

Roundtable discussion on La Niña episode

The El Niño Southern Oscillation (ENSO) forecasts issued this fall by the International Research Institute for Climate and Society (IRI) and the November 8 NOAA Climate Prediction Center Diagnostic Discussion indicated a strong probability that La Niña conditions will continue through early 2008. Models also suggested that the event may strengthen to moderate levels through late fall, dampening hopes for at least normal precipitation in the Southwest this winter season. La Niña events typically disrupt the winter storm track across the western U.S., bringing persistent precipitation to the Northwest and dry conditions to the Southwest. If this scenario plays out, the development of drought impacts across Arizona and New Mexico may continue to expand as snowpack totals dwindle.

On November 6, CLIMAS sought the expertise of scientists who discussed the current La Niña event and its potential fate and impacts in the West and Southwest. The following is a condensed version of that discussion. Some definitions and explanations are included within the discussion. Please see the CLIMAS online glossary (<http://www.ispe.arizona.edu/climas/forecasts/glossary.html>) for terms that are not defined here.

Roundtable participants:

Christopher Castro, PhD
*Assistant Professor, Atmospheric Sciences
The University of Arizona, Tucson*

David Gutzler, PhD
*Professor, Earth and Planetary Sciences
University of New Mexico, Albuquerque*

Klaus Wolter, PhD
*Meteorologist, Climate Diagnostics Center,
Boulder;
Research Associate, University of Colorado*

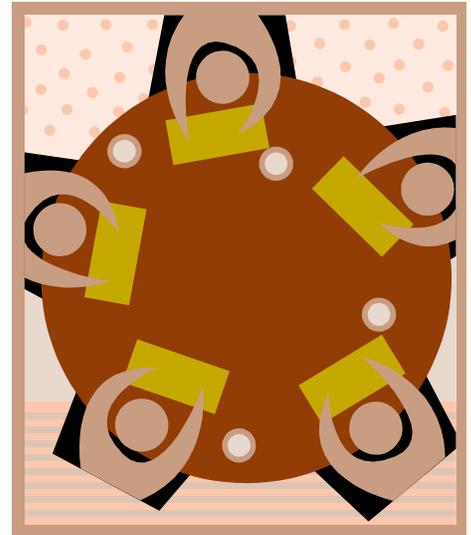
Gregg Garfin, PhD
*Roundtable Moderator
Deputy Director of Outreach, Institute for
the Study of Planet Earth, The University
of Arizona, Tucson*

Garfin: La Niña means dry conditions in the Southwest. Is there anything unusual we should expect from this developing La Niña episode?

Wolter: I should preface with the fact that this La Niña started a few months later than expected... and it is actually, in my book, one of the bigger [La Niña] events we have seen, especially in the last thirty years or so....It should be a pretty standard and moderate, maybe moderate to strong, event that's unfolding.

Gutzler: We've seen some events in the last few years, in this century really, where ocean temperature anomalies seem to have been strongest out near the dateline or really off-shore, and so far the anomalies we're seeing are farther toward the South American coast. In that respect, this event, at least to date, looks like some of the early El Niño/La Niña composites that were developed back in the 80s and early 90s, more so than some of the recent events. If that's a guide, then we might expect a somewhat more typical La Niña response compared to recent events, which haven't really all conformed to the nice composite picture that was developed a couple of decades ago. [A composite is a graphic showing the average of conditions for selected periods of time over a certain space. In this case, it refers to both the progression of the average of the sea surface temperatures in the equatorial Pacific Ocean during a La Niña episode, and to the average of the precipitation deficits and temperature increases in the Southwest associated with a La Niña episode in the Pacific Ocean.]

Castro: With respect to actual precipitation anomalies, we can just go ahead and look at the climate variations in our forecast, and it's a classic La Niña-like signal in the precipitation forecast. From what I've looked at, that signal seems to hold through the fall and winter, and into the next spring.



Garfin: Staying on that note of precipitation anomalies within the region, there's a hint that in January, February, and March, probabilities [for precipitation] become greater for New Mexico than Arizona. What's really driving that, and how much can we depend upon that sort of shift from Arizona to New Mexico in the precipitation anomalies?

Wolter: I'm updating my forecast and I have grim news. My actual forecast, which depends on much more than La Niña, is very pessimistic. I've never seen a regional seasonal forecast this dry in the outlook. I hate to point out that that's actually consistent with a couple of forecasts. Usually the mountains in northern Utah, Colorado, and southwestern Wyoming do reasonably well in mid-winter with the La Niña-type storm track. What these forecasts seem to point out is the potential that the storm track may not be quite as pronounced. La Niña itself seems to be on track to do its thing, but there seems to be some competing influences that are pointing a bit towards a drier scenario, unfortunately. In regard to Arizona versus New Mexico, I don't really see much difference there... The tools are pointing towards dryness. ...It seems that with at least some tools, and that includes forecast systems from the CPC

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[Climate Prediction Center] and my own updated forecast, March is predicted to be so dry that it more than cancels out any normal wet January or February. But the zero line, the line of equal probability for at or above or below normal, seems to be shifted a bit further toward the north than is typical for La Niña. That would include quite a bit of the Upper Colorado River Basin, with the possible exception of Wyoming. [Upper Colorado River Basin snowpack, and hence spring Colorado River streamflow that supplies water to the Southwest, may suffer from a La Niña storm track that is even more northern than average for La Niña winters.]

Castro: Where we need to start expecting the big change with respect to precipitation, in terms of the anomalies, is not going to happen until the monsoon. We'll have to wait until June or early July for that.

Garfin: I presume you were referring to the tendency for the monsoon precipitation to be above average following a La Niña winter?

Castro: Right. This summer was sort of a good example of that, at least in Tucson. It was a pretty wet July with a lot of upper-level disturbances responsible for the rainfall.

Wolter: One window of opportunity where the midwinter precipitation might try to catch up a bit is usually from about Christmas to mid-February. It seems like with the La Niña pattern there's typically a storm track that comes in from the Pacific Northwest in January, and sometimes these storms dip all the way into, say, northern Arizona. That's something to watch for. If that really happens, maybe this is a more typical La Niña. If it doesn't happen, then my dry outlook will really be on track.

Gutzler: There's another signal of La Niña that may come into play if we're

thinking about streamflows next year, and that is the tendency for spring time temperatures to be particularly warm. ...If La Niña persists through February into the snow ablation season, then it can contribute to low snowpacks. [In this case, ablation refers to the removal of snow by wind, melting, evaporation, or sublimation.] La Niña spring times tend to be warm and windy and La Niña can generate some of these large snow-eater events in spring time. That can bring subsequent streamflows down even farther. So, one of the things we'll be looking for as we get into this winter is whether La Niña looks like it will persist all the way into the winter and into the spring (April–May timeframe), or whether it's demise will come early, like last year's El Niño, which [fizzled] early in the season.

Castro: As a rejoinder to that, if the whole dry scenario plays out, the fire danger in May and June is going to be pretty critical around here.

Garfin: Let's jump back to the questions about the Upper Colorado and the Upper Rio Grande basins, where all that good snowfall should generate something. Klaus had mentioned that usually the Upper Colorado River Basin will be wet, but right now a couple of the tools are pointing to really dry conditions throughout the winter.

Gutzler: Well, we know very clearly from just looking at streamflow composites that there's a very strong expression of the ENSO [El Niño Southern Oscillation] cycle on subsequent years' streamflow for the rivers that have their headwaters in the southern Rockies. That is entirely consistent with the precipitation signal, and in a secondary way consistent with the tendency for warm springs. Both of those, during La Niña winters, tend to make streamflows lower in the following years, this year being spring 2008. Given the way this La Niña is developing, in what looks like a

traditional way with its spatial pattern looking very much like classic La Niña composites, I don't see any reasons to deviate from a prediction of low streamflows next year.

Castro: You also need to consider water usage. Usage goes up as well if there are drier conditions and if it's warmer.

Wolter: The one benefit of the northward extension of this track might be, in mid-winter at least, that it may not be very windy. We often actually get quite a few mid-winter windstorm events in Colorado with La Niña, and if the whole storm track shifts a bit more to the north to Wyoming and Montana, even into Canada, we may actually have less frequent windstorms. That doesn't really have very much bearing on the mid-winter snowpack, but when you get into February–March, it can play a role. ...With grassy surfaces, even though you may have low temperatures, snow sublimates and simply disappears if you blow it around a lot. That's a very common way in which southern Wyoming loses snowpack. In the mountains, snow gets scoured above the tree line. Below the tree-line you get the snow off the trees, so that changes the albedo and helps warm up the air a bit earlier. [Albedo is the fraction of solar radiation that is reflected from a surface. Albedo is higher for a white, reflective snow surface than for a dark, heat-absorbing forested surface].

Garfin: Is there a tipping point at which we could definitely kiss any hope of winter-spring precipitation goodbye?

Wolter: It depends on where you go. In Arizona, my guess is that it would be very unusual to get much relief in March–April.... If you go into the Upper Colorado River Basin, March and April are still very significant snowfall months. There is that little piece of hope that if this La Niña, for whatever reason, would be short-lived, if it does

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play itself out rather quickly, we might get a bit of a rebound in the spring. In sixty years of climate data, I've found only one case where we went from El Niño into a La Niña and right back into an El Niño within two years, and that was from 1963–64 to 1965–66. The spring of '65 was indeed a pretty decent recovery case, but that's one out of eight or ten cases. ...And of course, there's the January window of opportunity. If that doesn't come through, then the dry mid-winter forecast will look like it'll be on track.

Garfin: Actually, in the spring of 1999, in at least southern Arizona, we had a snowfall. That actually put a damper on what looked like was going to be a fairly robust fire season.

Wolter: That was an interesting case. April is a very peculiar month. We've had more than one case where, with a full-blown La Niña situation, April was the one month during the spring season that was wet. It was true in 1999 in Colorado, and it was also true in 1971.

Castro: The general message to stakeholders is that it's probably going to be a drier-than-normal winter, and they should plan for that.

Gutzler: Fifteen or twenty years ago, our understanding of these ENSO cycles was such that we just think about a single event where we had some knowledge of a composite, and we would go with that [composite] as a seasonal forecast. What I think we've done over the last decade is realize, having seen more events and looked at them more carefully, that it's worth revisiting the La Niña forecast, say in midwinter, around the end of the calendar year.

Garfin: Have you seen any changes in the La Niña characteristics that you might ascribe to decadal variations or to

climate change? Global warming, let's call it.

Wolter: We've had basically a lack of moderate to strong La Niña events since the mid 70s. ...There was a fairly short event in early '88 that was over by mid-'89. Then we had the long-winded affair from summer of '98 to, depending on how you count it, early 2000 or 2001. That's about it. Compared to that, we've had very long-lasting, strong La Niñas, both in the 70s and the 50s. So there has been a change in the decadal behavior of La Niña events, but I would be very hesitant to attach that to, say, global change. ...Despite the lack of La Niña events, it hasn't been just a transition to El Niño events; we've had a lot of neutral or complicated patterns where the cold anomalies were not where you would expect them. ...There's a bit of a debate right now over the warmth, especially in the spring season, that we have been seeing in the last thirty years or so that's consistent with La Niña, but it's also consistent with global change, and it's also consistent with an earlier meltout of snowpack. How much of that will continue into the future and whether it will continue to accelerate or not, that's a matter of debate, I guess. We need to focus some research on that.

Gutzler: More than any year over the past few years, this looks as much or more like a classical ENSO-driven winter compared to just about anything I've seen recently. I would lean heavily on long-term composites that have been generated based on La Niña winters for guidance and really pay attention to that forcing.

Castro: I think there is a question as to whether the PDO [Pacific Decadal Oscillation] has changed since the late 1990s into the present. ...If it has flipped back, then, as Klaus said, those are periods where we tend to have dry times in the Southwest during winter

and then dry in the central U.S. Those kinds of times are when you have the biggest drought in the central U.S., like in the 30s, the 50s, and the 70s. Now the big debate is whether this latest prolonged drought is due to whether the PDO has flipped. We don't know.

Wolter: I agree 100 percent with Dave. It looks much more like a La Niña than anything we've seen in almost ten years, but there may be more going on that could influence it, and one thing we haven't mentioned so far is the Atlantic. The North Atlantic is still warm. The hurricane seasons have been disappointing, if you're trying to bet on hurricane damage on the coast, but actually this was another hurricane season above normal, it just didn't hit the U.S. That seems to have an influence on our climate too, and, unfortunately, not a positive influence. It seems to help dry us out a bit.

Castro: I don't know whether there is any agreement in the climate change community as to whether we go more toward an ENSO-like state or a La Niña-like state in the future.

Wolter: I would agree with that. If you look very carefully at the IPCC [Intergovernmental Panel on Climate Change] Fourth Assessment Report, there's actually a graph in there that shows...whether or not we're going to get more El Niño- or La Niña-like behavior, and the models are all over the place. Knowing which model to pick, we don't have much guidance at this point.

Garfin: Thank you all for taking the time here. This has been an interesting discussion.

