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November Southwest Climate Outlook

Precipitation: Little precipitation fell in Arizona from mid-October to mid-November following the official end of the monsoon on September 30. New Mexico recorded some precipitation of note, mainly in the southeastern corner and in scattered pockets of the central and north-central parts of the state. This is a marked change from monsoon precipitation and the substantial contributions made by the incursions of tropical storms, but this drop-off in rainfall is typical for this time of year; November joins April as one of the driest months for the region.

Temperature: Most of Arizona and New Mexico were warmer than average in the past 30 days, a pattern that was consistent across much of the Southwest. The cold front that brought winter weather to much of the U.S. in mid-November also stretched into the region, but with limited effect and primarily in portions of eastern and southeastern New Mexico. There was a shift towards colder temperatures across the region in the last few days (at time of publication), and while the air feels colder given the previously above average temperatures, the temperatures are close to historical averages.

Snowpack: Sporadic early winter precipitation resulted in below to above-average snowpack levels across the region. It remains to be seen how much of this early season snowpack will remain, and an above-average snowpack is needed this winter to improve storage in the Upper Colorado and Rio Grande basins. **Water Supply:** In October, total reservoir storage was 46 percent (compared to 47 percent last year) in Arizona, while total reservoir storage was 22 percent (compared to 21 percent last year) in New Mexico.

Drought: Above-average monsoon precipitation and an active Pacific hurricane season provided some short-term drought relief in the Southwest. Long-term drought relief was limited by the inconsistency of precipitation coverage and the runoff and evaporation associated with high-intensity precipitation events. The likelihood of an El Niño event continues to offer hope for additional drought relief, as these events are typically associated with increased winter precipitation in the region.

ENSO: The latest ENSO projections indicate a 70-75 percent chance that an El Niño event will develop this winter. Some experts believe that conditions are already in place, and that it is only a matter of time before the El Niño event is officially declared. There is less confidence, however, that a moderate to strong event will form and uncertainty about whether a weak event will drive winter precipitation much above average.

Precipitation Forecasts: The NOAA-Climate Prediction Center is calling for elevated chances for above-average precipitation through the winter and into early spring. These predictions are thought to be picking up on both the possibility of an El Niño event this winter and the impact of the Pacific Decadal Oscillation.

Temperature Forecasts: The NOAA-Climate Prediction Center temperature forecasts are split across the region, with elevated chances for above-average temperatures along the West Coast, extending eastward into Arizona, and with increased chances for below-average temperatures along the Gulf Coast into New Mexico.

Tweet Nov SW Climate Snapshot

CLICK TO TWEET

Nov @CLIMAS_UA SW Climate Outlook -Climate Summary, ENSO Forecast, Water Supply, Tropical Storm Redux, CLIMAS News http://bit.ly/1tmToXA

Online Resources

Figure 1.
International Research Institute for Climate & Society
http://iri.columbia.edu/our-expertise/climate/forecasts/enso/

Figure 2.
Australian Bureau of Meterology
http://www.bom.gov.au/climate/enso/index.shtml

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

Figure 4.
NOAA-Climate Prediction Center
http://www.cpc.ncep.noaa.gov/products/NMME/current/plume.html

2014-15 El Niño Tracker

The long-awaited El Niño event projected to develop during winter 2014 – 2015 has yet to send a decisive signal regarding an official start, but a number of factors have increased forecasters' confidence that one will emerge. The strength of this event still remains in question, however with the most likely projection still centering on a weak or weak to moderate event.

On Nov 6, the NOAA-Climate Prediction Center (CPC) issued an El Niño Watch, assigning a 58 percent probability that an El Niño would form and that it most likely would be weak. This forecast was based on a slight increase of sea surface temperatures (SSTs) across the eastern equatorial Pacific, linked to the contribution of the Kelvin wave (discussed last month), which helped warm SSTs in the eastern Pacific. The CPC also reported the "ongoing lack of clear atmosphere-ocean coupling" (discussed in our previous Southwest Climate Podcasts) reduced confidence in the forecast. On Nov 18, the Australian Government Board of Meteorology increased its El Niño tracker status from El Niño Watch to El Niño Alert, with a 70 percent probability of an El Niño developing in winter 2014–2015. This outlook was based on a recent surge in above-average temperatures in the tropical Pacific Ocean (Fig. 1) and the Southern Oscillation Index (Fig. 2), which exceeded the El Niño threshold for the past three months, despite a lack of complete cooperation on the part of atmospheric conditions.

The Nov. 20 International Research Institute for Climate and Society (IRI) and CPC forecast reiterated these points, as the SSTs have exceeded the threshold for weak El Niño conditions, even while some of the atmospheric variables have yet to point towards an El Niño event. The mid-November forecast subsequently upped the probability of El Niño conditions developing to 75 percent (Fig. 3), and the North American multi-model ensemble shows a weak to moderate event peaking in mid to late winter and extending into the spring (Fig. 4).

The strength of the event, if and when it forms, will matter. The impacts associated with weak El Niño events are generally less certain than those of a moderate or strong event, with past weak events bringing both dry and wet conditions to the Southwest U.S. during the winter. Seasonal precipitation forecasts still indicate an enhanced chance of above-average precipitation over the upcoming winter, but confidence in this forecast is partially contingent on the strength of the emerging El Niño event. It should also be noted that the signal for the Pacific Decadal Oscillation (PDO) has moved into a positive phase, which bodes well for increased precipitation this winter, especially since the El Niño-Southern Oscillation (ENSO) and PDO signals have the potential to enhance, rather than work against, the other.

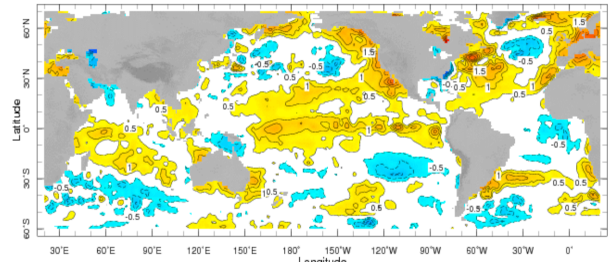


Figure 1: Sea surface temperature anomalies, Nov 9-15, 2014

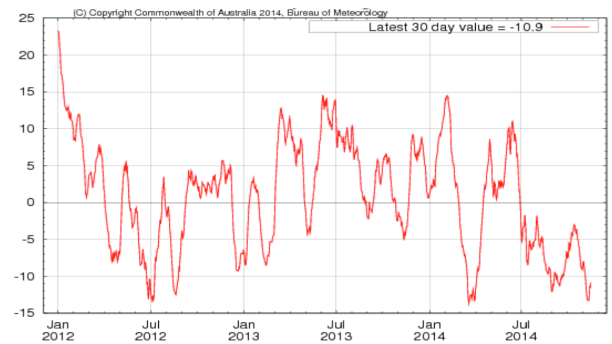


Figure 2: 30 Day Moving Southern Oscillation Index (SOI)

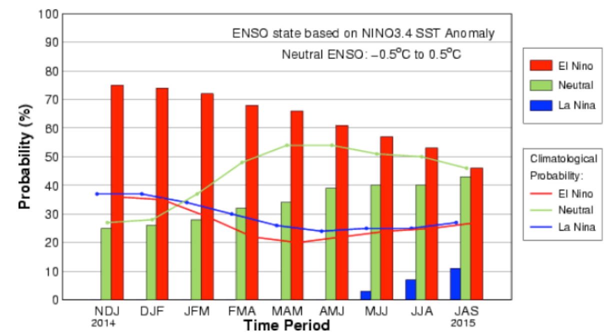


Figure 3: Mid-November IRI/CPC Plume Based Probabilistic ENSO Forecast

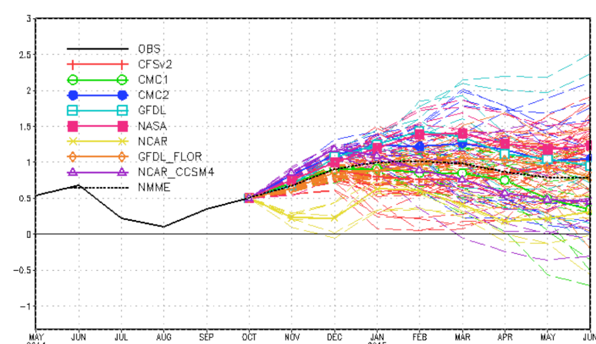


Figure 4: North American Multi-Model Ensemble (NMME) forecast for Niño 3.4

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

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).

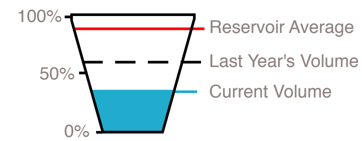
The table details more exactly the current capacity (listed as a percent of maximum storage). Current and maximum storage are given in thousands of acre-feet for each reservoir. One acre-foot is the volume of water sufficient to cover an acre of land to a depth of 1 foot (approximately 325,851 gallons). On average, 1 acre-foot of water is enough to meet the demands of 4 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.

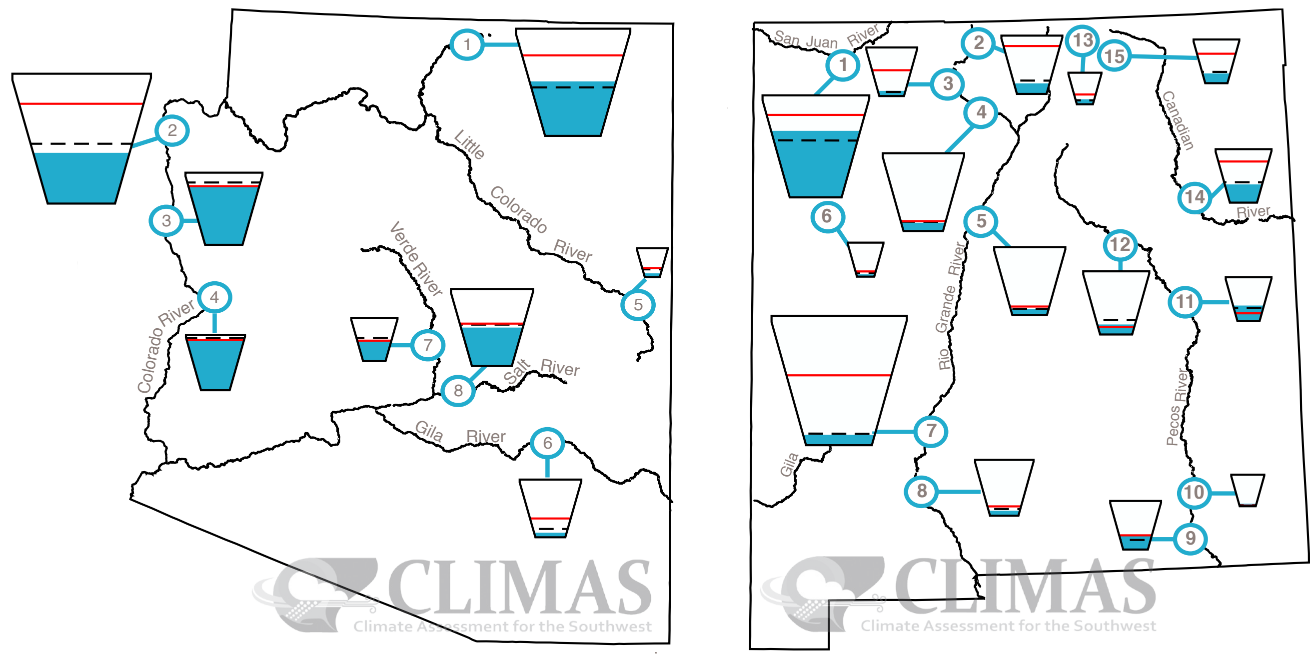
These data are based on reservoir reports updated monthly by the National Water and Climate Center of the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS).

Reservoir Volumes

DATA THROUGH OCTOBER 31, 2014

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	51%	12,290.0	24,322.0	4.0
2. Lake Mead	39%	10,243.0	26,159.0	122.0
3. Lake Mohave	81%	1,470.3	1,810.0	-174.9
4. Lake Havasu	89%	550.2	619.0	-33.0
5. Lyman	13%	4.0	30.0	0.0
6. San Carlos	8%	69.5	875.0	16.4
7. Verde River System	46%	132.2	287.4	-16.2
8. Salt River System	50%	1,005.8	2,025.8	21.4

*KAF: thousands of acre-feet

Reservoir	Capacity	Current Storage*	Max Storage*	One-Month Change in Storage*
1. Navajo	65%	1096.4	1,696.0	15.8
2. Heron	18%	70.4	400.0	-0.2
3. El Vado	11%	20.2	190.3	-3.1
4. Abiquiu	11%	127.5	1,192.8	-2.4
5. Cochiti	10%	46.9	491.0	-0.3
6. Bluewater	7%	2.6	38.5	-0.1
7. Elephant Butte	8%	183.6	2,195.0	11.5
8. Caballo	9%	31.2	332.0	0.1
9. Lake Avalon	28%	1.1	4.0	-3.3
10. Brantley	8%	78.1	1,008.2	1.4
11. Sumner	35%	35.3	102.0	-1.4
12. Santa Rosa	16%	70.6	438.3	-1.3
13. Costilla	16%	2.5	16.0	0.5
14. Conchas	34%	87.4	254.2	-9.4
15. Eagle Nest	22%	17.1	79.0	-1.3

* in KAF = thousands of acre-feet

Southwestern Oscillations

A longer version of this article can be found on the CLIMAS blog

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

Online Resources

Figure 1

NWS National Hurricane Center

http://www.nhc.noaa.gov/data/tcr/index.php?season=2014&basin=epac

Pacific Tropical Storms Recap

The 2014 Pacific hurricane season was the most active season on record since 1992, with 20 named storms (Fig. 1). Fourteen of those storms developed into hurricanes, including eight major hurricanes (category 3 or greater), also breaking a record held since 1992. This meets or exceeds the high end of the NOAA-Climate Prediction Center (CPC) seasonal forecast (May 22), which predicted 14 to 20 named storms, seven to 11 hurricanes, and three to six major hurricanes. The Pacific hurricane forecast was tied to the ongoing El Niño forecast discussion, as conditions linked to the formation of an El Niño event (e.g., decreased wind shear in the tropical Pacific) also favored increased hurricane frequency and intensity in the Pacific region, and it is safe to say this season did not disappoint. Conversely, the Atlantic hurricane season was relatively quiet, with eight named storms, six of which became hurricanes, including two major ones. This was also in line with NOAA-CPC projections of seven to 12 named storms, three to six hurricanes, and up to two major hurricanes.

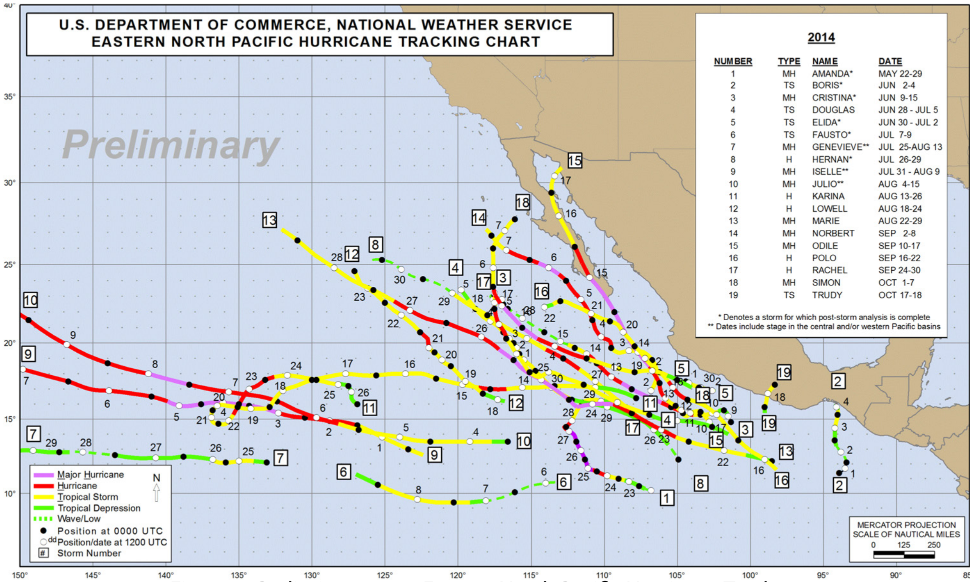


Figure 1: Preliminary 2014 Eastern North Pacific Hurricane Tracks

Seasonal Summary and Impact on the Southwest

The season started off strong and early with Hurricane Amanda on May 24 and continued with a number of early season tropical storms and hurricanes. A few early seasons storms, including Amanda, affected portions of Mexico but largely avoided the Southwest U.S. Most followed the typical early season pattern of staying out in the Pacific Ocean. Notably, Hurricanes Iselle and Julio headed towards the Hawaiian Islands in late July and early August, with only Iselle actually making landfall. As the season progressed, later season storms followed the expected pattern of recurving back into the Pacific Coast (see additional resources), and a number of major hurricanes, notably Marie, Norbert (with an assist from Atlantic Hurricane Dolly), Odile, and Simon, veered into the Pacific coast and brought considerable moisture into the Southwest. These incursions of rainfall made substantial contributions to the region's overall monsoon totals; without them, the Southwest likely would be looking at a very different monsoon picture (i.e., below-average precipitation), particularly in September.

Additional Resouces

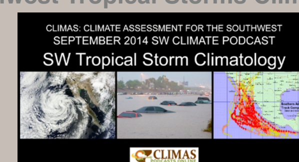
Southwestern Oscillations (Blog)

Notes from an Applied Climatologist: Tropical Storms and the Southwest Q&A

http://www.climas.arizona.edu/blog/notes-applied-climatologist-tropical-storms-and-southwest-qa

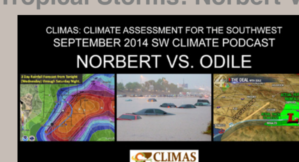
Southwest Climate (Video) Podcasts

Southwest Tropical Storms Climatology



https://www.youtube.com/watch?v=IPRQxKI_jrw

2014 Tropical Storms: Norbert Vs. Odile



https://www.youtube.com/watch?v=IPRQxKI_jrw

Southwestern Oscillations

A longer version of this article can be found on the CLIMAS blog

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

Online Resources

Figure 1

Climate Science Applications Program - University of Arizona Cooperative Extension

http://cals.arizona.edu/climate/misc/monsoon/az_monsoon.html

Pacific Tropical Storms (cont.)

Specific Impacts and Looking Forward

In the Southwest, we are accustomed to the seasonal threat of flooding associated with intense monsoon precipitation, but these storms are generally highly variable spatially and relatively short. Hurricane Odile, as it lumbered into the Southwest, presented a unique threat; it had the potential for widespread flooding over a large area and over a number of days. In a worst case scenario, it could have moved slowly across the Tucson region, and dumped six or more inches of rain across the city and Pima County, not to mention additional flood potential from mountain runoff.

This scenario posed unique challenges for emergency managers tasked with planning and preparing without sensationalizing or inciting fear in the community. Forecasters faced a related challenge of accurately characterizing a storm for which there was limited data available as it moved over data-poor regions of Mexico, knowing that the results of their forecast would be used to make widespread decisions that could prove costly if wrong. The lack of quality data, combined with apprehension about underestimating the threat of Odile, likely contributed to elevated predictions and certain planning decisions.

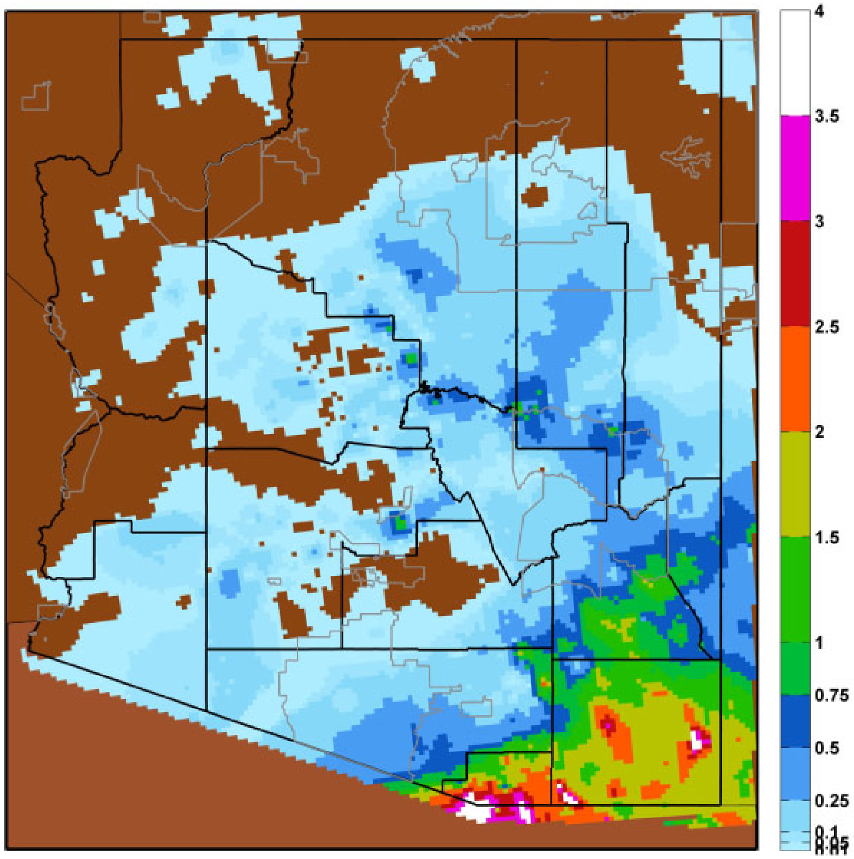


Figure 1: Single day rain total 09/17/14 (Hurricane/TS Odile)

Ultimately, Odile swung south of its predicted path by about 70 miles, leading to substantial rain events and considerable flooding in the southeastern corner of Arizona and across portions of southern New Mexico (Fig. 1). Tucson may have avoided the worst-case scenario in terms of hurricane impacts, but lingering effects may be more costly. The general public derided many of the forecasts as inaccurate or unreliable, saw sensational coverage from outside media sources, and were subject to considerable disruptions associated with school, road, and government closures despite no actual flooding in town. These circumstances may contribute to a decreased likelihood to act on emergency decrees in the near future.

In the coming months, CLIMAS researchers will work with regional planners and officials to further explore the experience of Odile as it relates to emergency management planning and forecasting.

Southwestern Oscillations

Be sure to visit our blog, Southwestern Oscillations

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

CLIMAS YouTube Channel

Visit our new YouTube channel for mini-videos of content/discussion pulled from the podcast

https://www.youtube.com/user/UACLIMAS/

CLIMAS Podcasts

Visit our website or iTunes to subscribe to our podcast feed

www.climas.arizona.edu/media/podcasts

https://itunes.apple.com/us/itunes-u/climate-in-the-southwest/id413143045

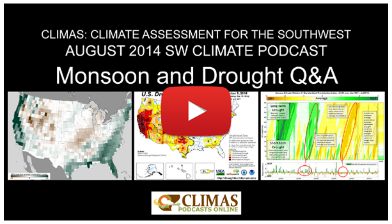
Notes from the Podcast - New Mini-Podcast Videos

Regular podcast listeners will know that we cover a wide range of Southwest climate topics in a conversational manner. To make these discussions even more accessible and useful, we are pulling small segments from the podcasts and adding maps, images, and video to supplement the content. These offer an opportunity to quickly digest key points from the podcast and also serve as stand-alone teaching/illustration tools that are suitable for a wide range of audiences. You can find the videos and subscribe to the YouTube channel at https://www.youtube.com/user/UACLIMAS/.

We already have posted several mini-video podcasts:

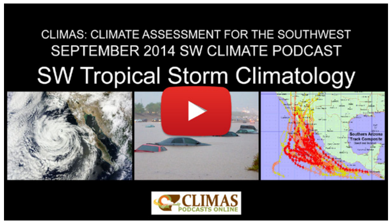
Monsoon and Drought Q&A

https://www.youtube.com/watch?v=Dk001_Yr-7k



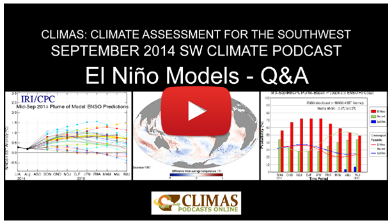
Southwest Tropical Storm Climatology

https://www.youtube.com/watch?v=IPRQxKI_jrw



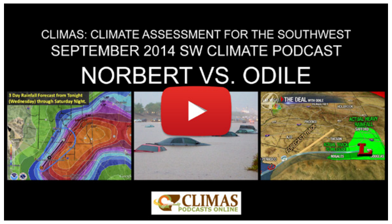
El Niño Forecast Models Q&A

https://www.youtube.com/watch?v=Dk001_Yr-7k



Norbert vs. Odile - Tropical Storms in the Southwest

https://www.youtube.com/watch?v=UZpfyV2YCtw



2014 Monsoon Recap

https://www.youtube.com/watch?v=xkB7zHHpypU