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Influence of hurricane-related activity on North American extreme precipitation

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Individual hurricanes and their remnants can produce exceptionally intense rainfall, and the associated flooding, even independent of storm surge, is one of the leading causes of hurricane-related death in the U.S. Despite the catastrophic societal costs of hurricanes and the considerable recent attention to possible trends in strength and number, little is known about the general contribution of hurricane-related activity to extreme precipitation over North America and the underlying dynamical mechanisms. Here we show, based on a 25-year observational analysis, that there are important contributions to the occurrence of extreme precipitation events over more than half of North America, including a pronounced signal over northern and inland areas, associated with an average span of influence that extends to several hundred kilometers. Large-scale vertical velocity, maximum wind speed, and tropical/extratropical character are important factors in the strength and range of influence, and the pattern of influence depends on whether an absolute or relative measure of precipitation is considered. Associated changes in stability, moisture, and vertical motion are analyzed to investigate the dynamics of the influence: the largest changes are in vertical motion, with the hurricane-related activity bringing deep tropical values even to inland and high latitude areas, consistent with the occurrence of very heavy, tropical-like precipitation. While the maximum contribution of hurricane-related activity to mean precipitation is generally less than 25% even for the most-affected coastal regions, the contribution to extreme events is much larger: well over 50% for several regions and exceeding 25% for large swaths of the continent. Typical track density plots do not capture the activity's influence on extreme precipitation.