**Identifying spatially variable compounding flood drivers along coastal rivers using observed and simulated data**

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**Abstract**

Coastal rivers are exposed to flooding from multiple processes such as high tides, storm surge, and river discharge. A compound flood event occurs when two or more of these flood drivers interact, exacerbating flooding impacts. Compound flooding along coastal rivers can be difficult to characterize based on observational data alone due to spatial and temporal limitations. Model simulations can fill in gaps between stations and allow for the identification of transition zones from coastal storm surge-dominated to river-driven events, critical for mitigating the impacts of such flood events.

The goal of this study is to integrate observational data sets of flooding with long, synthetic estimates of along-river water level to characterize joint river and coastal processes that cause flooding along coastal rivers. First, we identify flood events at United States Geological Survey stream gage stations moving from the coast upriver and specify whether extreme and/or non-extreme joint conditions of upstream river discharge and downstream coastal water level combine to drive flooding. Next, we employ a hybrid statistical/numerical modeling framework which stochastically simulates a large sample of upstream and downstream boundary conditions and then uses the Hydrologic Engineering Center’s River Analysis System to model along-river water levels in a computationally efficient manner. Together, the observational record analysis and hybrid modeling allow for a comparison of conditions likely to result in flood events to aid our understanding of how observational records can be used for compound flood evaluation.

We apply these methods to the Savannah River, separating Georgia and South Carolina, and the Suwannee River in northern Florida. We find that the transition zones where both coastal and river-driven processes drive flooding extend farther upstream than observations alone suggest. Furthermore, the hybrid simulations show river and coastal events may combine to drive flooding even when the extremes of both processes are not highly correlated.