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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.

March 2021 Southwest Climate Outlook

Monthly Precipitation and Temperature: February precipitation was mostly below average to record driest in Arizona and near average across most of New Mexico (Fig. 1a). February temperatures ranged between average and above average in most of Arizona and between average and below average in most of New Mexico (Fig. 1b).

Winter Precipitation and Temperature: Dec-Feb Precipitation ranks were average to below average across most of the Southwest, with a few pockets of much below average (Fig. 2a). Temperature ranks for the same period were average to above average across most of Arizona, and mostly average in New Mexico, with some pockets of both above and below average (Fig. 2b). Precipitation totals from stations around the region demonstrate the below normal precipitation conditions this winter (Fig. 3).

Drought: Water year precipitation to date (as of Feb 28, 2021) reveals widespread below normal and much below normal conditions across the Southwest, along with a large cluster of record driest in the CA/NV/AZ region (Fig. 4). The U.S. Drought Monitor (USDM) is mostly unchanged over the last month in the U.S. Southwest (Fig. 5). This is partly because much of the region is at the highest drought category (D4, Exceptional Drought): In Arizona and New Mexico, over 50-percent of the region is in D4, and over 80-percent is in at least D3 (Extreme Drought).

Snowpack and Water Supply: Snow water equivalent (SWE) is well below the 1981-2010 median for much of the region (see the NRCS website for details). Streamflow forecasts reflect this reality and are well below median across most of the Southwest (Fig. 6). Most of the reservoirs in the region are at or below the values recorded at this time last year. Most are below their long-term average (see Arizona and New Mexico reservoir storage on p. 5).

ENSO Tracker: La Niña conditions are present and are expected to continue through spring (see ENSO-tracker on p. 3 for details). Despite some winter storm activity (including some impressive snow totals), the expectation remains for cumulative cool season precipitation totals to be below average for much of the Southwest.

Precipitation and Temperature Forecast: The three-month outlook for Apr through Jun calls for increased chances for below-normal precipitation across most of the southwestern U.S., with a swath of increased chances of above-normal precipitation extending from central Mexico into southeastern Arizona (Fig. 7, top). The three-month temperature outlook calls for increased chances of above-normal temperatures across the southwestern U.S. and northern Mexico (Fig. 7, bottom).

Tweet Mar 2021 SW Climate Outlook

MAR2021 @CLIMAS_UA SW Climate Outlook, La Niña Outlook, Recent SW Temps, AZ & NM Reservoirs, News and Announcements, https://bit.ly/3r2bFir #SWclimate #AZWx #NMWx

Mar 2021 SW Climate Outlook

Online Resources

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

Figure 3
Climate Assessment for the Southwest
climas.arizona.edu

Figure 4
West Wide Drought Tracker
wrcc.dri.edu/wwdt

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

Figures 6
National Resource Conservation Service
nrcs.usda.gov

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

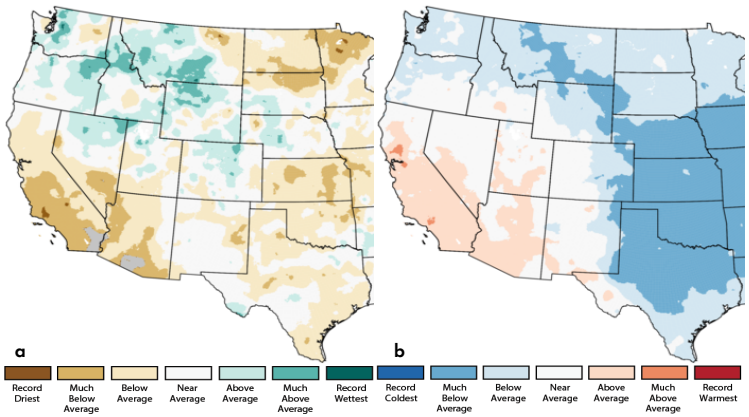


Figure 1: Feb 2021 Precipitation (a) & Temperature Ranks (b)

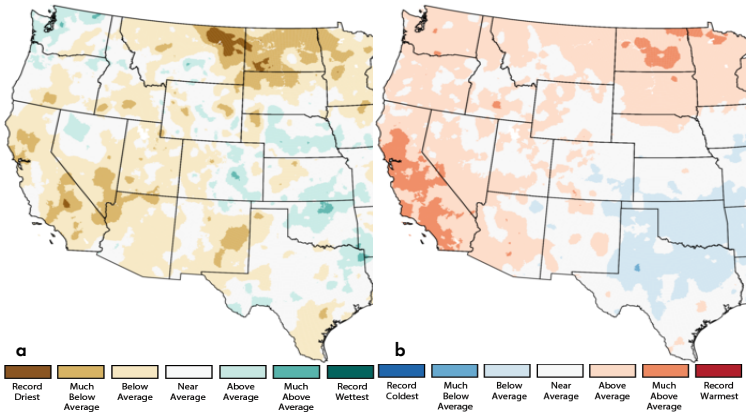
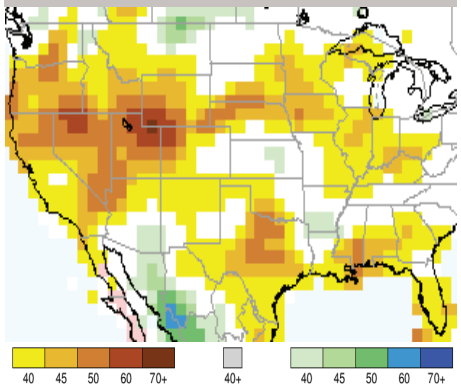


Figure 2: Dec 2020 - Feb 2021 Precipitation (a) & Temperature Ranks (b)



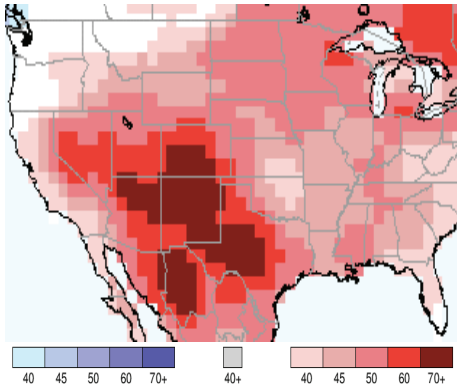


Figure 7: Three-Month (Apr-Jun) Forecast for Precip (top) and Temps (bottom)

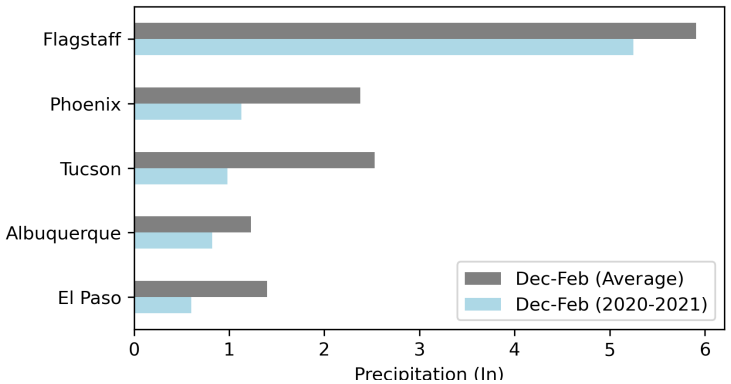


Figure 3: Dec-Feb Precipitation - 2020-2021 vs. Long Term Average

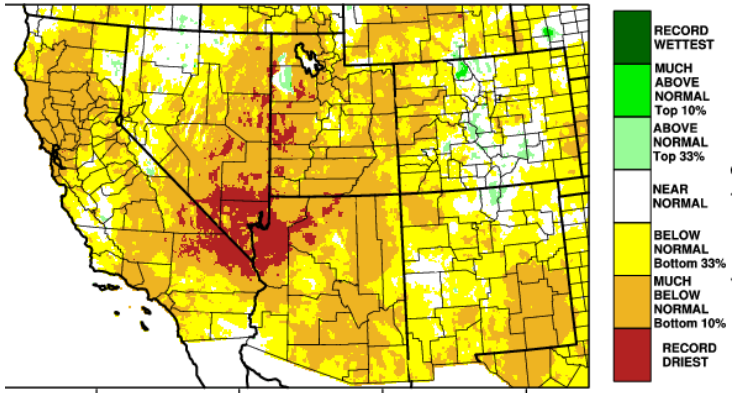


Figure 4: Water Year (Oct 2020 - Feb 2021) Precip Rankings

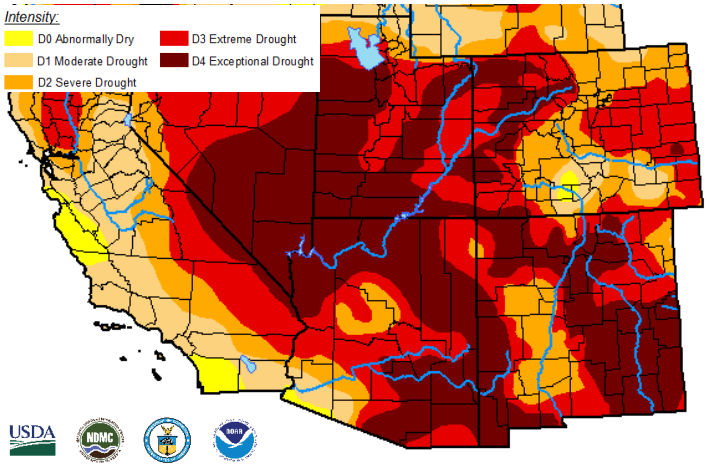


Figure 5: US Drought Monitor - Mar 2, 2021

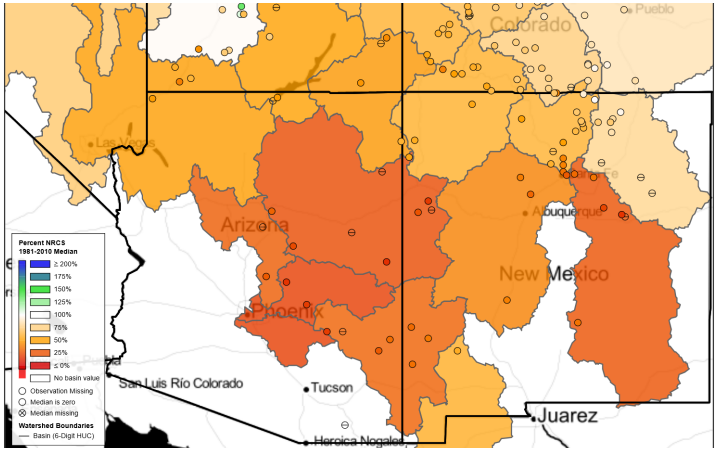


Figure 6: Mar 1 Streamflow Forecast Percent of Median (50% Exceedence Prob.)

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

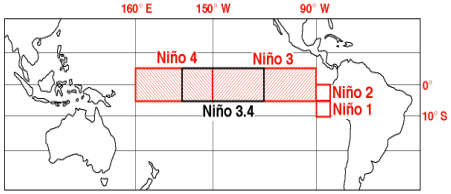
Figure 4
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

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) anomaly forecasts point to normal or slightly below normal conditions across much of the equatorial Pacific (Fig. 1). The current anomalies show a similar pattern, as they continue to move towards neutral conditions (Fig. 2). International climate outlooks reflect this trend, and see La Niña conditions waning along with winter, and returning to ENSO-neutral conditions over spring 2021.

Forecast Roundup: On Mar 10, the Japanese Meteorological Agency (JMA) maintained its observation of an ongoing La Niña, with an 80-percent chance that conditions "will fade into ENSO-neutral" by spring. On Mar 11, the NOAA Climate Prediction Center (CPC) ENSO status was at La Niña Advisory. The CPC called for a 60-percent chance of a transition to ENSO-neutral during spring. On Mar 11, the International Research Institute (IRI) issued an ENSO Quick Look (Fig. 3), noting "most key atmospheric variables are consistent with continued La Niña conditions." On Mar 16, the Australian Bureau of Meteorology was at official La Niña status, but stated "La Niña is nearing its end." They highlighted neutral oceanic conditions, and "a number of atmospheric indicators (that) remain at La Niña levels." They emphasized this could cause La Niña precipitation patterns to stick around a little longer. The North American Multi-Model Ensemble (solid and dashed black line, Fig. 4) indicates La Niña conditions are expected to return to ENSO-neutral conditions over the next few months.

Summary: La Niña conditions are present and should remain in place through spring. The monthly and seasonal climate outlooks reflect these conditions, with forecasts of mostly drier than normal conditions in the Southwest over the same period. Storm activity in the Southwest (including heavy snow) means this La Niña feels less extreme compared to years with nearly zero winter precipitation. Despite these events, this winter is following an expected pattern with less frequent precipitation events and lower seasonal totals compared to normal (see Fig. 3 on p 2). There are exceptions, but this is a pretty robust and predictable outcome in the U.S. Southwest for La Niña.

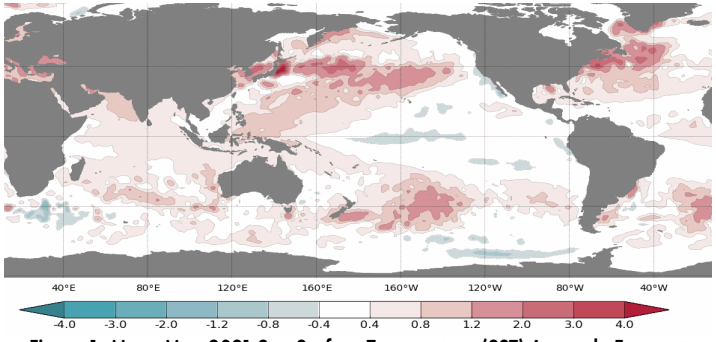


Figure 1: Mar - May 2021 Sea Surface Temperature (SST) Anomaly Forecast

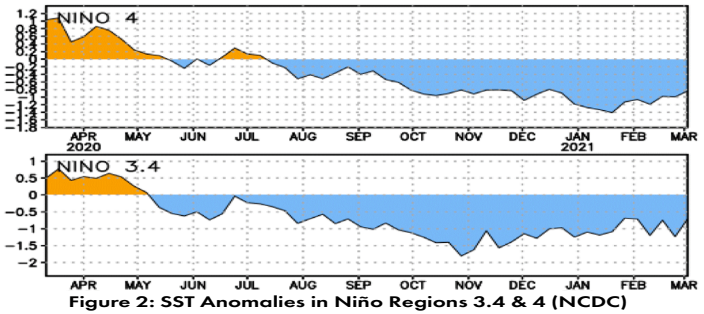


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

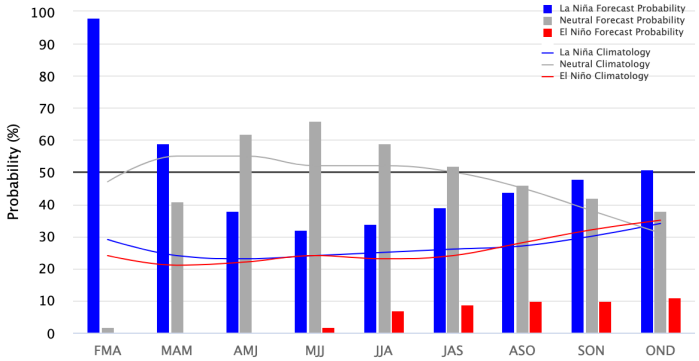


Figure 3: Early-Mar IRI/CPC Model-Based Probabilistic ENSO Forecast

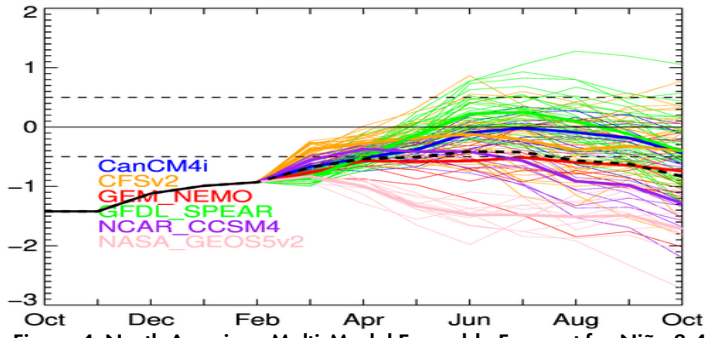


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

Figure 1
CLIMAS: Climate Assessment for the Southwest
climas.arizona.edu

data: RCC-ACIS

Recent Temperatures Around the Southwest

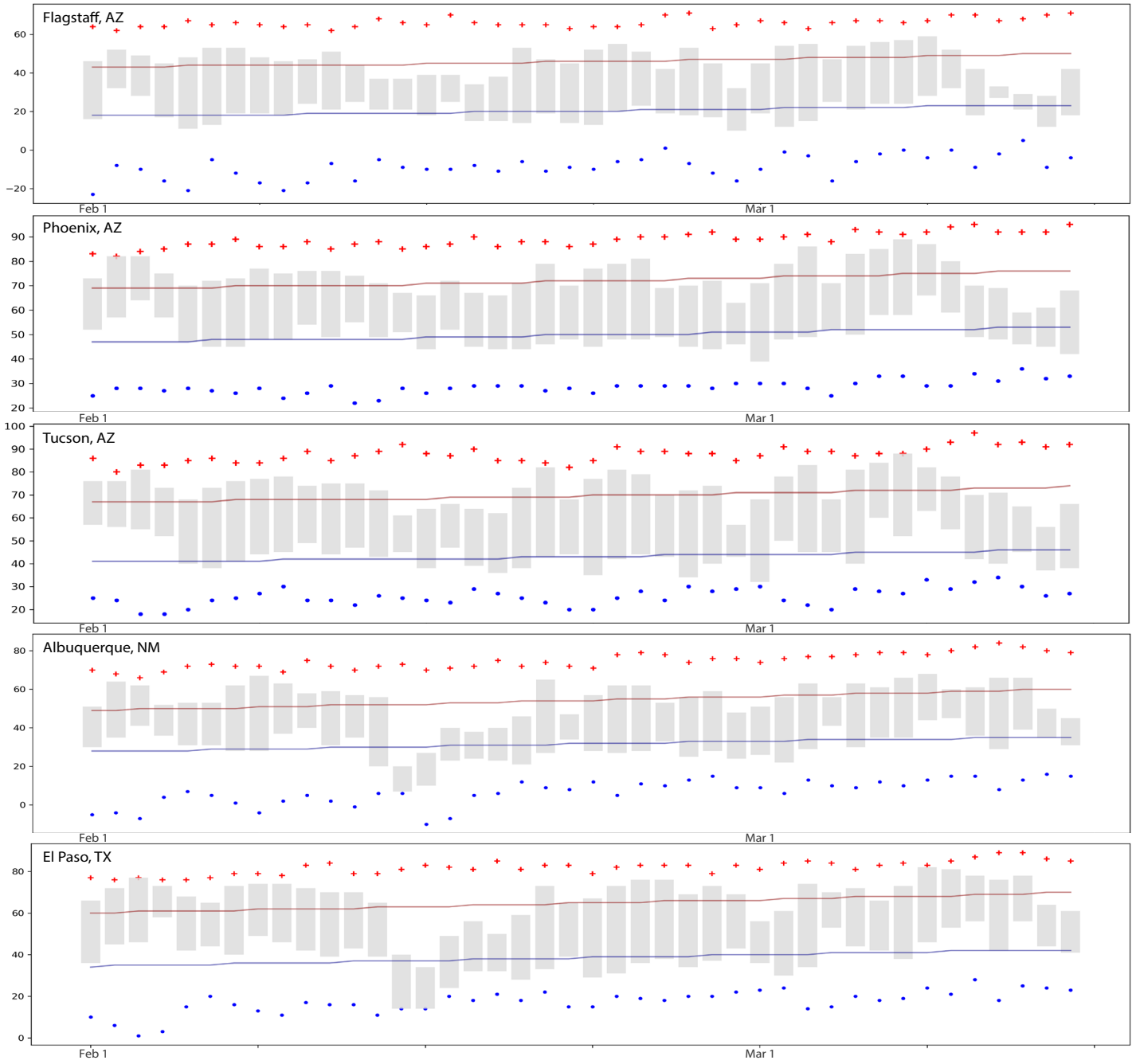


Figure 1: Daily Average, Normal, and Record High/Low Temperatures, Feb 1, 2021 - Mar 14, 2021

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.

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).

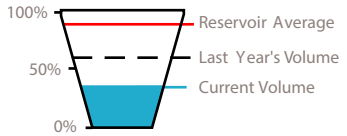
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons).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

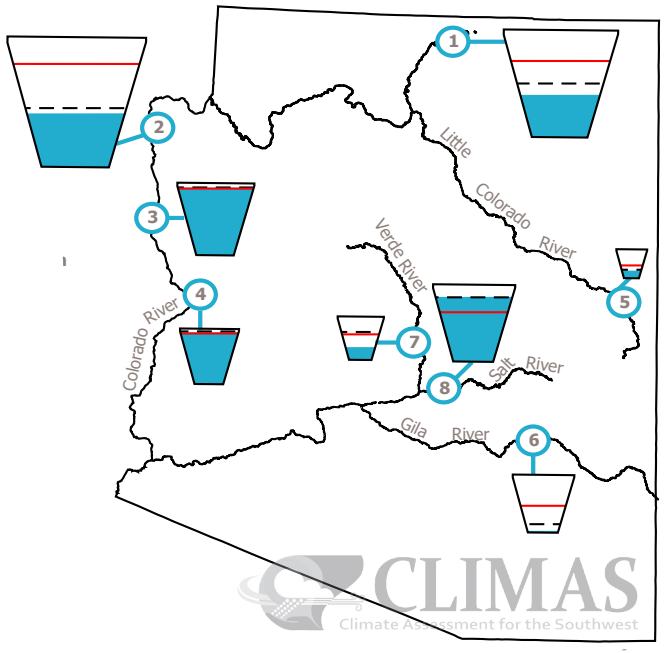
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

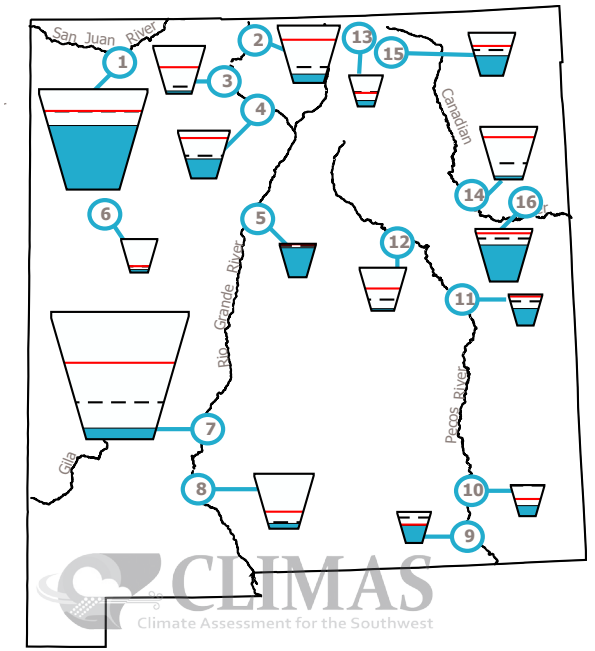
Reservoir Volumes

DATA THROUGH MAR 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	38%	9,225.6	24,322.0	-412.9
2. Lake Mead	41%	10,622.0	26,159.0	98.0
3. Lake Mohave	93%	1,689.0	1,810.0	-1.0
4. Lake Havasu	93%	573.9	619.0	-5.7
5. Lyman	25%	7.5	30.0	-0.1
6. San Carlos	2%	13.3	875.0	-6.5
7. Verde River System	29%	84.8	287.4	-6.4
8. Salt River System	83%	1,674.9	2,025.8	0.4

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	62%	1,051.9	1,696.0	-12.7
2. Heron	13%	53.6	400.0	0.2
3. El Vado	5%	10.2	190.3	-2.6
4. Abiquiu	39%	73.3	186.8	4.3
5. Cochiti	86%	43.2	50.0	0.2
6. Bluewater	8%	3.2	38.5	-0.1
7. Elephant Butte	8%	182.3	2,195.0	26.1
8. Caballo	9%	30.9	332.0	0.7
9. Lake Avalon	56%	2.5	4.5	0.4
10. Brantley	33%	13.9	42.2	2.0
11. Sumner	53%	19.1	35.9	2.4
12. Santa Rosa	4%	3.8	105.9	0.0
13. Costilla	19%	3.0	16.0	0.3
14. Conchas	6%	14.0	254.2	-0.8
15. Eagle Nest	45%	35.5	79.0	0.3
16. Ute Reservoir	68%	135	200	-2.0

CLIMAS News and Announcements

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

2020 Environment and Society Fellows - Final Blog Posts

Caring in Crisis: Challenges and Lessons in Practicing Collaborative Research in 2020
Rachel Rosenbaum
https://bit.ly/2NF7yec

Reflections on Research on the Little Bighorn River
JoRee LaFrance
https://bit.ly/3pyOADg

Reflections on the Community Cookbook Project
Kunal Palawat
https://bit.ly/2ZshnhY

V. parahaemolyticus: a small bacteria with a big name
Emily Cooksey
https://bit.ly/2ORMWjt

Recent Publications

Upper Colorado River Basin 20th century droughts under 21st century warming: Plausible scenarios for the future.

Woodhouse, C.A., R.M. Smith, S.A. McAfee, G.T. Pederson, G.J. McCabe, W.P. Miller, A. Csank.

Climate Services 21, 2021.

https://doi.org/10.1016/j.cliser.2020.100206.

"Drought isn't just water, it is living": Narratives of drought vulnerability in California's San Joaquin Valley.

Greene, C.

Geoforum 121: 33-43. 2021

https://doi.org/10.1016/j.geoforum.2021.02.007

Evaluating socially engaged climate research: Scientists' visions of a climate resilient U.S. Southwest.

Owen, G.

Research Evaluation, 2020

doi: 10.1093/reseval/rvaa028

Climate risk assessment and cascading impacts: Risks and opportunities for an electrical utility in the U.S. Southwest.

McMahan, Ben, and Andrea K. Gerlak.

Climate Risk Management 29:100240. 2020.

https://doi.org/10.1016/j.crm.2020.100240.

Empirical Application of Rubinstein Bargaining Model in Western U.S. Water Transactions

Rowan Isaaks and **Bonnie Colby**

Water Economics and Policy (WEP), 2020.

https://doi.org/10.1142/S2382624X19500103

Southwest Climate Podcast

climas.arizona.edu/media/podcasts

iTunes

https://apple.co/3kHh8bf

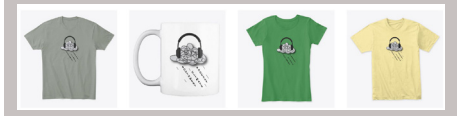
Android

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

Feb 2021 Southwest Climate Podcast - Recent Storms and Dry Forecasts - Diving into La Niña and 2021

In the February 2021 episode of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido jump back into discussing winter conditions in the Southwest. This includes what happened so far in 2021 with a few runs of storms that affected parts of Arizona and New Mexico. This also includes the role that La Niña may be playing this winter (snowpack, streamflow forecasts, rain/snow events, etc.), and how this compares to previous winters and La Niña events. They also discuss what we might expect over the rest of the winter and into early spring (Feb-Mar).

https://bit.ly/3prODAt

Previous Episodes

Dec 2020 - Tracking Drought Conditions, La Niña Forecasts, and What 2021 Might Bring

In the December edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido sit down to discuss drought, La Nina, and what to expect (or at least hope for) in 2021. First, they recap the event that swept through on Dec 9-11, to talk through how different locations in the region fared in terms of precip. Next, they transition into the drought situation, which is currently looking pretty dire for the region - and discuss 'just how much worse can it get' - given much of the region is at Exceptional Drought (D4, the highest category on the US Drought Monitor), looking to some past events for comparison. They wrap things up with some 2021 predictions - things they think could (or hope might) happen in 2021.

https://bit.ly/2IV7Awl

Nov 2020 - Unprecedented or Uncommon, A La Niña Winter after a Failed Monsoon

In the November episode of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido sit down to discuss weather and climate in the Southwest, including what we might expect over the next few months. They discuss La Niña and what this might mean for the Southwest, including implications of La Niña following a much drier than average monsoon and what the historical record says about just how unprecedented this pattern might be (dry monsoon, dry winter). Finally, they take a closer look at fire, and how the season has progressed in the Southwest, given the lack of rain, and what we might watch for going into next year's fire season.

https://bit.ly/35HCMYI

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.

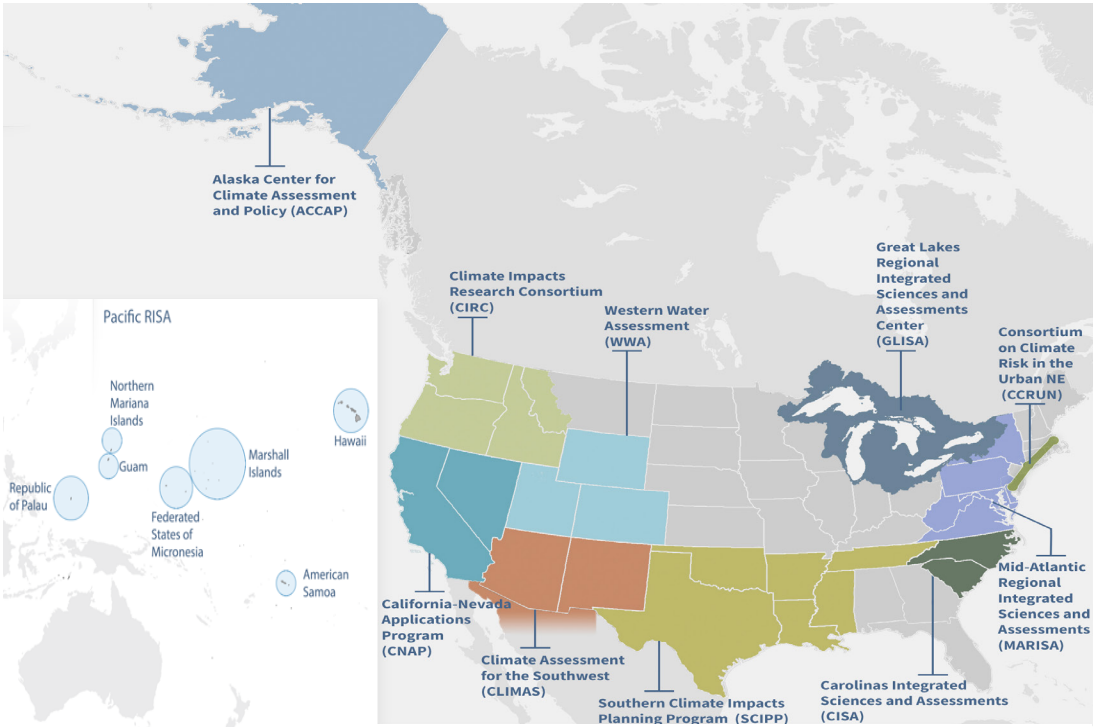


Figure 1: NOAA Regional Integrated Sciences and Assessments Regions