A CYCLONE CYCLE

Cyclones cause more warming, or more warming causes more cyclones?

any scientists think that climate change will likely intensify tropical cyclones, but a new study suggests that tropical cyclones could also intensify climate change. An analysis of satellite data suggests that these storms are responsible for a large portion of the water vapor — a strong greenhouse contributor — that lingers in the stratosphere. As tropical storms become more ferocious, they might spray even more water into the stratosphere, and therefore lead to more warming, the researchers say.

Water molecules have a tough job climbing all the way into the stratosphere. As they rise in clouds higher and higher in the troposphere, they eventually encounter the tropopause, the boundary between the troposphere and stratosphere, which is usually the coldest point between Earth's surface and the top of the stratosphere. Because it is so cold, this layer acts like a gate, keeping most water vapor from rising through it, says David Romps of Harvard University in Cambridge, Mass., and lead author of the new study in Geophysical Research Letters." As air lifts up toward the tropopause, it gets colder and colder, and more and more of the water it carries forms ice, which then falls out," he says. So, the higher the air, the drier the air, most of the time, he says. However, occasionally

a cloud will have enough energy to punch through the tropopause, thereby "sneaking around this gate" and catapulting ice particles into the stratosphere, he says. Because the rest of the stratosphere is warmer than the tropopause beneath it, these ice particles can turn into water vapor.

Romps and Zhiming Kuang, also of Harvard, wanted to find out what fraction of these overshooting clouds came from tropical cyclones. They studied satellite data and hurricane forecasters' best-track data — records of longitude and latitude of storms in progress — of thousands of cyclones in the tropics between 1983 and 2006 and found that convection in these storms was much more efficient at throwing ice particles through the tropopause barrier into the stratosphere than other cloud systems.

The phenomenon could result from behavioral differences between types of clouds, Romps says. "An isolated cloud that is trying to reach into the upper troposphere tends to pull in the dry surrounding air, and that evaporates some of the water droplets in the cloud and cools it off," he says. The loss of heat removes a lot of the energy stored in the cloud, preventing it from penetrating the tropopause. However, a big cloud that's in an eye wall of a hurricane is surrounded by other clouds, which are already very moist. "So you don't have the same drying effect." As a result, more energy remains stored in these clouds, allowing them to break through the tropopause more often.

"The biggest message [of this paper] is that there could be implications for climate change because we expect tropical cyclones to get stronger," says Stephen Garner of NOAA's Geophysical Fluid Dynamics Laboratory in Princeton, N.J. "This could mean more injection of water into the stratosphere," and thus more water vapor and more warming. Romps says that the magnitude of such a feedback would likely be small, "but we just don't have solid numbers on that yet. At this point it's just an idea."

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