**On the generation of high-resolution design events capturing the joint occurrence of rainfall and storm surge in coastal basins**

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**Abstract**

Coastal areas are subject to the joint risk associated with rainfall-driven flooding and storm surge. To capture this dependency and the compound nature of these hazards, bivariate modeling represents a straightforward and easy-to-implement approach that relies on the observational records. Most existing applications focus on a single tide gage - rain gage/streamgage combination, limiting the applicability of bivariate modeling to develop high-resolution space-time design events that can be used to quantify the dynamic, i.e. varying in space and time, flood risk in coastal basins. Moreover, there is a need to recognize that not all extreme events always come from a single population, but can reflect a mixture of different generating mechanisms.

Therefore, the goal of this study is to describe a practical approach to develop design storms with high resolution in space and time (i.e., ~5km and hourly) for different joint annual exceedance probabilities. We also stratify extreme rainfall and storm surge events depending on whether they were caused by tropical cyclones (TCs) or not. We find that there are significant differences between the TC and non-TC populations, with very different dependence structures that are missed if we treat all the events as coming from a single population. While we apply this methodology to one basin near Houston, Texas, our approach is general enough to make it applicable for any coastal basin.