

Introduction:

- Significant fraction(57-60%) of tropical precipitation can be attributed to the Strongly Electrified Cloud.
- Inside a strongly electrified cloud ,the charge densities could go up to 10^9 elementary charges and electric field can reach values 400kV/m.
- Numerous laboratory and numerical studies have reported that the electric forces inside Strongly Electrified cloud and lightning discharges can substantially influence the microphysical and dynamical properties of cloud.
- Projection of these laboratory and numerical evidences to the tropical atmospheric environment is still lacking.

Effect of Electric forces on Rain Size Distribution (DSD)

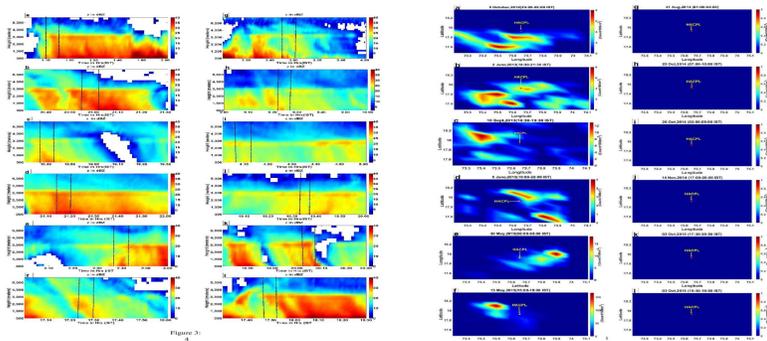


Figure1

Figure2

Figure1&2: 12 Stratiform rain events over the HACPL have been chosen. Presence of lightning in the events (a-f) makes them strongly electrified.

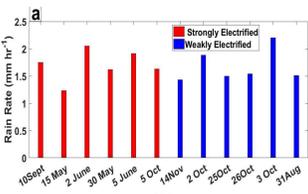


Figure3

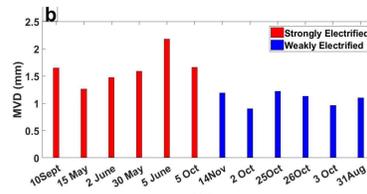


Figure 4

Figure3 &4: Bar plot of Rain intensity and corresponding Median Volume Diameter of raindrops.

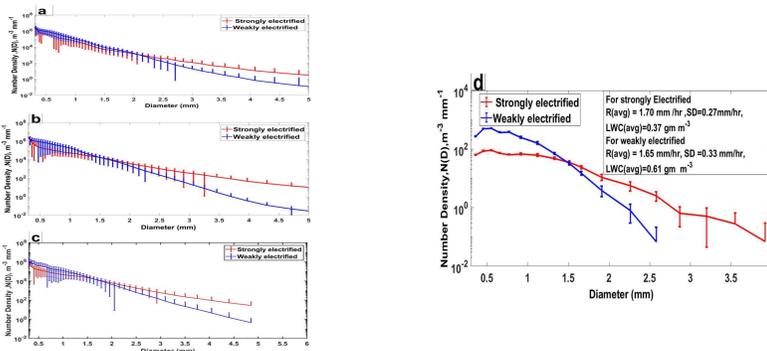


Figure 5: Rain DSD at upper level(a-c) and at the surface(d).

✓ **Electrically enhanced collision-coalescence of raindrops produces larger drops in strongly electrified events.**

How lightning discharges influences the near-surface rain intensity..??

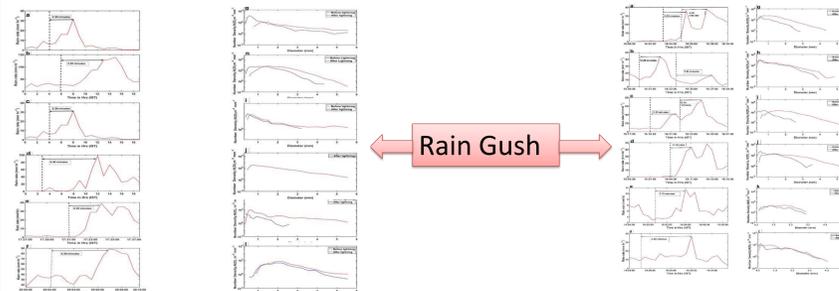


Figure6: Transient intensity amplification of rain associated with lightning. vertical bars represents the time of lightning.

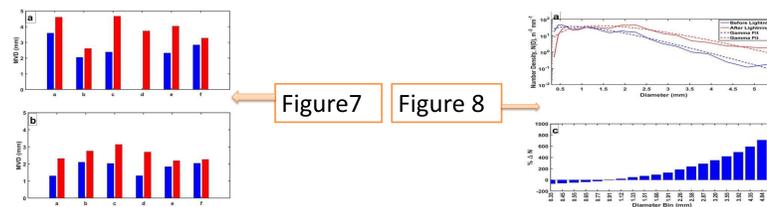


Figure7&8: Bar plot of MVD before and after lighting and the DSD averaged over all the events. The red and blue bars represents after and before lightning respectively.

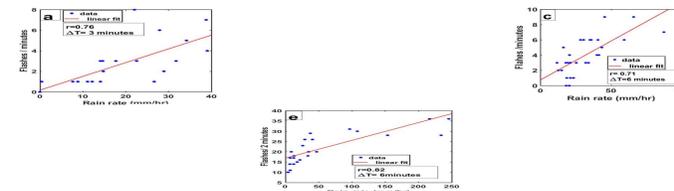


Figure9: The correlation analysis of rain rate with lightning frequency during thunderstorms.

- ✓ **Lightning can modify near-surface precipitation intensity through electrification of precipitation particles by depositing ions around the channel.**
- ✓ **The significant correlation between lightning and rain rate suggested that lightning can modify the total surface accumulated rain as well.**

Publications:

Mudiar, D., Pawar, S. D., Hazra, A., Konwar, M., Gopalakrishnan, V., Srivastava, M. K., & Goswami, B. N.(2018) :Quantification of observed electrical effect on the raindrop size distribution in tropical clouds. *Journal of Geophysical Research: Atmospheres*, 123. <https://doi.org/10.1029/2017JD028205>

WRF model response to Strongly and Weakly Electrified Cloud..!!

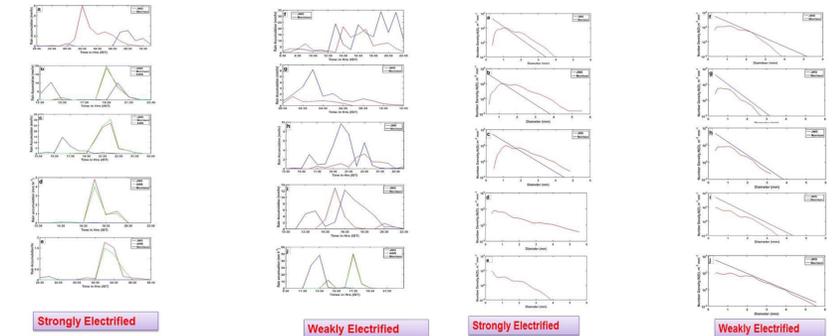


Figure10

Figure11

Figure10&11: Observed and simulated accumulated rain along with rain DSD.

✓ **Substantial underestimation of simulated rain intensity and larger raindrops can be observed in Strongly electrified events .**

Research Highlights:

- ✓ Electric forces inside strongly electrified tropical cloud can modify rain DSD substantially.
- ✓ Lightning can enhance precipitation intensity through electrification of precipitation particles.
- ✓ The study suggested that inclusion of electrical effect in calculation of the microphysical tendency equations of NWP models for collision-coalescence growth of precipitation particle could improve the estimation of rainfall in case of strongly electrified cloud.

Way Forward

- ✓ Parameterization of electrical effect in the NWP models in the endeavour to better estimation of rainfall.
- ✓ Laboratory study regarding influences of electrical forces on the freezing characteristics of super-cooled water droplets.

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