An Analysis of the Lightning Jump Algorithm Using Geostationary Lightning Mapper Flashes

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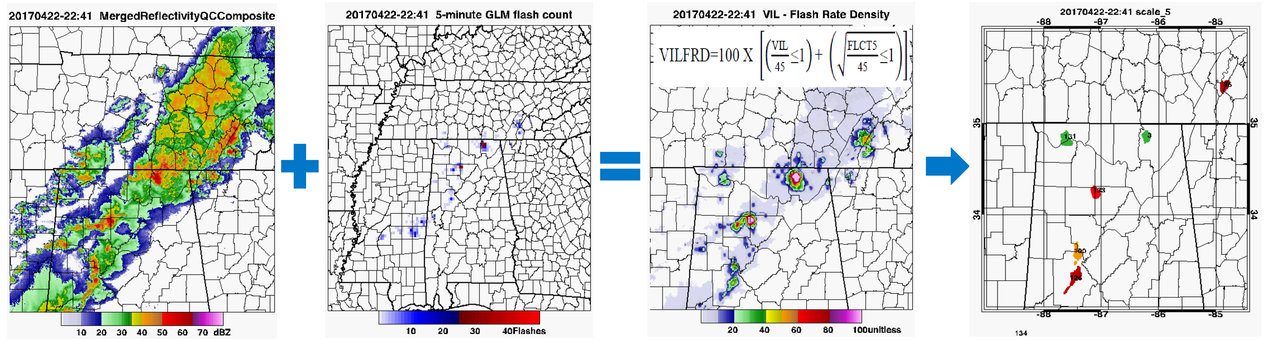
Introduction:

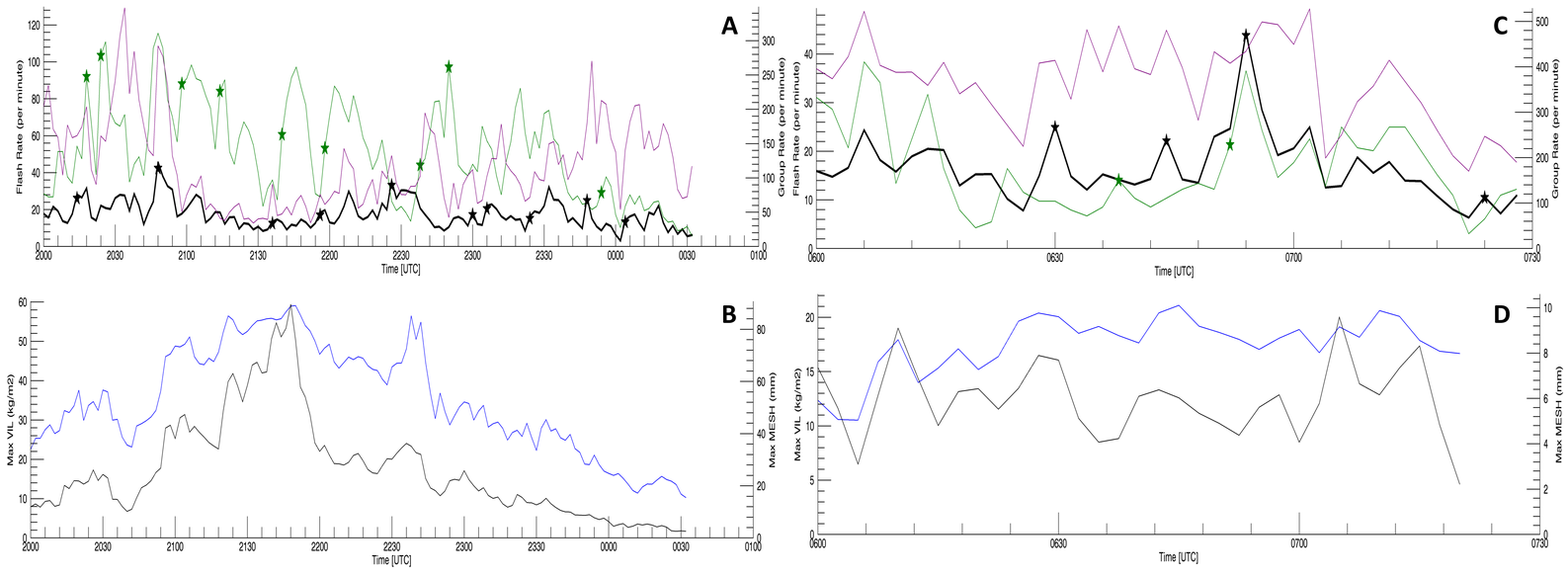
Lightning's relation to severe weather has been studied since the 1980's [Goodman et al. 1988, MacGorman et al. 1989]. The invention of the Lightning Mapping Array [Rison et al. 1999] allowed for total lightning measurements in a 125 km operational range. This brought forth an automated Lightning Jump Algorithm (LJA) [Schultz et al. 2009] that predicted severe weather based on two-sigma increases in total lightning. The LJA's biggest downfall is being restrained to the limited field of view (FOV) of LMAs. The launch of the Geostationary Lightning Mapper (GLM) aboard the GOES-16 satellite now gives us hemispheric total lightning measurements [Goodman et al 2013]. The wide FOV makes the GLM a good candidate to apply the LJA to. However the GLM and LMA have some differences. One being the coarser spatial resolution of GLM. Another being that LMA measures very high frequency (VHF) electromagnetic radiation while GLM measures optical radiation [Nag et al. 2015]. These differences suggest an extensive study must be done on using the LJA with GLM to understand potential differences in the LJA and to maximize its operational skill. Four deep dive cases are conducted showcasing the differences between the GLM and LMA and their jumps.

VILFRD tracking method combining reflectivity-based VIL and 5-minute GLM flash counts is used to assign characteristics to storms and track them [Schultz et al. 2016].



	LMA Flashes	GLM Flashes	GLM Groups	VIL	MESH
LMA Flashes	1	0.43813	0.15814	0.47142	0.421943
GLM Flashes	0.43813	1	0.62890	0.19602	0.13742
GLM Groups	0.15814	0.62890	1	-0.04369	-0.05089
VIL	0.47142	0.19602	-0.04369	1	0.69456
MESH	0.42194	0.13742	-0.05089	0.69456	1

Average Pearson Correlations for all four cases (~12 hours of data)



A) Skyline, AL (22 April 2017 tornadic supercell) time series (UTC) of LMA flashes (green, flashes per minute), GLM flashes (black, flashes per minute), and GLM groups (purple, groups per minute). Black (Green) stars are lightning jumps in GLM (LMA) flashes. B) Skyline, AL time series of max VIL (blue, kg/m2) and max MESH (black, mm) C-D same as A-B except for Central OK (17 May 2017 MCS).

Conclusions:

- Initial small sample sized study shows differences, sometimes significant, in the magnitudes and trends of GLM flashes and LMA flashes. In some of the cases LMAs see up to three times as many flashes as the GLM. Pearson correlations show only a moderate (0.43813) correlation between LMA and GLM flashes.
- GLM flashes saw 25 lightning jumps while LMA only saw 19. Out of these only 7 were within 10 minutes of each other. 14 of 19 LMA jumps saw corresponding increases in radar intensity metrics while only 15 of 25 GLM jumps saw those increases.
- Results suggest a larger sample sized study be conducted to better analyze how the LJA performs with the GLM and identify any needed changes to the algorithm.

References:
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