THE UNIVERSITY OF ALABAMA IN HUNTSVILLE | COLLEGE OF SCIENCE

Research and Creative Experience for Undergraduates (RCEU) Program 2024

Development and Calibration of a Lightning Sensor

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Overview

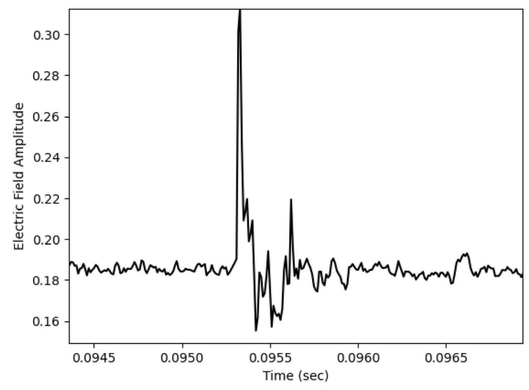
The Huntsville Alabama Marx Meter Array (HAMMA) can be used to identify and analyze surrounding lightning by changes in electric field. The lightning current can also be determined after a proper calibration. This project compared lightning data from local storms taken by HAMMA to the Earth Networks Total Lightning Network (ENTLN). Two HAMMA setups were tested at a ~8.2m difference in altitude to determine the effect of the altitude and the surrounding area on the measurement.

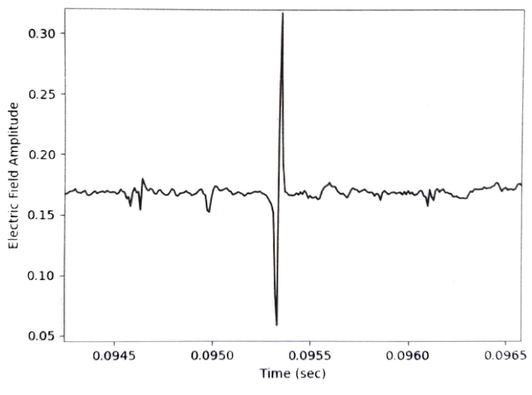
Key Findings

This experiment yielded a calibration plot for each HAMMA sensor (Figures 1 and 2). Because the measurement is range dependent, the range-normalized signal strength (RNSS) is used to compare against an independent estimate for the current from ENTLN. The linear relationship between the two measurements yields a general calibration ratio used to estimate current:

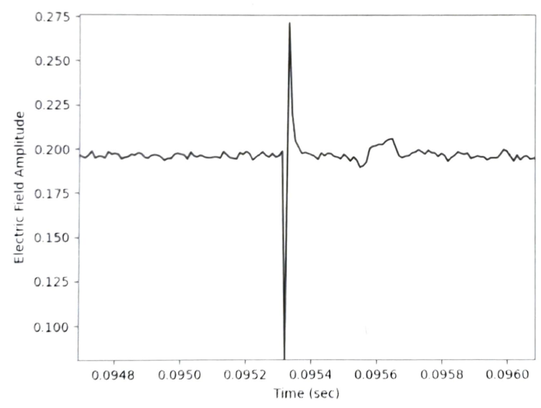
Current = (RNSS − y-intercept) / slope

Figure 1 shows a smaller slope than Figure 2, the difference of which may be used to adjust sensitivity of future sensors based on altitude. Further, there is data that does not follow the trend (e.g., first quadrant). The waveforms of this data suggest these are really intracloud discharges, which is likely due to a misclassification of ENTLN data.





Examples of cloud–to-ground *(top)* and intra-cloud *(above)* lightning strikes.



Above: Plot of a first-quadrant point.

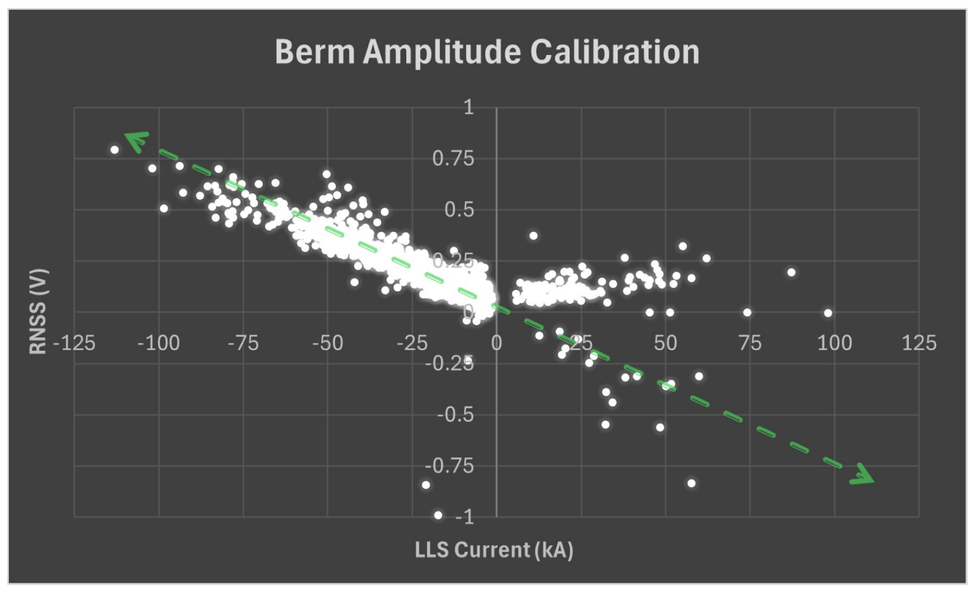


Figure 1 – Lower Altitude HAMMA

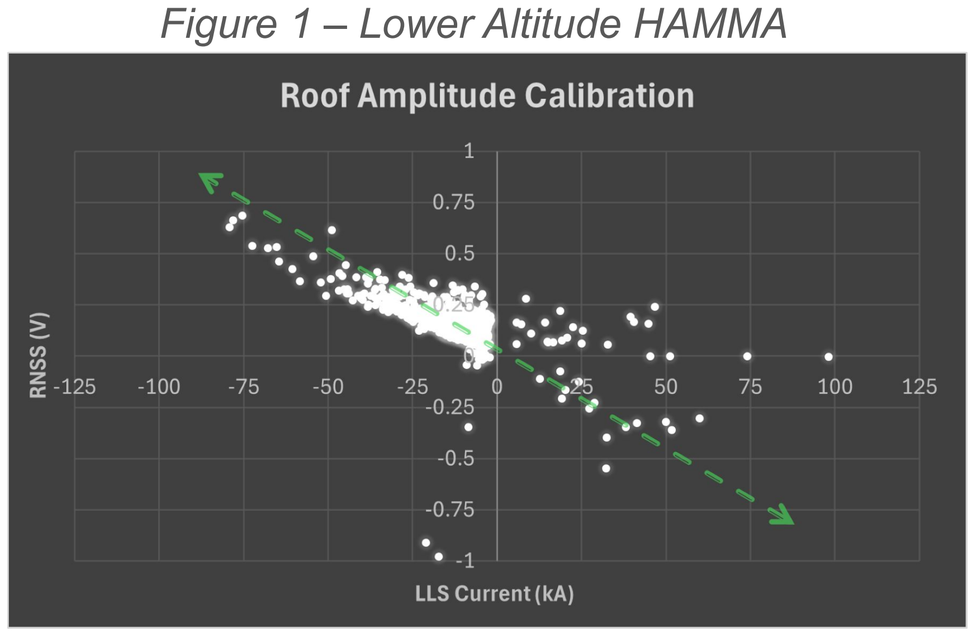


Figure 2 – Higher Altitude HAMMA

Conclusions

A method of estimating lightning current as found by these calibrations is crucial for lightning safety, wildfires, and severe weather. Further analysis on trends can help make these estimations more robust. Additionally, knowledge of how altitude affects HAMMA's measurements will aid in its future research.

Acknowledgements

Thanks to Jeffrey Burchfield , UAH Earth System Science Center, for guidance and assistance with data processing. All RCEU projects were sponsored in part by the Alabama Space Grant Consortium, the UAH Office of the President, Office of the Provost, Office of the Vice President for Research and Economic Development, the College of Science, the College of Arts, Humanities, and Social Sciences, and the College of Education.