**Tropical cyclone storm surge probabilities for the east coast of the United States: A cyclone-based perspective**

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**Abstract**

Regions along the coastline of countries, such as along the east coast of the United States, have become increasingly exposed to coastal flooding because of storm surge. The conditions that lead to the generation of storm surge are likely to become worse in the future. This can be attributed to rising sea levels, geomorphic changes in the coastal regions, and increasing storm intensities with anthropogenic climate change. The magnitude of the changes to these factors will influence how much destruction storm surge may cause in low-lying coastal communities in the future. Storm types, such as tropical cyclones (TCs) and extratropical cyclones (ETCs), occur on varying annual frequencies depending on the latitude of a location. Although TCs occur much less frequently along the east coast of the US, individual TCs can cause more damage as they often are associated with more moisture and stronger winds than ETCs. Therefore, it is the focus of this research to understand how differences in certain characteristics of TCs relate to storm surge.

In this paper we analyze the relationship between storm surge and TC characteristics, including TC proximity, intensity, and path angle, using observational data for 12 locations along the east coast of the United States. At each location, storm surge is influenced differently by these characteristics, with some more strongly influences by TC intensity and others by TC proximity. The correlation for individual and combined TC characteristics increases when conditional sorting is applied to isolate strong TCs close to a location. The probability of TCs generating surge exceeding specific return levels (RLs) are then analyzed for TCs that pass within 500 km of a tide gauge, where between 6% and 28% of TCs were found to produce surge exceeding the 1-yr RL. If only the closest (i.e., < 100 km) and strongest TCs are considered, between 30% and 70% of TCs at most locations north of Sewell’s Point, VA produce surge exceeding the 1-yr RL, whereas over 65% of TCs at almost all sites south of Charleston, SC produce surge exceeding the 1-yr RL. This analysis demonstrates that no individual TC characteristic dictates how much surge will be generated but offers a unique perspective on surge probabilities that is based on all TCs rather than focusing only on those that cause extreme surge.