EMS Annual Meeting Abstracts
Vol. 16, EMS2019-116, 2019

Statistical characteristics of the presummer extreme precipitation over Southern China as estimated by observations

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The presummer rainstorms occurred during April-June in southern China account for about a half of the annual precipitation amount. Their threats to life and property are often found to be significant and are likely to be exacerbated with the increased global warming. To understand the physical mechanisms governing the initiation, morphology, organization, and environments of the rainstorm-producing MCSs, a unique and broad database of severe rainstorms has been developed for the southern China region for 2008-2017 based on multi-source observations, including CMORPH hourly precipitation, ERA5 hourly reanalysis data and FengYun-2 series geostationary satellite observations and products. Based on the database, diurnal variations, spatio-temporal characteristics, as well as the atmospheric environments associated with the occurrence of severe rainstorms in southern China during presummer period were investigated. It is found that Pearl River Delta Metropolitan Region (PRDMR) and its adjacent area to the east has the highest probability for having extreme precipitation over Southern China. According to the diurnal variations, the extreme rainfall events around PRDMR occur most frequently in the early morning, typically peak during 0400-0700 LST, and in the late afternoon, during 1400-1800 LST. A comparison of the averaged upper-air sounding, satellite observations and surface meteorological variables of the two peaks of the extreme rainfall events around PRDMR suggests that the extreme precipitation over this area coincide with blocking patterns at upper-level which are favorable for forming easterly humid flows at lower-level. Besides, the extreme precipitation events are likely to occur in the presence of a moderately strong unstable environment with a CAPE of $\sim$ 1000 J kg^{-1} on average and a strong vertical wind shear of $\sim$ 1.7$\times$10^{-2} s^{-1} below 100 m. These results suggest that given favorable large-scale conditions, the urban environment and circulations induced by urban, land-sea and mountain-plain are likely to have positive impacts on the generation of the extreme rainfall over PRDMR.

Acknowledgement. This research is supported by the National Natural Science Foundation of China Grant 41575048.