**November 2021 Southwest Climate Outlook**

**Precipitation and Temperature:** Oct precipitation was between below average and above average in Arizona and between average and much below average in New Mexico (Fig. 1a). Oct temperatures were between average and below average in Arizona and between average and much above average in New Mexico (Fig. 1b). Jan-Oct precipitation was between below average and much above average in Arizona and between much below and much above average in New Mexico (Fig. 2a). Jan-Oct temperatures were between above average and much above average across the Southwest (Fig. 2b). Precipitation totals for the past few months were wetter than average in northern California, western Nevada, much of Utah, and parts of central and southeastern Arizona, but dry across much of eastern Colorado and New Mexico (Fig. 3).

**Drought:** The U.S. Drought Monitor (USDM) showed minor improvements in drought categorizations in New Mexico and Arizona, but drought conditions are still found across both states, and the entire western United States (Fig. 4). The variable monsoon totals and the impending La Niña this winter, continue to raise concerns about long-term and cumulative precipitation deficits.

**Snowpack & Water Supply:** It is early in the season, but Nov 1 snow water equivalent (SWE) is highly variable in the Southwest, including well-above- and well-below-average conditions (Fig. 6). 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 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 compared to Lake Mead.

**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. 5). The accumulated cyclonic energy (ACE) was near normal through August, but September and October were quiet with only a few 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).

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Tweet Nov 2021 SW Climate Outlook

NOV2021 @CLIMAS_UA SW Climate Outlook, Seasonal Forecasts, ENSO Tracker, AZ & NM Reservoirs, SW Climate Podcast, https://bit.ly/3HxyVy5 #SWclimate #AZWx #NMWx
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
US Dept of Commerce NWS
nhc.noaa.gov

Figure 6
National Resource Conservation Service (NRCS)
nrcs.usda.gov

November 2021 - Climate Summary

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

Figure 2: Jan-Oct 2021 Precipitation (a) & Temperature Ranks (b)

Figure 3: Sept - Oct 2021 Precip Rankings

Figure 4: US Drought Monitor - Nov 9, 2021

Figure 5: Eastern North Pacific 2021 Hurricane Tracking Chart

Figure 6: Snow Water Equivalent (SWE) - Percent of NRCS Median (1991-2020)
November 2021 - Seasonal Forecasts

Precipitation

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

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

Sea surface temperature (SST) forecasts for Dec 2021 – Feb 2022 indicate cool conditions across the equatorial Pacific (Fig. 1). Current Niño 3.4/4 anomalies appear to 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: Forecast Roundup: On Nov 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. On Nov 9 the Australian Bureau of Meteorology ENSO maintained their La Niña ALERT status noting “International climate models have strengthened their forecast likelihood of La Niña forming before the end of the year”, but that “atmospheric and oceanic observations have yet to consistently reach La Niña levels.” On Nov 11 the NOAA Climate Prediction Center (CPC) maintained their “La Niña Advisory” noting strengthening La Niña conditions, and calling for a 90-percent chance of La Niña during winter 2021-2022. On Nov 11 the International Research Institute (IRI) issued an ENSO Quick Look (Fig. 3), noting “the evolution of key oceanic and atmospheric variables is consistent with La Niña conditions”. 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 shifted to near 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, with overall consensus on a La Niña event of weak to moderate intensity. There are still lingering questions about whether conditions will last long enough to be classified as a La Niña event, but each month the forecasts are more confident the conditions will meet that threshold. La Niña winters are frequently warmer and drier than average in the Southwest, so this forecast is something to watch, given the drought conditions and cumulative precipitation deficits affecting the region.
Reservoir Volumes
DATA THROUGH NOV 1, 2021
Data Source: National Water and Climate Center, Natural Resources Conservation Service

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).

<table>
<thead>
<tr>
<th>Reservoir</th>
<th>Capacity</th>
<th>Current Storage*</th>
<th>Max Storage*</th>
<th>One-Month Change in Storage*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lake Powell</td>
<td>30%</td>
<td>7,180.8</td>
<td>24,322.0</td>
<td>-76.9</td>
</tr>
<tr>
<td>2. Lake Mead</td>
<td>34%</td>
<td>8,934.6</td>
<td>26,159.0</td>
<td>-81.4</td>
</tr>
<tr>
<td>3. Lake Mohave</td>
<td>81%</td>
<td>1,468.0</td>
<td>1,810.0</td>
<td>-102.0</td>
</tr>
<tr>
<td>4. Lake Havasu</td>
<td>95%</td>
<td>589.5</td>
<td>619.0</td>
<td>-2.4</td>
</tr>
<tr>
<td>5. Lyman</td>
<td>16%</td>
<td>4.9</td>
<td>30.0</td>
<td>-0.3</td>
</tr>
<tr>
<td>6. San Carlos</td>
<td>3%</td>
<td>29.0</td>
<td>875.0</td>
<td>-2.4</td>
</tr>
<tr>
<td>7. Verde River System</td>
<td>50%</td>
<td>143.8</td>
<td>287.4</td>
<td>-4.7</td>
</tr>
<tr>
<td>8. Salt River System</td>
<td>71%</td>
<td>1,440.9</td>
<td>2,025.8</td>
<td>-21.9</td>
</tr>
</tbody>
</table>

* in KAF = thousands of acre-feet

Reservoir Average
Last Year’s Volume
Current Volume

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 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).


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

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


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 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.