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March 2022 Southwest Climate Outlook

Monthly/Seasonal Precipitation and Temperature: Feb precipitation was between much below average and average in Arizona and New Mexico (Fig. 1a). Feb temperatures were mostly average to below average in Arizona and mostly below average to much below average in New Mexico (Fig. 1b). Winter (DJF) precipitation was mostly average to below average in Arizona, and mostly below average to much below average in New Mexico (Fig. 2a). Winter (DJF) temperatures were mostly above average to much above average across the Southwest (Fig. 2b). Water year precipitation is between average and much below average in most of Arizona and New Mexico (Fig. 3).

Drought: The U.S. Drought Monitor (USDM) in the Southwest is relatively stable since last month, with drought conditions still found across nearly the entire western United States (Fig. 4). Most of Arizona is classified as experiencing either abnormally dry conditions (D0) or in moderate drought (D1), with approximately 30-percent in higher drought categories (D2-3). Approximately 85-percent of New Mexico is classified as severe drought (D2) or worse, with 35-percent of the state classified in the higher drought categories (D3-D4). Long term accumulated precipitation deficits are a factor in these designations, but the relatively dry conditions over the cool season so far are also playing a large part.

Snowpack & Streamflow: As of Mar 1, snow water equivalent (SWE) is highly variable across the Southwest (Fig. 5), with SWE ranging from well below to well above median. Mar 1 streamflow forecasts are mostly below median in both the Colorado River and Rio Grande basins, with southern Arizona and parts of New Mexico showing the lowest probability of exceeding the 50% forecast threshold (Fig. 6). April 1 is peak snowpack in the higher country, so March precipitation and snowfall will be important to monitor. Most outlooks call for warm and mostly dry conditions in the remaining cool season, which is not unexpected in a La Niña winter (see seasonal outlooks on p. 3)

Water Supply: Most of the reservoirs in Arizona and New Mexico are at or below the levels from this time last year, and below their long-term average (see Arizona and New Mexico reservoir storage on p. 5).

ENSO Tracker: La Niña conditions are still present. Most outlooks call for a transition to neutral conditions sometime this summer, with some indications this might be a more gradual transition in mid-to-late summer. See ENSO tracker on p. 4 for more details.



Tweet Mar 2022 SW Climate Outlook

MAR2022 @CLIMAS_UA SW Climate Outlook, Forecasts, ENSO Tracker, Streamflow & Snowpack, AZ & NM Reservoirs, CLIMAS Grad Fellows Blog & Podcast bit.ly/3wcnTv3 #SWclimate #AZWx #NMWx



Online Resources

Figures 1-2
National Centers for Environmental Information
[ncdc.noaa.gov/sotc](https://www.ncdc.noaa.gov/sotc)

Figure 3
West Wide Drought Tracker
[wwdt.dri.edu](https://www.wwdt.dri.edu)

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

Figures 5-6
National Resource Conservation Service (NRCS)
[nrcs.usda.gov](https://www.nrcs.usda.gov)

March 2022 - Climate Summary

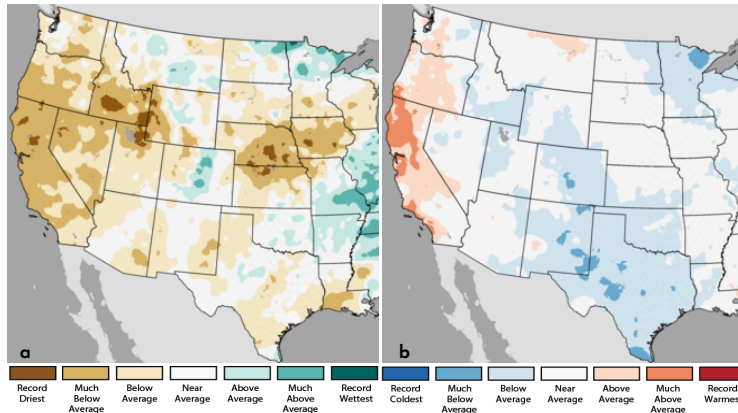


Figure 1: Feb 2022 Precipitation (a) & Temperature Ranks (b)

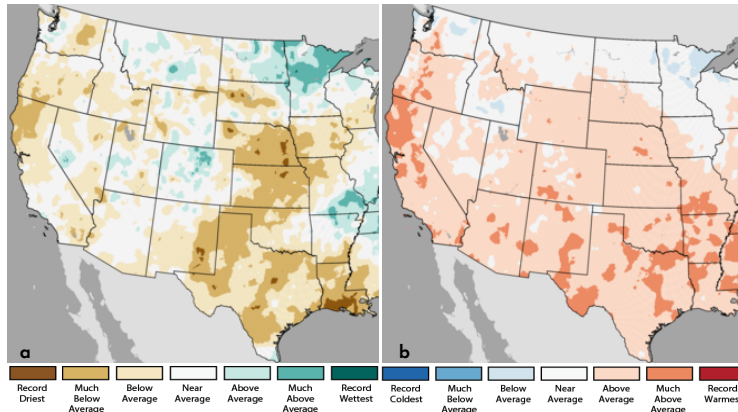


Figure 2: Dec 2021-Feb 2022 Precipitation (a) & Temperature Ranks (b)

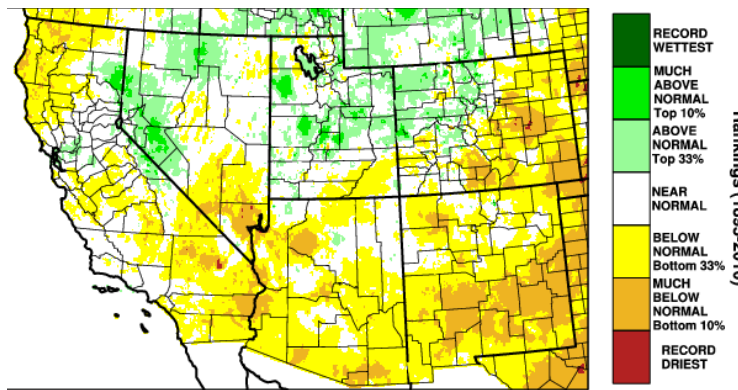


Figure 3: Water Year (Oct 2021 - Feb 2022) Precip Rankings

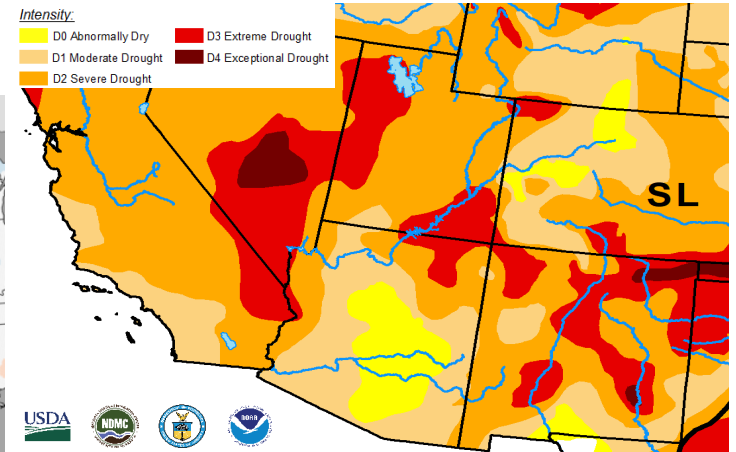


Figure 4: US Drought Monitor - Mar 1, 2022

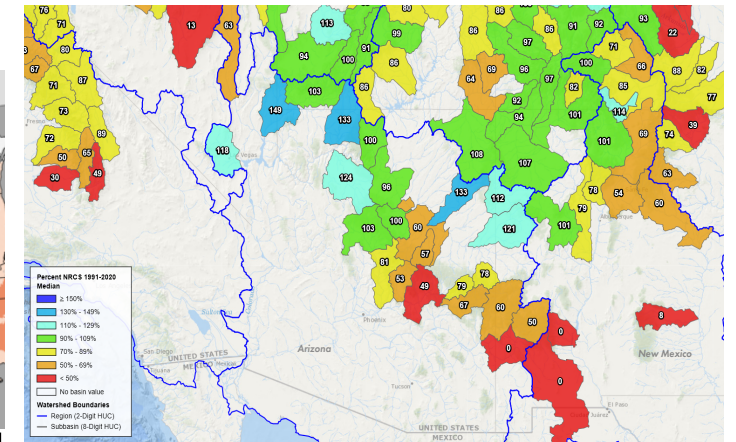


Figure 5: Mar 1 2022 Snow Water Equivalent (SWE) - Pct NRCS Median (1991-2020)

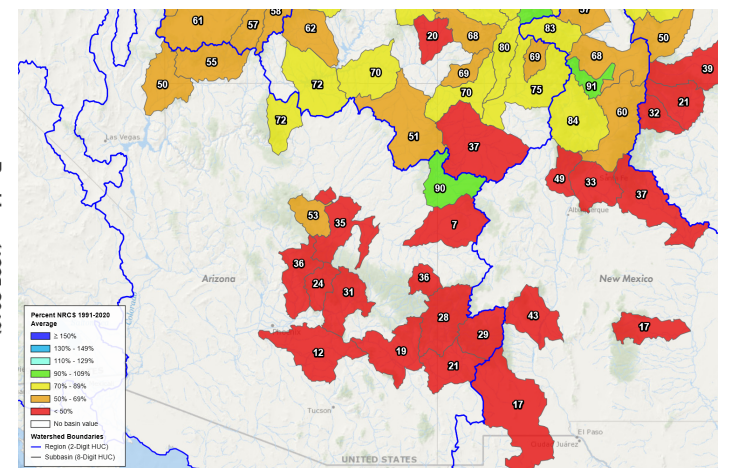


Figure 6: Mar 1 2022 Streamflow Forecast 50% Exceedance Prob., NRCS Median

Online Resources

Figure 7

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

Figure 8

NOAA Climate Prediction Center
cpc.ncep.noaa.gov

March 2022 - Seasonal Forecasts

Precipitation

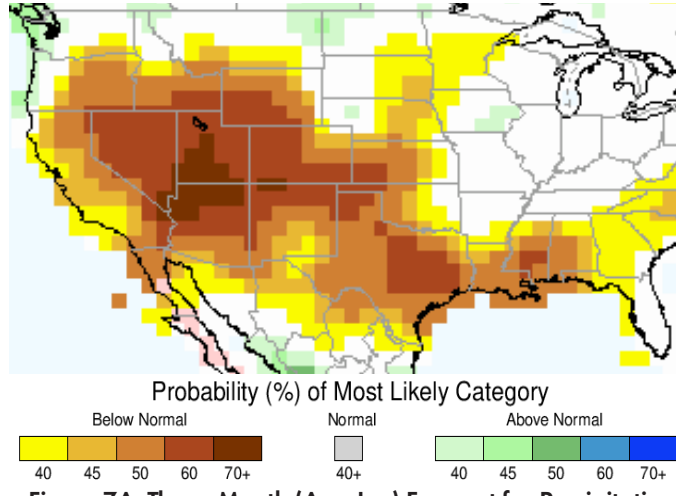


Figure 7A: Three-Month (Apr-Jun) Forecast for Precipitation

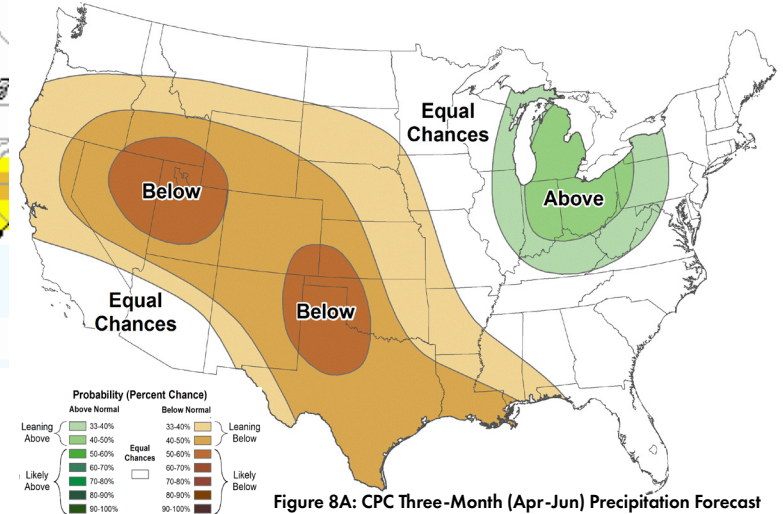


Figure 8A: CPC Three-Month (Apr-Jun) Precipitation Forecast

Temperature

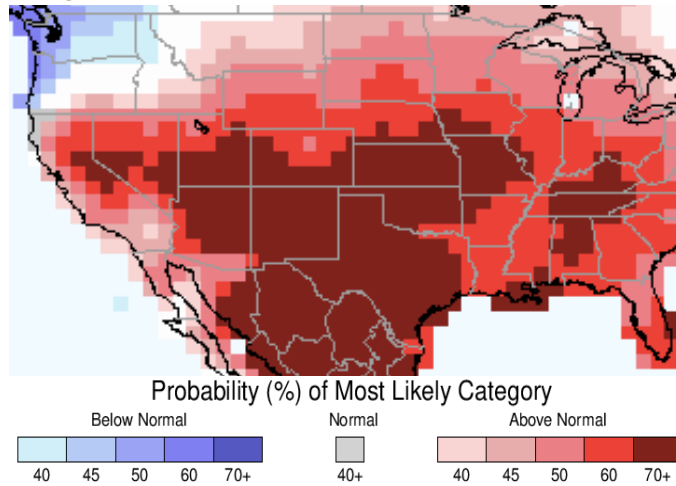


Figure 7B: Three-Month (Apr-Jun) Forecast for Temperature

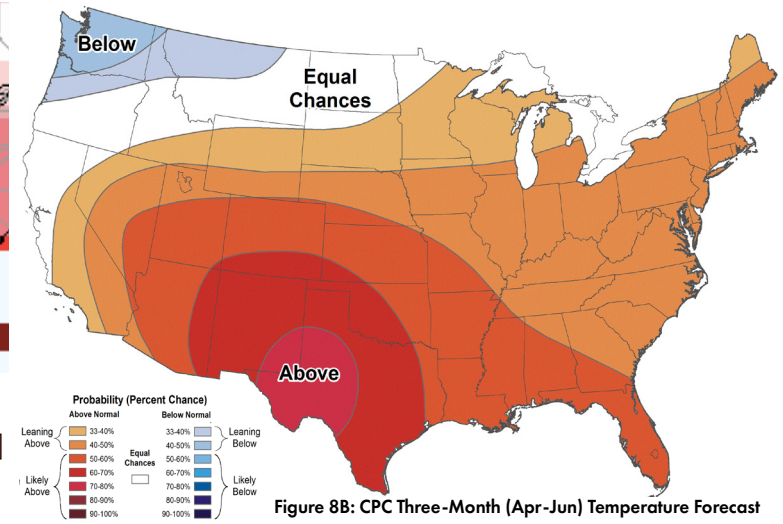


Figure 8B: CPC Three-Month (Apr-Jun) Temperature Forecast

Precipitation Forecasts: The IRI outlook calls for increased chances of below-normal precipitation across the southwestern U.S. and northern Mexico (Fig. 7a). The CPC outlook calls for increased chances of below-normal precipitation across much of the Southwest, save for a swath that includes southern Arizona and California (Fig. 8a).

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

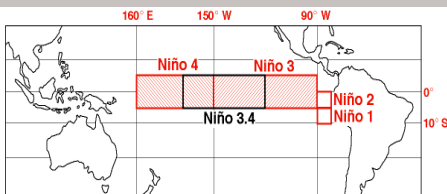
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

El Niño / La Niña

Information on this page is also found
 on the CLIMAS website:

[climas.arizona.edu/sw-climate/
 el-niño-southern-oscillation](http://climas.arizona.edu/sw-climate/el-niño-southern-oscillation)

Equatorial Niño Regions



For more information: [ncdc.noaa.gov/
 teleconnections/enso/indicators/sst/](http://ncdc.noaa.gov/teleconnections/enso/indicators/sst/)

Image source: aoml.noaa.gov/

ENSO Tracker

Sea surface temperature (SST) forecasts for Mar – May 2022 indicate cool conditions across the equatorial Pacific (Fig. 1). Current Niño 3.4/4 anomalies are still below the La Niña threshold (Fig. 2), and ENSO outlooks generally call for La Niña conditions to last into summer, with some not seeing a return to neutral conditions until the end of summer.

Forecast Roundup: On Mar 1 the Australian Bureau of Meteorology ENSO outlook stated “Atmospheric and oceanic indicators remain at La Niña levels”, but called for a “slow warming of deeper waters...[that] typically foreshadows a breakdown in La Niña”. On Mar 10 the NOAA Climate Prediction Center (CPC) maintained their “La Niña Advisory” noting “the coupled ocean-atmosphere system reflected the continuation of La Niña” and called for a 53-percent chance of La Niña lasting through the Jun-Aug period, and a 40-percent chance of ENSO-neutral by Fall 2022. On Mar 10 the International Research Institute (IRI) issued an ENSO Quick Look (Fig. 3), noting “Sea Surface Temperatures remain below-normal in the central-eastern equatorial Pacific” and “the evolution of key oceanic and atmospheric variables is consistent with weak La Niña conditions”. On Mar 10 the Japanese Meteorological Agency (JMA) observed La Niña conditions are present and an 60-percent chance they would continue through the end of spring, and a 70-percent chance of ENSO-neutral by summer. The North American Multi-Model Ensemble (solid and dashed black line, Fig. 4) remains in La Niña territory, but indicates weak intensity and an increasingly gradual transition back to neutral conditions by mid-to-late 2022.

Summary: Some recent outlooks call for an increasingly gradual transition out of La Niña. Some forecast a transition by early-to-mid summer, but others forecast La Niña conditions could persist through the end of summer. La Niña winters are usually warmer and drier than average in the Southwest, and this was consistent with most observed conditions in winter 2021-2022. If La Niña does persist through summer, the impact on spring and summer in the Southwest is less consistent or predictable. April or May are relatively dry in the Southwest, and the onset of monsoon activity in June and July is highly variable, so there are numerous moving parts in terms of precipitation activity, regardless of ENSO status.

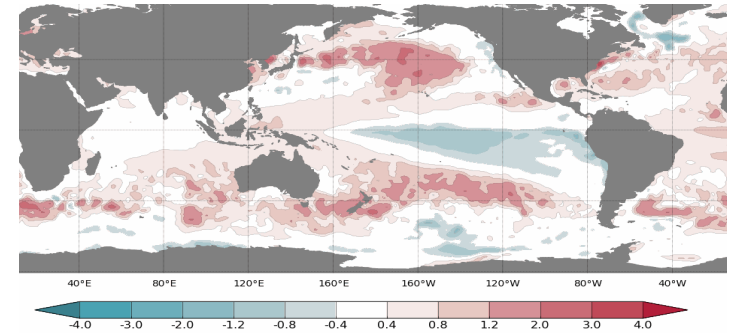


Figure 1: Feb 28 (Mar-May 2022) SST Anomaly Forecast

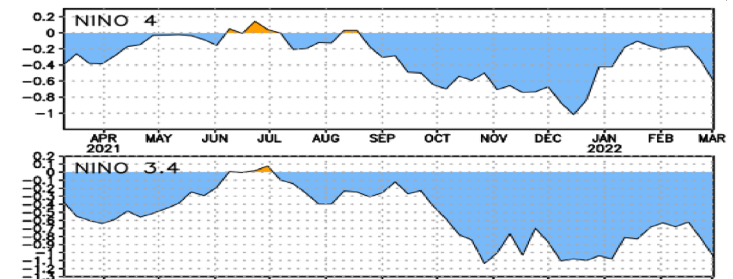


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

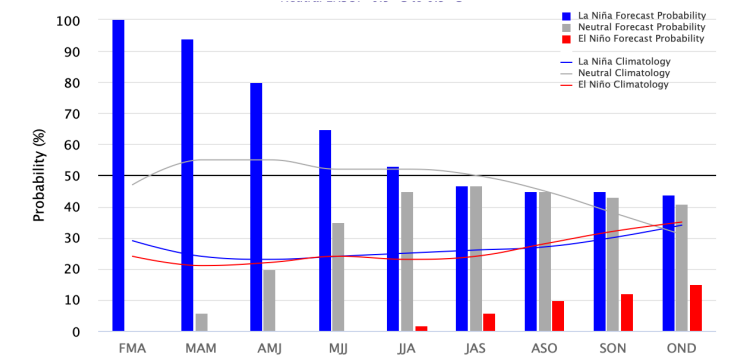


Figure 3: Early-Mar IRI/CPC Model-Based Probabilistic ENSO Forecast

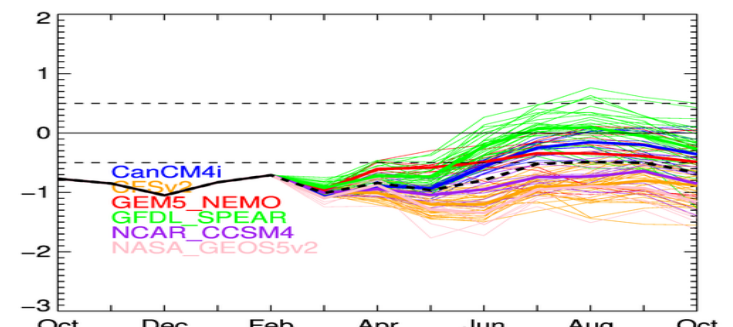


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

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).

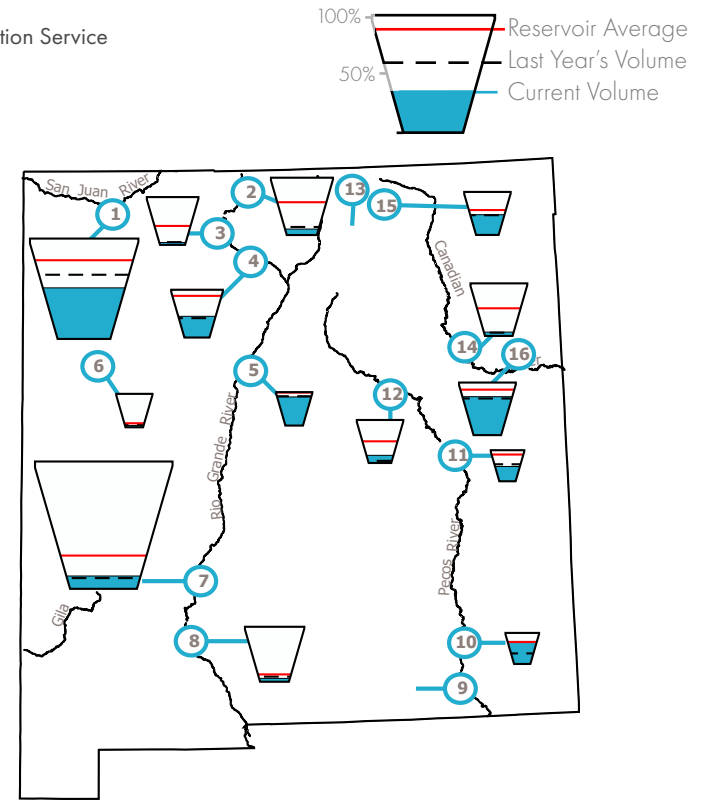
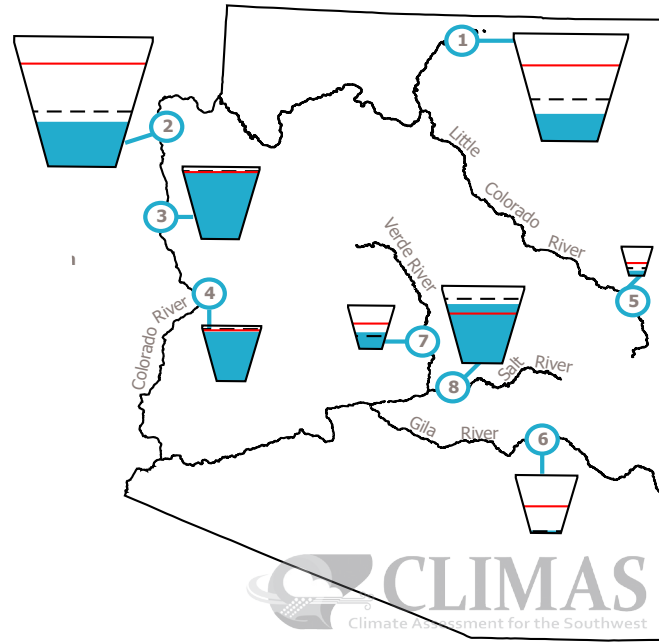
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). 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, 2022

Data Source: National Water and Climate Center, Natural Resources Conservation Service



* in KAF = thousands of acre-feet, ** = missing/incomplete data this month

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Lake Powell	25%	6,048	24,322.0	-287
2. Lake Mead	34%	8,946	26,159.0	-24
3. Lake Mohave	92%	1,665	1,810.0	+1
4. Lake Havasu	89%	553	619.0	+0.3
5. Lyman	16%	4.8	30.0	-0.1
6. San Carlos	4%	31.1	875.0	-5.3
7. Verde River System	38%	107.9	287.4	-12.5
8. Salt River System	76%	1,530	2,025.8	+10

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	50%	848.5	1,696.0	-10.7
2. Heron	10%	40.4	400.0	+0.1
3. El Vado	4%	7.8	190.3	-3.1
4. Abiquiu	43%	81.2	186.8	+0.2
5. Cochiti	84%	41.9	50.0	+0.8
6. Bluewater	5%	1.9	38.5	-0.1
7. Elephant Butte	10%	218.0	2,195.0	+22.5
8. Caballo	5%	16.0	332.0	+0.2
9. Lake Avalon	**	**	4.5	**
10. Brantley	71%	30.0	42.2	+1.8
11. Sumner	46%	16.5	35.9	+1.7
12. Santa Rosa	17%	18.1	105.9	-0.2
13. Costilla	**	**	16.0	**
14. Conchas	7%	18.6	254.2	-0.7
15. Eagle Nest	46%	36.3	79.0	+0.5
16. Ute Reservoir	72%	143	200	-1.0

Environment and Society Fellows

The Environment & Society Fellowship was created in 2013 as a funding opportunity for graduate students to practice use-inspired research and science communication.

The Fellowship supports projects that connect social or physical sciences, the environment, and decision-making

climas.arizona.edu/education/fellowship-program

The 2021 E&S Fellows shared reflections on their experience on the CLIMAS blog, and in a recap podcast hosted by Gigi Owen.

Full versions of the blog posts at:

climas.arizona.edu/blog/

Listen to the podcast episode on Spotify, Apple Podcasts, the CLIMAS website, or wherever you listen to podcasts - details here:

climas.arizona.edu/media/podcasts/

climas.arizona.edu/podcast/special-episode-2021-climas-environment-society-graduate-fellows-interviews

2021 E&S Fellows - Final Blog Posts & Podcast



Lessons Learned as a CLIMAS Environment & Society Fellow

Lea Schram von Haupt

In my year as an Environment & Society Fellow with CLIMAS, I learned just as much about the research process and collaborative research as I did about my actual research topic. I learned that things almost never go as planned or according to schedule, and whatever your original vision for your research was will probably change and evolve into something different – and probably better.



Reflections: Exploring Karst Groundwater Vulnerability and Risks in Arizona in 2021

Simone Williams

Groundwater is among the world's most important natural resources. It provides drinking water to rural and urban communities, supports agriculture and industry, sustains wetland and riparian ecosystems, and maintains the flow of rivers and streams. In many places, groundwater resources are susceptible to risks of overuse and contamination. Its sustainable management is increasingly critical; especially in climate-sensitive geographic areas such as islands and arid lands. My main interest is in researching karst groundwater sustainability because aquifers storing groundwater in karst systems are commonly found throughout my home country, Jamaica, and other islands in the Caribbean. In Arizona, the major karst aquifer system is found in the north in the Coconino Plateau area; which includes the city of Flagstaff, and the Grand Canyon region. The physical characteristics of karst groundwater systems make them highly susceptible to pollution and climatic influences. Geologic features of karst landscapes, such as sinkholes, act as quick pathways for pollutants to be transported to the aquifer, given that there are little or no soil layers to filter pollutants en route to the aquifer.



Reflections on 2021 as a CLIMAS Environment & Society Fellow

Moriah Bailey Stephenson

In late August of 2021, I called Rebecca Jim holding back tears. I had met Jim around 2013 when I was working with a coalition to raise awareness about tar sands extraction and to oppose the construction of the southern leg of the Keystone XL pipeline. Jim is the director of Local Environmental Action Demanded (LEAD), and she has devoted much of her life to bringing attention to the Tar Creek Superfund Site and other environmental justice issues in Ottawa County, Oklahoma. Jim's work was inspiring and exciting to me, and from 2013 to the present, we maintained a relationship centered around our shared concern for environmental justice issues in Oklahoma. As I began my PhD program and envisioning my dissertation research project, I contacted Jim and asked her if there was some way my research could be useful to her and LEAD. She was excited about the possibility, and over time, we developed a collaborative research project focused on residents' stories and experiences of water and work throughout processes of industrial development, environmental remediation, and ongoing environmental concerns around the Tar Creek Superfund Site.

Read the rest of their posts and previous E&S fellows posts, at climas.arizona.edu/blog/

Southwest Climate Podcast

climas.arizona.edu/media/podcasts

iTunes

<https://apple.co/3kHh8bf>

Spotify

<https://spoti.fi/3zZlVWu>

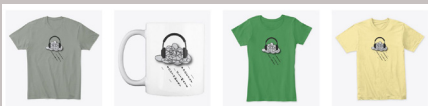
Android

<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.

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



Mar 2022 Southwest Climate Podcast Cold(ish), Windy, and Dry - Winter Recap

In the Mar 2022 edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido dive into a recap of winter (so far) in the Southwest. First, recap winter to date, and put it in the context of a double-dip La Niña, including precipitation totals, temperature, and snowpack. Then they take a closer look at the phases of the PNA (Pacific/North American pattern) and how this links to ENSO/La Niña and the weather conditions this winter. Finally, they revisit temperature to consider just how “cold” it has actually been, and preview a closer look at fire outlooks, snowpack, and water supply in upcoming podcasts.

<https://bit.ly/3lcHrBU>

Jan 2022 Southwest Climate Podcast - La Niña, Winter Storms, & the Jetstream

In the January 2022 edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido dive into the winter weather so far, tracking how this lines up with expectations in a La Niña year, and what to track this winter to look for La Nina effects - temperature, snow water equivalent, streamflow forecasts, etc. They also take a closer look at the jetstream and the role this plays in winter weather in the Southwest, and where these recent events (and the monsoon) leave us in terms of drought. They wrap with some discussion of the outlooks for the next month/season, as well as some obligatory pining for the monsoon.

<https://bit.ly/3LgUbKp>

2021 CLIMAS Environment & Society Graduate Fellows Interviews

In this special episode, Gigi Owen sits down for one on one conversations with Moriah Bailey Stephenson, Simone Williams, and Lea Schram von Haupt (the 2021 CLIMAS E&S Grad Fellows) to chat with each of them about their reflections and perspectives and their fellowship experience. You can also find more information about their projects in blog posts at climas.arizona.edu/blog.

<https://bit.ly/3Jk5IHw>

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



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.

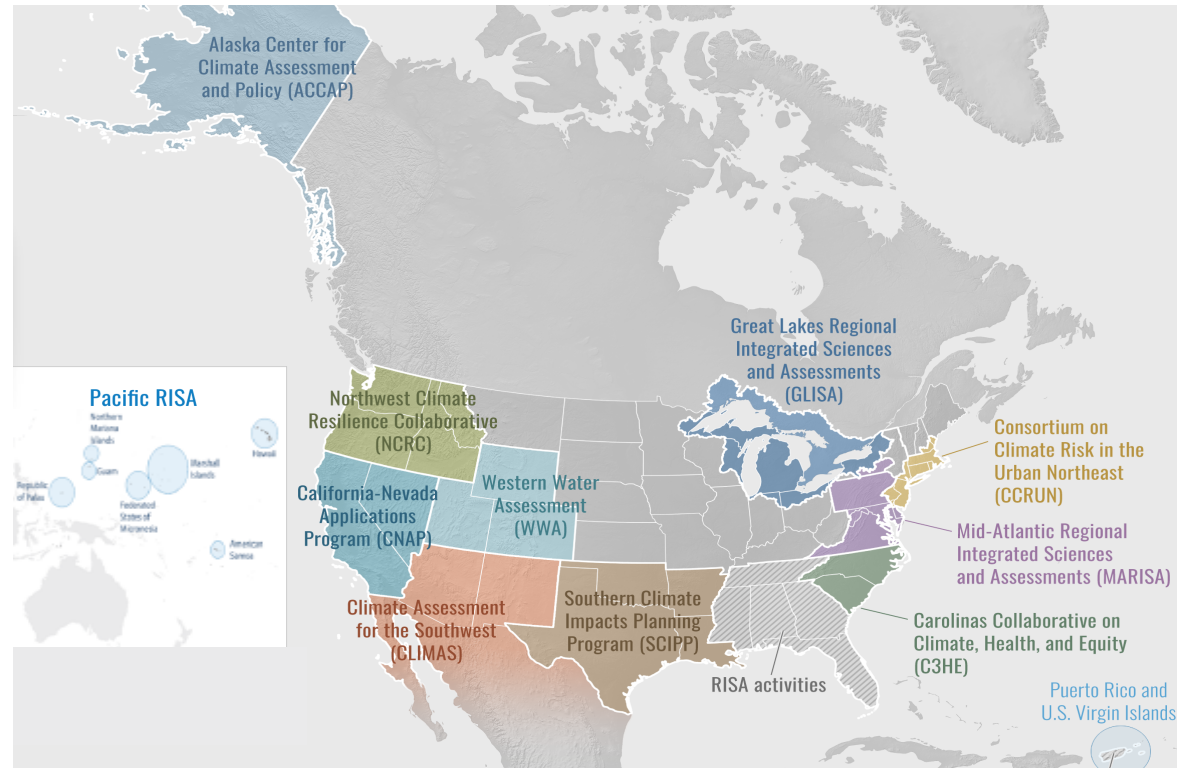


Figure 1: NOAA Regional Integrated Sciences and Assessments Regions