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May Southwest Climate Outlook

Precipitation & Temperature: Across most of the Southwest, April 2016 precipitation totals were above average (Fig 1a) and temperatures were average to above average (Fig 1b). Over the past 30 days, the Southwest experienced a minor cooling trend, with much of the region recording below-average temperatures (Fig. 2a) and a mix of above- and below-average precipitation (Fig. 2b). Increased rainfall and below-average temperatures are a welcome, albeit temporary, break from the typical warming and drying trend observed in late spring and early summer.

Drought, Snowpack and Water Supply: Long-term drought persists across the Southwest (Fig. 3). El Niño's middling performance did little to alter the trajectory of long-term drought, despite hope and optimism for just such a possibility leading into the winter season. The increasingly likely return of La Niña conditions this fall raises the specter of drier-than-average conditions for the Southwest, which could further exacerbate long-term drought. Reservoir storage values reflect this persistent drought with Lakes Mead and Powell in Arizona and Elephant Butte Reservoir in New Mexico at 37, 45, and 15 percent of capacity, respectively (see reservoir storage diagrams on page 6 for more details). Snowpack is mostly gone in the lower Southwest, while the upper basin regions of Colorado and Utah and northern New Mexico still have snow water equivalent (SWE) values ranging from 50 to 150 percent of normal (Fig. 4). Water year precipitation to date (October 1 to present) is normal to below normal across most of Arizona and normal to above normal for most of New Mexico.

El Niño Tracker: El Niño is in decline and forecasts call for continued weakening, leading to an ENSO-neutral state by summer and an increasing possibility of La Niña conditions by fall. The climatology of the Southwest in late spring and early summer is typically warm and dry, but there have been a few late season pulses of moisture that have helped bring below-average temperatures and some upper elevation precipitation to the region. This activity is not expected to bring significant additional precipitation, as sufficient moisture to help fuel these storms is unlikely. This intermittent activity may not alter seasonal cumulative precipitation totals significantly, but these events are helpful in suppressing wildfire risk and delaying the onset of the intense heat of pre-monsoonal summer.

Environmental Health and Safety: Warm and dry conditions over the winter have exacerbated already dusty conditions associated with both land-use change and long-term drought, with notable hazards in particularly dangerous stretches of Interstate-10 in both Arizona and New Mexico. Wildfire season is well underway, and while intermittent moisture in April helped tamp down fire risk, fine fuel growth from a wet fall combined with dry conditions this winter have contributed to above-normal wildland fire risk for the rest of May and June (Fig. 5).

Precipitation and Temperature Forecast: The May 19 NOAA-Climate Prediction Center three-month seasonal outlook calls for equal chances of above- or below-average precipitation for the Southwest (Fig. 6, top) and increased chances of above-average temperatures across most of the western United States (Fig. 6, bottom).

Tweet May SW Climate Outlook

CLICK TO TWEET

MAY2016 @CLIMAS_UA SW Climate Outlook - Climate Summary, El Niño Update and Recap, Looking towards a La Niña in 2016.

May Southwest Climate Outlook

Online Resources

Figure 1
National Weather Service - AHPS
http://water.weather.gov/precip

Figure 2
Western Regional Climate Center
http://www.wrcc.dri.edu/

Figure 3
U.S. Drought Monitor
http://droughtmonitor.unl.edu/

Figure 4
Western Regional Climate Center
http://www.wrcc.dri.edu/

Figure 5
National Interagency Fire Center
http://www.nifc.gov/

Figure 6
NWS Climate Prediction Center
http://www.cpc.ncep.noaa.gov/

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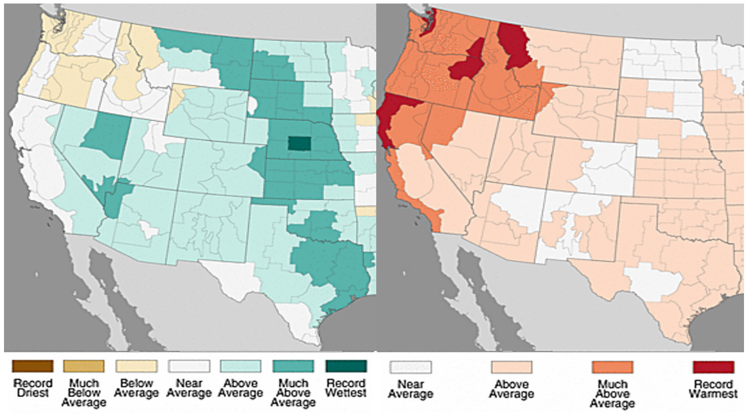

Figure 1: April 2016 Precipitation (a) & Temperature Ranks (b)

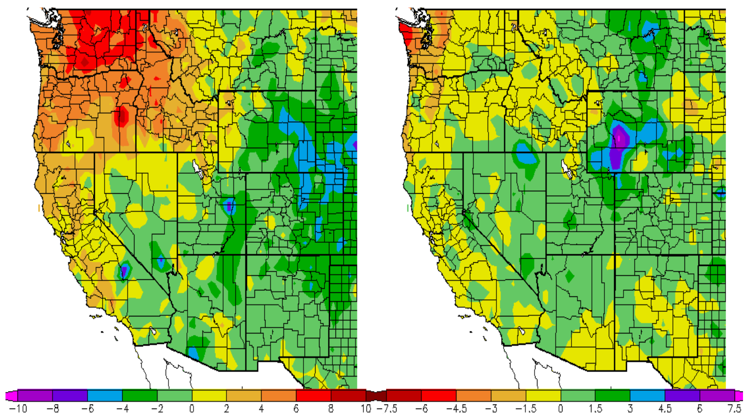

Figure 2: Departure from Ave Temp (a) & Precip (b) April 19 - May 18, 2016

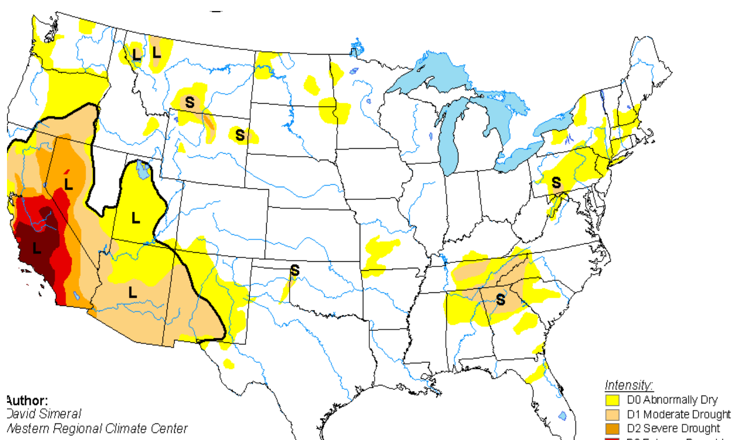

Figure 3: US Drought Monitor - May 17, 2016

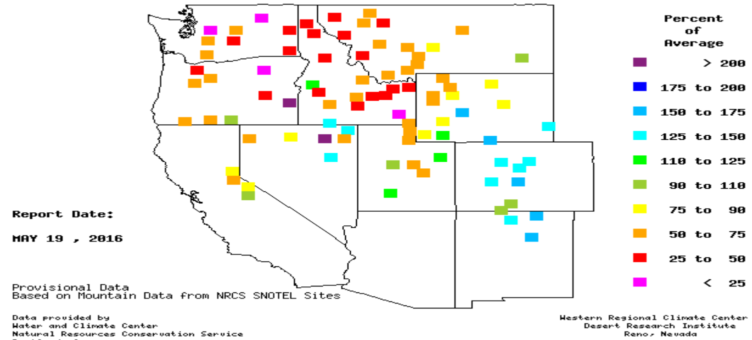

Figure 4: Basin Average Snow Water Content - May 19, 2016

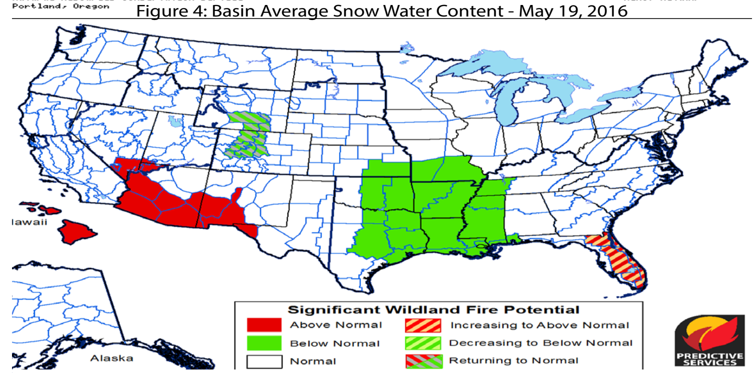

Figure 5: Significant Wildland Fire Potential Outlook - June 2016

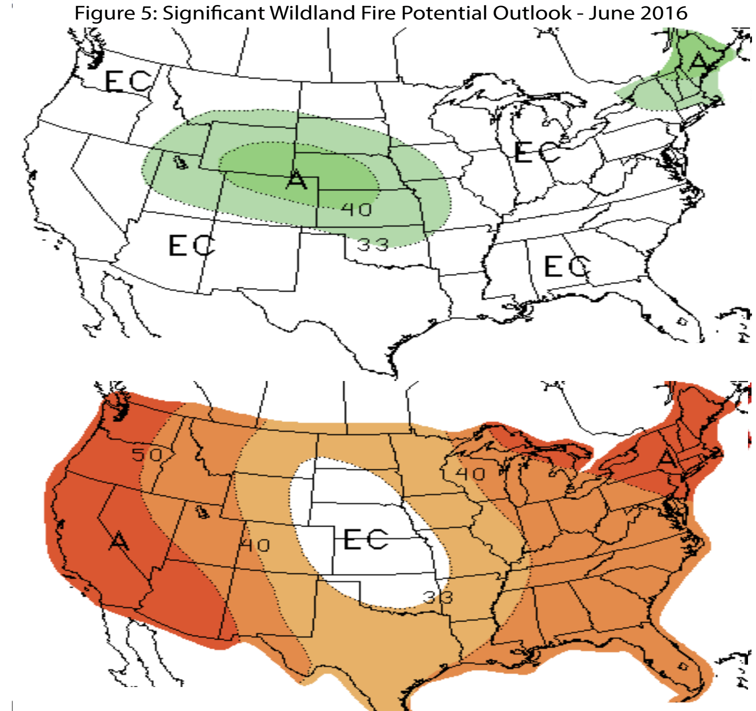

Figure 6: Three-Month Precipitation & Temperature Outlook-May 19, 2016

Online Resources

Figure 1
Australian Bureau of Meteorology
http://www.bom.gov.au/climate/enso/index.shtml

Figure 2
NOAA - National Climatic Data Center
http://www.ncdc.noaa.gov/teleconnections/enso/

Figure 3
International Research Institute for Climate and Society
http://iri.columbia.edu/our-expertise/climate/forecasts/enso/

Figure 4
NOAA - Climate Prediction Center
http://www.cpc.ncep.noaa.gov/

El Niño

Information on this page is also found on the CLIMAS website:
www.climas.arizona.edu/sw-climate/el-niño-southern-oscillation

2015–2016 El Niño Tracker

El Niño conditions continued for a 15th straight month, but the peak intensity has long since passed and the event is moving toward ENSO-neutral status (see 'What is ENSO?' sidebar on page 5). Forecast discussions focused on the decline of atmospheric and oceanic anomalies that characterize an El Niño event, many of which are trending towards—or have nearly reached—ENSO-neutral status. Seasonal ENSO outlooks and forecasts have coalesced around the likely transition to La Niña conditions in fall or winter 2016. The spring predictability barrier—a time during seasonal transition that introduces a high degree of uncertainty into seasonal forecast models—makes identifying the exact timing of this transition difficult, but most models and forecasts center on the general framing of "Not if, but when?" regarding La Niña in 2016.

On May 10, the Australian Bureau of Meteorology maintained its outlook at La Niña Watch status, noting that El Niño conditions had weakened to borderline neutral status and that there was a 50 percent probability of a La Niña event developing in 2016. On May 12, the Japan Meteorological Agency identified a decaying El Niño event that is expected to weaken to neutral conditions by late spring followed by a developing La Niña by summer 2016. On May 12, the NOAA-Climate Prediction Center (CPC) extended its El Niño Advisory and its La Niña Watch. The CPC identified current atmospheric anomalies as reflecting an ongoing but declining El Niño event, while oceanic anomalies were much more indicative of ENSO-neutral status. The CPC forecast an end to El Niño by early summer (i.e., a return to neutral conditions), with a 75 percent probability of a transition to La Niña in fall or winter 2016. On May 19, the International Research Institute for Climate and Society (IRI) and CPC forecasts described a rapidly declining El Niño event, with La Niña conditions more than likely developing by late summer (Fig. 3). The North American multi-model ensemble shows the current decline from strong to moderate El Niño status over the past few months, as well as the possibility of a relatively rapid swing to weak to moderate La Niña conditions by summer (Fig. 4).

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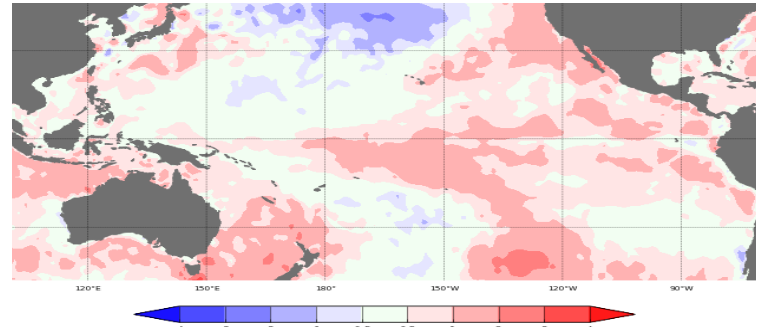

Figure 1: Apr 2016 Sea Surface Temperature (SST) Anomalies

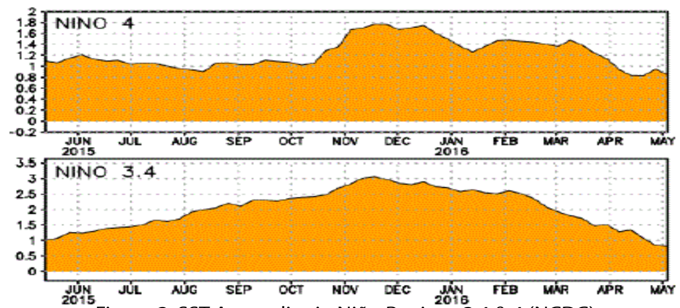

Figure 2: SST Anomalies in Niño Regions 3.4 & 4 (NCDC)

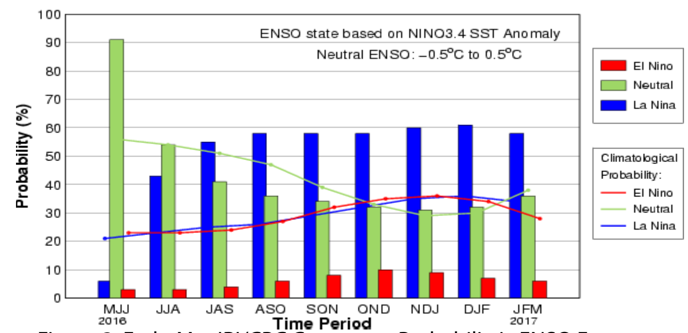

Figure 3: Early-Mar IRI/CPC Consensus Probabilistic ENSO Forecast

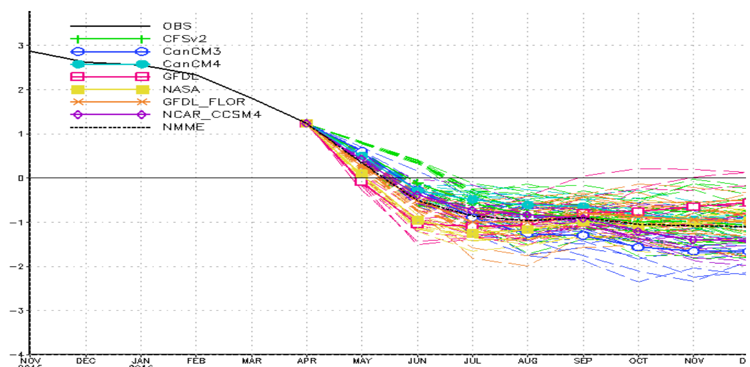

Figure 4: North American Multi-Model Ensemble Forecast for Niño 3.4

Online Resources

Figure 5
Climate Assessment for the Southwest
climas.arizona.edu

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

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

El Niño

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El Niño Recap

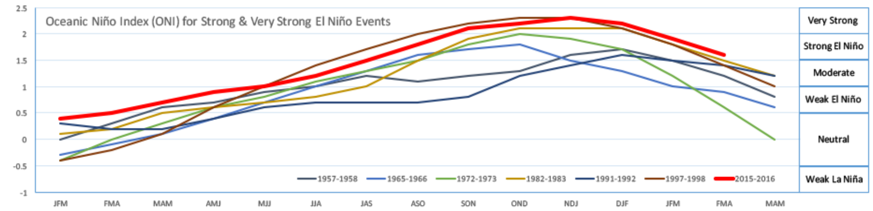


Figure 5: Oceanic Niño Index for Strong & Very Strong El Niño Events

This El Niño event was one of the strongest ever recorded (Fig. 5), and if past performance was any indication of what was expected for the Southwest, the region should have seen above-average precipitation over much of the cool season (winter and spring). The Southwest generally saw lower-than-expected precipitation totals that were much closer to average, or even below average in some cases. There are several reasons why this event did not meet expectations. One explanation is the difficulty of predicting highly variable weather events within the context of climate. In the case of the El Niño event of 2015–2016, a ridge of high pressure diverted moisture away from the Southwest during the prime time we might have expected to see increased activity (see El Niño tracker in April 2016 SWCO for details). Another reason is related to the use of analogs, past strong events, such as the El Niño event in 1982–83 or 1997–98). This El Niño event looks to be a clear outlier compared to most other observations that quantify the relationship between the ENSO index value and precipitation anomalies (Fig. 6). This analysis is hampered by limited sample size, which means making broad pronouncements about these patterns is problematic until there are more observations of strong El Niño events to compare to this event, and more data to feed into seasonal forecasts and outlooks. A final reason for the recent El Niño falling short of expectations is the relative infancy of the science of El Niño. The climate and atmospheric/oceanic science community is still developing its understanding of El Niño and the influence of the Arctic Oscillation Index or the Pacific Decadal Oscillation. Experts in these fields will certainly look to this El Niño event to determine what additional information can be gleaned from an event that, by all accounts, could have blanketed the Southwest with regular and steady winter precipitation. Instead, warm and dry conditions dominated throughout much of the cool season in the Southwest, even while the El Niño event performed closer to expectations across most of the globe (Fig. 7).

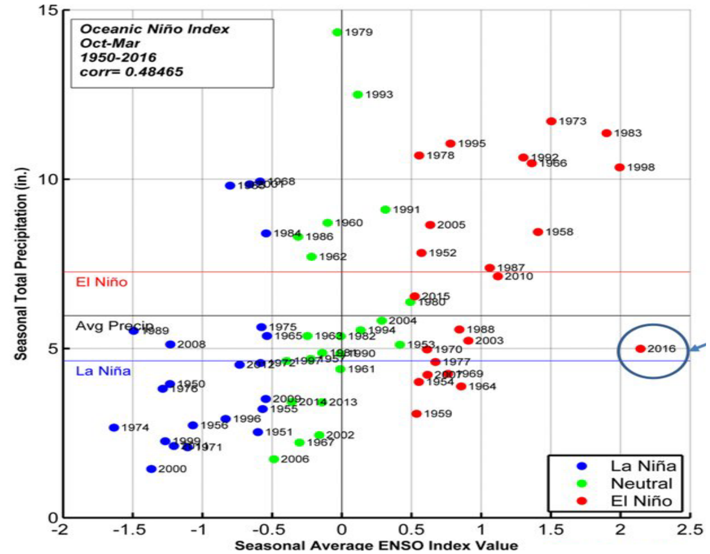


Figure 6: Arizona Climate Division 7 - ENSO vs. Precipitation

Perhaps just as importantly, this discrepancy between seasonal outlooks and forecasts and the observed weather of the cool season did not take place in a vacuum. Long-term drought has affected the Southwest throughout much of the 21st century, and the prospect of a strong El Niño event generated considerable hope and optimism for the potential positive impacts of above-average precipitation. *(cont. on next page)*

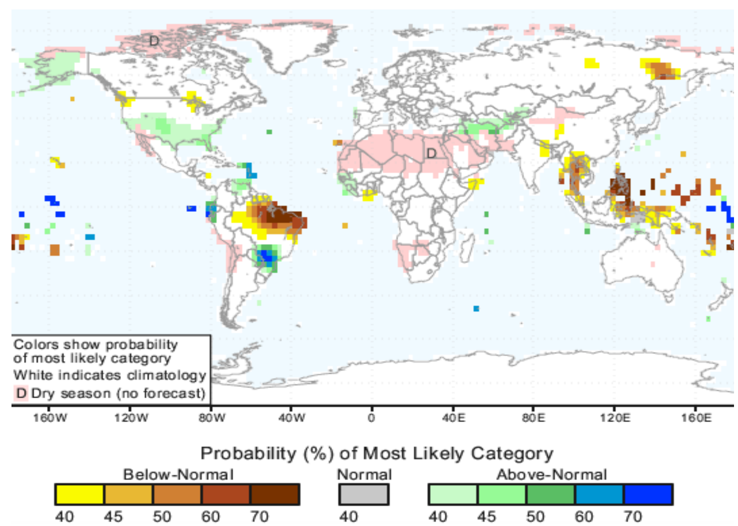


Figure 7: IRI Multi-Model Probability Precipitation Forecast - Apr-Jun 2016

Online Resources

Figures 8-9
NOAA - Climate.gov
https://www.climate.gov/

El Niño

Information on this page is also found on the CLIMAS website:
www.climas.arizona.edu/sw-climate/el-niño-southern-oscillation

El Niño Recap (cont. from previous page)

This optimism was augmented by media-fed narratives about the potential for extreme precipitation during a strong El Niño event that did not include the necessary caveats associated with most scientific models and forecasts. Still, it was generally understood that a single strong year would not “fix” long-term drought, but that it might at least bend the curve back towards some modicum of recovery. Near-average cool-season precipitation was disappointing when held up to these expectations but was much wetter than would be expected in a typical La Niña winter, a comparison that will be all the more salient by this time next year.

A strong El Niño event is typically associated with increased precipitation across the cool season in the Southwest, but there is a practical limit to how much additional precipitation a desert environment might experience, even in a record El Niño year. Conversely, a La Niña event is associated with decreased cool-season precipitation in the Southwest, somewhat more reliably in terms of forecasts and predictions; layering a dry signal (i.e., La Niña) onto an already dry climate may produce a more consistent result compared to layering a wet signal (i.e., El Niño) onto a dry climate (Fig. 8). The correlations between ENSO status and precipitation anomalies do generally follow this pattern; La Niña events are more reliably dry than El Niño events are reliably wet, and there is considerable variability between wet and dry in ENSO-neutral years. The El Niño event of 2015–2016 was decidedly average and a likely outlier from previous (and subsequent) El Niño events. The La Niña conditions forecast for 2016–2017 are much more likely to produce drier-than-average cool season precipitation totals, with implications for long-term drought in the Southwest.

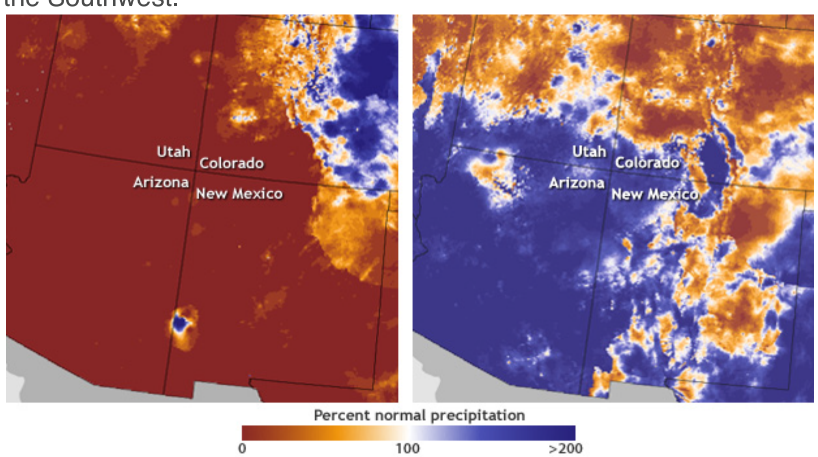


Figure 8: La Niña Winter (2011, left) vs. El NIño WInter (2010, right)

What is the El Niño-Southern Oscillation (ENSO)?

El Niño and La Niña are part of the El Niño-Southern Oscillation (ENSO), a natural fluctuation in oceanic sea surface temperatures (SSTs) and surface air pressure between the east and west tropical Pacific Ocean. During an El Niño event, easterly trade winds weaken, allowing warmer surface water from the western tropical Pacific Ocean to flow eastward. During a La Niña event, these trade winds intensify, preventing warmer water in the west from moving east, and stacking warm surface water in the west. Large areas of lower surface air pressure and convective precipitation follow the warmer water as it migrates across the tropical Pacific Ocean, altering broad-scale atmospheric circulation patterns (e.g., the Walker Circulation), which can influence weather around the world (Fig. 9).

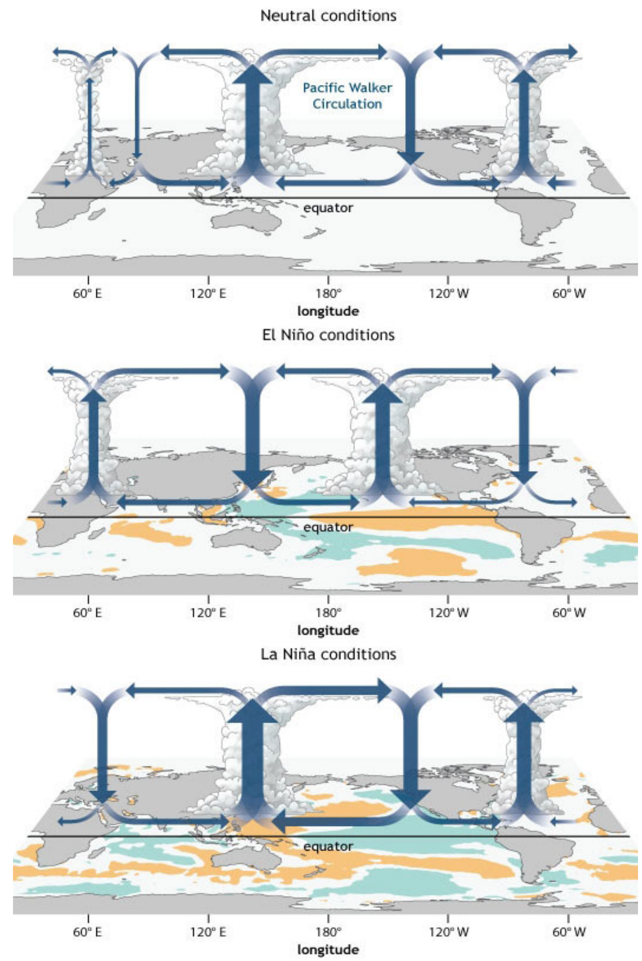


Figure 9: Walker Circulation - Neutral (top), El Niño (middle), & La Niña (bottom)

Online Resources

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

Arizona: http://1.usa.gov/19e2BdJ

New Mexico: http://www.wcc.nrcs.usda.gov/cgibin/resv_rpt.pl?state=new_mexico

We updated our 'max storage' values for numerous NM reservoirs based on conservation storage vs. maximum flood capacity. This altered the percent full calculations, even while 'current storage' numbers are unchanged.

Contact Ben McMahan with any questions or comments about these or any other suggested revisions.

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).

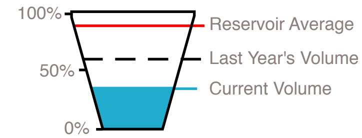
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons).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

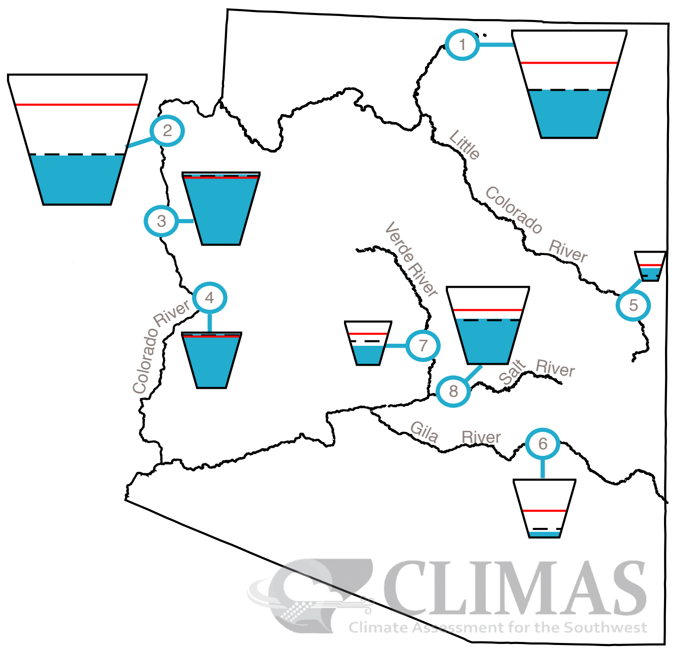
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

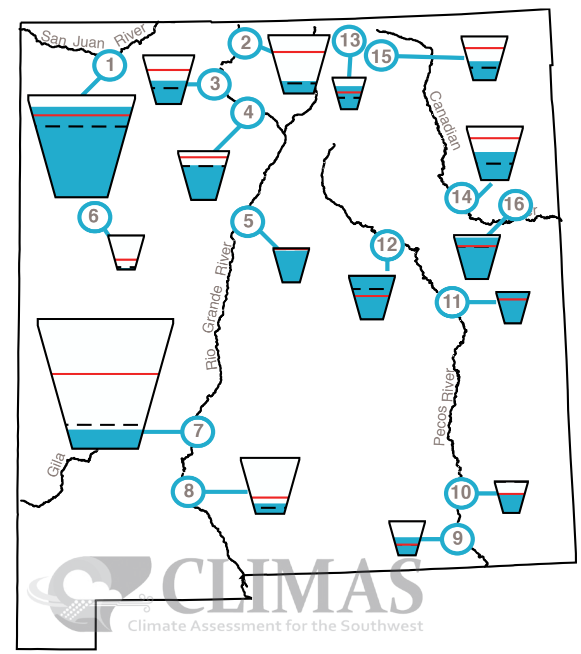
Reservoir Volumes

DATA THROUGH APR 30, 2016

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	45%	10,985.2	24,322.0	-21.8
2. Lake Mead	37%	9,690.0	26,159.0	-344.0
3. Lake Mohave	97%	1,747.0	1,810.0	40.0
4. Lake Havasu	97%	599.2	619.0	28.3
5. Lyman	43%	12.9	30.0	0.4
6. San Carlos	9%	78.5	875.0	-21.4
7. Verde River System	44%	125.5	287.4	2.5
8. Salt River System	58%	1,181.1	2,025.8	-26.3

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	88%	1,491.0	1,696.0	50.4
2. Heron	21%	82.8	400.0	9.4
3. El Vado	48%	90.7	190.3	42.4
4. Abiquiu	71%	132.2	186.8**	-1.2
5. Cochiti	93%	46.7	50.0**	-0.1
6. Bluewater	5%	2.0	38.5	-0.1
7. Elephant Butte	15%	334.6	2,195.0	-72.7
8. Caballo	19%	63.1	332.0	23.3
9. Lake Avalon	53%	2.4	4.5**	0.9
10. Brantley	58%	24.5	42.2**	-8.0
11. Sumner	111%	39.7	102.0**	-3.1
12. Santa Rosa	99%	104.7	105.9**	4.8
13. Costilla	73%	11.7	16.0	0.9
14. Conchas	52%	131.1	254.2	-5.9
15. Eagle Nest	43%	33.8	79.0	1.5
16. Ute Reservoir	95%	190	200	-2.0

On the CLIMAS Website

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http://www.climas.arizona.edu/blog

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Rio Grande|Bravo

CLIMATE IMPACTS & OUTLOOK

The Rio Grande–Bravo Climate Impacts & Outlook is a monthly product that provides timely climate, weather, and impacts information to stakeholders, researchers, and other interested parties in the Rio Grande–Bravo Basin region of New Mexico, Texas, and Mexico. Each edition recaps conditions over the previous months, including notable events, and then shows forecasts for the next three months for temperature, precipitation, and fire conditions.

The outlook is a product of the North American Climate Services Partnership (NACSP), an innovative trilateral partnership between the U.S., Mexico, and Canada. This partnership was established to respond to an increasing demand for accessible and timely scientific data and information in order to make informed decisions and build resilience in our communities. CLIMAS is an active participant in the NACSP Rio Grande–Rio Bravo Regional Pilot Area. CLIMAS co-produces the Rio Grande–Bravo Climate Impacts & Outlook with NACSP partners and is one of several partners hosting the outlook.

Read more at: http://www.climas.arizona.edu/rgbo

CLIMAS Southwest Climate Podcast
Apr 2016 - An Exceptional El Niño - For all the "Wrong" Reasons?

In the early April edition of the CLIMAS Southwest Climate Podcast, Mike Crimmins and Zack Guido look back at our exceptional El Niño event, which may be standing out for all the wrong reasons, especially in the Southwest. They discuss the anomalously warm and dry conditions the Southwest has experienced since early January and put these conditions into context regarding our expectations in a strong El Niño year, what might be driving these patterns (and the moisture away from us), and just where that moisture has gone. They also discuss the similarities of the current precipitation pattern to La Niña (i.e., dry in the Southwest and wet in the Northwest) but highlight how this event is very different from La Niña-associated atmospheric patterns (even if the precipitation patterns feel like a La Niña year). They also point out that while we're not in a La Niña yet, forecasts call for much higher chances of a swing to La Niña by fall of this year. In addition they look forward to the rest of the spring, including the last gasp of moisture the second week of April and what this underwhelming El Niño might mean for regional drought, snowpack, and wildfire conditions.

Listen: http://www.climas.arizona.edu/podcast/apr-2016-climas-sw-climate-podcast-exceptional-el-niño-all-wrong-reasons

On the Web
Mrs. Green's World - El Nino: Impact in the Southwest & Our World

Mike Crimmins and Zack Guido appeared on Mrs. Green's world to talk El Niño. Broadcast 4/16/2016 - Just what is El Nino? What are its impacts on the Southwest and what are some "events" that might be of interest to all of us? This show made possible due to the generous support of The University of Arizona, Institute of the Environment.

Listen: http://www.mrsgreensworld.com/2016/04/16/el-nino-impact-in-the-southwest-our-world-2/