



Regional-scale weather regimes and observed rainfall trends over Singapore and the Maritime Continent

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The Maritime Continent (MC) region experiences substantial rainfall variations on multiple time scales. In this study, we analysed rainfall over Singapore and the wider MC using objectively identified weather regimes (WRs). Eight regional-scale WRs are derived by k-means clustering of local vertical profiles of zonal and meridional winds, temperature and specific humidity extracted over Singapore from ERA-Interim reanalysis data for the period December 1980 to November 2014. Composite synoptic flow and rainfall patterns over the region reveal that the WRs correspond to the seasonal migration of the Inter-Tropical Convergence Zone (ITCZ) across the Equator. For Singapore, the regimes represent seasonal rainfall variability by capturing the alternating dry and wet phases of the prevailing local monsoon and transition periods associated with the regional-scale ITCZ movement.

The WRs are also used to examine the annual rainfall trend by calculating the contributions due to: (1) changes in regime frequency, indicating regional-scale circulation changes and; (2) changes in within-regime precipitation, indicating altered thermodynamic conditions. The overall trend observed at Singapore and many other MC locations is overwhelmingly due to (2). However, since circulation changes tend to offset one another, the overall trend conceals the larger contribution resulting from (1). When aggregated in an absolute sense, summed rainfall changes due to regime frequency changes outweigh those coming from changes in within-regime precipitation in many MC areas (including Singapore).