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Diurnal variations of warm-season convective storms over contiguous North China based on radar mosaic and radiosonde observations

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Diurnal variations in the formation, evolution and propagation of convective storms over contiguous North China were studied using reflectivity from six China Next Generation Weather Radars and sounding observations from Beijing radiosondes in the warm season from 15 May to 15 September during 2008–2011. One of our results, including temporal and spatial analysis of hourly storm frequency through the warm season, and inter-month comparisons during June, July and August (JJA), indicates that most storms initiate over the northwestern mountains in the afternoon as a result of solar heating, with the highest frequency in June, and the lowest in August. Storms propagate from the mountains to the southeastern foothills and plains, with the highest rates occurring in June, and the lowest in August. In the late afternoon, there is a remarkably high storm frequency over the foothills and plains, which indicates a significant topographic control on the southeastward propagation and intensification of storms during the warm season. Storm activity occurs mainly on the plains through the night, with the highest frequency in July and the lowest in June, as a result of a favorable nocturnal convection mechanism. The region-averaged hourly storm frequencies for the warm season, and also for each month in JJA, are all bimodally distributed, with peak frequencies occurring in late afternoon and during the night, with the highest frequency recorded in the late afternoon during June and July, but at night in August. In general, the mean storm frequency is highest during the day and night in July, and lowest from afternoon to evening in August, but from nighttime to the next morning in June. Another of our results further describes that diurnal evolution and propagation of warm-season convective storms in different prevailing wind regimes at 500 hPa and 925 hPa over the contiguous North China in the warm season. The occurrence frequency of convective storms in the 500 hPa prevailing wind regimes has a pronounced maximum for west-southwest wind, and most of these storms initiate and develop over foothills and plains. Convective storms in this wind regime have the primary structure formation and slow eastward propagation characteristics of well-organized, long-lived convective systems. The occurrence frequency of convective storms for west-northwest wind is second only to the frequency for west-southwest wind. Convective storms under the west-northwest wind direction initiate over mountains to the northwest in the early afternoon and then propagate rapidly to plains in the southeast. These storms have the primary structure formation characteristics of short-lived and isolated convective cells, and intensify noticeably as they move from the mountains to the foothills and plains. In the prevailing wind regimes at 925 hPa, the occurrence frequency of convective storms is highest for south-southwest wind, followed by that for south-southeast wind. The low-level southerly warm and moist flow over the foothills and plains is forced upward by steep topography, thereby favoring the initiation and intensification of convective storms over the foothills and plains in this region.