College of Engineering

TENNESSEE TECH

The Department of

Civil and Environmental Engineering

Announces the Dissertation Defense

of

Tigstu Tsige Dullo

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy in Engineering

August 10, 2020

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Prescott Hall 313

Tennessee Tech University

Zoom Link:
https://tntech.zoom.us/j/92638538054?pwd=N3NCM0NyU01oQmtyeVMyNGNGOHRFQT09

FIELD OF STUDY

Civil and Environmental Engineering

Dissertation Topic

Assessing Flood Risk and Flood Policy using an integrated Modeling Framework

EXAMINING COMMITTEE

Dr. Alfred Kalyanapu, Chair
Dr. Evan Hart
Dr. Tania Datta
Dr. Lenly Weathers
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ABSTRACT

Recent observations exhibit an increase in the frequency and intensity of extreme precipitation events, which have strengthened the magnitude and frequency of flooding. Thus, the ability to conduct spatially explicit simulations of flood regimes at high resolution and large spatial extent within a reasonable time is critical in determining the impacts and risks associated with these events. The goal of this dissertation is to highlight the challenges in a large-scale flood inundation modeling and to evaluate flood risk and floodplain regulation standards in a changing environment by applying an integrated modeling framework. The flood inundation responses associated with different model parameterizations, digital elevation model errors, and reservoir storage capacities were evaluated to understand their relative importance in a large-scale flood simulation. A 20% increase in the base Manning's n map resulted in about 1% increase in the peak water depth value and around 2% (65 km2) increase in the inundation area. The flood depth and velocity outputs from 880-ensemble simulations were summarized to evaluate the potential changes in flood risk, electricity infrastructure vulnerability, and floodplain regulation standards under changing climate. It is observed that nine out of eleven ensemble members project an increase in the flood inundation area in the future period. At the 1% annual exceedance probability (AEP) level, the flood inundation frequency curves indicate ~16 km2 increase in floodplain area under future climate. The comparison between the flood depth frequency maps from the baseline and future simulations indicated that, on average, ~80% of grid cells exhibit from 0.2 m to 1.5 m increase in the flood depth values. The flood risk analyses demonstrated a potential increase in the projected flood severity for electric substations and building infrastructures in the future period. The outcomes of the research are (1) supporting information to guide and prioritize the development of future large-scale flood inundation modeling, (2) a better understanding of how climate change may affect flood risk, electricity infrastructures, and existing floodplain regulations, and (3) an alternative floodplain delineation technique that incorporates the uncertainties from climate data and selected flood events.

BIOGRAPHICAL SKETCH

Tigstu Tsige Dullo received Bachelor of Science in Hydraulic Engineering from Arba Minch University (AMU), Ethiopia in 2007. After his graduation, he worked as a Graduate Assistant for one year at the same university. He then further pursued his academic career and received a Master of Science in Water Resources Engineering and Management from the University of Stuttgart, Germany in 2010. Later, he returned to Ethiopia and resumed teaching and research activities in AMU. He entered Tennessee Technological University in August 2013 and attends to recieve a Doctor of Philosophy in Engineering in August 2020. His research focuses on large-scale flood inundation modeling.

EDUCATION

B.Sc. Hydraulic Engineering
Arba Minch University 2007

M.Sc. Water Resources Engineering and Management
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