Correlation between leader speed and peak current in natural lightning

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COMPONENTS OF LIGHTNING

STEPPED LEADER

Figure 1a. Stepped leader downward motion. The pictures are about 300 µs apart.

RETURN STROKE

Figure 1b. Return stroke upward motion. The pictures are about 250 µs apart.

DART LEADER

Figure 1c. Dart leader downward motion. The pictures are about 25 µs apart.

OBJECTIVES

• Contrast our theoretical notions of lightning with the empirical results from this research.

• Compare our results for natural lightning with those from previous studies done on triggered lightning (Idone et al. (1984) and Jordan et al. (1992)).

• Test the validity and precision of the peak current estimates from two widely used lightning detection networks.

DATA ANALYSIS

\[ x = d \times \frac{P}{f} \]

Distance \((d)\) from flash to camera in km:
- National Lightning Detection Network® (NLDN)
- Earth Networks Total Lightning Network™ (ENTLN).

Focal length \((f)\) in mm

Pixel size in camera \((p)\) in µm

Pixel size in reality \((x)\) in m

\[ x = \frac{d \times P}{f} \]

Camera

Lightning

RESULTS

Stepped leader speed vs NLDN reported peak current

• Sample size: 48 stepped leaders
• Possible correlation \((R^2 \approx 0.56)\)
• Result consistent with our theoretical model

ENTLN vs NLDN reported peak current

• 58 out of 78 commonly detected flashes
• Points lay roughly on the line \(y = x\), indicating almost identical readings

Dart leader speed vs NLDN reported peak current

• Sample size: 26 dart leaders
• No visible correlation
• Different result than for triggered lightning

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