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Role of convective precipitation in relationship between sub-daily extreme precipitation and temperature in Korea

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On a sub-daily timescale, the intensities of extreme precipitation rise markedly at high temperatures with an exceeding the rate of water vapor constraints according to the Clausius–Clapeyron (C-C) relationship. In particular, the contribution of convective precipitation associated with dynamic upward motion is important for overcoming thermodynamic limitations, and it is critical to distinguish convective events from total precipitation events. Here we examine the sub-daily precipitation–temperature relationship in Korea using in situ observations made over a recent 35-year period and the influence of convective rainfall the relationship based on cloud types. The results reveal that changes in hourly extreme precipitation were higher than those in water vapor-holding capacity, which is known as super C-C scaling, in which the relation undergoes a transition from the C-C rate to double the C-C rate with temperature. However, this transition was found to occur at around 20°C in Korea, higher than European regions (around 12°C). The proportion of convective precipitation played a critical role in the higher transition temperature owing to the relatively lower fraction of convective precipitation in Korea, whereas the response of precipitation types to changes in temperature was similar to that in other regions. We conclude that convective precipitation responded to changes in temperature more sensitively, in particular on a shorter timescale, contributing majorly to the scaling pattern of extreme precipitation events in Korea.