GLM SCIENCE MEETING
(virtual meeting format)

Differences in GLM-Observed Energetics Between Ground & Cloud Flashes in June 2020

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INTRODUCTION

GLM observables [i.e., flash optical energy (Q), Max Group Area (MGA), …] generally differ between ground & cloud flashes, and so there is a desire to **find** and **exploit** these differences for beneficial purposes. This allows us to fully realize & apply the true **information content** of GLM data.

Previously (and ongoing):

MGA ⟶ flash-typing (is it ground or cloud flash ?)

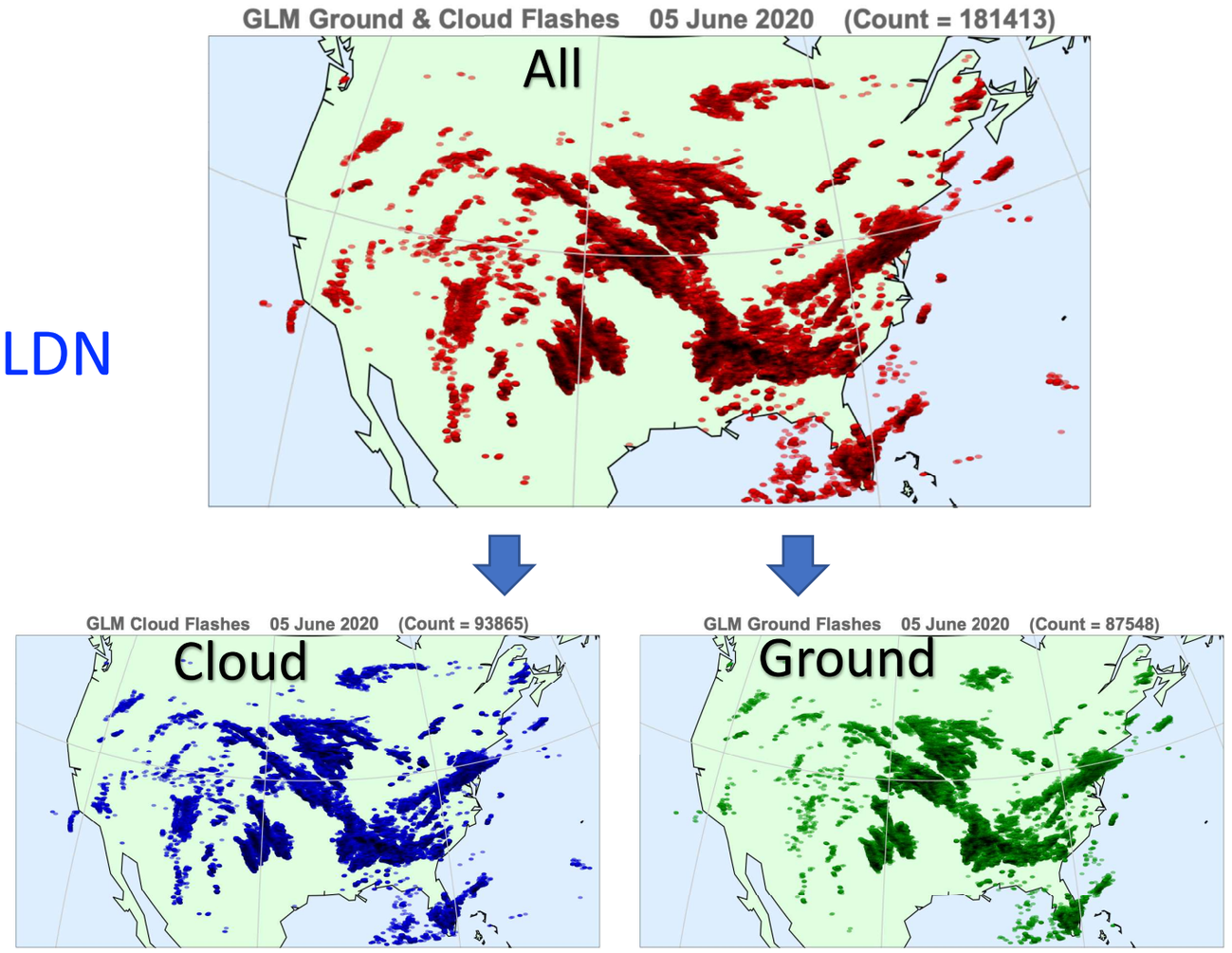
This Study:

Q ⟶ Is it larger for ground or cloud flash?, i.e.,. which flash-type produces more LNOx?

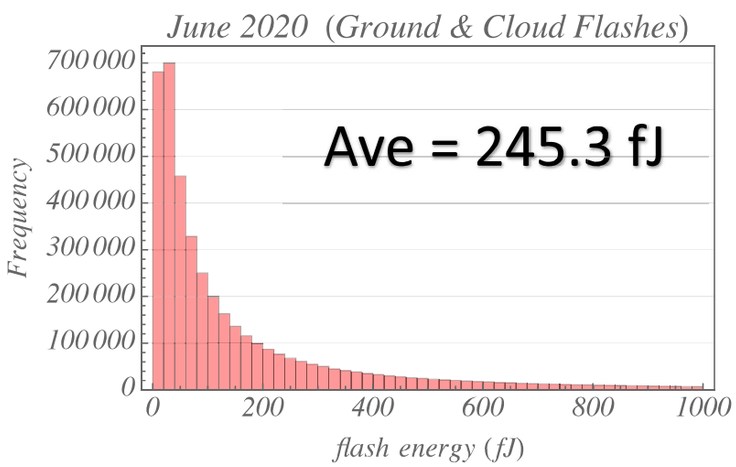
$\{Q, MGA, \ldots\}$ ⟶ Can these be used to retrieve estimates of CG peak current ?

METHOD

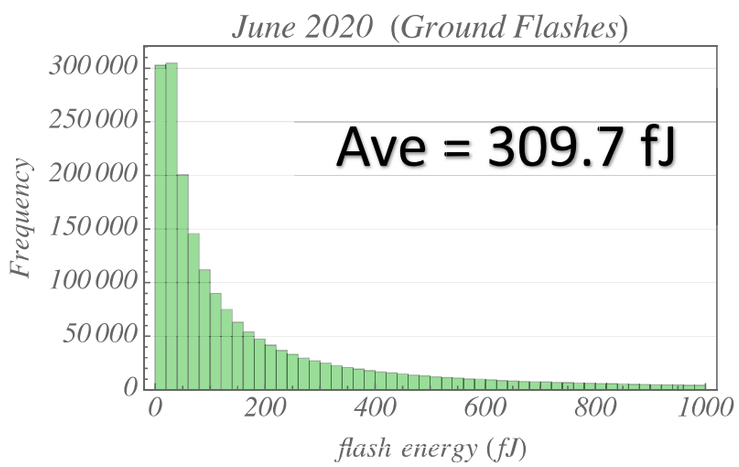
- **Mathematica v12.1.1**
- **Period:** June 2020 (entire month)
- **Region:** CONUS
- **Flash-typed:** GLM flashes using NLDN
  - **4,370,460 GLM flashes typed**
  - 2,077,872 typed Ground
  - 2,292,588 typed Cloud
- **Removed:** Ambiguous type
- **Compared:**
  - Q, for Ground & Cloud
  - Q, MGA, i_{peak} for Ground



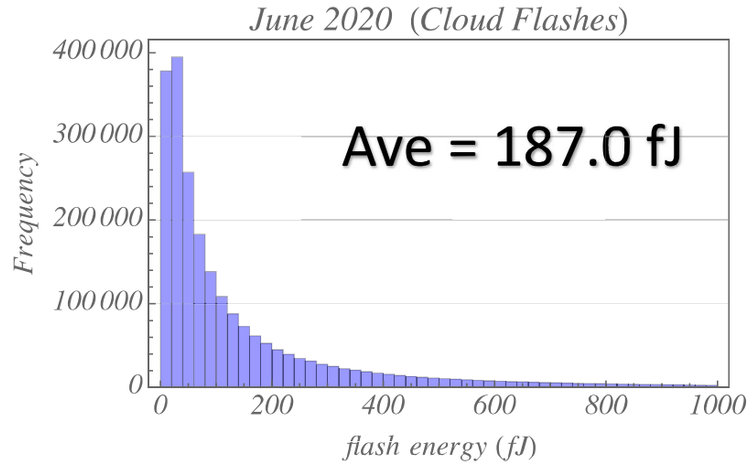
RESULTS



Q



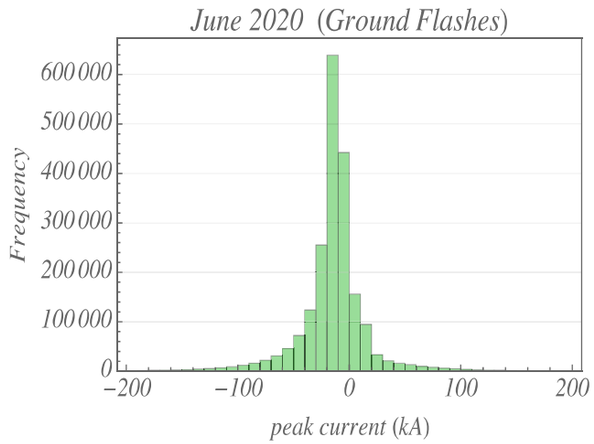
Q_{grd}



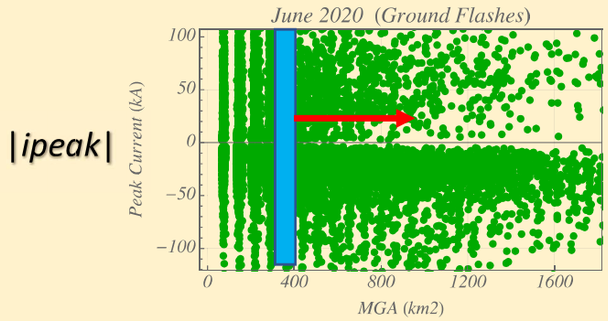
Q_{cld}

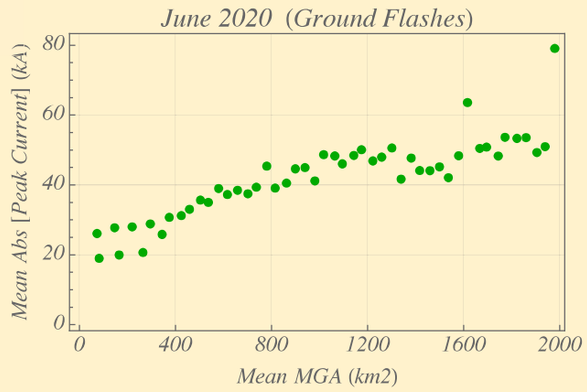
- **So GLM ground flashes are optically more energetic than GLM cloud flashes:** $Q_{grd} > Q_{cld}$
- **Similarly** $MGA_{grd} > MGA_{cld}$ **; Ave: (335.2, 411.6, 265.9) km², respectively**

RESULTS (cont.)

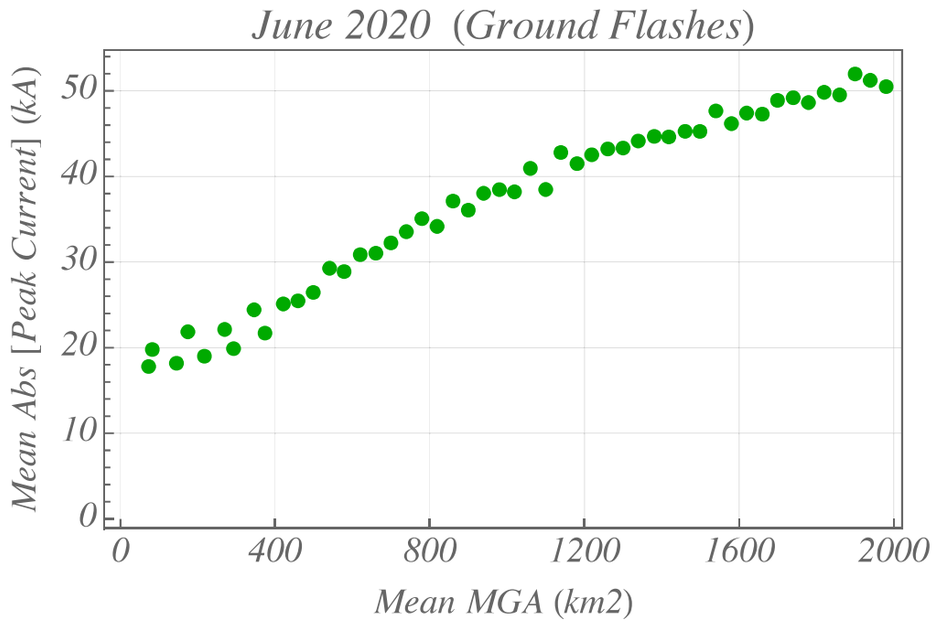


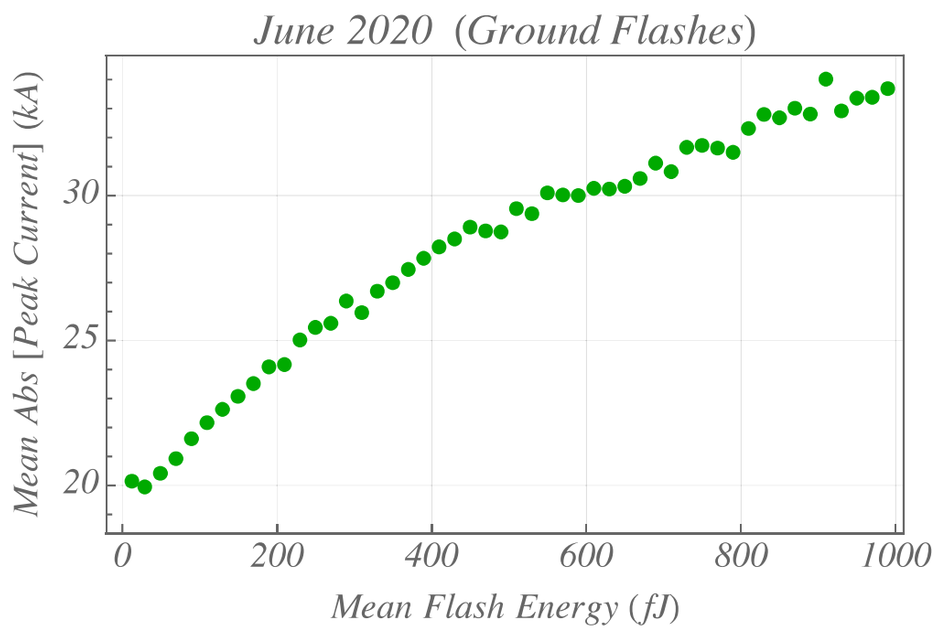
Sample Day: June 1





Find mean |*ipeak*| in the sliding MGA bin





CONCLUSIONS/FUTURE WORK

- **Since ground flashes are optically more energetic than cloud flashes, this study provides additional* evidence that ground flashes produce more LNOx than cloud flashes.**

- **Previous bullet emphasizes importance of flash-typing GLM flashes for optimal LNOx estimation (i.e. for chemistry/climate studies, and NCA studies).**

- **This study confirms correlation between average NLDN peak current magnitude and average MGA (and flash optical energy).**

- **Future: uncovering information content of GLM data is "just beginning" … work on many fronts still to be pursued; e.g. GLM-estimated LNOx & TEMPO NO_2 obs.**

*** CGs likely produce more LNOx than ICs because CGs have: longer channel lengths, larger currents, more channel near ground where air density is higher (greater yield Y), in-cloud components like ICs but w/additional energetic return strokes to ground.**