Warming Oceans Linked to Global Rise of Cyclone Intensity

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Climate researchers at Purdue University have concluded in a new study that rising sea-surface temperatures over the past 40 years are linked to a trend of more globally intense tropical cyclone activity.

"If you add up every puff of wind associated with tropical cyclones annually, that number has increased substantially, which means that either storms are getting stronger or there are more of them," said Matthew Huber, an assistant professor of earth and atmospheric sciences. "This is an important result because our measure of tropical cyclone activity has doubled with only a quarter degree of tropical ocean warming, and a two-degree increase from global warming is expected over the next century."

The research provides evidence supporting the hypothesis that rising temperatures of tropical waters on the surface and just below the surface are causing more intense cyclones and hurricanes, the term used for tropical cyclones that form over the Atlantic Ocean.

The findings will be detailed in a paper to appear in an upcoming issue of the journal Geophysical Research Letters. The paper was written by doctoral student Ryan Sriver and Huber.

The research represents an independent confirmation of findings reported in 2005 by Kerry Emanuel, a professor in the Department of Earth, Atmospheric and Planetary Sciences at the Massachusetts Institute of Technology.

"We used a different technique and different data than Dr. Emanuel, who looked specifically at the Atlantic and western Pacific oceans, whereas we looked at the entire world," Huber said. "Nevertheless, we got the same results that he did, the same basic trends."

The Purdue researchers used wind and temperature data generated by computational models in the European Centre for Medium-Range Weather Forecasting Reanalysis 40 Year Project, which encompasses climate data and trends over a 40-year period beginning in 1958. As part of the European project, scientists used forecasting models to retrospectively "reanalyze" past weather events that were already known. From the reanalysis data, Huber and Sriver calculated the "globally integrated tropical cyclone power dissipation," which incorporates the total wind associated with tropical cyclones worldwide, representing the potential damage that could be caused by storms.

The power dissipation is a storm's overall surface wind velocity multiplied to the third power, or cubed.

"Cubing the surface wind velocity tells us approximately how much damage would be caused by the winds produced by cyclones," Huber said. "The thing to keep in mind is that the quantities that we are calculating are actually over the ocean and just on the margins of land masses, so we are not actually calculating the dollar amount of damage. We are estimating a quantity that has been related to damage by other researchers.

"This is the first time that anyone has made this particular calculation."

Emanuel had previously calculated an approximate "power dissipation index" to evaluate trends in tropical cyclone activity.

"This involves taking the maximum wind velocity produced by a tropical

cyclone and adding up the number of times that velocity happened in a storm track," Huber said. "However, we said that approximating the overall behavior of tropical cyclone winds using just the storm's maximum velocity might not be valid. What if the overall amount of storm activity is not related to the maximum velocity, but the velocity everywhere within the storm track — as if you included every puff of wind during the entire storm? So we calculated the storm's overall velocity and cubed that number to arrive at the power dissipation, added that up for every storm and then analyzed trends in a normalized version of the time series."

The Purdue results matched Emanuel's findings most closely after 1979, which is when the introduction of satellites improved the European reanalysis data.

"This is important work because it provides scientific evidence that models may be helpful in understanding the future state of hurricanes in a warming world," said Peter J. Webster, a professor at Georgia Institute of Technology's School of Earth and Atmospheric Sciences and School of Civil and Environmental Engineering. Webster was one of the scientists who reviewed the paper, and he has led research indicating the number of Category 4 and 5 hurricanes worldwide has nearly doubled over the past 35 years, findings that were detailed in a paper published last year in the journal Science.

The recent Purdue findings could provide a tool for officials and scientists seeking insights into the possible consequences of future cyclone activities.

Source: Purdue University

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