Q&A: Seeing coastal storm impacts in advance can help communities prepare

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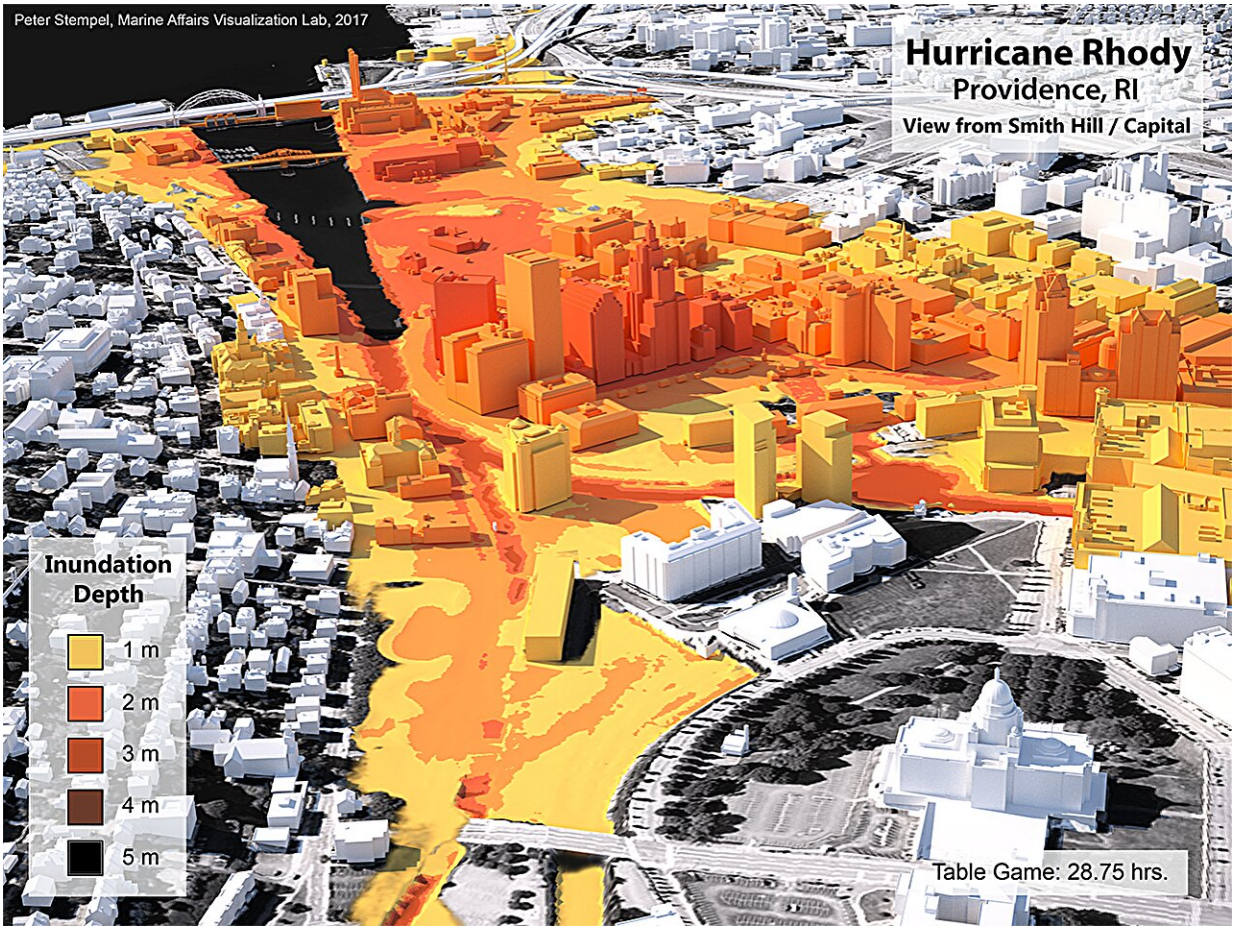

A three-dimensional visualization showing inundation depths in Providence, Rhode Island, from a hypothetical storm dubbed "Hurricane Rhody." Darker colors indicated deeper inundation levels. Peter Stempel, associate professor of landscape architecture, creates visualizations such as the one above to help coastal communities quickly understand the risks posed by hurricanes and other coastal storms. Credit: Image courtesy of Peter Stempel.

Knowing the potential dangers posed by storm surge and high winds before a storm hits can help coastal communities and emergency responders prepare. Visualizations showing projected storm impacts can make the complex science behind the projections easy to understand and immediately available to individuals in the storm's path, according to Peter Stempel, associate professor of landscape architecture.

Penn State News spoke with Stempel, who works with colleagues at Penn State and the Department of Homeland Security's Coastal Resilience Center for Excellence to transform intricate scientific models into easy-to-understand visuals communicating the science to coastal communities.

Q: Tell us about your research in water-related resilience and hurricanes.

Stempel: One dimension of my work has to do with visualizations, or the visual pictures that we use to communicate with people about storm risk and how we can better communicate those risks in what we depict. Another has to do with predicting the impacts of natural disasters such as hurricanes as they make their way up the coast. It kind of goes without saying, given how destructive these storms are, but why is it so important to communicate all that effectively? Obviously, we want people to get out of the way of the storms. But also, most people have an imprecise understanding of what a storm can really do. Even people who have experienced storms may not have experienced the full brunt of a storm. Our perceptions really have to do with our individual experiences.

One of the great challenges we have is how do you communicate something to somebody that is unimaginable? This is especially true in a

time of climate change. When you have storms that are exceptional event after exceptional event after exceptional event, at some point you have to begin to redefine what normal is. So, we ask: how do we communicate something that's unimaginable to people and make that actionable? That's both for planning, so people can prepare and adapt for the storm, but also at the time of the event, how do we convey that information effectively to emergency managers who have to respond so they can most effectively meet the challenges?

Q: What did you learn from Hurricane Sandy that you are now using to prepare for future storms?

Stempel: Hurricane Sandy is an interesting case because it was a superstorm that actually combined characteristics of a very large nor'easter into a hurricane. In New Jersey, it was utterly devastating. We saw damages from all kinds of factors like wind, storm surge and a very large secondary fire in the far Rockaways. That's one kind of impact. But we also found that, in a state like Rhode Island where the damage was less severe, many people heard and perceived the news about Sandy being extreme. So for some people, we found that information sort of pegged their expectations to what an extreme storm would be, even though much bigger storms had made landfall and hit the Rhode Island coast before Sandy.

We find that people's perceptions change, and people's perceptions are often set by the storm. This is something we work with emergency managers on because many times, so much of what we know about responding to events is learned from what went wrong the last time. These are lessons earned in blood and treasure. A lot of times, emergency managers will prepare for the last event they experienced. But hurricanes do damage through multiple ways, like wind and storm surge. In the example of Hurricane Sandy, what happened in the Rockaways, not being able to access some place meant the fire apparatus

couldn't respond to a fire and massive blocks burned down. Those were secondary hazards. Those are some of the things that we look for in our preparedness work.

Q: We've heard people say, "Well, I've weathered storms here for 10, 15 years and never had trouble." You're saying that's not the way to look at this?

Stempel: No. Storms are asymmetrical. We saw a situation during Hurricane Irma where, based on how the storm made landfall, water actually moved away from the coast. I wrote an article for Penn State's Institute of Energy and the Environment about reverse storm surge. It can happen. But a minor variation in track and that storm could have made a much more significant hit to a major city. The fact that we can predict storms as accurately as we can is a miracle. I think many people have become accustomed to saying, "Well, you know, you can't predict the weather." Realistically, I think you need to brace for the fact that you could be that one-in-a-million. Fortunately, most of us aren't, but it could easily be you.

If I had to say something to anyone who is listening to media or looking at storms, it's to take the warnings seriously and recognize that your prior experience may not be a template for what you're facing. You might be annoyed that you evacuated when you think you didn't need to. That's much better than the situation we saw during some of the more recent hurricanes where we had people drowning in their cars. Also recognize that everyone's just doing the best they can.

Q: What are you and your colleagues doing to protect national parks and cultural sites along the coast?

Stempel: I'm working with a really wonderful and diverse project team

that includes colleagues at the University of Rhode Island and the National Park Service. We're working in six national parks and wildlife refuges and with adjacent communities to explore coastal adaptation and management decision-making. There's a profound amount of change taking place, and there are differences between how a national park or a wildlife refuge manages something and how a community might manage it. By looking at them together, we're trying to build understanding across those audiences. Where a community might be more concerned about a bathhouse or facilities that are important to their economy, a national park may be more concerned with managing the ecology. Understanding how to coordinate those concerns and how those concerns work together can be beneficial both for the ecology and the community.

We're also partnering with colleagues in Maine who are working closely with the Wabanaki Confederacy, ensuring that Indigenous people have access to cultural resources on the coast. We're ensuring that they can use traditional shellfishing grounds and gather traditional materials. As we consider coastal adaptation, we're recognizing and understanding traditional lifeways, and that makes this project really exciting.

I think the project is emblematic of what the National Oceanic and Atmospheric Administration is doing. They want to operationalize the science. It's no longer science for science's sake. They want to put the science to work for real-world management decisions. More than that, they want it to affect and benefit everyday people, not just a well-heeled community that can afford to write grants. They want to make sure that it's really getting out to all corners of our society.

The cool thing about what I do is I am not a physical scientist. I am not an oceanographer. I am not a manager of the national parks. I am not an extension expert. I work with all those people, and the work that I do deals with connecting scientific modeling to the visual rhetoric. I need to ask myself, "How do I take this really advanced modeling that has these

really interesting dimensions that can literally show the shoreline change, and how can I make that into a visualization where real people can actually see that, and not just the scientists? How can I work really closely with those extension experts and people who are on the ground in communities, and with community members directly, and work with the scientists, to have a foot in both worlds and sort of be like Doc Brown from 'Back to the Future' holding both ends of the wire, and make those things connect together?"

There is an important role for translational work to bridge sophisticated modeling and real-world decision-making.

Q: Why are visualizations so effective?

Stempel: Many people think that visualizations are effective because they evoke an emotional response and they're going to cause people to have a dramatic reaction to the information presented. My research says that's really not the case.

Visualizations, especially 3D visualizations, allow people to apprehend the context in a place very quickly. You can see very complex information and understand what's happening almost immediately. It doesn't require you to relate an abstraction to reality. If it already looks like reality a little bit, and I can put that information in context, people can orient themselves. We can make that information tangible to them. And I think in truth, that is the most powerful effect of visualizations.

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