PREDICTION OF SMALL BAY FLOODING THROUGH TIDAL INLET AND BY WAVE OVERTOPPING OF BARRIER BEACH

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ANALYTICAL MODEL

Low-laying barrier beach is easily overtopped by waves during a severe storm, resulting in increased water level in the inland bays and extensive flooding along the long bay shoreline. Kobayashi and Zhu (2017) developed a simple analytical model to predict bay peak still-water elevation in Indian River Bay and Rehoboth Bay (I, R, and D in Figure 1) for given ocean peak still-water elevation and surge duration at Lewes (L in Figure 1). 27 storms identified during 2005-2015 (blue points in Figure 2) were used to calibrate the dimensionless parameter K^* related to the inlet and bay characteristics. The agreement is within 10% at tide gauges I and R and within 30% at tide gauge D (Figure 2).

WAVE OVERTOPPING

Sand overwash deposit was observed after Hurricane Sandy. Wave overtopping over barrier beaches may have never been measured, and the degree of wave overtopping has been inferred from surveyed overwash. The cross-shore numerical model CSHORE is modified to predict the profile evolution of the barrier beach and wave overtopping rate during Hurricane Sandy (2012). The computed total overtopping water volume over barrier beach of 7.2-km alongshore length (L1-L14 in Figure 1) is of the order of 10^8 m^3. The analytical model including wave overtopping predicts the peak still-water elevations at tide gauges I and D next to barrier beach within 2% errors, and at tide gauge R within 8% error (Table 1).

VERIFICATION OF CALIBRATED MODEL

The calibrated model was verified by additional 7 storms in 2016 and 2017 (red points in Figure 2). There are three points outside the 10% errors in I and R stations, partly because the dimensionless parameter K^* was kept the same.

Table 1 Peak still-water elevation at Lewes (L), in Indian River Bay (I and R), and Rehoboth Bay (D) during Hurricane Sandy.

Tide Gauge	Peak Still-water Elevation (m)		
	Measured	Analytical	
		no overtopping	with overtopping
L	1.85	1.85 (input)	1.85 (input)
I	1.75	1.63 (6.9%*)	1.76 (0.6%)
R	1.66	1.67 (0.6%)	1.79 (7.8%)
D	1.34	1.14 (14.9%)	1.36 (1.5%)

* *Relative error between measured and analytical values*

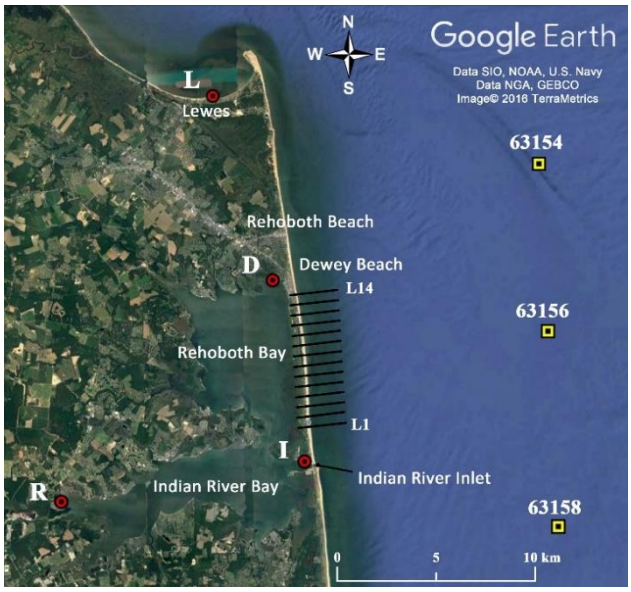

Figure 1 Available tide gauge data (red circle), wave data stations (yellow squares), and barrier beach profiles along 14 cross-shore lines (L1-L14) in the study site.

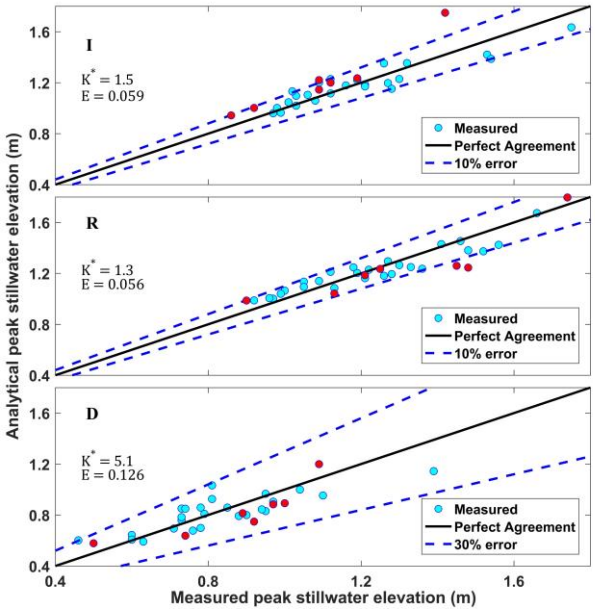

Figure 2 Measured and analytical peak still-water elevations in bay at tide gauges I (K^* = 1.5), R (K^* = 1.3), and D (K^* =5.1) with 10% or 30% error range and RMS relative error E.

REFERENCES

Kobayashi, N. and Zhu, T. (2017). "Bay flooding through tidal inlet and bay wave overtopping of barrier beach." J. Waterway, Port, Coastal, Ocean Eng, 143(5), 1-14.