

Beyond Irene: Future Hurricanes Will Get Worse

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NEW YORK — Hurricane Irene battered the East Coast this weekend, blasting buildings and trees that hadn't felt such strong winds in decades, and flooding subways, tunnels and entire coastal neighborhoods.

Thankfully, Irene diminished in strength before making landfall on the Mid-Atlantic Coast and New England; though she is estimated to have caused [\\$7 billion in damages](#), things could have been a lot worse. And atmospheric scientists say they will be.

They warn that hurricanes will get more destructive in the future. And as oceans warm, more and more of the strongest storms will creep north.

Warm seas

About 90 tropical cyclones form worldwide each year; that pace hasn't changed recently. Rather than causing more hurricanes and typhoons to develop, the 0.5-degree Celsius rise in tropical sea surface temperatures that has occurred over the past 30 years seems to have another effect. As Colorado State atmospheric scientist James Elsner ominously put it: "The strongest storms are getting stronger."

Hurricanes are like heat engines, Elsner explained. When the ocean puts more heat in, more energy comes out in the form of faster winds that blow for longer. As detailed in a 2008 paper in *Nature* (and in later studies analyzing subsequent hurricane seasons), he and his colleagues have noticed a [steady upward trend](#) in the maximum wind speed of the strongest hurricanes. For the top fifth most intense hurricanes, wind speeds have increased by 4.5 miles per hour per degree-Celsius rise in the ocean temperature. For storms in the top 10th of the intensity ranking, wind speeds have increased by 14.5 mph per degree Celsius.

That's a jump of almost an entire [category on the Saffir-Simpson Hurricane Scale](#) that rates hurricane intensity. [[Are Category 6 Hurricanes Coming Soon?](#)]

Only the strongest tropical storms seem to be affected by rising ocean temperatures; Elsner says this is because they alone experience a "thermodynamic perfect environment" — open waters with no wind shear coming from land. "Most storms are struggling as they pass near the coast. Only strong storms in this favorable thermodynamic environment are able to intensify with the warm ocean," he told [Life's Little Mysteries](#).

Theoretical models for how ocean temperatures should affect hurricane intensity square with Elsner's real-world data. Kerry Emanuel, a professor of meteorology at MIT and an expert on hurricane intensification, has developed a model called the "maximum potential intensity theory," which predicts that the strongest storms will get stronger as seas warm.

The effect seems especially apparent in the North Atlantic, where cooler waters used to knock the wind out of hurricanes as they moved north, but no longer do.

Emanuel first presented his model in a 2005 article in *Nature*. "The correlations between Atlantic hurricane power and sea surface temperature have actually improved [since then]," he wrote in an email. This strengthens the predictions laid out in his theory. He regularly updates [maps displaying the maximum cyclone intensity](#) throughout the world's oceans.

Controversy

Not everyone is convinced that the growing intensity of hurricanes results from global warming.

Tony Barnston, the lead forecaster at the International Research Institute for Climate and Society, said there are more factors than just ocean temperature involved in making storms stronger.

"So far, the ocean temperatures have not increased by a sufficient amount to make an obviously higher observed hurricane activity level," he told us. A climate cycle called the Atlantic Multi-decadal Oscillation may explain the seeming surge in hurricane activity over the past 15 to 20 years, he said. Ultimately, more study — or time — is needed before the impact of higher ocean temperatures will become apparent.

David Easterling, chief of the Global Climate Applications Division at the National Oceanic and Atmospheric Administration, thinks that both man-made climate change and natural climate cycles are playing roles.

"Certainly, ocean temperatures in the tropical regions have an impact. But the effect of climate change might be superimposed onto the Atlantic Multi-decadal Oscillations. Hurricanes are very complicated storms that are impacted by a lot of different things," he said. [[Tornadoes, Floods, Hurricanes: Is All the Wild Weather Connected?](#)]

Either way, the scientists we contacted all agree: Global warming *will* make hurricanes more destructive.

Surf's up

"Sea level rise *is* generally accepted," Barnston wrote in an email. The physical explanation is straightforward: Warmer air is melting the glaciers, so there's more water. Observations have shown that [the ocean is rising](#) by 0.12 inches per year, and rising at a faster rate all the time.

One model by Vivien Gornitz of NASA's Goddard Institute for Space Studies and colleagues predicts that the sea level around New York City could jump 15 to 19 inches by 2050 and by more than 3 feet by 2080. When it comes to hurricane impacts, Barnston said the consequence of a higher sea level is also straightforward.

"With a higher 'normal' sea level, the sea level during a hurricane would cause more severe flooding, since the normal sea level would already be higher than it was in the past," Barnston wrote. Hurricanes can cause enormous storm surges, pushing 30-foot-tall walls of water in front of them.

"If the tides are higher on the coasts, then your mitigation efforts, such as seawalls, will not be designed for the storms of tomorrow," Elsner said.

Coping mechanisms

The researchers also agreed that Atlantic and Gulf Coast cities need to improve their hurricane plans, regardless of the fact that storms may get worse.

Barnston thinks coastal cities should discourage development along low-lying areas. "The worst need is not to build new homes or businesses at very low elevations anymore, such as anything below 6 feet elevation above current sea level," he wrote.

Hurricanes have always been extremely dangerous, and people have always tended to underprepare for them, Easterling said. "Hurricanes are not something you want to mess around with. Standards and that sort of thing need to be updated, and need to be looked at regularly, especially in developments and infrastructure along the coast. People need to review their hurricane plans, and cities need to have evacuation routes set up."

He, too, believes people need to stop building in low-lying coastal areas. "But of course, there are always people willing to take that risk."

After all, a house by the sea is the most peaceful place in the world — most of the time.

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