**A catchment scale assessment of the potential for compound river discharge - storm surge events**

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**Abstract**

In the lower reaches of coastal catchments, the compounding effects of river discharge and storm surge often intensify flooding impacts. Independent assessment of the fluvial and coastal hazard in these areas will thus potentially mischaracterize the true flood risk. Although large scale analyses of the dependence between the two drivers have identified regional hotspots, exposure to compound flooding is heavily influenced by local factors such as catchment size and morphology. Accounting for the compound effects necessarily increases the complexity and computational cost of the statistical analysis and hydrologic modeling. A high-level assessment of the dependence between flooding drivers is a pertinent first step for stakeholders undertaking site specific analysis. Two-sided conditional sampling coupled with copula theory has become an established method for such high-level assessments, where the extreme river discharge observations are paired with maximum surge within a specified time-lag and vice versa to create two conditional samples. The nature of the dependence, when each driver is conditioned to be extreme, is found by finding the best fitting copula for each sample. The approach involves many subjective choices including the method for identifying extreme events (block maxima or peaks-over-threshold), whether to account for the fit of marginal distributions, and the time-lags considered between the drivers.

The aim of this study is to estimate the potential for compound events at three sites on the Texas Gulf Coast where the U.S. Army Corps of Engineers plan to upgrade or install new hurricane flood protection systems. This includes a comprehensive sensitivity analysis, showing that results are highly sensitive to the subjective assumptions in the model setup. A pragmatic approach that accounts for the marginal fit in a POT framework is proposed leading to stable estimates of the potential for compounding high discharge and storm surge events. Adopting precipitation as a proxy for discharge in the absence of sufficiently long discharge records results in an increase in the estimated potential for compound events.