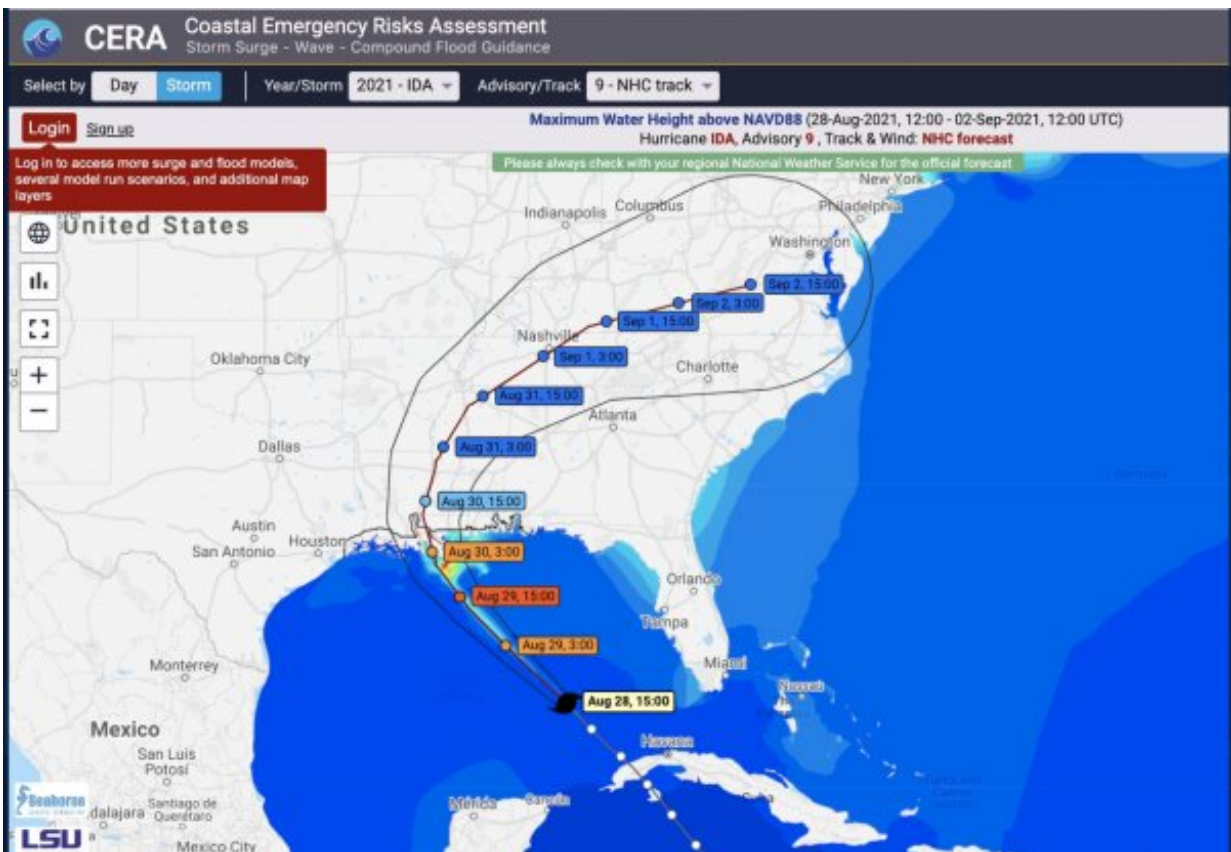


# Developing digital twins for improved hurricane prediction

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An image from storm surge models of Hurricane Ida developed using the ADCIRC Surge Guidance System (ASGS). Credit: Coastal Emergency Risks Assessment (CERA)

More than half of the U.S. population lives in coastal watershed counties

or parishes. Coastal communities along the Gulf of Mexico are among the most heavily populated—also a region where high concentrations of energy resources have made it a national hub for many large-scale carbon-to-capture storage facilities.

The proximity to the ocean of both local communities and energy infrastructures make both extremely vulnerable to the devastation that can be caused by flooding and wind damage from severe weather events in the Gulf, which are increasing in both frequency and intensity with every [hurricane season](#).

Clint Dawson, a professor in the Department of Aerospace Engineering and Engineering Mechanics (ASE/EM) and director of the Computational Hydraulics Group at the Oden Institute for Computational Engineering and Sciences at UT Austin, is working to make storm surge predictions for hurricanes more accurate than ever. Thanks to a new grant from the Department of Energy (DOE), Dawson will lead an interdisciplinary research project to develop a computational "digital twin" framework that bridges the gap between multi-physics simulations and knowledge discovery through artificial intelligence (AI) and machine learning (ML) technologies, called MuSiKAL.

Simply put, a digital twin is a virtual representation of an object or system that spans its entire lifecycle through regular real-time data updates provided by sensors spread across the object or system. Using simulations, machine learning and other decision-making technologies, digital twins can help predict future performance and behavior.

Dawson's team has been modeling storm surge predictions for two decades, from Hurricane Katrina, Rita, Ike and Harvey to this season's biggest storm to date, Hurricane Ida. And the storm surge expert will be the first to tell you that each brings its own set of unique characteristics. But lessons can still be learned from each that could inform future

responses.

Currently when a hurricane model is running, measurements are being collected at very discreet places—along the coastline and in the ocean, for example—but these points don't represent every point in every region that might be impacted.

"We need to have a model that provides additional information. If we have that data available to use, it can better inform the models we are currently running," Dawson said. "And then we can go back and compare the models to the data for a more accurate picture."

Digital twins have already been developed for a variety of situations—from modern aircraft design to systems assisting in the management of entire cities. In the context of extreme weather modeling, the tech could enable even faster predictions of storm behavior in real-time by combining knowledge about previous storms with the aid of AI and ML.

"These models are very complex and can take hours to simulate on a supercomputer. If we can use [machine learning](#) based on data that's been collected from prior hurricanes that are very similar, then we could perhaps give faster predictions in real-time," Dawson said.

Through the Advanced Scientific Computing Research (ASCR) program the DOE will support a collaborative team of experimental and computational scientists from the University of Texas at Austin, Louisiana State University, the University of Notre Dame and Pacific Northwest National Laboratory. They will be led by Dawson alongside fellow ASE/EM professor and Oden Institute core faculty member, Tan Bui-Thanh.

Other UT experts participating include Bridget Scanlon and Alexander

Sun from UT's Bureau of Economic Geology and Dev Niyogi and Zong-Liang Yang from the Jackson School of Geosciences.

The DOE has recently been investing in the development of Earth system models for climate research. Dawson said he looks forward to working on research that is directly related to climate predictions.

"I think this is going to be a groundbreaking project, and aligns well with the expertise we've been building up for 20 years," Dawson said.

"Connecting with the Department of Energy to develop longer scale projections of what's going to happen to the energy sector and to society as a whole because of future climate is very exciting."

The Department of Energy's fund for Integrated Computational and Data Infrastructure for Science Research will provide \$5.2 million overall to the project with UT Austin receiving \$3 million.

**More information:** Coastal Emergency Risks Assessment page [cera.coastalrisk.live/](https://cera.coastalrisk.live/)

Provided by Oden Institute for Computational Engineering and Sciences

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