**Spatial and temporal distribution of extreme total water levels drivers along the Atlantic margin of the Southeastern United States**

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**Abstract**

Coastal zones along the Atlantic margin of the Southeastern United States (U.S.) have different physical characteristics due to the region’s long coastline, frequent storms, and the varying exposure to coastal hazards driven by extreme total water levels (TWLs). TWLs, the combination of waves, tides, and non-tidal residuals, are influenced by global, regional, and local factors, making every location unique in terms of TWL magnitude and susceptibility to coastal hazards. Recent studies suggest that specific processes contributing to extreme TWLs (e.g. storm surge, tides, and waves) may not reach their maximum elevation at the peak of the maximum TWL. As the magnitude of extreme TWLs dictates flooding and erosion potential, understanding the relative contribution of individual processes to these events can provide insights into how changes to wave climate, sea level, and storminess may affect extreme TWLs now and in the future.

This study evaluates how the distributions of processes that combine to drive annual maximum TWL events compare to the annual maxima of the drivers individually, at sandy beaches across the Southeastern U.S. TWL is defined as the linear superposition of still water levels (SWLs) from NOAA water level stations and wave runup. SWLs are decomposed into 3 components, mean sea level, tide, and non-tidal residual. The non-tidal residual is further split into an intra-annual seasonal signal, monthly mean sea level anomalies representing interannual variability, and storm surge. TWL time series approximately 40 years long are generated by combining the decomposed SWLs with wave runup, estimated using an empirical model that relates runup to deep-water wave conditions and beach morphology. Differences in the distributions of the components that drive annual maximum TWLs are assessed through comparison with the annual maxima distributions of each process individually. The spatial and temporal variability of the dominant drivers of extreme TWLs is also explored.

Preliminary results indicate that wave runup, mean sea level, and tides are the main drivers of extreme TWLs in the Southeastern U.S. However, maxima TWLs do not occur concomitantly with components’ maxima elevations for most stations. Hence, worst-case scenarios are not frequently experienced across time, indicating that future settings conditioned by climate change may result in higher or more frequent extreme TWL events if drivers reach their maxima simultaneously. Evaluating the variability of TWLs drivers will lead to a better understanding of how changes in future conditions may alter coastal flooding and erosion along the Southeastern U.S. coastline.