Supplemental Material

Title: Field Performance of a Novel Passive Bioaerosol Sampler using Polarized Ferroelectric Polymer Films

Running title: Passive Bioaerosol Sampler Outdoor Field Testing

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Calibration of the DustTrak DRX Aerosol Monitor (DRX, model 8534, TSI Inc., Shoreview, MN) to PM2.5 Personal Modular Impactors (PMIs, SKC Inc., Eighty Four, PA)

The DRX uses light scattering laser photometers to collect real-time aerosol mass data. The instrument is factory calibrated with the respirable fraction of standard ISO 12103-1, A1 test dust. Thus, assumptions are made about the relationship between light scattering and mass concentration based on this test dust's particle size and material properties (TSI Incorporated 2012). In order to calibrate the DRX aerosol monitor to the specific particulate matter characteristics of dust at the sampling site, two 24-hour sampling periods (randomly chosen days of the sampling campaigns) were conducted where the DRX monitor sampled at the site simultaneously with two PMI's. The impactors were operated at 3 L/min using 37 mm PTFE filters (2 µm, SKC Inc.) and 25 mm pre-oiled impaction substrates (SKC Inc.). The filters used in the PMI's were weighed with a Mettler Toledo MT5 Microbalance before and after each sampling using a temperature and humidity controlled weighing room (20-23°C, 35-40% relative humidity). Filters were kept in their own cassettes before and after use and allowed to equilibrate in the weighing room for at least 72 hours before being weighed. Three filters were kept in the weighing room throughout all experiments to use as standards to weigh them every time before new mass measurements were taken to ensure consistency of results on different days. A 200 mg NIST standard was weighed prior to taking any mass measurements to also ensure consistency of results. The change in weight of each filter and total sampled air volume was used to calculate the average PM2.5 mass concentration collected by the impactors over the 24-hour period and this data was used to obtain a correction factor for the PM2.5 mass concentration of the DRX aerosol monitor.

Table S1. Average Results for Sampling Runs to Calibrate Mass Concentration of DRX to PMI's ($\mu g/m^3$)

Aerosol Sampler	Sampling Run 1	Sampling Run 2
PMI's	18.305	11.074
DRX	21.542	12.230

DRX Correction Factor = [(18.305/21.542) + (11.074/12.230)]/2 = 0.877

Sampling Site Conditions

Table S2. Summary of Meteorological Conditions During Field Test Campaigns [a] Data show mean ± 1SD, (Min, Max)				
Dates	Sept. 20 – Sept. 30	Nov. 1 – Nov. 11	Nov. 14 – Nov. 24	Dec. 13 – Dec. 23
Temperature, °C	20 ± 4, (10, 33)	14 ± 6, (0, 27)	10 ± 5, (0, 21)	9 ± 5, (-2, 21)
Relative Humidity, %	66 ± 20, (17, 98)	75 ± 22, (23, 99)	61 ± 21, (23, 99)	72 ± 21, (34, 99)
Wind Speed, m/s	0.5 ± 0.5, (0, 3.4)	0.5 ± 0.6, (0, 4.1)	0.7 ± 0.8, (0, 5.4)	0.5 ± 0.7, (0, 4.4)
Peak Wind Gust, m/s	0.9 ± 0.8, (0, 5.8)	0.9 ± 1.0, (0, 5.8)	1.3 ± 1.3, (0, 8.2)	1.1 ± 1.2, (0, 8.5)
Total Precipitation, mm	0	17	21	39

[a] All meteorological data, except total precipitation, represent five-minute averages of continuously recorded data throughout each sampling campaign. Total precipitation data are from observations at a nearby weather station (The Rutgers Gardens Weather Tower 2016) located about 1200 m away from the sampling site.

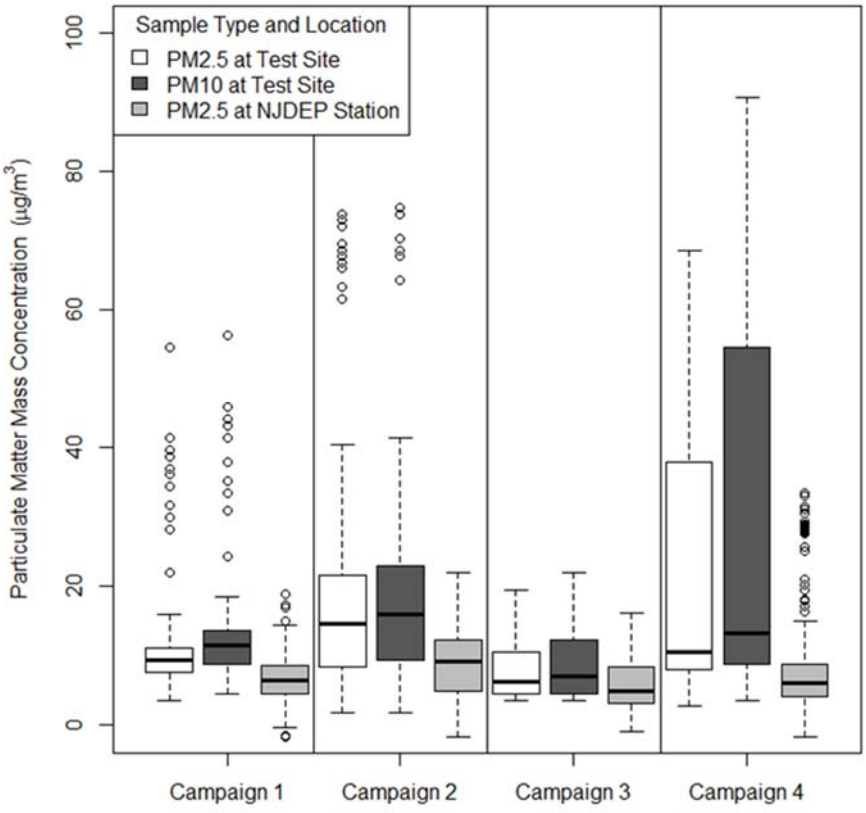

Fig. S1 PM2.5 and PM10 mass concentration recorded daily for one hour at the sampling site using the DRX (TSI Inc.) versus PM2.5 mass concentration recorded hourly at a nearby NJDEP station by beta attenuation monitor.

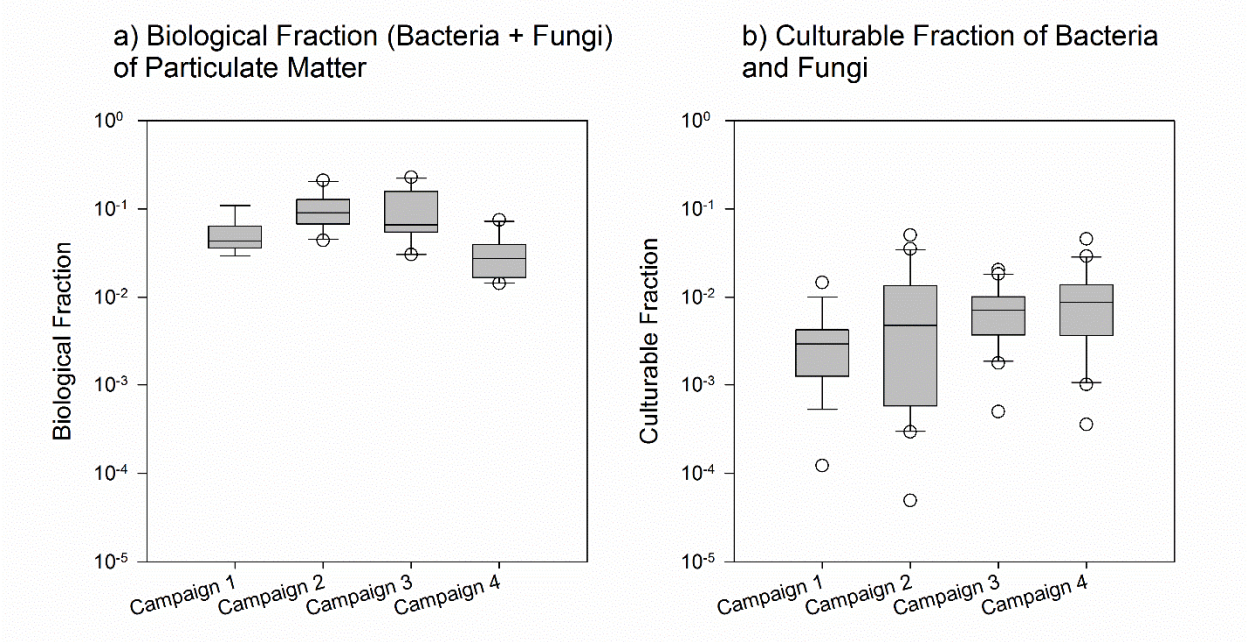

Fig. S2 The biological fraction (a) and the culturable fraction (b) for all sampling campaigns. The biological fraction of particulate matter was determined by dividing the average total number of bacteria and fungi collected across campaigns by the Button Samplers by the average total number of particles larger than 1 µm registered by the Aerotrak OPC (Aerotrak handheld particle counter 9306, TSI Inc.). The culturable fraction was determined as a ratio of the culturable microorganism number determined by culture technique versus the total number of microorganisms determined by staining and microscopy.

Table S2 presents a summary of all meteorological data collected for each field sampling campaign. Fig. S1 presents PM2.5 and PM10 concentrations recorded at the sampling site and PM2.5 reported by the nearby NJDEP sampling station. The sampling site was located in an active, community garden and the particulate matter pollutant levels were higher relative to the NJDEP sampling station (up to 74 µg/m^3 for PM2.5 at the test site) (Fig. S1). The presence of local particulate pollutant sources most likely resulted from high levels of activity observed at the site, such as composting, gardening, construction, and vehicles passing on unpaved roads. The results suggest that most particulate pollution at the site was in the fine fraction of particulate matter as the mass concentrations of PM2.5 and PM10 were similar across all campaigns.

Fig. S2 presents bioaerosol fractions of particulate matter (combined bacteria and fungi compared to total particles larger than 1 µm) and culturable fractions of these bacteria and fungi. While the particulate pollutant concentrations were high, the measured biological fractions of particulate matter at the site (7 ± 5%) and culturable fractions of bacteria and fungi (1 ± 1%) were similar to values previously reported in the literature (Boreson et al. 2004; Glikson et al. 1995; Jaenicke 2005; Tham and Zuraimi 2005; Ting et al. 2010; Womiloju et al. 2003). According to the Button Sampler data, the average total bioaerosol concentration for the field campaigns (bacteria + fungi) was $5x10^4 \pm 3x10^4/m^3$ and the observed microorganism concentrations ranged from 10^4 to $10^5/m^3$. These values are typical for outdoor bioaerosol concentrations (Cox and Wathes 1995). Together, these data support the broad applicability and relevance of the presented research to different sampling environments and conditions. The normalized particle number concentrations by particle size bins of the Aerotrak OPC used to estimate the total number of particles greater than 1 µm are depicted below in Fig. S3.

Normalized Particle Number Concentrations by Particle Size Bins of the Aerotrak OPC (Aerotrak handheld particle counter 9306, TSI Inc.) for Determining Biological Fractions of Particulate Matter

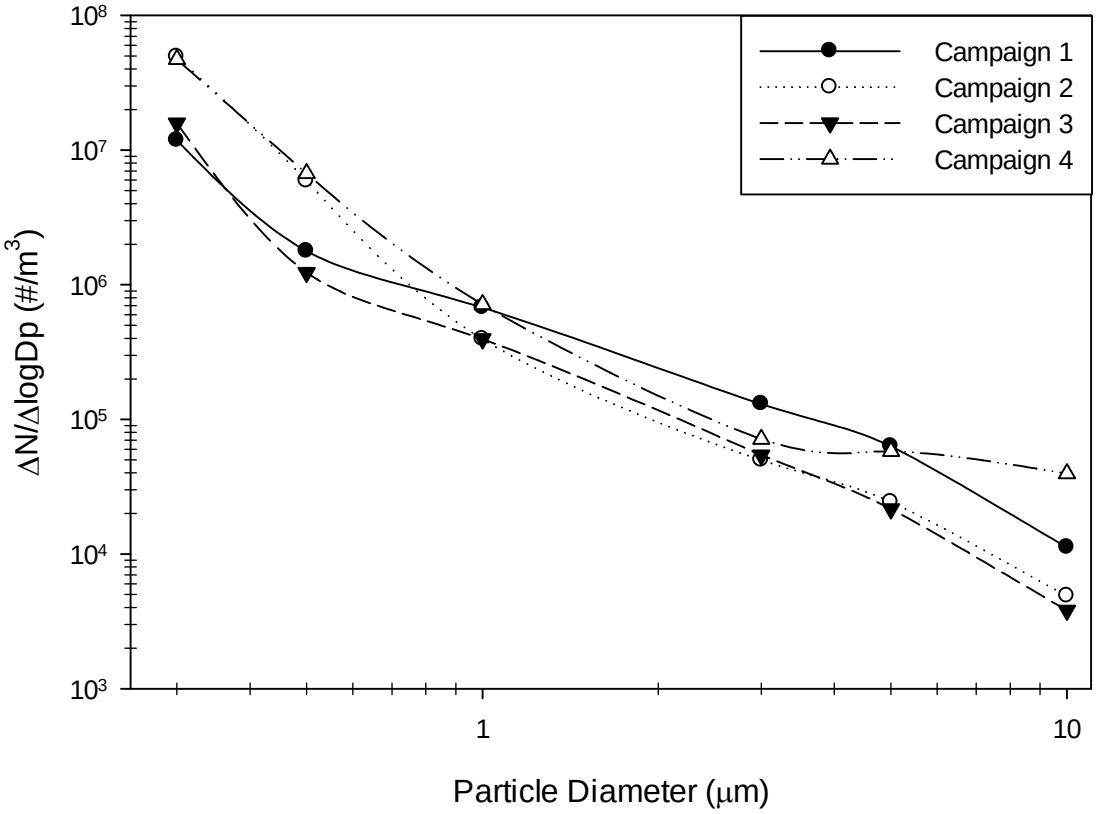

Fig. S3 Normalized particle number concentrations by particle size bins of the Aerotrak OPC (Aerotrak handheld particle counter 9306, TSI Inc.). These particle number concentrations were measured daily for 60-min, then averaged across each sampling campaign to reduce daily variability.

References

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