

Predicting the Perfect Storm

Sophisticated weather models are getting much closer to foretelling real storms

Forecasters have never effectively predicted specific weather events beyond several days into the future. Humidity, wind speeds, air temperatures, water temperatures, and cloud formations all play a role in determining weather developments. All of these factors are constantly changing. Building computer models to account for this complex stream of information and accurately predict weather outcomes has proven extremely difficult. Clouds, in particular, are difficult to simulate at local and regional levels due to the mathematical difficulty inherent in simulating water vapor forms with variable densities and temperatures.

In December 2008, a team of scientists from the International Pacific Research Center (IPRC) at the University of Hawai'i at Mānoa, the Japan-Agency for Marine Earth Science and Technology (JAMSTEC), and the University of Tokyo made a significant step towards better weather predictions

when their simulation model successfully reconstructed the emergence and evolution of two tropical cyclones. The scientists used atmospheric weather data recorded one to two weeks before the storms occurred in the Indian Ocean in December 2006 and January 2007, respectively, to seed the simulation. The model then accurately recreated the lifecycle of the cyclones including when and where they formed, their paths over the oceans and their dissipation.

A greatly improved modeling system, called the Nonhydrostatic ICosahedral Atmospheric Model (NICAM) allowed researchers to fine tune their predictive assumptions. Most significantly, NICAM allowed the scientists to resolve weather models down to individual clouds globally, an enormous improvement over previous models. "The improvements to the model made it possible for us to get to describe in great detail the cloud formations leading up to the birth of the cyclones," said Yuqing

Wang, a team leader at the IPRC and a professor of meteorology at UH Mānoa. NICAM was designed specifically for use on JAMSTEC's Earth Simulator supercomputer.

The findings are only the first results emerging from tests using NICAM, the most advanced global climate modeling system constructed to date. Still, according to Wang, the improved models cannot yet accurately predict cyclones or hurricanes several weeks in advance from current atmospheric conditions. Wang, however, feels that accurate prediction in the near future is possible. That is welcome news for countries in cyclone and hurricane zones around the Pacific and Indian Oceans, where meteorologists expect storms to become more intense due to dramatically warming ocean temperatures. ✨

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