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What's Hot in Modeling Software

BY JANICE CESSNA

Developers of hydraulic and hydrologic modeling software have recently unveiled exciting new program updates and products to increase the efficiency and effectiveness. Dramatic decreases in model run times, thoughtful assembly of multiple information sources, and greater flexibility within hydrologic connectivity options demonstrate just a few ways these changes have improved the science of modeling. A complete list of every change recently introduced to the market would be overwhelming to the average modeler. Instead, a few case studies of some impressive changes are presented here.

Even small firms with limited budgets can make significant improvements to their overall productivity by updating as appropriate to their workload and budget. But any computing change demands caution. Conduct a full investigation into advantages and disadvantages of the new product, upgrade glitches and headaches experienced by others, and how changes within the new programming may affect modeling results, especially for ongoing projects or models periodically updated every few years. Not all software upgrades improve workflow or model results in every situation. Every engineer, company, and organization must consider their specific circumstances.

Real-Time Flash Flood Prediction

Originally established in 1991, the city of Austin's Watershed Protection Department (WPD) focuses on reducing the effects of flooding, erosion, and water pollution. The department's role is especially important as Austin lies within the swath of Central Texas known as Flash Flood Alley, an area of steep terrain and shallow soil that also receives very high rainfall. The topographic transition between the state's Hill Country and coastal plain regions means that frequently, atmospheric moisture sent aloft by the Gulf of Mexico delivers intense rainfall events across the transition zone, which runs roughly from Dallas in the

northeast, through Waco and Austin, to San Antonio in the southeast.

The frequency of flash flooding and resulting destruction led WPD to create a Flood Early Warning System roughly 30 years ago to continually monitor rainfall, water levels, and low water crossings within Austin. "We have significant numbers of flood hazards, on the order of 10,000 properties with some level of flood risk, and around 400 roads that flood in a 100-year event," says Kevin Shunk, floodplain administrator at WPD.

The monitoring system utilizes 130 rain or creek gauges, gauge-adjusted radar rainfall data, 15 low water crossing signals, cameras at low water crossings, and predictive modeling and mapping. "When it rains, I have my methods of opening up various software, and those are my tools to watch things," says Shunk. "We wanted to have software that can ingest these different sources of information and display it in one location, on a single site or map for us to look at."

Unfortunately, the motivator to develop a consolidated system was a flood of record on October 31, 2013, on Onion Creek in neighborhoods between Interstate 35 and the Austin-Bergstrom International Airport. In 15 minutes, Onion Creek rose 11 feet and crested at a record 41 feet later in the day. The speed of inundation caught residents completely off guard and resulted in fourth deaths.

"We had about 850-plus homes flood, some with up to eight feet of water in them," says Shunk. "It revealed some issues we had with the Flood Early Warning System and overall communication across different departments within the city."

The need to create an integrated system led to Austin to bring in Vieux and Associates Inc., a firm based in Norman, OK, specializing in rainfall and runoff software. Together, WPD and Vieux are developing FloodVieux, a common operating picture of rainfall, water level, and runoff information, by connecting diverse sets of mission-critical data. By leveraging cloud computing through Amazon Web Services, FloodVieux facilitates situational awareness during emergency events. By harnessing the Web app, FloodVieux allows quick access to real-time information and easy retrieval of archival data. This software as a service (SaaS) mimics other cloud-based services, but specializes as an integrated system for display, data visualization, analysis, and notification used in flood warning and water management.

Karl McArthur, supervising engineer with WPD, explains that a large situational map view comprises the centerpiece of FloodVieux's interface and can be surrounded by smaller pieces depicting source information, such as remote low water crossing pictures and real-time data from a particular rain or stream gauge watch point. In short, it combines all the source data in a single navigable program, focused around the overall map view.

"[FloodVieux] draws information

from our other software models to help with predictions and operations. It's a real-time flood inundation mapping application that can build on those other models that predict flows based on gauge-adjusted radar data or predicted rainfall data," says McArthur. "It pulls together pieces we already had and puts them all more at our fingertips."

The program can also monitor and report on social media activity, particularly Twitter, for potential flood conditions. "If it finds any tweets that have the word 'flood' in them, it populates them on a map," says Shunk. "If you see 50 'flood' tweets in one area, that gives you an idea something's going on there."

Because FloodVieux monitors the entire Austin metro area at one time, it can greatly reduce the burden on human monitoring of such extensive real-time conditions and spot where potential flood issues may arise. By writing conditional rules within the program, WPD can focus its attention on the most critical areas.

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"We can write rules that trigger us to take appropriate action," says Shunk. If specified conditions occur and relevant rules triggered, WPD can deploy public safety personnel. This rule-writing flexibility incorporates institutional knowledge into the system and facilitates better handling of future flood problems due to development-induced changes to drainage infrastructure.

Once the floodwaters subside, FloodVieux will also make post-event reporting easier. "It will summarize everything that went on during the storm for us, greatly facilitating that process and helping us identify places we could improve," says McArthur, although this function has not been fully tested yet as FloodVieux is still under development.

"Some of it's in place that we can use as an alpha version," says Shunk. "All the pieces aren't there yet. We're building it on the fly, so something we learn today helps change the design of it next week."

At present, WPD plans to use FloodVieux internally with Austin city government, providing flood-related information to other departments, but there has been initial discussion on making the program available outside WPD. "The emergency management department is very interested in having this available in the emergency operations center and maybe some expansion of it, similar to [FloodVieux], for their use as well."

Vieux and Associates indicates that this is certainly possible—for other Austin departments, or totally unrelated groups—because the program builds on a common foundation and is extended to meet unique needs. "There are a lot of different services

municipalities provide that might be able to benefit from such software that ingests a variety of information," says Shunk. "It's a way of taking in information and somewhat automating its management to alert the user to actions that need to be taken."

Both Shunk and McArthur have found the software easy to use. "It's not so much a learning curve on how to use it as it is a learning curve to figure out how to create it uniquely for us," says Shunk.

However, McArthur points out that if a program like FloodVieux is intended for real-time flood conditions and a municipality does not already have a flood early warning system, it would be a big effort to generate all the contributing data pieces.

"If someone were to start from scratch, it's a monumental effort just to have enough data to make the decisions," says Shunk. "We were fortunate to already have the data in hand, and we're using it to make decisions."

The FloodVieux common operating system connects diverse internal and external datasets including US Geological Survey stream gauges and National Weather Service radar and forecast information, and can be expanded over time with development of additional data sources. As an Amazon cloud-based service, FloodVieux has a reliable and secure foundation that can be leveraged for application by other communities who have a need for some or all the components already developed. Customized permissions can be configured to allow limited data viewing by user groups within the community, including optional public viewing of generalized or less technical data.

As WPD and Vieux continue to develop the FloodVieux program, all are eager to make revisions and refine its use. "We have great hopes for it and we're very optimistic that it's going to be helpful for us," says Shunk.