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Comparison of LINET and LIS Lightning Characteristics

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Lightning causes different kinds of emissions along the electromagnetic spectrum. In this study we compare the long wave sferics emissions in the VLF/LF band as measured by LINET (Lightning Location Network) to the optical emissions at 777 nm as detected by the LIS (Lightning Imaging Sensor) aboard the TRMM satellite. LINET detects the impulsive radiation connected to strokes from intra-cloud (IC) as well from cloud-to-ground (CG) activity. These emissions can be attributed to predominantly vertically oriented channels with sufficiently large electric currents. Optical emission can be connected to these channels as well to a many other components of a flash not seen in VLF/LF.

Studying the relations between radio wave and optical emissions by lightning is of large interest not only for general understanding of lightning processes but also with respect to future applications of planned lightning detectors operating from space. As for some other satellites, an optical lightning detector is foreseen to be part of the MTG (Meteosat Third Generation) payload. The sensor will work similar to the LIS sensor which is in low earth orbit over the tropics and thus can only provide 90 sec snapshots of the lightning history from an individual thunderstorm.

The present study investigates data obtained from a series of field campaigns performed with the DLR 6-stations LINET system during TROCCINOX in Brazil (Jan/Feb 2005), SCOUT-O3 and TWP-ICE in Northern Australia (Nov 2005 - Feb 2006) and AMMA in W-Africa (June-Nov 2006). In total from all the observations there were around 150 LIS overpasses of the respective wider LINET network areas during lightning activity. The LINET data have been restricted to those observed during LIS view time and then have been clustered into flashes.

It was found that in many cases a LINET stroke was directly followed in time by a LIS group which was recorded within 2 ms after the stroke. This delay can only partly be attributed to the scattering processes of light within the thunderstorm, but is otherwise due to the limited LIS sampling rate which is determined by the 2 ms integration time of the CCD array. The inter-stroke optical activity is of a much more irregular nature, thus statistical representation will be adequate. The coincident events did not show strong correlations between LINET stroke peak current and LIS group radiance. As LINET can discriminate CG and IC strokes and can also indicate IC stroke height, a stratification of the data along these categories was performed. The statements made above for the overall sample did not show distinctive differences in these categories. This indicates that also CG strokes might produce enough optical radiation at cloud top, possibly due to large enough in-cloud channel extension.