**Benefits and challenges of separating tropical and non-tropical cyclone data in assessing extremes**

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**Abstract**

A fundamental challenge with coastal storm hazard assessment for the U.S. Mid-Atlantic and Southern New England is that tropical cyclones (TCs) are responsible for the largest events but occur infrequently relative to extratropical cyclones (ETCs). Therefore, TC hazard data are non-ergodic, meaning that distributions are typically under-sampled. As a result, in spite of large differences in TC and ETC maximum intensities, observation-based assessments of surge, wind and rain hazards typically merge data from TCs with far more numerous data from ETCs. An alternative solution to this problem has been model-based assessments of coastal flooding (e.g. by FEMA and USACE) that create synthetic TC events to enable separate extreme value analyses (EVA) of TCs and ETCs. By assessing storm-types individually, model-based approaches (e.g. of FEMA and USACE) have often shown substantially higher estimates of water level extremes than observation-based assessments. However, such model-based hazard-assessments have a high epistemic uncertainty and are challenging to independently validate.

Here, we more broadly explore the utility and challenges of separating storm types for EVA of extreme rain, wind and storm surge. First, we use idealized data representing TC and ETC hazards along the US East Coast in Monte Carlo analyses to demonstrate how EVA using merged TC and ETC data can lead to underestimation of extremes. Second, using the New York Bight (NYB) region as a case study site, we study the different perspectives provided by merged and separated analyses of rain, wind and surge, including both historical observations and synthetic storm sets that were used in a recent study by FEMA. Lastly, we demonstrate potential solutions to these challenges, including use of archival data and news accounts to help improve TC data ergodicity, and we explore the development of a regional indicator of the importance of storm type separation in EVA.