MODELING THE OPTICAL EMISSIONS OF LIGHTNING TO BE OBSERVED FROM MTG-LI

Hartmut Höller[1], Hans-Dieter Betz[2], Kersten Schmidt[1]

(1) Institut für Physik der Atmosphäre, DLR-Oberpfaffenhofen, (2) Physics Department, University of Munich

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.

This study investigates the future data streams by developing a statistical model of RF (radio frequency) -based prediction of lightning optical emissions resulting from a comparison of ground based lightning measurements from LINET (Lightning Location Network) in the VLF/LF radio frequency (RF) range and the optical lightning imaging sensor (LIS) aboard the TRMM satellite. As LINET had been operated in a series of field campaigns in the tropics (TROCCINOX, SCOUT-03 and AMMA) statistical analyses of a large number of TRMM overpasses (up to 90 sec local observing time) could be performed. It was found that often a direct temporal coincidence of RF signals (LINET strokes) and optical pulses (LIS groups) exists. Due to the complex flash structures and scattering processes of light within a thunderstorm stroke peak current and optical radiance were only poorly correlated to each other. The same conclusion holds for peak current and the size of the optical footprint observed at cloud top. Besides the directly corresponding RF and optical counterparts there are a series of inter-stroke optical pulses to be observed within the duration of a flash. But also cases were observed consisting of a series of strokes having no obvious optical correspondence. In addition to this flash specific behaviour there are also non-coincident events in space and time.

The flash comparisons described above are used for modelling the time series of optical emissions from thunderstorms as expected to be seen by MTG-LI from geostationary orbit. In addition to lightning time series from African tropical storms another focus of the present study is on thunderstorms occurring over Europe. In a comparative study using LINET in four different continents it was found that lightning in mid-latitude storms was as intense as in extreme cases from the tropics. Continuous LINET observations over Europe are available now for several years. Based on some typical European case studies we investigate the stream of optical data to be expected during such convective periods. The output of this study will be used for the development of the MTG-LI lightning data processor.