Diurnal variations of precipitation and convective clouds over South China Sea during summer monsoon onset

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Abstract

The abrupt onset of the South China Sea (SCS) summer monsoon is a key precursor of the East Asia summer monsoon. The present study provides a climatological analysis on the evolution of diurnal precipitation and cloud vertical structures over SCS during the critical transition periods of onset. Pre-onset and post-onset composites are created from the 17-year precipitation estimates of the Tropical Rainfall Measuring Mission (TRMM) 3B42 datasets and the 7-year vertical cloud mask data based on the CloudSat radar profiles. Clear signals in the diurnal cycle (DC) peak time and amplitude of precipitation, as well as the daytime and nighttime contrast of convective cloud size are observed. Comparing the pre-onset and post-onset statistics, the DC amplitudes increase all over the northern SCS, while the amplitudes increase over open ocean area and decrease near coastal regions over the southern SCS. The DC peak time shifts towards more synchronous over the SCS, as the areas in the open ocean exhibiting DC peak times around 1400LT become more extensive after monsoon onset. The most significant increase of diurnal cycle amplitude occurs over the west coast of the Philippines, and is mainly contributed by the enhanced occurrence of contiguous precipitation areas with horizontal scales over 300 km. The convective cloud number and rainfall intensity also show strong modulation during monsoon onset period. Over the northern SCS during both daytime and nighttime, the number of large convective cloud (area of vertical cross section >1000 km^2) increases significantly, while the occurrence of the small and medium convective clouds (10-1000 km^2) decreases after monsoon onset. Over the southern SCS, the numbers of large convective cloud increases post onset during daytime but decreases during nighttime, while the small convective clouds show an opposite change. The average rainfall intensity per convective cloud object increases post onset, and the increase is more significant over the northern SCS than over the southern SCS. The current results highlight the sensitivity of moist convection processes to environmental conditions over the monsoonal regions, such as the triggering and aggregation of convection.