BIOGRAPHICAL SKETCH

John Brackins grew up in Franklin, Tennessee. He earned his Bachelors of Science in Civil and Environmental Engineering from Tennessee Tech University in 2017, and he went on to earn his Masters of Science in Civil Engineering there the next year. In 2018, he was selected to participate in the National Water Center Innovators Program Summer Institute, where he pursued research to improve the National Water Model. He was selected as a recipient of the prestigious National Science Foundation's Graduate Research Fellowship Program (NSF-GRFP) in 2019.

EDUCATION

Ph.D. Civil Engineering
Tennessee Tech University, 2022 (expected)

M.S. Civil Engineering
Tennessee Tech University, 2018

B.S. Civil and Environmental Engineering
Tennessee Tech University, 2017

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College of Engineering

TENNESSEE TECH

The Department of

Civil and Environmental Engineering

Announces the Dissertation Defense of

John Brackins, E.I.

In Partial

Fulfillment of the Requirements

For the degree of

Doctor of Philosophy in Engineering

April 6, 2022

2:00 p.m.

Held in

Prescott Hall, Room 225

Tennessee Tech University

You can join the Teams meeting at this link.

FIELD OF STUDY

Civil and Environmental Engineering

DISSERTATION TOPIC

Evaluation of Nonlinear Interactions Between Tropical Cyclone Storm Surge and Rainfall-Runoff to Improve Understanding of Joint Coastal Flood Risk

EXAMINING COMMITTEE

Dr. Alfred J. Kalyanapu (Chair), CEE

Dr. Tania Datta, CEE

Dr. Daniel Badoe, CEE

Dr. Sheikh Ghafoor, CSC

Dr. Jie Cui, ME

ABSTRACT

While the interactions of tropical cyclone storm surge and rainfall-runoff flooding result in greater hazards to coastal residents, storm surge and rainfall-runoff flooding are currently modeled as separate phenomena for the purpose of coastal flood risk mapping and insurance underwriting, likely underestimating the flood risk inherent in the interaction of these two flooding phenomena. Therefore, the overarching objective of this dissertation is **to develop a methodology accounting for the nonlinear interactions between storm surge and tropical cyclone rainfall-runoff flooding**. This methodology will have the potential to expose currently hidden flood risks and allow communities to better map and mitigate these "new" risks.

The first research objective aimed to predict tropical cyclone rainfall using only five tropical cyclone parameters used in joint probability methods (landfall position, storm intensity, storm size, storm forward speed, and landfall approach angle). While the four statistical rainfall models considered in this study are likely insufficient for direct use in coastal risk flooding, the methodology used in this study to evaluate these models can be applied in similar flood risk studies. The second research objective sought to couple together hydrology models (forced with boundary conditions of rainfall from the parametric models in the first objective) to hydrodynamic storm surge and wave models to simulate joint flooding during tropical cyclone events. To accomplish this objective, a relatively novel approach extending the `water-coupler` framework of Choudhary (2021) was pursued, allowing the dynamic coupling of typically separate hydrologic (GSSHA) and coastal (ADCIRC) numerical models along a curvilinear boundary. The third research objective explored improvements to the coastal flooding joint probability method framework in order to better represent statistical properties of the underlying marginal distributions, such as skewness.