Is Katrina a Harbinger of Still More Powerful Hurricanes?

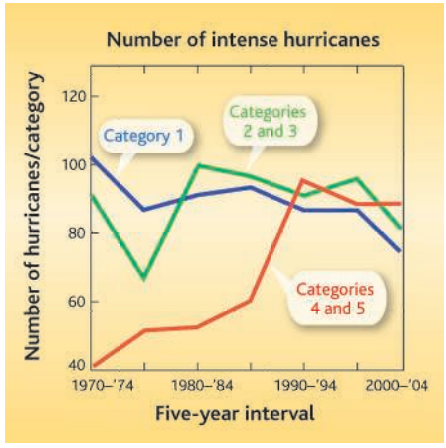
Mounting evidence suggests that tropical cyclones around the world are intensifying, perhaps driven by greenhouse warming, but humans still have themselves to blame for rising damage

Were New Orleans and coastal Mississippi victims of global warming? Greenhouse alarmists and the tabloids say yes, but until recently, most scientists would have answered no way. There was no evidence that global warming has had any effect on the planet's most powerful storms—dubbed hurricanes, typhoons, or cyclones depending on the ocean that spawns them.

Now, however, a connection is emerging between warming oceans and severe tropical cyclones. On page 1844, meteorologists report a striking 80% increase worldwide in the abundance of the most powerful tropical cyclones during the past 35 years. The study lends support to another, independent study published just last month that found a similar intensification in the Atlantic and western North Pacific. At the same time, the tropical oceans have been warming, driven, most researchers agree, by rising greenhouse gases. "There's a strong suggestion of a link" between the growing greenhouse and intensifying tropical cyclones, says meteorologist Kerry Emanuel of the Massachusetts Institute of Technology, sole author of the earlier paper.

But you still can't blame Katrina's damage on global warming, says Emanuel. There have been too few powerful storms striking densely populated coasts to declare with any confidence that intensifying storms are increasing the damage. And vulnerable coastal populations have swollen so much in recent decades that the increase in damage due to demographics is swamping any sign of increased damage due to storm intensification. But just wait until the second half of the century, he says.

Global warming and tropical cyclones are naturally linked by the storms' appetite for heat. Tropical storms are heat engines that draw their energy upward from warm ocean water to drive their winds before expelling waste heat to the upper atmosphere. So warming the tropical oceans—in effect throwing more wood on the fire—might be expected to spawn more frequent or more intense tropical cyclones. To find out whether warming has done that, meteorologist Peter Webster of the Georgia Institute of Technology in Atlanta and his colleagues examined satellite records of storms around the tropics, a history now 35 years long. The temperature contrast between a storm's eye and the adjacent cloud tops provides a gauge of maximum wind speed, as calibrated in the Atlantic and western North Pacific against direct measurements of wind speeds by storm-penetrating aircraft.



Bad trend rising. The number of the most intense tropical cyclones is increasing worldwide.

Webster and colleagues seem to have been one for two in their search for warming effects. They found no long-term trend in the number of storms per year, only natural ups and downs, even as summer tropical sea surface temperatures rose 0.5°C. In the North Atlantic, where hurricane numbers have surged since 1995, such variability arises from changes in the strength of warm ocean currents (*Science*, 1 July, p. 41). But the researchers did find a sharp increase during the past 35 years in the number of category 4 and 5 tropical cyclones, the most intense storms that cause most of the damage on landfall. Globally, category 4 and 5 storms climbed 57% from the first half of the period to the second.

That growing proportion of tropical cyclones in categories 4 and 5 "is very consistent with my results," says Emanuel. As he reported in the 4 August issue of *Nature*, he calculated the total power released during the life of Atlantic and western North Pacific storms (the Pacific spawns about five times as many storms as the Atlantic does) based on reported maximum sustained winds. Because of stronger winds and longer storms, this power dissipation index rose between 40% and 50% from the first half of the 45-year record to the second, in step with rising ocean temperatures. With two studies finding that the same trends correlate with sea surface temperatures in a half-dozen ocean basins, "it's fairly well established that the measure of hurricane intensity has been increasing," says Emanuel.

Perhaps predictably, that hasn't stopped other researchers from giving the two papers a guarded initial reception. Meteorologist Kevin Trenberth of the National Center for Atmospheric Research in Boulder, Colorado, notes inevitable reservations about such indirectly measured records. And modeler Thomas Knutson of the Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey, says, "We would not have expected the signal [of storm intensification] to be detectable at the present time," based on theory and his modeling of storms under a growing greenhouse. That, he says, prompts the question, "Are these trends real?"

In any case, no one, including Webster and Emanuel, is claiming that these two positive results suffice to link global warming firmly to tropical cyclone intensification. Webster, for one, would first want to understand exactly how warming waters could trigger such a large response.

Even if global warming is driving a real intensification of tropical cyclones, notes climatologist Roger Pielke Jr. of the University of Colorado, Boulder, it shouldn't change anyone's plans. It's easy to see a rising trend in U.S. hurricane damage as people flock to the coasts, he says, and even the effects of the natural North Atlantic oscillation and of El Niño on hurricanes are recognizable in storm damage. But there's no sign of an effect of storm intensification. That's down in the noise and will be for many decades, he says.

A beach house owner on the southeast U.S. coast has plenty to worry about from current storm hazards, Emanuel agrees. But anyone operating globally on a half-century time scale or longer, such as some insurance companies, should expect to see big changes later this century, he says. Then global warming can start taking the blame. **–Richard A. Kerr**

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