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El Niño has become more intense over last 40 years than the previous 1,000 years

An El Niño of historic proportion is taking shape in the tropical Pacific. As a result, water temperatures off Santa Barbara climbed into the low 70s Fahrenheit in late August, and anglers have reported catching dorado and yellowtail around the Channel Islands.

While 2026 promises exceptional conditions, a new study in the journal Science found that El Niño events have become nearly 40% stronger in the last 40 years than they were in the pre-industrial era.

In fact, the authors — who examined modern and ancient corals in the Galápagos Islands — found that El Niño events in the last four decades were stronger than in any of the 1,000 years prior to about 1850, when humans began impacting the climate with greenhouse gases.

“Thanks to these new coral reconstructions, we can go farther back in the eastern Pacific's past than we ever could before,” said co-author Samantha Stevenson, an assistant professor at UC Santa Barbara’s Bren School of Environmental Science & Management. “When we do that, we see that El Niño has been getting stronger, and that the changes have really taken off in the past few hundred years.”

“We show that the strength of El Niño changes in parallel with the warming of global temperature,” added lead author Julia Cole, professor and chair of University of Michigan’s Department of Earth and Environmental Sciences. “Our findings tell us that the big El Niño events of the last 40 years are not normal in the context of the last thousand years.”

A natural cycle with large impacts

El Niño is a natural phenomenon that, every few years, causes the tropical Pacific to become warmer than usual. Under normal conditions, trade winds blow along the equator from east to west. This pushes warm water from South America toward Australia. But when the trade winds weaken, this warm water spreads eastward, back towards South America, kicking off an El Niño event.

The atmospheric circulation responds, in turn. Strong rainfall shifts from Indonesia into the central Pacific, leaving the western Pacific dry. This weakens the trade winds further, locking in El Niño conditions that can persist for one to two years. While these fluctuations in temperature and precipitation originate in the tropical Pacific, they affect weather all over the world.

These changes push the jet stream farther south in the western U.S. This steers atmospheric-river storms away from the Pacific Northwest toward California. “A big El Niño tends to mean wet winters for us in Southern California,” Stevenson said. Often, conditions reverse the following year under “La Niña”.

Similar shifts around the world lead to droughts and flooding that bring disease, crop failure, wildfires and other crises that impact people's health and well-being. “The question is not whether the current El Niño is going to happen, but how bad is it going to be, and how bad will the impacts be?” Cole said. “This event is superimposed on global warming, and it's likely to supercharge the temperature increase that we would normally see from greenhouse gases.”

Some forecasts suggest we might get as hot as 1.7º or 1.8º Celsius (3.1º or 3.2º F) above pre-industrial temperatures, “which is quite a bit higher than the current record,” Cole added.

A history written in coral

To examine historic El Niño patterns, the authors sampled cores from 13 corals — including living colonies and boulders of ancient coral — from the Galápagos Islands. Corals grow one to two centimeters per year by secreting layers of calcium carbonate. The chemistry of these layers provides a record of the seawater temperature in which the corals grew.

Since El Niño extremes occur every few years, the researchers focused on core samples that spanned at least 20 years. Sampling a millimeter at a time, the group measured two aspects of the coral skeleton's chemistry. They analyzed the ratio of the element strontium to calcium, which depends on seawater temperature. They supplemented these results by looking at the ratio of the different isotopes, or atom weights, of the element oxygen, also a proxy for the temperature of the site.

The team was left with a history of variations in temperature in the Galápagos — a location where El Niño has its largest impact, Cole explained. They saw that strong El Niños occurred in the last 40 to 50 years, whereas the El Niños prior to that time period showed “a pretty consistent pattern of lower intensity.”

“We kept adding records thinking ‘well, this is going to get more complicated,’ but it really didn't,” Cole said. “This is such a clear story.”

Confirming the connection

The researchers then examined whether other natural processes could have caused similar intensifications of El Niño over the past millennium. To do this, they used climate models that account for histories of volcanic eruptions and solar variability. The models found no reason to believe such large shifts in El Niño were caused by other natural processes.

“I’m concerned that none of the climate models picked up on the increase we observed in the coral record,” Stevenson said. “That probably means the models are missing something about how El Niño responds to climate change, and we need to know why that's happening.” Her group is currently investigating the subtle

differences between climate models in an effort to further improve predictions.

The findings underscore the need to seriously tackle global warming. “If this trend continues into the future, ‘super El Niños,’ like the one developing right now, might become much more common — with all the impacts that go along with them,” Stevenson said.

“Impacts like droughts, floods, wildfire and food insecurity,” Cole added. “Changes in the hydrologic cycle also lead to issues like damage to infrastructure: floods that wipe out homes, highways or railroads; or to health effects, such as diseases like cholera.

“We believe global warming is supercharging El Niño,” Cole continued. “And if that's true, then we expect stronger climate extremes that will amplify ecological, infrastructural and human losses. No country has the resources to be fully protected from these impacts. This is one more reason we need to move away from fossil fuels, the root cause of the problem.”

The findings were supported by the U.S. National Science Foundation and the United Kingdom Natural Environmental Research Council. The Galápagos National Park and the Charles Darwin Research Station in Galápagos also provided support for the research.

The study’s co-authors include U-M researchers Kelsey Dyez, Cameron Tripp, Jonathan Overpeck and alumnus Jake Okun; University of Arizona researchers Diane Thompson and Marcus Lofverstrom; University of Edinburgh researcher Sandy Tudhope; Colorado College researcher Allison Lawman; University of Illinois researcher Jessica Conroy; Gloria Jimenez of Moody's Risk Management Services; and University of Minnesota researcher R. Lawrence Edwards.

This story was adapted for The Current from a release by Morgan Sherburne at the University of Michigan.

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