Researchers building resilience amid the roiling waters

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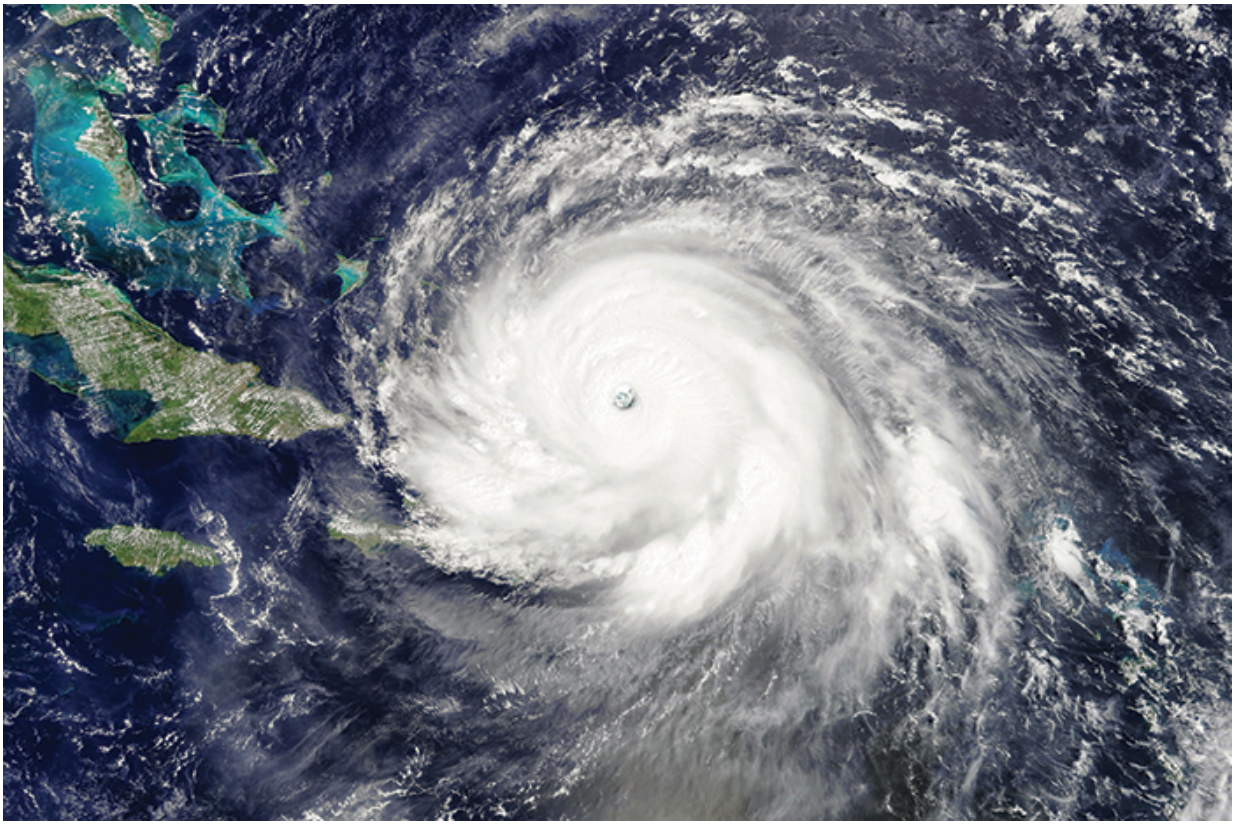

Credit: University of Western Ontario

They produce winds strong enough to swallow whole islands in their maw. They whip up waves that re-shape cityscapes. And they bring rains and floods, devastating and seemingly relentless.

The hurricane trifecta of Harvey, Irma and Jose have dominated headlines weeks. Irma alone has set a series of records, including:

- Its 185 mph lifetime winds made it the strongest Atlantic Ocean storm outside of the Caribbean and Gulf of Mexico on record. Hurricane Allen in 1980 had 190 mph winds;
- That same wind speed was sustained for 37 hours straight – the longest any cyclone has maintained that intensity. Typhoon Haiyan previously held the record at 24 hours; and
- It was the strongest storm on record to hit the Leeward Islands, the first Category 5 hurricane to hit the Bahamas since 1992, the first major hurricane to make landfall in Florida since Wilma (2005) and the first Category 5 hurricane to make landfall in Cuba since 1924.

And to think, hurricane season just passed its halfway point – the National Oceanic and Atmospheric Administration considers the eight-week period around Sept. 10 as a 'hurricane season within the season.'

At Western – where world-class labs focus on mitigating the effects of wind, rain and flood – the intense storms have made researchers all the more determined to find ways to reduce the human cost and property loss.

The news images flattened of cities are more than just theoretical to Engineering professor Greg Kopp, Associate Dean of Engineering and an expert on the effects of structures of extreme winds. He recalls going into the frenzy of Hurricane Dennis in 2005, with the coastline under an evacuation order, to place an array of sensors along a Florida beach.

"It's interesting, being in a storm after all the emergency personnel have left. It's raining so hard that it stings like needles on exposed skin," he said.

When the storm had abated and the team returned to pick up their gear, "a woman was standing there, suddenly unemployed. Her home was fine but the restaurant she worked at had been just blown away. It made a profound impact on me, and continues to do so, more than a decade later," Kopp said.

That memory gives him additional impetus to ensure that structures are better braced against disasters.

At the Insurance Research Lab for Better Homes, Kopp and his team test how wind affects structures, at what point they become unstable and how to make them wind-resilient in the best and most efficient ways.

"The lowest-hanging fruit is how we fasten the whole roof onto the walls," he said.

For example, they've found attaching the roof of a building to its walls with hurricane straps during the construction process can cost as little as $200 and make a building resistant to 40 per cent more wind pressure.

Adding more nails, and making sure they are just a centimetre longer than the building code requires, doubles the strength of roof sheathing for an additional cost of just $10, he said. Those fortified standards can mean the difference between storm devastation and storm resilience.

"It's not just chance that in Hurricane Ike in 2008, we saw that there was virtually nothing left of some homes, while others were seemingly unscathed."

Only in the modern era have people built intensively in areas that once were off limits. "Our work as engineers is to make houses and all built infrastructure resilient. Our task isn't just to build things, it's to build them efficiently and appropriately to the context."

A nuclear-energy facility, for example, must be built to withstand higher forces than would be necessary in a home's design.

But smarter building standards alone are no substitute for sound planning decisions. "We can't make the risk (of storm damage) go to zero, so we should be careful about where we build at least as much as how we build," Kopp said.

Engineering professor Slobodan Simonovic is equally adamant about the need for improved flood resilience. As Director of Engineering Studies with the Institute for Catastrophic Loss Reduction, Simonovic argues that traditional approaches to flood control are insufficient.

Current tools that plan for the 100-year flood, or the 500-year flood, ignore the reality that no single-system approach works, Simonovic said from an international conference in the U.K. where he was giving a lecture on the need for a paradigm shift in flood resilience.

"Houston experienced 1.2 metres of rainfall in a very short time. In a traditional approach, you plan for an event – say, a 100-year flood – and decide if it's worth building or not building from there. That number simply doesn't tell you what will happen to the water treatment plant. It won't tell you anything about what will happen to your home, your factory."

Instead, he said, planners should look at a multitude of variables to determine how each design would withstand individual events. If wastewater treatment plants and their mechanical and electrical systems are raised above floodplain, for example, they may become more resilient, he added.

Similar assessments need to take place when designing, building, repairing and protecting all structures and infrastructure, he said. "This is

a very different kind of approach" that goes beyond simply assessing whether the cost/risk analysis makes it worthwhile to build citywide water-diversion channels or barriers.

The flood resilience model is being used by various municipalities, including Toronto, to understand how specific facilities might be affected by, and can be protected against, specific events.

Climatologist Gordon McBean, Professor Emeritus in Geography and Nobel Peace Prize co-recipient for his work on climate change, is impressed by Western's inter-disciplinary approach to the issues. Wind engineers, hydrologists, social scientists, physicists, sociologists, anthropologists, psychologists and geographers are all needed to examine and mitigate a host of climate-related changes to the environment, he said.

The science and physics predicting more intense weather systems have been borne out on the ground. "We understand climate systems more than we used to," said McBean, who is also president of the International Council for Science. "Scientifically, the community has been saying we will have an increase in the frequency of Category 4 and 5 hurricanes."

McBean, a former Deputy Minister of the Environment, whose decades of research and advocacy has led to international policy change, said governments and others need to ramp up disaster risk reduction in the face of inevitable severe weather events.

"Adaptation doesn't mean we've lost the battle" to halt and ultimately reverse climate change, he said. "It doesn't mean we shouldn't focus on emission reduction. We should do both."

He said every one of his public presentations ends with a slide that shows photos of his grandchildren and other children. "There's the whole issue

of inter-generational ethics and responses. We do climate science for the benefit of society. We do it for all families, for all kids and grandkids."

Provided by University of Western Ontario