Scientists counter threat of flooding on coral reef coasts

November 23 2017, by Roeli Suiker

Credit: The image is released free of copyrights under Creative Commons CC0.

Scientists have developed a computer simulation tool to predict short-

term flood hazards on coral-reef-lined coasts and to assess longer-term impacts from climate change. The assessments will give input to estimate societal or economic risk and damage from such flooding. The tool can be used to play "what-if" games and ask questions such as, "how will flood risk change if the coral on this reef dies, or if sea level rises by more than 1 meter?"

Hurricanes Harvey, Irma, Jose, and Maria became household names this fall as they tore a path of destruction through the Caribbean and southern United States. The waves generated by such hurricanes or cyclones can have devastating effects on low-lying tropical coasts fronted by coral reefs. Scientists from Deltares, the U.S. Geological Survey, and Delft University of Technology have developed a tool called "BEWARE": Bayesian Estimator of Wave Attack in Reef Environments for predicting flooding caused by waves on coral reef-lined coasts. The results were published this month in the *Journal of Geophysical Research*: *Oceans*.

Thousands of islands threatened

Coral reef-lined tropical coasts face the threats of climate change, sea-level rise, and coral degradation. Many of these islands are low-lying (less than 3 m above mean sea level), with their freshwater in thin, fragile aquifers just beneath the surface of the ground. This makes residents of such coastal areas extremely vulnerable to sea-level rise and flooding caused by waves, which can threaten their food and water supply, public health, and critical infrastructure. Population growth and the impact of climate change are expected to escalate such hazards.

Flood prediction: a challenging task

However, "it is quite challenging to predict flooding caused by waves along coral reef-lined coasts," said Stuart Pearson, lead author from

Deltares and Delft University of Technology. "This is because coral reefs differ widely in their physical structure. Furthermore, the wave and sea level conditions affecting them often vary significantly in space and time. For many locations, there are little to no data available regarding these factors. The task of coastal flood prediction is made even more difficult by the complex changes that waves undergo as they move across coral reefs and approach the shore."

Tackling the problem

BEWARE solves the challenge of working in regions with poor data availability by generating an artificial database of wave conditions on coral reefs using the physics-based XBeach Non-Hydrostatic wave model. This database is open-access and downloadable here. These data are compiled in a statistical Bayesian network model that enables the kind of fast predictions needed to power early warning systems for coastal flooding. By feeding BEWARE information about waves and sea level plus the structure of the reef, flood hazards can be predicted at the coastline. Dr. Curt Storlazzi, a co-author from the U.S. Geological Survey: "Such tools are key to assess hazards and prioritize efforts to reduce risk and increase the resiliency of coral reef-lined coastal communities".

More information: S.G. Pearson et al. A Bayesian-Based System to Assess Wave-Driven Flooding Hazards on Coral Reef-Lined Coasts, *Journal of Geophysical Research: Oceans* (2017). DOI: 10.1002/2017JC013204

Provided by Deltares