



Footprints of Tropical Cyclones in WNP Summer Monsoon Variability

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Tropical cyclones (TCs) in the western North Pacific (WNP) are modulated by large-scale circulation systems such as monsoon trough, intraseasonal oscillation, teleconnection pattern, El Niño and Southern Oscillation, and some interdecadal oscillations. While the low-frequency, large-scale circulation produces a clustering effect on TCs, the latter in return leave marked footprints in climate mean state and variability because of large amplitudes in circulation and strong heating. In this study, we applied PV inversion technique to remove TCs from reanalysis and evaluate their contribution to mean circulation and climate variability. It is found that the mean climatological circulation (e.g., low-level monsoon trough and upper-tropospheric anticyclone) would be much weaker with TCs removed. Intraseasonal and interannual variance of certain variables could decrease by as much as 40–50 percent. An accompanied study indicated that TCs had slowed down the sea surface warming in the WNP for the past few decades because of TC-induced cooling. Our results suggest that TC effect has to be considered to understand the climate variability in the tropical atmosphere and ocean. The ensemble effect of TCs, at least in the statistical sense, has to be resolved in climate models to better simulate climate variability and produce more reliable climate projection in the TC-prone regions.