Towards the development of a beach hazards warning system for Puerto Rico

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OVERVIEW

Accurate surfzone forecasts communicated in a concise manner are important in planning nearshore activities and preventing drowning fatalities. In Puerto Rico, an average of 25 beach drownings occur per year and most are due to the fact that beachgoers are not well aware of surfzone dangers. Complications arise when forecasting surfzone conditions, especially the exact conditions that present a threat for swimmers, surfers, kayakers and many other beachgoers. The present study set out to develop a beach hazards warning system that takes into account data from CariCOOS's bouys and from their Nearshore Wave Model (SWAN), as well as local bathymetry and empirical knowledge, to emit a "surfzone hazard level" for recreational beaches in Puerto Rico with the same hazard levels used in the Hawaii Beach Safety Initiative (http://oceansafety.soest.hawaii.edu/about/matrix.asp):
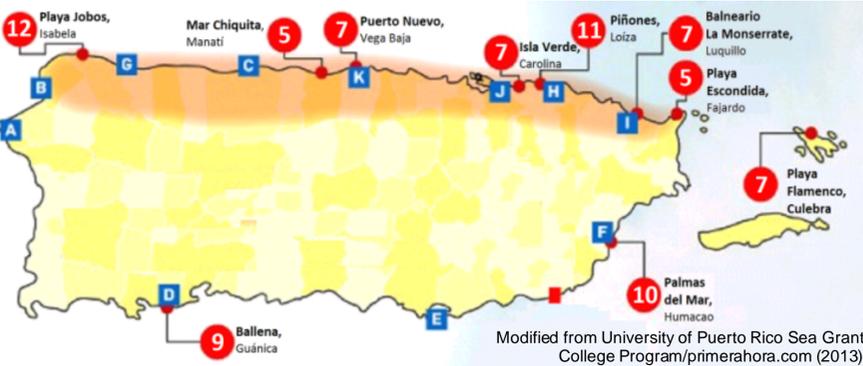
Modified from University of Puerto Rico Sea Grant College Program/primerahora.com (2013)

Moderate Risk
Approach with caution, conditions can change. Safest level of beach conditions.

High Risk
Conditions are hazardous. Advisory to stay out of the ocean.

Extreme Risk
Conditions are extremely hazardous. People are advised to stay out of the ocean.

UNDERSTANDING SURFZONE CONDITIONS

In order to understand surfzone conditions at the most dangerous beaches in Puerto Rico, numerical simulations were conducted with the BOUSS2D wave model. The picture on the right shows typical rip currents at Palmas del Mar Beach in Humacao. The far right plot shows the variation in simulated rip current velocities for Hs = 2 meters and increasing Tp.
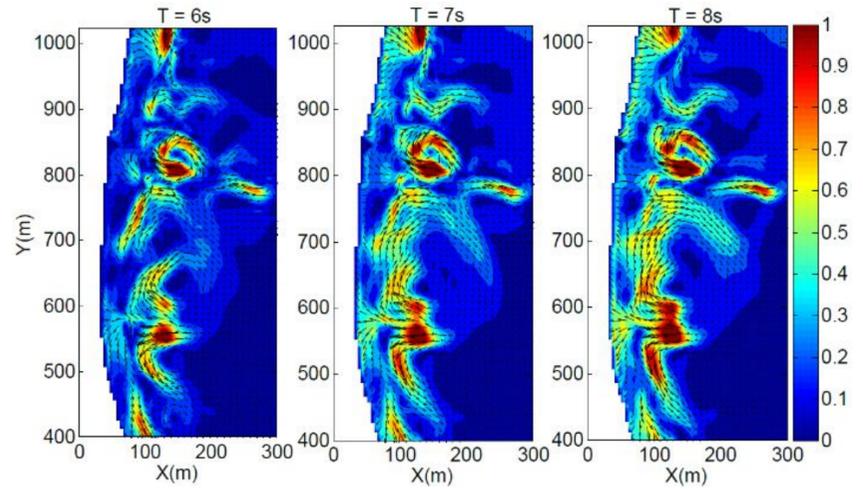

FORECASTING HAZARDOUS CONDITIONS

The present study set out to develop a beach hazards warning system that takes into account data from CariCOOS buoys and from the CariCOOS Nearshore Wave Model, as well as local bathymetry and anecdotal evidence, to emit a "surfzone hazard level" for recreational beaches in Puerto Rico. At the moment, beach hazard levels are estimated for 57 of Puerto Rico's most popular beaches. Within the validated SWAN model, a network of virtual buoys provides forecasts of 3 to 5 days in advance for wave breaking height distributions using a combination of analytical and empirical formulae (Komar and Gaughan, 1973; Caldwell and Aucan, 2006). Using the range of expected nearshore breaker heights as well as beach-specific hazard information, beach hazard levels are estimated for each beach.

Estimated hazards levels for Puerto Rico beaches on February 19, 2014
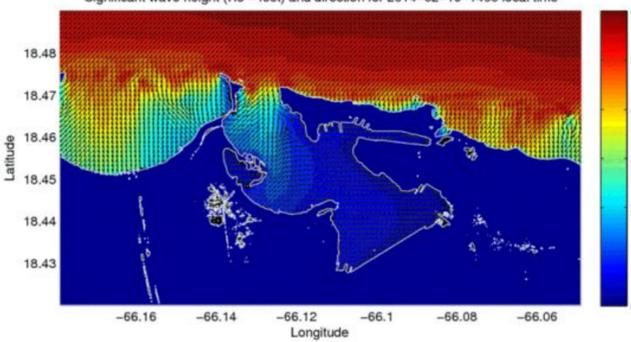
Hazard level estimates for San Juan beaches (February 19, 2014)
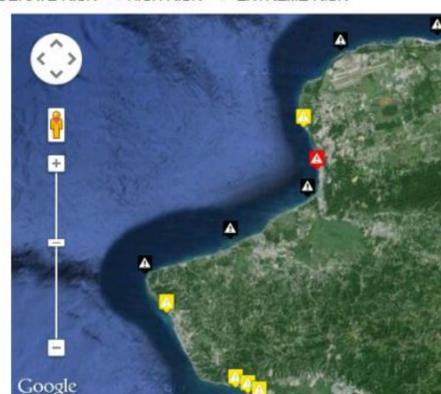
Hazard level estimates for NWPR beaches (February 19, 2014)
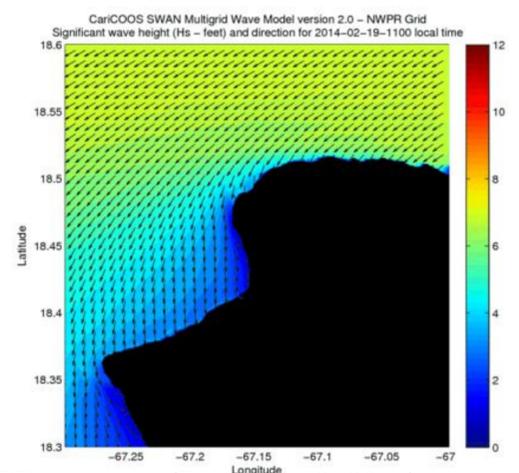
SUMMARY

- An operational (although experimental) wave-induced beach hazards forecasting system has been developed for Puerto Rico
- Continuous monitoring and tweaking will occur as the model is evaluated in the following months
- Legal implications currently being discussed with state and federal agencies