

# Hurricanes to intensify as Earth warms

June 16 2005

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Warmer oceans, more moisture in the atmosphere, and other factors suggest that human-induced climate change will increase hurricane intensity and rainfall, according to climate expert Kevin Trenberth of the National Center for Atmospheric Research. His paper, "Uncertainty in Hurricanes and Global Warming," appears in the Perspectives section of the June 17 issue of *Science*.

"Trends in human-influenced environmental changes are now evident in hurricane regions," says Trenberth. "These changes are expected to affect hurricane intensity and rainfall, but the effect on hurricane numbers remains unclear. The key scientific question is how hurricanes are changing."

Trenberth's paper follows extensive tropical activity last year, including a record number of hurricane landfalls affecting Florida and typhoons striking Japan. These landfalls were related to persistent large-scale circulation features that steered these systems toward land, Trenberth says. It is unclear how global warming will affect these circulation patterns, he adds.

The strongest links between hurricane intensity and climate change, according to Trenberth, are a long-term rise in ocean temperatures and an increase in atmospheric water vapor. Both processes are already under way and expected to continue, he says. The additional water vapor will tend to produce heavier rains within hurricanes and an increased risk of flooding at landfall, Trenberth notes.

Most hurricanes that strike the U.S. coastline are born in the tropical North Atlantic, where sea-surface temperatures over the last decade have been the warmest on record. Water vapor over oceans worldwide has increased by about 2% since 1988. The warmer sea surface and moister atmosphere furnish potential energy for the showers and thunderstorms that fuel hurricanes.

"Computer models also suggest a shift in hurricane intensities toward extreme hurricanes," says Trenberth.

Much more uncertain is the effect of human-induced climate change on hurricane numbers and landfalls. Models disagree on how global warming might affect the wind shear that can either support or discourage hurricane formation.

Globally, the number of hurricanes and typhoons tends to hold relatively steady from year to year. When activity increases in the Atlantic, it often decreases in the Pacific, and vice versa, based in part on El Niño and La Niña.

Trenberth points out that, because hurricane numbers vary so greatly on a regional level from year to year and decade to decade, it is difficult to use statistical techniques to extract longer-term trends in the number of hurricanes that form and where they move.

"There is no sound theoretical basis for drawing any conclusions about how anthropogenic climate change affects hurricane numbers or tracks, and thus how many hit land," Trenberth says.

Source: National Center for Atmospheric Research/University Corporation for Atmospheric Research

Citation: Hurricanes to intensify as Earth warms (2005, June 16) retrieved 30 June 2024 from <https://phys.org/news/2005-06-hurricanes-earth.html>

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