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TRACER Lightning Mapping Array Field Campaign Report

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May 2023

ARM

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Acronyms and Abbreviations

ARM	Atmospheric Radiation Measurement
HLMA	Houston Lightning Mapping Array
LMA	Lightning Mapping Array
NASA	National Aeronautics and Space Administration
TRACER	Tracking Aerosol Convection Interactions Experiment
TTU	Texas Tech University
VHF	very high frequency

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Figures

1.0 Summary

Our observational contribution to the U.S. Department of Energy Atmospheric Radiation Measurement (ARM) user facility's Tracking Aerosol Convection Interactions Experiment (TRACER) was the deployment of additional Lightning Mapping Array sensors to provide enhanced capability to the Houston Lightning Mapping Array (HLMA) during the TRACER intensive operational period. To that end, the Texas Tech University personnel (Professor Bruning and Dr. Brunner, and graduate students Jessica Souza, David Singewald, Stephanie Weiss, and Matthew Miller) deployed two portable LMA antennae at locations G and B shown in the map below. The map also shows the predicted lightning flash detection efficiency in black contours, as well as color-shaded very-high-frequency (VHF) source detection efficiency, which roughly corresponds to the sensitivity to lightning channel detail.

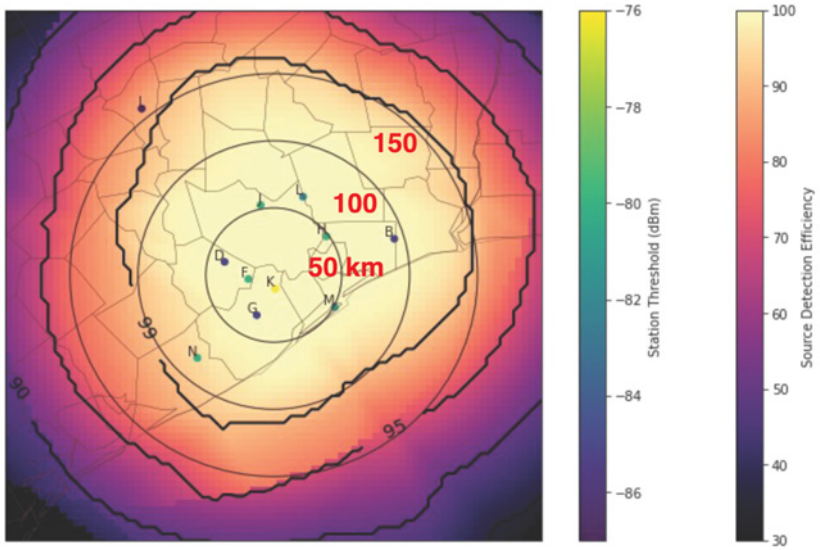

Figure 1. Map showing portable LMA deployment locations during TRACER (locations G and B), predicted lightning flash detection efficiency (black contours), and color-shaded VHF source detection efficiency.

Feeds from these sensors were integrated in the HLMA processing in real-time and in post-processing, partially leveraging National Science Foundation support through the TRACER campaign that supported the core HLMA, operated by Timothy Logan.

2.0 Results

Processing of HLMA data confirms the enhanced ability of HLMA to detect lightning − excluding these sensors results in lower source counts, and decreased range of minimum sensitivity, as illustrated by the following plots.

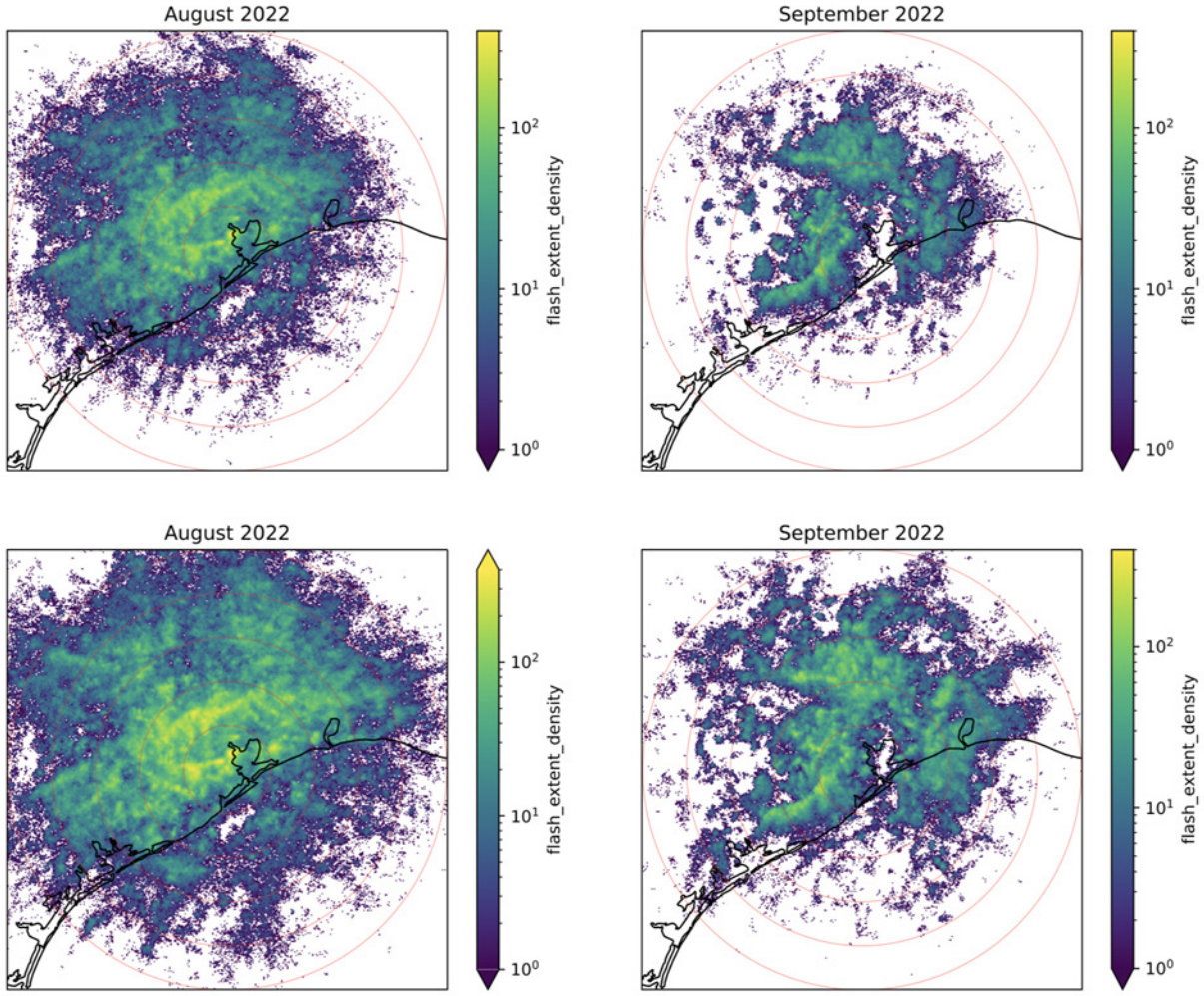

Figure 2. Flash extent density (number of flashes that propagated through a particular location) without (top) and with (bottom) the TTU stations, illustrated for the last two months of the TRACER campaign.

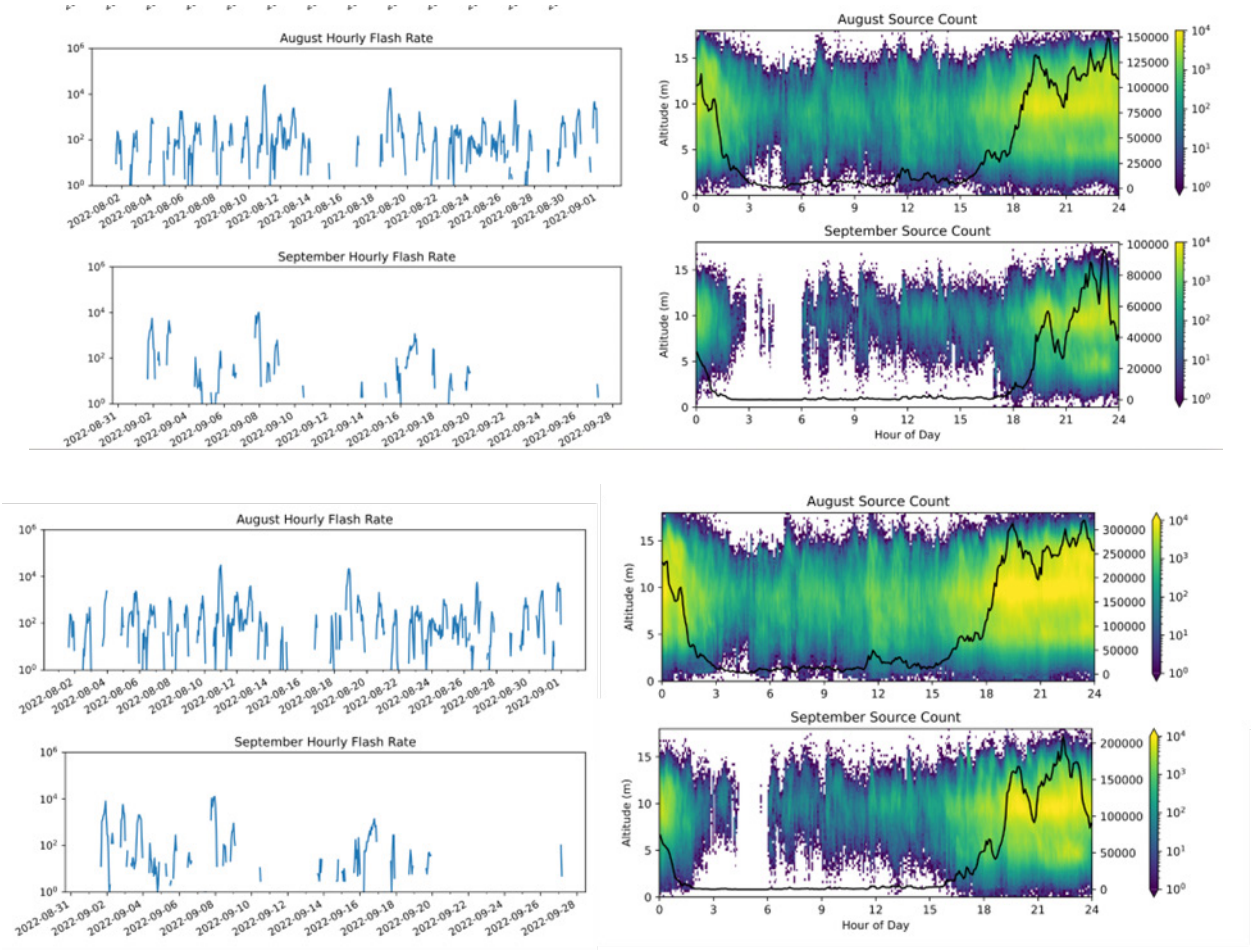

Figure 3. Domain-total flash counts and VHF source counts and time-height distributions by hour for August and September, before (top) and after (bottom) including the supplemental stations.

3.0 Publications and References

Presentations

Bruning, EC, K Brunner, J Souza, M van Lier-Walqui, and T Logan. 2022. "Observations of mixed-phase microphysics and lightning for the 2022 TRACER/ESCAPE field campaigns." Presented at the Fifth Texas Weather Conference.

van Lier-Walqui, M, K Brunner, EC Bruning, T Matsui, T Iguchi, D Hernandez-Deckers, and A Fridlind. 2022. "Tracking isolated thunderstorms in Houston TX with polarimetric radar and the lightning mapping array." Presented at the European Conference on Radar Meteorology. Locarno, Switzerland.

Bruning, EC, T Logan, K Brunner, M van Lier-Walqui, and JCS Souza. 2022. "Houston Lightning Mapping Array Observations during ESCAPE." Presented at the ESCAPE Science Meeting. Norman, Oklahoma.

Bruning, EC, K Brunner, M van Lier-Walqui, T Logan, M Miller, JCS Souza, D Singewald, and S Weiss. 2022. “Radar polarimetry and flash rate variability in varying thermodynamic and aerosol environments in Houston, Texas.” Presented at the American Geophysical Union Fall Meeting.

van Lier-Walqui, M, EC Bruning, K Brunner, T Matsui, T Iguchi, A Fridlind, V Chandra, and T Logan. 2023. “Lagrangian analysis of isolated cells during TRACER: comparison of cell lifetime-relative polarimetric radar and lightning.” Presented at the TRACER/ACPC workshop. Houston, Texas.

4.0 Lessons Learned

LMAs are reliable, continuous-monitoring technology for lightning, and can be supplemented with additional stations to optimize detection efficiency at locations of interest. Integration of stations into a network requires some expert configuration of each station and care to ensure data are incorporated properly into post-processed data. Note that the distributed nature of LMA sites is somewhat unusual for an ARM campaign. University partners are able to deploy in such a mode, typically with handshake agreements with local land owners, since the sites only require 1 square meter of land and are self-contained on solar power.

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