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January Southwest Climate Outlook

December Precipitation and Temperature: December precipitation was variable across the Southwest, although temperatures were more consistently average to above average. Precipitation in Arizona was mostly below average to average with small areas of above average in the southeastern and northeastern corners of the state (Fig. 1). In New Mexico, precipitation was average to above average across most of the state (Fig. 1). Temperatures ranged from normal to above normal across Arizona and New Mexico.

Seasonal & Annual Precipitation and Temperature: Three-month precipitation totals reflect the much-wetter-than-average October, in conjunction with some December storm activities, with most of the Southwest receiving above-normal to much-above-normal precipitation since Oct. 1 (Fig. 2). Temperatures over the same period ranged from mostly normal to above normal in Arizona and mostly normal to below normal in New Mexico.

Drought: The Jan. 8 U.S. Drought Monitor (USDM) captures some of the improvements in drought conditions in the Southwest, particularly along the US-Mexico border in Arizona and New Mexico, even while persistent drought conditions remain in the Four Corners region (Fig. 3). Drought in the Southwest poses a challenge in mapping different timescales and intensities of drought on a weekly basis. In a region already characterized by dry conditions, where accumulated precipitation deficits build over seasons and years, these drought characterizations can struggle to capture all of these inputs. Twelve-month precipitation rankings identify areas with accumulated precipitation deficits on an annual timescale (Fig. 4), while the 36-month standardized precipitation index (SPI) for the Southwest (Fig. 5) highlights overlapping areas experiencing drought and precipitation deficits on an even longer timescale.

Snowpack & Water Supply: Snow water equivalent (SWE) has seen an uptick with recent storm activity (see an extended discussion of snowpack in the Dec. 2018 CLIMAS Southwest Climate Podcast), although current SWE values in Arizona and New Mexico remain generally near or below average as of Jan. 13 (Fig. 6). Reservoir storage remains a persistent concern, as water levels have been impacted by long-term drought and accumulated precipitation deficit. Most of the reservoirs are at or below their long-term averages, and a few of the Rio Grande reservoirs are especially low (see Arizona and New Mexico reservoir storage on p. 4).

El Niño Tracker: The seemingly imminent El Niño event looks a little less certain at this point (see El Niño tracker on p. 3). Sea-surface temperatures (SSTs) remain above average, but are closer to normal compared to last month, and there still has not been the definitive coupling between oceanic and atmospheric conditions that would more clearly delineate El Niño conditions. The forecasting community has been discussing the role that the Madden Julian Oscillation (MJO) might be playing in hindering the development of more definitive El Nino conditions, but forecasters continue to look to spring as the mostly likely period of increased coupling. A weak El Niño event remains the scenario with the highest probability, but it is far from the seemingly sure thing of last month, with forecasted probabilities now ranging from 60 to 80 percent.

Precipitation and Temperature Forecast: The three-month outlook for January through March calls for increased chances of above-normal precipitation in much of Arizona and northern Mexico and nearly all of New Mexico (Fig. 7, top). The three-month temperature outlook calls for increased chances of above-normal temperatures in northern Arizona and New Mexico (Fig. 7, bottom).

Tweet Jan 2019 SW Climate Outlook

CLICK TO TWEET

JAN2019 @CLIMAS_UA SW Climate Outlook, El Niño Tracker, CLIMAS Environment & Society Graduate Fellows, AZ & NM Reservoir volumes https://bit.ly/2FwFzbf #SWclimate #AZWX #NMWX

January 2019 SW Climate Outlook

Online Resources

Figures 1-2,4-6
Western Regional Climate Center
wrcc.dri.edu

Figure 3
U.S. Drought Monitor
droughtmonitor.unl.edu

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

Please Note: Due to the U.S. government shutdown, some federal data and resources are unavailable or are not updating.

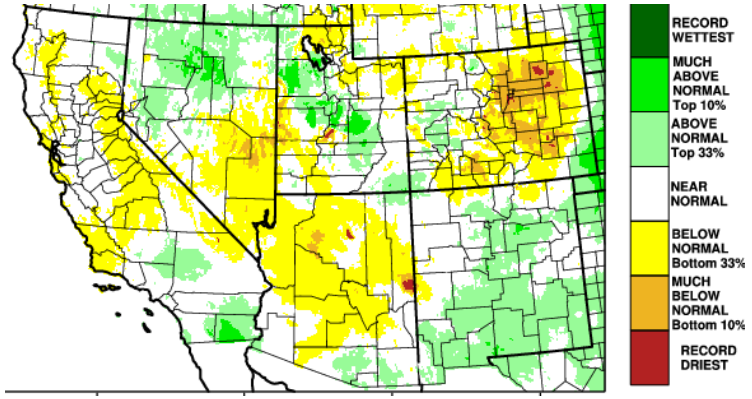


Figure 1: Dec 2018 - Precipitation Rankings

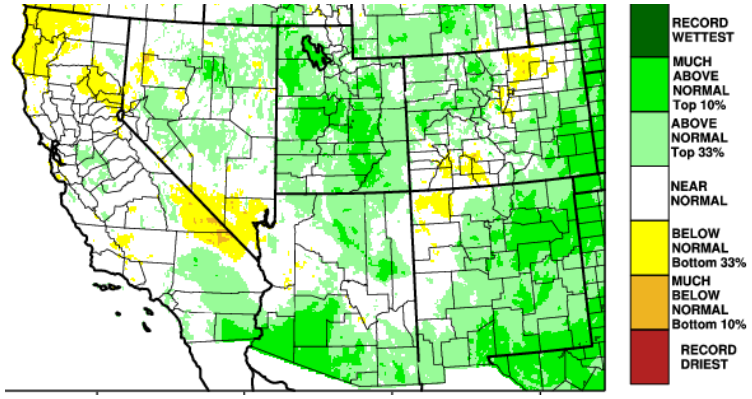


Figure 2: Oct-Dec 2018 - Precipitation Rankings

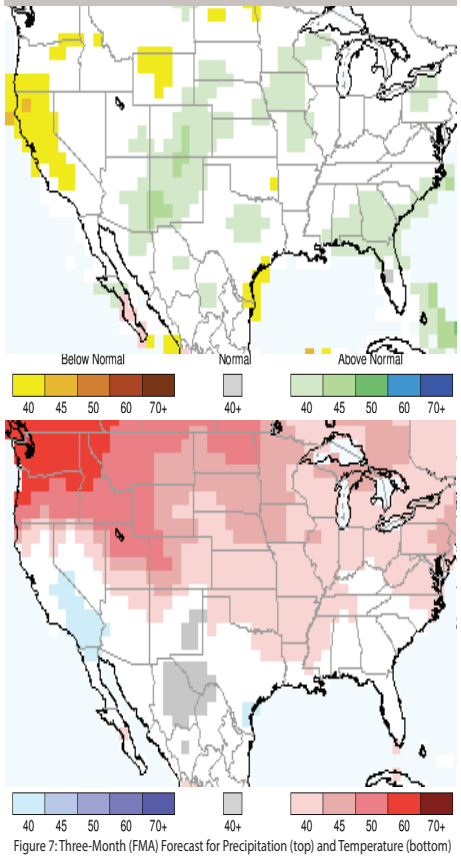


Figure 7: Three-Month (FMA) Forecast for Precipitation (top) and Temperature (bottom)

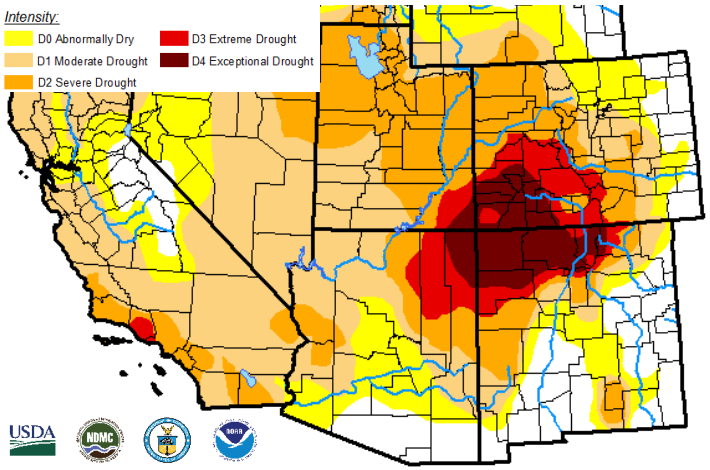


Figure 3: US Drought Monitor - Jan 8, 2019

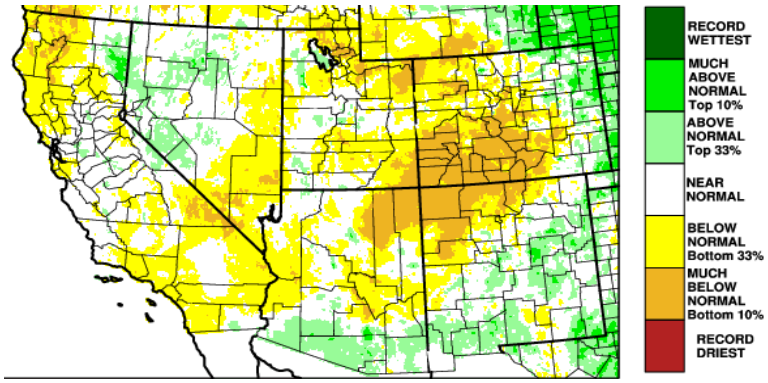


Figure 4: Jan - Dec 2018 - Precipitation Rankings

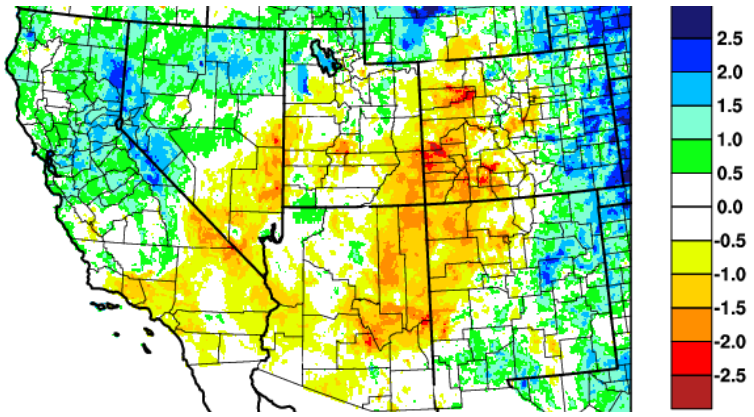


Figure 5: Dec 2018 - 36 Month Standardized Precipitation Index

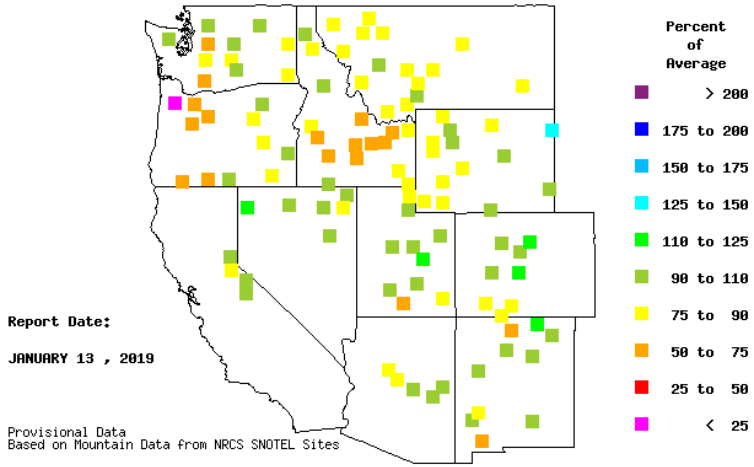


Figure 6: Snow Water Equivalent (SWE) - Jan 13, 2019

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

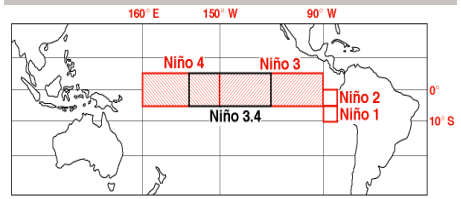
Figure 4
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

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/

Madden Julian Oscilation

For more information: cpc.ncep.noaa.gov/products/precip/CWlink/MJO/mjo.shtml

El Niño Tracker

Sea surface temperatures (SSTs) are still above average across the equatorial Pacific (Fig. 1), but they have fallen since last month (Fig. 2). Atmospheric conditions still have not coupled with oceanic conditions, and the Madden Julian Oscillation (MJO) is being discussed as one source of this delayed interaction. Forecasters continue to expect an El Niño to form, provided atmospheric conditions catch up with oceanic conditions and that SSTs remain above normal, but the window for relevance of such an event to the Southwest (i.e. the effect on cool-season precipitation) is closing. On Jan. 8, the Australian Bureau of Meteorology remained in an El Niño alert, with the tropical Pacific Ocean in line with a weak El Niño but the atmosphere showing "no consistent El Niño signal," a requisite part of sustaining an El Niño event. The agency noted that it is late in the season for El Niño formation. On Jan. 10, the International Research Institute (IRI) issued an ENSO Quick Look, highlighting above-average SSTs along with lagging atmospheric conditions. It maintained an 82-percent chance of an El Niño during January to March and a 66-percent chance from March to May (Fig. 3). On Jan. 10, the Japanese Meteorological Agency (JMA) maintained its assertion of the presence of El Niño conditions in the equatorial Pacific despite lack of atmospheric reinforcement, and called for an 80-percent chance of these conditions lasting through the spring. On Jan. 10, the NOAA Climate Prediction Center (CPC) continued its El Niño watch, but saw decreases in SST anomalies, noted the continued lack of atmospheric reinforcement of El Niño, and highlighted a possible link to the MJO. CPC's outlook dropped to a 65-percent chance of an El Niño forming and lasting through spring. The North American Multi-Model Ensemble (NMME) points toward a weak El Niño at present lasting through the spring (Fig. 4).

Summary: This year highlights the challenge of seasonal forecasting with unclear El Niño signals. Equatorial SSTs are within the range of a weak El Niño, but the delayed development of atmospheric conditions is the main factor holding back a more confident outlook. The presence of seasonal variability attributed to the MJO further complicates the contingencies and uncertainty attached to seasonal outlooks. In the Southwest, El Niño events are typically associated with increased chances for above-normal winter precipitation, but weak events demonstrate limited correlation with above-normal precipitation, and some of the wettest winters in the Southwest have been under ENSO-neutral conditions. This winter, portions of Arizona and New Mexico have recorded wetter- and cooler-than-average conditions for much of December and January thus far, which lines up with the narrative of wetter winters under El Niño. However, direct attribution to El Niño is challenging given the small sample size, aforementioned weak correlations, and the challenges in tracking precipitation anomalies in a region that already sees relatively infrequent rain events in a "wet" year.

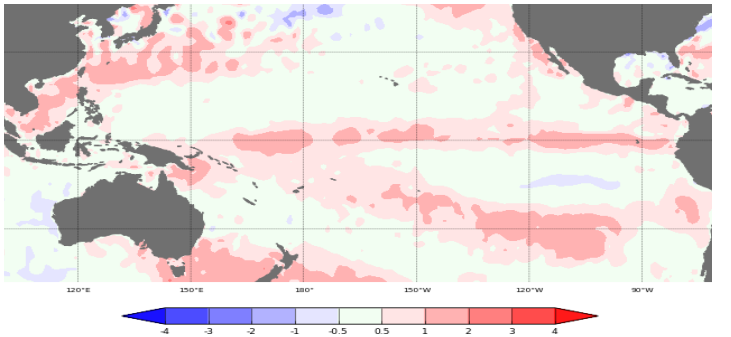


Figure 1: December 2018 Sea Surface Temperature (SST) Anomalies

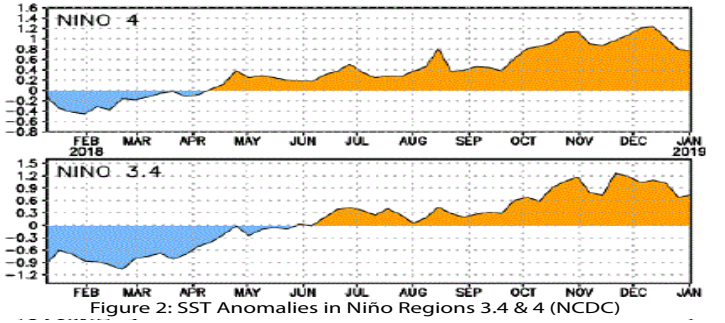


Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

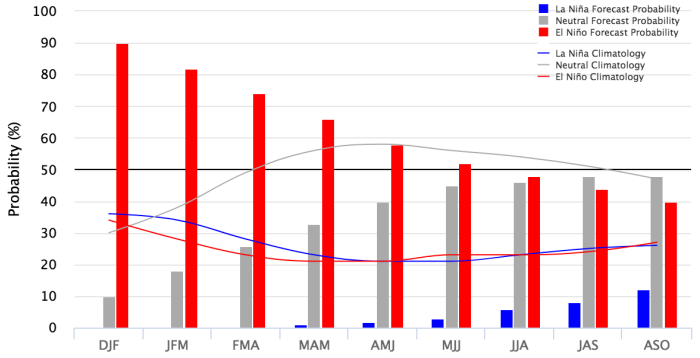


Figure 3: Early-Jan IRI/CPC Model-Based Probabilistic ENSO Forecast

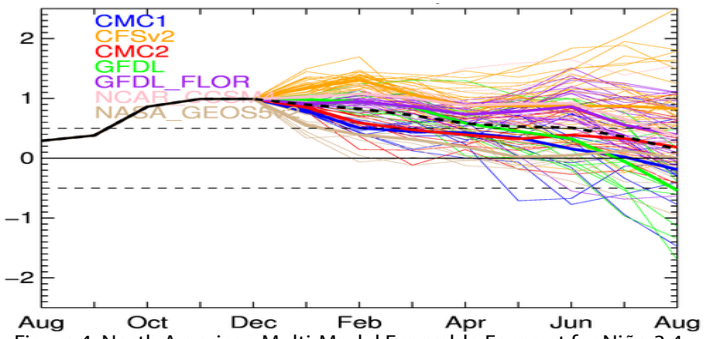


Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

Portions of the information provided in this figure can be accessed at the Natural Resources Conservation Service

www.wcc.nrcs.usda.gov/BOR/basin.html

Contact Ben McMahan with any questions or comments.

Please Note: Due to the U.S. government shutdown, some federal data and resources are unavailable or are not updating.

Notes

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).

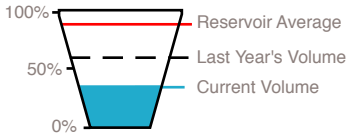
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons).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

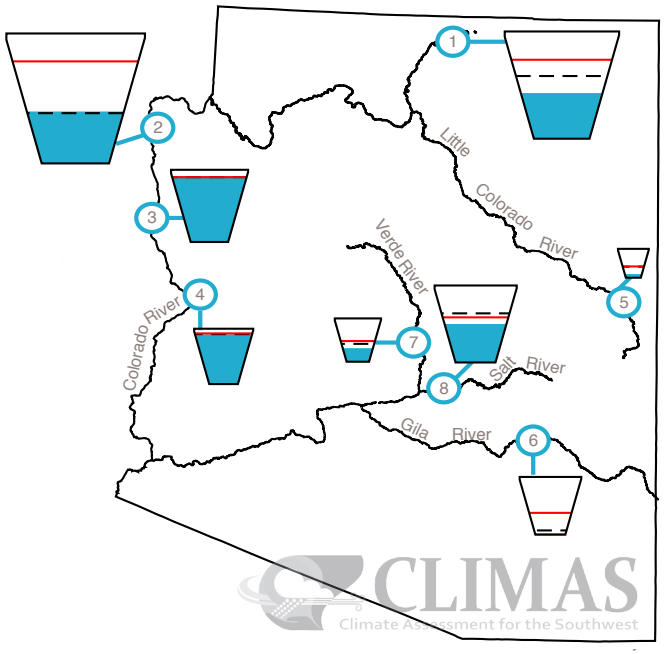
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

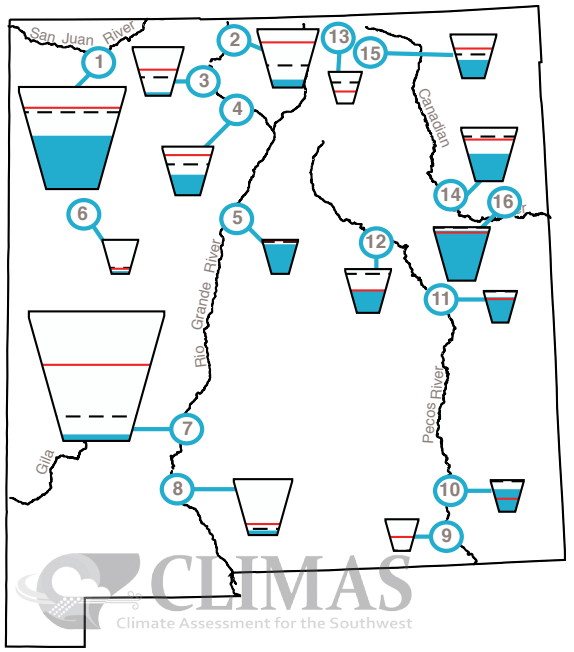
Reservoir Volumes

DATA THROUGH JAN 1, 2019

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







Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Lake Powell	42%	10,098.9	24,322.0	-407.8
2. Lake Mead	39%	10,132.0	26,159.0	260.0
3. Lake Mohave	90%	1,634.0	1,810.0	55.0
4. Lake Havasu	89%	552.4	619.0	-29.7
5. Lyman	12%	3.7	30.0	-0.1
6. San Carlos	2%	19.5	875.0	4.6
7. Verde River System	30%	86.2	287.4	-1.3
8. Salt River System	49%	994.0	2,025.8	6.4

*KAF: thousands of acre-feet

* in KAF = thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	52%	878.7	1,696.0	-9.5
2. Heron	14%	56.3	400.0	-2.3
3. El Vado	7%	12.5	190.3	2.0
4. Abiquiu	42%	78.1	186.8	-3.7
5. Cochiti	87%	43.6	50.0	-1.1
6. Bluewater	8%	3.1	38.5	0.0
7. Elephant Butte	5%	114.9	2,195.0	25.4
8. Caballo	8%	26.7	332.0	0.8
9. Lake Avalon	0%	0.0	4.5	0.0
10. Brantley	71%	29.8	42.2	2.6
11. Sumner	80%	28.6	35.9	3.5
12. Santa Rosa	50%	53.4	105.9	0.1
13. Costilla	0%	0.0	16.0	-2.4
14. Conchas	51%	129.6	254.2	0.3
15. Eagle Nest	42%	33.3	79.0	0.1
16. Ute Reservoir	93%	186	200	-1.0

CLIMAS

Environment & Society Graduate Fellows Program

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.

For more information about the program: climas.arizona.edu/education/fellowship-program

Save the Date:

2018 CLIMAS Environment and Society Fellows

Final Presentations

Date: Friday Jan 25, 2019

Location: ENR2 Room N604

1064 E. Lowell Street

University of Arizona

Time: 10:30-Noon

2018 CLIMAS Environment and Society Fellows

Beyond the Ranchers-Versus-City Narrative of the Owens Valley Water Conflict

Sophia Borgias

The conflict over the City of Los Angeles' extraction and export of water from California's Owens Valley has long captivated the public and policymakers alike. However, narratives about the Owens Valley water conflict have often fixated on the demise of the agricultural economy at the hands of the Los Angeles Department of Water and Power (LADWP) in the early 20th century. Though often described as an act of theft and lawlessness, Los Angeles' acquisition of 95% of the valley's land and water was in fact authorized under the law and facilitated by the federal government in the name of "the greatest good of the greatest number in the long run." But, over the 105 years since the Los Angeles Aqueduct was completed, notions of what constitutes the greatest good – and the long run, for that matter – have shifted. Read more: https://bit.ly/2Mhk8LZ

Hunting for Black Gold

Stephanie Doerries

With the aid of my headlamp, I check the contents of my backpack in the pre-dawn darkness. Food, water, vials, coin envelopes...check. I strap a shovel to the outside of my pack and swing it across my shoulders with a huff, shrugging to adjust the weight. Two and a half gallons of water is not light, but I'll drink most of it over the course of the next 12 hours. A warm breeze blowing across the Pinta Sands, a remote area on the Cabeza Prieta National Wildlife Refuge, hints at the heat to come. I sling the strap of my binoculars over my shoulder and start walking at a brisk pace so I can cover the three plus miles to the first wildlife water before sunrise. If I'm lucky, I'll see a pronghorn at the edge of the playa—a dried lakebed—like I did last year.

Read more: https://bit.ly/2QTSGVe

Groundwater in Southern Arizona: People, Perceptions, and Policies

Tamee Albrecht

The fan made it difficult to hear, but the room was hot. Attendees were seated in tightly spaced rows, shoulder-to-shoulder. It was the Southeast Arizona Citizen's Forum—a public meeting of the International Boundary and Water Commission that brings together stakeholders interested in water resources in the U.S.-Mexico border region. As each person stood up to introduce themselves the diversity of stakeholders became even more apparent—representatives from U.S. Senator's offices, state agency scientists, water utility professionals, local farmers, citizen activists, NGO employees, and concerned residents. They gathered to discuss water—each bringing a unique perspective.

Read more: https://bit.ly/2QUvXs3

Understanding Farmers' Choices, Trade-Offs, and Barriers for Selecting Land Management Practices in Northern Ghana

Marie Blanche Roudaut

In June and July of 2018, I conducted field work in the Bawku East and Nabdam Districts located in the Upper East region of northern Ghana. This is a semi-arid region that has been historically one of the least developed areas in the country. This regional inequality is in part related to the country's colonial past, a growing population, low soil fertility, increasing environmental degradation, period droughts, and erratic rainfall. My research focuses on understanding the socio-economic and ecological drivers of land degradation in this region of Ghana as well as understanding the barriers that prevent farmers from adopting sustainable land management practices (SLM) to combat land degradation.

Read more: https://bit.ly/2QTSGVe

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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

2019 Fellows

Introducing the 2019 cohort of the CLIMAS Environment and Society Graduate Fellows

Alma Anides Morales

Alma's project is in collaboration with Cochise Health and Social Services to sample and analyze the chronic untreated effluent flowing north into Naco, Arizona, a town of about 1,000 residents in the US-Mexico border. The sewage flows are a community concern as sewage flow is in close proximity to a school, private property, and eventually discharges into tributaries of the San Pedro River. The study will center on the determining potential environmental impacts and health risks for residents. Information produced will be used to help inform residents and assist CHSS in their preparedness and response to such events.

Norma Villagomez-Márquez

Norma Villagómez-Márquez has a background in Environmental Engineering investigating the role of advanced membrane technologies such as reverse osmosis (RO), nanofiltration (NF) and electrodialysis reversal (EDR) in water treatment, primarily desalination. As a member of the organic analysis team within Project Harvest: Be Informed-Grow Smarter, she is engaging community members through citizen science about the health of their harvested rainwater, soil, and plants. Norma's doctoral research examines the presence of emerging contaminants in roof-harvested rainwater using analytical techniques, particularly liquid chromatography-high-resolution mass spectrometry (LC-HRMS). As a 2019 Environment & Society Fellow Norma will create an illustrative children's book that will spark interest in water conservation alternatives by addressing the global water crisis and the vital role rainwater harvesting will have when it comes to maximizing our existing water supply.

Nupur Joshi

Nupur is an urban geographer interested in studying urbanization and development in African and Indian cities. Her doctoral dissertation is based in low-income settlements of Nairobi, Kenya. Through a mixed-methods approach, she is conducting a spatial analysis of informal water infrastructures (locally called 'water cartels') and their health implications on women. She conducts research with women community members, Nairobi County government officials, non-profit groups and cartels themselves, to understand water quality, affordability and accessibility issues.

Sean Schrag-Toso

Increasing variance in groundwater recharge conditions due to climate change and increasing demand for groundwater have residents and stakeholders with the Sonoita Creek Watershed in Southeastern Arizona concerned about future groundwater and surface water flow conditions. To address these concerns, a two-stage project is proposed. The first phase is an analysis of isotope ratios and the geochemistry of local springs to create a conceptual model of groundwater flow. These insights, coupled with available data and knowledge on the hydrology of the area will guide the second phase. The second phase is the creation of a monitoring plan that is within a local citizen science group's resources, capabilities, and level of enthusiasm. The plan will expand the current efforts of the Citizen Science group to include monitoring of spring flow around Harshaw Creek; a tributary of Sonoita Creek, with its headwaters in the Patagonia Mountains, and other vulnerable tributaries. The data collected by the group will contribute to future hydrologic studies within the basin and aid in making management decisions around water use by the Town Council. In addition, the project will empower stakeholders and well owners to be vigilant about monitoring their water supply through documenting and monitoring the effects of varying precipitation and groundwater use on spring flow and the groundwater table.

Online Resources

Figure 1
Climate Program Office
cpo.noaa.gov

RISA Program Homepage

http://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 (UA) Institute of the Environment—is a collaboration between UA 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

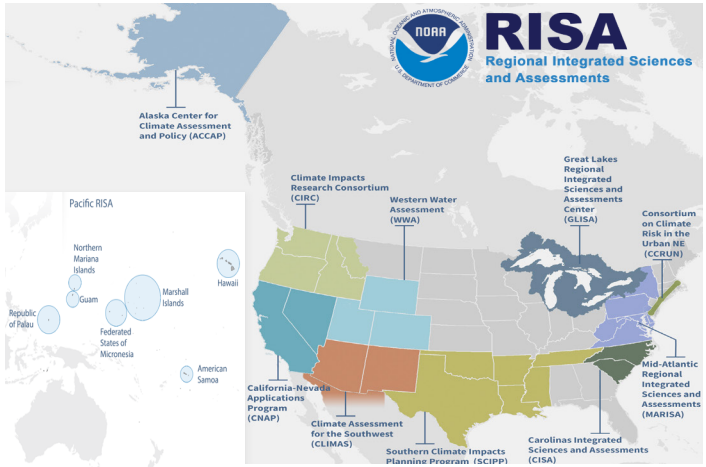

Figure 1: NOAA Regional Integrated Sciences and Assessments Regions

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.

RISA Program Video on CLIMAS Dust Research

Interstate 10 traverses southwest New Mexico connecting Las Cruces with El Paso, TX and Tucson, AZ. Dust storms in the Southwest can create dangerous and fatal driving conditions, reducing visibility to near zero with very little warning. Interstate 10 is especially vulnerable to dangerous dust-related driving conditions as it passes through a dry lake bed west of Lordsburg, near the Arizona border.

The Climate Assessment for the Southwest (CLIMAS), a NOAA RISA team, built on existing partnerships with state transportation managers from New Mexico and Arizona to address the impacts of extreme drought and dust storms on transportation systems. The team characterized and documented the climatic and visual conditions that exist during these storms through interviews, time-lapse camera imagery, and dashboard cameras and worked closely with the New Mexico Department of Transportation, NWS Weather Forecast Offices, and trucking companies to improve education and warning about dangerous dust storm events.

https://youtu.be/ENyIO-coRKg