
Hurricanes & Climate Change

Hurricanes Stronger Due to Warming

Key hurricane ingredient: Warm water

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Hurricanes are storms that form near the equator and gain wind speeds of at least 74 miles per hour. They get their power from warm ocean water. For a hurricane to occur, the surface of the ocean must be at least 80 degrees Fahrenheit. This is why the U.S. hurricane season is from June to November, when ocean waters in the North Atlantic are warmest.

As global warming continues, thanks to a buildup of pollution in the atmosphere, scientists project that the oceans will continue to get warmer. Increasingly warmer oceans paint a sobering outlook for future hurricane seasons.

Warmer oceans have long led scientists to predict that hurricanes would become more intense. The questions that remained were: "When will we see stronger storms?" and "How much stronger will they be?" A torrent of scientific papers published over the last two years provide strong evidence that the answers are "already" and "a lot."

NOAA's 2007 Forecast of Atlantic Tropical Storms

| | |
|-------------------------|-------|
| Tropical Storms | 13-17 |
| All Hurricanes | 7-10 |
| Major Hurricanes | 3-5 |

More details available at the National Weather Service's [web site](#).

Definitive international report highlights the link

On February 2, 2007, the international group of experts tasked with evaluating climate science — the Intergovernmental Panel on Climate Change (IPCC) — released their summary of the latest findings on global warming. Their report, which summarizes the science uncovered from about 2001 through the end of 2005, concludes that "numerous long-term changes in climate have been observed. These include changes in...the intensity of tropical cyclones." The report also finds that in the North Atlantic fiercer hurricanes are "correlated with increases of tropical sea surface temperatures." (More about [how the IPCC reaches conclusions](#).)

In other words, global warming is already causing storms in general and hurricanes in particular to intensify, and the evidence of the link is strongest in the Atlantic.

Hurricanes have been getting stronger since the 1970s

It was in 2005 that the first study connected the dots between hurricane and climate change. Kerry Emanuel, of the Massachusetts Institute of Technology (and elected to the U.S. National Academy of Sciences in 2007), published research showing hurricane intensity has doubled over the past 30 years and is linked to rising sea surface temperatures (caused by global warming). Since then, no fewer than 16 studies on hurricanes and global warming have surfaced, most strongly supporting the link. (See [research summaries](#).)

Following on Emanuel's paper, Peter Webster, Judy Curry and colleagues at the Georgia Institute of Technology found that the number of Category 4 and 5 hurricanes around the world has doubled over the past 35 years. Category 4 storms can produce 250 times more damage than Category 1 storms — a staggering increase that ramps up the number of homes and people at risk.

The Georgia Tech scientists, led by Carlos Hoyos, also looked into the different environmental factors that make up a storm's brew to see which were associated with increased storm intensity. From the broad set of data they looked at, including the four main environmental factors involved in hurricane formation (sea surface temperature,

humidity, wind shear and the winds' tendency to be cyclonic), only sea surface temperatures could explain the long-term, global changes in hurricane intensity. (See Webster et al. and Hoyos et al in our [research summaries](#).)

Ironically, skeptics' research also supports the link

A couple of papers claim to provide evidence against a hurricane-global warming link. However, a close review of these papers reveals that in many cases they actually bolster the tie. Colorado State University's Philip Klotzbach found that the number of Category 4 and 5 hurricanes has increased. Patrick Michaels and his colleagues at the University of Virginia found that there may be a tipping point of 83 degrees Fahrenheit for hurricanes to jump to a Category 3 or higher, adding more grist to the link. (See Klotzbach and Michaels for more detail in our [research summaries](#).) Thus, even skeptical research shows that global warming may very well be adding to the fury of hurricanes.

Responding to the "Poor Data" Criticism

A major criticism of the analyses by Emanuel and the Georgia Tech scientists, raised by a group led by Christopher Landsea of the National Hurricane Center, is that pre-1990 hurricane data are not sufficiently accurate to determine historical trends in hurricane intensity. The issue of data quality is important and the scientific community is trying to address this through a re-analysis of old hurricane data. But two recent studies suggest that the link between hurricane intensity and global warming is robust.

In 2006 Ryan Sriver and Matthew Huber of Purdue University published a paper that looked at global hurricane strength using an entirely different hurricane dataset than the one used in earlier studies. Their independent analysis also indicated that storms are getting stronger, not just in the Atlantic but all over the world.

But perhaps the most compelling evidence comes from a 2006 study by Kevin Trenberth and Dennis Shea from the National Center for Atmospheric Research. Rather than focus on historical hurricane data, they looked at the factors that caused 2005's brutal Atlantic hurricane season. Their conclusion: global warming was a significant contributing factor. (Read more about [2005's hurricanes](#).)

Discussion continues as evidence mounts

As with most climate science, the research on hurricanes and its link to global warming continues. But the general conclusion of the research thus far seems clear: hurricane intensity is on the rise as a result of increasing global temperatures.

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