Project 18
Community Measurements of Aviation Emissions Contribution to Ambient Air Quality

Motivation

Multiple studies have identified aircraft arrival emissions as a contributor to ultrafine particulate matter (UFP), but it is unclear whether the findings are interpretable or robust (i.e., due to longer averaging times, a lack of real-time flight activity data, and no connection with aircraft plume dynamics).

Objectives

- Conduct ambient monitoring of UFP measured as particle number concentration (PNC) at sites with varying proximity to landing and take-off (LTO) flight paths:
  - 2017 - Focus on arrivals to KBOS on runway 4R/4L.
  - 2018 - Focus on multiple LTO flight paths.

Methods and Materials – Site Selection

- Sites were chosen to be >200 m from major roadways, at varying distances from the airport and flight paths (Fig. 1).
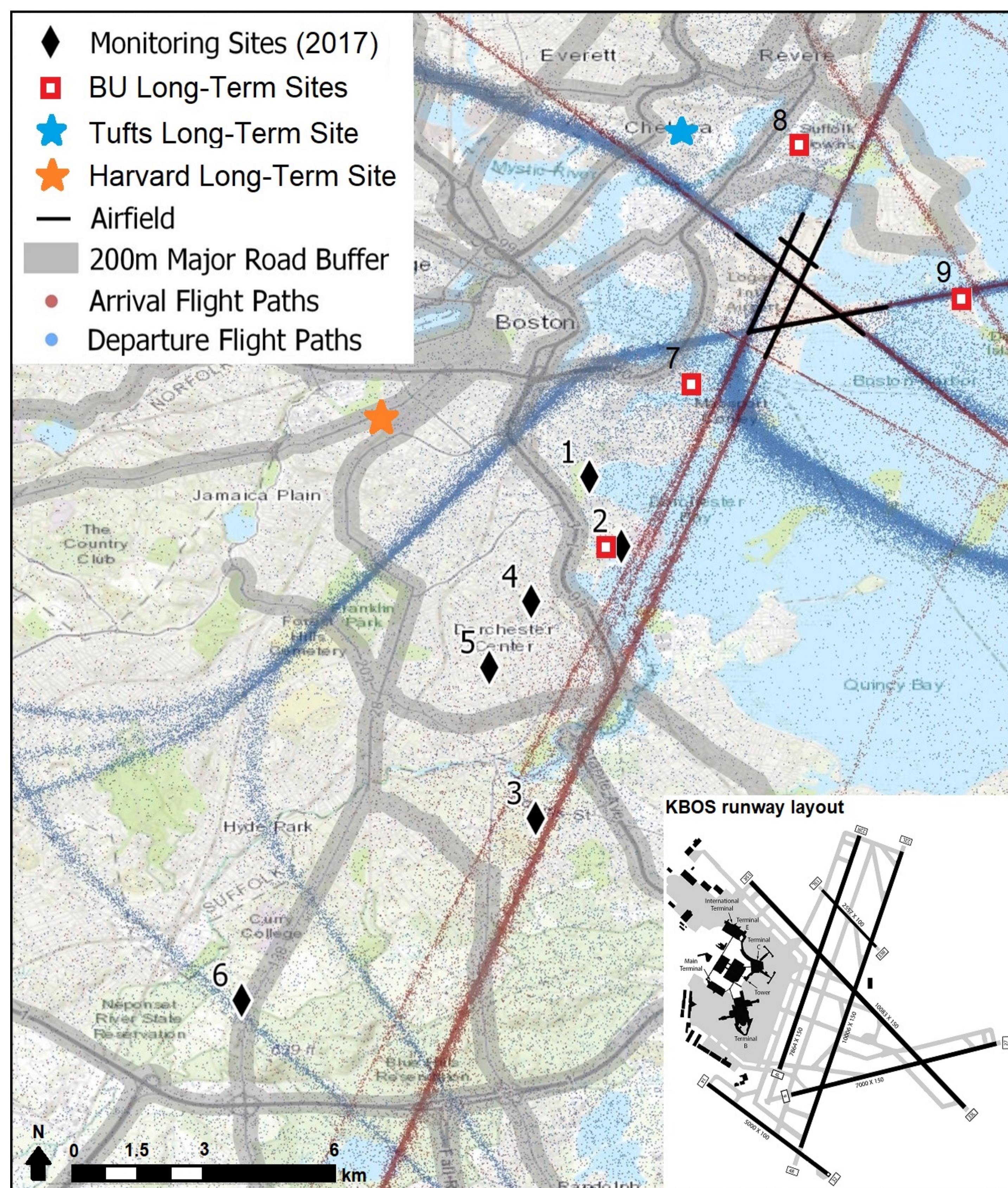

Figure 1. Map of monitoring sites, flight paths, and runway configurations.
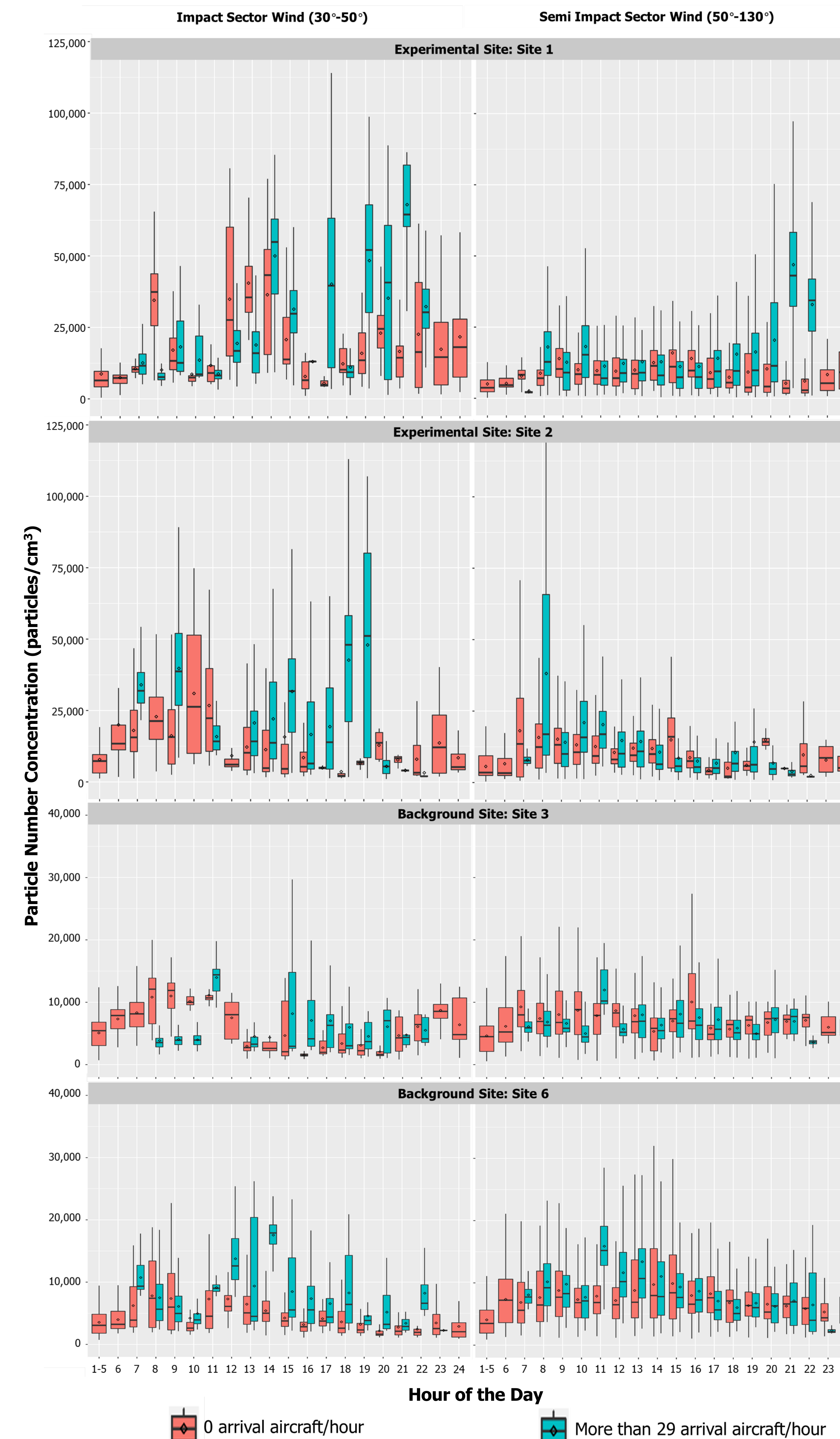
Results and Analysis

Figure 2. Boxplots showing diurnal patterns of PNCs at Sites 1, 2, 3 and 6 under two different wind sectors stratified by 4R/4L arrival flight activity conditions.

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Table 1. PNC distribution at air monitoring sites (2017).

	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Sample Size (days)	67	71	57	61	57	62
Location	2nd Floor	Ground	2nd Floor	Ground	Ground	Ground
Nearest Runway	4R	4R	4R	4R	4R	4R
Distance to Runway (km)	4.0	4.9	10.8	6.7	8.2	16.6
0.1st PCTL	800	1,100	1,600	2,500	2,000	1,800
1st PCTL	1,000	2,900	2,500	5,100	2,900	2,500
5th PCTL	4,300	5,800	4,300	8,200	5,700	4,300
50th PCTL	14,100	16,600	11,600	20,600	17,100	12,000
95th PCTL	55,600	63,000	28,000	67,900	47,100	31,400
99th PCTL	116,800	119,200	47,400	103,200	70,700	50,500
99.9th PCTL	180,200	206,600	87,500	150,800	96,500	95,800

Table 2. PNC distribution at air monitoring sites (2018).

	Site 2	Tufts Site	Site 7	Site 8
Sample Size (days)	264	250	123	167
Location	Ground	3rd Floor (roof)	5th Floor (roof)	2nd Floor
Nearest Runway	4R	15R	4R	22R
Distance to Runway (km)	4.9	2.4	2.8	1.6
0.1st PCTL	500	1,000	600	700
1st PCTL	700	1,770	1,200	1,300
5th PCTL	1,200	3,300	2,600	2,300
50th PCTL	7,600	11,900	8,300	10,800
95th PCTL	24,600	43,700	36,300	60,900
99th PCTL	47,500	87,800	66,200	120,000
99.9th PCTL	77,100	152,000	99,200	230,000

Conclusions and Next Steps

- This project provided novel insight regarding the magnitude of arrival aircraft contributions relative to background PNCs.
- Data structure is suitable for regression modeling that can capture the varying impact of arrival aircraft on local PNCs under different meteorological conditions.
- Data collected at KBOS will be used to develop and compare source attribution estimates with dispersion modeling outputs to inform UFP modelling for other airports.