Contributors

Ben McMahan
SWCO Editor; Assistant Research Scientist
Climate Assessment for the Southwest (CLIMAS)

Mike Crimmins
UA Extension Specialist

Dave Dubois
New Mexico State Climatologist

Gregg Garfin
Founding Editor and Deputy Director of Outreach, AIRES

Nancy J. Selover
Arizona State Climatologist

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January Southwest Climate Outlook

Monthly Precipitation and Temperature: December precipitation was average to above average in most of Arizona, while New Mexico ranged from below average to above average (Fig. 1a). December temperatures were average to above average in Arizona and above average to much above average in New Mexico (Fig. 1b). Daily average temperature anomalies for Dec 1 – Jan 15 (Fig. 2) highlight the fluctuations at select stations around the region. Positive anomalies reflect above average daily temperatures, while negative anomalies reflect below average daily temperatures. The histograms show the frequency of the anomalies for each location.

Seasonal Precipitation: Three month precipitation rankings for Oct-Nov-Dec were above normal or much above normal for most of Arizona and New Mexico, with the notable exception of the Four Corners region (Fig. 3), which continues to miss out on recovery from both short and long term drought conditions.

Annual Precipitation and Temperature: Total precipitation for 2019 in Arizona ranged from below average to much above average, while New Mexico ranged from below average to above average (Fig. 4a). Mean temperatures in 2019 were average to above average in Arizona and average to much above average in New Mexico (Fig. 4b).

Snowpack & Water Supply: As of Jan 13, snow water equivalent (SWE) was mostly above median in Arizona, New Mexico, and southern Utah and Colorado (Fig 5, see detailed SWE map on p. 5). Many of the reservoirs in the region are at or above the values recorded at this time last year, but most are below their long-term average (see reservoir storage on p. 4).

Drought: The Jan. 6 U.S. Drought Monitor (USDM) has scaled back the intensity and extent of some drought characterizations in the Southwest, but the Four Corners region remains consistently in the center of regional drought designations (Fig. 6). A large pocket of "Moderate Drought" (D1) and "Severe Drought" (D2) is centered on the Four Corners region, reflecting acute and accumulated precipitation deficits.

ENSO Tracker: Oceanic and atmospheric conditions are generally consistent with an ENSO-neutral outlook for 2020 (see ENSO-tracker on p. 3 for details).

Precipitation Forecast: The three-month outlook for February through April calls for increased chances of below-normal precipitation in California and in small pockets along the U.S.-Mexico borderlands, with equal chances of above or below normal precipitation across much of the rest of the Southwest. Notably, the upper Colorado River Basin is forecast for increased chances of above normal precipitation (Fig. 7, top). **Temperature Forecast:** The three-month temperature outlook calls for increased chances of above-normal temperatures across Texas, New Mexico, and most of Arizona, along with much of north central Mexico (Fig. 7, bottom).

Tweet Jan 2020 SW Climate Outlook

CLICK TO TWEET

JAN2020 @CLIMAS_UA SW Climate Outlook, ENSO Tracker, AZ & NM Reservoir volumes, Environment and Society Graduate Fellows - https://bit.ly/35W4Cgr #SWclimate #AZWX #NMWX

January 2020 SW Climate Outlook

Online Resources

Figures 1, 4
National Centers for Environmental Information
ncei.noaa.gov

Figure 2
Climate Assessment for the Southwest
climas.arizona.edu

Figure 3
West Wide Drought Tracker
wrcc.dri.edu/wwdt/

Figure 5
Natural Resources Conservation Service
nrcs.usda.gov

Figure 6
U.S. Drought Monitor
droughtmonitor.unl.edu

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

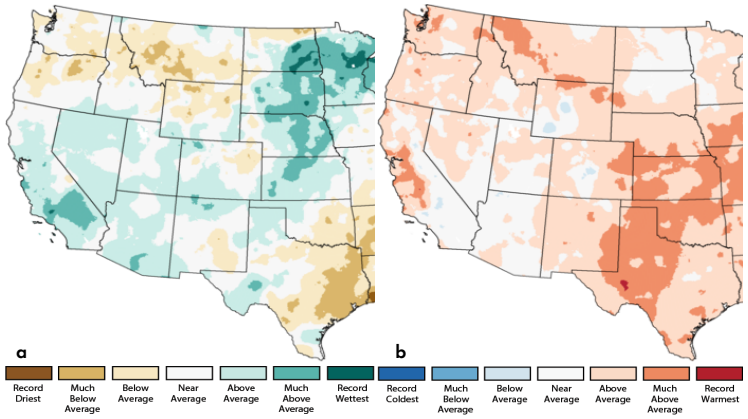


Figure 1: Dec 2019 Precipitation (a) & Temperature Ranks (b)

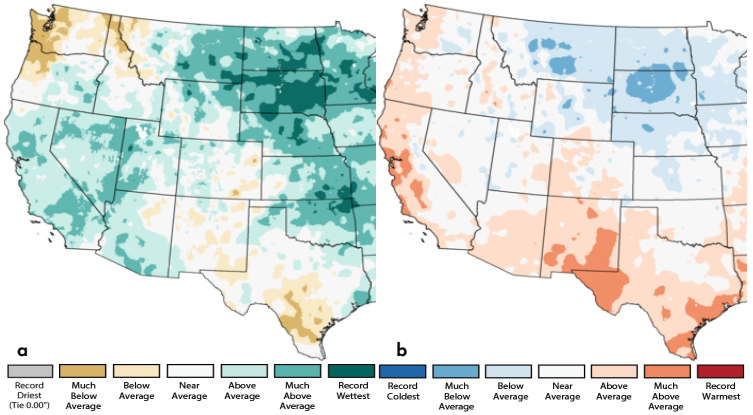


Figure 4: 2019 (Jan-Dec) Precipitation (a) & Temperature Ranks (b)

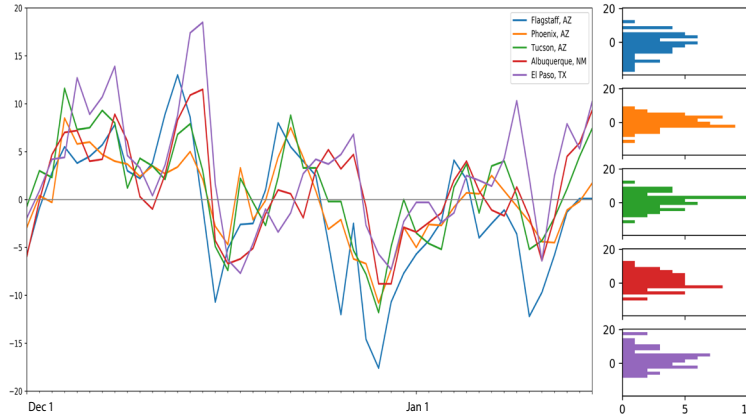


Figure 2: Daily Temperature Anomalies Dec 1 - Jan 15 (L) & Frequency of Anomalies (R)

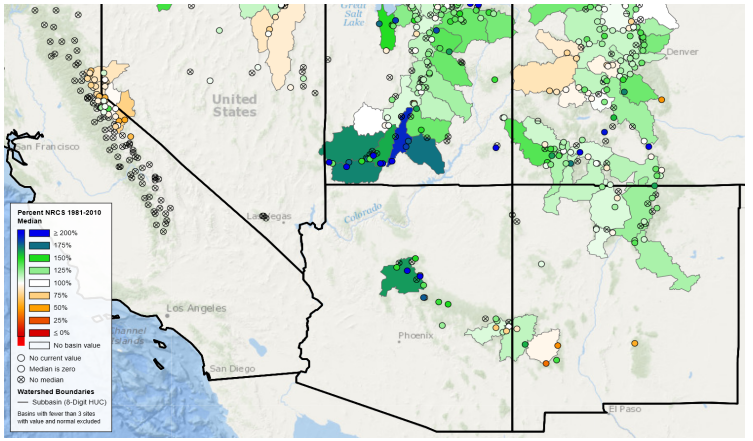
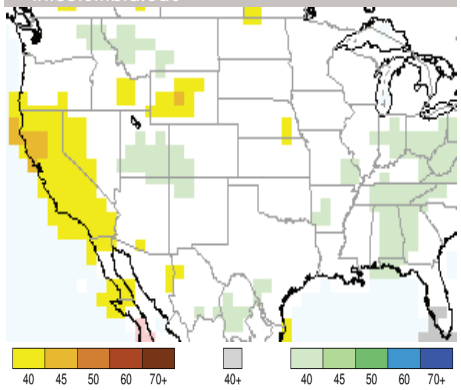


Figure 5: Jan 13 Snow Water Equivalent (Pct. 1981-2010 Median)



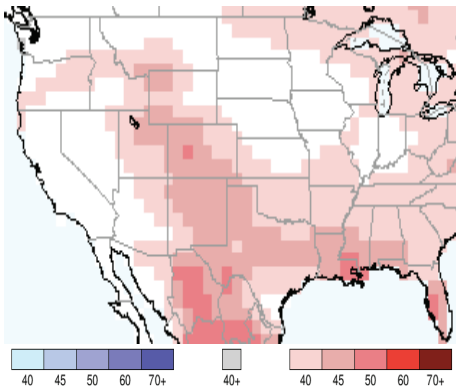


Figure 7: Three-Month (Feb-Apr) Forecast for Precip (top) and Temps (bottom)

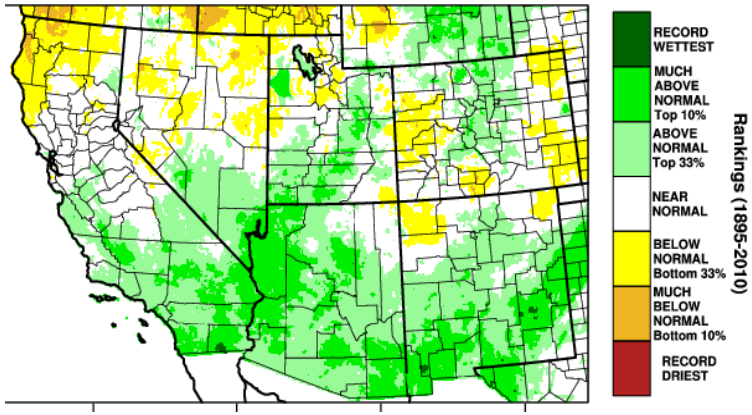


Figure 3: Oct-Nov-Dec, 2019 - Precipitation Rankings

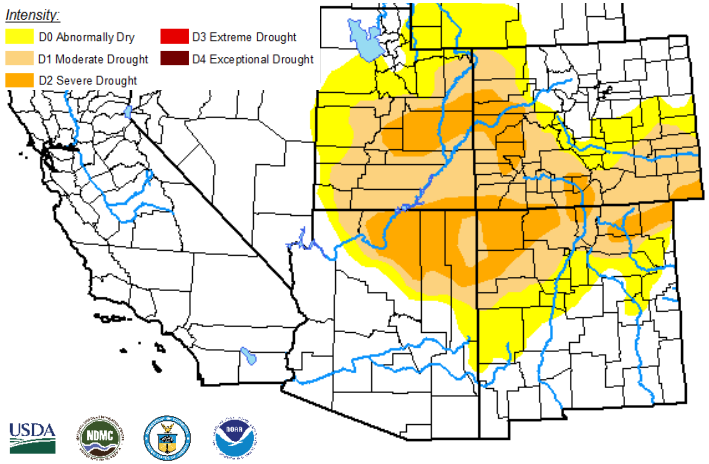


Figure 6: US Drought Monitor - Jan 7, 2020

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

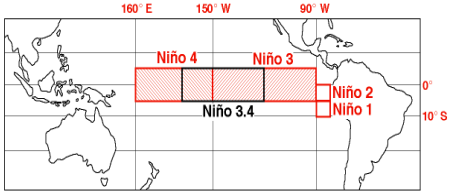
Figure 4
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

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

Warm waters continue to linger in the equatorial Pacific (Figs. 1-2), and while sea surface temperatures (SSTs) are expected to fall back within the range of ENSO-neutral, some forecasters made note of these warm conditions as something to keep an eye on in 2020.

Forecast Roundup: On Jan 7, the Australian Bureau of Meteorology noted "the tropical ocean...remains warmer than average" but that ENSO indicators remained consistent with neutral conditions. On Jan 9, the NOAA Climate Prediction Center (CPC) issued their ENSO diagnostic discussion with an inactive alert status and called for a 60-percent chance of ENSO-neutral through spring and a 50-percent chance of ENSO-neutral lasting through summer. They stated "the oceanic and atmospheric system was consistent with ENSO-neutral, though recent observations reflected a trend toward warmer conditions that will be monitored." On Jan 9, the International Research Institute (IRI) issued an ENSO Quick Look noting that despite recent above normal SSTs that were likely to last for another month or so, they would not last long enough to meet the criteria for an El Niño event. They maintained a 60-percent chance of neutral conditions through spring (Fig. 3). On Jan 10, the Japanese Meteorological Agency (JMA) maintained their call for a 60-percent chance of ENSO-neutral conditions to continue until spring 2020. The Jan 2020 North American Multi-Model Ensemble (NMME) shows positive SST anomalies into January, but is predicted to return and remain within the range of ENSO-neutral in February (Fig. 4).

Summary: Recent positive SST anomalies in the equatorial Pacific have been attributed to seasonal variability and not the return of El Niño. This appears to still be the case, with forecast consensus on ENSO-neutral conditions lasting into mid-2020. Most recent forecast discussions emphasized that these positive SST anomalies were large enough, but would not last long enough to meet the El Niño criteria, not to mention a lack of atmospheric coupling that is characteristic of El Niño events. A few agencies made note of warm oceanic conditions lasting longer than expected, but so far, all still see ENSO-neutral as the most likely outcome. In the Southwest, ENSO-neutral winters have produced some of the wettest and driest winters (and everything in between). We continue to monitor sub-seasonal and short term forecasts for insight into upcoming events. Given recent and long-term drought conditions in the Southwest, and regardless of ENSO status, a sustained run of regular precipitation events spread out over the cool season would be most welcome.

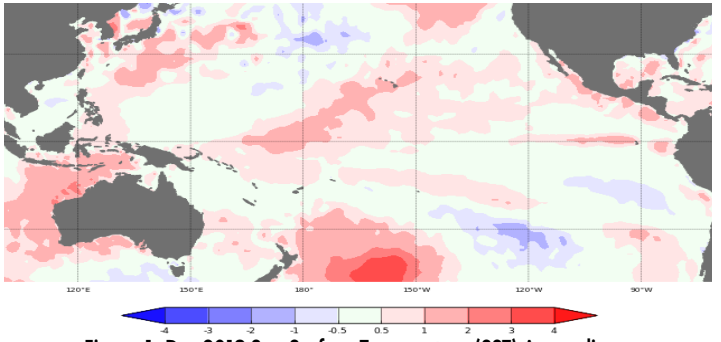


Figure 1: Dec 2019 Sea Surface Temperature (SST) Anomalies

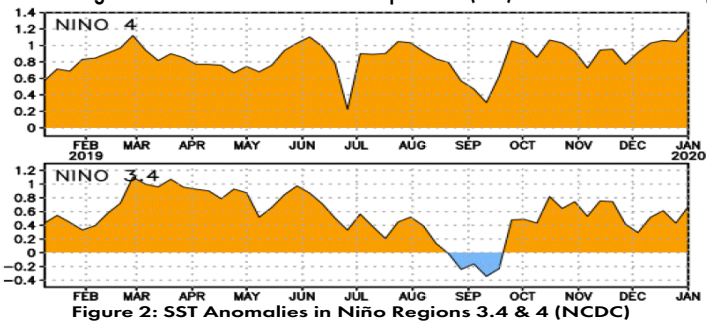


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

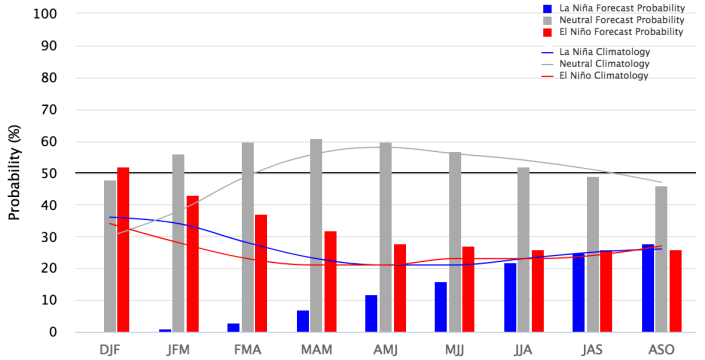


Figure 3: Early-Jan IRI/CPC Model-Based Probabilistic ENSO Forecast

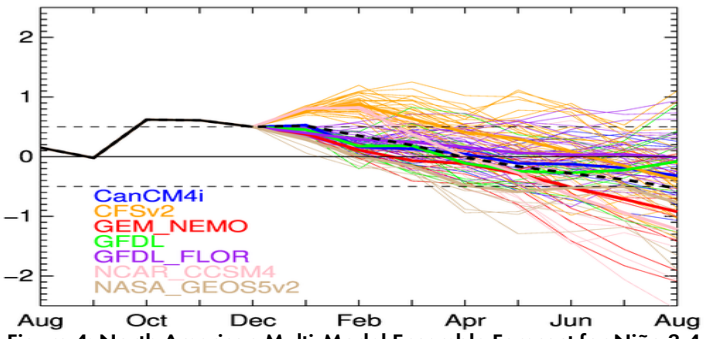


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

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).

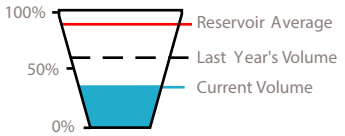
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons).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

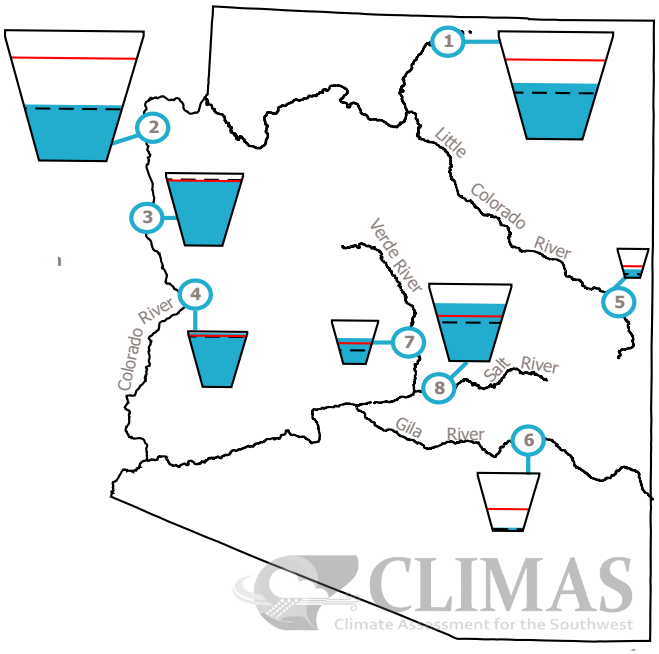
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

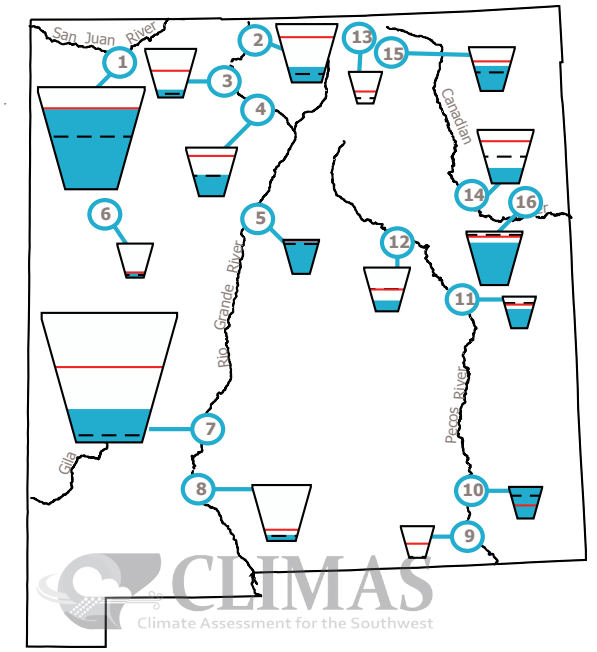
Reservoir Volumes

DATA THROUGH JAN 1, 2020

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	52%	12,603.9	24,322.0	-250.6
2. Lake Mead	42%	10,912.0	26,159.0	576.0
3. Lake Mohave	90%	1,634.0	1,810.0	-38.0
4. Lake Havasu	97%	602.9	619.0	-0.5
5. Lyman	29%	8.7	30.0	0.1
6. San Carlos	5%	42.7	875.0	32.8
7. Verde River System	59%	169.3	287.4	55.1
8. Salt River System	75%	1,516.7	2,025.8	78,9

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	78%	1325.7	1,696.0	-22.6
2. Heron	27%	106.2	400.0	-25.6
3. El Vado	16%	30.6	190.3	12.2
4. Abiquiu	44%	81.9	186.8	3.8
5. Cochiti	96%	47.8	50.0	1.3
6. Bluewater	17%	6.6	38.5	-0.1
7. Elephant Butte	25%	557.3	2,195.0	57.0
8. Caballo	10%	33.9	332.0	1.7
9. Lake Avalon	0%	0.0	4.5	0.0
10. Brantley	100%	42.1	42.2	2.4
11. Sumner	60%	21.5	35.9	3.6
12. Santa Rosa	25%	26.0	105.9	0.0
13. Costilla	0%	0.0	16.0	0.0
14. Conchas	29%	74.0	254.2	-0.5
15. Eagle Nest	57%	44.8	79.0	0.4
16. Ute Reservoir	79%	157	200	-3.0

Online Resources

Figure 1
University of Arizona - SnowView
climate.arizona.edu/snowview/

Snow Water Equivalent - Details Across the Southwest

Researchers at the University of Arizona recently developed a prototype data visualization tool for snow cover and snow water equivalent (Fig. 1). This helps demonstrate the variability of snowpack and deviations from median across the Southwest, at finer scales compared to basin and sub-basin estimates, and with greater spatial coverage than single SNOTEL station measurements.

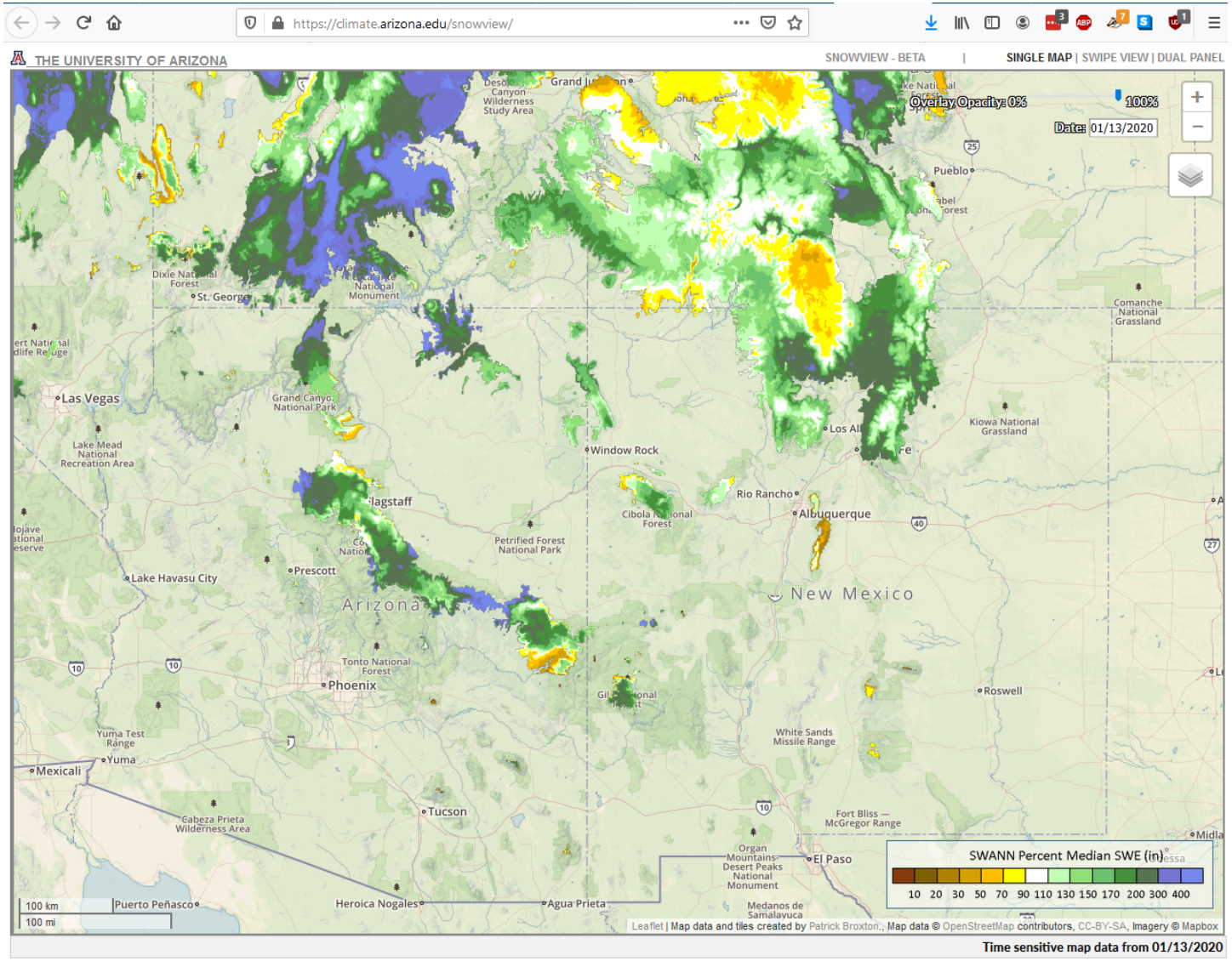


Figure 1: Snow Water Equivalent (SWE) Percent of Median - Source: UArizona SnowView Data Viewer (climas.arizona.edu/snowview)

Environment & Society Graduate 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.

Projects must be use-inspired and address research and information needs voiced by the students' project partners.

The Fellowship is funded and supported by the University of Arizona Office of Research, Innovation, & Impact, and CLIMAS.

climas.arizona.edu/education/fellowship-program

CLIMAS
Climate Assessment for the Southwest
A NOAA RISA TEAM

2019 Environment and Society Fellows Final Presentations

Please join us for the final presentations of our 6th cohort of Environment & Society Fellows. The Fellowship supports projects that connect social or physical sciences, the environment, and decision-making, and is made possible by the University of Arizona's Office of Research, Innovation, & Impact and the Climate Assessment for the Southwest (CLIMAS).

Over the past year, each student has delved into interesting and important research questions by developing relationships with community partners locally and around the world. Presentations will be held on Thursday, January 30 from 12:00-1:30 pm in Room N604 of the Environment and Natural Resources 2 Building (ENR2, 1064 E Lowell St.).

You may also connect remotely through Zoom:

arizona.zoom.us/webinar/register/WN_lJAAJp3bTV2pJV4PYbXKzQ

Building a Risk Assessment - A combined effort between Naco Elementary School, Cochise County Health and Social Services, and the University of Arizona

Alma Anides Morales, a masters student in Soil, Water, and Environmental Science, will discuss her past year of relationship building, skill training, and sample collection in an effort to produce a risk assessment specific to Naco Elementary students from the potential microbial hazards due to sewage overflows in the area.

Hybrid Waters: Informal Water Provision, Municipal Governance and Household Water Security in Nairobi's Informal Settlements

Nupur Joshi, a doctoral student in Geography, will discuss how small scale private water sellers operate and the roles that Nairobi's municipal water governance play in these private operations. Her presentation is a story of water's urbanization in low-income settlements of Nairobi, and the everyday struggles of the urban poor to secure water.

Isotopes, geochemistry, citizen science, and local partnerships as tools to build upon a fractured understanding of the hydrology of the Patagonia Mountains

Sean Schrag-Toso, a masters student in Hydrology and Atmospheric Sciences, will present on how drought and increased demand for groundwater resources have led to concern about future groundwater availability and dwindling spring flow in the Patagonia Mountains of southern Arizona. This research aims to better understand groundwater movement in the Mountains, and through collaborating with local partners, will inform monitoring and management of groundwater resources in the area.

Let it Rain: Discovering the Chemistry of a Raindrop

Norma Villagómez-Márquez, a doctoral student in Soil, Water, and Environmental Science, presents personal illustrations of rainwater collection systems, rainwater contamination, and quality through the eyes of urban children.

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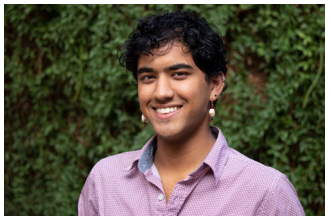
Please welcome our 2020 cohort!

climas.arizona.edu/education/fellowship-program

2020 Environment and Society Fellows

Emily Cooksey (she/her) is PhD student in Environmental Health Science in the Mel and Enid Zuckerman School of Public Health. Her doctoral dissertation is focused on presence, persistence, and human health risk associated with pathogenic Vibrio from oysters harvested in Southern California through a collaboration with Southern California Coastal Water Research Project (SCCWRP). The primary focus of her research is to expand scientific knowledge of the interactions between shellfish, microbial water quality, environmental factors, and public health. As an Environment and Society Fellow, Emily will identify implications for human health by coupling oyster research in Southern Californian estuaries and in simulated marine environments with QMRA. Her laboratory findings will influence her QMRA model and assess regulatory standards. The collaboration between the University of Arizona and SCCWRP provides a platform for groundbreaking Vibrio research on the West Coast and the ability to influence current oyster harvesting policy in Southern California. Emily will use her research to evaluate existing policy to reduce human health risk from exposure to pathogenic Vibrio.

JoRee LaFrance (she/her) is a PhD student in the Department of Environmental Science. She comes from the Crow Reservation located in southeastern Montana and is Apsáalooke (Crow). Her Apsáalooke name is Iichiinmaaáatchilash – Fortunate with Horses and she comes from the Greasy Mouth clan and is a child of Ties in the Bundle clan. She uses the intersection of her background in earth sciences and Native American studies to focus on water quality issues on her reservation. JoRee's PhD research aims to understand the contaminant behavior in the Indigenous Food, Energy, Water Security and Sovereignty (Indige-FEWSS) nexus in the Little Bighorn River watershed. More specifically, she will address the contaminant concentration-discharge relationship in the river to further determine any implications and to characterize exposure routes unique to Apsáalooke people. As a CLIMAS fellow, she plans to produce a short documentary about surface water sampling and will collaborate with artists to create the hydrologic cycle from an Apsáalooke perspective.



Kunal Palawat (they/them) is pursuing a masters in soil and water science at the University of Arizona Department of Environmental Science. They have a background in soil/water science and community organizing from their time living in Vermont and are excited to blend their passions together in Arizona. Kunal's research focuses on public participation in science, environmental pollution, and ecological modeling through the community rainwater harvesting study called Project Harvest. They are also passionate challenging the oppressive norms of western science through the democratization of science, supporting queer, trans, and two-spirit BIPOC (Black, Indigenous, and People of Color) students, mentorship, and climate activism. Their project with CLIMAS involves creating a climate change and contamination informed community cookbook. The Arizonan communities participating in the process are the members of Project Harvest in four towns (Dewey, Globe, Hayden, Tucson) and the Mission Garden in Tucson. The cookbook will have recipes developed by community members and Kunal in addition to photographs and historical narratives of each dish.

Rachel Rosenbaum (she/her) is a sociocultural anthropologist studying the politics of urban infrastructure in Beirut, Lebanon. Her doctoral dissertation research examines how Lebanese grapple with decades of infrastructural and environmental degeneration, histories of violence, and issues of ineffective governance. Her research centers local environmental and infrastructural change-makers who are working collectively to tackle these issues and institute alternatives. Her project with CLIMAS will use this ongoing research to facilitate the design and implementation of a data visualization platform with her local partners, Recycle Lebanon. The platform, "Regenerate Lebanon," is an open-source online platform visualizing interconnected environmental and infrastructural issues around the country and connecting people to solutions.

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Each year the fellows are asked to develop blog posts to communicate some aspect of their project to a wider audience.

climas.arizona.edu/education/fellowship-program

Working on Projects with Students at Naco Elementary

Alma Anides Morales

Energetic middle schoolers fill the classroom air with excitement. Three UA graduate students are standing in the way between their final hours of summer school and unlimited summer fun. We better make this engaging! I think to myself. Today, we are there to talk about environmental science, and how the quality of our environment- the air that we breathe, the water that we drink, the soil that we run on- affects our every day lives, including our health. Read more:

climas.arizona.edu/blog/working-projects-students-naco-elementary

Mining and Groundwater in Southern Arizona

Sean Schrag-Toso

As I drive southwest along highway 82 from Sonoita, Arizona toward the Town of Patagonia, Red Mountain emerges on the skyline. The north face of the mountain is covered in vegetation, cloaking the red rhyolite that is visible from the south. Even more concealed are the systems of fractures, faults and old mining tunnels that complicate the hydrology of the area. I turn off the highway, ascend a winding dirt road, park my car and walk down a steep valley south of Red Mountain, keeping an eye on my GPS. I soon find myself at the entrance a gaping hole in the rock. The hole appears to be a cave, but it is not. Old mine adits; the mouths of snaking underground tunnels of abandoned mines, leak water, sludge, and a cool, ominous, vapor. The entrance of some are covered in a tongue of green moss; the opportune plant making the most of the moist mouth of the adits. Historic mines create a unique plumbing system in a mountain of fractured rock and act as massive pipes that drain out groundwater from the mountain. Read more:

climas.arizona.edu/blog/Mining-and-groundwater-southern-arizona

The Story of H2O: Informal Water Provision in Nairobi's Low-income Settlements

Nupur Joshi

"Nairobi is a city of opportunities" said Mwangi – a 26-year old man who worked as an assistant to a private water provider. Mwangi's job was to keep a check on the water pipes and kiosks that this employer recently installed in the settlements of Mukuru to sell water at a price of 5 Kenyan Shillings ($0.05) per 20-liter jerrycan. Mwangi aspired to start his own water business one day, as he explained, "Sister, in this city, water is the most valuable possession one would have. If I can run a water business consistently, it is pesa ya haraka – cash cow/quick money." Responding to the perplexed expression on my face, he said, "It is simple, just work on making the right connections, with the right people." Every year I go to Nairobi to conduct fieldwork, Mwangi's words echo in my mind. Read more:

climas.arizona.edu/blog/story-h2o-informal-water-provision-nairobi's-low-income-settlements

Save it for a rainy day: Roof-Harvesting Rainwater in the Sonoran Desert

Norma Villagomez-Márquez

Energetic middle schoolers fill the classroom air with excitement. Three UA graduate students are standing in the way between their final hours of summer school and unlimited summer fun. We better make this engaging! I think to myself. Today, we are there to talk about environmental science, and how the quality of our environment- the air that we breathe, the water that we drink, the soil that we run on- affects our every day lives, including our health

climas.arizona.edu/blog/save-it-rainy-day-roof-harvesting-rainwater-sonoran-desert

Online Resources

Figure 1
Climate Program Office
cpo.noaa.gov

RISA Program Homepage

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

UA Institute of the Environment

environment.arizona.edu

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.

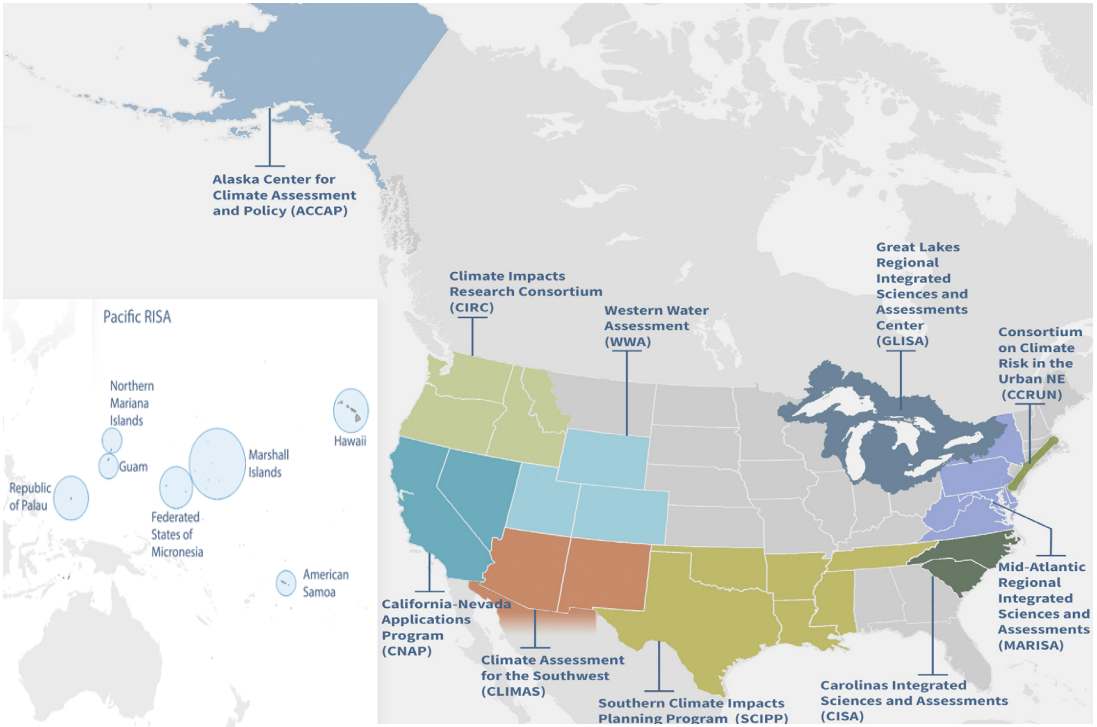

Figure 1: NOAA Regional Integrated Sciences and Assessments Regions