

Remote Detection of Lightning Positive Leaders Using Radio Waves

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A lightning discharge extends in space usually through the progression of positive and negative leaders which normally emit a series of radio waves. It is through detecting and locating such radio waves that makes lightning 3D mapping possible and thus lightning observation much easier particularly deep inside thunderclouds. However, compared to negative leaders, positive leaders usually radiate much weaker electromagnetic signals and for this reason the quality of the positive leader part of a 3D lightning map is generally poor. In this presentation, we will first make a comparison between the positive leader part and negative leader part of several example 3D lightning maps obtained by using a lightning mapping system called DALMA (Discone Antenna Lightning Mapping Array) [1]. Then we will compare the positive and the negative leaders mapped by using InLMA [2, 3]. Finally, we will present a method and some preliminary results to improve the quality of the positive leader part as an example 2D map of elevation versus azimuth shown in Figure 1. As can be seen in this figure, clearly, we can map more points during about 30 ms progression of a positive leader after the improvement. We will report more detailed results during the conference.

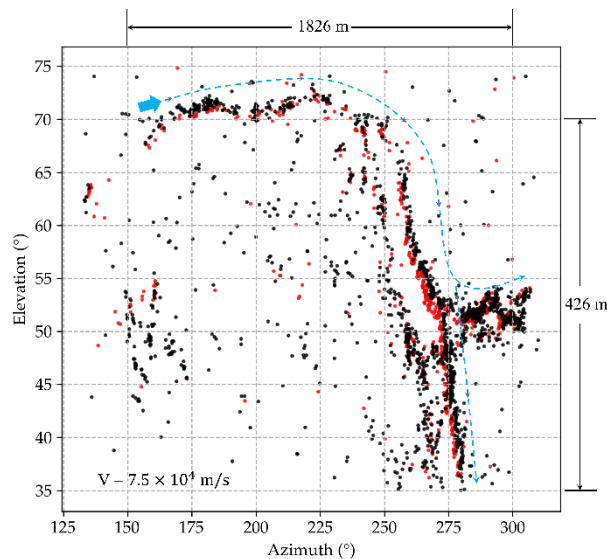


Figure 1. A comparison of the mapping results of a positive leader before and after the improvement. Red and black points are, respectively, for the results before and after the improvement.

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2. J. Yang, D. Wang, H. Huang, T. Wu, N. Takagi, and K. Yamamoto, "A 3D Interferometer-Type Lightning Mapping Array for Observation of Winter Lightning in Japan, " *Remote Sensing*, 15(7), 1923, 2023, <https://www.mdpi.com/2072-4292/15/7/1923>.
3. Q. Yang, D. Wang, J. Yang, and T. Wu, "Observation of the first stepping process of three winter lightning discharges," *Geophysical Research Letters*, 52, e2024GL111468, 2025, doi: <https://doi.org/10.1029/2024GL111468>.