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United States East Coast Storm Surge and Cyclone track Characteristics: Differences and Similarities for Extratropical Cyclones and Hurricanes

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Storm surge on the east coast of the United States can be generated by hurricanes or extratropical cyclones (ETCs). Understanding the differences in the impacts of these two phenomena is important for improving strategies to mitigate the damage created. As such, this work examines the magnitude, spatial footprint, and paths of hurricanes and ETCs that caused strong surge along the east coast of the US. Lagrangian cyclone track information, for hurricanes and ETCs, is used to associate surge events with individual storms. First, hurricane influence is examined using ranked surged events per site. The fraction of hurricanes among storms associated with surge decreases from 20-60% for the top 10 events to 10-30% for the top 50 events, and a clear latitudinal gradient of hurricane influence emerges for larger sets of events. Second, surge on larger spatial domains is examined by focusing on storms that cause exceedance of the probabilistic 1-year surge return level at multiple stations. Results show that if the strongest events, in terms of surge amplitude and spatial extent, are considered hurricanes are most likely to create the hazards. However, when slightly less strong events that still impact multiple areas during the storm life cycle are considered, the relative importance of hurricanes shrinks as that of ETCs grows.

Next we examine the details of the tracks of the storm events that cause strong surge events. We find that paths for ETCs causing multi-site surge at individual segments of the US east coast pass very close to the regions of impact. We find that the paths of hurricanes that cause the strongest multi-site surge are often influenced by nearby large-scale circulation patterns. We also examine the relationship between the storm surge time-evolution and the propagation speed of the low-pressure center of the storm events. For extratropical cyclones, slower moving events have weaker cyclonic winds which offsets the enhanced surge associated with the longer duration of the cyclone influence on surge. For hurricanes, there is less correlation between propagation speed and cyclonic wind motion, meaning slower moving events can still generate very strong winds. However, slow moving events still don't cause the absolute largest events.