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Climatic Lightning Activity and its relation with Meteorological Parameters over South Asian Monsoon Region

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The Lightning activity has an important effect on human life with the destructiveness caused by its randomness, large current and strong electromagnetic radiation. It is also an imperative support indicating the convections and even climate change. Lightning is a common natural phenomena associated with many different atmospheric and surface processes with severe weather conditions that cause extensive damages to agriculture, property and life [1]. Lightning flashes are produced mainly from cumulonimbus cloud involving the four mechanism buoyant warm air rising due to intense surface heating, strong heating contrast between surface, frontal lifting or orographic lifting. Lightning activity and its associated rainfall are important weather phenomenon over India and surrounding regions, particularly during (March-May) and (September- November). The importance of lightning activity lies in the fact that it is associated with thunderstorms.

This paper attempts to provide a description of lightning flash density, precipitation rate and cloud work function (CWF) over the domain of interest (0º- 40ºN, 60º-100ºE). The plateau regions of this domain play an important role in the Asian monsoon circulation as major source of heat during summer [2]. The oceanic regions also play a very important role to transport moisture to the land region during monsoon season. We studied the geographical distribution, annual and seasonal variation of flash density, precipitation and CWF. A 20 year period (1995-2014) monthly mean surface precipitation and CWF were taken from National Centre for Environmental Prediction (NCEP) reanalysis project (https://www.esrl.noaa.gov). Daily gridded (0.5º x 0.5º) total lightning data were obtained from Global Hydrology Resource Centre (http://ghrc.msfc.nasa.gov). The total flash density (fl/km^2/yr) from Optical Transient Detector (OTD) and Lightning Imaging Sensor (LIS) covering the same period as taken for the NCEP. The maximum lightning experiences over the Southern Himalayan front and North eastern part of India during March to May as shown in figure 1. Satellite observations of lightning over the study region show a maximum flash density in May.

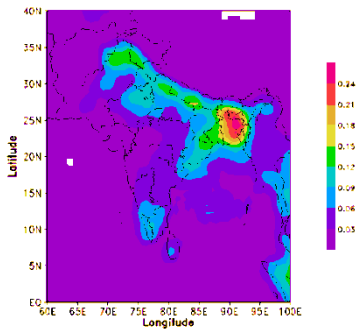

Figure 1. Mean Lightning flash rate density (fl/km^2/yr) from 1995-2014 during March-May.

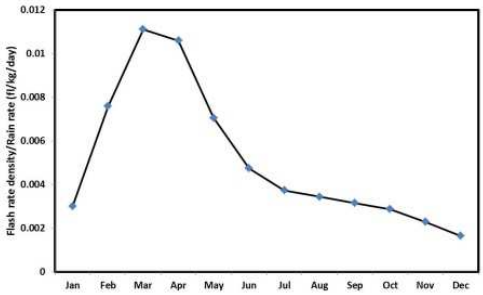

Figure 2. The ratio of monthly mean lightning falsh density to NCEP rain rate.

The figure 2 shows the ratio of lightning flash density to the rain rate, which highlights the pre-monsoon is strongly emphasised. From the seasonal variation of NCEP monthly mean CWF and precipitation it is observed that the maximum value during the month of June and July due to onset of Asian Monsoon. The precipitation rate and CWF are highly co-relate with each other and shows an increasing trend from 1995-2014 study. The CWF increased by ~8% and the precipitation increases approximately by 2% during the study period of 1995-2014 over the entire study region. This study provides that the increase of temperature and CWF responsible for the increase of lighting flash and precipitation rate ratio.

1. U. Saha, D. Siingh, A. K. Kamra, E. Galanki, A. Maitra, R.P. Singh, A.K. Singh, S. Chakraboty, Rajesh Singh, "On the association of lighting activity and projected change in climate over the Indian sub-continent," *Atmospheric Research*, **183**, 2017, pp. 173-190, doi:10.1016/j.atmosres.2016.09.001.

2. R. Toumi, X. Qie, "Seasonal variation of lightning on the Tibetan Plateau: A spring anomaly?," *Geophysical research letter*, **31**, 2004, L04115, doi: 10.1029/2003GL018930.