APPLICATION OF VIRTUAL REALITY (VR) FOR URBAN FLOOD MODELING AND MITIGATION

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Rapid urbanization, ecological stress, climate change, and associated extreme rainfall events pose a threat to the urban environment. Many cities recognize the potential of nature-based solutions (NbS) in managing and mitigating urban stormwater runoff, yet most lack systematic strategies for transitioning away from their existing conventional drainage systems. This paper introduces a comprehensive strategy that combines Virtual Reality (VR) based 3D Flood Visualization and Grey to Green (G2G) transition tools. These tools are designed to assess the impacts of extreme rainfall events and identify flood mitigation measures. They are intended to provide natural resource managers, planners, foresters, and engineers with a step-wise approach to aid the flood modeling and planning process for NbS. The strategic approach includes: (i) GIS-based model setup, (ii) 1D/2D flood model, (iii) Virtual Reality (VR) based 3D flood visualization, and (iv) G2G for assessment and selection of flood mitigation measures. First, GIS mapping is employed to establish hydrology, map green infrastructure, identify areas for protection and restoration, tailor development projects to the site, and identify NbS opportunities while considering site conditions and existing drainage systems. Second, 1D/2D flood modeling is carried out using the Interconnected Channel and Pond Routing (ICPRv4) hydrologic and hydraulic model. Third, a 3D model of areas under investigation is developed using dronedeploy and linked with the 1D/2D flood model in the VR platform. Fourth, G2G scenario analysis is applied to quantifying volume and pollutant load reduction while exploring the use of different NbS. The final stage involves the selection of the most suitable combination of current stormwater systems and NbS. This choice takes into consideration site constraints, the objectives of minimizing water quality and quantity issues, and the noteworthy additional social and ecological benefits, such as aesthetics, air quality, and addressing heat island effects. When used in combination, the strategic approach identifies a prioritized, optimal transition pathway from existing conventional drainage systems to NbS. The impacts of flooding are presented using 3D animation that places viewers at the center of the flooding event. In this way, the urgency and need to address flood risks are effectively communicated—making it hard for viewers not to be affected by and act on what they see. The outcomes demonstrated the efficacy of the strategic approach and tool, and its application for cities flood resiliency.

PRESENTER BIO: Dr. Seneshaw Tsegaye is an Associate Professor and serves as the Interim Chair of the Department of Bioengineering, Civil Engineering, and Environmental Engineering at Florida Gulf Coast University. In addition, he has been appointed as the Backe Chair for Sustainable Water Research within the U. A. Whitaker College of Engineering. For a span of 15 years, Dr. Tsegaye has accrued experience in the realms of integrated urban water management and flood mitigation.