COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

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for the degree of Doctor of Philosophy (Ph.D.)

"Stochastic Methodology to Quantify Flood-Risk for South Florida Coastal Areas"

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Engineering West, Room 231B
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ABSTRACT OF DISSERTATION
Stochastic Methodology to Quantify Flood-Risk for South Florida Coastal Areas

Current flood-risk models lack fidelity at the municipality level. The Federal Emergency Management Agency (FEMA) develops flood maps based on experts' experience and estimates on the probability of flooding for long-term flooding events. A recent effort undertaken by the First Street Foundation with 103 flood technical experts in 23 universities and organizations across the United States evaluates flood risk with regional and subjective measures, while not considering neighborhood-level impacts from torrential rain and resulting nuisance flooding. The purpose of this research is to develop a data-driven method to determine a comprehensive flood-risk that accounts for severe and nuisance flood events at the single-family home level, which includes an estimate of the average recovery time anticipated from a flooding event, not present in current global flood-risk modeling.

The method developed here supports more effective community decision-making in flood-risk management by adapting the American Society of Quality industry standard, Failure Mode and Effect analysis method to determine the Consequence of Flooding (CoF) following a short-term severe event, i.e., the 1-day 100-yr storm. The CoF is a function of occurrence, severity, and damage avoidance. Probability of Flooding (PoF) is a hydrologic response to a pre-determined rainfall event, given key features of the sub-watershed, such as topography, surface water features, groundwater elevations, soil water holding capacity, and current/future land infrastructure. The product of CoF and PoF at a particular location provides an estimate of the flood-risk. A Resilience Index value is calculated from the flood-risk and is used to determine the recovery time after a severe or moderate storm event, such as hurricanes with more than 6.5 inches of rain deposition.

FEMA and FSF comparison with the Resilience Index for southwest Florida and southeast Florida inland locations are in agreement for at least 85% of the locations studied. For the coastal locations, the FSF results and the Resilience Index are in agreement with 70% of the locations. However, the FEMA results are not in agreement with either FSF or the Resilience Index (<35%) likely due to limited input data being included in the FEMA approach in addition to political concessions playing an important role in the southeast Florida coastal area.

The Reliability Index is a function of the Consequence of Nuisance Flooding (CoNF) and Probability of Nuisance Flooding (PoNF). The CoNF is determined from the community mitigation efforts to prevent flooding damage, and the PoNF is derived from the frequency and duration of torrential rainfall, not associated with hurricanes, causing delays and disruptions to daily transportation, acute human illnesses, and property

damage not covered by FEMA insurance protocols. Transportation is the socio-environmental activity at highest risk from nuisance flooding, with up to 4.5 hr. commute delay expanded for two days in the heavily populated areas of southeast Florida.

The recovery time from nuisance flooding and from severe storms is consolidated into a conflation Resilience-Reliability (&RR) model. In the &RR model the variance from moderate and severe storms is considerably greater than the variance for nuisance flooding. When conflating more than two distributions, the variation contribution of each independent input is weighted to favor the distribution with minimum variation. In this study, nuisance flooding dominates the resulting &RR variation, with a variance of 4.9 $days^2$ for the southwest and 30.2 $days^2$ for the southeast, compared to the variance from moderate storms of 400 $days^2$. The conflated &RR model variation is 327 $days^2$ for the southwest, and 278 $days^2$ for the southeast. The &RR distribution is between nuisance flooding recovery time and that of moderate storms. The median, as the best measure of central tendency for a skewed distribution, is approximately equal for both geographical locations. Southwest &RR median is 12.5 days and 11.5 days for the southeast. This framework transforms subjective flood-risk estimation into a quantitative model, eliminating interpretations and arriving at data-based results at the property level. This comprehensive approach provides awareness to local municipalities on their flood-risk and gives insight for severe and nuisance flood management actions.

BIOGRAPHICAL SKETCH
Born in Puerto Rico
B.S., Florida Atlantic University, Boca Raton, Florida, 2000
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CONCERNING PERIOD OF PREPARATION
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Time in Preparation: 2019 - 2022

Qualifying Examination Passed: February 2021

Published Papers:

Suarez E. and D. E. Meeroff, 2021. Interdisciplinary approach to flood risk and the Consequence of Flooding, Poster FLOODrisk 2020 Conference, Proceedings and Poster June 22-24, 2021.

Bloetscher, F., A. Abbate, J. Huber, W. Liu, D. E. Meeroff, D. Mitsova, S. Nagarajan, C. Polsky, H. Su, R. Teegavarapu, Z. Xie, Y. Yong, C. Zhang, R. Jones, G. Oglesby, E. Suarez, and T. Hindle, 2021. Establishing a Framework of a Watershed Wide Screening Tool to Support Development of Watershed Based Flood Protection Plans in Low-lying Coastal Communities, Journal of Infrastructure, Policy and Development, Vol. 5, Issue 1. doi: 10.24294/jipd.v5il.1273.