Capturing Compound Flooding for Operational and Research Settings

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Background/Objectives. Floods have been, and continue to be, among the most prevalent natural disasters resulting in billions of dollars in damage each year. Components of flooding consist of pluvial (upland), fluvial (river), and coastal flooding. To capture the true impact and gain a full picture of flood risk within the coastal zone, all components of flooding (compound flooding) must be considered simultaneously. Risks related to compound flooding are expected to change as a result of increasing sea levels and changes in the frequency and intensity of extreme weather events.

Approach/Activities. We present an approach to characterize coastal flood risk that captures the compounding effects of coastal flooding. We use an integrated modeling capability that can be used both operationally (e.g., emergency response) and for fundamental research purposes to explore future risk changes in coastal urban environments. The pipeline consists of multiple models and data sources to capture inland (pluvial and fluvial) and coastal flooding. The models include the Rapid Infrastructure Flood Tool (RIFT) and the Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model. RIFT is a two-dimensional hydrodynamic model developed to quickly produce flood estimates for multiple types of flooding. RIFT has been used extensively to model the impacts of inundation caused by elevated river stages, dam breaks, and extreme rainfall events. SLOSH is a physics-based National Weather Service (NWS)-developed model that predicts storm-surge heights for real-time and hypothetical events. Our pipeline orchestrates the data extractions and transfers, inputs/outputs, and model executions. In an operational context, the pipeline utilizes NWS P-Surge data from SLOSH ensembles which are used as initial conditions for RIFT simulations, combined with precipitation forecast forcings (e.g., QPF). In a research setting, the modeling capability is used to understand the fundamental drivers of coastal flood risk and changes due to climate change. This is accomplished by using output from the Risk Analysis Framework for Tropical cyclones (RAFT), which is a statistical dynamical model that generates large ensembles of track, intensity, and precipitation. Track and intensity are used to force a coastal hydrodynamic model (e.g., SLOSH) and the precipitation is used to force an inland flood model (e.g., RIFT) to develop ensembles of compound flooding.

Results/Lessons Learned. This work presents an automated pipeline for compound flood modeling and examples of how this is used in both operational and research settings. This integrated modeling pipeline is shown to be effective in simulating the nonlinear interactions from multiple flooding sources.