

# Investigation on the occurrence of positive cloud to ground (+CG) lightning in UMP Pekan

Hwee Geem Chan\*, Amir Izzani Bin Mohamed

Sustainable Energy & Power Electronic Research Cluster (SuPER), Faculty of Electrical and Electronics Engineering, UMP, 26600, Pekan, Pahang, Malaysia

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## ABSTRACT

This paper is going to find the direction of +CG lightning and its relationship with monsoon season in Malaysia by using data obtained from Malaysia Meteorological Department (MMD) for 2015. Analysis from this study found that a high numbers of lightning occur during dry season compares to rainy season. This is contradicted with general perception in Malaysia where lightning only occurs during rainy day. It is also understood that +CG lightning makes up approximately 20% of total lightning and the rest is –CG lightning events. The occurrence of +CG lightning during day and night will be discussed. From this, the direction where most +CG lightning occurs will be determined and used as a guide in order to observe TLEs afterward.

## 1. Introduction

Lightning refers to a natural phenomenon that happens frequently during thunderstorms (Williams, 1987; Uman, 1972). This phenomenon was described as an event of electrical discharge at the rate where the discharge process will deliver a large quantity of current and voltage (GAM Odam, n. d.) (Yair, 2008) stated that, a large quantity of radio frequency made up of electromagnetic field (E-field) and magnetic field (H-field) are emitted during lightning. TLEs are also known as a part of a lightning event that happened in the upper atmosphere where the electrical discharge is visible with various form. The observation on TLEs has progressed since 1989 (Franz et al., 1990). Various studies classify TLEs by the differences of colours and stroke patterns. Sprites and Elves are commonly known TLEs in research studies. Yet, there are lesser specific characteristics that justify the occurrence patterns of Sprites and Elves.

Refs. National Lightning Safety Institute (NLSI) (1988); Ab-Kadir (2016) reported that Malaysia is ranked the third in having the most thunderstorms in the world. This fact suggested that there is a high possibility of TLEs to occur in this country. Sprites are often displaced from the parent positive clouds to ground (+CG) lightning. The displacement can be up to several tens of kilometres (Dan Robinson, 1995; Lyons et al., 2003; Soula et al., 2009; Pasko et al., 2012). In addition (Dan Robinson, 1995), concluded that the percentage of +CG lightning is less than –CG and found that the occurrence of Sprites events are usually triggered by a very strong +CG lightning.

A review from Uman (1994) reported that +CG lightning occurs at

the upper part of a thundercloud which is positively charged. It starts with the electrical breakdown at the upper part of thunderclouds and is initiated by a positively charged downward-moving step leader. In addition, (National Aeronautics and Space Administration (NASA), n. d.) reported that +CG lightning occurs during the last stage of the thunderstorm.

According to Rocha et al. (1999), Pettegrew et al. (2003), and Arnone et al. (2008), +CG lightning also takes place during the winter season in northern countries such as Italy, US, UK, and Japan and southern countries such as Brazil. The winter month for northern countries starts from December to February while for southern countries from June until August. However, the four-season climate does not exist in Malaysia. Instead, Malaysia only experiences monsoon seasons such as the Southwest Monsoon season, Northeast Monsoon season, and inter monsoon season (Tangang et al., 2012). Inter monsoon season represents the transition period in between monsoon seasons. Hence, the occurrences of +CG lightning during these monsoon seasons make an interesting topic to be discovered.

This paper will elaborate about the occurrence of both +CG and –CG according to data obtained from Malaysia Meteorological Department. It is one part of verification process for another study, where video observation of upwards lightning was carried out. The location and polarity of lightning were analysed based on data obtained from Malaysia Meteorological Department (MMD) and the authors do not involve on how MMD acquired the data. The sole purpose of this paper is to determine the timing and direction on where to point the camera in order to observe lightning/TLEs.

\* Corresponding author.

E-mail addresses: [hweegeemchan@hotmail.com](mailto:hweegeemchan@hotmail.com) (H.G. Chan), [amirizzani@ump.edu.my](mailto:amirizzani@ump.edu.my) (A.I. Bin Mohamed).

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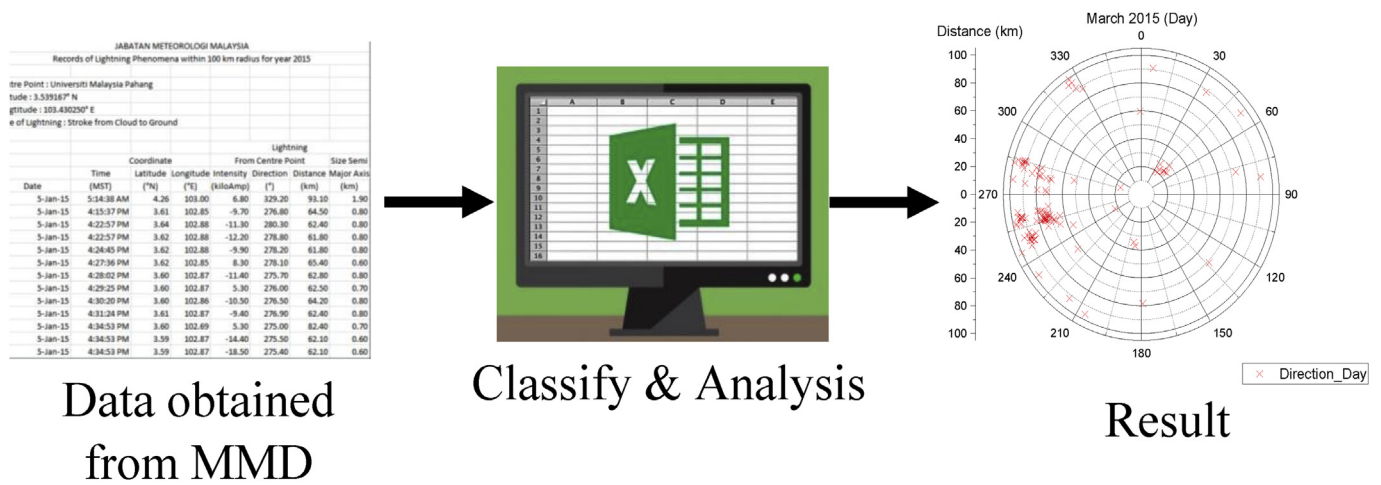


Fig. 1. Data processing flow.

## 2. Data processing

Fig. 1 clarifies the function flow for the process of data collection. The data from Malaysian Meteorology Department (MMD) within an area of 100 km radius coordinated at the centre point of Universiti Malaysia Pahang's (UMP) Pekan campus. Fig. 2 presents the coverage area of within 100 km radius. The MMD use *Surveillance et Alerte Foudre*

*par Interférométrie Radioélectrique* (SAFIR 3000) with 8 sensors installed around Peninsular Malaysia. The system is able to detect and record the lightning events such as IC, CG activities and the peak current (in kA) with using VHF interferometry technique (Suparta et al., 2011). The maximum distance between the SAFIR sensor and between the stations is about 160 km–220 km that can cover the range of detection is between 270 km and 280 km. However, the efficiency will be reduced to

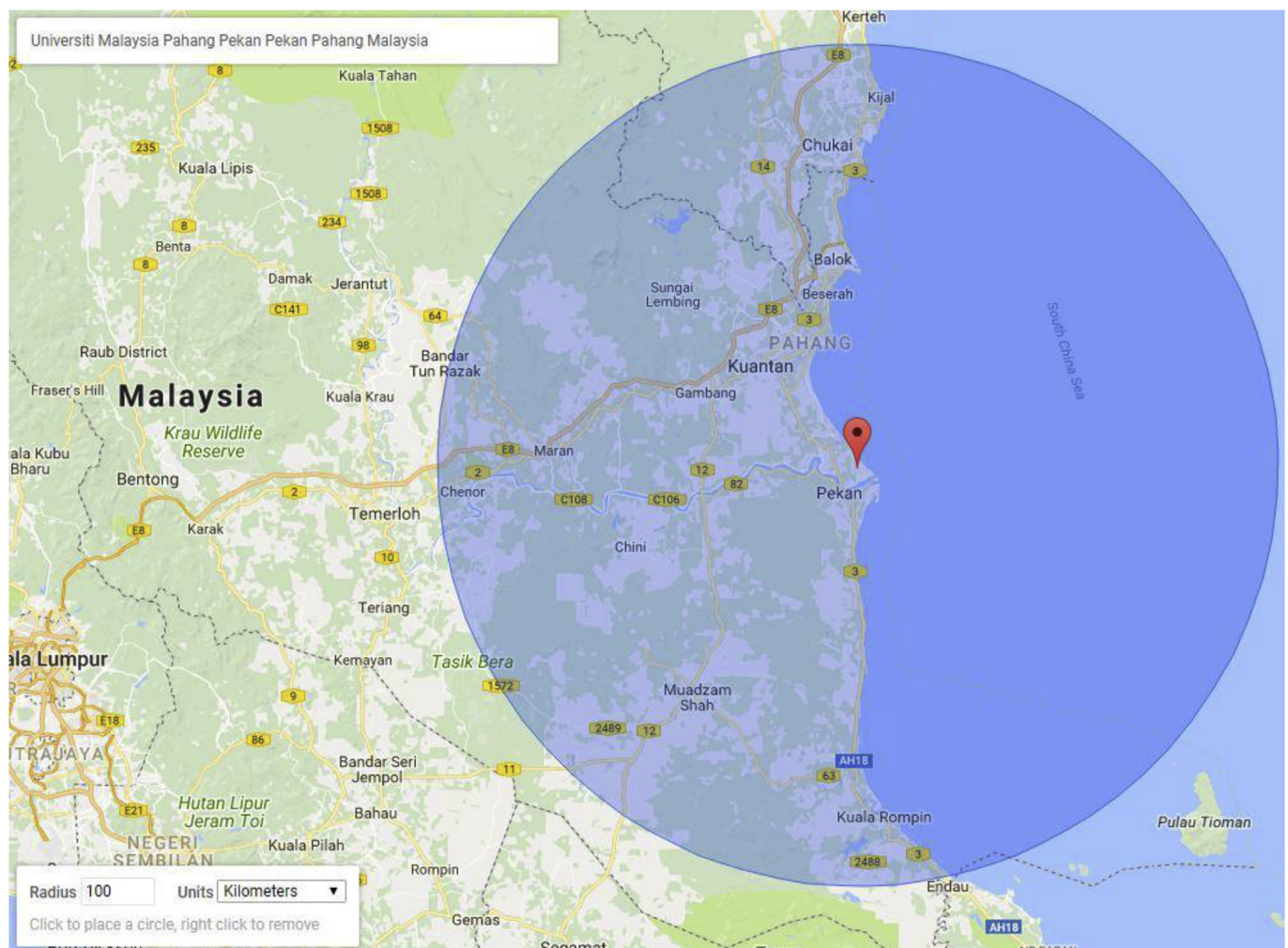


Fig. 2. Covered area within 100 km radius from Universiti Malaysia Pahang Pekan Campus.

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