

Extreme Precipitation Scaling with Temperature: A Storm-Type Perspective

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Abstract

Extreme precipitation and its associated hydrometeorological hazards pose serious concerns to human well-being, society, and ecosystems. The frequency and intensities of such events are projected to increase in the future due to climate change. Despite substantial efforts to better understand these extremes and their underlying physical mechanisms, how these extremes will respond to increasing temperature remains an ongoing debate. In particular, the different response of different precipitation processes, such as convective and non-convective precipitation, to warming remains poorly understood. In this context, we explore sub-daily precipitation extremes at the quasi-global scale (60°N–60°S) from the high-resolution Integrated Multi-satellite Retrievals for the Global Precipitation Measurement (IMERG). The dataset has 0.1° spatial and 30-minute temporal resolutions, enabling us to capture short-term convective events even at localized scales. We utilize lightning datasets to classify storms into convective and non-convective types, and we assess the scaling of extreme hourly precipitation intensities with temperature using a quantile regression approach. Our analyses will provide the first global-scale assessment of precipitation-temperature scaling rates across various storm types, providing new insights into sub-daily precipitation extremes. This will help us to better understand the underlying physical mechanisms of the extremes, and consequently to better prepare appropriate mitigation strategies.

Key words: Scaling, GPM, IMERG, Storms, Convective precipitation, Remote sensing, satellite, Extremes