

Characteristics of Lightning Signals over the Tibetan Plateau Observed by FY-4A Lightning Mapper Imager

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Because of its topographic features, lightning flashes that form over the Tibetan Plateau are unique and closely related to the thermodynamics over the plateau. Limited by adverse observation conditions, for many years, research on lightning activity over the Tibetan Plateau mainly relied on the ground-based lightning detection networks, and the low-Earth-orbit satellite-borne lightning imagers. But the observation of the former is related to its station layout, and the latter can only fixate on a special location for a very brief period of time. The Lightning Mapper Imager (LMI) on board the launched China's Fengyun (FY)-4A geostationary satellite observes most land and sea regions of China as well as the neighboring regions and is capable of detecting lightning flashes in a real-time continuous manner. Acquisition of lightning data from FY-4A LMI provides a useful tool for studying lightning flashes over the Tibetan Plateau. In this study, firstly, the temporal and geographical variations of lightning activities, and the optical radiation characteristics of lightning flashes over the Tibetan Plateau were analyzed by using the LMI data from 2017 to 2018. The results show that the lightning flashes mainly occur on the central and eastern plateau, and most of them have weak intensity, small scale structure and quite short duration of lightning discharging. The mean optical radiance of LMI events is $3.86 \mu\text{J}\cdot\text{sr}^{-1}\cdot\text{m}^{-2}\cdot\text{nm}^{-1}$. The mean radiation area of LMI flashes is 234.9 km^2 , and their mean duration is 0.2 s, which is much less than the central and eastern land region of China at the same latitude. Additionally, the FY-4A LMI and International Space Station (ISS) LIS data for lightning events over the Tibetan Plateau acquired in the same period were compared. Based on the statistical results, a time/space coincidence window of 40 s/40 km was selected. On this basis, the mean coincidence ratio (CR) for FY-4A LMI and ISS LIS lightning events for the Tibetan Plateau was found to be 54.01%. It also found that the spatial distribution of the CR values was correlated with the optical radiance of lightning events and the duration of lightning flashes as well as the number of events in flashes, with the Pearson's correlation coefficients (r) of 0.80, 0.82 and 0.78, respectively. These results suggest that the optical radiation characteristics of lightning flashes over the Tibetan Plateau have a great impact on their detection by the FY-4A LMI. It is necessary to enable the Real-Time Event Processor (RTEP) algorithm of LMI to more finely distinguish various regions based on lightning flash characteristics and to set a more flexible and smaller threshold for extracting lightning events.

Keywords: Lightning, Lightning detection, Geostationary meteorological satellite, Lightning imager, Tibetan Plateau