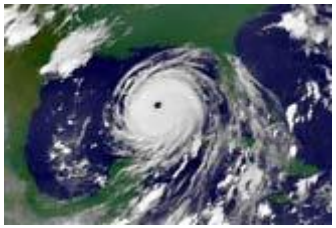

Hurricanes to Unleash Dormant, Hidden Power

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Kerry Emanuel sparked a debate among his colleagues last year when he published a paper that linked global warming to the trend of increasingly stronger Atlantic Ocean hurricanes observed in recent decades.

In a study to be published soon, the Massachusetts Institute of Technology climatologist will make another bold claim: The cycling of hurricane activity from high to low, which some scientists have attributed to a natural cycle in global weather patterns, is in fact caused by the rise and fall of pollution released by humans.

Furthermore, Emanuel, along with Michael Mann of Pennsylvania State University, contend that the microscopic aerosol particles, which reflect sunlight and cool the atmosphere, have been masking the effect of global warming on Atlantic Ocean hurricanes for several decades. The researchers say that it is only in recent decades, as aerosol emissions from North America and Europe have declined due to clean air standards, that the full impact of greenhouse gas emissions on hurricane strength has been realized.

Meanwhile, other new research by Purdue University scientists supports Emanuel's original finding and extends it to the entire globe.

Together, the two new studies suggest that hurricanes, known as cyclones elsewhere, are getting stronger all over the planet and that humans play a role in the change.

Stronger cyclones worldwide

Research done by Matthew Huber and Ryan Sriver at Purdue University in Indiana independently verifies and expands upon Emanuel's 2005 study, which showed that hurricanes in the Atlantic and Pacific Oceans had increased in duration and intensity by about 50 percent since the 1970s. Emanuel linked the trend to rising sea surface temperatures, or SSTs, caused in part by global warming.

"We used a different technique and different data than Dr. Emanuel, who looked specifically at the Atlantic and western Pacific oceans, whereas we looked at the entire world," Huber said. "Nevertheless, we got the same results that he did, the same basic trends."

The researchers used surface wind and temperature records from the European Centre for Medium-Range Weather Forecasts 40 Year Reanalysis Project to estimate the total wind output of tropical cyclones worldwide from 1958 to 2001. Called the "globally integrated tropical cyclone power dissipation," this value represents the potential damage that a storm can cause.

The Purdue study marks the first time this value has been calculated on a global scale. It found that tropical cyclone activity has doubled over the past 40 years with only a quarter degree Celsius of tropical ocean warming. This is cause for concern, the researchers say, because scientists expect a two-degree warming over the course of the next century.

"The signal that we looked at is a measure of not only the intensity but also the duration of the storm," Sriver told LiveScience. "What we've seen is

an increase in strength and duration but not necessarily in the number of storms."

Huber and Sriver's study will be published in an upcoming issue of the journal *Geophysical Research Letters*.

Polluting the issue

Although Huber and Sriver's study did not examine whether the increase in cyclone activity was due to human-caused global warming, a number of recent studies suggest that this is the case.

One study, performed last year by researchers at Georgia Tech and the National Center for Atmospheric Research (NCAR), linked a global rise in SSTs over the past 35 years to a near doubling in the number of intense Category 4 or 5 hurricanes seen worldwide, from 10 a year in 1970 to about 18 a year since 1990.

A follow-up study by Carlos Hoyos and colleagues at Georgia Tech concluded that this trend was due primarily to rising SSTs, ruling out other factors such as humidity in the lower atmosphere and wind shear.

The new study by Mann and Emanuel, which will be published in an upcoming issue of *EOS Transactions*, a publication of the American Geophysical Union, disputes the longstanding claim made by some scientists that the recent increase in frequency and strength of Atlantic Ocean hurricanes is due to a natural cycle known as the Atlantic Multidecadal Oscillation, or AMO.

Instead, the researchers believe the trend can be better explained by the competing actions of two human activities: greenhouse gas emissions that warm the atmosphere and cause SSTs to rise and the release of aerosol particles which cool the atmosphere.

Competing forces

Scientists think the AMO cycle involves different atmospheric conditions that combine to produce periods of heightened hurricane activity lasting 20 to 40 years followed by lulls of roughly the same length. Some scientists believe we are currently in an active period of the AMO that began in 1995. According to scientists such as Chris Landsea, a meteorologist at the Atlantic Oceanographic and Meteorological Laboratory, the effects of global warming on Atlantic hurricane activity are negligible compared to that of the AMO.

Emanuel and Mann, however, believe that the change in hurricane activity normally attributed to the AMO can be explained by the rise and fall of aerosol concentrations during the late 20th century.

While greenhouse gases such as carbon dioxide and methane lead to warming of the upper atmosphere, aerosol particles like sulfur dioxide and nitrogen oxides cool the lower atmosphere by reflecting sunlight. Because of the directions of major air currents, aerosol particles released in North America and Europe find their way to the tropical Atlantic, where they settle in the lower atmosphere like a fine mist.

The aerosol particles' cooling effect is greatest during late summer—exactly the time of highest hurricane activity.

Hidden power

From about 1950 to 1980, the cooling effects of aerosol particles in the atmosphere served to mask the warming effects of greenhouse gas emissions, the new thinking goes. Hurricane activity in the Atlantic was thus lower than it might otherwise have been during this period.

But since the 1980s, North America and Europe have reduced the amount of aerosols they pump into the atmosphere.

"Aerosols have had this masking, cooling impact for several decades, and now as we begin to clean up this atmosphere we may get something we didn't bargain for," Mann told LiveScience.

Without aerosols to offset the warming effect of greenhouse gases, waters in the Atlantic will continue to warm and hurricanes will continue to increase in intensity for decades to come, the researchers say.

"The assumption that the recent upturn in Atlantic Hurricane activity is due to a [natural] oscillation has been the basis of claims by the National Hurricane Center that what we're likely to see is just a temporary increase in hurricane activity for the next two decades," Mann said. "Our analysis suggests that this is simply not the case."

Hurricane season begins June 1, and researchers predict another above-normal year of activity.