Flash Characteristics: Sizes, Energetics, Comparisons to GLM and NLDN and other winter storms

LEE Science Meeting
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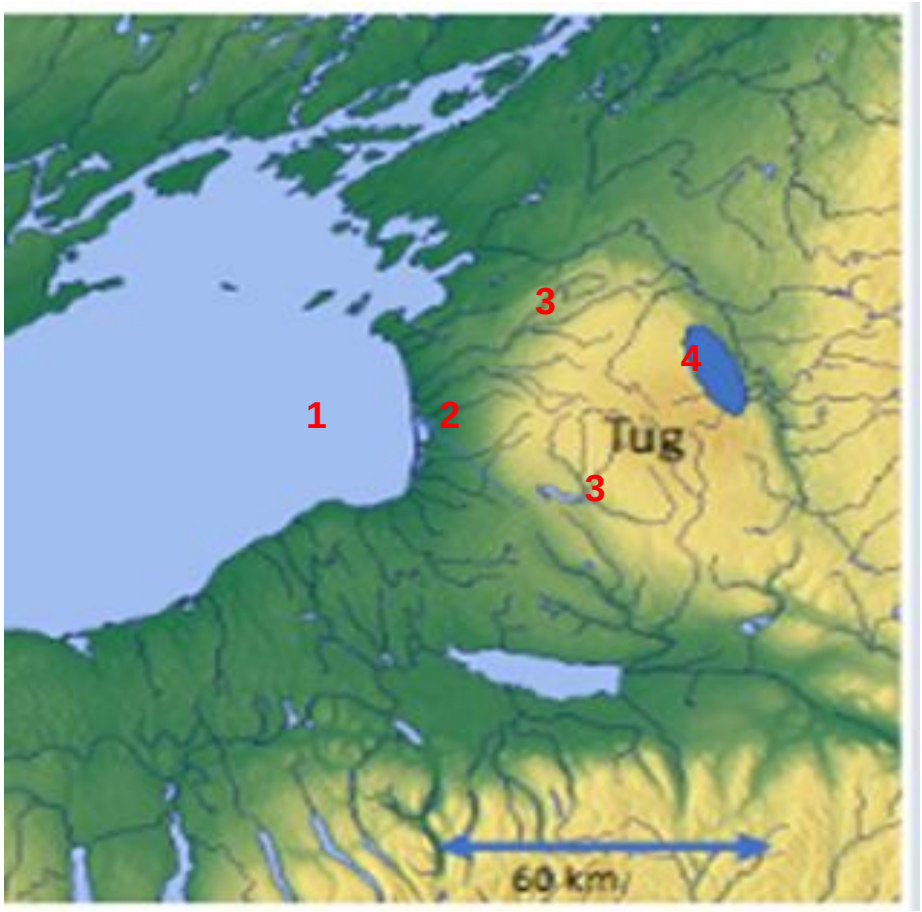
John Trostel, Levi Boggs, Jessica Losego: Georgia Tech Research Institute, Atlanta
Geoffrey Stano: University of Alabama - Huntsville
Scott Steiger: State University of New York – Oswego

And all participants who made LEE possible

Areas to study

- 1: Offshore
- 2: Just on-shore
- 3: On the Tug: not near turbines
- 4: On the Tug: near turbines



Datasets & Studies to be used

- LEE data
  - LMA
  - EFM
  - DOW
  - Soundings
- GLM
- NLDN
- Reanalysis (?)

Are there student research projects that are applicable?

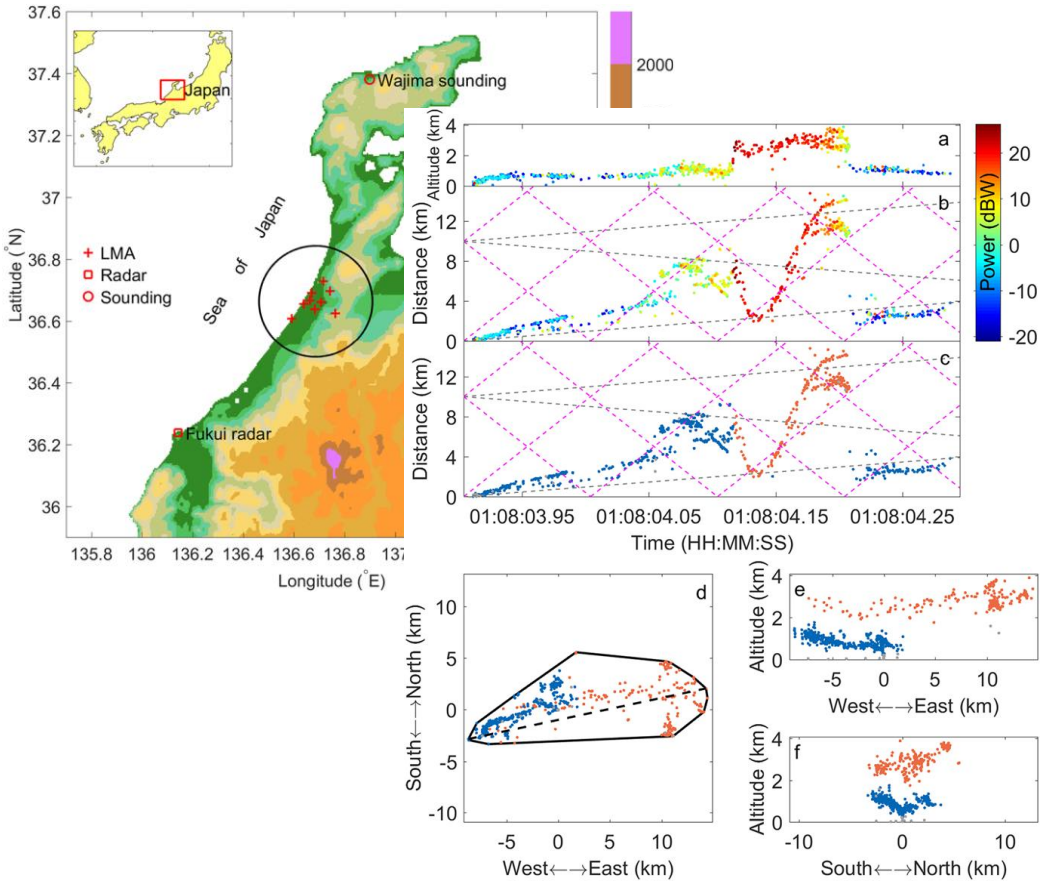
Previous Measurements of Winter Storms

- Various measurements of storms off the Sea of Japan
  - For instance:
  - Zheng, D., Wang, D., Zhang, Y., Wu, T., & Takagi, N. (2019). Charge regions indicated by LMA lightning flashes in Hokuriku's winter thunderstorms. Journal of Geophysical Research: Atmospheres, 124, 7179– 7206. https://doi.org/10.1029/2018JD030060
  - Wang, Daohong & Zheng, Dong & Wu, Ting & Takagi, Nobuyuki. (2021). Winter Positive Cloud-to-Ground Lightning Flashes Observed by LMA in Japan. IEEJ Transactions on Electrical and Electronic Engineering. 16. 10.1002/tee.23310.
- Schultz, C. J., Lang, T. J., Bruning, E. C., Calhoun, K. M., Harkema, S., & Curtis, N. (2018). Characteristics of lightning within electrified snowfall events using lightning mapping arrays. Journal of Geophysical Research: Atmospheres, 123, 2347– 2367. https://doi.org/10.1002/2017JD027821
- Kumjian, M. R., and W. Deierling, 2015: Analysis of Thundersnow Storms over Northern Colorado. *Wea. Forecasting*, **30**, 1469–1490, https://doi.org/10.1175/WAF-D-15-0007.1.

Zheng, D etal, 2019

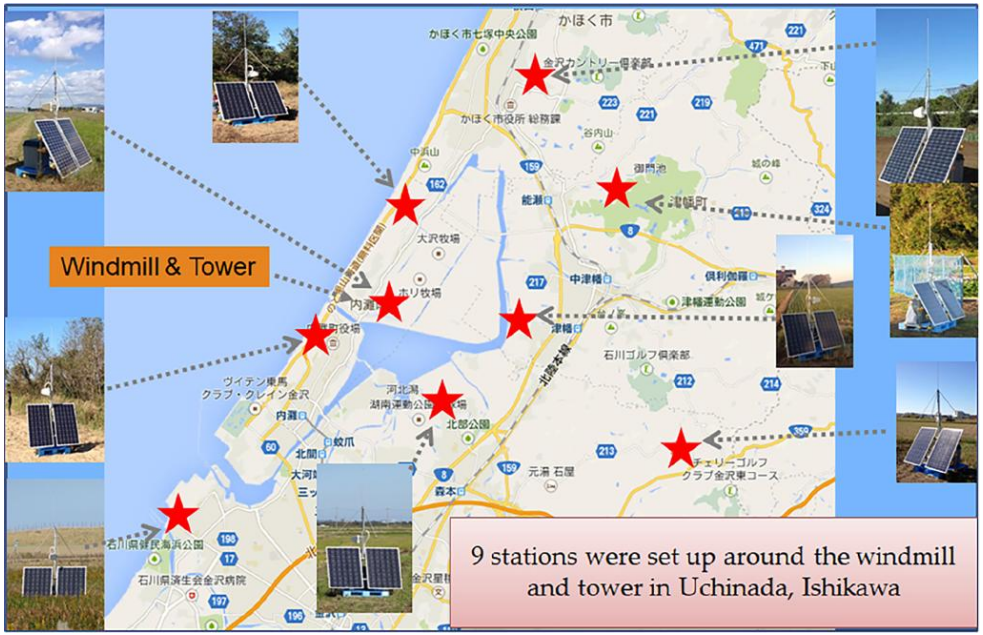
Key Points

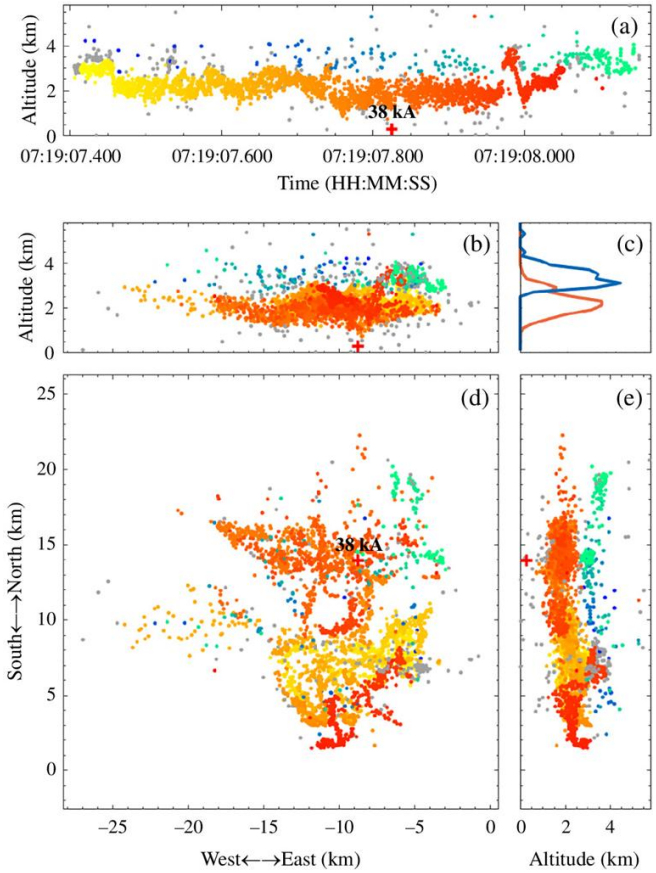
- Distribution patterns of charge regions with lightning discharges are diverse during Hokuriku's winter storms
- The height, temperature, and horizontal extent of the charge regions and the distance between charged cores are revealed
- Flash initiations feature low heights and large power in Hokuriku's winter storms



Also Wang, etal, 2020

Winter Positive CG Flashes

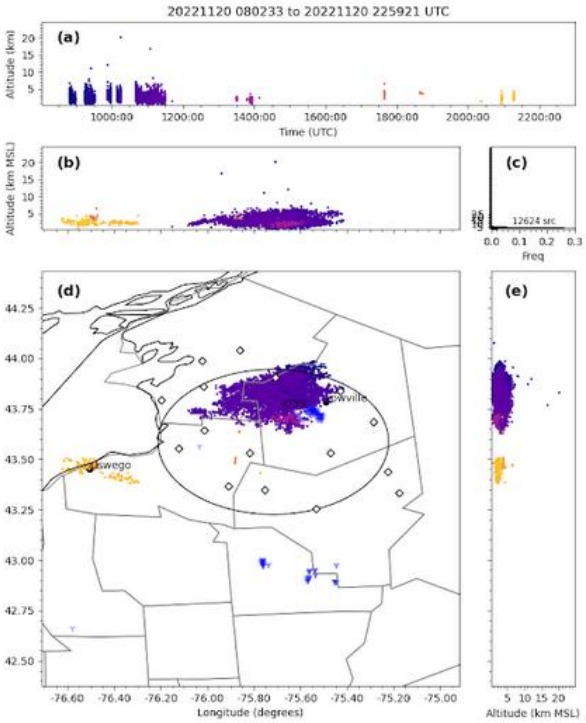




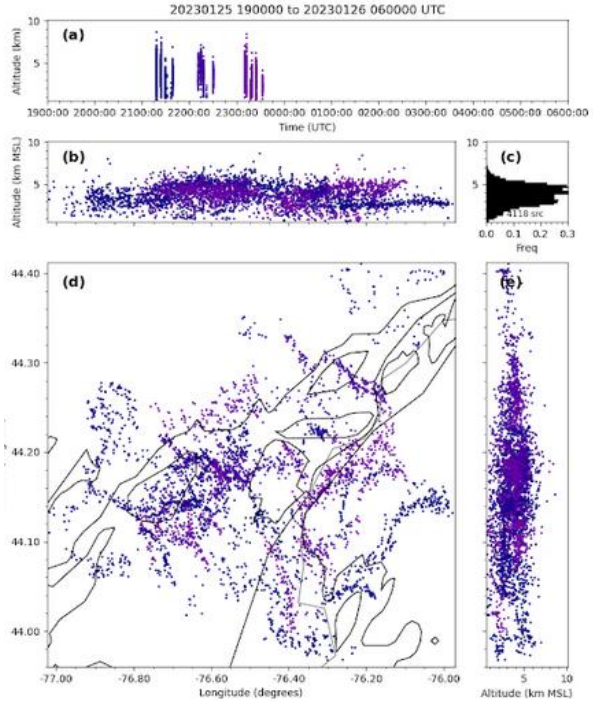
Tools to be used

- Xlma (NMT) (examples)
- TTU python tools (examples)
  - Lmatools - including flash sorted files (as mentioned by Vanna)
  - Glmtools
  - pyxlma
- Others
  - GTRI processing for GJ using GLM data may be adapted

Examples from pyxlma



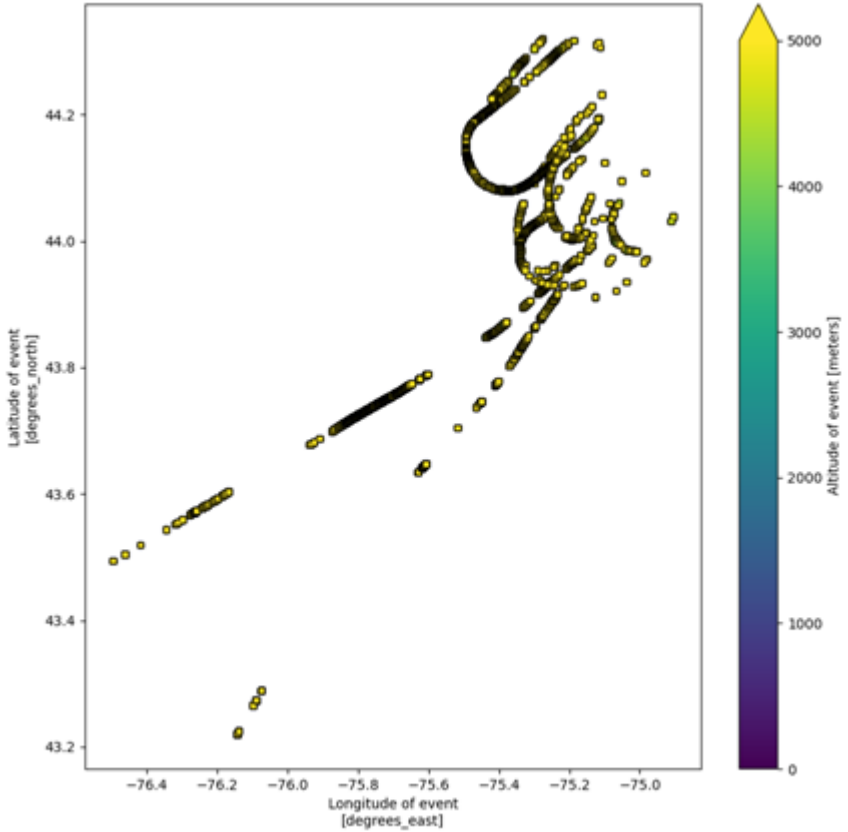
Nov 20 IOP3, Stn min = 7



Jan 25 ET, Stn min = 7

Airplane Track (just because it’s neat)

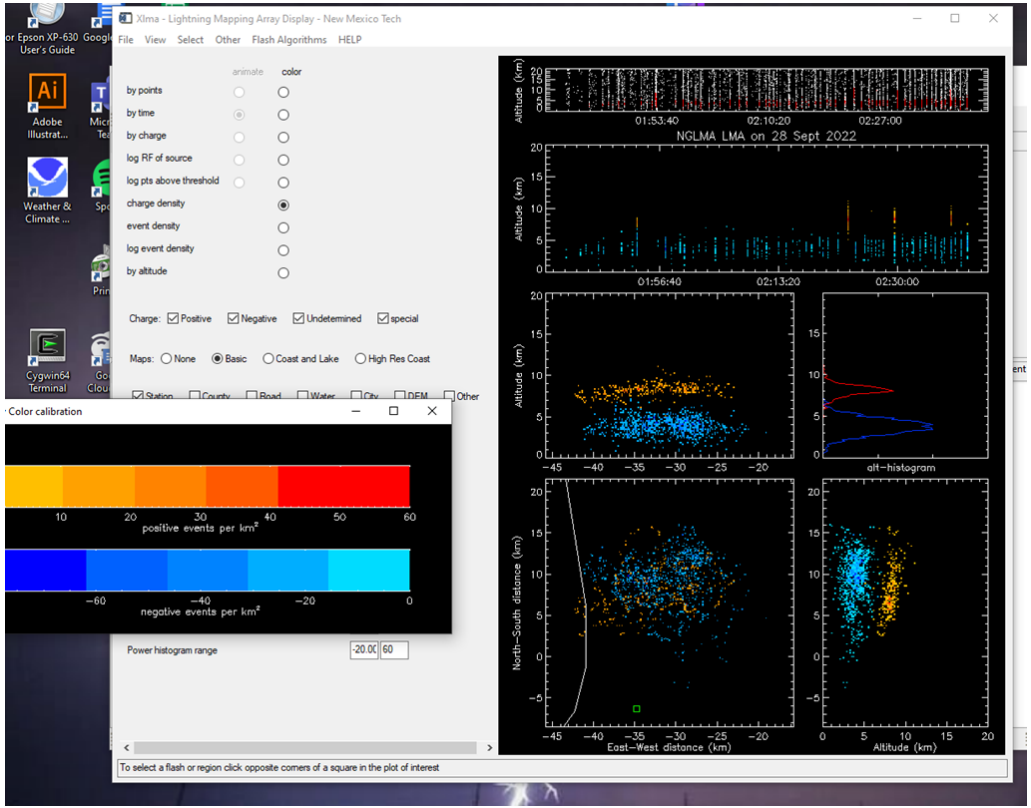
- Lots of tracks
  - Fort Drum
  - Watertown Airport
- Can they be used to bound vertical accuracy of LMA data?
- Are airplane and helicopter data different?



11/30/22, station min =7, chi2=1.0

Xlma example from LEE

- XLMA preliminary charge analysis from early LEE event
  - 9/28/2022
- Charge identified using characteristics of positive and negative leaders
- Dipolar charge structure
- Large lower/middle negative charge region



GLM processing

- Example of a random flash observed by GLM
- Group data is plotted
- Left column show the entire flash
  - Top panel: energy as a function of time
  - Middle panel: spatial position of groups, colored wrt time
  - Bottom panel: dots are sized according to energy
- Right column has same format, zoomed to the peak