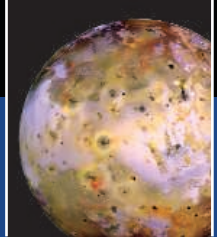
The enigma of the Natufians 404



Io's magma ocean 408

GLOBAL WARMING

Models Foresee More-Intense Hurricanes in the Greenhouse

Fewer but fiercer and more-destructive hurricanes will sweep the Atlantic Basin in the 21st century as climate change continues, a new modeling study by U.S. government researchers suggests. The results, reported on page 454, bear out tentative forecasts from earlier studies, although the researchers caution that this is still far from the last word.

"The models seem to be converging," says tropical meteorologist James Kossin of the National Climate Data Center's office at the University of Wisconsin, Madison, who was not involved in the work. Plenty of uncertainties remain, Kossin notes, but compared with earlier studies, this one "is more credible; … it's important."

What makes the new study more realistic is its sharper picture of the atmosphere. In low-resolution models such as global climate models, the fuzzy rendition of the atmosphere can't generate any hurricanes, much less the intense ones that account for most of the damage hurricanes cause. The high-resolution models used by the U.S. National Weather Service to forecast hurricane growth and movement do produce a realistic mix of both weak and strong storms, but those models can't simulate global warming.

So climate modeler Morris Bender of the National Oceanic and Atmospheric Administration's Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey, and his colleagues used a technique sometimes called "double-downscaling." The group started with the average of atmospheric and oceanic conditions forecast for the end of the century by 18 global climate models. They transferred those averaged conditions into a North Atlantic regional model detailed enough to generate a realistic number of hurricanes, although still too sketchy to get their intensities right. Finally, the team transferred the regional model's storms to an even higher-resolution hurricane forecast model capable of simulating which ones would develop into category 3, 4, and 5 storms.

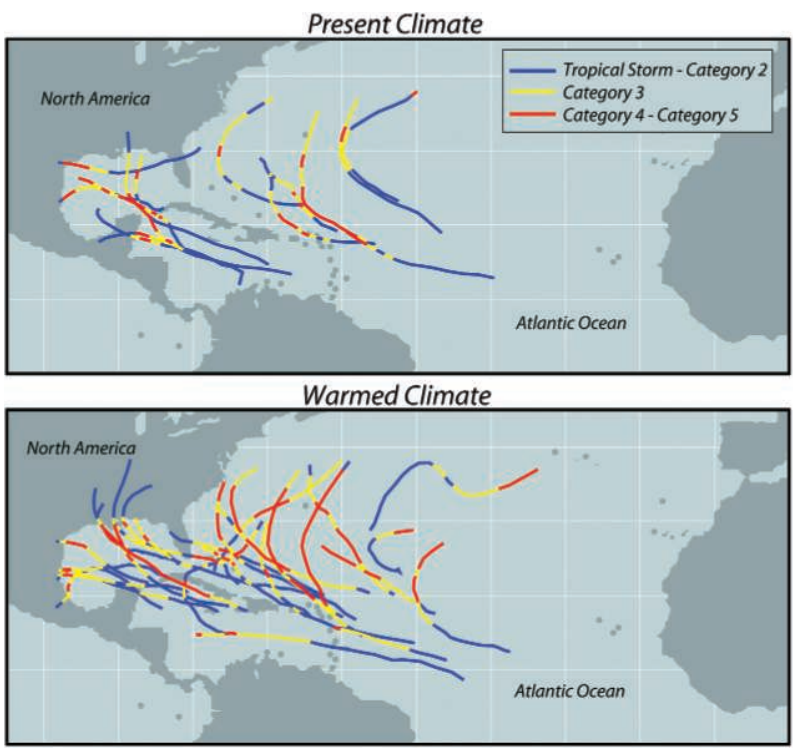
The first downscaling showed an 18% decline in the total number of hurricanes. In the second downscaling, that decline in the number of storms was limited to moderate-strength storms. Category 4 and 5 storms, with maximum winds of 216 kilometers per hour and above, about doubled in frequency by the end of the century; the strongest storms, with winds of 234 kilometers per hour and above, more than tripled. The results generally matched those of earlier studies that took different approaches to coping with limited resolution. They were also consistent with long-standing theory that as ocean temperatures rise, the additional water vapor driven into the atmosphere can both intensify existing storms and inhibit the formation of new storms.

The group calculates that although the overall number of hurricanes would decline in a warmer world, they would still cause more damage, according to the modeling. Category 3 to 5 hurricanes have accounted for 86% of all U.S. damage despite constituting only 24% of U.S. landfalls, the group notes. That's because when storms move up from one category to the next, the potential damage roughly doubles. The group finds that in the models, the increase in the rare, most intense storms dominates, leading to a net increase in potential damage of roughly 30%.

The researchers note that the new modeling offers no support for claims that global warming has already noticeably affected hurricane activity. In the real world, the number of Atlantic hurricanes observed during the past 25 years has doubled; in the model, global warming would cause a slight decline in the number over the same period. Given that the mid-resolution model used by the group duplicates the observed rising trend, it may be natural. And the group estimates—very roughly—that so far any effect greenhouse warming has had on hurricane intensity should still be unrecognizable amid natural variations in hurricane activity.

"It's a good step, a big step forward," says tropical meteorologist Peter Webster. "They've done about as much as you can do with downscaling, [but] it's not the final step." As ever, researchers are looking for yet more computer power and higher resolution to boost the realism of simulations. If the models continue to converge as realism increases, the monster storms that seemed to be already upon us would be removed to decades hence.

–RICHARD A. KERR



More big blows in the greenhouse. Computer simulation of the most intense hurricanes shows an increase from today (*top*) to a warmer world at the end of the century (*bottom*).

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