MULTI-SENSOR FIELD STUDIES OF LIGHTNING AND IMPLICATIONS FOR MTG-LI

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ABSTRACT

Future geostationary satellite systems will offer a variety of improved observing capabilities which will be extremely useful for many applications like numerical weather forecasting, nowcasting of severe weather, climate research or hydrology. The planning for MTG (Meteosat Third Generation) includes an optical lightning imager (LI) as part of the payload. One requirement for a proper interpretation of these optical data is a better understanding of what components of a flash are to be seen from space and how these observations relate to ground based radio frequency observations. Therefore, the objectives of the present study concern the improvement of the understanding of the complex lightning process which then enables a proper interpretation of the optical data.

For assessing the future performances and benefits of a geostationary lightning sensor this study takes advantage of the comprehensive lightning data sets obtained from the recent CHUVA field experiment performed in Brazil. (CHUVA - Cloud processes of tHe main precipitation systems in Brazil: A contribUtion to cloud resolVing modeling and to the GPM (GlobAl Precipitation Measurement)). During the rainy season of 2011-2012 a large number of ground based lightning detection systems was set up in the Sao Paulo area in Brazil. In the present study we look at the detailed radio frequency (RF) based observation from LINET (Lightning detection network operated by DLR, nowcast and USP) and observing strokes in the VLF/LF (very low and low frequency) range, the LMA (Lightning mapping array) from NASA observing RF sources in the VHF (very high frequency) range and the TRMM-LIS (Tropical Rainfall Measuring Mission-Lightning Imaging Sensor) optical space borne lightning imager. The LIS is used as a reference instrument for the future MTG-LI sensor as well as for the corresponding GLM sensor (Geostationary Lightning Mapper) on GOES-R. Thus it is possible to study the relations between the RF and optical signals from lightning in detail and to assess the performance of the future geostationary observations from a set of proxy satellite data generated from the ground based observations.

In confirmation of previous studies, it was found that often a direct temporal coincidence of RF signals (LINET strokes) and optical pulses (LIS groups) exists. The short baseline configuration of LINET allowed to observe the strokes mapping the flash branches similar to LMA, but by locating the limited number of strong cloud strokes rather than a large number of weak source points from leader steps. An initial breakdown phase of vertically propagating sources can often be found in LINET and LMA data. The higher level LINET and LMA signals have higher probability to be optically detected. Lower level LINET and LMA signals are optically detected from above in case of missing high level precipitation as inferred from radar observations provided by USP. The new comprehensive data set allows for constructing proxy data for the future geostationary lightning mappers.