COMPOUNDING EFFECTS OF SURFACE-SUBSURFACE WATER INTERACTIONS AND SEA LEVEL RISE IN NORTH MIAMI

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Southeast Florida is highly vulnerable to heavy rainfall, hurricanes, king tides, and shallow water tables due to its flat terrain, geographical location, karst morphology, and rising sea levels. Despite innovations in hydroinformatics to simulate the combined effects of pluvial, fluvial, and coastal flood drivers, groundwater flooding is not envisioned in most 2D hydraulic models and flood mapping products. Here, we proposed an integrated surface-subsurface modeling framework capable of simulating the compound interactions of pluvial, coastal, and groundwater flooding in the Arch Creek Basin in North Miami. The framework applies a copula-based statistical analysis to estimate the flood hazard levels over a range of gauge stations near the study site. A two-way coupled FLO-2D and MODFLOW-2005 model then simulates inundation depths and extents for different combinations of 100-year precipitation – storm tide events paired with predefined water table levels. The analysis was repeated with sea level rise projections to assess the severity of future scenarios. The presented framework for surface-subsurface water interactions reveals that the emergence of groundwater to the surface increases the inundation extent in low elevation areas with minimal flood damage to buildings. The revelation of hidden risks caused by the compound effects of pluvial, coastal, and groundwater flooding may prove beneficial for better urban planning policies as well as prevention, mitigation, and adaptation strategies.

PRESENTER BIO: Mr. Peña is a Ph.D. Candidate in Earth Systems Science and Civil and Environmental Engineering with an extensive professional background in flood risk management. He has applied his flood risk expertise to support environmental, financial, urban resilience, and disaster risk reduction initiatives, projects, and scientific research in multicultural environments.