

**CHARACTERISTICS OF CLOUD-TO-GROUND  
LIGHTNING FLASHES OBSERVED WITH A WIDEBAND  
MAGNETIC DIRECTION FINDING SYSTEM**

**By**

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**This thesis is submitted in fulfilment of the requirement for the degree of MASTER  
OF PHILOSOPHY of the UNIVERSITY OF COLOMBO, SRI LANKA.**

**2001**

**501167**

## ABSTRACT

### Characteristics of Cloud-to-Ground lightning Flashes Observed with a Wideband Magnetic Direction Finding System

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An analysis of lightning ground flash data recorded by a network of wideband magnetic direction finding system which was installed in Sri Lanka during the period 1999-2001 is presented in this thesis. Lightning peak currents of the first return stroke and the subsequent strokes of negative ground flashes were measured for the first time for this region.

The activity of cloud-to-ground lightning flashes was studied for thunderstorms observed during Northeast monsoon, Southwest monsoon and second inter monsoon periods over Sri Lanka during the year 1999. During the Northeast monsoon period, a peak lightning rate of 96 flashes per hour was observed whereas during the Southwest monsoon and the second inter monsoon, a peak rate of 104 flashes per hour was observed. A relative flash density maximum of 198 flashes per  $28 \times 28 \text{ km}^2$  was observed near Colombo ( $6.75^\circ \text{N}$ ,  $79.75^\circ \text{E}$ ). The percentages of positive flashes are found to be 6.5% and 1.8% for Northeast and Southwest monsoon periods respectively. The average multiplicity of 2.7 was observed for negative CG flashes with a highest multiplicity of 11.

By using 57 published triggered lightning data it has been shown that the source peak currents can be estimated by using the relationship  $I \text{ (kA)} = 6.02 + 0.16 \times (S_N)$  where  $S_N$  is the range normalised signal strength measured by LLP-DF stations. The errors in the peak current measurements follow the relationship  $\delta = a \times e^{(b \times D)}$  where  $D$  is the distance between the strike location and LLP-DF station site, and,  $a$  and  $b$  are constants having values 0.347 and 0.0051 respectively. Using the above relationship, lightning peak currents were calculated for data taken during the year 1999. The calculated average lightning peak current values in the range of 10-250 km and 20-120 km are, 38 kA and 27 kA respectively for Sri Lanka.

Time intervals between subsequent strokes, subsequent stroke peak radiation fields, and peak currents of subsequent strokes for lightning ground flashes were studied using the data obtained from an advanced direction finding system which was used to record lightning ground flashes during early 2001. The percentage of subsequent strokes with peak radiation fields larger than the first return stroke for negative flashes in Sri Lanka was found to be 15%. Results also revealed following characteristics for lightning strokes occurring in Sri Lanka. The percentage of negative flashes having at least one subsequent stroke peak radiation fields greater than that of first return stroke is 22%. The average inter-stroke interval is 120 ms. The most frequent inter-stroke time intervals falls within 60-80 ms range. The peak currents of subsequent strokes are about 50-60% of that of the first return stroke.