With El Nino, be careful what you wish for

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Mudslides near Los Angeles in October, 2015. Credit: Tehachapi Life Photography via Facebook

A few weeks ago in the hills north of Los Angeles, heavy rain set off widespread mudslides that blocked roads and covered highways, burying

hundreds of vehicles and bringing much of Los Angeles' infamous traffic to a standstill.

For Californians, these mudslides are just one of many recent harbingers signaling the imminent arrival of a "monster" El Niño—an El Niño that started bubbling up from unusually warm temperatures in the tropical Pacific last summer.

In Southern California, a strong El Niño usually signals rain. Given that California is now in the throes of a severe drought, it seems like that should be a good thing, even if it comes with risk of floods. But the reality of climate is more complex and counter-intuitive than it first appears.

"It turns out," when it comes to explaining climate in a place like California, "there are details you'd like to be able to smooth out as not part of the big picture—but those details are the big picture," says Scott Steinschneider, a postdoctoral research fellow at the Columbia Water Center.

A "Poster-Child" El Niño

The El Niño/Southern Oscillation is a semi-periodic climate pattern that cycles every 2 to 7 years, depending on the warmth of ocean temperatures in the South Equatorial or Central Pacific. In the El Niño phase, warmer than average sea surface temperatures set off chain reactions in the climate around the world, impacting everything from the quality of fishing to the global price of chocolate, coffee, rice and sugar and the inflation targets of the European Central Bank. The warmer the temperatures, the more dramatic the impact. By contrast, the Pacific's cooler phase ("La Niña") has different effects.

Lisa Goddard, the director of Columbia University's International

Research Institute for Climate and Society and one of the world's leading experts on the El Niño/La Niña cycle, expects that this year's El Niño will be "an iconic event" comparable to the 1997-98 season. "This is a kind of poster-child El Niño," she says. "The garden variety events no one really looks at because they're not very interesting. It's the iconic events that we're used to looking at. And this one is icon-worthy."

She adds that this year's El Niño may still not turn out to be as big as the 1997-1998 season, but "it's a contender."

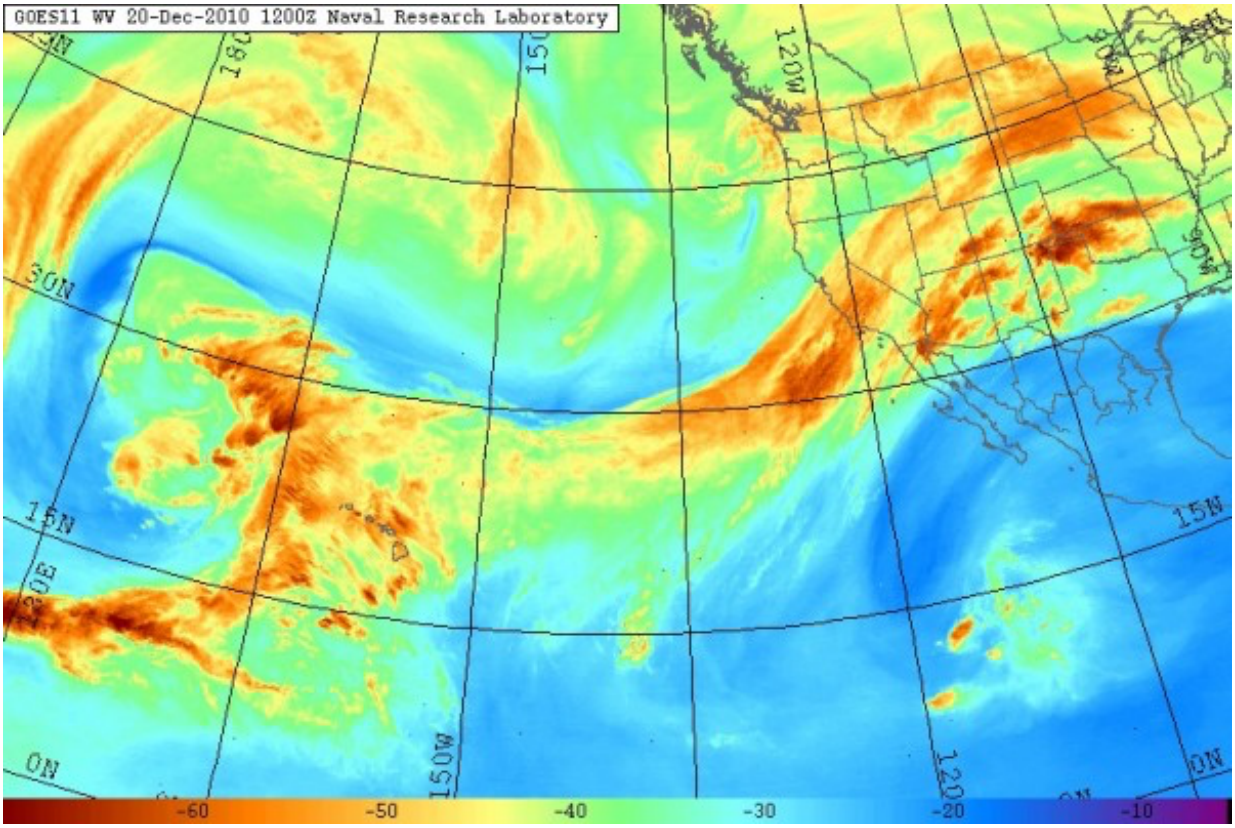
What that means for California is more rain—possibly a lot more rain. Unfortunately, for as envious as its mild weather makes the rest of the country, California is also a place of climate extremes, which means that drought can easily be followed by heavy rainfall and flooding. What's worse, that rain doesn't necessarily provide much relief from dry conditions in a place where parched earth and paved surfaces are either too dry or too impervious to absorb much water.

But could this year's El Niño be even more frightening? Californians should be careful what they wish for, warned Todd Dwyer, a high school economics teacher, in a recent editorial in the San Jose Mercury News. There is a real risk, he argued, that the coming rain could be catastrophic. "A weather event of this kind is only unimaginable because there is nobody alive who has borne witness to a flood of such biblical proportions."

Dwyer was referring to the risk of a kind of extreme rainfall event that some scientists believe occurs in California every 100 to 200 years. In 2011, the United States Geological Survey released a report about what they called "an ARkStorm Scenario" in which a series of intense, persistent "Atmospheric River" storms drop 10 feet of water on the state over the course of a few weeks ("ARkStorm" stands for "Atmospheric River Storm 1000 (k)").

In an ordinary year, a California Atmospheric River (sometimes called "The Pineapple Express") refers to a relatively narrow band of atmospheric moisture that originates in the waters near the Hawaiian islands and shoots into the West Coast of the United States.

Steinschneider, who has recently published a paper on statistical correlations between atmospheric rivers and flooding, explains that the phenomena begins as a Pacific cyclone in the mid-latitudes. "Part of the cyclone, called the warm sector, sucks in moisture ahead of the cold front," he says. "If it's set up right, the cyclone ends up pulling in a lot of moisture starting from the tropics but continuing all along its path, delivering a ton of precipitation to the West Coast."



The Pineapple Express hits central California in December of 2010. Credit: The Watchers

The USGS report hypothesized that a series of persistent and intense Pineapple Express events could destroy up 25 percent of homes in the state and cost $725 billion. When the last California ARkStorm hit in 1861-62, it inundated the entire Central Valley, killed thousands of cattle, washed away entire mining towns and destroyed so many homes that the State of California, which depended on property taxes, went bankrupt.

So what would happen, then, if an ARkStorm piled onto a monster El Niño as Dwyer suggests? Author Linda Davies explored just such a scenario in her recent conspiracy disaster thriller, Ark Storm.

In reality, though, such event is not that likely, says Goddard, at least not this year. "I think that most of those major atmospheric river events that really hit Central California—the ones you see pictures of on the wall when you go into the general store in gold mining country, where you see the historic floods—those are not happening in El Niño years."

Steinschneider agrees. "I don't think there's a lot of evidence to suggest that you get substantially more of these big Pineapple Express events during El Niño."

But will there be be enough rain to end the drought?

So maybe there won't be an an apocalyptic atmospheric river storm—but will this El Niño at least bring enough rain to end the drought? Not likely, says Goddard.

"So this is a tough communications thing," she says. "The message that is going out is that the El Niño rains are not going to solve California's drought. I'm sure some people are thinking that that means it's not going

to be a heavy rainfall year.

"But the people that know realize that while it's not going to be enough rain to fill up the reservoirs—that would take a lot—you're still going to get rain-related disasters, because the soil is so dry you're going to get a crazy amount of runoff, flash floods, things like that."

And a good amount of that rain, says Steinschneider, will not necessarily be in the right places. "There will be a lot of rain in Southern California this year," he says. "The unfortunate thing for California is that most of its storage is in the wetter north, because that's where they get most of their rainfall. What they really need is not just to get rainfall this year, but get it in a place where they can store it for later use."

Steinschneider points to the work of University of California-Davis Professor Jay Lund, who has charted the relationship of El Niño conditions to streamflow in the Sacramento and San Joachim river basins and found no clear relationship. Current seasonal forecasts from IRI and from the National Oceanic and Atmospheric Administration suggest that Northern California may get above-average precipitation this year, but not nearly to the degree Southern California will.

So if even this monster El Niño won't bring an end to drought, what will? Ironically, likely as not its end will come in the form of a series of Atmospheric River storms at some point in the future.

K Street in Sacramento during February 1862. Credit: Hudson Valley Geologist

In a 2013 paper, Michael Dettinger, a research hydrologist for the U.S. Geological Survey in California, published a paper in the Journal of Hydrometeorology showing that between 33 and 74 percent of persistent droughts on the West Coast between 1950-2010 were broken by Atmospheric River storms.

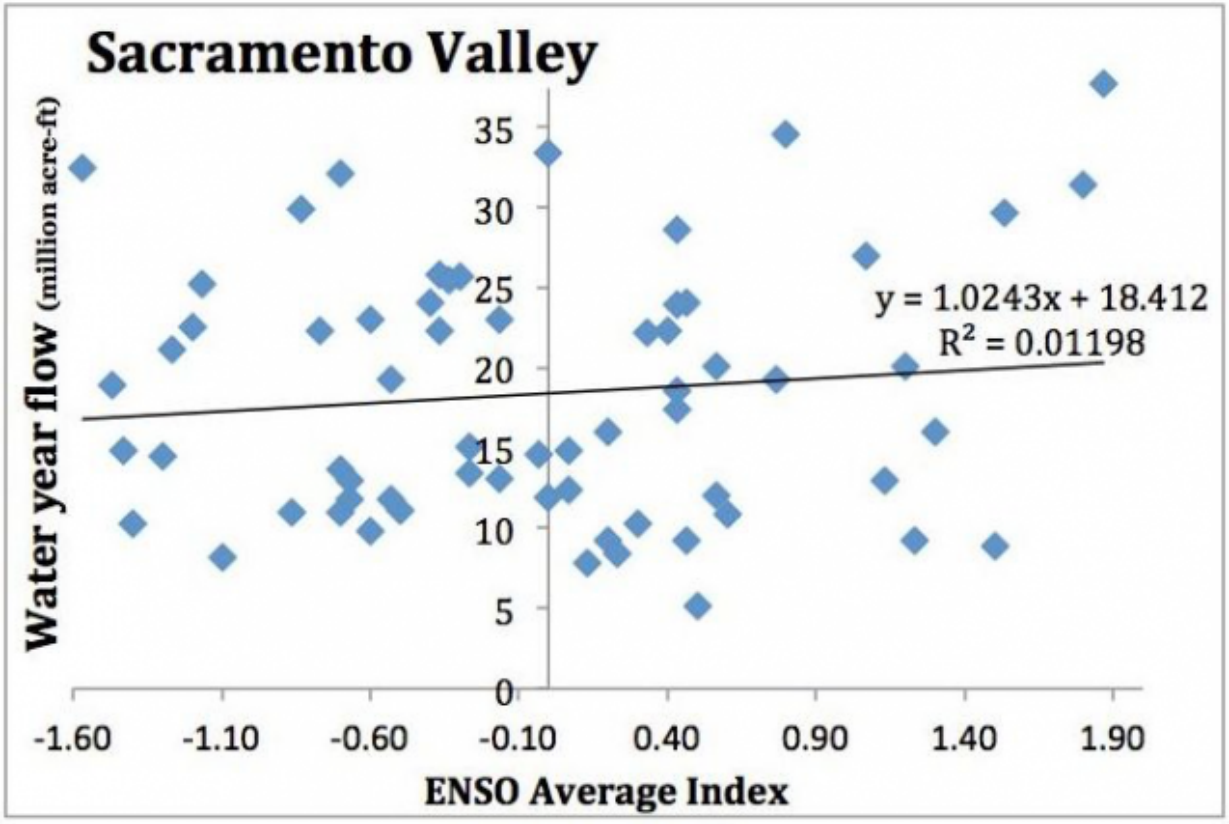
"Unfortunately," says Steinschneider, for California, often "the way to get out of one extreme is to get hit by another extreme."

All of which makes communicating climate to the public—the reality of droughts and floods, El Niños and ARkStorms—challenging.

"These kinds of mixed message things—actually mixed realities—are a problem everywhere," says Goddard. She points to the Philippines, where, she says, it tends to be very dry toward the end of the year.

"The forecast for this year has very confident probabilities that it will be dryer than average. But they just had a typhoon hit the northern island. So now you've got all these people who are displaced, and all this flooding, things like that, when people have been telling them for months that there's going to be a drought." But she adds, the Philippines is a large country, and drought happens over a wide area, which means that one storm—even a typhoon—isn't going to solve the drought.

Figure 1. ENSO conditions don't help predict annual streamflow for the Sacramento or San Joaquin river basins



ENSO index plotted here is the average of December-April for each water year. From the dots there appears to be little correlation between water year flow and the strength of El Nino. Credit: Jay Lund, California Water Blog

So what's going to happen in California this year? The answer is: It depends. "El Niño is the 800-pound gorilla monkeying with the climate system right now," says Goddard, "but it's not the only thing. So especially locally, especially outside of the immediate tropical Pacific, you have other influences that might be enhancing or against your expectations. Just knowing that there's an El Niño event is not the final answer."

Unfortunately, figuring out what exactly is going to play out in the climate is more complicated than it seems. On the other hand, that's also what makes it interesting, says Upmanu Lall, the director of the Columbia Water Center.

"A reason nature is so fascinating is because of the drama things like El Niño create in our everyday lives—floods, droughts, landslides, fires, transportation disruptions, that lead to pain and suffering—and they are appropriately mysterious," says Lall.

Lall would know: He has spent a good portion of his career as a hydrometeorologist looking for connections between climate patterns like El Niño and extreme events such as flooding.

"Just as we think we understand nature's vagaries and can predict and control them, a new twist emerges challenging accepted science, and breeding talk of uncertainty even for the most iconic aspects of the phenomena. In the aftermath, we say, we need to learn to live with such things. Perhaps as we anticipate this event, we can reflect on that and engineer longer term solutions in California to flood and drought, even as the excitement mounts."

More information: Michael D. Dettinger. Atmospheric Rivers as Drought Busters on the U.S. West Coast, *Journal of Hydrometeorology* (2013). DOI: 10.1175/JHM-D-13-02.1