

Continuing Current Seen Above and Below the Cloud: Comparing Observations from the GLM and Video Cameras

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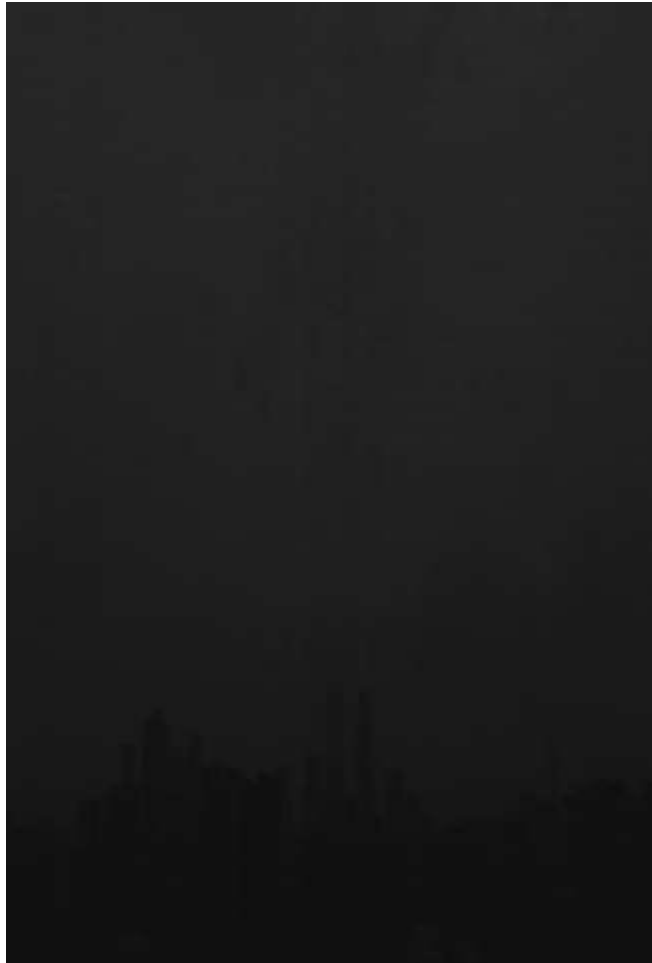
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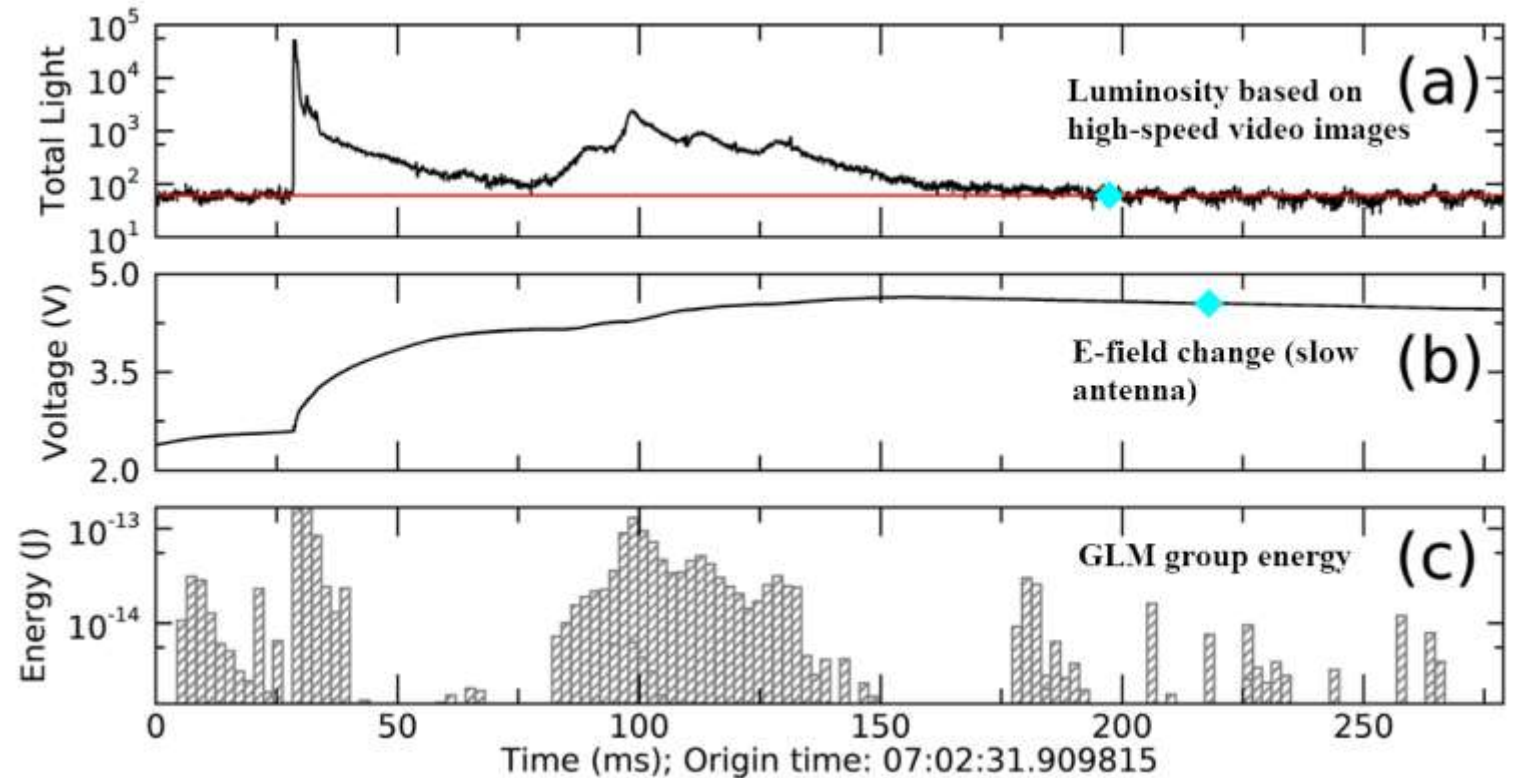
Continuing Current

- Low-level current of typically tens to hundreds of amperes that immediately follows a return stroke, in the same channel to ground, and typically lasts for tens to hundreds of milliseconds. It can be classified as **long** (>40 ms), **short** (10–40 ms), and **very short** (3–10 ms) continuing current.
- Long CC are responsible for most serious lightning damage associated with thermal effects (e.g. burned ground wires and forest fires). (Rakov and Uman, 2003)
- High-speed video observations in Brazil: **55%** (2459 out of 4495) **negative** strokes were followed by some CC. The percentage of flashes containing at least one stroke followed by a long CC was **27%** (Medeiros et al., 2012).
- CC in **positive** flash is very common. **97%** **positive** strokes were followed by some CC. The percentage of flashes containing at least one long CC is **68%** (Schumann and Saba, 2012)
- Detecting continuous current is more straightforward in the optical range than in the radio frequency spectrum.

Continuing Current Seen Above and Below the Cloud



A +CG flash terminated on a tall building. Courtesy of Dr. Weitao Lyu



Fairman and Bitzer (2022)

Question for this study:

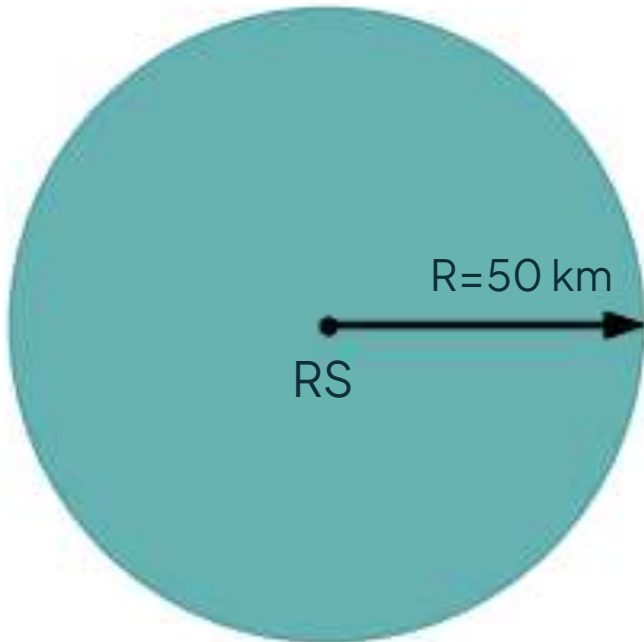
- How many of the CCs observed by video cameras at the ground can be detected by the GLM?
- If detected, what's the GLM-CC duration vs. Video-CC duration?

Ground-Truth Video Camera Dataset

Location	Camera Speed	Number of CC (≥ 10 ms)	Number of Long CC	Number of +CC	Number of -CC	Year
Florida, USA	High (>1000 fps)	60	21	5	55	2018-2022
Sao Paulo, Brazil	High (>1000 fps)	55	30	1	54	2018-2020
Utah, USA	High (>1000 fps)	72	44	50	22	2021-2022
Maryland, USA	Normal (90 fps)	21	10	2	19	2022
Arizona, USA	Normal (90 fps)	2	1	0	2	2022
Total		210	106	58	152	2018-2020

Method

Search Area



Search Time Window



Detection Efficiency (DE)

**One-Group
Detection
Efficiency
(DE₁):**

The CC is considered as detected if \geq **one GLM group** is detected

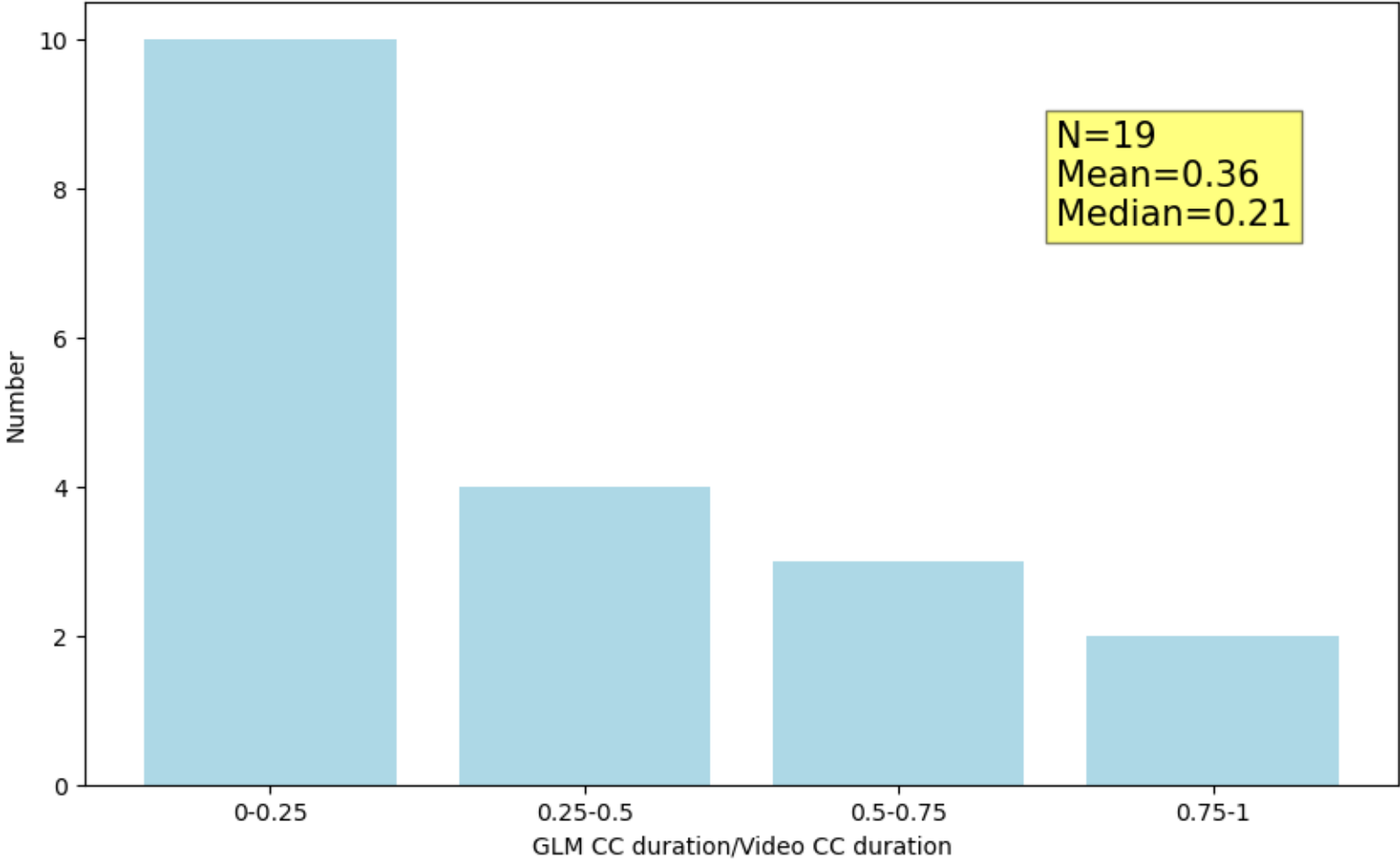
**Five-
Consecutive
-Group
Detection
Efficiency
(DE₅):**

The CC is considered as detected if \geq **five consecutive GLM groups** are detected . (Bitzer, 2017)

Results: GLM16

Location	DE_1	DE_5	DE_1 for Long CC	DE_5 for Long CC	DE_1 for +CC	DE_5 for +CC	DE_1 for -CC	DE_5 for -CC
Florida, USA	27/60 (45%)	7/60 (12%)	10/21 (48%)	3/21 (14%)	5/5 (100%)	5/5 (100%)	23/55 (42%)	2/55 (4%)
Utah, USA	41/72 (57%)	8/72 (11%)	25/44 (57%)	5/44 (11%)	32/50 (64%)	8/50 (16%)	9/22 (41%)	0/22 (0%)
Sao Paulo, Brazil	32/55 (58%)	3/55 (5%)	17/30 (57%)	3/30 (10%)	1/1 (100%)	1/1 (100%)	31/54 (57%)	2/54 (4%)
Maryland, USA	11/21 (52%)	1/21 (5%)	6/10 (60%)	1/10 (10%)	1/2 (50%)	1/2 (50%)	10/19 (53%)	0/19 (0%)
Arizona, USA	0/2 (0%)	0/2 (0%)	0/1 (0%)	0/1 (0%)	NA	NA	0/2 (0%)	0/2 (0%)
Total	111/210 (53%)	19/210 (9%)	58/106 (55%)	12/106 (11%)	39/58 (67%)	15/58 (26%)	73/152 (48%)	4/152 (3%)

GLM CC duration vs. Video CC duration



Summary:

- For video observations of 210 continuing currents (≥ 10 ms), the GLM one-group detection and five-consecutive-group detection efficiencies are 53% and 9%. Such numbers increase slightly for long CCs (≥ 40 ms), which are 56% and 11%.
- The CC detection efficiency for +CCs is significantly higher than that for -CCs.
- In cases where the GLM detected 19 CC events with five consecutive groups, the CC duration recorded by the GLM was on average 36% of the duration captured in video recordings.

Location	DE_1	DE_5	DE_1 for Long CC	DE_5 for Long CC	DE_1 for +CC	DE_5 for +CC	DE_1 for -CC	DE_5 for -CC
Total	111/210 (53%)	19/210 (9%)	58/106 (55%)	12/106 (11%)	39/58 (67%)	15/58 (26%)	73/152 (48%)	4/152 (3%)

Thank you!

QUESTIONS OR COMMENTS?

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