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Distinguished Lecture Series

What Recent Research Has Revealed About Hurricanes

Presented by: Prof. Kerry Emanuel

Cecil and Ida Green professor of atmospheric science
at the Massachusetts Institute of Technology

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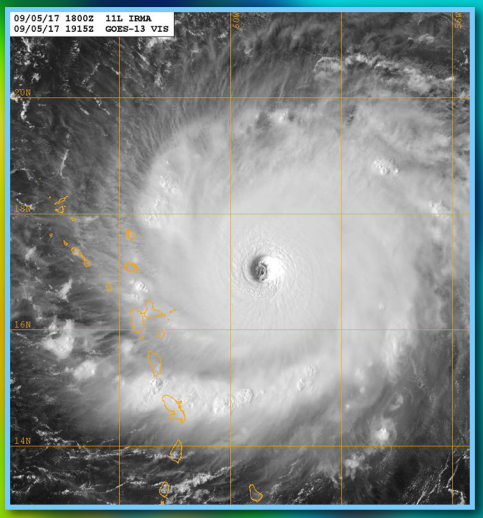
IN THE JUNKER CENTER



Office of Naval Research
875 N. Randolph St., Arlington, Virginia
Bobby Junker Executive Conference Center, 14th Floor

What Recent Research has Revealed about Hurricanes

Hurricanes are natural heat engines whose thermodynamic cycle is very close to that of an ideal Carnot engine. The engine is powered by heat flux from the ocean and the efficiency of the engine depends on the difference between the ocean temperature and the very low temperatures found in the upper tropical atmosphere. The heat engine theory and computer simulations of hurricanes both show that the structure and power of the storm depend on coefficients governing the rate at which heat can leave the ocean and determining how much drag the surface exerts on the atmosphere. But there is no theory for these coefficients at hurricane winds speeds, when the surface of the ocean is torn apart by the high winds, and the problem is too difficult to tackle by brute force computation alone.

In addition to this difficulty, the original theory predicted a highly unrealistic storm structure. A revised theory, which resolved this difficulty, postulated, somewhat implausibly, that the structure is determined by processes operating high in the hurricane's outflow layer.

The unknown exchange coefficients and the radical hypothesis about storm structure could only be resolve by making measurements in actual hurricanes. I will describe how two field experimental programs have helped us overcome these two hurdles to understanding, and ultimately to predicting, hurricanes.

ABOUT

Prof. Kerry Emanuel

Dr. Kerry Emanuel is the Cecil and Ida Green professor of atmospheric science at the Massachusetts Institute of Technology, where he has been on the faculty since 1981, after spending three years on the faculty of UCLA. Professor Emanuel's research interests focus on tropical meteorology and climate, with a specialty in hurricane physics. His interests also include cumulus convection, and advanced methods of sampling the atmosphere in aid of numerical weather prediction. He is the author or co-author of over 200 peer-reviewed scientific papers, and three books, including Divine Wind: The History and Science of Hurricanes, published by Oxford University Press and aimed at a general audience, and What We Know about Climate Change, published by the MIT Press. He is a co-director of MIT's Lorenz Center, a climate think tank devoted to basic, curiosity driven climate research.