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Global Extreme Precipitation Changes in Relation to Urbanization

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Extreme rainfall is expected to increase because of global warming, driven by the increase in atmospheric heat which boosts the atmospheric water content, subsequently altering precipitation patterns. The Clausius□Clapeyron (CC) equation dictates a 7\% increase in atmospheric capacity to hold water for every 1 °C temperature increase, and although many deviations from CC scaling have been observed, there is a consensus in the literature that extreme precipitation is changing. Urban areas are particularly affected by weather extremes, although the impact of urbanization on intense rainfall remains difficult to quantify. This study investigates changes in extreme precipitation events using daily data from 6028 weather stations worldwide, extracted from the Global Historical Climatological Network (GHCN). While previous studies examined similar trends and found the largest frequency increase for the most intense events, this work also incorporates urbanization factors. The analysis focuses on the 60 most intense precipitation events within the 1962-2021 timeframe, evaluating trends in frequency at each station, and considering stationarity assumptions. Two urbanization indices were used to categorize stations, revealing correlations with changes in extreme event frequency, indicating that the occurrence of extreme precipitations is increasing significantly more in densely populated urban areas. In addition to these observations, the study conducted seasonal analyses, revealing that, for both indices, the frequency versus urbanization index trend is primarily attributed to measurements in the autumn and winter seasons. The observed changes offer a valuable insights into the intricate relationships between heavy rainfall and urban areas, highlighting a correlation between the frequency of extreme precipitation events and urbanization at a global scale. Future research should focus on how specific variables contribute to the observed variations in the characteristics of extremes. These deeper investigations can provide insights into the underlying physical mechanisms driving the variations in the characteristics of extreme precipitation found in this work.