

In Brief

Researchers from the University of Texas partnered with other researchers, federal agencies, commercial partners, and first responders to create the National Flood Interoperability Experiment (NFIE). They used Microsoft Azure to help build a prototype for a national flood data-modeling and mapping system with the potential to provide life- and cost-saving information to the public. The goals of the NFIE include standardizing data, demonstrating a scalable solution, and helping to close the gap between national flood forecasting and local emergency response.

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Centralizing National Flood Data in the Cloud Can Help Save Lives and Property

Floods claim the most lives and cost citizens of the United States more money than any other type of national disaster. Flash floods—common in many areas—happen suddenly and can cause massive amounts of damage in a very short time. Texas leads the country in flood deaths with 84 victims since 2007.

SHARING FLOOD INFORMATION FOR BETTER PREDICTION AND RESPONSE

What if it were easier to predict more accurately where floods will occur? What if more flood information could be shared in real time to aid in more effective response planning and prevent deaths and property damage? Those are the questions that David Maidment, Professor of Civil Engineering at the University of Texas at Austin, wanted to answer.

Maidment specializes in hydrology and flooding at the Center for Research and Water Resources. In order to create a system comprehensive enough to accurately predict flooding events in



In October 2013, the Onion Creek area near Austin faced a particularly destructive flood.



“The National Flood Interoperability Experiment used Microsoft Azure to explore ways in which the nation’s citizens can become safer, more secure, and better able to withstand the effects of flooding.”

David Maidment, Professor of Civil Engineering, University of Texas

specific locations, Maidment brought together four federal agencies that deal with physical aspects of flooding: the National Weather Service, the US Geological Survey, the Army Corps of Engineers, and the Federal Emergency Management Agency. He wanted a technology infrastructure that would allow information to flow in from various agencies and academia, and then flow out to allow citizens and first responders to better understand what was happening.

In October 2013, the Onion Creek area near Austin faced a particularly destructive flood. While onsite studying the flood, Maidment connected with Harry Evans, Chief of Staff for the Austin Fire Department. They realized that they had similar goals for flood prediction and response, and could collaborate well with their different areas of expertise.

“We wanted to combine the knowledge and the science of the academic community with the first response capabilities of our public safety entities. We had the tools and the ability—we just needed to put them together,” says Evans.



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Students from the University of Texas at Austin, Fernando Sales (left) and Marcelo Somos (right) analyze the technology infrastructure that would allow information to flow in from various agencies and academia, and then flow out to allow citizens and first responders to better understand what was happening.

Maidment brought together participants from academia, government, and industry to start the National Flood Interoperability Experiment (NFIE), designed to explore the best solution for the next generation of flood forecasting for the United States and better connect the Federal Flood Forecasting System with local emergency response to create real-time flood information services.

MICROSOFT AZURE FOR DATA ANALYSIS, STORAGE, AND SHARING IN THE CLOUD

Professor Barbara Minsker from the University of Illinois at Urbana-Champaign introduced Maidment to Microsoft Research, which helped the NFIE find the computational power it needed with Microsoft Azure. NFIE uses Azure to perform the statistical analysis necessary to compare present with past data and design flood prediction models.

“What we’re trying to do in the National Flood Interoperability Experiment is to prototype a set of infrastructure and services that can communicate with one another and with the public in a uniform and open way,” says Maidment.

The ability to model the flows of rivers and smaller streams is an important part of the project. Cedric H. David, Project Scientist at the University of California Center for Hydrologic Modeling, is the lead developer of the river-modeling application used by the NFIE. David started developing the RAPID (Routing Application for Parallel Computation of Discharge) computer model while working on his PhD at UT Austin under Maidment. He works closely with the NFIE team to ensure that the RAPID simulations and modeling satisfies the project’s needs.

Working with Microsoft Research, the NFIE team configured two Azure Virtual Machines with the RAPID model, all of the software necessary to run the RAPID model, and the data storage shared between the two machines. The team also installed a Data Wolf workflow system on the Virtual Machines that runs the sequence of all the logistics for setting up the RAPID model.

One of the benefits of using Azure is that the NFIE can now standardize and store data in the cloud. Maidment and colleagues at the University of Texas developed a new language called Water Markup Language (WaterML), which provides both a common way to store time-value pairs, like river flow time, and a standard way of

communicating that information through the Internet. The US Geological Survey adopted WaterML to publish its time-series data on water observations, and the National Weather Service will also use the language to publish forecasts as part of the NFIE. When a common language is implemented operationally, those organizations will be able to communicate and collaborate more readily with one another.

“Even with ubiquitous communications and large cloud storage, we still need a common communicating mechanism for all this to knit together,” says Maidment.

Originally, the university’s computer system kept just one copy of the data that came in from the geological survey, the Lower Colorado River authority, and the city of Austin. This worked only on a regional scale.

“To attempt to do the same thing nationally and globally, we need something that scales much bigger than what the university’s facilities allow,” says Maidment. “We’re very grateful to Microsoft Research for making Azure available so we can scale up to a national prototype to foster water information exchange across the country.”

MORE FLOOD INFORMATION PROVIDES POTENTIAL FOR IMPROVED PUBLIC SAFETY

NFIE uses Azure to deliver more forecasts than any one agency could. Currently, the National Weather Service makes forecasts at about 3,600 locations on rivers in the country. The NFIE expects to demonstrate delivery of specific and actionable data for 2.67 million locations nationally, including smaller streams. It also expects to increase the spatial density of flood forecast locations by a factor of more than 700, compared to the current National Weather Service system.

Ultimately, the greatest contribution of the NFIE is to show that more detailed information has the potential to increase real-time responsiveness in order to improve public safety and save lives. Working closely with the Austin Fire Department, the NFIE shows how data can be used to improve decision making. Evans says, “By working on this proof of concept, we can develop a template that agencies nationwide can use, alongside their threat and risk analysis, to help their communities better protect themselves.”