Contributors

Ben McMahan
SWCO Editor; Assistant Research Scientist
CLIMAS, Institute of the Environment

Mike Crimmins
UA Extension Specialist

Dave Dubois
New Mexico State Climatologist

Gregg Garfin
Founding Editor and Deputy Director of Outreach, Institute of the Environment

Nancy J. Selover
Arizona State Climatologist

Published by the Climate Assessment for the Southwest (CLIMAS), with support from University of Arizona Cooperative Extension, the Arizona State Climate Office, and the New Mexico State Climate office.

March Southwest Climate Outlook

February Precipitation and Temperature: February precipitation was above-average across most of Arizona and northwestern New Mexico (and much of the western United States), but quickly transitioned to below-average in southern and eastern New Mexico, a pattern that extended into western Texas (Fig. 1a). February temperatures were below-average in most of Arizona and northwestern New Mexico, and average to above-average in central and eastern New Mexico (Fig. 1b).

Seasonal Precipitation and Temperature: Dec-Feb precipitation was mostly above-average across Arizona and northwestern New Mexico, while southern and eastern New Mexico ranged from average to below-average (Fig. 2a). Dec-Feb temperature rankings were mostly average to below-average in Arizona, and average to above-average in New Mexico (Fig. 2b). Water year precipitation includes a particularly wet October, and most of the Southwest recorded above-normal precipitation since Oct. 1 (Fig. 3). Twelve month totals highlight above-normal precipitation in much of Arizona and portions of southern and eastern New Mexico, and persistent precipitation deficits in the four corners region (Fig. 4).

Drought: The Mar. 12 U.S. Drought Monitor (USDM) shows widespread improvements in regional drought conditions in much of the western U.S. (Fig. 5). Persistent drought conditions remain in the Four Corners region, although characterizations of drought extent and intensity are further reduced on this map compared to last month. Accumulated precipitation deficits built up over seasons and years, and in terms of drought recovery, above-normal precipitation in the short term is likely insufficient to make up for years of drought.

Snowpack & Water Supply: Snow water equivalent (SWE) increased considerably since last month. SWE values (as of Mar. 17) in Arizona and New Mexico are mostly above average, ranging from 110-200 percent of average across most of the region, with only south-central NM at less than 25-percent of average (Fig. 6). Reservoir storage remains a persistent concern with long-term drought and accumulated precipitation deficits. Most of the reservoirs are at or below their long-term averages and a few of the Rio Grande reservoirs are especially low, while central Arizona reservoirs (Verde and Salt River) have recorded large increases over the last month (see Arizona and New Mexico reservoir storage on p. 4).

El Niño Tracker: Atmospheric conditions finally caught up with the ocean, with both indicating weak El Niño conditions. The current forecasts indicate a strong likelihood of a weak El Niño lasting through spring, and a moderate likelihood it will persist through summer and into fall. This raises the possibility of a second year of El Niño (i.e. continuing next fall into winter 2020), but spring and early summer introduce considerable uncertainty into forecasts, so this is more speculative than certain (see El Niño tracker on p. 3 for details).

Precipitation and Temperature Forecast: The three-month outlook for April through June calls for increased chances of above-normal precipitation in most of Arizona, New Mexico, Texas, and northern Sonora and Chihuahua, Mexico (Fig. 7, top). The three-month temperature outlook calls for slightly increased chances of above-normal temperatures in pockets of northern Arizona, but otherwise suggests equal chances of above, below, and near normal temperatures (Fig. 7, bottom).

Tweet Mar 2019 SW Climate Outlook

CLICK TO TWEET

MAR2019 @CLIMAS_UA SW Climate Outlook, El Niño Tracker, CLIMAS Environment & Society Graduate Fellows, AZ & NM Reservoir volumes bit.ly/2HQ6glp #SWclimate #AZWX #NMWX

March 2019 SW Climate Outlook

Online Resources

Figures 1-2
National Centers for Environmental Information
ncei.noaa.gov

Figures 3-4,6
Western Regional Climate Center
wrcc.dri.edu

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

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

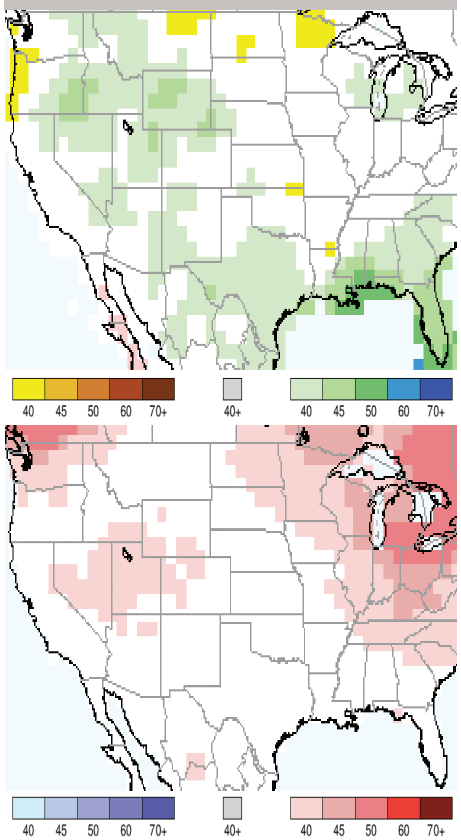


Figure 7: Three-Month (AMJ) Forecast for Precipitation (top) and Temperature (bottom)

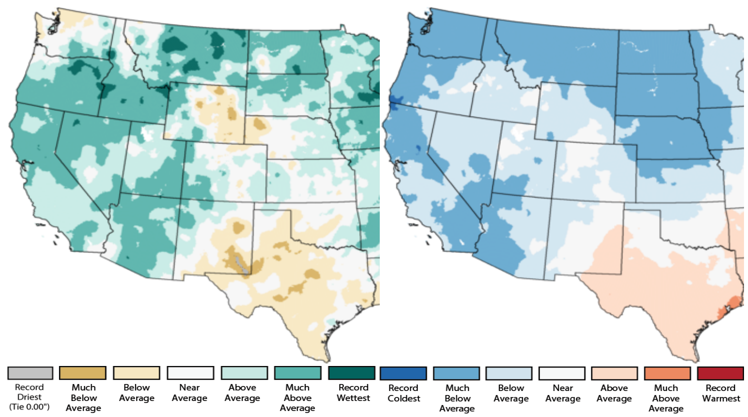


Figure 1: February 2019 Precipitation (a) & Temperature Ranks (b)

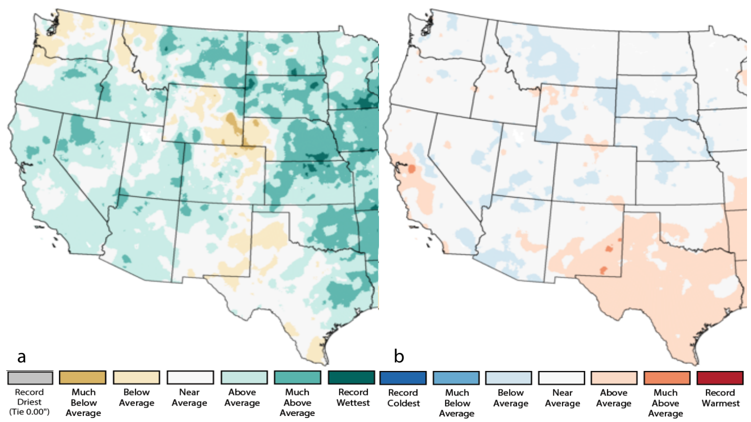


Figure 2: Dec 2018 - Feb 2019 Precipitation (a) & Temperature Ranks (b)

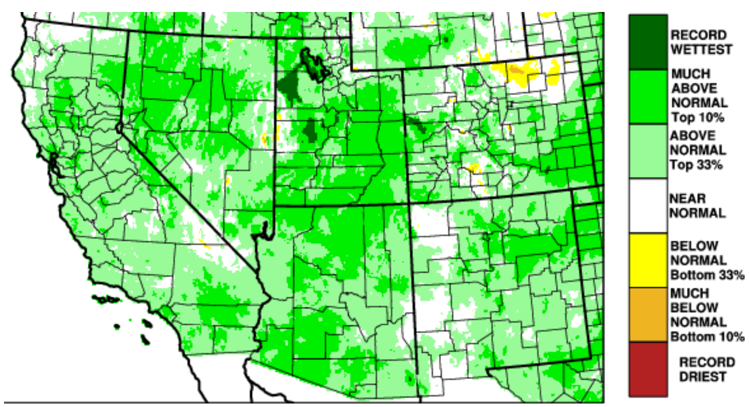


Figure 3: Oct 2018 - Feb 2019 - Precipitation Rankings

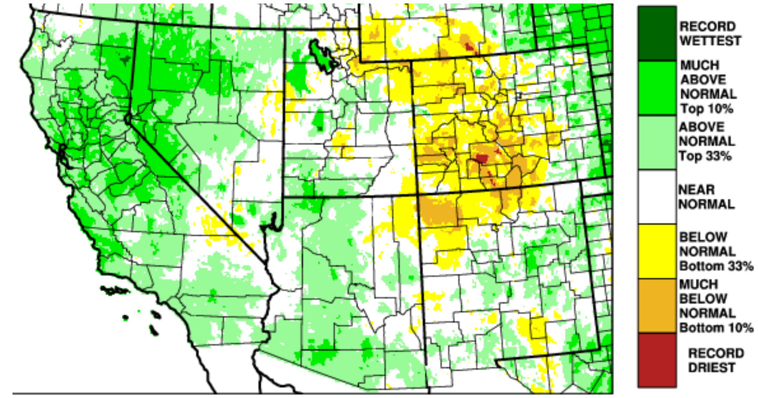


Figure 4: Mar 2018 - Feb 2019 - Precipitation Rankings

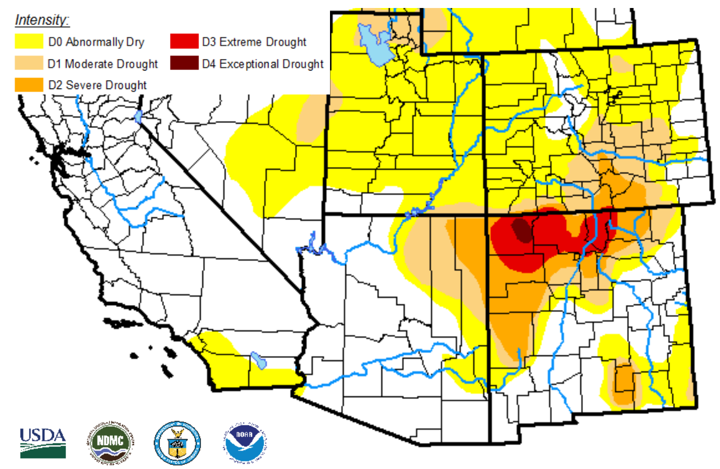


Figure 5: US Drought Monitor - Mar 12, 2019

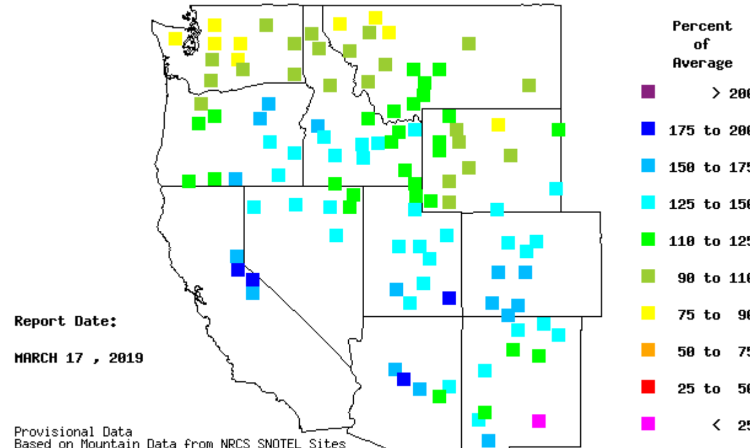


Figure 6: Snow Water Equivalent (SWE) - Mar 17, 2019

Online Resources

Figure 1
International Research Institute for Climate and Society
iri.columbia.edu

Figure 2
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

Figure 3
Australian Bureau of Meteorology
bom.gov.au/climate/enso

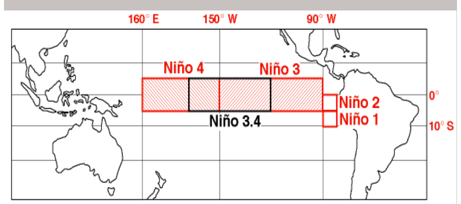
Figure 4
NOAA - Climate Prediction Center
cpc.ncep.noaa.gov

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/

El Niño Tracker

Seasonal outlooks have mostly converged on forecasts that emphasize atmospheric and oceanic conditions consistent with a weak El Niño event. This is expected to last through spring, with a chance for a longer event if these conditions persist through summer and into fall. On Mar. 11, the Japanese Meteorological Agency (JMA) maintained their assertion of the presence of El Niño conditions in the equatorial Pacific and called for a 70-percent chance of these conditions lasting until summer 2019. On Mar. 14, the NOAA Climate Prediction Center (CPC) maintained their El Niño advisory, given the convergence of oceanic and atmospheric conditions, as well as warm subsurface waters on the way, and their outlook jumped to an 80-percent chance of an El Niño lasting through spring (and 60-percent through summer). On Mar. 19, the International Research Institute (IRI) issued an ENSO Quick Look (Fig. 1), highlighting above-average sea surface temperatures (SSTs), warm subsurface waters, and the development of atmospheric conditions over the past few months. On Mar. 19, the Australian Bureau of Meteorology updated to an El Niño Alert, reflecting increasing chances of an El Niño developing over spring and summer. The North American Multi-Model Ensemble (NMME) points toward a weak El Niño at present lasting through at least summer 2018 (Fig. 2).

Summary: With sea surface temperatures (SSTs) above-average across the equatorial Pacific (Figs. 3-4), warm sub-surface waters supplementing these anomalies, and atmospheric conditions demonstrating a clearer connection – El Niño appears locked in at this point. Yet for the Southwest, we are rapidly approaching months that are typically warmer and drier, so the impact of this late arrival remains to be seen. Will this alter our current trajectory, or have we already been observing borderline weak El Niño impacts? Or, is this a wetter winter within the range of normal that just happened to occur as a weak El Niño finally spun up? In the Southwest, it can be hard to say, as El Niño events are associated with increased chances for above-normal winter precipitation, but weak events demonstrate limited correlation with above-normal precipitation. Considering the accumulated drought conditions affecting the Southwest, whatever ends up being given credit for these wetter and cooler than average conditions - even if it ends up only being a 'normal' southwestern winter – is welcome.

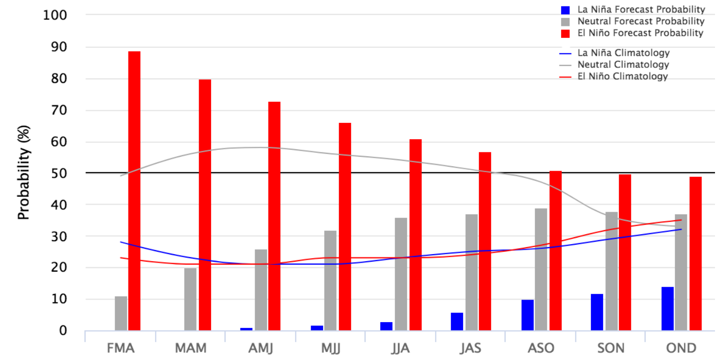


Figure 1: Early-Mar IRI/CPC Model-Based Probabilistic ENSO Forecast

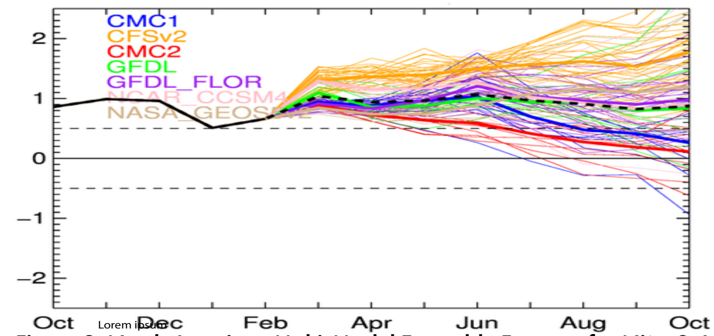


Figure 2: North American Multi-Model Ensemble Forecast for Niño 3.4

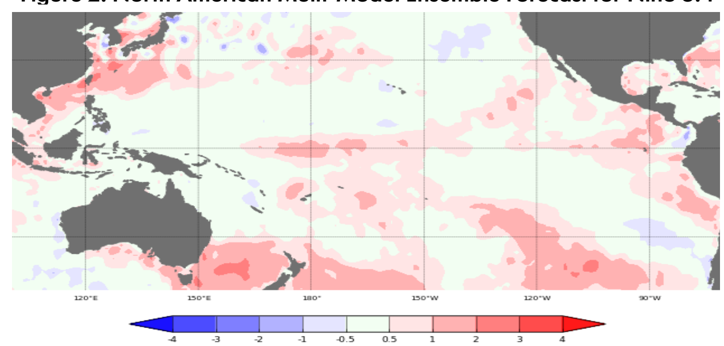


Figure 3: February 2019 Sea Surface Temperature (SST) Anomalies

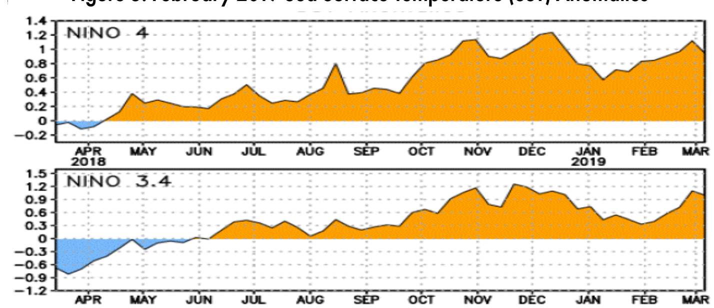


Figure 4: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

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.

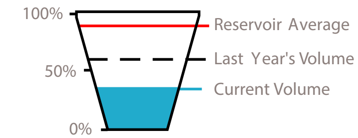
The map gives a representation of current storage for reservoirs in Arizona and New Mexico. Reservoir locations are numbered within the blue circles on the map, corresponding to the reservoirs listed in the table. The cup next to each reservoir shows the current storage (blue fill) as a percent of total 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).

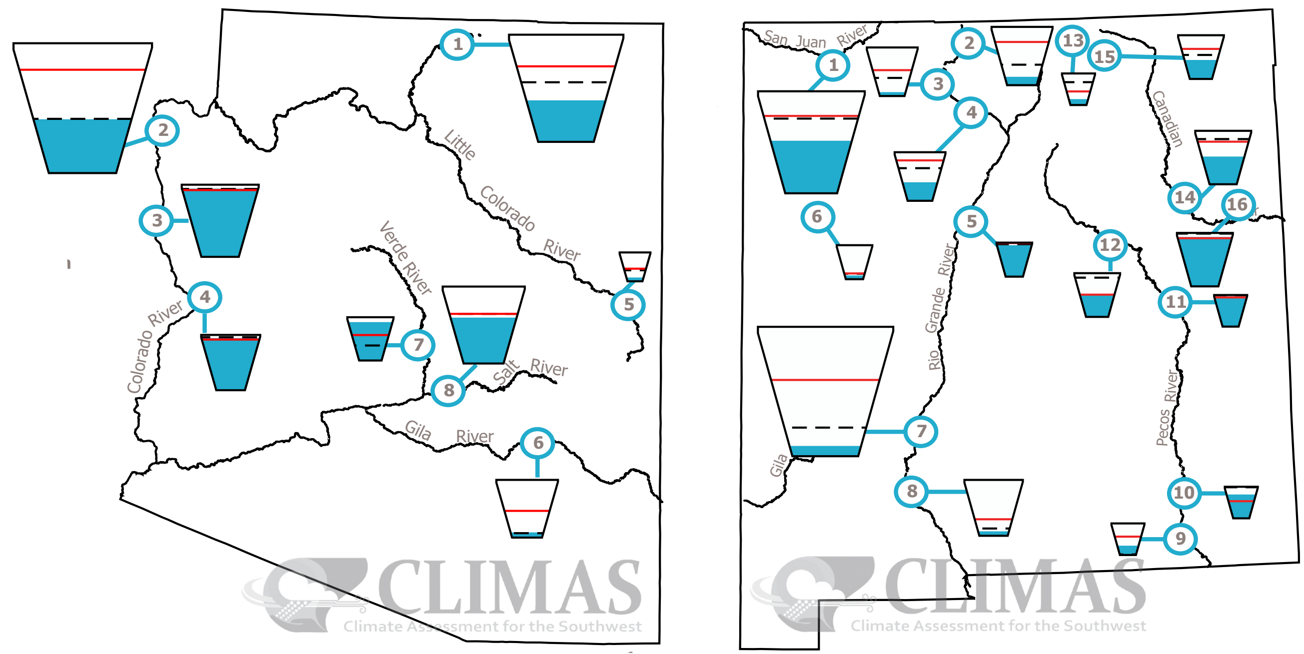
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). 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, 2019
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	38%	9,260.7	24,322.0	-368.5
2. Lake Mead	41%	10,682.0	26,159.0	187.0
3. Lake Mohave	94%	1,704.0	1,810.0	38.0
4. Lake Havasu	93%	573.4	619.0	17.6
5. Lyman	12%	3.7	30.0	0.0
6. San Carlos	8%	67.2	875.0	35.4
7. Verde River System	88%	252.6	287.4	151.6
8. Salt River System	59%	1,190.0	2,025.8	174.3

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	51%	865.2	1,696.0	-3.9
2. Heron	14%	56.7	400.0	0.6
3. El Vado	8%	15.9	190.3	1.9
4. Abiquiu	32%	71.0	186.8	-1.2
5. Cochiti	92%	46.2	50.0	1.1
6. Bluewater	11%	4.1	38.5	1.0
7. Elephant Butte	8%	170.8	2,195.0	27.4
8. Caballo	8%	27.7	332.0	0.3
9. Lake Avalon	29%	1.3	4.5	0.2
10. Brantley	75%	31.8	42.2	1.2
11. Sumner	94%	33.8	35.9	2.0
12. Santa Rosa	50%	52.7	105.9	-0.6
13. Costilla	19%	3.1	16.0	0.1
14. Conchas	51%	128.4	254.2	-1.1
15. Eagle Nest	43%	34.0	79.0	0.6
16. Ute Reservoir	92%	184	200	-2.0

CLIMAS

Environment & Society Graduate Fellows Program

The program 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: climas.arizona.edu/education/fellowship-program

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

CLIMAS

Environment & Society Graduate Fellows Program

The program 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: climas.arizona.edu/education/fellowship-program

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.