

**Test Flights of NOAA Ozone Photometer for  
Uncrewed Aerial Systems (UAS)/Balloon-Based  
Studies during TRACER (OPUS)  
Field Campaign Report**

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## **Acronyms and Abbreviations**

ARM	Atmospheric Radiation Measurement
DOE	U.S. Department of Energy
LED	light-emitting diode
NOAA	National Oceanic and Atmospheric Administration
OPUS	Ozone Photometer for UAS/Balloon-Based Studies
RH	relative humidity
TBS	tethered balloon system
TRACER	Tracking Aerosol Convection Interactions Experiment
UAS	uncrewed aerial system(s)

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## 1.0 Summary

We proposed to integrate and fly the National Oceanic and Atmospheric Administration (NOAA) Ozone Photometer for Uncrewed Aerial Systems (UAS)/Balloon-Based Studies (OPUS) on the U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) user facility's tethered balloon system (TBS) during the second phase (August 1-15) of the 2022 Tracking Aerosol Convection Interactions Experiment (TRACER) in southwest Houston, Texas. The two main goals were: 1) Test fly the sensor to discover and address any potential problems such as interface and communication with other instruments, interferences with other instruments and radio, and 2) If OPUS performs well, then inter-compare OPUS with the EN-SCI ozonesondes that will also be flown on the TBS.

The collaborating institutions are DOE Sandia National Laboratories TBS team, the University of Houston, and St. Edward's University.

## 2.0 Results

The OPUS instrument was successfully integrated to the TBS with the help of the TBS team. OPUS were flown during the entire deployment period and produced raw data. The flight series showed the overall instrument design is sound and the construction of the instrument is robust for the field deployment. The instrument was easy to operate in the field. There was no electronic interference between OPUS and the TBS.

We discovered two issues with OPUS. The first one was noisy signal and the second one was a large signal artifact caused by rapid ambient relative humidity (RH) change during profiling. The first issue was traced to a problematic light-emitting diode (LED) by a specific manufacturer and a bad design of the LED current source. The issue has been addressed with a new type of LED and an improved current source. The second issues has been addressed with two RH equalizers. Unfortunately, these two issues prevented us from produce any ozone data of science quality for inter-comparisons with another ozone instrument on the TBS.

## 3.0 Publications and References

No publications have been produced yet. NOAA filed a patent application for the OPUS technology in December 2022, which is pending.

## 4.0 Lessons Learned

- 1) The TBS team was very helpful through this project. Thanks!
- 2) OPUS should be ready for deployment again in the fall. The TBS team is welcome to use it for future deployments.



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