# Monitoring hurricanes for better life-saving, property-preserving decisions

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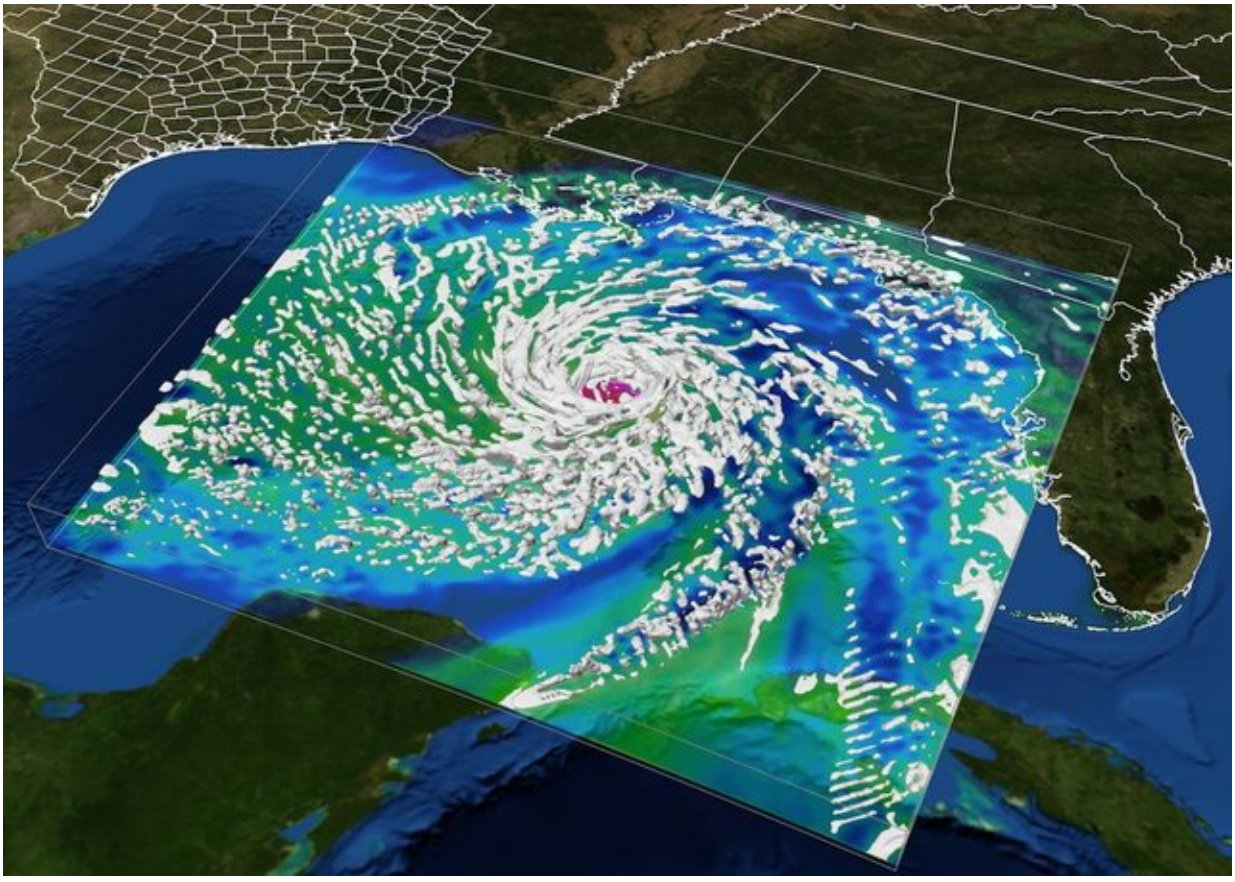

A computer visualization of Hurricane Ike shows the storm developing in the Gulf of Mexico before making landfall at the Texas coast. Credit: TACC

When a natural disaster strikes, first responders step in to reduce harm

and save lives. They risk their lives in highly unpredictable environments—often without clear knowledge of the dangers they are facing or where they are needed most.

Now, imagine if responders could make use of cutting-edge disaster forecasting models in conjunction with real-time data to predict a disaster's impact and then use that information to make better-informed decisions. Fewer lives would be lost and more people would receive the help they need.

The Texas Advanced Computing Center (TACC) at The University of Texas at Austin is making this possible—helping top researchers push the boundaries of science to new limits and run complex models for smarter and more informed real-world decisions.

State and federal emergency agencies use live, geographic data from satellites and software systems such as the ADCIRC (Advanced Circulation) to simulate coastal tides and current movement. Crunching all this data and turning it into usable visual maps requires intensive, high-speed processing power. As a result, agencies use the output from supercomputers at TACC to forecast storms and support life-saving, property-preserving decisions in real time. TACC supported response efforts during hurricanes Harvey in 2017 and Florence in 2018.

Now, this response will be even faster and more targeted with the launch of UT's newest supercomputer—Frontera—the fastest supercomputer at any U.S. university and the fifth-most-powerful system in the world.

Clint Dawson, a professor of aerospace engineering and engineering mechanics and head of the Computational Hydraulics Group, is using Frontera to investigate one of the most dangerous aspects of hurricanes: storm surge.

Storm surge is the flow of water on land created by powerful storms. It creates high-risk situations such as inland flooding and battering waves.

"It's a big problem, and it's getting to be even bigger because more and more people live on the coast, and sea level is rising because of climate change," said Dawson. "We also have bigger and more intense hurricanes than we've had in the past."

The proportion of tropical storms that strengthen into powerful hurricanes has tripled during the past 30 years, according to recent research.

With Frontera, storm surge models will be able to account for the effects of rainfall and erosion on flooding. Emergency managers can incorporate information about structures to predict which buildings will flood when a surge hits and how badly they will be affected.

Dawson recalls how in the past researchers had access to computers with only limited memory and computing power. Predicting hurricane tracks and storm surge levels was "just completely out of the question," he said.

However, with the advent of supercomputers, these simulations can now run faster and produce higher resolution forecasts. Moreover, researchers can make several forecasts for a variety of situations, with more up-to-date information, allowing them to produce more precise and accurate predictions.

"We've added more and more physics, better numerical algorithms, better software, better use of high performance computing resources, and it just continues to improve to the present day," said Dawson.

Enhanced simulations will also inform decisions about future planning. "Should we build new protection systems or move people out of harm's

way? Who lives in a floodplain? Who doesn't?" said Dawson.

Finding these answers will lead to the creation of better shelters, improved infrastructure, and more thorough information about every aspect of a storm's impact.

TACC's supercomputers are revolutionizing the previously slow and inaccurate process of predicting natural disasters, allowing emergency responders, the private sector and the general public to make better decisions—ultimately preserving property and minimizing loss of life.

This is just one application of these transformative machines. "We can now solve problems that we just have not been able to solve before," said Dawson. "I'm always interested to see what happens when we push the envelope because we always learn new things."

**More information:** Kieran T. Bhatia et al. Recent increases in tropical cyclone intensification rates, *Nature Communications* (2019). DOI: 10.1038/s41467-019-08471-z

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