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December 2021 Southwest Climate Outlook

Precipitation and Temperature: Nov precipitation was between record driest and near average in Arizona and New Mexico (Fig. 1a). Nov temperatures were between much above average and record warmest in Arizona and New Mexico (Fig. 1b). Sept-Nov precipitation was mostly average to below average in Arizona, and average to much below average in New Mexico (Fig. 2a). Sept-Nov temperatures were between above average and much above average in Arizona, and between much above average and record warmest in New Mexico: a pattern that extended across much of the western U.S. (Fig. 2b). Twelve-month precipitation totals show the influence of the monsoon in southern Arizona and New Mexico, as well below normal to record driest regions across most of the western U.S. (Fig. 3).

Drought: The U.S. Drought Monitor (USDM) showed minor improvements in drought categorizations in a few areas of the Southwest, but drought conditions are still found across the Southwest (Fig. 4), and the entire western U.S. The variable monsoon totals and La Niña this winter, continue to raise concerns about long-term and cumulative precipitation deficits.

Snowpack & Water Supply: Mid-December snow water equivalent (SWE) is highly variable in the Southwest, with most of the region recording below-average conditions (Fig. 5). Most of the reservoirs in Arizona and New Mexico are at or below the values recorded at this time last year. Most are also below their long-term average (see reservoir storage for Arizona and New Mexico on p.5). Water levels at Lakes Mead and Powell continue to drive the conversation about Colorado River water management and shortage declarations in response to those water levels. The Rio Grande in New Mexico and Elephant Butte Reservoir raise similar concerns in New Mexico, although there has been less national attention to date.

Hurricanes & Tropical Storms: The Eastern North Pacific saw activity across the bulk of the season, with 19 named storms but only two major hurricanes (Fig. 6). The accumulated cyclonic energy (ACE) was near normal through August, but Sept-Nov were quiet with five named storms, resulting in a seasonal ACE of approximately 75% of normal.

ENSO Tracker: ENSO has reached La Niña status according to most outlooks, based on observed and forecast SSTs, emergent atmospheric conditions, and coupling between the two that is indicative of La Niña (see ENSO-tracker on p.4 for details).

Tweet Dec 2021 SW Climate Outlook

DEC2021 @CLIMAS_UA SW Climate Outlook, Seasonal Forecasts, ENSO Tracker, AZ & NM Reservoirs, SW Climate Podcast, https://bit.ly/3p4Y1gE #SWclimate #AZWx #NMWx

December 2021 - Climate Summary

Online Resources

Figures 1-2
National Centers for Environmental Information
ncdc.noaa.gov/sotc

Figure 3
West Wide Drought Tracker
wwdt.dri.edu

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

Figure 5
National Resource Conservation Service (NRCS)
nrcs.usda.gov

Figure 6
US Dept of Commerce NWS
nhc.noaa.gov

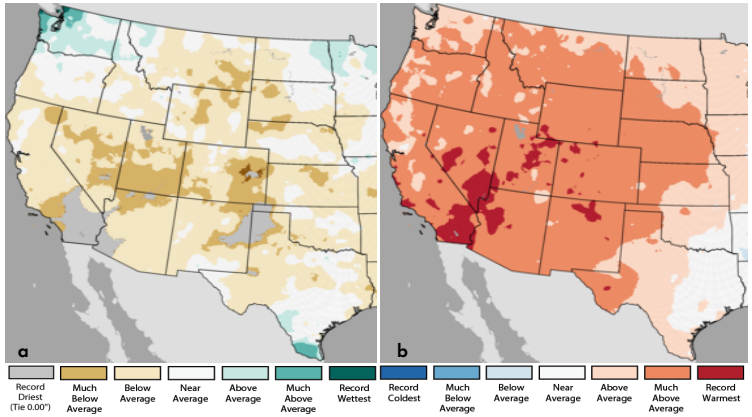


Figure 1: Nov 2021 Precipitation (a) & Temperature Ranks (b)

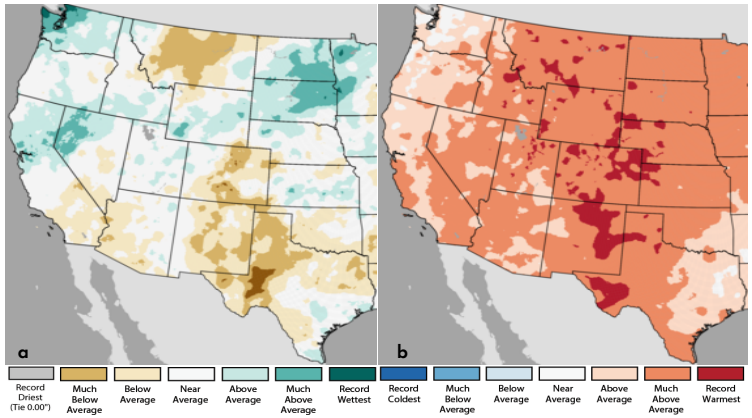


Figure 2: Sept-Nov 2021 Precipitation (a) & Temperature Ranks (b)

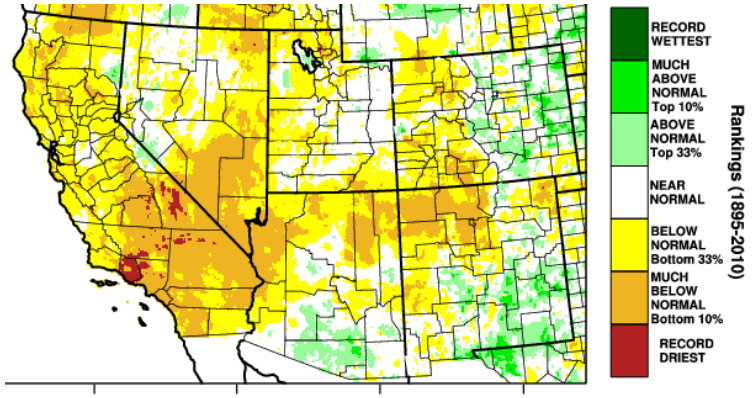


Figure 3: 12 month (Dec 2020 - Nov 2021) Precip Rankings

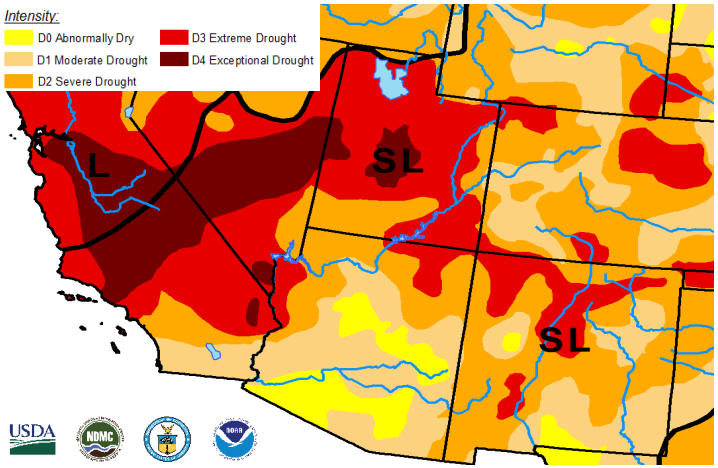


Figure 4: US Drought Monitor - Dec 7, 2021

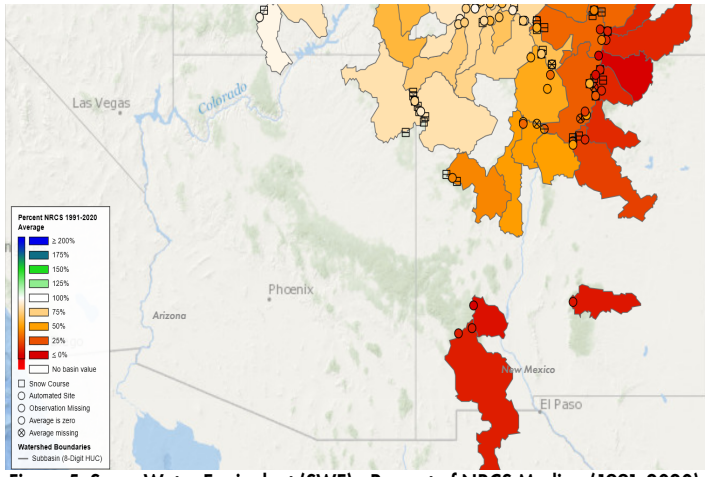


Figure 5: Snow Water Equivalent (SWE) - Percent of NRCS Median (1991-2020)

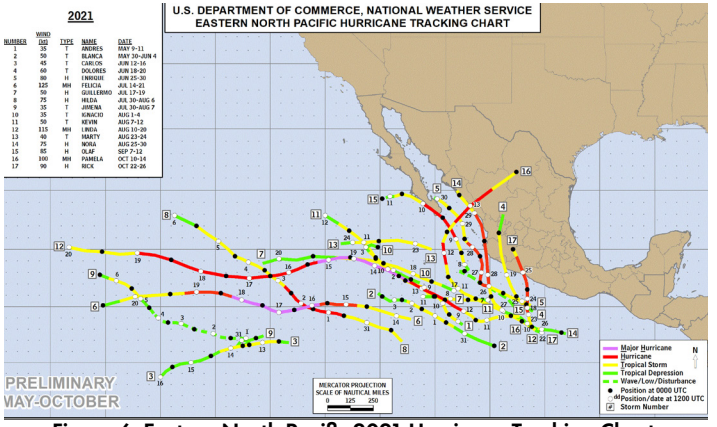


Figure 6: Eastern North Pacific 2021 Hurricane Tracking Chart

Online Resources

Figure 7
Intl. Research Institute for Climate and Society
iri.columbia.edu

Figure 8
NOAA Climate Prediction Center
cpc.ncep.noaa.gov

December 2021 - Seasonal Forecasts

Precipitation

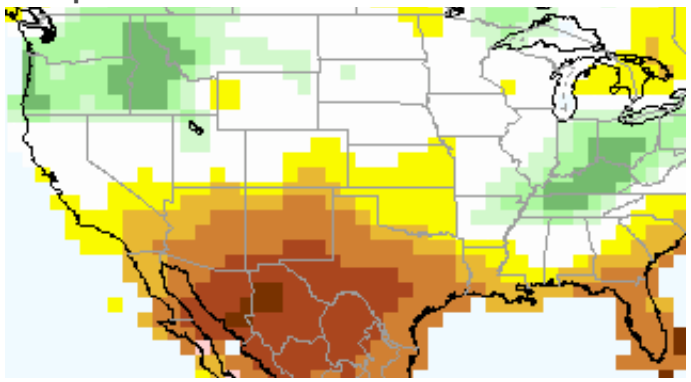


Figure 7A: Three-Month (Jan-Mar) Forecast for Precipitation

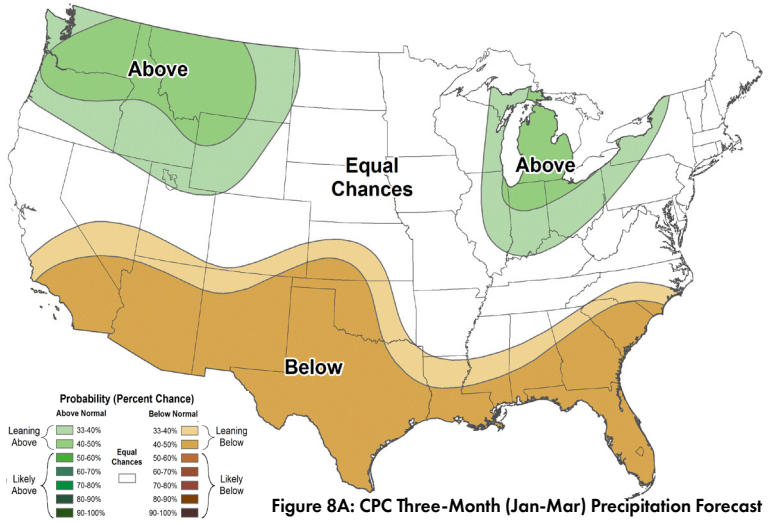


Figure 8A: CPC Three-Month (Jan-Mar) Precipitation Forecast

Temperature

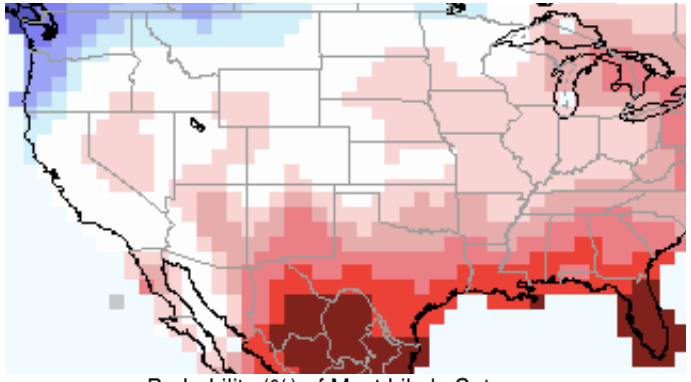


Figure 7B: Three-Month (Jan-Mar) Forecast for Temperature

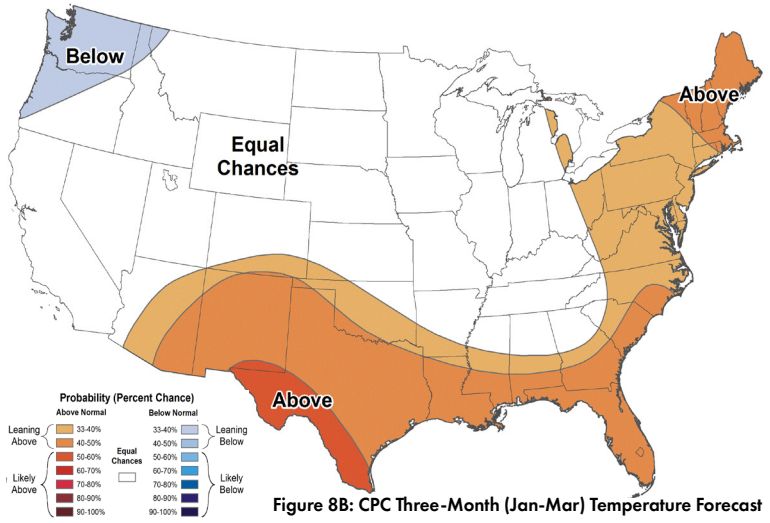


Figure 8B: CPC Three-Month (Jan-Mar) Temperature Forecast

Precipitation Forecasts: The IRI outlook calls for increased chances of below-normal precipitation across most of the southwestern U.S. and northern Mexico, (Fig. 7a). The CPC outlook calls for increased chances of below-normal precipitation across the Southwest (Fig. 8a).

Temperature Forecasts: The IRI outlook calls for mostly increased chances of below-normal temperatures in most of the southwestern U.S. and northern Mexico (Fig. 7b). The CPC outlook calls for increased chances of above-normal temperatures across much of the Southwest (Fig. 8b).

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

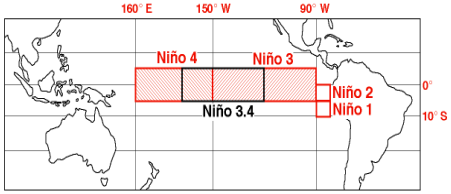
Figure 4
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

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

Sea surface temperature (SST) forecasts for Jan – Mar 2022 indicate cool conditions across the equatorial Pacific (Fig. 1). Current Nino 3.4/4 anomalies have reached the La Niña threshold (Fig. 2), and most ENSO outlooks now call for La Niña conditions to last through winter 2021-2022.

Forecast Roundup: On Dec 7 the Australian Bureau of Meteorology ENSO outlook was at La Niña status, noting "Sea surface temperatures in the tropical Pacific have cooled to La Niña thresholds, with climate model outlooks expecting them to cool further", and highlighting the presence of oceanic/atmospheric coupling. On Dec 9 the NOAA Climate Prediction Center (CPC) maintained their "La Niña Advisory" noting strengthening La Nina conditions, and calling for a 95-percent chance of La Niña during winter 2021-2022. On Dec 9 the International Research Institute (IRI) issued an ENSO Quick Look (Fig. 3), noting "A large majority of the models predict SSTs to cool further or stay below-normal during boreal winter, and then return to ENSO-neutral levels during spring." On Dec 10 the Japanese Meteorological Agency (JMA) observed La Niña conditions are present and called for a 60-percent chance of La Niña conditions to last through winter and an 80-percent chance they would "dissipate" by the end spring. The North American Multi-Model Ensemble (solid and dashed black line, Fig. 4) reached La Niña levels, and indicates a further swing to moderate La Niña in late 2021 and into 2022.

Summary: The seasonal outlooks have reached consensus on a La Niña event in winter 2021-2022. This is tied to cooling SSTs in the equatorial region, and oceanic/atmospheric coupling indicative of La Niña. The event is expected to last through winter and into spring 2022. La Niña winters are frequently warmer and drier than average in the Southwest, so the prospects of an improvement in drought conditions and the cumulative precipitation deficits are slim (but not none).

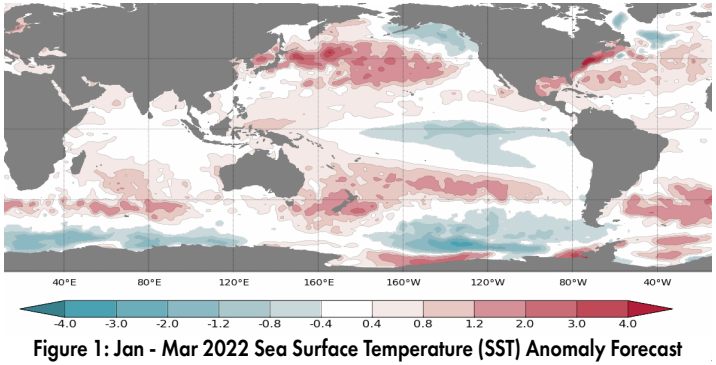


Figure 1: Jan - Mar 2022 Sea Surface Temperature (SST) Anomaly Forecast

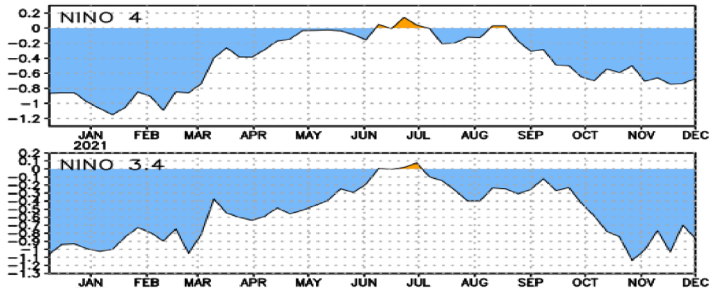


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

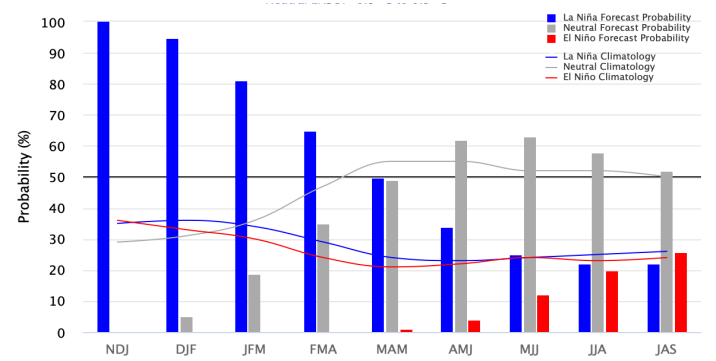


Figure 3: Early-Dec IRI/CPC Model-Based Probabilistic ENSO Forecast

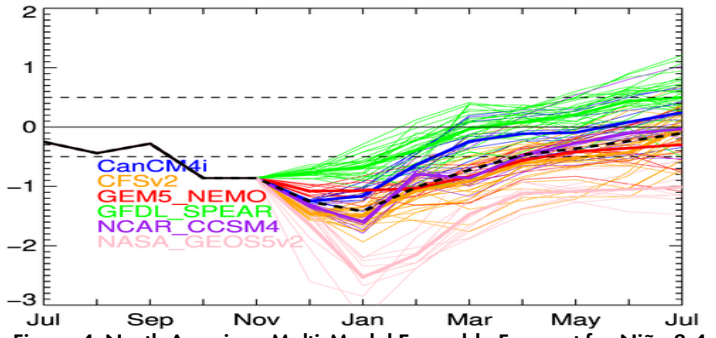


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

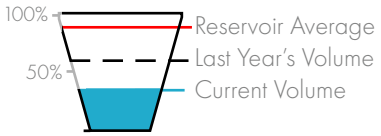
Online Resources

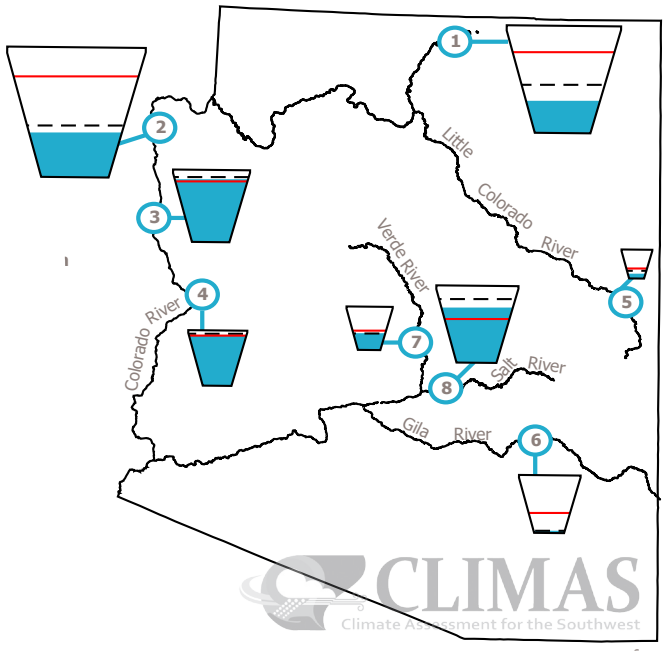
Portions of the information provided in this figure is available at the Natural Resources Conservation Service
www.wcc.nrcs.usda.gov/BOR/basin.html

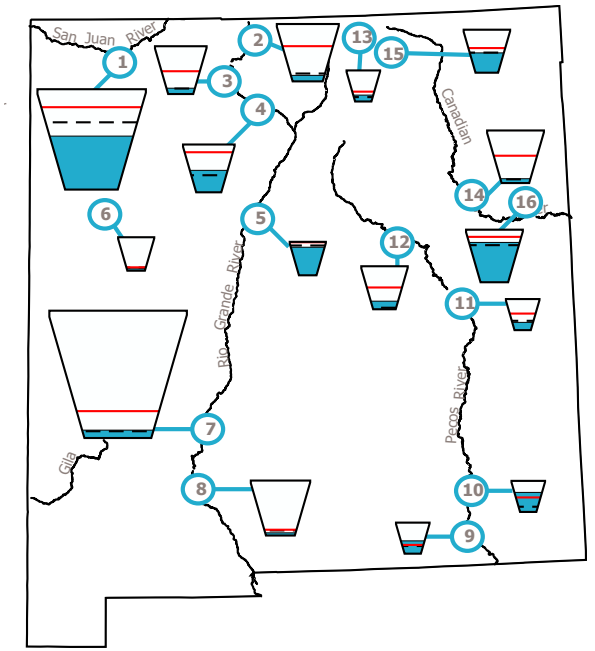
Contact Ben McMahan with questions/comments.

Reservoir Volumes

DATA THROUGH DEC 1, 2021
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	29%	7,016	24,322.0	-165
2. Lake Mead	34%	8,802	26,159.0	-133
3. Lake Mohave	86%	1,548	1,810.0	+80
4. Lake Havasu	91%	565	619.0	-24.5
5. Lyman	16%	4.9	30.0	-0.1
6. San Carlos	3%	29.9	875.0	+0.9
7. Verde River System	38%	110.2	287.4	-33.6
8. Salt River System	71%	1,441.6	2,025.8	+0.7

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	52%	877.7	1,696.0	-8.4
2. Heron	10%	41.6	400.0	-2.4
3. El Vado	12%	22.3	190.3	-9.8
4. Abiquiu	45%	83.7	186.8	+7.8
5. Cochiti	82%	41.1	50.0	-0.1
6. Bluewater	5%	2.0	38.5	-0.1
7. Elephant Butte	6%	135.2	2,195.0	+18.6
8. Caballo	4%	14.7	332.0	+0.3
9. Lake Avalon	40%	1.8	4.5	+0.7
10. Brantley	62%	26.2	42.2	+0.4
11. Sumner	24%	8.5	35.9	+3.6
12. Santa Rosa	18%	18.8	105.9	-0.2
13. Costilla	20%	3.3	16.0	+0.4
14. Conchas	8%	20.9	254.2	-1.2
15. Eagle Nest	45%	35.2	79.0	-0.5
16. Ute Reservoir	74%	147	200	-2.0

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).

Southwest Climate Podcast

climas.arizona.edu/media/podcasts

iTunes

https://apple.co/3kHh8bf

Spotify

https://spoti.fi/3zZIvWu

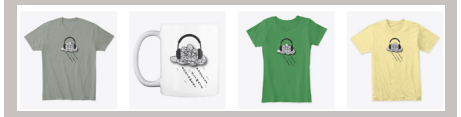
Android

https://bit.ly/2ILYHos

Stitcher

https://bit.ly/3nEWhHd

We also finally have podcast gear (shirts and mugs).



Order at: teespring.com/stores/the-southwest-climate-podcast.

Prices are the wholesale cost, so we don't make any money, but if you are interested in showing your support - or enjoying the (lack of a) monsoon in style, this is one way to do so.

The Southwest Climate Podcast

Nov 2021 Southwest Climate Podcast
Monsoon 2021 Roundup

In the November edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido look back to monsoon 2021 to do a recap of the seasonal totals. They are joined by Paul Iniguez, the Science and Operations Officer for the National Weather Service office in Phoenix, to take a closer look at the 2021 monsoon, how it stacked up around the region, and to hear a bit more about how the NWS offices work across the monsoon. This is a single focus episode - see the Oct 2021 episode for the normal monthly roundup and recap. Watch this space: https://www.weather.gov/psr/eventsummaries for the 2021 monsoon recap from NWS Phoenix, as well as some detailed storm event reports from across the season (and year).

https://bit.ly/3FcjvNH

Oct 2021 Southwest Climate Podcast
Diving into ENSO and the La Niña Double Dip

In the October 2021 edition of the Southwest Climate Podcast, Mike Crimmins and Zack Guido reconvene after a long pause to revisit recent conditions in September and October, dive into what ENSO and La Niña might have in store for the Southwest, and what the Double Dip is and why it's more likely in back to back La Niñas. For monsoon fantasy players, they recap the monsoon game and how the leaderboard shook up in the final day in the first segment. Production note: We recorded two podcasts this week, the standard monthly recap (this podcast) and a monsoon recap extravaganza with Paul Iniguez of the NWS office up in Phoenix. Look for that monsoon recap podcast in a few days (also in this feed) and keep an eye on the NWS pages for their in-depth monsoon recaps.

https://bit.ly/3orYfwP

Online Resources

Figure 1
Climate Program Office
cpo.noaa.gov

RISA Program Homepage

cpo.noaa.gov/Meet-the-Divisions/Climate-and-Societal-Interactions/RISA

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

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 Institute of the Environment—is a collaboration between the University of Arizona 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.

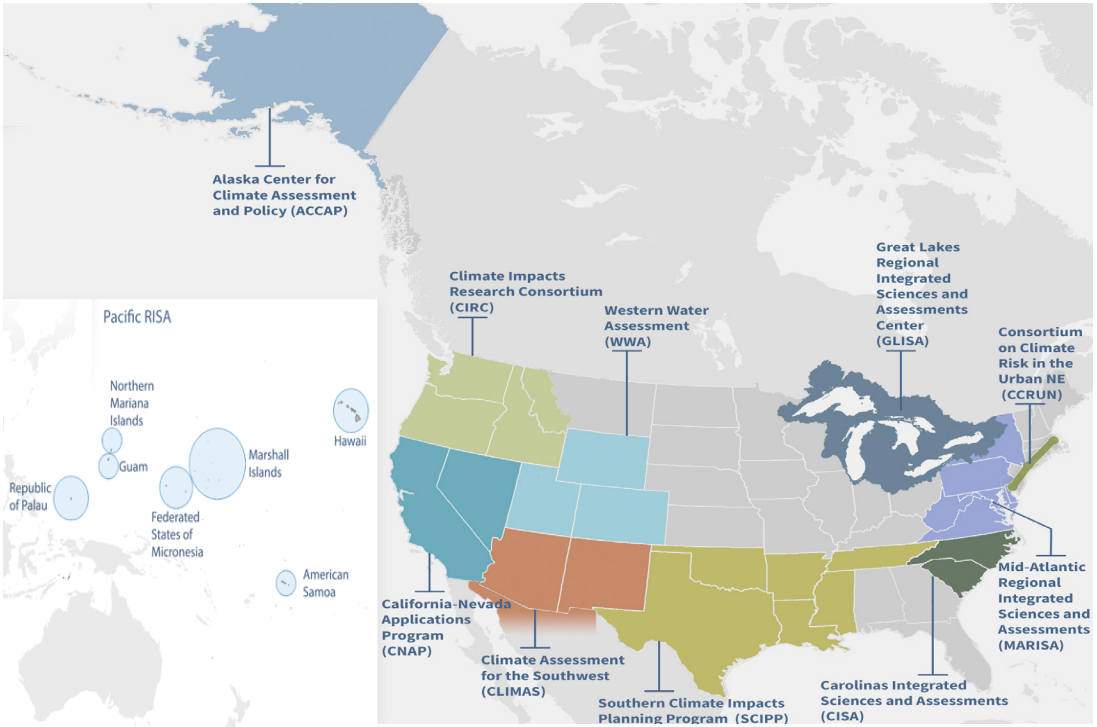


Figure 1: NOAA Regional Integrated Sciences and Assessments Regions