to our podcast feed.

www.climas.arizona.edu/media/podcasts

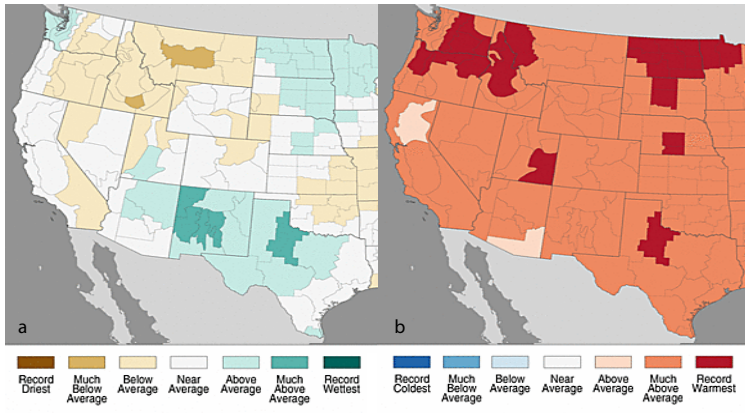


Figure 1: Nov 2016 Precipitation (a) & Temperature Ranks (b)

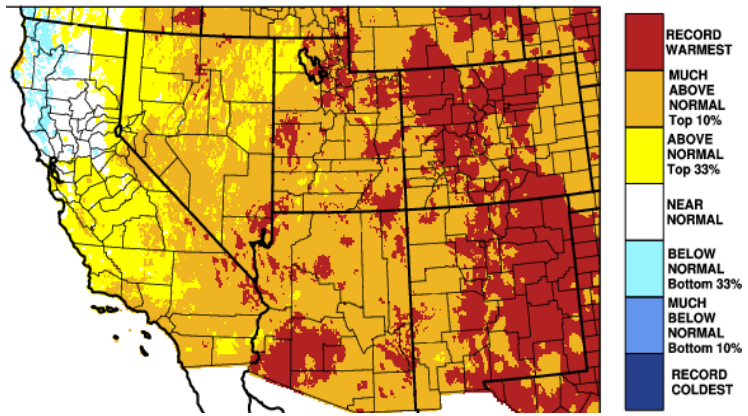


Figure 2: Oct-Nov 2016 Temperature Percentile

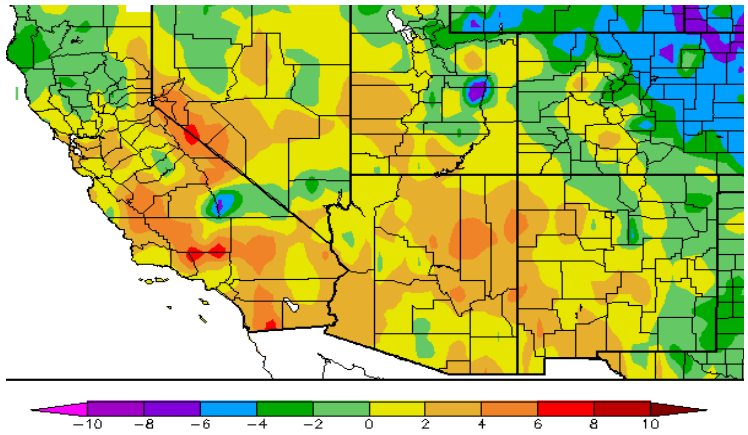


Figure 3: Departure from Normal Temperature December 2016

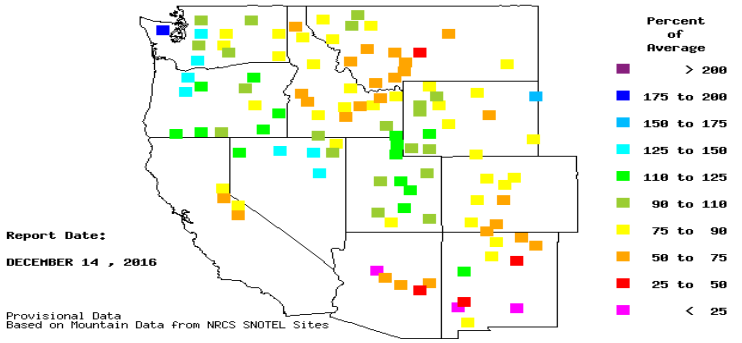


Figure 4: Basin Percent of Average Snow Water Content

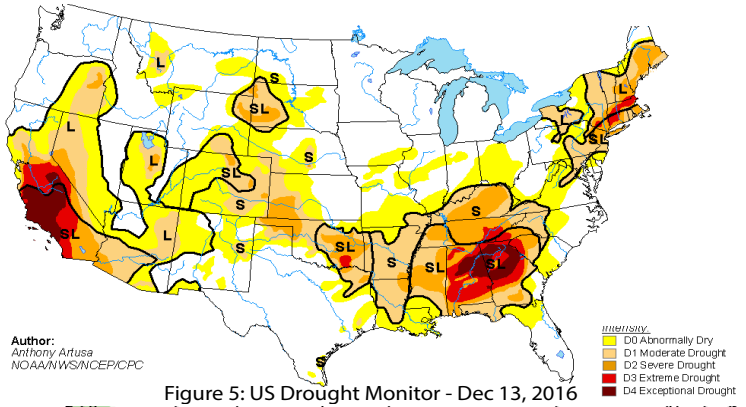


Figure 5: US Drought Monitor - Dec 13, 2016

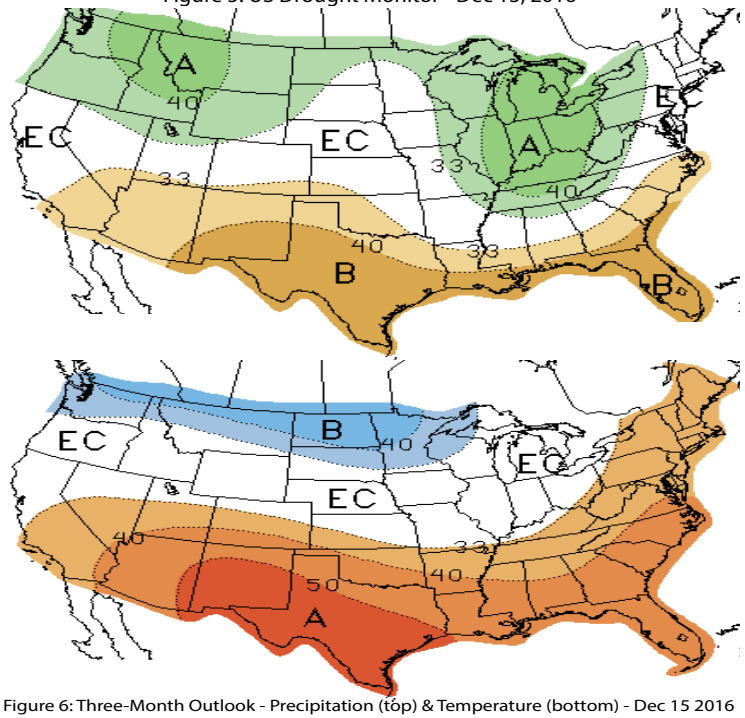


Figure 6: Three-Month Outlook - Precipitation (top) & Temperature (bottom) - Dec 15 2016

Online Resources

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

Figure 2
NOAA - National Climatic Data Center
http://www.ncdc.noaa.gov/teleconnections/enso/

Figure 3
International Research Institute for Climate and Society
http://iri.columbia.edu/our-expertise/climate/forecasts/enso/

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

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

Oceanic and atmospheric indicators of the El Niño-Southern Oscillation (ENSO) continue to indicate a weak La Niña event that is likely to last through mid-winter at least and perhaps into early spring (Figs. 1-2). The borderline weak status of the event, along with some discrepancy between the forecast agencies discussed here, means a more rapid transition to ENSO-neutral conditions cannot be ruled out. As with last month, there is some hedging in the forecasts and outlooks that likely stems from ongoing uncertainty as to whether the event can maintain even weak La Niña strength through winter 2017 (December–February). Fluctuations in forecasts and models are due to the limited coordination between oceanic and atmospheric conditions described in previous outlooks, "masking…by intra-seasonal activity" (as described by the CPC on Dec 8), and the difficulty in categorizing borderline conditions into a binary choice between weak La Niña and ENSO-neutral.

A closer look at the forecasts and seasonal outlooks continues to provide some insight into the range of expectations for a La Niña event this winter. On December 6, the Australian Bureau of Meteorology ended its La Niña Watch, declaring that La Niña is no longer likely in the coming months. They identified "very weak La Niña-like patterns," including cool sea surface temperature (SST) anomalies, but the cluster of conditions did not meet the bureau's threshold for designating an official La Niña event. On December 8, the NOAA Climate Prediction Center (CPC) maintained its La Niña advisory for an ongoing weak La Niña event, based on oceanic and atmospheric conditions during November, and forecast a transition to ENSO-neutral conditions during January–March 2017. On December 9, the Japanese Meteorological Agency identified the ongoing presence of La Niña conditions in the equatorial Pacific and forecast equal chances (50 percent) of this La Niña lasting through winter 2017 or a return to ENSO-neutral conditions. The agency also identified a 70 percent chance of ENSO-neutral conditions by spring 2017. On December 15, the International Research Institute for Climate and Society (IRI) and CPC forecasts identified a borderline weak La Niña event that was "just barely going," and forecast a likely rapid decline to ENSO-neutral conditions in winter 2017 (Fig. 3). The North American Multi-Model Ensemble (NMME) characterizes the current model spread and highlights the variability looking forward to 2017. The NMME mean already has risen above the La Niña threshold in the current run and is forecast to remain ENSO-neutral through the first half of 2017 (Fig. 4).

(continued on next page)

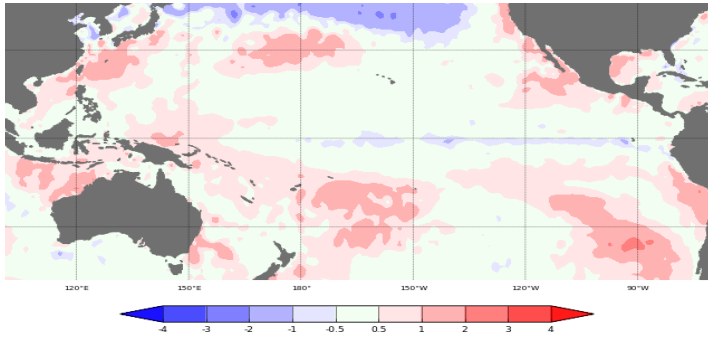


Figure 1: November 2016 Sea Surface Temperature (SST) Anomalies

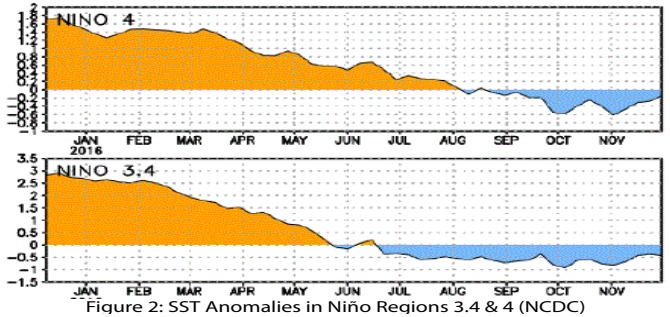


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

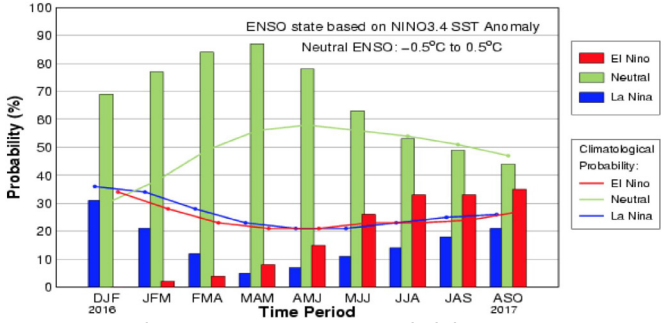


Figure 3: Mid-Dec IRI/CPC Consensus Probabilistic ENSO Forecast

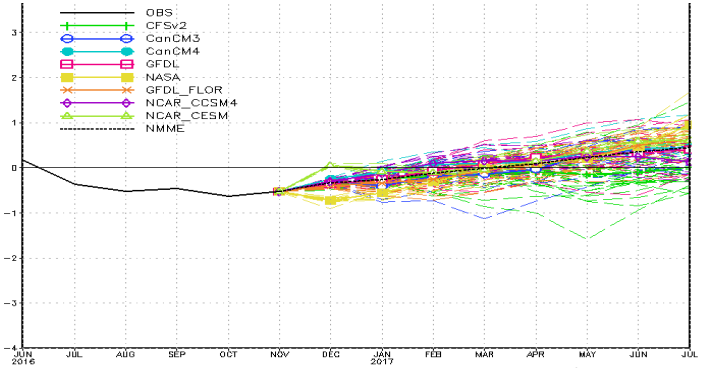


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

Figure 5
Climate Science Applications Program
http://cals.arizona.edu/climate

Figures 6a-6b
NOAA - Climate Prediction Center
http://www.cpc.ncep.noaa.gov/

Figure 7
IRI - International Research Institute for Climate and Society
http://iri.columbia.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 - continued

According to most forecasts, a weak La Niña remains in the cards for the Southwest during winter 2017, which is more likely than not to bring warmer- and drier-than-average conditions to the region over the cool season. Even if the event decays more rapidly than currently forecast and conditions tack back toward neutral conditions, borderline La Niña conditions still could affect temperature and precipitation patterns through the winter. Southwestern winters are relatively dry already; La Niña years tend to cluster on the dry end of the distribution (Fig. 5), so even a weak event could shift that seasonal pattern to an even drier state. Given the baseline climate of the Southwest, a weak La Niña event might not stand out, but snowpack and water supply could be affected going into the spring and summer, so this is something to keep an eye on. Seasonal forecasts likely were already incorporating the influence of La Niña into monthly and seasonal forecasts, and for as long as this La Niña event persists, even in a weak form, we can expect these forecasts will continue to suggest warmer- and drier-than-average conditions (Figs. 6a–b, 7).

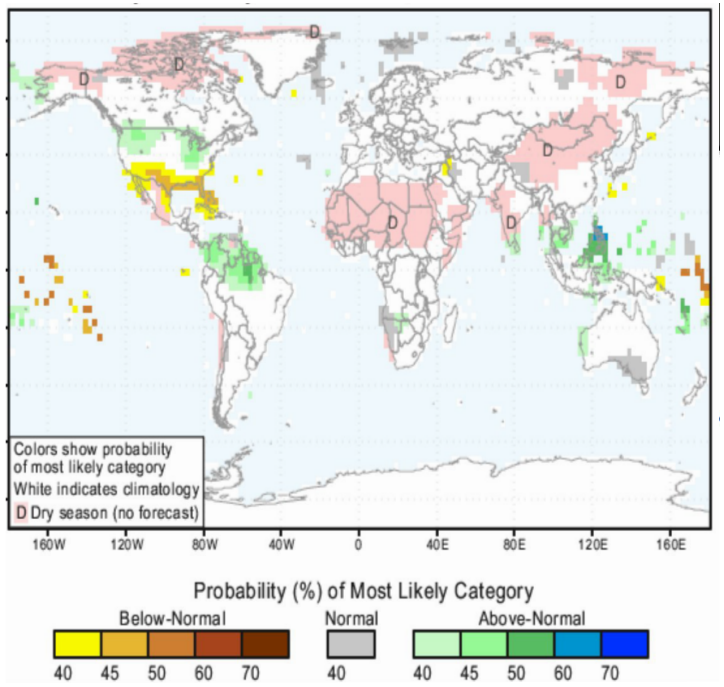


Figure 7: IRI Multi-Model Precipitation Probability Forecast Jan-Mar 2017

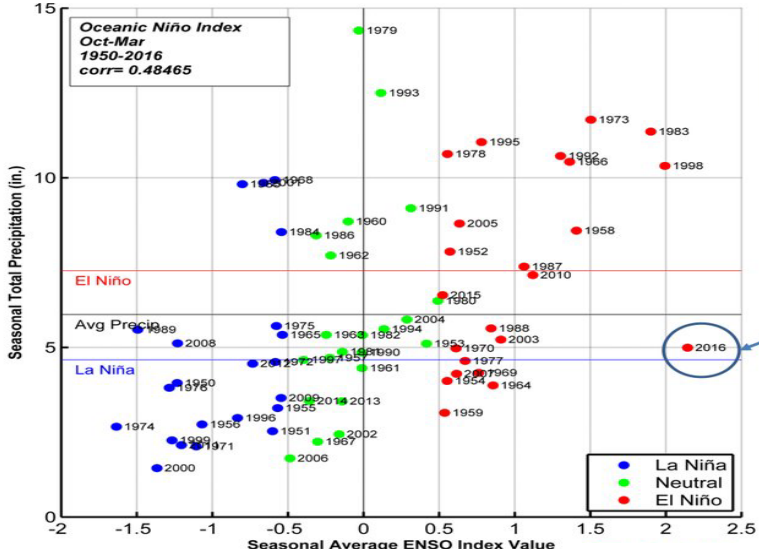


Figure 5: Arizona Climate Division 7 - ENSO vs. Precipitation

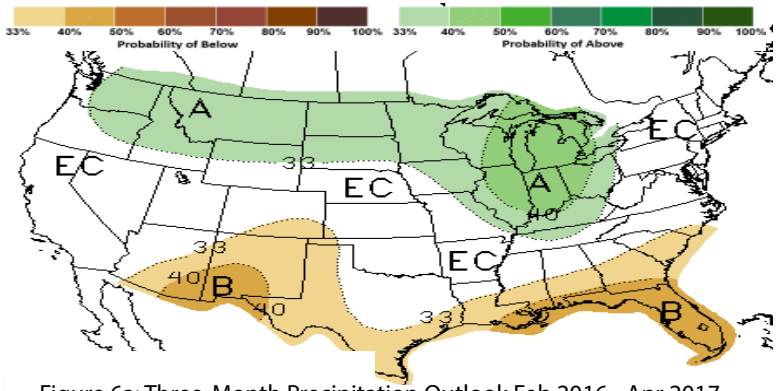


Figure 6a: Three-Month Precipitation Outlook Feb 2016 - Apr 2017

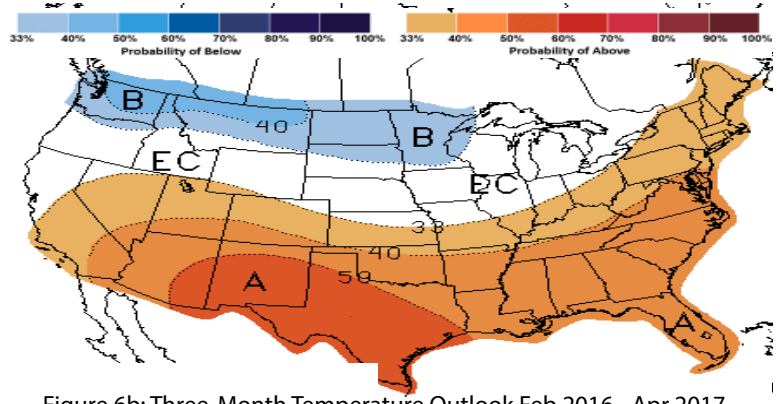


Figure 6b: Three-Month Temperature Outlook Feb 2016 - Apr 2017

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

We updated our 'max storage' values for numerous NM reservoirs based on conservation storage vs. maximum flood capacity. This altered the percent capacity calculations, even while 'current storage' numbers are unchanged.

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).

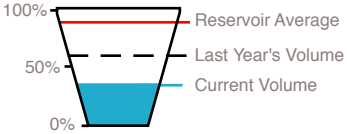
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons).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

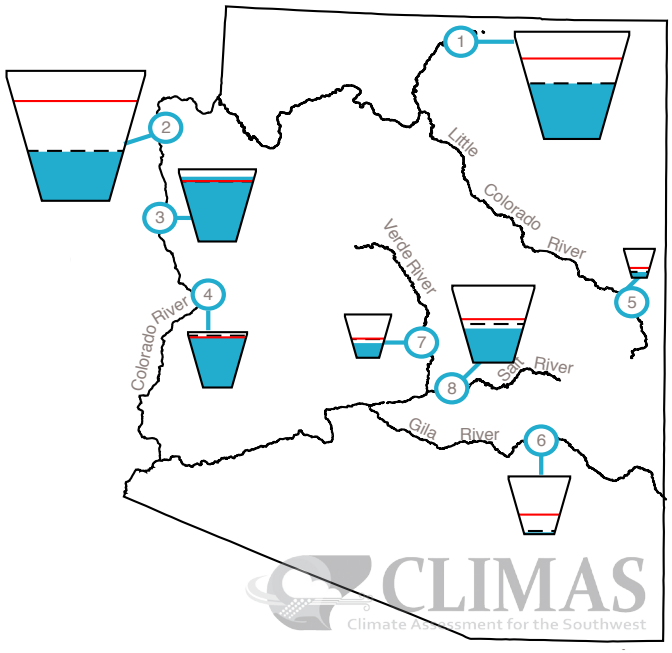
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

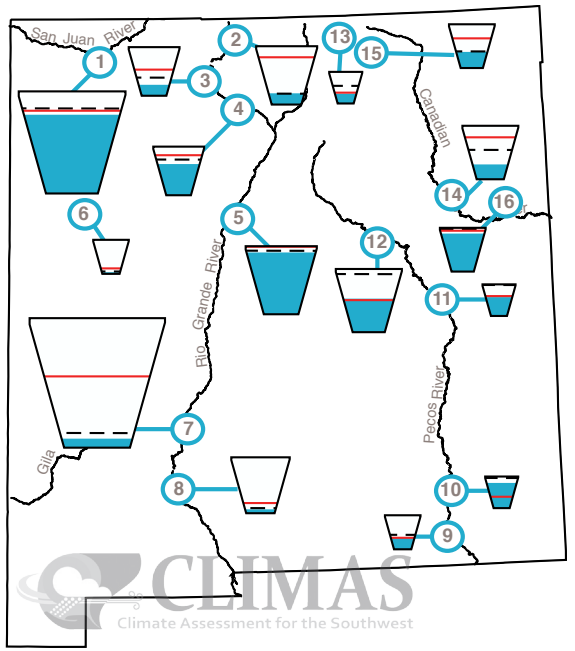
Reservoir Volumes

DATA THROUGH NOV 30, 2016

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	51%	12,322.0	24,322.0	-506.2
2. Lake Mead	37%	9,727.0	26,159.0	18.0
3. Lake Mohave	89%	1,616.0	1,810.0	137.0
4. Lake Havasu	89%	550.8	619.0	-10.9
5. Lyman	20%	6.0	30.0	-0.1
6. San Carlos	3%	30.3	875.0	8.2
7. Verde River System	33%	95.3	287.4	--20.4
8. Salt River System	45%	917.9	2,025.8	7.1

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	76%	1,295.9	1,696.0	-4.2
2. Heron	19%	77.8	400.0	-10.3
3. El Vado	22%	41.8	190.3	-3.2
4. Abiquiu	64%	120.2	186.8**	-2.2
5. Cochiti	90%	45.2	50.0**	0.5
6. Bluewater	4%	1.6	38.5	0.0
7. Elephant Butte	7%	162.1	2,195.0	33.4
8. Caballo	6%	19.2	332.0	3.0
9. Lake Avalon	36%	1.6	4.5**	0.7
10. Brantley	79%	33.3	42.2**	3,7
11. Sumner	60%	21.7	102.0**	4.4
12. Santa Rosa	53%	56.3	105.9**	0.2
13. Costilla	31%	4.9	16.0	0.3
14. Conchas	28%	71.3	254.2	-0.5
15. Eagle Nest	28%	29.3	79.0	-0.3
16. Ute Reservoir	88%	174	200	-2.0