Reliable tropical weather pattern to change in a warming climate

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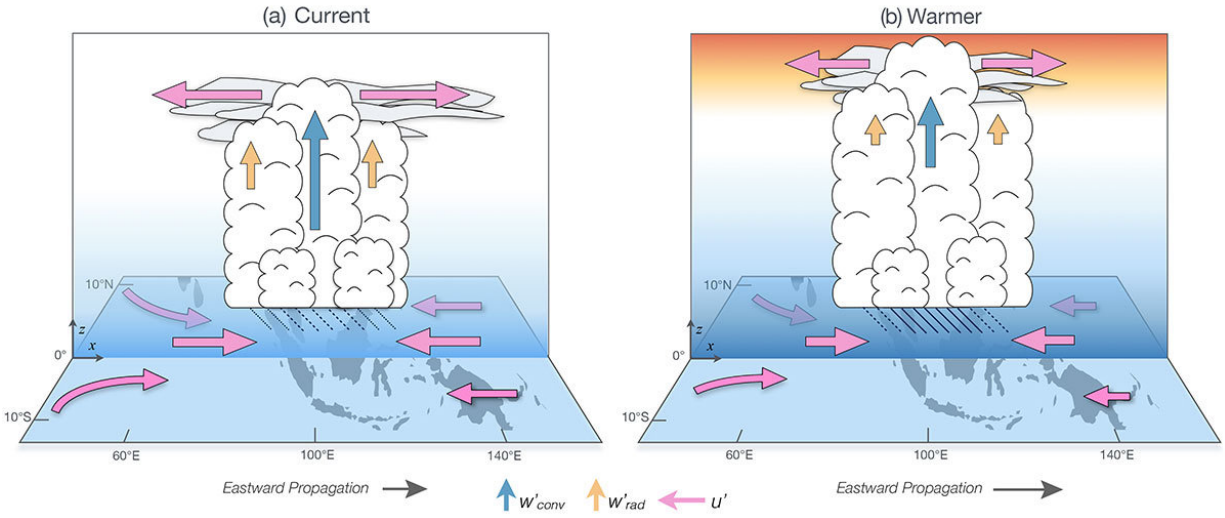

Current climate is represented in (a), and a warmer climate in (b). As the climate warms, the mean vertical gradient in water vapor (blue) increases. Tropospheric temperature (orange shading) will also increase more than the lower atmosphere. Credit: Eric Maloney/Colorado State University

Every month or two, a massive pulse of clouds, rainfall and wind moves eastward around the Earth near the equator, providing the tropics their famous thunderstorms.

This band of recurring weather, first described by scientists in 1971, is called the Madden-Julian Oscillation. It has profound effects on weather

in distant places, including the United States. Atmospheric scientists have long studied how the Madden-Julian Oscillation modulates extreme weather events across the globe, from hurricanes to floods to droughts.

As human activities cause the Earth's temperature to increase, reliable, well-studied weather patterns like the Madden-Julian Oscillation will change too, say researchers at Colorado State University.

Eric Maloney, professor in the Department of Atmospheric Science, has led a new study published in *Nature Climate Change* that attributes future changes in the behavior of the Madden-Julian Oscillation to anthropogenic global warming. Maloney and co-authors used data from six existing climate models to synthesize current views of such changes projected for the years 2080-2100.

Separating precipitation, wind

Their analysis reveals that while the Madden-Julian Oscillation's precipitation variations are likely to increase in intensity under a warmer climate, wind variations are likely to increase at a slower rate, or even decrease. That's in contrast to the conventional wisdom of a warming climate producing a more intense Madden-Julian Oscillation, and thus an across-the-board increase in extreme weather.

"In just looking at precipitation changes, the Madden-Julian Oscillation is supposed to increase in strength in a future climate," Maloney said. "But one of the interesting things from our study is that we don't think this can be generalized to wind as well."

Atmospheric science relies on weather patterns like the Madden-Julian Oscillation to inform weather prediction in other areas of Earth. For example, atmospheric rivers, which are plumes of high atmospheric water vapor that can cause severe flooding on the U.S. west coast, are

strongly modulated by certain phases of the Madden-Julian Oscillation.

According to Maloney's work, the Madden-Julian Oscillation's impact on remote areas may gradually decrease. Degradation in the oscillation's wind signal may thus diminish meteorologists' ability to predict extreme weather events. In particular, preferential warming of the upper troposphere in a future, warmer climate is expected to reduce the strength of the Madden-Julian Oscillation circulation.

Next steps

Maloney and colleagues hope to continue studying the Madden-Julian Oscillation using a broader set of climate models to be used in the next Intergovernmental Panel on Climate Change assessment.

Co-authors of the *Nature Climate Change* study are Ángel Adames of the University of Michigan and Hien Bui, a CSU atmospheric science postdoctoral researcher.

More information: Eric D. Maloney et al, Madden–Julian oscillation changes under anthropogenic warming, *Nature Climate Change* (2018). DOI: 10.1038/s41558-018-0331-6

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