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Scientist works to puzzle out how tropical rainfall will change with a warming planet

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For scientist Shang-Ping Xie, there is a good reason to research how climate change will alter weather patterns in the tropics, even if, to most of us, tropical regions seem remote.

"What happens in the tropics," Xie -- a professor at the Scripps Institution of Oceanography at the University of California, San Diego, and the International Pacific Research Center at the University of Hawaii, Manoa -- noted in a recent interview, "is highly influential on midlatitude climate."

Much of North America sits in those middle latitudes. Rainfall and temperatures here, Xie pointed out, can be greatly influenced by tropical climate phenomena like El Niño and La Niña. So it's in our interest to understand what the tropics are up to.

But beyond what happens in Americans' backyards, there are many other reasons for caring about tropical climate and weather patterns.

Most of the world's population lives in the tropics. And much of the farming that goes on in tropical regions relies heavily on seasonal rainfall -- monsoons -- which may shift or change as the climate changes.

Xie is among many scientists working to understand how climate change will affect that rainfall. In a paper published Sunday in *Nature Geoscience*, he and his colleagues proposed a way to reconcile two different views of how tropical rainfall will change as the climate changes.

The first, known as the "rich get richer" or "wet get wetter" hypothesis, posits that tropical areas that already get a lot of rain will get even more as the world warms, and dry subtropical areas will get less.

According to David Neelin, a researcher at UCLA, the basic idea behind this view is that warmer atmospheres hold more moisture. This is likely to enhance the patterns that already exist for rainfall.

"There is a tendency for the rain in rainfall events to increase," Neelin said.

Interplay of two theories

The second hypothesis is called "warmer get wetter."

As Xie explains it, the focus in this view is that ocean temperatures are going to increase, but not in a uniform way, as the climate changes. The places where the ocean's surface gets warmer will, as in the other scenario, have more moisture and thus get more rainfall.

But where this ocean warming is going to happen is unknown at this point, Xie said, and is another focus of his research.

In the paper, Xie and his colleagues show how both the "wet get wetter and "warmer get wetter" hypotheses can work as explanations for what will happen to tropical rainfall in a warming world.

When the researcher ran models looking at what would happen to rainfall in the tropics, the wet areas did get wetter, but primarily in the monsoon times of year. So the wet areas got wetter during their rainy seasons.

UCLA's Neelin said this agreed with what he would expect to see happen under a wet get wetter scenario.

Xie also found that areas where the oceans warmed got wetter, but in their annual rainfall: the amount of rain that fell over the course of the entire year.

Massimo Bollasina, a postdoctoral research associate at the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory who also works on tropical rainfall and climate change, called Xie's paper a "very reasonable analysis" of how the two hypotheses interplay.

Picture for small regions remains 'messy'

Understanding what will happen to monsoon rains, particularly in places like India, where agriculture depends on them, is "extremely important," Bollasina said.

Bollasina was careful to point out, as were Xie and Neelin, that although these hypotheses might play out on the large scale, making them useful for climate models, regionally there are many other factors that will affect tropical rainfall as the climate changes.

"The whole rich get richer mechanism is a good explanation at somewhat larger scales, like when you are talking about an average over a whole convection zone, a whole monsoon area or a fairly large region," Neelin said.

Small countries or states, though, might see different outcomes, especially if they are on the edge of wet or dry.

"We are really doing the broadest brush at this point," Xie said.

"In climate, if you average over a larger area, you can reduce uncertainties, so that's a trick we employed. Because if you come to a small region like New Mexico or Arizona [both places with seasonal monsoons], a lot of other things are going to come into play. Things become messy, and we don't want them to be messy at this point," he said.

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