HINDCASTING FLOOD INUNDATION DEPTHS ACROSS CENTRAL AND SOUTHERN FLORIDA DURING HURRICANE IAN USING SPATIALLY-DISTRIBUTED MACHINE LEARNING ALGORITHMS

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Hindcasting flood characteristics is integral to advancing our capacity to predict future events accurately. While machine learning (ML) algorithms have proven efficient in forecasting flood features, previous ML research primarily fixated on predicting flood extents, neglecting vital characteristics like flood depths. In this study, we present a spatially-distributed ML model to hindcast maximum flood depths during Hurricane Ian across Central and Southern Florida. Our approach integrated geospatial analyses and meticulous feature selection to forecast flood depths at various stream locations. Key features, representing crucial physical processes such as topography, regulating water infrastructure, levees, soil moisture, hydrodynamics, land surface, hydrology, hydrogeology, and meteorology, were acquired from public domain databases and incorporated into the model. We trained and validated this model using flood depths recorded at stream gauges (USGS' HCDN and SFWMD's DBHYDRO). Our evaluation of the model performance for hindcasting maximum flood depths affirmed the model competence in rivers, with high R-squared values. However, the ML model, when solely trained on river flood data, demonstrated unsatisfactory performance for flood depths on floodplains. To augment the accuracy of flood depth hindcasts on floodplains, we implemented an innovative approach that combines streamflow data with satellite imagery (e.g., MODIS, Sentinel and Landsat) and high-water marks (HWMs). This approach yielded a significant enhancement in the overall hindcast accuracy of the ML model. The model provides a computationally efficient platform to hindcast maximum flood depths during historical major events across Central and Southern Florida.

PRESENTER BIO: Maryam Pakdehi is a third-year Ph.D. candidate in the civil and Environmental Engineering Department at Florida State University, specializing in characterizing major flood events via ML models. She has over a decade of expertise in industry, and has contributed to planning, design, and rehabilitation of water distribution networks. Her research has been published in peer-reviewed articles.