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DOE/SC-ARM-22-004

TRACER NASA Goddard Space Flight Center TOLNet Field Campaign Report

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October 2022

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How to cite this document:

Sullivan, JT, LW Twigg, TH Nguyen, and M Roots. 2022. TRACER NASA Goddard Space Flight Center TOLNet Field Campaign Report. U.S. Department of Energy, Atmospheric Radiation Measurement user facility, Richland, Washington. DOE/SC-ARM-14-032.

Work supported by the U.S. Department of Energy,
Office of Science, Office of Biological and Environmental Research

Acronyms and Abbreviations

AERONET	Aerosol Robotic Network
AMF1	First ARM Mobile Facility
ARM	Atmospheric Radiation Measurement
DOE	U.S. Department of Energy
GALION	GAW Aerosol Lidar Observation Network
GAW	Global Atmospheric Watch
GCAS	GEO-CAPE Airborne Simulator
GEO-CAPE	Geostationary Coastal and Air Pollution Events
GSFC	Goddard Space Flight Center
HSRL	high-spectral-resolution lidar
LaRC	Langley Research Center
LMOL	Langley Mobile Ozone Lidar
MPL	micropulse lidar
MPLNET	Micro-Pulse Lidar Network
NASA	National Aeronautics and Space Administration
TEMPO	Tropospheric Emissions: Monitoring of Pollution
TOLNet	Tropospheric Ozone Lidar Network
TRACER	Tracking Aerosol Convection Interactions Experiment
TRACER-AQ	Tracking Aerosol Convection Interactions Experiment-Air Quality
WMO	World Meteorological Organization

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1.0 Summary

In September 2021, the National Aeronautics and Space Administration (NASA) deployed assets to the Houston, Texas region to measure air-quality-relevant constituents at high spatial and temporal resolutions. This effort was conducted in partnership with the Texas Commission on Environmental Quality, the U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) user facility-led **Tracking Aerosol Convection interactions ExpeRiment (TRACER)** field campaign, and several academic collaborators. This synergistic deployment approach aims to address research questions under the umbrella of three focus areas:

1. Ozone Photochemistry and Meteorology
2. Modeling and Satellite Evaluation
3. Intersection of Air Quality and Socioeconomic Factors.

Contributed assets from NASA focus on the development of a geostationary air quality capabilities (e.g., **NASA Tropospheric Emissions: Monitoring of Pollution [TEMPO]**) as well as our continued partnership with the air quality and health decision-making community through collaborative field measurements and research. Specific NASA observations at the La Porte, Texas First ARM Mobile Facility (AMF1) site are the profiles from a subset of instruments from the **Tropospheric Ozone Lidar Network (TOLNet)** to support aircraft observations of ozone precursors (NO_2 and HCHO columns) from the Geostationary Coastal and Air Pollution Events (GEO-CAPE) Airborne Simulator (GCAS) and ozone and aerosol profiles from the high-spectral-resolution lidar-2 (HSRL-2).

Complementary observations from partners include suites of atmospheric composition and meteorological measurements from ground sites, mobile laboratories, and boat platforms. All current planning and logistics information for the TRACER-Air Quality (TRACER-AQ) field study can be found in the TRACER-AQ Science Plan (linked below) Through summer 2021 and beyond, this group aimed to build partnerships and collaborations within the air quality and health research community. To ask questions or to get involved, please contact Laura Judd (laura.m.judd@nasa.gov) and John Sullivan (john.t.sullivan@nasa.gov).

2.0 Results

There is a continuing need for tropospheric O_3 and aerosol observations to better understand processes relevant to air quality and pollution transport. To address fundamental science and policy questions relating to O_3, ground-based remote-sensing efforts from O_3 and aerosol lidar remain a high priority for the regulatory and scientific community. To ensure support of these efforts (especially with current and future geostationary satellites coming online) and to leverage the existing framework of knowledge within the larger atmospheric community, an interagency network initiated by NASA, the National Oceanographic and Atmospheric Administration, and the Environmental Protection Agency in 2011 began, known as TOLNet. Previous inter-network comparisons of TOLNet lidars describing accuracy and precision confirm these results are within reasonable uncertainty bounds.

The NASA Micro-Pulse Lidar Network (MPLNET) is a federated network of micropulse lidar (MPL) systems designed to measure aerosol and cloud vertical structure, and boundary-layer heights. The data are collected continuously, day and night, over long periods from sites around the world. Most MPLNET sites are co-located with sites in the NASA Aerosol Robotic Network (AERONET). MPLNET is also a contributing network to the World Meteorological Organization (WMO) Global Atmospheric Watch (GAW) Aerosol Lidar Observation Network, GALION.

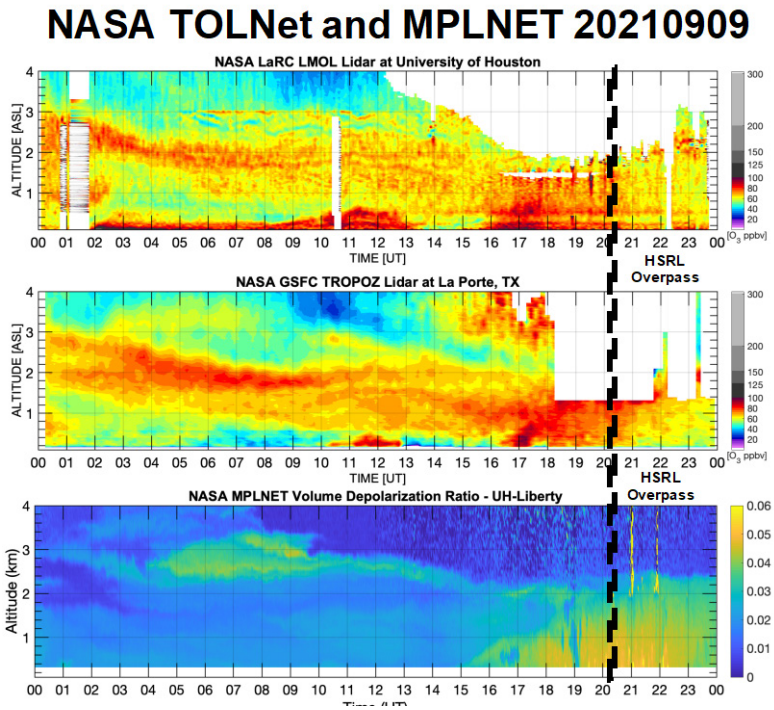

Figure 1. The NASA LaRC LMOL (University of Houston, top), NASA GSFC TOLNet (La Porte, middle), and NASA GSFC MPLNET (Liberty, bottom) systems on 9 September 2021.

The NASA Langley Research Center (LaRC) Langley Mobile Ozone Lidar (LMOL) (University of Houston, Figure 1, top panel), NASA GSFC TOLNet (La Porte, Figure 1, middle panel), and NASA GSFC MPLNET (Liberty, Figure 1, bottom panel) systems were deployed to TRACER-AQ to better quantify the temporal and vertical evolution of O_3 and aerosols. The MPLNET lidar was able to run continuously for the entire campaign and the TOLNet lidars were able to run continuously under certain episodes and to support flight days. This TOLNet/MPLNET hybrid approach at analyzing ozone/aerosol transport in the free troposphere should continue to be explored.

3.0 Publications and References

Sullivan, JT, et al. 2022. Advances in Characterizing Pollution Transport with Ground-Based and Airborne Profilers: Case Studies within Houston, Texas, presented at the 30th International Laser Radar Conference.

Jensen, MP, JH Flynn, LM Judd, P Kollias, C Kuang, G Mcfarquhar, R Nadkarni, H Powers, and J Sullivan. 2022. "A Succession of Cloud, Precipitation, Aerosol, and Air Quality Field Experiments in the Coastal Urban Environment." *Bulletin of the American Meteorological Society* 103(2): 103−105, https://doi.org/10.1175/BAMS-D-21-0104.1

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