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Tracking precipitation features of meso-scale convective systems in the Third Pole region

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The Third Pole (TP) refers to the Tibetan Plateau and all the mountain ranges that surround it, as it acts as the world's largest freshwater storage after the Arctic and Antarctica. The region is characterized by faster warming rates compared to global average, which has led to vigorous hydroclimatic changes during the past decades. These changes include changes in large-scale atmospheric moisture transport, a generally increasing precipitation trend and an accelerated hydrological cycle through increased local moisture recycling.

Since the plateau is marked by intensive surface heating and sufficient moisture supply through mid-latitude westerlies and the monsoon circulation, convection is a key component for the water cycle. Furthermore, the TP has a clear seasonal cycle of convective clouds and precipitation, which is primarily due to the impact of the large-scale atmospheric circulation. During the summer monsoon season between May and September, meso-scale systems such as Tibetan Plateau vortices (TPV) and Tibetan convective systems (TCS) have been found to be the major precipitation-producing systems in the region. These systems are therefore directly linked to river runoff and water resources, as well as to severe storm and flooding events which affect downstream located societies.

Furthermore, meso-scale weather systems in the TP region encompass systems at different spatial and temporal scales which originate from various thermodynamic processes. Yet, it is unknown how this organized forms of convection are linked to the large-scale atmospheric circulation and surface features. In order to draw more robust conclusions about hydroclimatic changes in the TP region, it is thus crucial to understand what role precipitation induced by meso-scale systems has in comparison to small-scale convection and how possible changes in large-scale circulation would affect these systems.

Using different high-resolution satellite precipitation products in conjunction with infrared brightness temperatures from geostationary satellites, we identified and tracked precipitation features which are associated with meso-scale convective systems in the TP region. We created a climatology of observed precipitation which is associated with meso-scale systems and compared the results to precipitation features derived from two high-resolution reanalyses for the TP region. We also evaluated how much of the observed precipitation can be attributed to meso-scale systems, in order to establish a more clear relationship between meso-scale systems and precipitation in the TP region. This work provides the first step for a more comprehensive analysis of the synoptic environment which favor such systems and which type of meso-scale system trigger the most extreme precipitation.