



Portable Testbed for Bioaerosol Detector Performance Evaluation

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Motivation

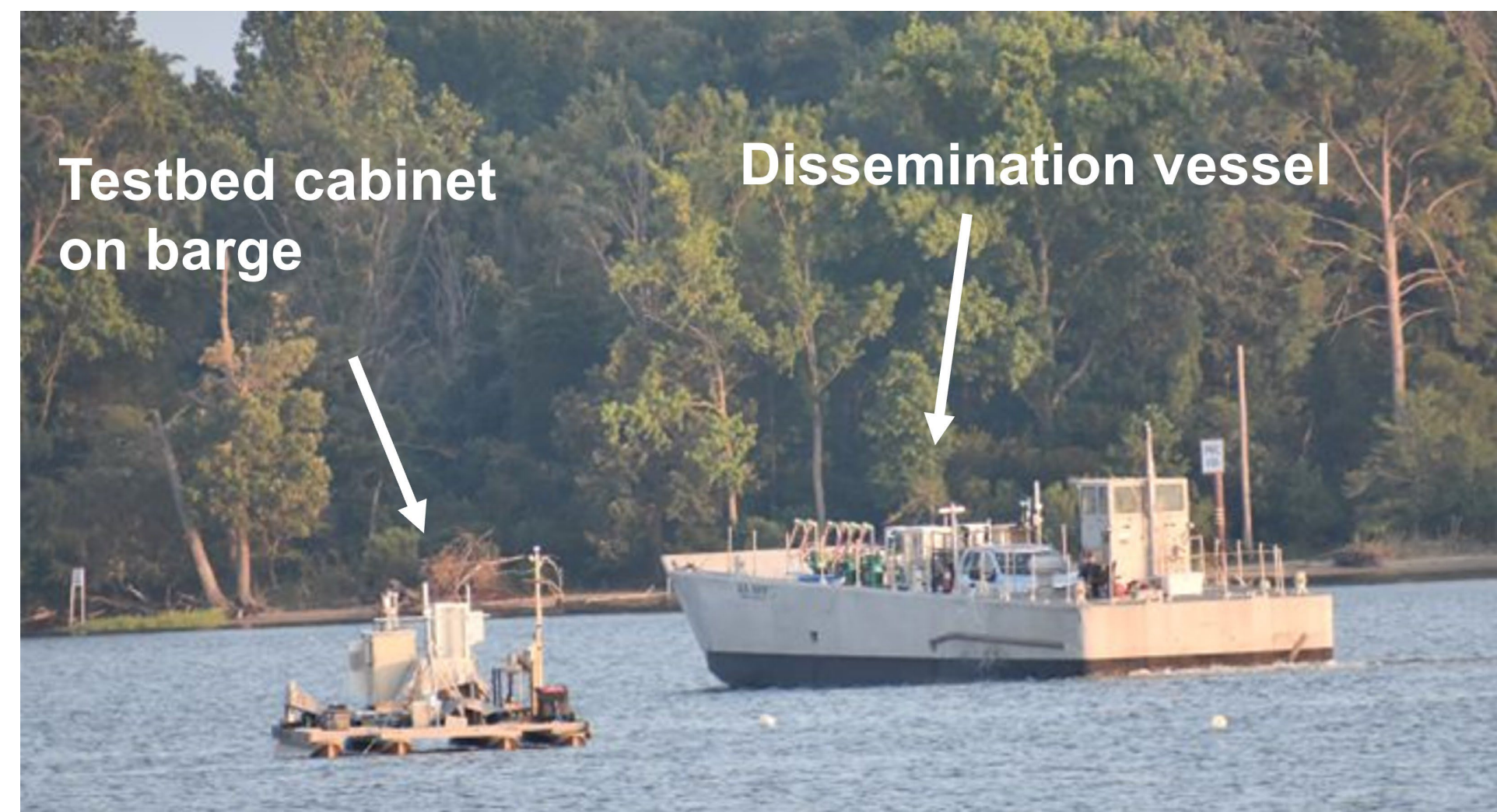
- A common platform that combines reference instrumentation and systems under test (SUTs) is important for *in situ* testing and characterization of both the technology and the operational environment.
- Portability and remote operation allow for deployment of testing capabilities to multiple locations and therefore enable testing in more diverse environments.
- An instance of such a capability was developed to evaluate performance of biological aerosol detectors and characterize the background aerosol environment.

Remote Autonomous Operation

- Referee instruments and SUTs were integrated into a data collection command and control (C2) system inside the cabinet
- Raw data was transmitted over a cellular data link using ISA messaging protocols and archived on the cloud using Amazon Web Services (AWS)

Marine Test Environment

- Testbed was deployed on a barge on the Potomac River
- Aerosol releases were measured using biological simulants *Bacillus atrophaeus* (BG) and *Bacillus thuringiensis subsp. kurstaki* (Btk)

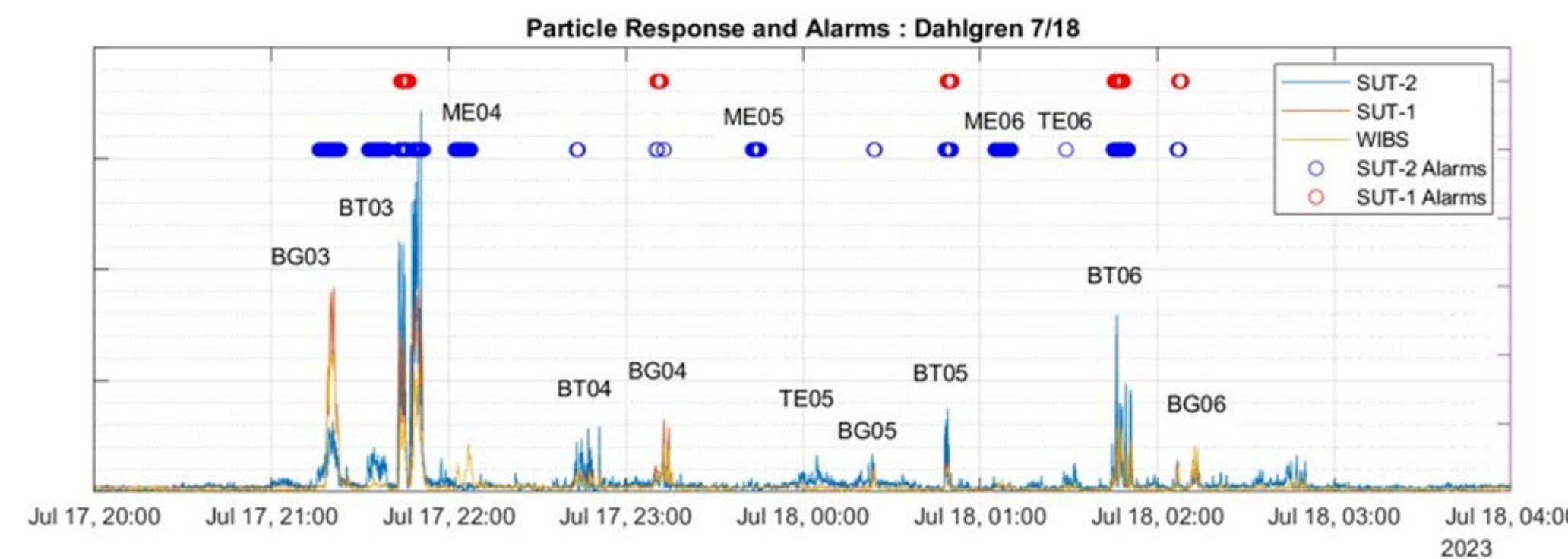


Bioaerosol Sensor Test Payload

- Four bioaerosol detectors were tested, which were based on similar light induced fluorescence (LIF) technology
- Reference sensors included the Aerodynamic Particle Sizer (APS), the Wideband Integrated Bioaerosol Sensor (WIBS) multi-wavelength LIF spectrometer, and ambient meteorological sensors

Test Data

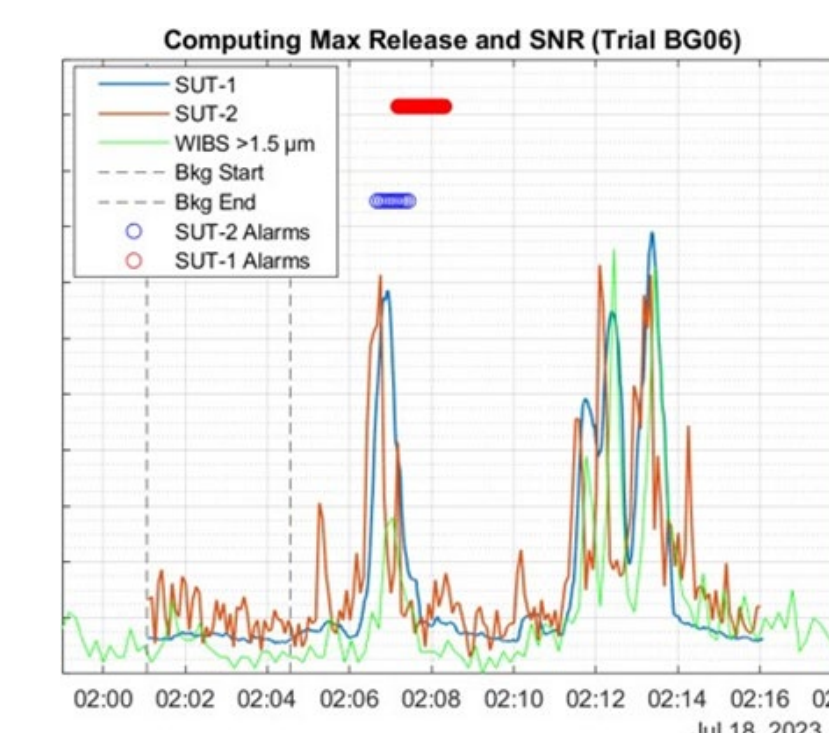
- Twenty-eight bioaerosol simulant trials were conducted
- Alarm results for two of the four SUTs were analyzed and compared to the APS (concentration + size) and WIBS (fluorescence + size) referee data
- Analysts had access to the raw sensor data in addition to the alarm data (total particle counts and fluorescent particle counts)



- Alarm results were ranked according to the magnitude of the bioaerosol concentration using the APS and WIBS particle concentration data

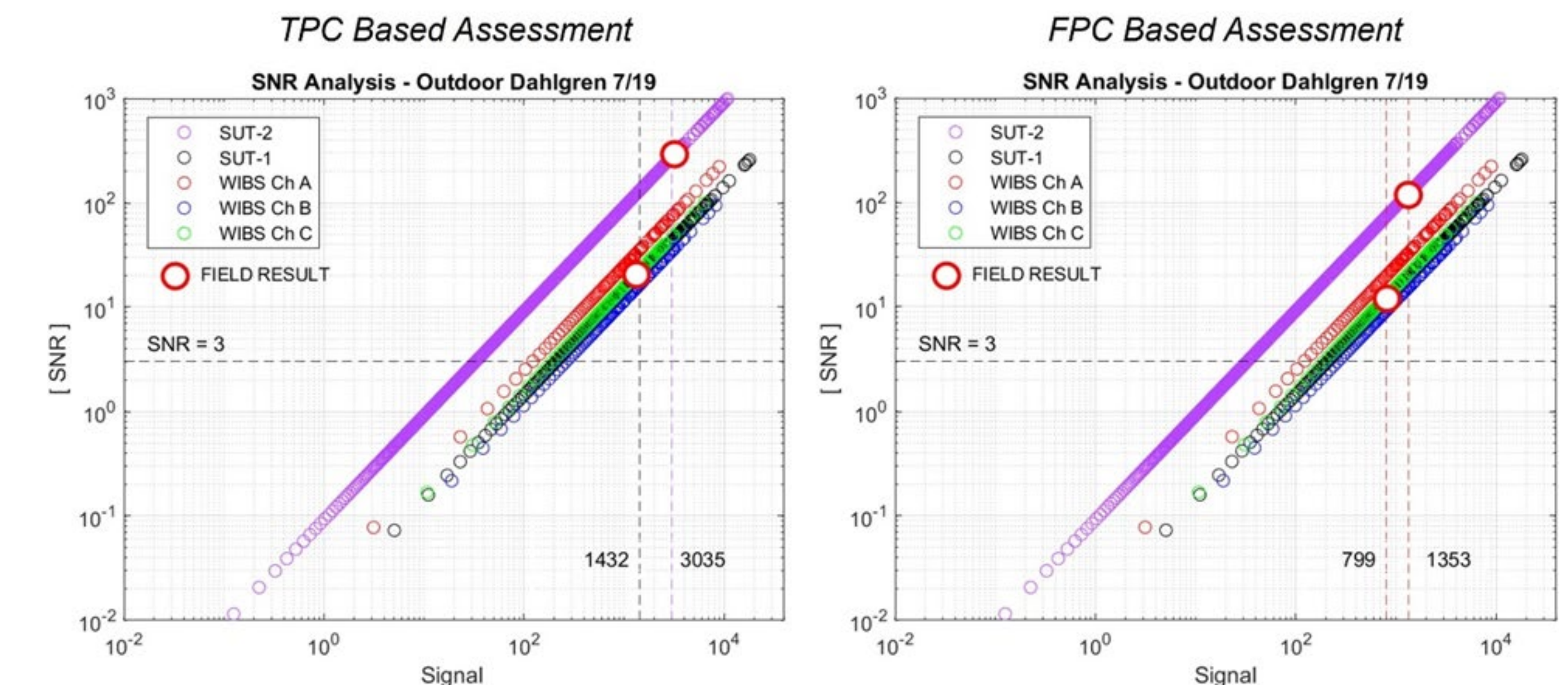
Trial #	Trial Name	Material	APS Counts	WIBS Node-B	WIBS Ch A	WIBS Ch C	Alarms
5	BG03	BG	58,587	25,573	5,964	2,093	N Y
6	BT03	Btk	36,393	14,377	5,472	1,759	Y Y
14	BT07	Btk	75,988	25,953	8,893	6,315	Y Y
15	BT08	Btk	17,133	8,952	4,353	3,106	Y Y
13	BG07	BG	26,374	7,570	3,594	2,317	N Y
28	BG14	BG	12,567	6,568	3,050	2,266	Y Y
8	BG04	BG	10,230	2,976	1,912	1,135	Y Y
3	BT02	Btk	5,625	14,365	6,476	4,964	N Y
11	BT06	Btk	12,066	5,287	2,755	2,018	Y Y
27	BT14	Btk	6,941	4,286	2,553	1,824	Y Y
12	BG06	BG	5,219	3,158	1,928	1,504	Y Y
18	BT09	Btk	4,892	3,035	1,959	1,353	N Y
10	BT05	Btk	4,323	1,432	938	720	Y Y
7	BT04	Btk	3,327	1,774	700	551	N Y
2	BT01	Btk	4,323	4,775	3,062	4,775	N Y
16	BG08	BG	3,399	1,790	1,115	727	N N
9	BG05	BG	3,025	2,233	1,163	1,206	N Y
22	BT11	Btk	2,380	1,544	724	632	Y Y
23	BT12	Btk	2,712	1,987	1,000	919	N N
17	BG09	BG	2,781	1,210	713	581	N N
19	BT10	Btk	3,461	1,432	799	616	N Y
21	BG11	BG	1,348	686	424	273	N N
20	BG10	BG	1,239	753	421	236	N N
24	BG12	BG	918	452	261	185	N N

- Signal-to-noise ratio (SNR) relative to the background was computed for each SUT and referee sensor as a metric for performance analysis



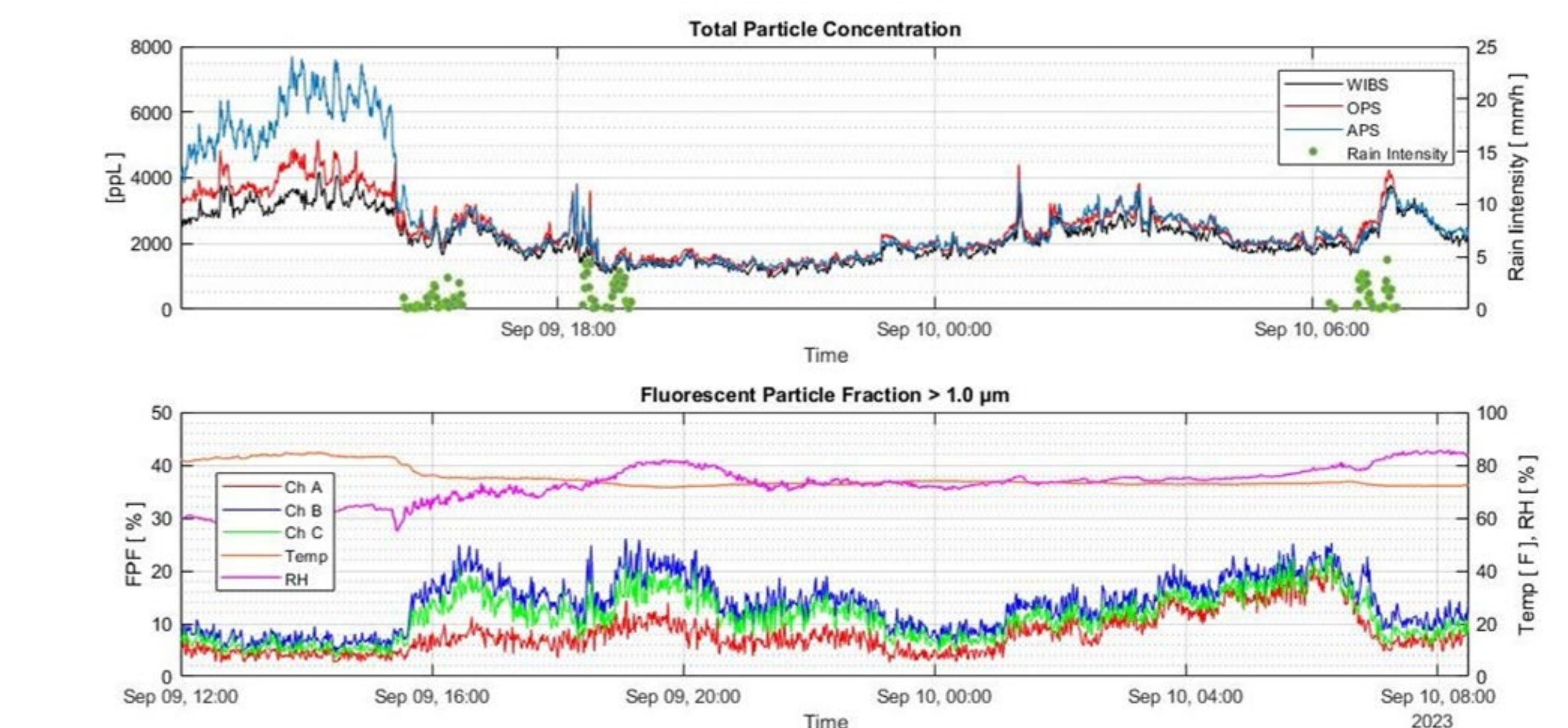
Performance Analysis

- Performance analysis was based on two metrics: total particle count (TPC) and fluorescent particle count (FPC)
- Count data was examined for particles >0.6 μm and >0.1 μm



Impact

- Data from the bioaerosol Testbed were used to develop innovative sensor performance metrics using the *in-situ* reference instruments and raw sensor data components
- The portable testbed was successfully deployed and demonstrated as an autonomous aerosol monitoring platform for characterize the background operational environment in three CONUS locations.



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