

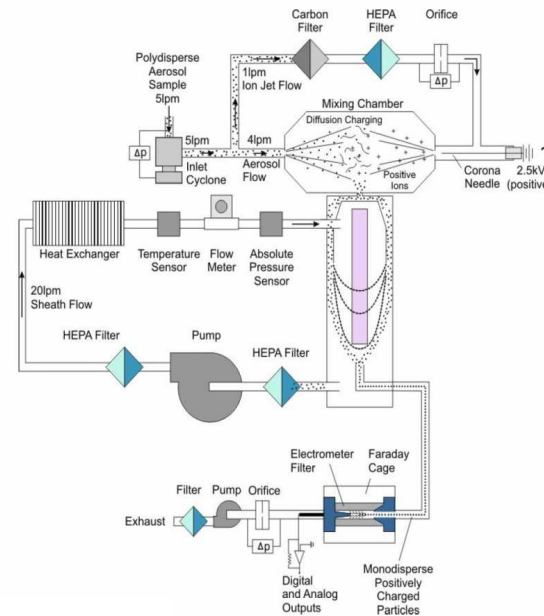
Intercomparison of Long-Term Ambient Ultrafine Particle Size Distribution Measurements at a Near-Roadway and a Representative Urban Site in New York City

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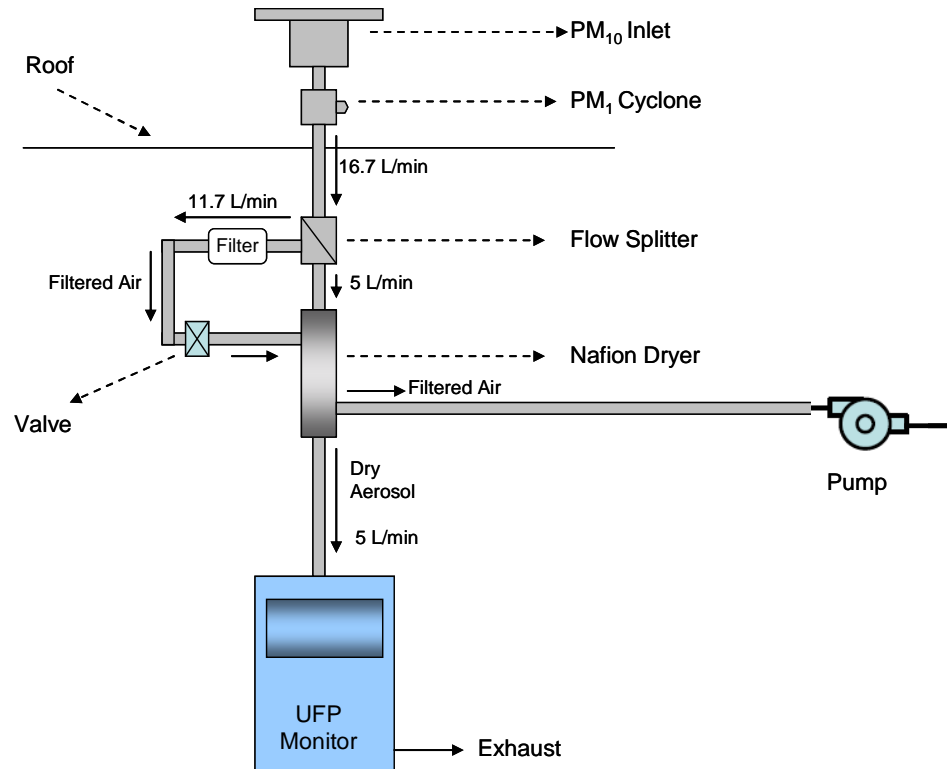
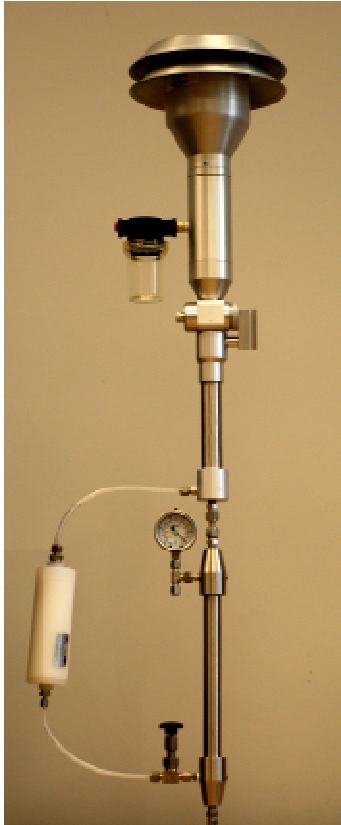
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TSI Model 3031 Ultrafine Particle Monitor

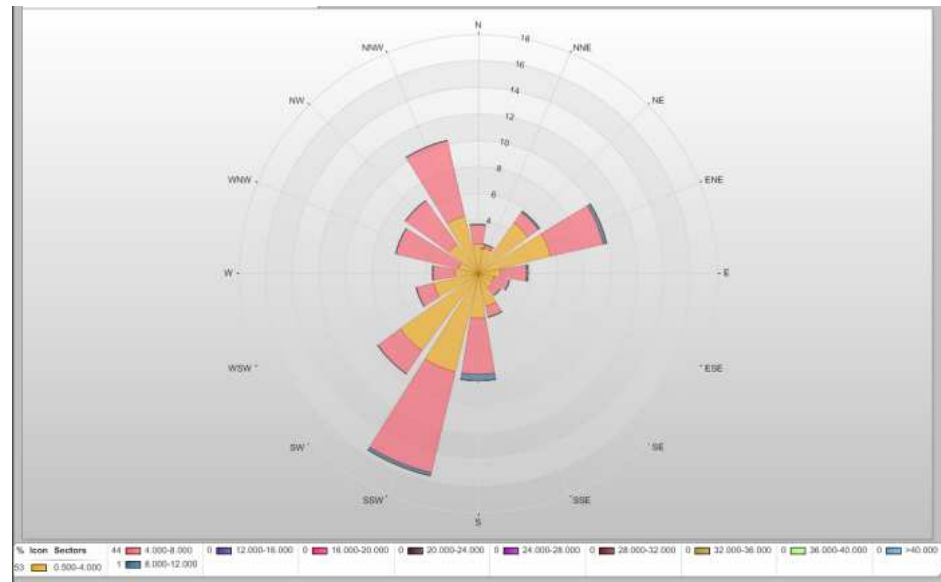
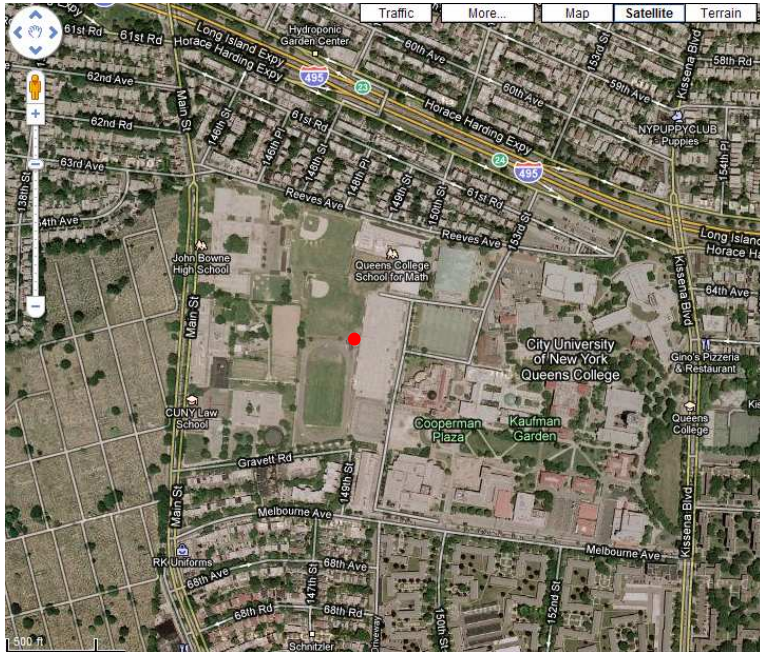


The operating principle of the UFP Monitor is based on diffusion charging of particles, followed by size segregation within a Differential Mobility Analyzer (DMA) and detection of the aerosol via a sensitive electrometer. The charging device in the UFP Monitor is a "Corona-Jet" charger. Within the charger, the total flow of 5.0 L/min is split into 1.0 L/min passing through two filters (a carbon and a HEPA) and an ionizer and 4.0 L/min of aerosol remaining as sample flow. The flow streams are merged in a mixing chamber where particles in the aerosol flow mix with the ions carried by the filtered clean air. The charged aerosol then moves on to the DMA for size segregation. After leaving DMA, the aerosol enters a faraday cage where the particles, and their charge, are collected on a particle filter. The filter is conductive, and is electrically connected to the input of a sensitive electrometer amplifier. One measurement cycle takes approximately 10 minutes with one minute zeroing time between cycles.



The UFP Monitor was deployed in concert with the TSI Model 3031200 Environmental Sampling System. A representative sample of ambient air is continuously drawn through a size selective PM₁₀ inlet at a standard flow rate of 16.7 L/min. Next, the sample passes through a PM₁ cyclone which removes larger particles. The main sample stream is subsampled into the UFP Monitor at a flow rate of 5 L/min. A Nafion dryer upstream of the UFP Monitor ensures proper conditioning of the aerosol to minimize effects due to relative humidity. The remaining 11.7 L/min of make-up air is routed through the Nafion dryer as purge air and drawn through a vacuum pump and exhausted.

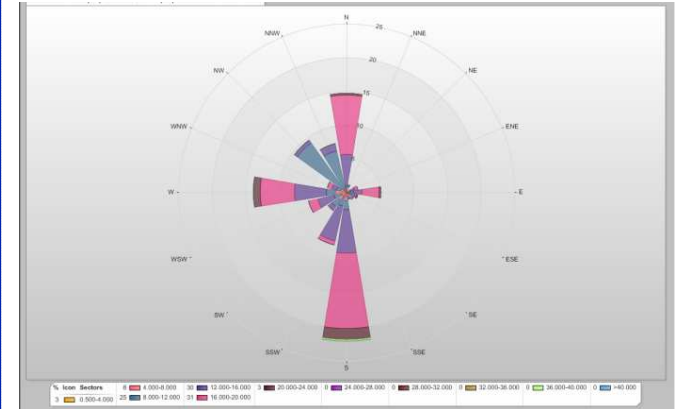
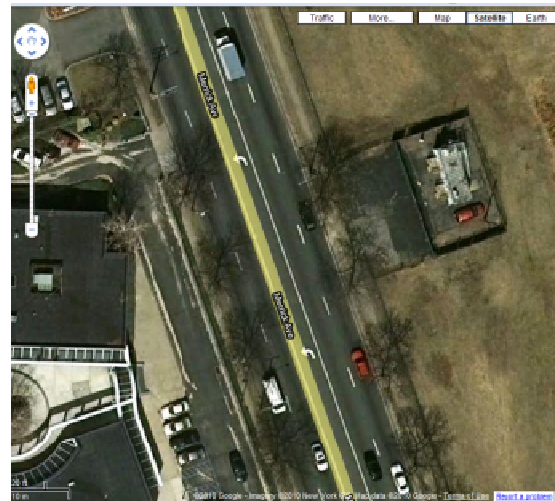
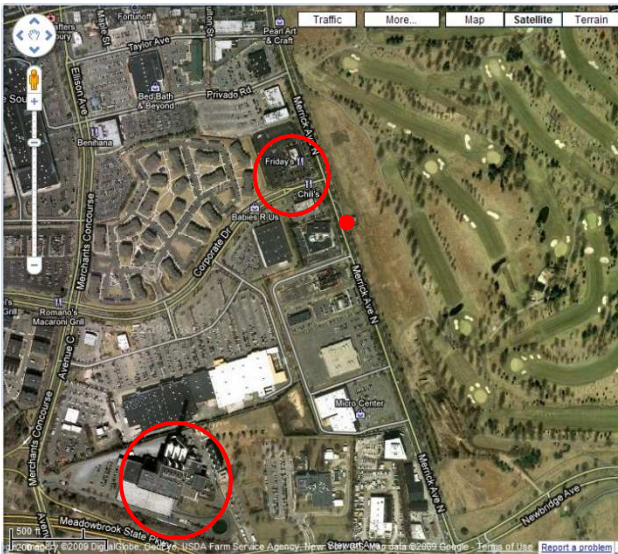
Queens College



Hourly wind rose for Queens College averaged over the analysis period.

The Queens College monitoring site is a well instrumented monitoring site representative of the New York City metropolitan area located on the campus of Queens College in New York City. The site is bordered by a mix of sources, including mobile sources from the Long Island and Horace Harding Expressways, as well as local campus parking. It is located 27 kilometers NW of the Eisenhower Park monitoring site.

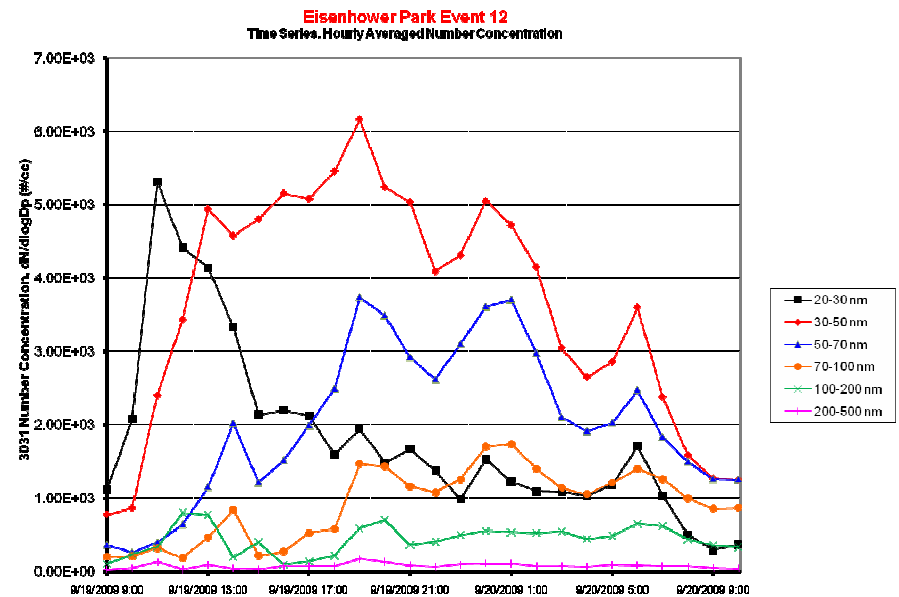
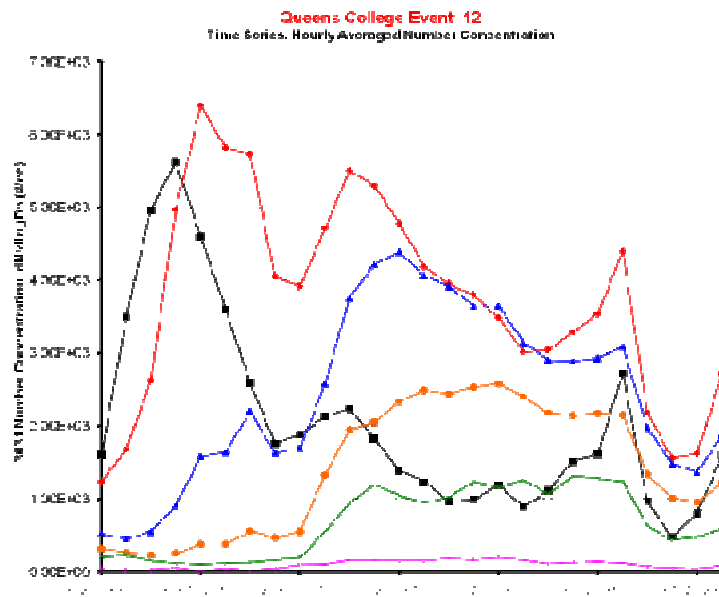
Eisenhower Park



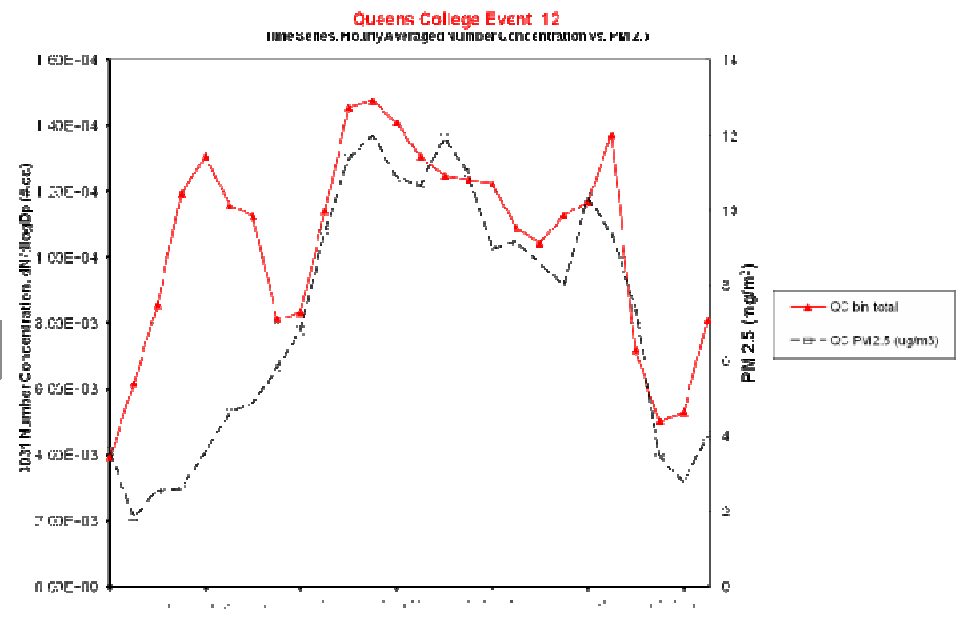
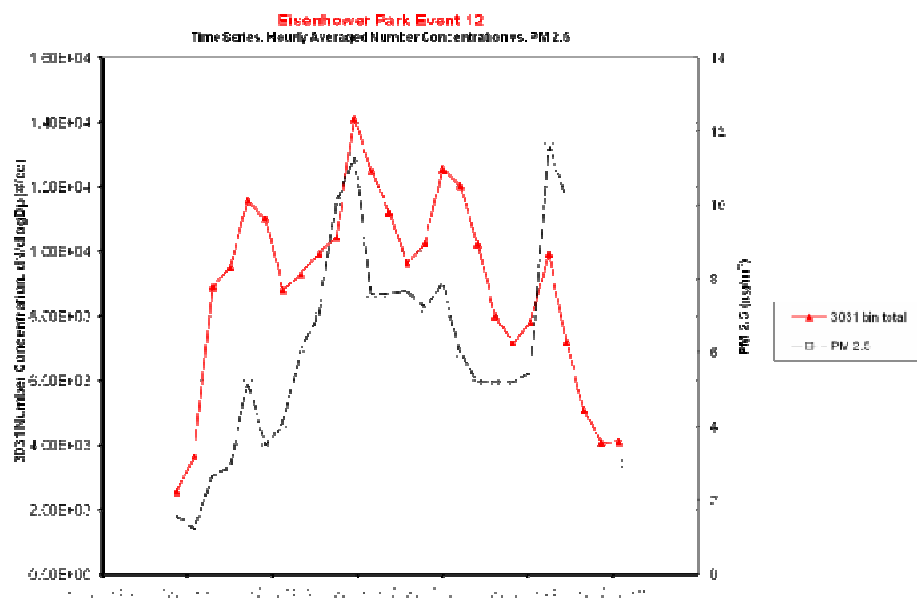
Hourly wind rose for Eisenhower Park averaged over the analysis period.

The Eisenhower Park monitoring site is located at a near-roadway site on Long Island, 27 kilometers SE of the Queens College Site. The site is backed by unoccupied parkland and is adjacent to a 4 lane roadway that runs parallel to the site in a NNW direction. The site is within 22 meters of the roadway in a W-WSW direction, and within 53 meters of the roadway in a S direction. A waste-to-energy conversion plant and several restaurants are also proximate to the site.

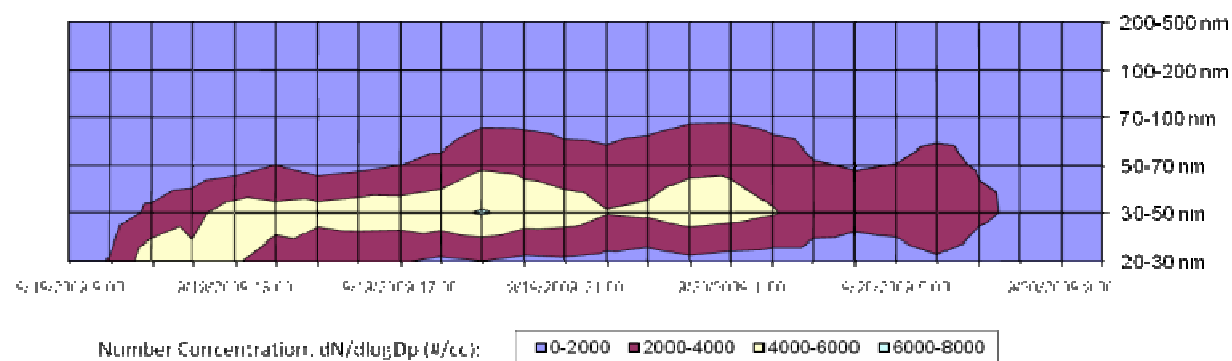
Regionally Correlated Atmospheric Formation Events



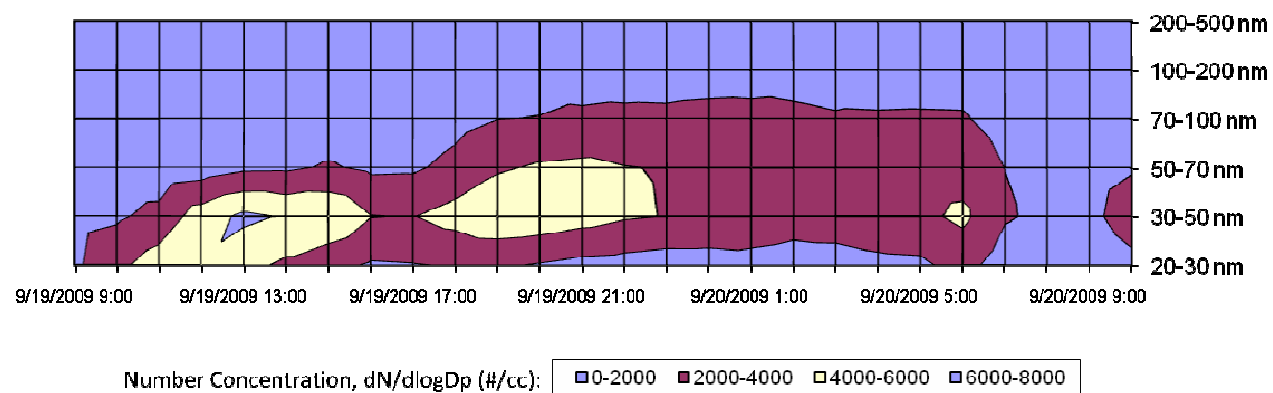
For events of this type, the behavior of ultrafine particles < 100 nm was closely correlated with the behavior of larger ultrafine particles and with PM 2.5.



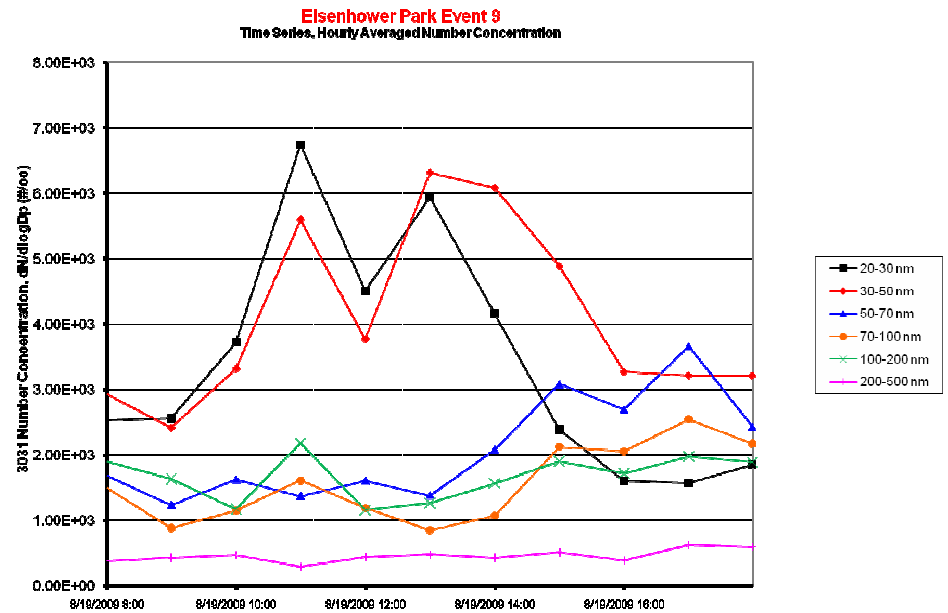
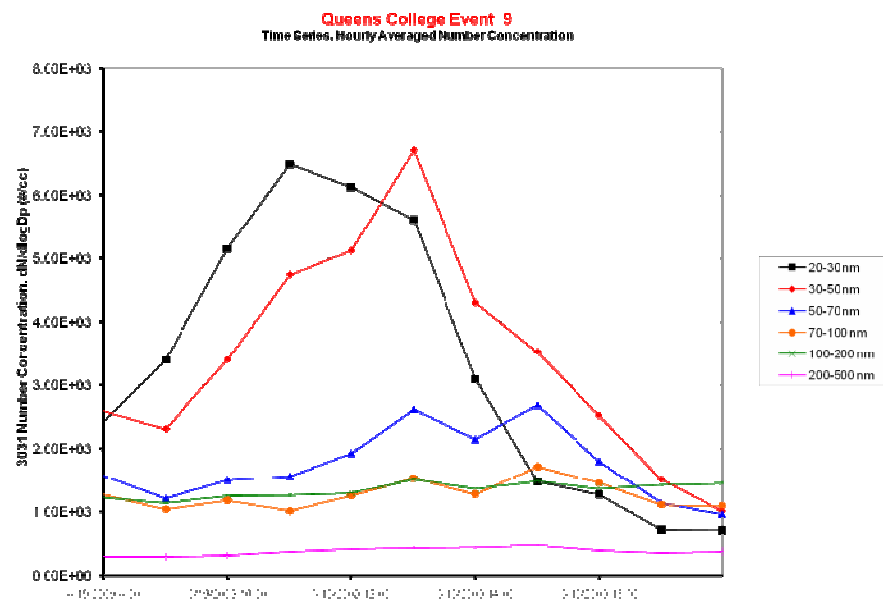
Eisenhower Park Event 12 Contour



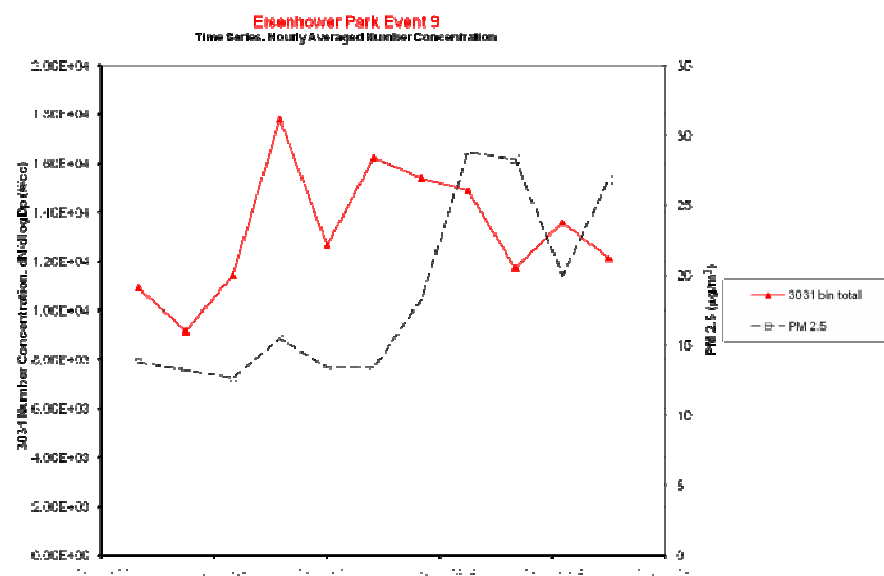
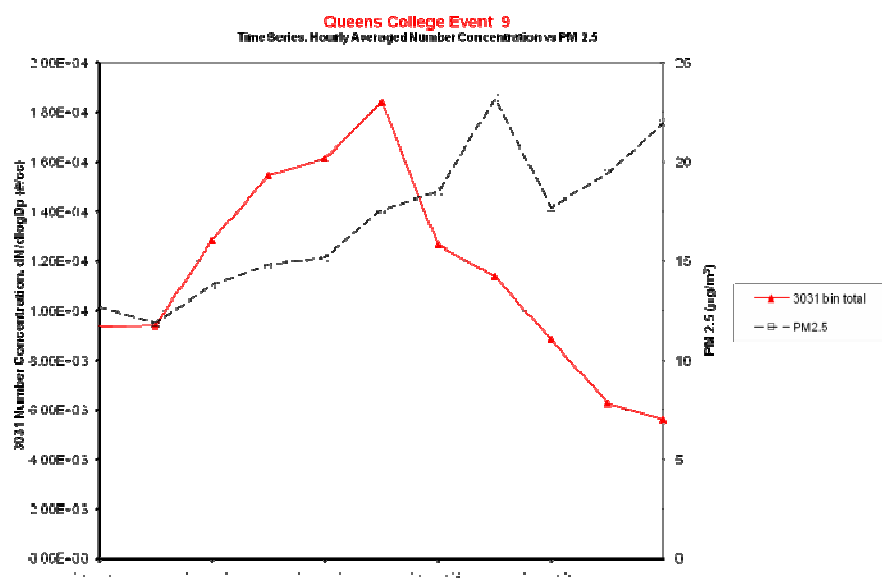
Queens College Event 12 Contour



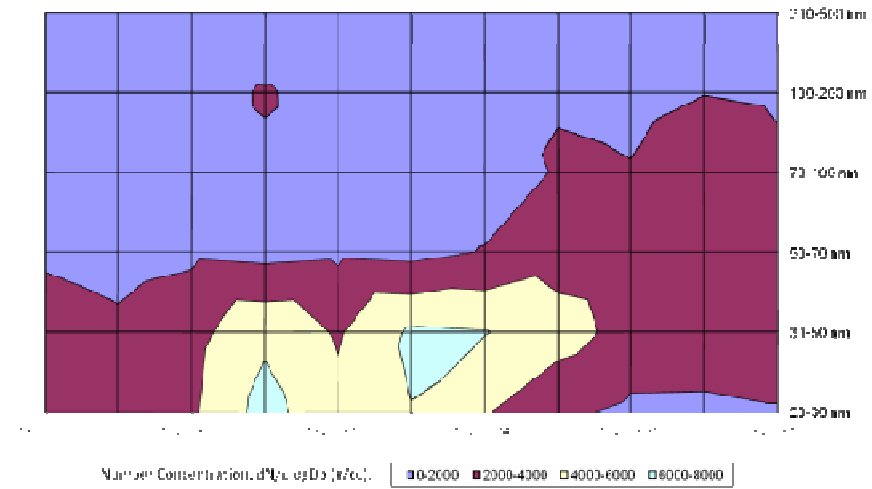
Regionally Correlated Atmospheric Formation Events



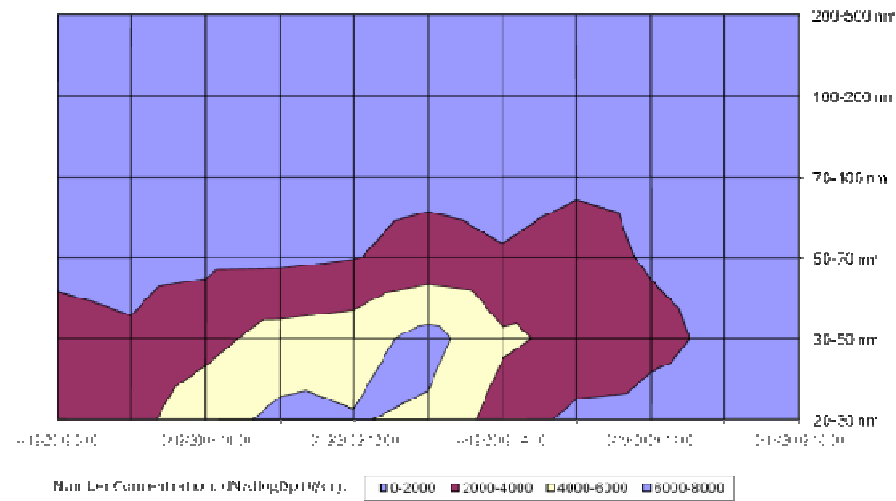
For events of this type, the behavior of ultrafine particles < 100 nm was not closely correlated with the behavior of larger ultrafine particles or with PM 2.5, suggesting that PM2.5 is not necessarily a good indicator of the near-road behavior of ultrafine particles < 100 nm.



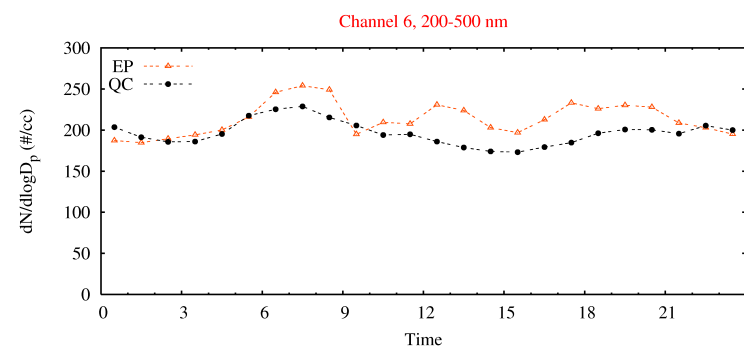
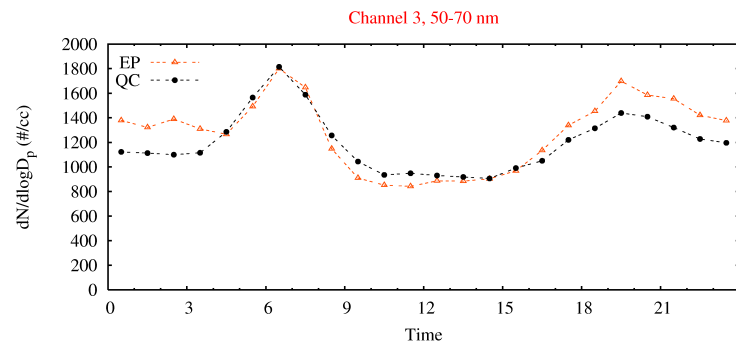
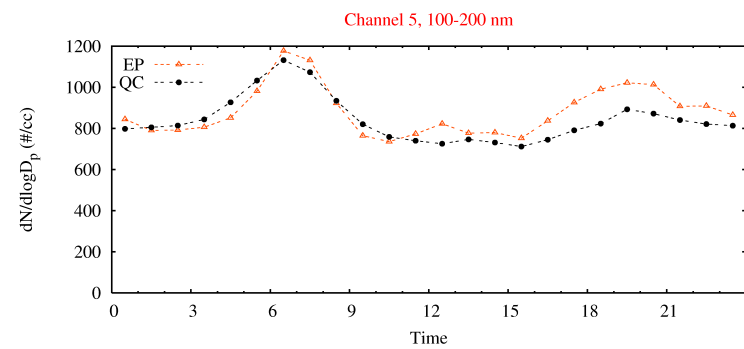
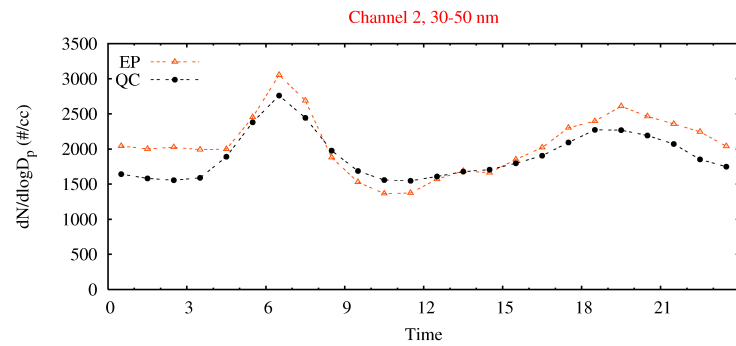
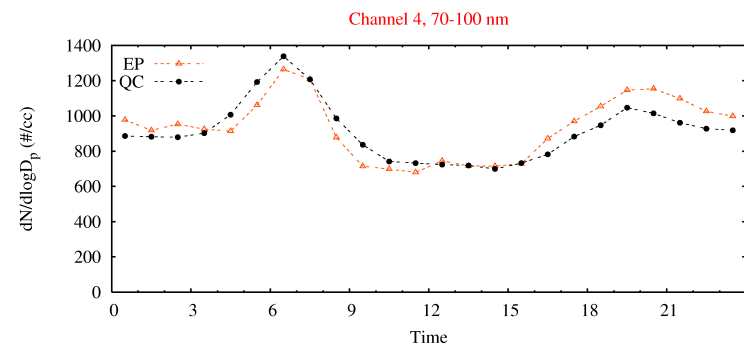
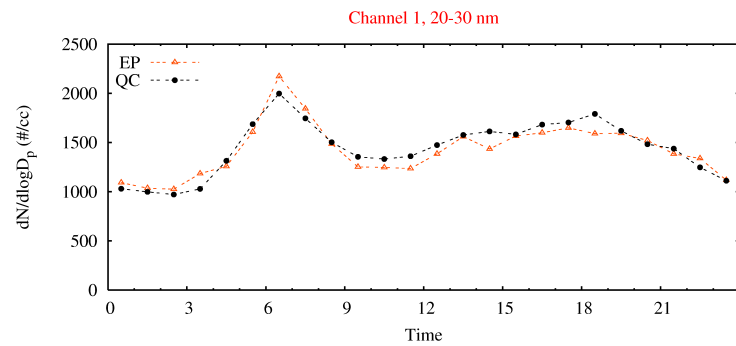
Eisenhower Park Event 5 Contour



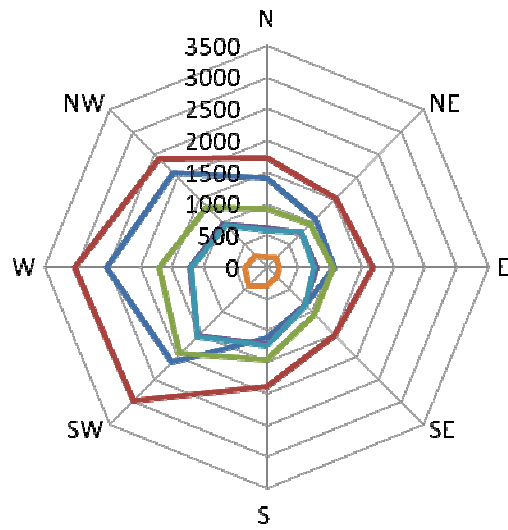
Queens College Event 8 Contour



Regionally Correlated Diurnal Patterns

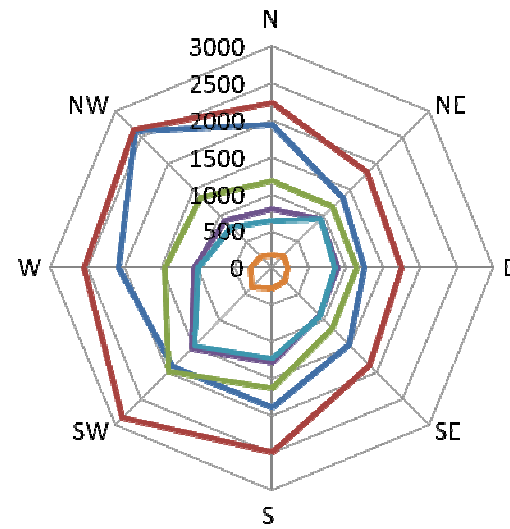


Eisenhower Park, all seasons



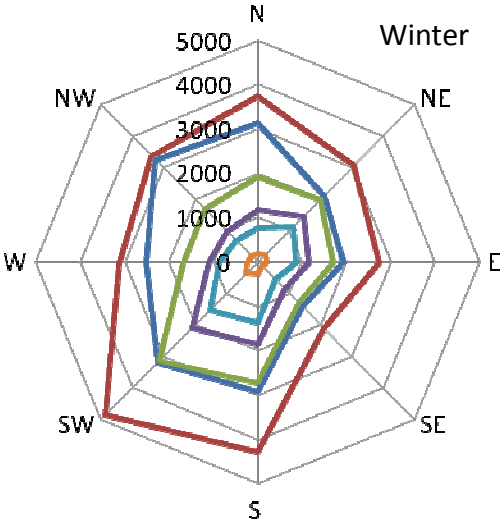
- CH1
- CH2
- CH3
- CH4
- CH5
- CH6

Queens College, all seasons

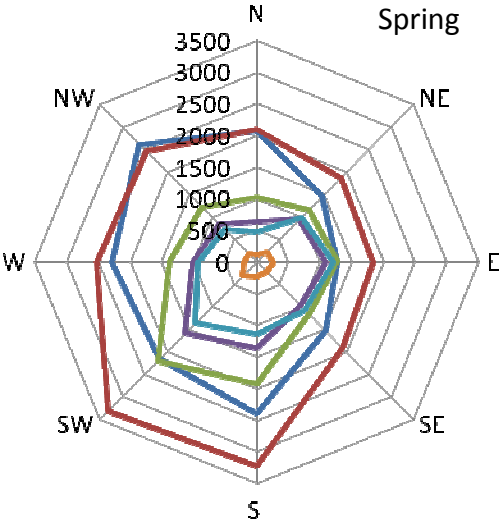


- CH1
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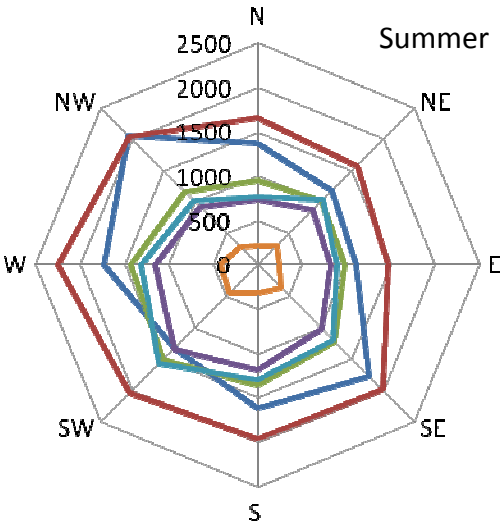
Queens College – By season



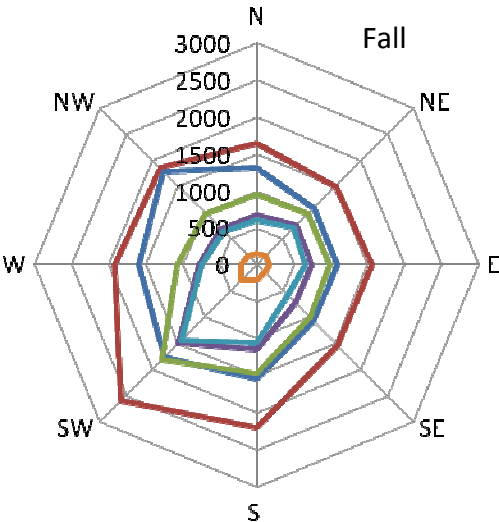
CI1
CI2
CI3
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CI1
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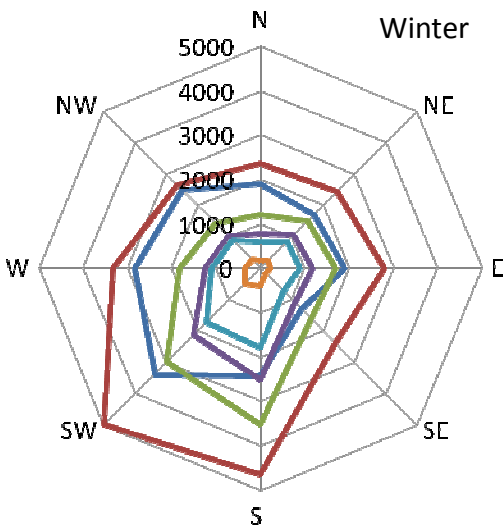


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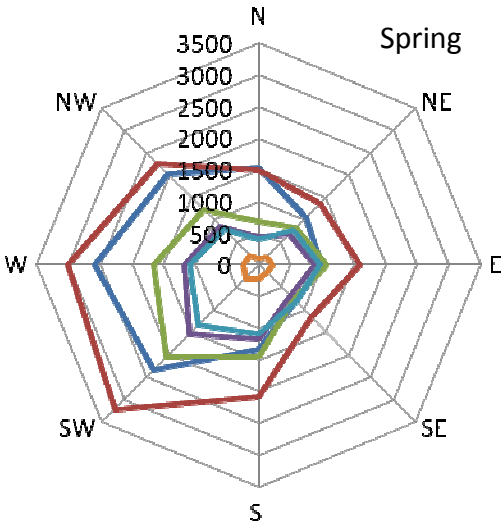


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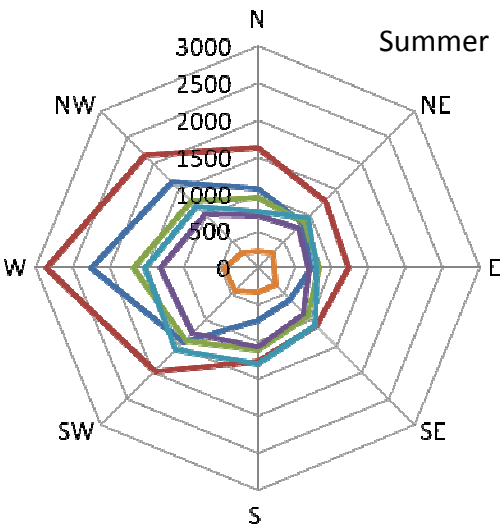
Eisenhower Park – By season



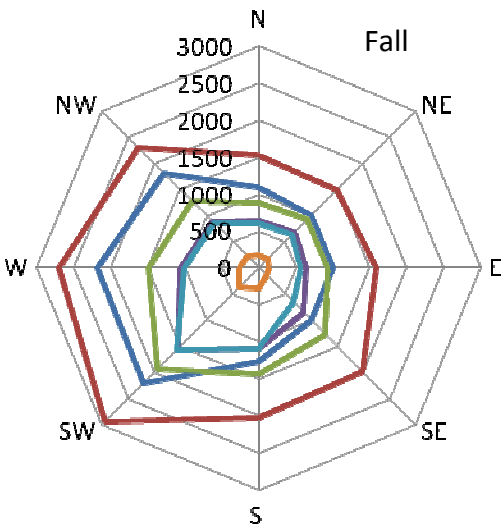
- CI11
- CI12
- CI13
- CI14
- CI15
- CI16



- CI11
- CI12
- CI13
- CI14
- CI15
- CI16



- CI11
- CI12
- CI13
- CI14
- CI15
- CI16



- CI11
- CI12
- CI13
- CI14
- CI15
- CI16

Conclusions

- Ultrafine particle measurements were regionally correlated between the representative urban (Queens College) and near-roadway (Eisenhower Park) sites which were 27 kilometers distant from each other, despite the fact that the near-roadway site was within 22 meters of the roadway. Atmospheric formation events were observed simultaneously at both sites on multiple occasions.
- Near-road PM 2.5 is not necessarily a good indicator of near-road behavior of ultrafine particles < 100 nm
- The ultrafine size fraction < 100 nm is significant for the identification of local sources.
- Long term particle counts were higher at the representative urban site (Queens College) than at the near-roadway site (Eisenhower Park) across almost all size fractions. This result suggests that for locating ambient sites for monitoring of mobile sources, the density of the urban area is likely to be more important than proximity to a single roadway.

Future Work

- Examine seasonal and diurnal correlations of 3031 measurements with regional sulfate, elemental carbon, and total carbon.
- Investigate short term high concentration events at Eisenhower Park possibly due to contributions from nearby stationary sources.
- Analyze independent evidence for secondary aerosol formation during atmospheric events to determine source contributions on a size-resolved basis.
- Assess pollution roses for evidence of local source contributions.

Acknowledgements

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