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ORIGINAL PAPER

# Climatology of lightning flash activities over Sri Lanka

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**Abstract**
Seventeen years of remotely sensed satellite mounted Lightning Imaging Sensor (LIS) data were used to determine the characteristics of lightning activities over Sri Lanka. From 1998 to 2014, there were 12.5 million lightning flashes over the land mass covered by Sri Lanka. There is an increasing trend in the intensity of lightning activities with 22,000 flashes year$^{-1}$. The annual cycle of lightning flashes shows a clear spatial difference of lightning activities during the southwest and northeast monsoon seasons. The highest occurrence of lighting activities is confined to the highly populated western region of the island while the coastal areas in the northern and eastern regions and central hills show relatively low occurrences. The estimated maximum cloud to ground lightning flash density was 53 flashes year$^{-1}$ km$^{-2}$ and the average being 7.7 flashes year$^{-1}$ km$^{-2}$. The density of lightning in the wet zone tends to be twice as much compared to the dry zone. The onset and retreat of lightning seasons are February 25 through May 15 for the warm season which coincides with the first inter-monsoon season and July 31 through November 19 for the cold season which coincides with the latter part of the southwest monsoon season and second inter-monsoon season. Based on thunder day measurements, it is shown that a simple linear relationship can be used to estimate lightning flash densities from thunder days. We have also examined the relationship between lightning flash activities and sea surface temperature over the Arabian Sea and the Bay of Bengal and conclude that sea surface temperature can be used as a proxy to estimate change in lightning activities as sea surface temperatures have strong persistence in the temporal characteristics.

## 1 Introduction

Characteristics of lightning flashes over Sri Lanka have been studied during the last three decades by a number of researchers (Cooray and Lundquist 1985; Cooray and Jayaratne 1994; Gomes et al. 1998; Sharma et al. 2008; Gunasekara et al. 2016). Most of the early studies were carried out remotely by using a flat plate antenna system together with a digital storage oscilloscope to sense and record the electric field generated by lightning strikes. In recent years, the work has been extended by measuring optical and thunder signals generated by lightning (Bodhika et al. 2013). Over the years, these studies have provided valuable insight into the understanding of the physics of the lightning process in Sri Lanka particularly applicable to the tropics.

Today, lightning detection systems are used in many countries to study long-term characteristics of cloud-to-ground lightning activities. These systems have a typical detection range of 600 km, with many sensors interconnected to form lightning detection networks that span thousands of kilometers covering lightning activities in vast land masses (Diendorfer et al. 1998; Huffines and Orville 1999; Orville and Huffines 2001; Sonnadara et al. 2006). These are more suitable for studies that involve in investigating average lightning parameters and lightning distributions since they are weak in extracting the details of individual lightning parameters but strong in detecting and processing data from many different thunderstorms (Sonnadara et al. 2014).

In late 1990s and early 2000, there have been attempts to study the cloud to ground flash activities of Sri Lankan thunderstorms using the data provided by a lightning locating system (Fernando et al. 1998; Sonnadara et al. 2000; Weerasekera et al. 2001; Liyanage et al. 2002). However, due to number of problems including instrumentation issues, these studies failed to provide an insight into the climatology of lightning characteristics over Sri Lanka. Using thunder day data, for the first time, a recent study reported thunderstorm climatology (Sonnadara 2016) over Sri Lanka.

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