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Thermodynamic Scaling of Extreme Daily Precipitation over the Tropical Ocean

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The theory of extreme precipitation has come to a more mature state over the last decade and highlights the balance between the change in extreme precipitation and in surface humidity with warming. The latter is further constrained by the changes in surface temperature. The analytically derived scaling coefficient based on the Clausius-Clapeyron derivative is ~6 %.K^{-1} under typical tropical surface conditions. While frequently confronted with observations over land, the theory has so far only been marginally evaluated against precipitation data over the ocean. Using an ensemble of satellite-based precipitation products and a suite of satellite-based sea-surface temperature (SST) analyses at 1°-1day resolution, extreme scaling is investigated for the tropical ocean (30°S – 30°N). The focus is on the robust features common to all precipitation and SST products. It is shown in this study that microwave constellation-based precipitation products are characterized by a very robust positive scaling over the 300 – 302.5K range of 2-days-lagged SST. This SST range corresponds to roughly 60 % of the amount of tropical precipitation. The ensemble mean scaling lies around the theoretically expected rate of 6 %.K^{-1} regardless of the extreme indices computed or the length of the period considered. The robustness of the results confirms the suitability of the current generation of constellation-based precipitation products for extreme precipitation analysis. Furthermore, the ability of the RCEMIP models to properly simulate the observed behavior with tropical SST is discussed.