FY-4A LMI Observed Lightning Activity in Super Typhoon Mangkhut (2018)

Authors

Dr. Wenjuan Zhang - State Key Laboratory of Severe Weather (LASW), Chinese Academy of Meteorological Sciences

Ms. Wen Hui - National Satellite Meteorological Center

Dr. Dongjie Cao - National Satellite Meteorological Center

Prof. Weitao Lyu - 1. State Key Laboratory of Severe Weather (LASW), Chinese Academy of Meteorological Sciences

Abstract

China's new generation geostationary meteorological satellite Fengyun-4A (FY-4A) was launched in Dec 2016. After nearly one year of on-orbit testing and evaluation, it was put into operation in Sept 2017. The FY-4A Lightning Mapping Imager (LMI) is the first satellite lightning imager in China. It aims to achieve continuous observation of total lightning in stationary orbit in the region of Asia and Oceania.

Using lightning observations from the FY-4A LMI, best-track data from China Meteorological Administration, bright temperature (TBB) data from Himawari-8 satellite and composite reflectivity (CR) data from the South China radar network, this study investigates the temporal and spatial distribution of lightning activity and convective evolution during the landfall of Super Typhoon Mangkhut, the strongest landing typhoon in China in 2018. Three stages of active total lightning are observed and different lightning characteristics between the inner core and the outer rainbands are present. The onset of inner-core lightning outbreak is about 4 h ahead of the maximum intensity of the storm, providing indicative information on typhoon intensity change. Lightning rates in the outer rainbands increase rapidly 12 h before the landfall and lightning activity is mainly confined in the outer rainbands after the landfall.

A good correlation in hourly variation is shown between lightning rates from the LMI and TBBs from the satellite. The averaged TBB within the inner core reaches its minimum (-80°C) when the inner-core lightning outbreak occurs, indicating the occurrence and enhancement of deep convection there. Lightning locations observed by the LMI has a good spatial correspondence with regions of low TBBs and high CRs, revealing the monitoring capability of the LMI to lightning activity and deep convection in landing typhoons.

Comparisons between data from the LMI and the World Wide Lightning Location Network reveal that the spatial distribution, temporal evolution, and radial pattern of lightning activity in Mangkhut observed by the two systems are consistent. Furthermore, due to the detection capability of total lightning, the LMI has advantages in revealing the higher ratio of intra-cloud lightning within the inner core in typhoon. The continuous and real-time observation of FY-4A LMI provides an unprecedented platform for monitoring total lightning and deep convection in landing typhoons in China, which will promote the generation of new research and applications in the future.

Topic Areas

Applications of Lightning Data: Community events, Advanced Warnings

Submission Format

Poster