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September 2021 Southwest Climate Outlook

Precipitation and Temperature: August precipitation was between much below average and much above average in Arizona and New Mexico (Fig. 1a). August temperatures were average to much above average in Arizona and New Mexico (Fig. 1b). Summer precipitation ranks (Jun-Aug) were below average to record wet in Arizona and New Mexico, with much of the region recording wetter than average seasonal totals (Fig. 2a). Temperature ranks for summer (Jun-Aug) were above average to record warm across the Southwest (Fig. 2b). Annual totals are skewed by the wet monsoon in southern Arizona and parts of New Mexico, while most of the rest of the southwest was average to below average for precipitation, and above average to much above average for temperature (Fig 3a-3b).

Drought: Water year precipitation (as of Aug 31, 2021) is between much below normal and above normal across most of Arizona and New Mexico, with much below normal and record driest more prevalent in much of the rest of the Southwest (Fig. 4). The U.S. Drought Monitor (USDM) further scaled back drought categorizations in New Mexico and Arizona, following heavy monsoon precipitation (Fig. 5). The monsoon storms brought short-term relief, while long-term and cumulative precipitation deficits remain a concern.

Water Supply: Most of the reservoirs in the region are at or below the values recorded at this time last year. Most are also below their long-term average (see Arizona and New Mexico reservoir storage, p.7).

Monsoon Tracker: Monsoon activity was widespread and persistent through mid/late August but has tapered in the first few weeks of September. The season generally reflects the normal timing and progression of monsoon activity, even if some of the seasonal totals are much higher across parts of the region, and in southern/central Arizona in particular (Fig. 6; Totals as of Sept 12, 2021; p.5-6 for more maps and information). There is still time for some locations to break monsoon records, but the probability of widespread monsoon or transitional activity is relatively low at this point. Nora brought moisture into the Southwest in early September, but at this time, there are no tropical storms queued up to bring late-season incursions of moisture, and the forecasts through the end of September are for drier than normal conditions.

ENSO Tracker: ENSO conditions are neutral but seasonal outlooks are uncertain about La Niña this winter. This is based on cooling sea surface temperatures (SSTs) that would suggest a La Niña event, and models that lack certainty about the duration of La Niña, and whether it would reach and remain below SST thresholds long enough to be classified as a La Niña (see ENSO-tracker on p.4 for details).



Tweet Sept 2021 SW Climate Outlook

SEPT2021 @CLIMAS_UA SW Climate Outlook, Seasonal Forecasts, Monsoon Tracker, AZ & NM Reservoirs, SW Climate Podcast & 1075, <https://bit.ly/3fThykX> #SWclimate #AZWx #NMWx



Online Resources

Figures 1-3
National Centers for Environmental Information
ncdc.noaa.gov/sotc

Figure 4
West Wide Drought Tracker
wwdt.dri.edu

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

Figure 6
UA Climate Science Applications Program
cals.arizona.edu/climate

Sept 2021 SW Climate Summary

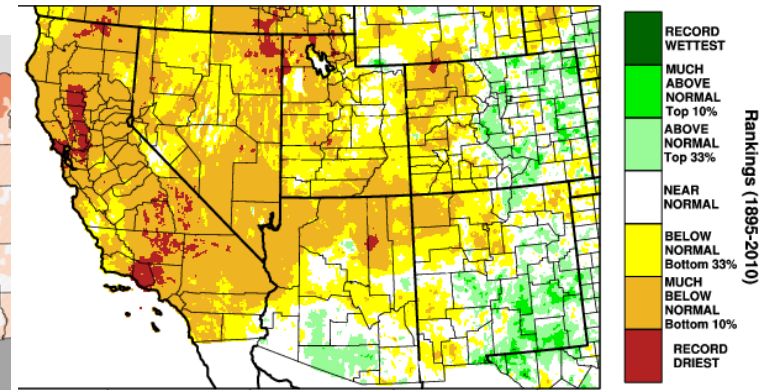
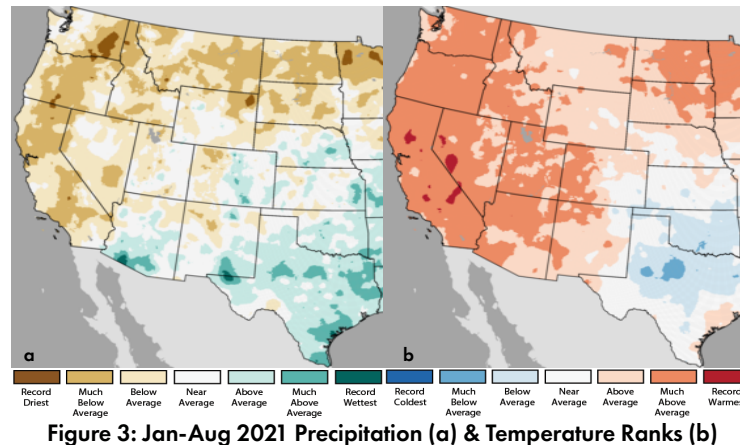
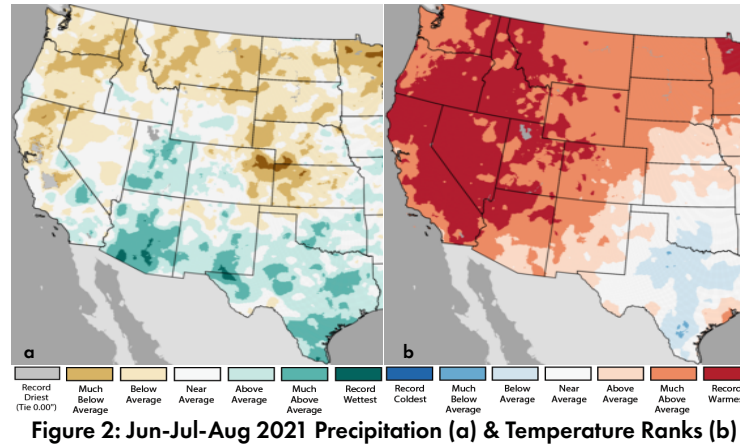
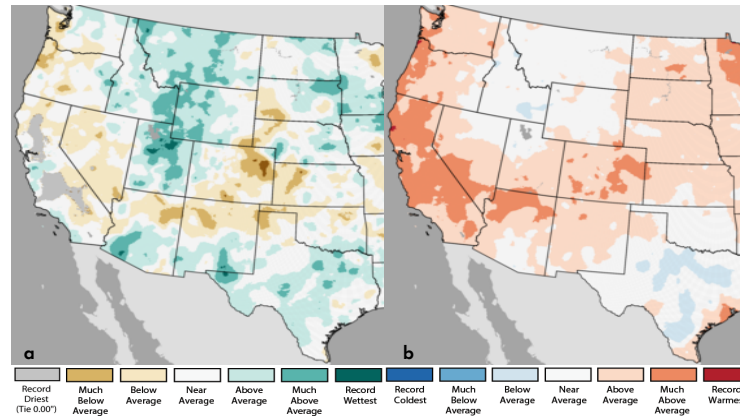


Figure 4: Water Year (Oct 2020 - Aug 2021) Precip Rankings

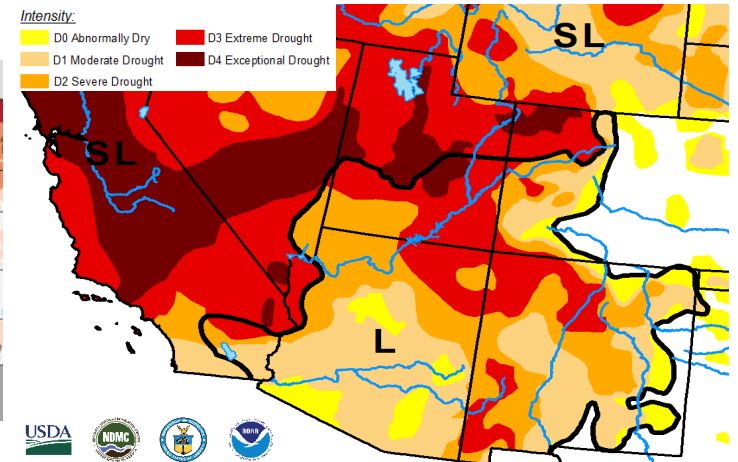


Figure 5: US Drought Monitor - Sept 7, 2021

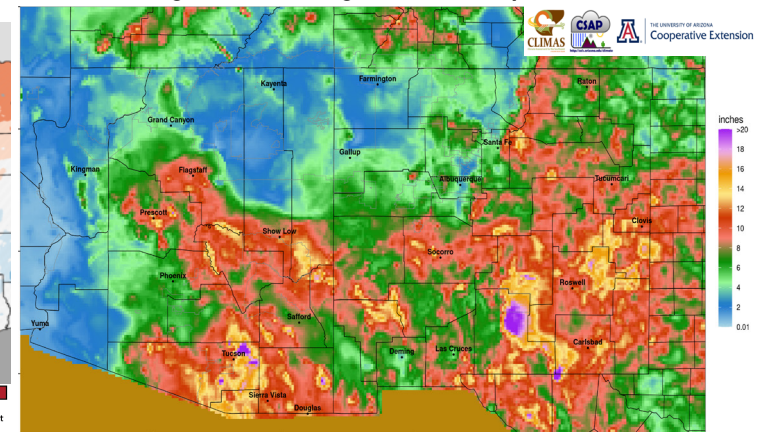


Figure 6: Total Precipitation, Jun 15 - Sept 12, 2021 (PRISM Data)

Online Resources

Figure 7

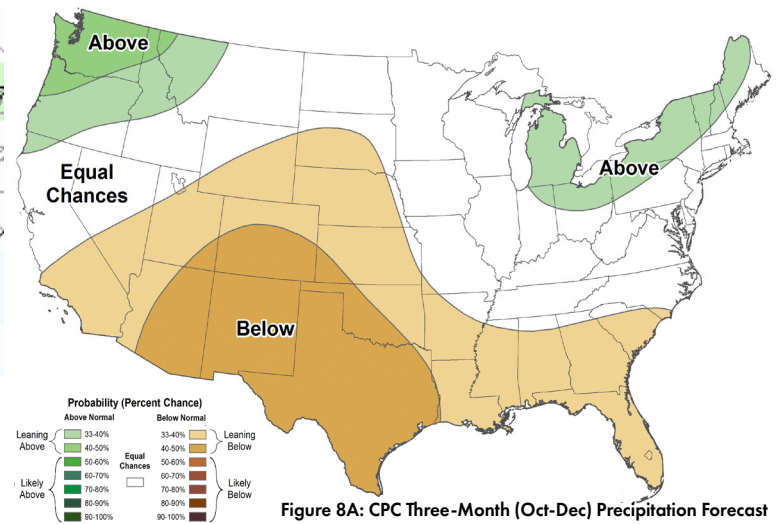
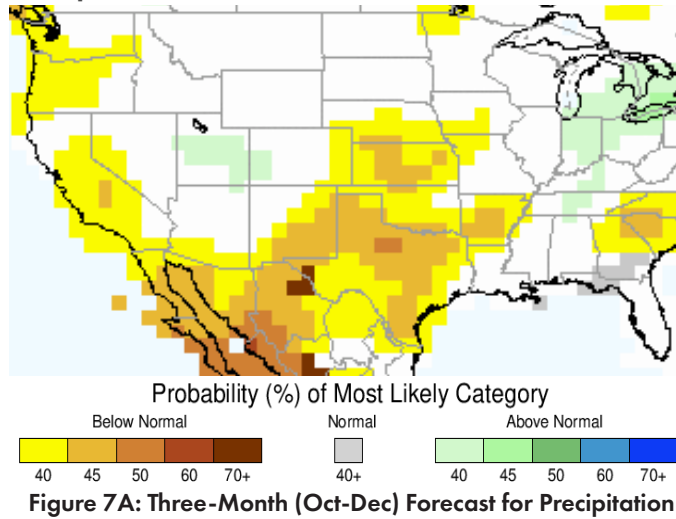
Intl. Research Institute for Climate and Society
iri.columbia.edu

Figure 8

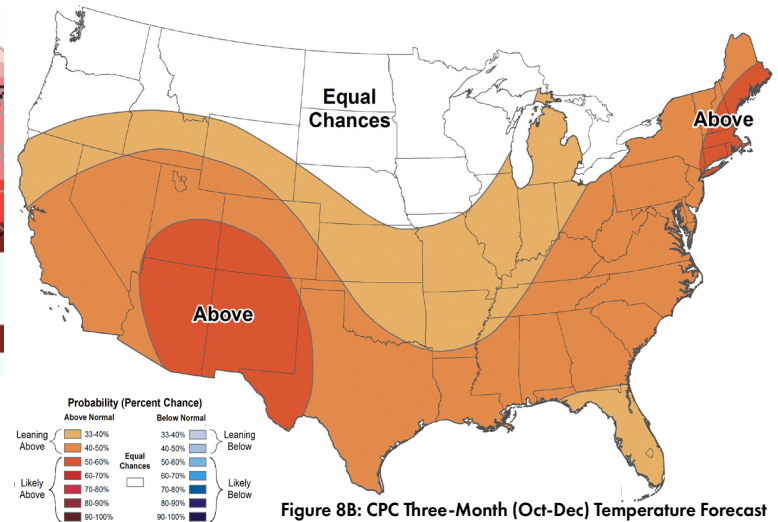
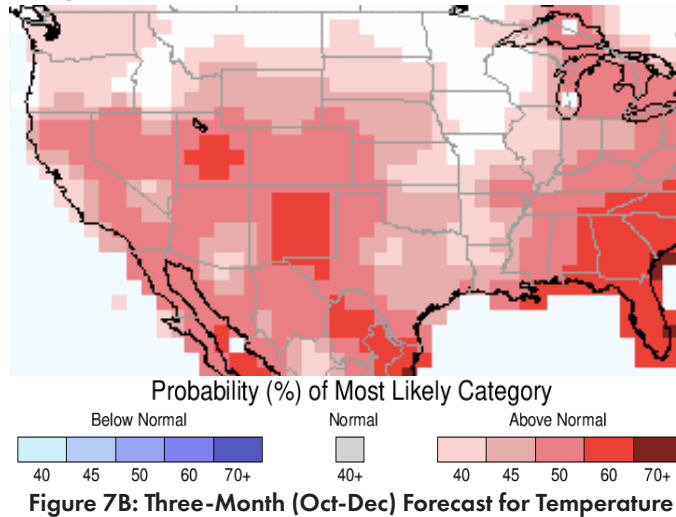
NOAA Climate Prediction Center
cpc.ncep.noaa.gov

Sept 2021 SW Climate - Seasonal Forecasts

Precipitation



Temperature



Precipitation Forecasts: The three-month IRI outlook calls for increased chances of normal to below-normal precipitation across southern Arizona and New Mexico, along with most of northern Mexico (Fig. 7a). The three-month CPC outlook calls for increased chances of below-normal precipitation across much of the Southwest (Fig. 8a).

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

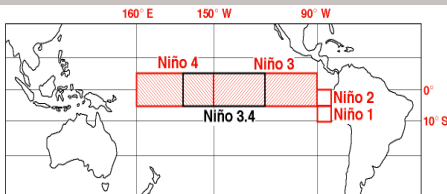
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

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 Oct-Dec 2021 indicate cooling conditions across the equatorial Pacific (Fig. 1). Current Niño 3.4/4 anomalies are neutral (Fig. 2), and ENSO outlooks note the persistence of neutral conditions in the short term. The outlooks generally see La Niña conditions in place by winter 2021-2022, but there is still some uncertainty about whether those conditions will last long enough to reach the La Niña threshold.

Forecast Roundup: On Sept 9, the NOAA Climate Prediction Center (CPC) ENSO status remained at “La Niña Watch” with an outlook calling for a 70- to 80-percent chance of La Niña during winter 2021-2022. On Sept 9, the International Research Institute (IRI) issued an ENSO Quick Look (Fig. 3), noting “The evolution of most key atmospheric variables is consistent with ENSO-neutral conditions” but that “many models suggest further SST cooling to La Niña levels”. On Sept 10, the Japanese Meteorological Agency (JMA) observed ENSO-neutral conditions continued and called for a 70-percent chance of neutral conditions continuing through autumn. On Sept 14, the Australian Bureau of Meteorology ENSO tracker shifted to La Niña watch status, stating “sea surface temperatures in the central tropical Pacific Ocean have cooled over the past two months, supported by cooler than average waters beneath the surface. Climate models continue this cooling trend over the coming months.” The North American Multi-Model Ensemble (solid and dashed black line, Fig. 4) is at ENSO-neutral levels and is expected to remain neutral through September, but then indicates a quick swing to La Niña conditions in late 2021 and into 2022.

Summary: The seasonal outlooks support plausible scenarios for both ENSO-neutral and La Niña conditions in winter 2021-2022. The forecasts for cooling SSTs in the equatorial region and cooler subsurface temperatures are one reason to lean into a La Niña forecast, but forecasters are still grappling with variability in the models, along with questions about whether La Niña conditions would last long enough to be classified as a La Niña event. 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.

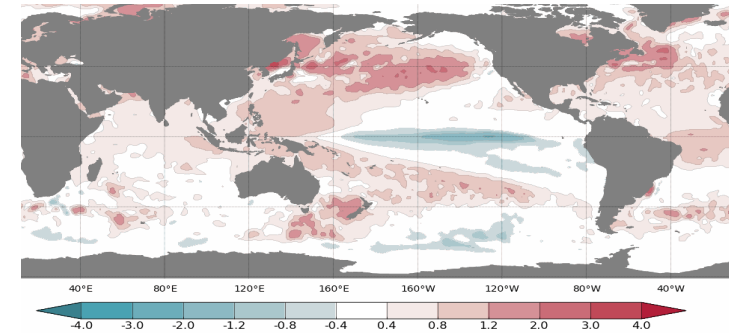


Figure 1: Oct - Dec 2021 Sea Surface Temperature (SST) Anomaly Forecast

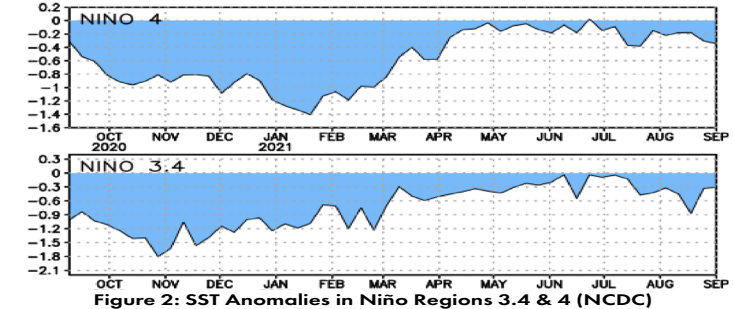


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

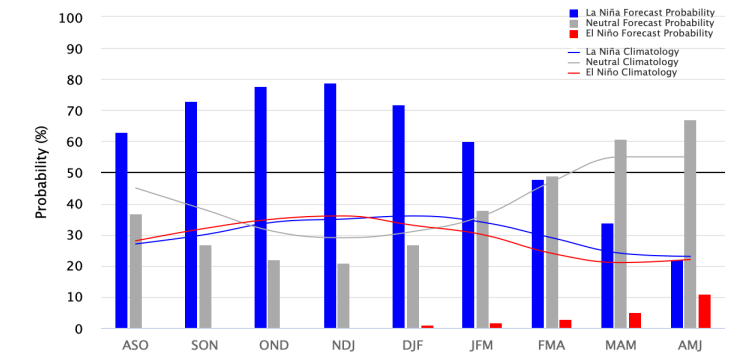


Figure 3: Early-Sept IRI/CPC Model-Based Probabilistic ENSO Forecast

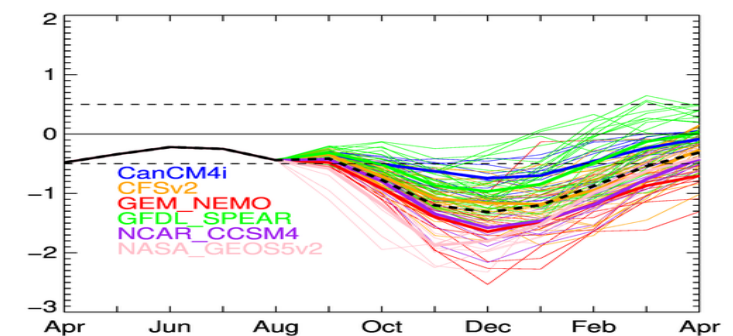


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

Figures 1-2
UA Climate Science Applications
Program
cals.arizona.edu/climate
Data: PRISM

SW Monsoon Tracker - 2021 to Date

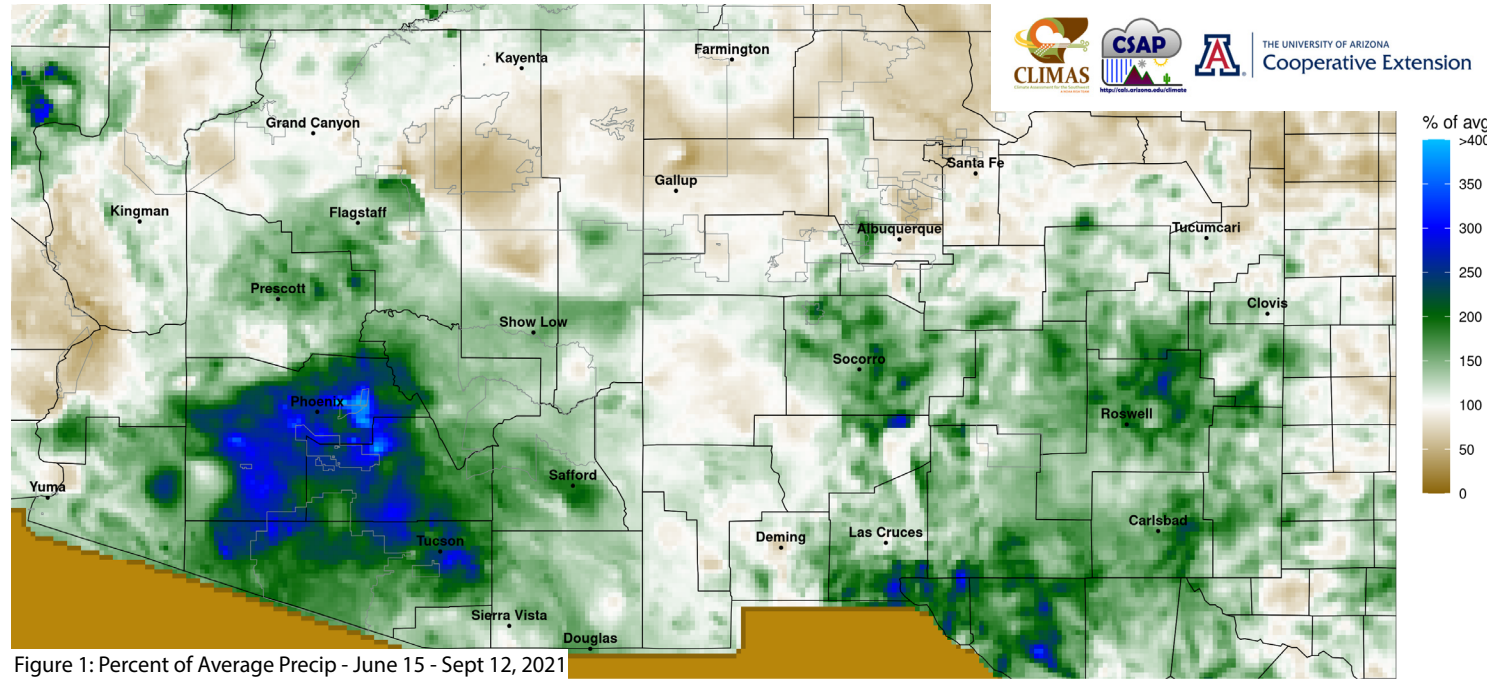


Figure 1: Percent of Average Precip - June 15 - Sept 12, 2021

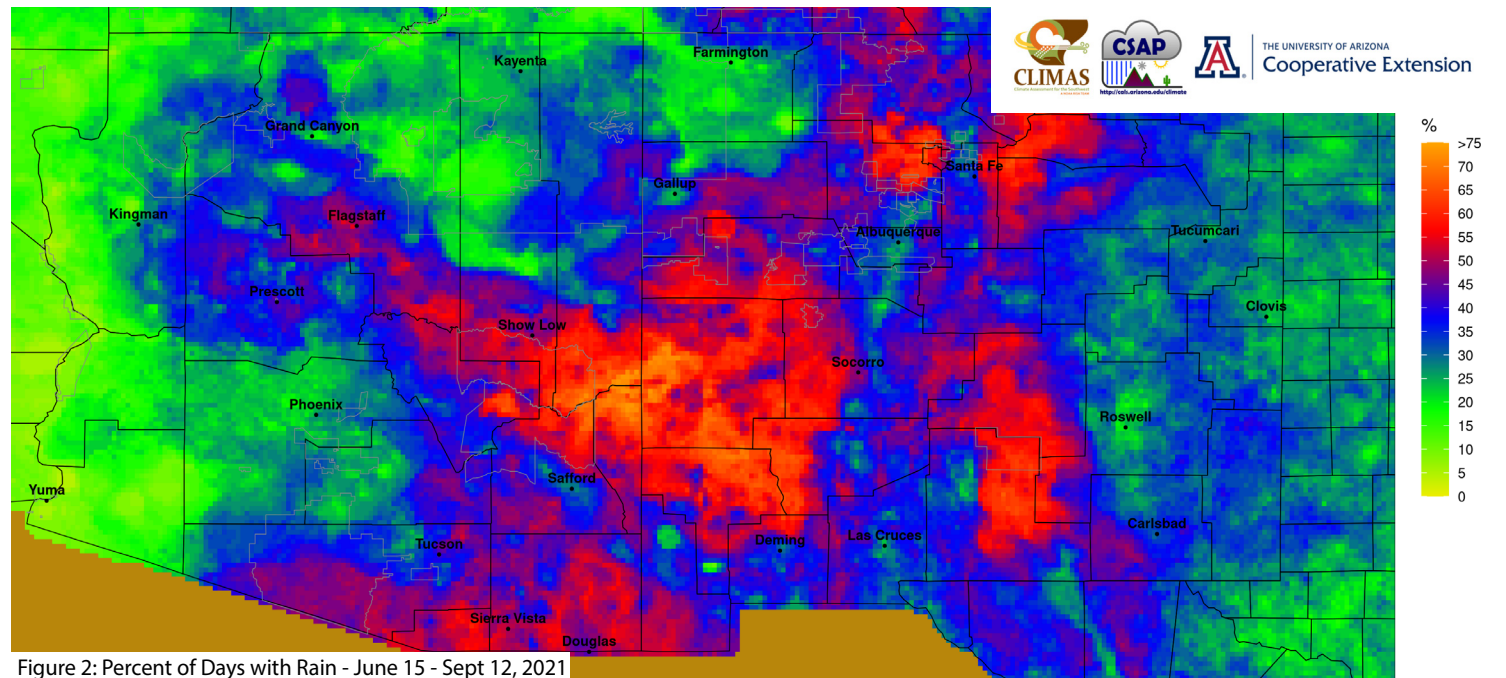
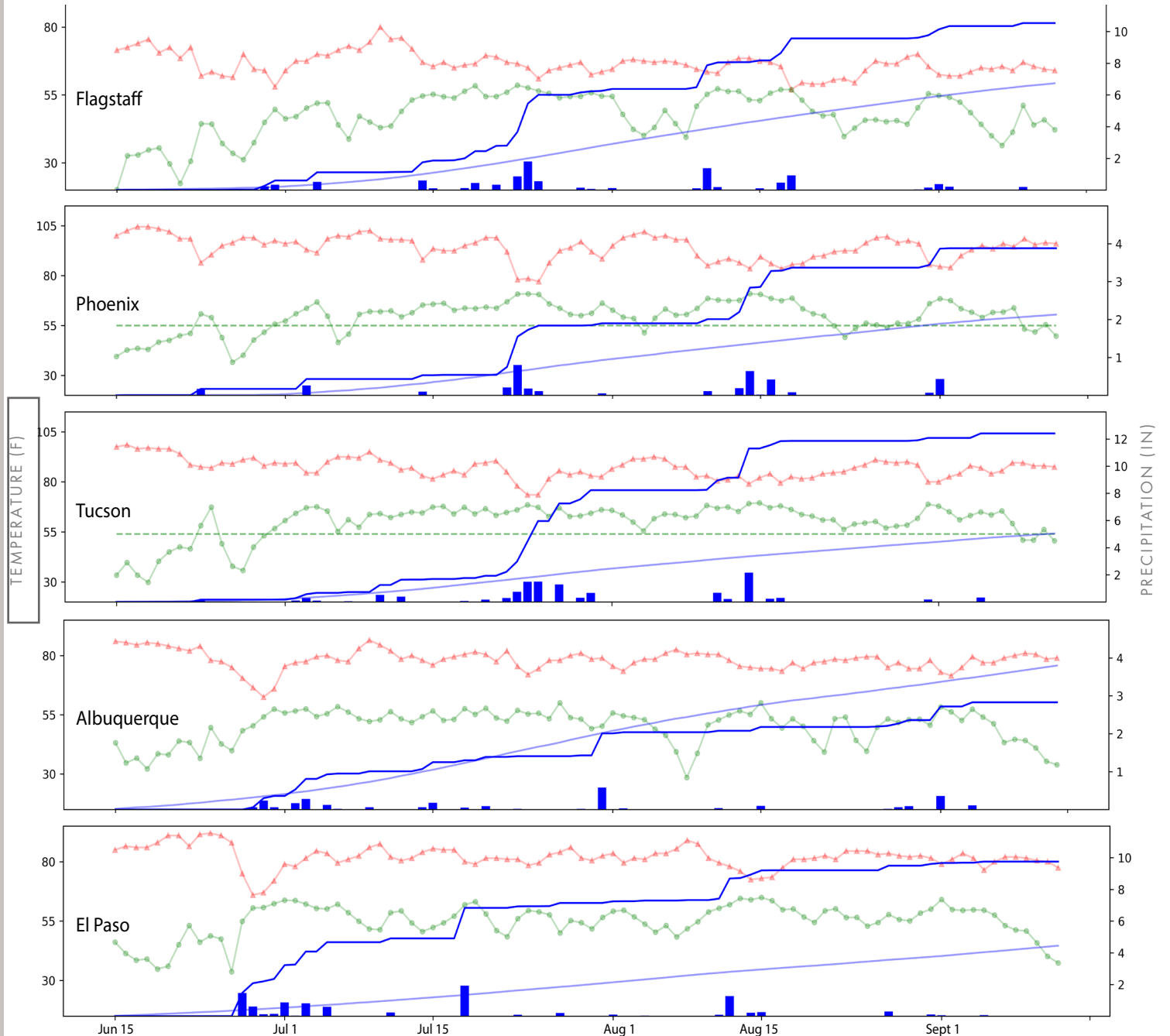


Figure 2: Percent of Days with Rain - June 15 - Sept 12, 2021

Online Resources

Figure 3
 CLIMAS: Climate Assessment for the Southwest
climas.arizona.edu
 Data: ACIS & MesoWest

SW Monsoon Tracker: 2021 Temperature, Dewpoint & Precipitation



- ▲ Daily Ave
- Dewpoint
- 2021 Precip
- Normal Precip

Figure 3: Daily Average Temperature and Dewpoint, Daily and Cumulative Precipitation - Jun 15 - Sept 12, 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).

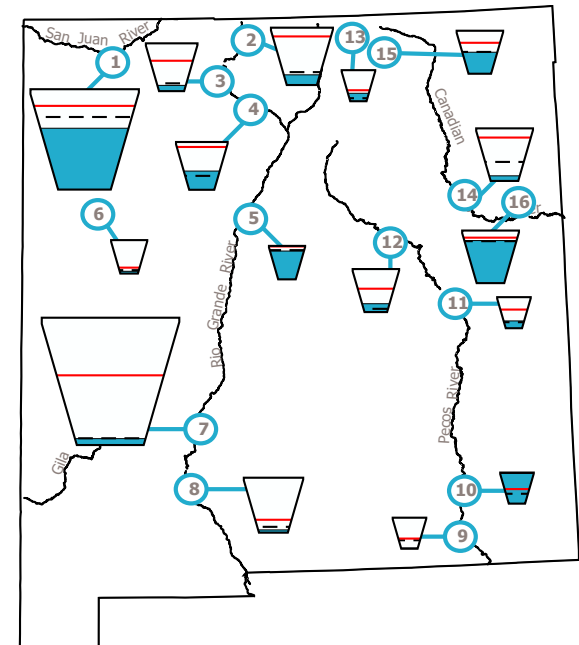
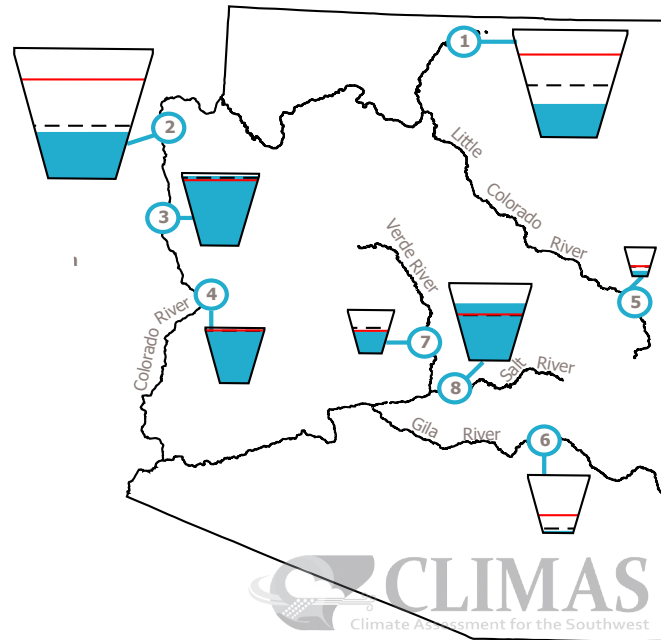
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). 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 SEPT 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	31%	7,511.0	24,322.0	-355.3
2. Lake Mead	35%	9,038.0	26,159.0	24.0
3. Lake Mohave	95%	1,715.0	1,810.0	5.0
4. Lake Havasu	93%	573.2	619.0	-13.6
5. Lyman	18%	5.5	30.0	-0.4
6. San Carlos	3%	27.4	875.0	19.5
7. Verde River System	50%	144.7	287.4	31.1
8. Salt River System	73%	1,482.5	2,025.8	45.3

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	60%	1,010.4	1,696.0	-59.4
2. Heron	17%	67.9	400.0	-15.0
3. El Vado	12%	23.3	190.3	4.3
4. Abiquiu	38%	71.6	186.8	1.8
5. Cochiti	83%	41.4	50.0	-0.3
6. Bluewater	6%	2.3	38.5	-0.1
7. Elephant Butte	5%	104.5	2,195.0	-16.4
8. Caballo	4%	13.5	332.0	-4.1
9. Lake Avalon	0%	0.0	4.5	0.0
10. Brantley	96%	40.7	42.2	-0.4
11. Sumner	22%	8.0	35.9	-0.9
12. Santa Rosa	18%	18.6	105.9	8.2
13. Costilla	25%	3.9	16.0	-1.0
14. Conchas	10%	25.6	254.2	4.5
15. Eagle Nest	49%	38.5	79.0	-0.3
16. Ute Reservoir	79%	158	200	12.0

Southwest Climate Podcast

climas.arizona.edu/media/podcasts

iTunes

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

Spotify

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

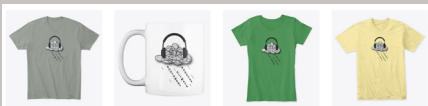
Android

<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.

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

Sept 2021 Southwest Climate Podcast Is the (Generational) Monsoon Over?

In the September Edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido sit down to revisit last month's discussion of a generational monsoon. They check in around the region to see how various locations are faring and discuss the interesting patterns they've seen in monsoon activity so far. They put the totals to date into climatological context and rankings, to see who is experiencing a generational monsoon, vs. areas that are "just" above average (or who are lagging behind). They wrap with a discussion of "Is the Monsoon Over" - and talk about the reasons why you may/may not think so, and what the transition season means for the last few weeks of the monsoon (and the final seasonal rankings).

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

August 2021 Southwest Climate Podcast - 2021 - A Generational Monsoon?

In the August 2021 edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido sit down to discuss the "monsoon that comes to you" (i.e. it's just about everywhere, and it just keeps coming!). They discuss the (record) July for some areas, as well as the well above average conditions around much of the region. They also deconstruct the elements that are feeding into this persistent monsoon rainfall and take a deep dive into a few of the events that have contributed to impressive totals. They wrap up with a discussion of outlooks for the rest of the season, whether any stations might hit record monsoon totals (Tucson is definitely in the running), and what this has meant for the monsoon fantasy game (suffice to say, the guesses for July did not anticipate the record wet conditions).

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

1075' - Shortage on the Colorado River Ep. 1 - Management of the Colorado River

Originally released in 2014, this CLIMAS podcast series that explores what the first ever shortage declaration on the Colorado River would mean to those living in the Southwest. The first episode takes a broad view of the Colorado River Basin, exploring how the river is managed, who uses the water, and what a potential shortage could mean for the system. The guest is Doug Kenney, Director of the Western Water Policy Program at the University of Colorado School of Law.

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



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

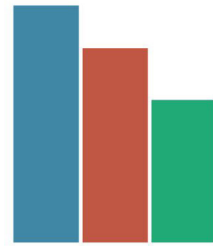
climas.arizona.edu/research

CLIMAS Outreach

climas.arizona.edu/outreach

Climate Services

climas.arizona.edu/climate-services



ASAP Private Sector Climate Service Providers Academy

AMERICAN SOCIETY OF
ADAPTATION PROFESSIONALS



GLISA
A NOAA RISA TEAM



American Society of Adaptation Professionals 2021 Private Sector Climate Service Providers Academy

Oct 14-28, on Zoom

Despite growing demand, we know it can be challenging to build a business in the climate change space. What if you could get the best climate data and information, put into practice innovative climate resilience principles, and attract more customers? We are looking for companies to join the Private Sector Climate Service Providers Academy in October to do just that!

Hosted by American Society of Adaptation Professionals (ASAP), this virtual course will give you the tools you need to develop higher quality climate services and help your business succeed in the rapidly evolving climate services marketplace.

You will come away with:

- New skills for accessing the very best climate data and information for the Great Lakes, Carolinas, and Southwest regions.
- Sophisticated knowledge and relevant examples of the strategies and approaches that constitute high quality climate change adaptation and resilience practice across North America.
- Connections to complementary businesses and potential partners and collaborators.

This virtual course will give you the tools you need to develop higher quality climate services and help your business succeed in the rapidly evolving climate services marketplace.

<https://adaptationprofessionals.org/private-sector-workshop-registration/>

The ASAP Climate Services Provider Academy is in partnership with Adaptation International, CLIMAS, Carolinas Integrated Sciences & Assessments, and GLISA.

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.

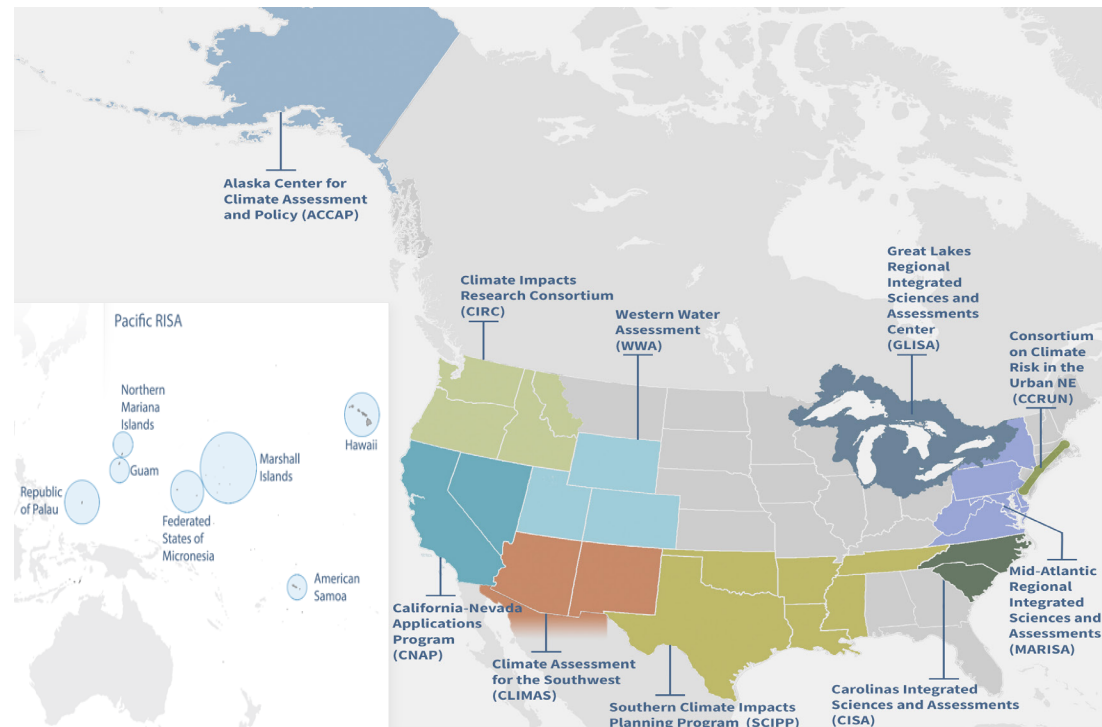


Figure 1: NOAA Regional Integrated Sciences and Assessments Regions