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Conditioning the precipitation-temperature relationship on storm duration

Conrad Wasko, Ashish Sharma, and Fiona Johnson
University of New South Wales, School of Civil and Environmental Engineering, Australia

Predicting future extremes is difficult and therefore many studies condition climatic variables on exogenous variables to try to gain insights on how extremes may change in the future. In hydrology there has been a large focus on the historical relationships between extreme precipitation intensity and temperature. Such a relationship, termed scaling, suggests that precipitation extremes will increase in intensity in the future. However, in tropical areas, scaling relationships have a negative relationship suggesting lower precipitation intensities at higher temperatures.

In this work we condition the relationship of hourly precipitation burst intensity and temperature on the storm duration from which the precipitation burst originates. We demonstrate that calculating precipitation burst scaling from an aggregation of precipitation bursts originating from storm events of differing duration is unlikely to be representative for individual storm durations. We find that conditioning the precipitation-temperature relationship on storm duration results in a greater scaling. In tropical regions, the result, particularly for short durations, is a positive scaling, contrary to previous studies.

Sensitivity tests on storm duration and the percentile show that for longer storm durations and more extreme percentiles the effect of conditioning on storm duration is less. This suggests moisture limitations are more pronounced at more extreme percentiles and longer storm durations. Notwithstanding, the results suggest that higher temperatures could result in greater precipitation intensities than previously thought and, consistent with model predictions, precipitation intensity may increase in the tropics with higher temperatures.