# A study on Lightning variability with climate parameters over Indian domain

Pramod K Yadava1*, Sunita Verma[1,3] ,Ajay Sharma[1] and Swagata Payra[2]

[1] Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi- 221105, Uttar Pradesh, India

[2]Department of Remote Sensing, Birla Institute of Technology Mesra,Ranchi, India

[3]DST-Mahamana Centre of Excellence in Climate Change Research, Institute of Environment and Sustainable Development, Banaras Hindu University, Varanasi, Uttar Pradesh, India

*Email ID: pkindia002@gmail.com*

## Motivation

- Lightning is an electrical discharge caused by imbalances between storm clouds and the ground, or within the clouds themselves (Verma et al 2021).
- Lightning basically occur in lower cloud of atmosphere that is cumulonimbus cloud.
- LF has been to be associated with convective rain (Dai el al. 2009; Zheng et al. 2020), TCWV, and relative humidity over both oceans and land (Yadava et al. 2020; Shi et al. 2018).

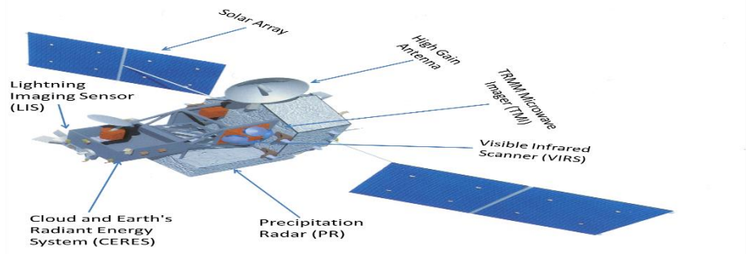



Figure 1.Instrument Detail.

## Objectives

- To determine the spatial variability of lightning, prone regions and seasons.
- To estimate the lightning variability and impact of climatic parameters.

## Methodology & Study Area

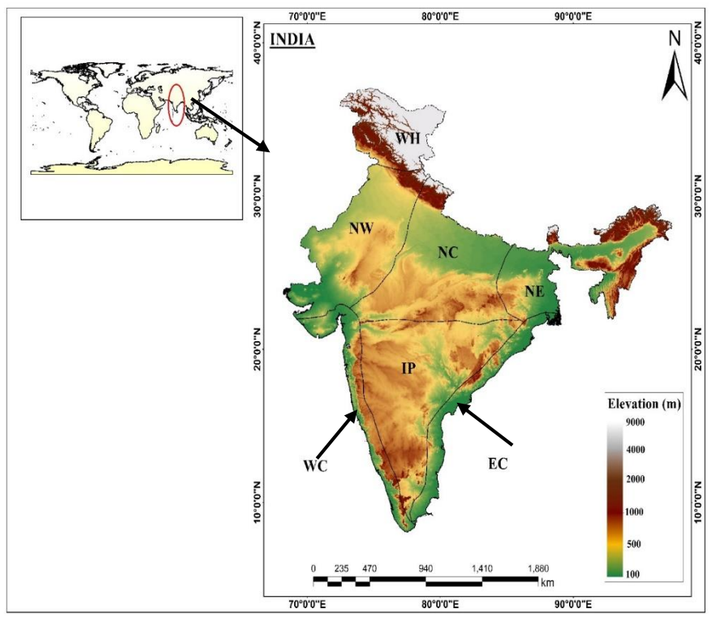



Figure 2. Study Area Map.

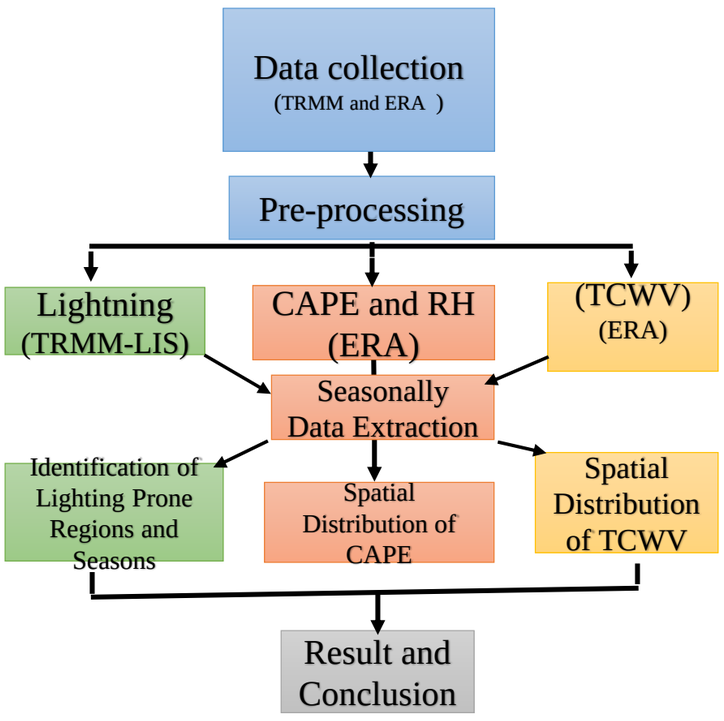



Figure 3. Flowchart of the methodology employed.

## Results

- Analysis has been carried out on the retrieved LF for seasonal and annual variability using LIS TRMM satellite data (1998-2013) over Indian domain as shown in Figure 2 (lat 8°4′–37°6′N and lon 68°7′–97°25′E in details).

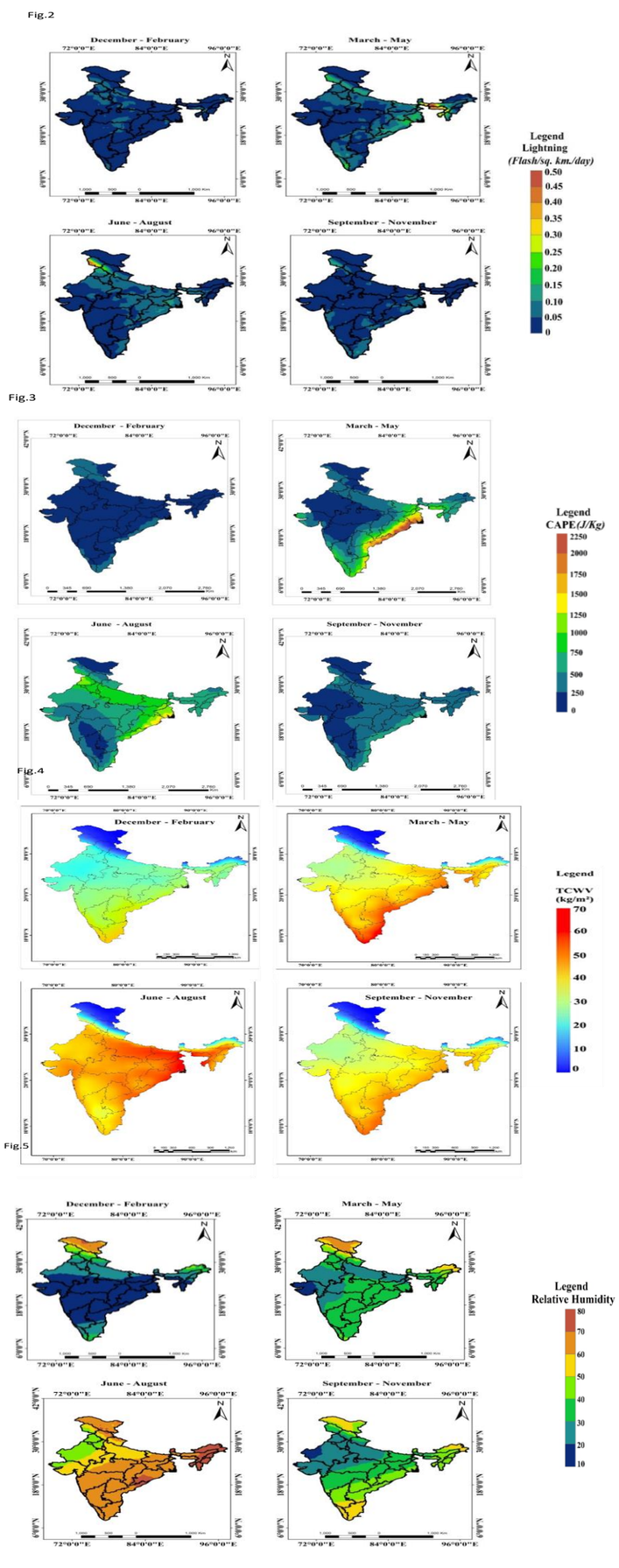
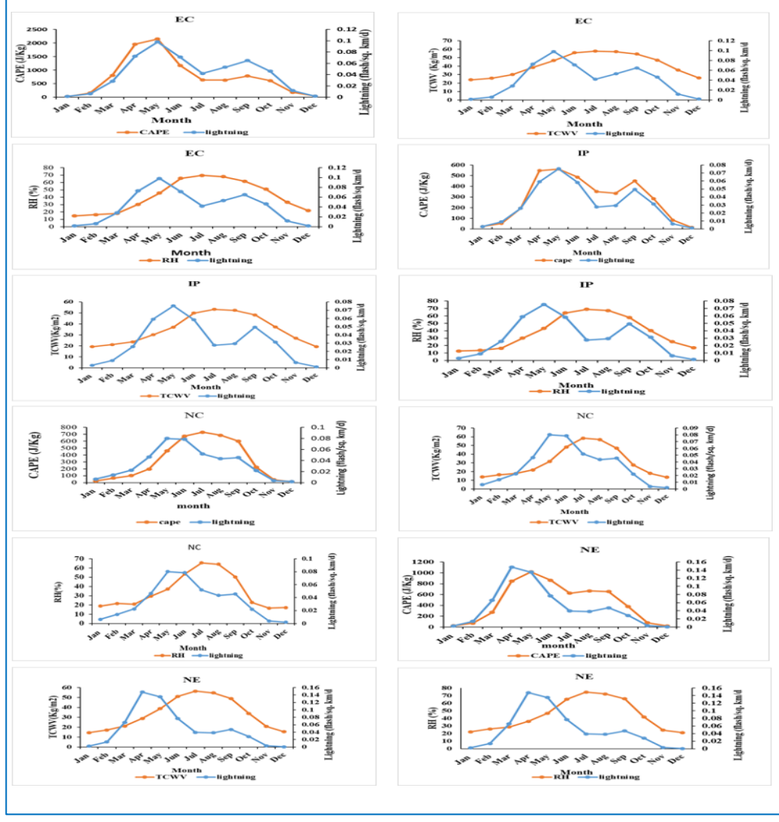



Figure 4.Spatial distribution of lightning flashes, CAPE, TCWV and RH respectively.



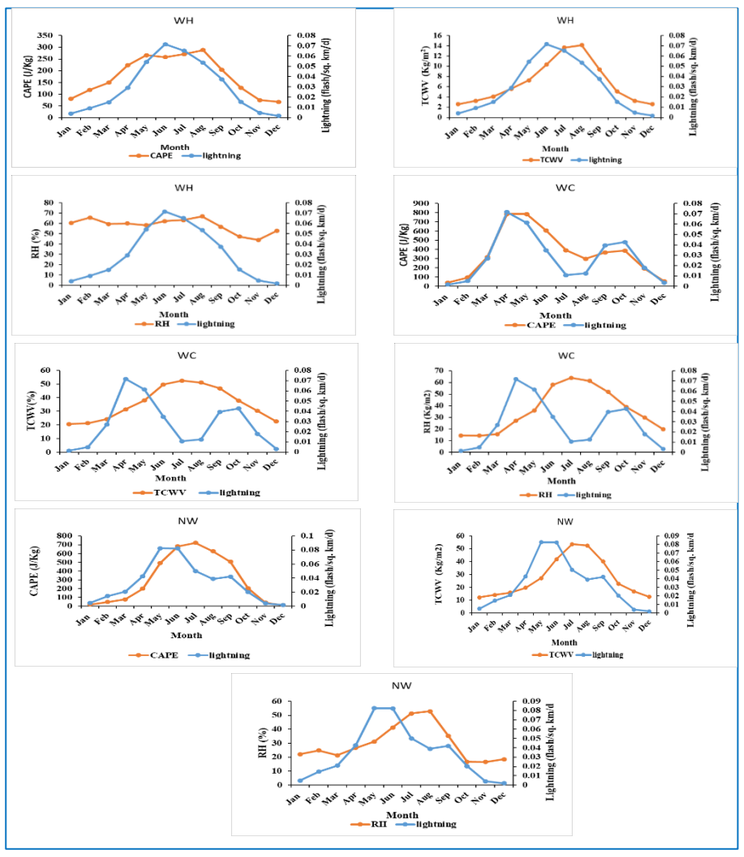




Figure 5. Region-wise monthly variability in Lightning, CAPE, TCWV and RH over seven regions.

## Conclusion

- In this work, we present an analysis of 16 years lightning, CAPE, RH and TCWV over India from 1998-2013.
- The most prominent season for lightning is pre-monsoon (MAM) and monsoon (JJA) where lightning as high as 0.4–0.5 flash/sq. km/day is observed in the northeastern part of India, and in monsoon season northwest part of India varies as 0.35-0.4 flash/sq. km/day.
- The statistical analysis shows that lightning flash rate follow the CAPE in pre-monsoon season. In pre-monsoon season high CAPE is found over eastern coastal region (1750-2250 J/Kg) and during monsoon season high over northern region (1250-1500 J/Kg) as compared to winter and post-monsoon season
- The RH show a large value over all seven regions except the WC and NW region which is approximately 53% and over rest regions range varies from 55 to 74%.
- Lastly TCWV was found to be highest in EC region of India i.e. 57.71 kg/m2. This could be the probable reason behind increased lightning activity over these regions.

## Acknowledgements & References

Acknowledgements:

We gratefully thank the Earth Observatory System and Science Programme for providing the Tropical Rainfall Measuring Mission/Lightning Imagine sensor (TRMM/LIS) data and ERA Interim produced by the European Centre for Medium-Range Weather Forecasts (ECMWF) for necessary data providing.

References:

Verma, S., Yadava, P.K., Lal, D.M., Mall, R.K., Kumar, H. and Payra, S., 2021. Role of Lightning NOx in Ozone Formation: A Review. Pure and Applied Geophysics, 178(4), pp.1425-1443.

Yadava, P.K., Soni, M., Verma, S., Kumar, H., Sharma, A. and Payra, S., 2020. The major lightning regions and associated casualties over India. Natural Hazards, 101(1), pp.217-229.

Dai J, Wang Y, Chen L, Tao L, Gu J, Wang J, Xu X, Lin H, and Gu Y 2009 A comparison of lightning activity and convective indices over some monsoon-prone areas of China. Atmos. Res 91(2-4), 438-452.

Shi Z, Tan Y, Liu Y, Liu J, Lin X, Wang M, and Luan J 2018 Effects of relative humidity on electrification and lightning discharges in thunderstorms. Terr. Atmos. Ocean. Sci, 29(6).

6th WGNE workshop on systematic errors in weather and climate models

**31 October – 3 November , 2022,** Bonn, Germany