

One of the most prominent weather and climate variations occurs at the diurnal time scale. This thesis explores the diurnal relationship between convective available potential energy (CAPE) and precipitation, long-term changes in the diurnal cycle of rainfall, and the diurnal evolution of shallow, deep convective, and stratiform precipitation. Using reanalysis-derived surface CAPE and satellite-based precipitation data, we show that the peak in CAPE does not always precede the peak in precipitation over central India. Although less frequent, days on which CAPE peaks after the precipitation maximum are associated with more intense rainfall. The temporal evolution of the rainfall diurnal cycle reveals a delayed diurnal rainfall phase over central India and an advanced phase over northwest India. Statistical analyses indicate that the delayed phase over central India is primarily associated with an increased frequency of heavy rainfall events, whereas the advanced phase over northwest India results from an increase in the intensity of heavy rainfall events. When looking at the diurnal evolution of shallow, deep, and stratiform precipitation, it was found that over central India, the transition from shallow convection to deep convection and subsequently to stratiform precipitation follows a robust diurnal sequence, irrespective of the daily accumulated rainfall, unlike the Himalayan foothills and the Bay of Bengal. Furthermore, heavy rainfall days over central India are characterized by an enhanced time lag between shallow, deep convective, and stratiform precipitation, opposite to that over the Bay of Bengal. Overall, these findings contribute to a better understanding of monsoon convection and shall aid in the improvement of diurnal rainfall prediction in weather and climate models.