GLM Validation with the RELAMPAGO Lightning Mapping Array

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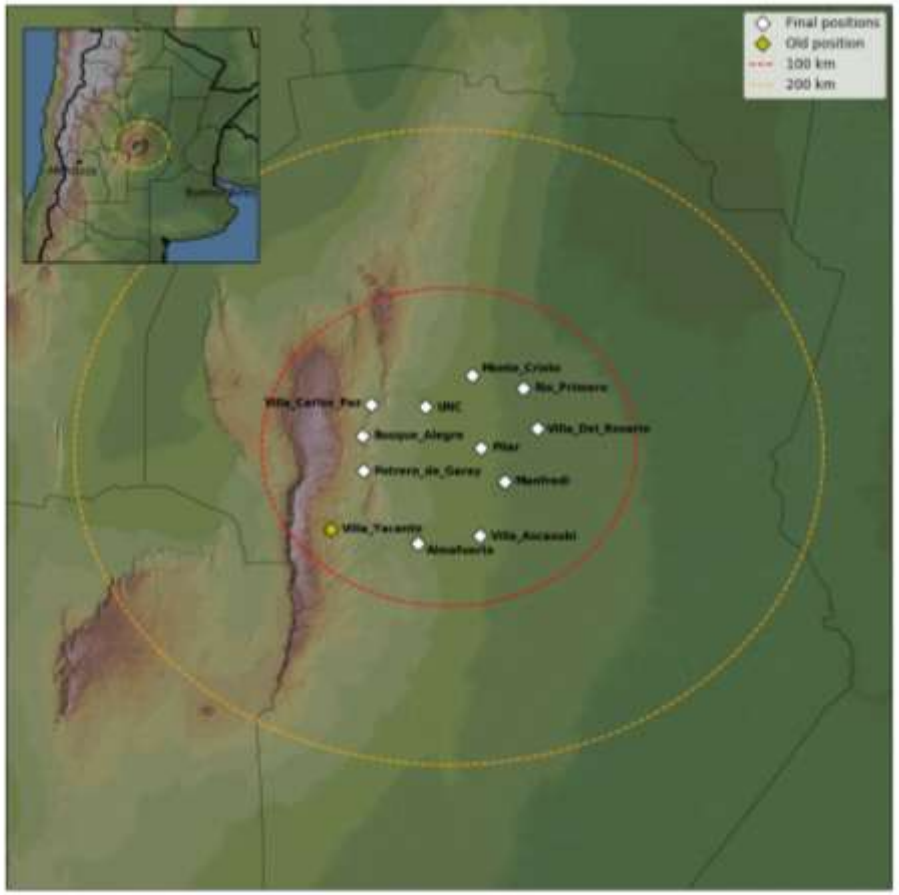
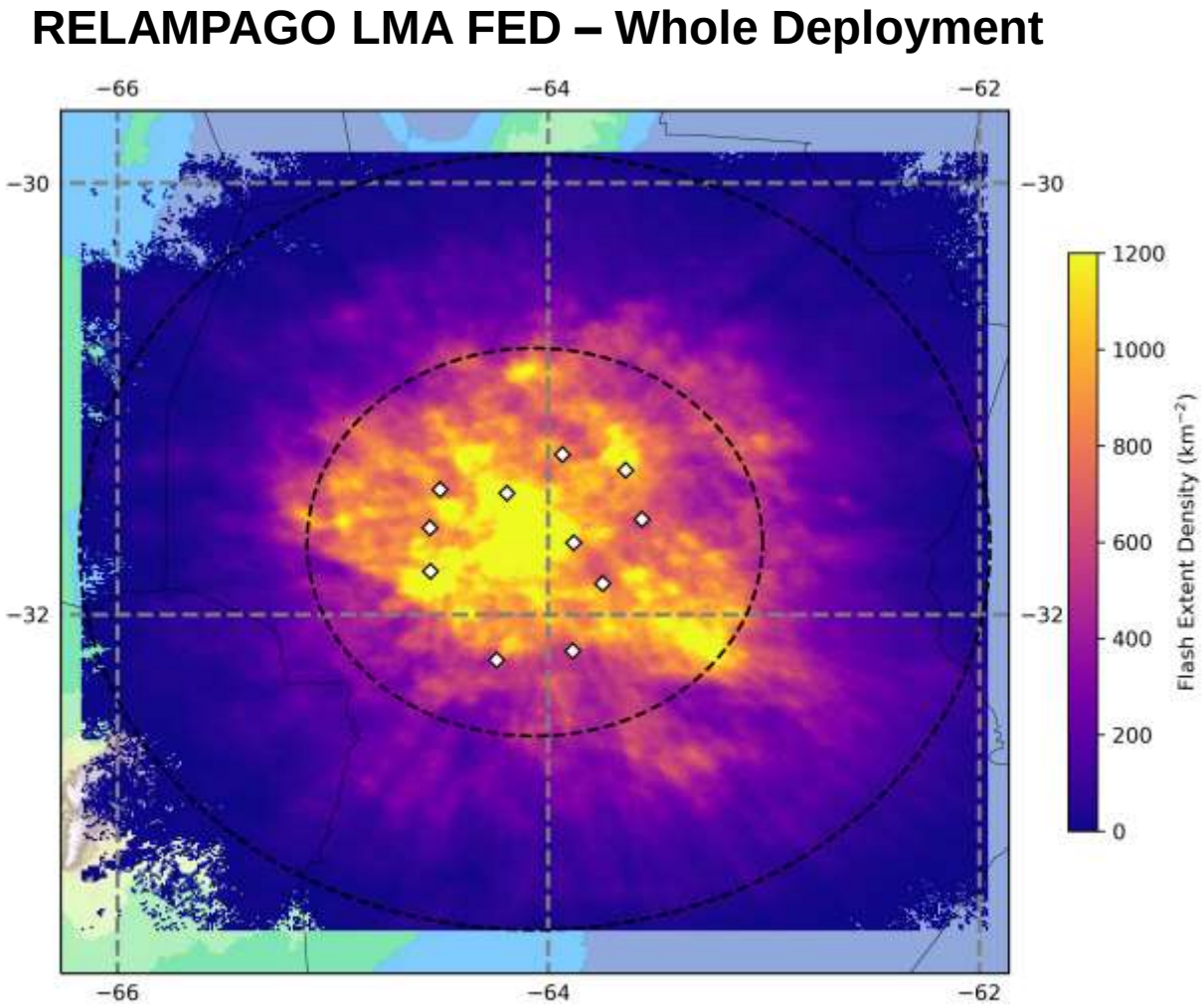


Introduction

- 11-station LMA near Cordoba, Argentina
- Ops 8 Nov 2018 – 19 Apr 2019
- Primarily funded by GOES-R, deployed by MSFC & partners
- Supported NSF/DOE/NASA/NOAA/ Argentina/Brazil RELAMPAGO-CACTI field campaign

Methods

- Focus on lightning within 100 km of LMA
- 71 case days – Full thunderstorm spectrum
- LMA source data processed to flashes using lmatools
- Flash-level GLM-16 from L2 LCFA
- Unit of comparison: 10-minute blocks
- Thresholding: 25-km distance and +/- 500 ms
- Allowing 1 GLM flash to correspond to multiple LMA flashes
- Day = 11-22 UTC; Night = 00-08:30 UTC



Results

- Overall good GLM performance in north-central Argentina
- DE negatively correlated with flash rate – implications for usage in case studies (see next slide)

(Spearman rank correlations significance $p << 0.01$)

	Day	Night	Overall	Notes
GLM Detection Efficiency	71%	84%	77%	10+ LMA pts (2% less for 3+ pts)
GLM/LMA Flash Rate Correlation	0.95	0.97	0.95	3+ LMA pts
Correlation of DE w/ TFR	-0.38	-0.62	-0.50	3+ LMA pts
Correlation of DE w/ Points per LMA Flash	0.28	0.22	0.24	3+ LMA pts
Correlation of DE w/ Flash Altitude	-0.28	-0.35	-0.31	Influence of stratiform lightning

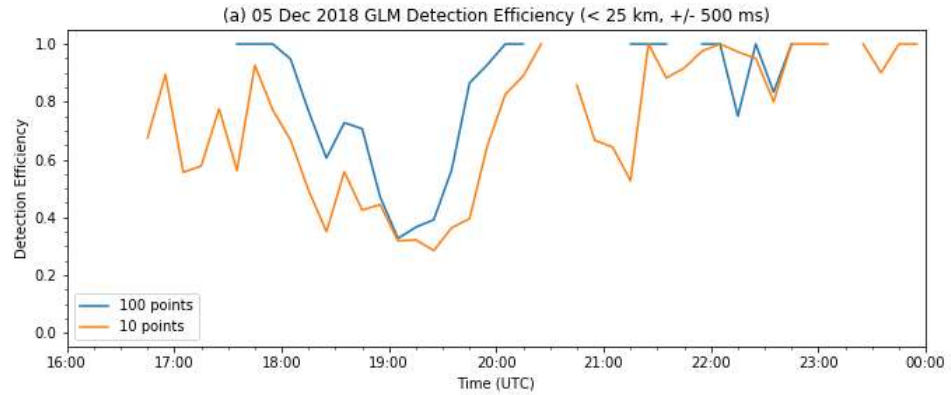
5 Dec 2018

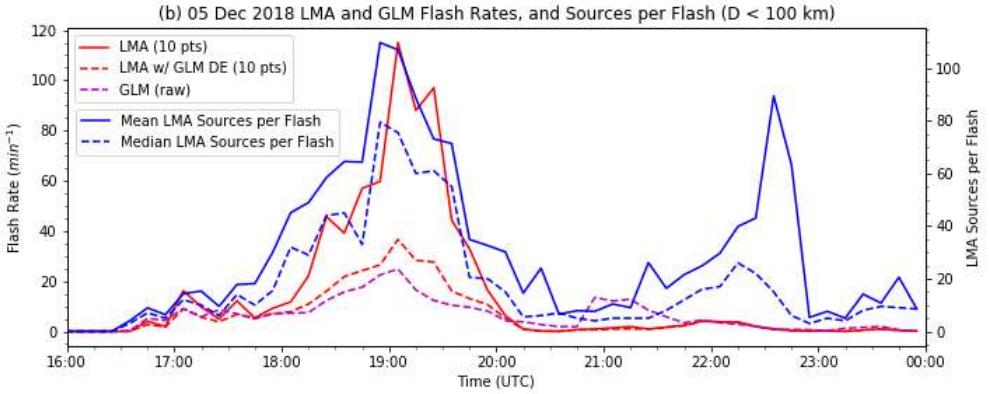
25 Jan 2019

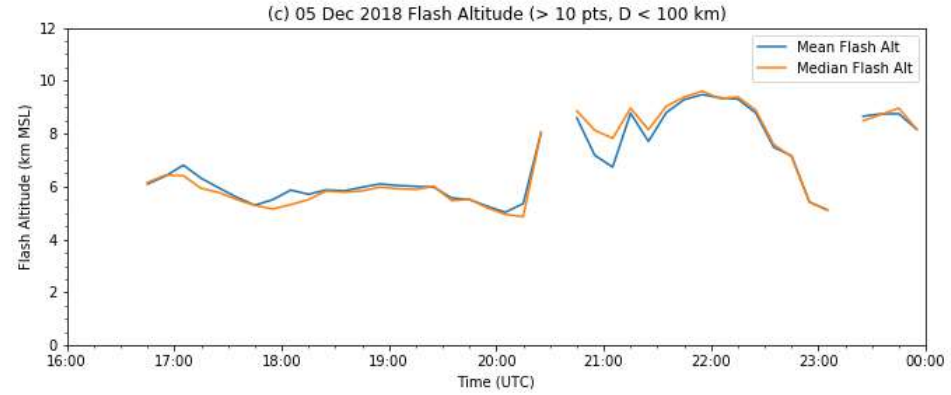
GLM DE

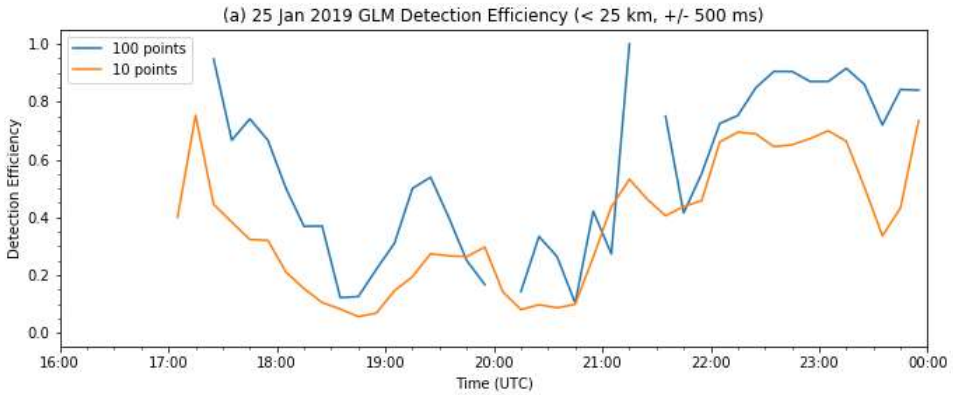
LMA Rate/Size

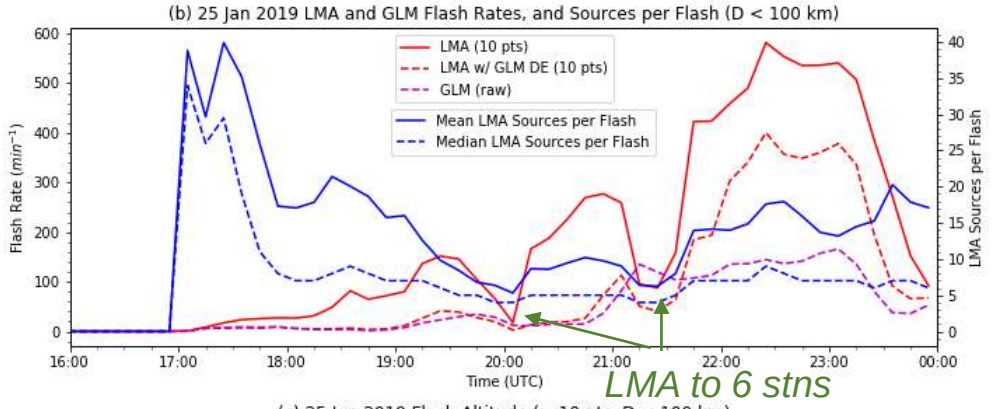
Altitude

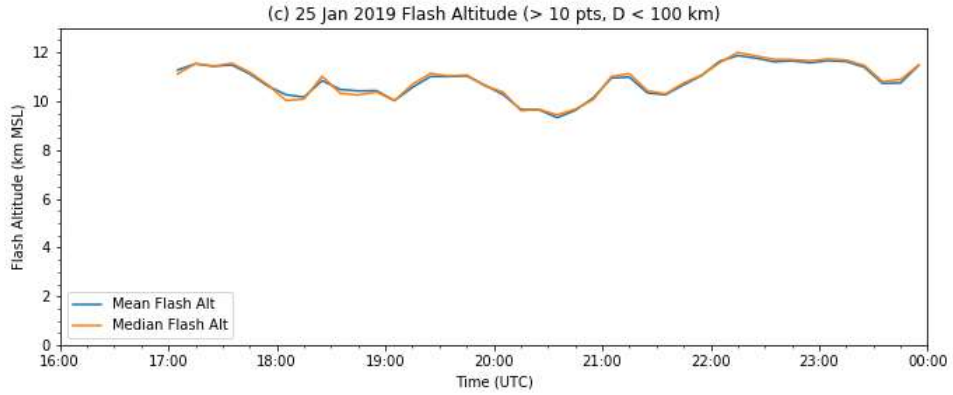












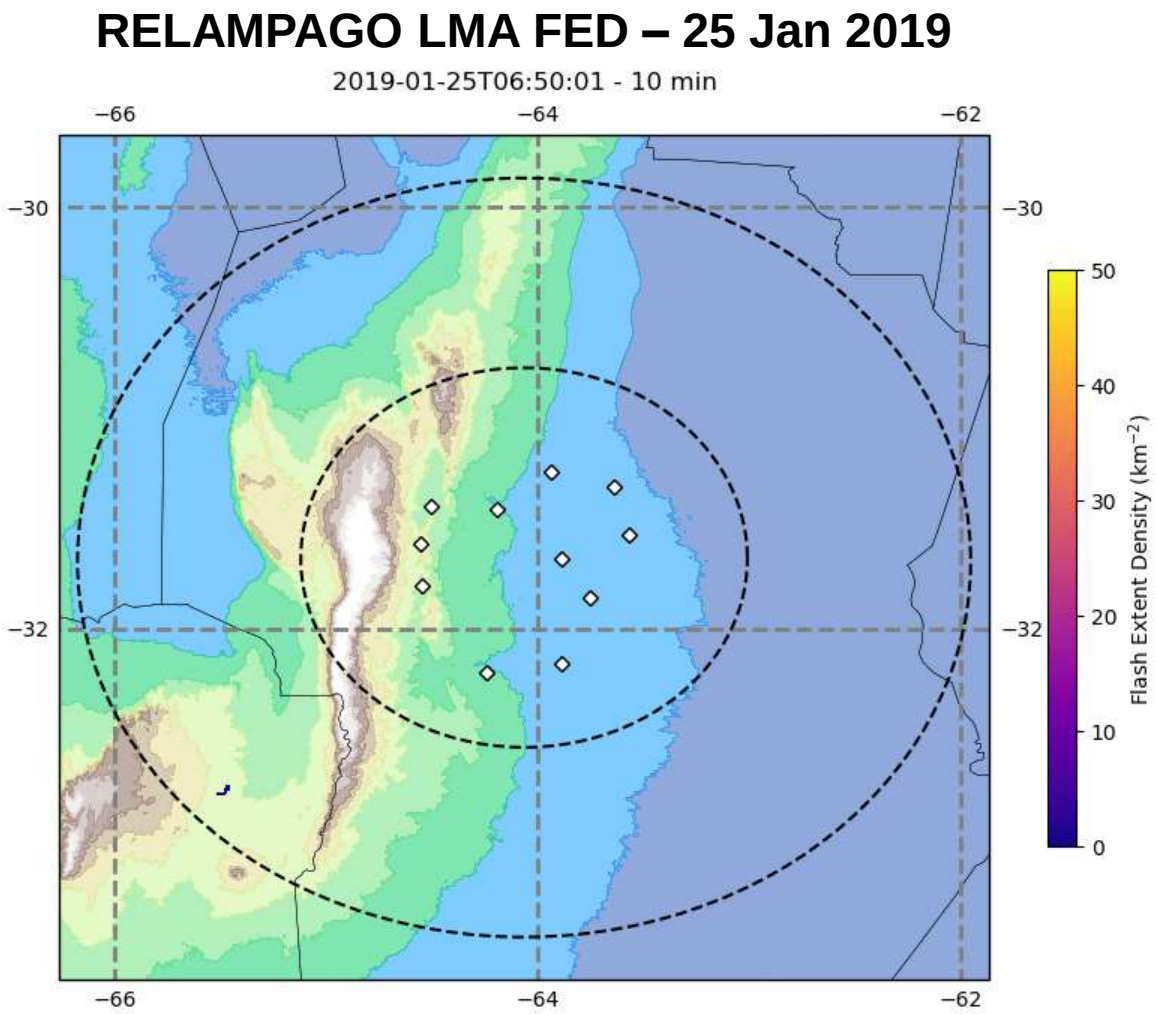
Anomalous storm – Low-altitude convective flashes

Severe convection – Small flashes, increase in DE @ dusk

Conclusions

- Despite favorable bulk statistics, RELAMPAGO LMA provides significant evidence that GLM detection efficiency degrades in intense, high-flash-rate convection, as well as anomalous storms

- Sensitivity study – Halving match criteria to 250 ms & 12.5 km gives 65% night & 57% day DE (60% overall)



RELAMPAGO LMA data available @ http://dx.doi.org/10.5067/RELAMPAGO/LMA/DATA101

RELAMPAGO LMA References

- Lang, T. J., and Coauthors, The RELAMPAGO Lightning Mapping Array: Overview and initial comparison to the Geostationary Lightning Mapper. *J. Atmos. Oceanic Technol.*, doi: https://doi.org/10.1175/JTECH-D-20-0005.1.
- Peterson, M. J., Lang, T. J., Bruning, E. C., Albrecht, R., Blakeslee, R. J., Lyons, W. A., et al. (2020). New WMO Certified Megaflash Lightning Extremes for Flash Distance (709 km) and Duration (16.73 seconds) recorded from Space. *Geophysical Research Letters*, 47, e2020GL088888. https://doi.org/10.1029/2020GL088888
- Zhu, Y., Bitzer, P., Stewart, M., Podgorny, S., Corredor, D., Burchfield, J., et al. (2020). Huntsville Alabama Marx Meter Array 2: Upgrade and capability. *Earth and Space Science*, 7, e2020EA001111.https://doi.org/10.1029/2020EA001111
- Borque, P., L. Vidal, M. Rugna, T. J. Lang, M. G. Nicora, and S. W. Nesbitt (2020). Distinctive Signals in 1-minute Observations of Overshooting Tops and Lightning Activity in a Severe Supercell Thunderstorm. Conditionally accepted in *Journal of Geophysical Research: Atmospheres*.