



Variations of Summer Extreme and Total Precipitation over Southeast Asia and Associated Atmospheric and Oceanic Features

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Southeast Asia lies at the heart of heavy precipitation on Earth, and a large amount of latent heat released here provides substantial energy for the global atmospheric circulation. Utilizing gauge-based daily precipitation and the self-organizing map technique, the summertime extreme and total precipitation over Southeast Asia during 1979–2019 are classified into three and five distinct patterns, respectively. The three extreme precipitation clusters are characterized by southern dry and northern wet (C1_extreme), overall wet (C2_extreme), and northern dry and southern wet (C3_extreme) structures. The frequencies of these patterns exhibit increasing trends during the analysis, although they are not statistically significant for C1_extreme. The C1_extreme pattern is accompanied by an anomalous cyclone over the South China Sea in response to negative Indian Ocean sea surface temperature anomalies (SSTAs). The C2_extreme and C3_extreme clusters are characterized by a westward extension of the western Pacific subtropical high, regulated by cool SSTAs over the tropical central-eastern Pacific that are induced by the tropical North Atlantic warming and the tropical Pacific and Atlantic SSTAs, respectively. For total precipitation, the first and second clusters show overall dry distributions, which are mainly composed of nonextreme precipitation. The spatial patterns and atmospheric and oceanic features associated with the other three clusters of total precipitation bear large resemblances to those of C1_extreme, C2_extreme, and C3_extreme, respectively, but their trends exhibit smaller similarities. Comparing the differences between extreme and total precipitation over Southeast Asia could improve our understanding of their regional variabilities and relationships, and potentially their global impacts.

