LOCAL NEWS

UVM prof works to aid hurricane forecasts

Device creates a 'toy climate'

BY TIM JOHNSON FREE PRESS STAFF WRITER • SEPTEMBER 17, 2009

This has been a fairly tame hurricane season, although that wasn't the forecast a few months ago, when "above-average" activity and up to 14 named storms were predicted.

But then, as University of Vermont applied mathematician Chris Danforth knows very well, hurricanes can be notoriously difficult to predict. The forecasting challenges range from the seasonal (how many big Atlantic storms will there be between June 1 and Nov. 30?) to the particular (now that Hurricane X has formed in the Caribbean, where it be three days from now?)

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Danforth, an assistant professor, is more interested in the second kind of prediction — foretelling the swath in which a hurricane is likely to move, or as forecasters like to call it, the "cone of uncertainty."

Getting that right means a lot. Take Hurricane Katrina, which hit New Orleans on Aug. 29, 2005.

When Katrina was off the east coast of Florida, on Aug. 26, New Orleans was not believed to be in its path. A day later, the forecast had changed and New Orleans was suddenly deemed vulnerable — but a day's preparation had been lost, and only on Aug. 28 was a mandatory evacuation ordered. For many, that was too late.

Danforth is engaged in a research project that seeks, among other things, to improve the model used by the National Weather Service to predict hurricane trajectories. He's taking a two-pronged approach. He's crunching millions of numbers with a high-speed computer; and studying the fluid dynamics inside a custom-built contraption that he calls a "toy climate," which hangs on the wall of the Votey Building engineering lab.

In the number-crunching exercise, he's looking at 50 years worth of meteorological data and how the model's predictions compare to the hurricane realities. The model draws on millions of pieces of data — wind speed, temperature and so on — that are regularly recorded and estimated throughout the world and its atmosphere.

When it comes to predicting the weather, you can't look too far ahead with any reliability. As Danforth puts it: Even if you had perfect meteorological data from every nook of the atmosphere and fed it into a computer with infinite capacity to produce a forecast, "the best you could do is about two weeks." After that, it's like a coin toss. Predictions for a given hurricane are typically just three or five days out.

So it goes with the chaos of atmospheric dynamics. In a chaotic system, Danforth says, the reality can diverge from the prediction exponentially fast.

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The "toy climate" — a circular aluminum case that contains a hula-hoop-like tube of water — is a kind of chaotic microcosm that Danforth hopes will offer clues to improving atmospheric prediction. That's because the behavior of warm and cold water, flowing one way or the other depending on temperature gradients, could suggest patterns of convection in the atmosphere that drive the weather.

The device, called a Thermal Convection Loop, isn't fully operational yet. When it's all hooked up with thermocouples, it will be feeding temperature data directly into Danforth's computer.

Floyd Vilmont, manager of the prototype lab at the UVM College of Engineering and Mathematical Sciences, built the loop to Danforth's specifications. Vilmont likes to call it "the weather maker."

Whether "the weather maker" can suggest computational improvements to the national predictive model is an open question. Danforth figures it will take two or three years to find out.

Meanwhile, as a student of hurricanes, he's experienced the best of both worlds recently — computer models in the office and the real thing in the field.

GLENN RUSSELL, Free Press

Chris Danforth, assistant professor of applied mathematics at the University of Vermont, explains how a thermal convection loop will help him more accurately predict hurricanes in Burlington on Wednesday September 16, 2009.

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In Maine for a wedding last month, Danforth got a taste of Hurricane Bill when it blew by. He was impressed.

“It created massive surf,” he said. “Fifteen to 20 foot swells.”

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