Warmer seas linked to strengthening hurricanes

September 3 2008

The theory that global warming may be contributing to stronger hurricanes in the Atlantic over the past 30 years is bolstered by a new study led by a Florida State University researcher. The study will be published in the Sept. 4 edition of the journal *Nature*.

Using global satellite data, FSU geography Professor James B. Elsner, University of Wisconsin-Madison Professor James P. Kossin and FSU postdoctoral researcher Thomas H. Jagger found that the strongest tropical cyclones are, in fact, getting stronger -- and that ocean temperatures play a role in driving this trend. This is consistent with the "heat-engine" theory of cyclone intensity.

"As seas warm, the ocean has more energy that can be converted to tropical cyclone wind," Elsner said. "Our results do not prove the heat-engine theory. We just show that the data are quite consistent with it."

Kerry Emanuel of the Massachusetts Institute of Technology first suggested the possible connection between global warming and increases in tropical cyclone intensity in a 2005 paper. He linked the increased intensity of storms to the heating of the oceans, which has been attributed to global warming.

Critics argued that the data were not reliable enough to make assertions about the relationship between climate change and hurricanes. Moreover, when scientists looked at the mean tropical cyclone statistics, they did not see an upward trend.

Elsner's team addressed both issues by using globally consistent, satellite-derived tropical cyclone wind speeds as opposed to the observational record and by focusing on the highest wind speeds of the strongest tropical cyclones each year.

Emanuel's theory is that the intake of warm air near the ocean surface and the exhaust of colder air above the cyclone is what drives a hurricane. Other factors being equal, the warmer the ocean, the warmer the intake of air. This heat-engine theory of how hurricanes increase their intensity is well accepted, but there are many environmental factors, such as wind shear, that might prevent a hurricane from strengthening, Elsner said.

To address that problem, Elsner's team looked at a subset of hurricanes that are closest to their maximum possible intensity (MPI). Under the heat-engine theory, every storm will lose some energy through inefficiency, and that loss will limit the storm's potential. The MPI represents the storm's maximum potential under ideal environmental

conditions.

"We speculated that you might not see a trend in the intensity of typical hurricanes due to environmental factors, but if the heat-engine theory is correct, you should see a trend in the intensity of hurricanes at or near their MPI," Elsner said. "On average, the strongest storms are closest to their MPI."

The researchers created a data set from satellite observations of hurricane intensity of all tropical cyclones around the globe and looked at the maximum wind speeds for each one during a 25-year period. Tropical cyclones, which include hurricanes, typhoons and tropical storms, occur on average about 90 times per year worldwide.

The researchers found that the strongest tropical cyclones are getting stronger, particularly over the North Atlantic and Indian oceans. Wind speeds for the strongest tropical storms increased from an average of 140 mph in 1981 to 156 mph in 2006, while the ocean temperature, averaged globally over the all regions where tropical cyclones form, increased from 28.2 degrees Celsius to 28.5 degrees Celsius during this period.

"By creating a better, more consistent historical data set, we've been able to weed out quality issues that introduce a lot of uncertainty," Kossin said. "Then, by looking only at the strongest tropical cyclones, where the relationship between storms and climate is most pronounced, we are able to observe the increasing trends in storm intensity that both the theory and models say should be there."

While Elsner said the heat-engine theory might explain how tropical cyclones intensify given that everything else is the same, he noted, "We still do not have a complete understanding of why some cyclones intensify, sometimes quite rapidly, and others don't."

Source: Florida State University