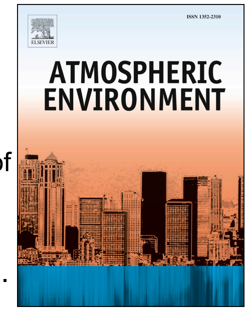
Accepted Manuscript



Understanding the $PM_{2.5}$ imbalance between a far and near-road location: Results of high temporal frequency source apportionment and parameterization of black carbon

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PII: S1352-2310(17)30736-7

DOI: 10.1016/j.atmosenv.2017.10.063

Reference: AEA 15657

To appear in: *Atmospheric Environment*

Received Date: 6 August 2017

Revised Date: 21 October 2017

Accepted Date: 29 October 2017

Please cite this article as: Sofowote, U.M., Healy, R.M., Su, Y., Debosz, J., Noble, M., Munoz, A., Jeong, C.-H., Wang, J.M., Hilker, N., Evans, G.J., Hopke, P.K., Understanding the $PM_{2.5}$ imbalance between a far and near-road location: Results of high temporal frequency source apportionment and parameterization of black carbon, *Atmospheric Environment* (2017), doi: 10.1016/j.atmosenv.2017.10.063.

Understanding the $PM_{2.5}$ imbalance between a far and near-road location: Results of high temporal frequency source apportionment and parameterization of black carbon.

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Abstract

The differences in $PM_{2.5}$ concentrations between two relatively close stations, one situated near a major highway and the other much more distant were used to develop a protocol for determining the impact of highway traffic on particulate matter concentrations at the roadside. The roadside station was <15 m away from the edge of a major highway while the other was located ~170m away. The roadside station contains a suite of continuous instrumentation capable of near-real-time speciation of $PM_{2.5}$. The particulate matter difference, formally termed the $PM_{2.5}$ imbalance was arbitrarily defined as a case wherein |Near-road $PM_{2.5}$ - Far from road $PM_{2.5}$|/Near-road $PM_{2.5}$ ≳50%. Of interest was the variation of multi-time factors based on ME2 analyses of the speciation data from the roadside station during these imbalance events. Of the 7 mass-contributing ME2 factors, a black carbon factor was determined to be the major cause of the $PM_{2.5}$ imbalance and was especially dominant for the case when $PM_{2.5}$ concentrations at the roadside station were greater than the farther-station $PM_{2.5}$. The black carbon concentrations observed during these specific events were further regressed against other traffic-related and meteorological parameters with two nonlinear optimization algorithms (generalized reduced gradient and rules ensemble) in our attempts to model any potential relationships. It was observed that the traffic counts of heavy duty vehicles (predominantly diesel-powered) dominated the relationship with black carbon while contributions from light duty vehicles were negligible during these $[PM_{2.5}]_{Roadside} > [PM_{2.5}]_{Farther}$ events at the roadside station. This work details the most critical ways that highway traffic can contribute to local ambient $PM_{2.5}$ concentrations that commuters are exposed to and will be important in informing policies and strategies for particulate matter pollution reduction.

Keywords: Multilinear Engine (ME), Multi-time resolution, Receptor modeling, $PM_{2.5}$, Black carbon, Aerosol, Nonlinear modelling, Machine learning, Source apportionment

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