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Estimation of Thunderstorms Occurrence from Lightning Cluster Recorded by WWLLN Network and its Comparison with the 'UNIVERSAL' Carnegie Curve

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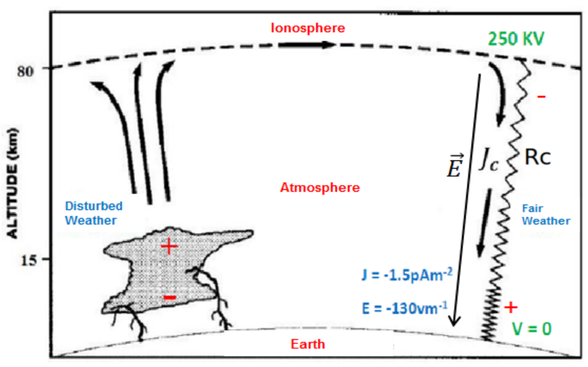
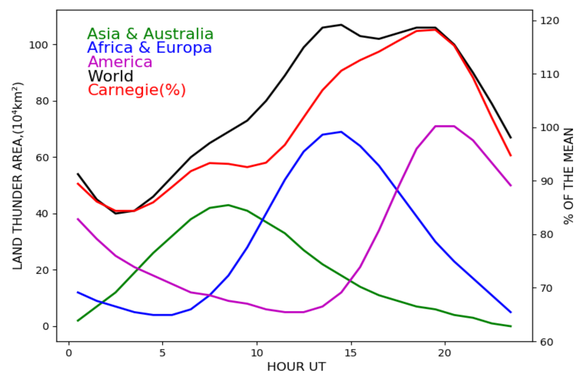
INTRODUCTION

Studies carried out by the Carnegie Institute of Washington (1909 - 1929), observed that the diurnal variation of the electric field in fair weather regions, was independent of the place of measurement. Wilson (1921), proposed that the earth is a conductor and storms are responsible for charging the earth negatively and the base of the ionosphere positively. This proposal allowed the birth of the GAEC concept. Whipple (1929): Estimated the variation of electrical storms and their continental contributions. Whipple and Scrase (1936): They connected these global storm variations and the Carnegie curve.



MacGorman e Rust (1998)



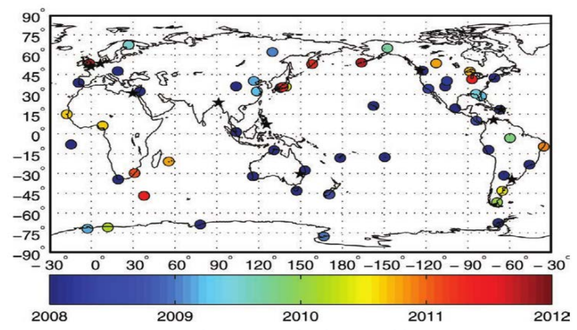
Whipple e Scrase (1936)

OBJECTIVES

Our objective is to analyze the variability of electrical storms at different times of the year, to understand the role they play in the global atmospheric electrical circuit (GAEC) and its relationship with the Carnegie curve.

- Obtain average curves (2012-2013) of thunderstorms and compare them with the Carnegie curve in different time scales (seasonal and annual).

INSTRUMENTATION



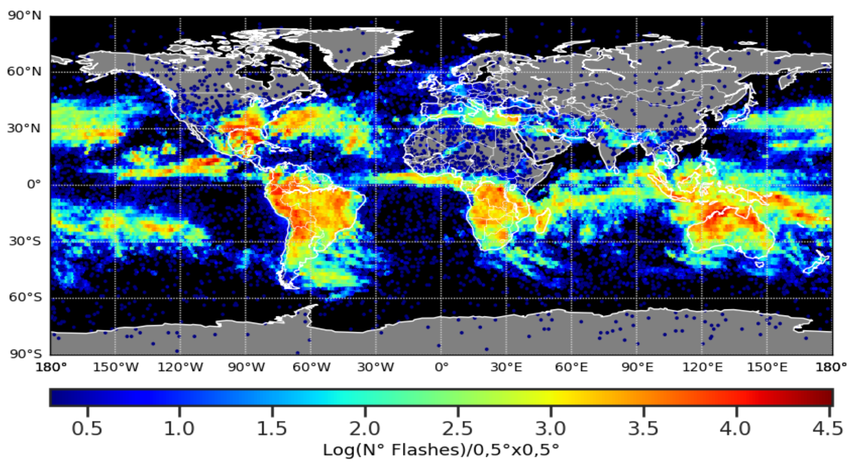
Virts et al. (2013))

World Wide Lightning Location Network (WWLLN)

It is a global lightning localization network, where sensors detect electromagnetic radiation produced by lightning in the VLF frequency range (3-30 KHz).

METHODOLOGY

In this work we analyze the data of the WWLLN network for the periods 2012 and 2013. Where our methodology consisted of converting lightning detections into groups of storms.

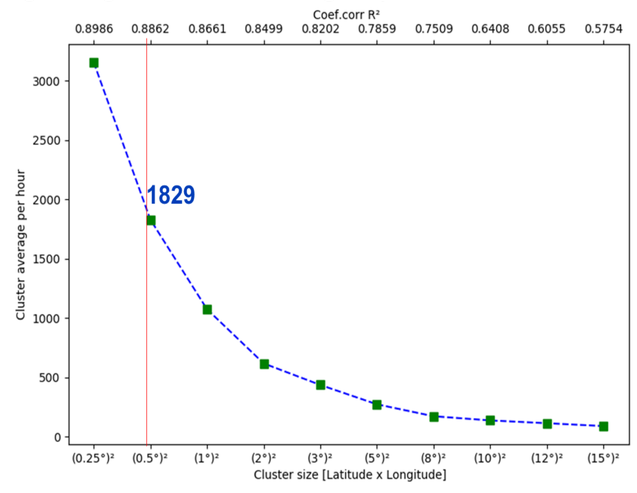


— x° —

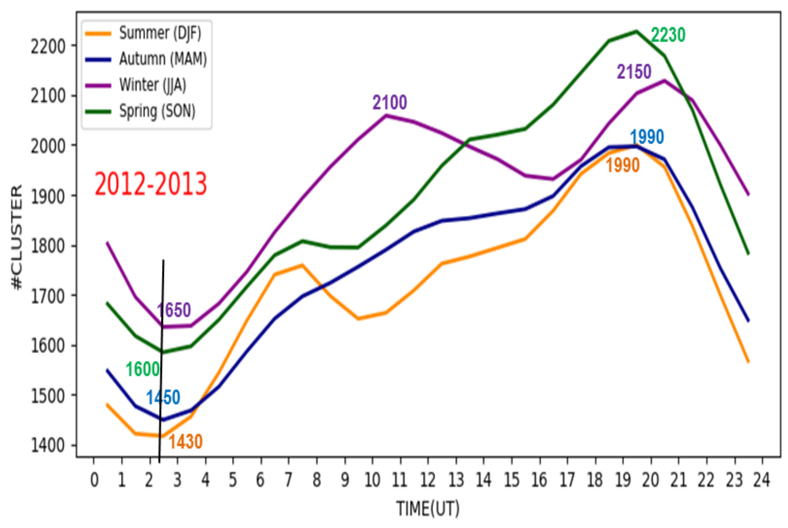
— x° —

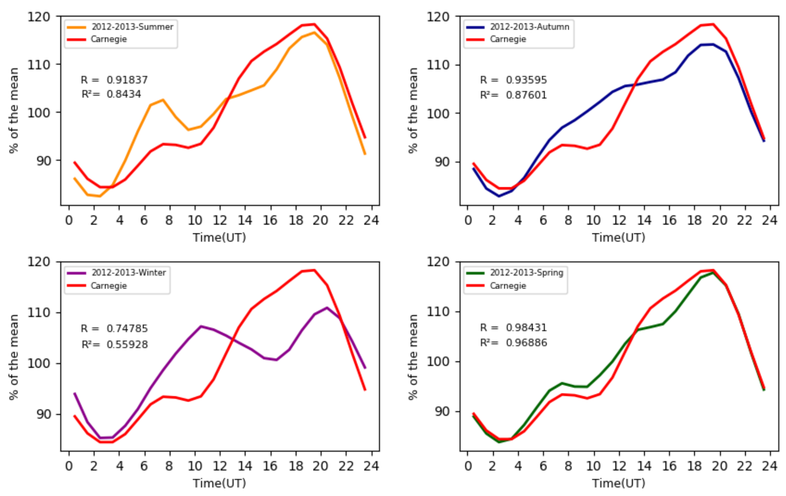
0	1	3	25	1	0
5	8	0	2	0	10
0	6	1	7	4	0
3	0	9	1	0	14
2	4	1	0	2	12

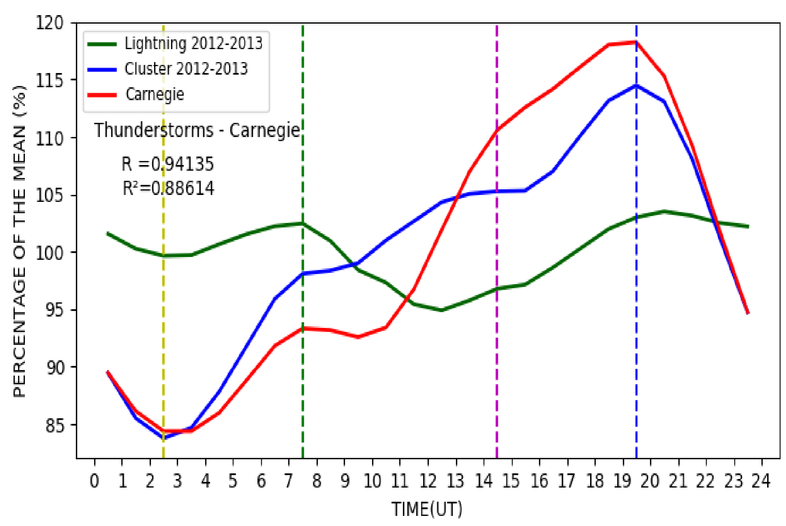
X	0,25	0,5	1	2	3	5	8	10	12	13	15



PRELIMINARY RESULTS







CONCLUSIONS

- We observe that, in the spring and winter seasons, the diurnal variation of thunderstorms is higher than in autumn and summer. Performing an hourly average for each season of the year, we observe that winter is the season with the highest number of electrical storms with 1920, while in summer, we have the least amount of electrical storms per hour with 1716.
- The seasonal curves show that, in summer, autumn and spring, there is a good correlation with the Carnegie curve, but in winter a low correlation is observed. Perhaps due to the lack of sensors in the African and South American regions, or perhaps it is a natural behavior in winter.
- The annual average curve of electrical storms shows a good correlation with the electric field curve, with R = 0.94, where we can observe the time of minimum activity (03 TU), the time of maximum activity (19 TU), and the three continental maximums, Asia - Australia (08 UT), Africa - Europe (14 UT) and America (19 UT).

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