TEMPORAL AND SPATIAL VARIATIONS OF ULTRA-FINE PARTICLES IN THE URBAN ENVIRONMENT

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The candidate confirms that the work submitted is his/her own and that appropriate credit has been given where reference has been made to the work of others.

Abstract

Temporal and Spatial Variations of Ultra-Fine Particles in The Urban Environment

This PhD research has resulted in a comprehensive understanding of the spatial and temporal variations of particle number count concentrations (PNC]). The aim of the study was to quantify the influence of traffic flows and meteorological conditions on [PNC] in the vicinity of a congested urban intersection. The experimental work was conducted at a semi-permanent research site in the suburb of Headingley, City of Leeds, UK, where data have been continuously surveyed for a 12 month period. Instrumentation included: traffic flow and speed sensors, prevailing wind, in-street air-flows and four compact air quality stations measuring ultra-fine PNC using butanol based Condensation Particle Counters (TSI 3775) including nitrogen oxides were also observed.

The open-source software 'R' and associated packages such as *openair* and *gbm* package analysis packages were used to analyse the data. Analysis demonstrates significant variations in [PNC] between the stations, largely influenced by the prevailing wind and in-street air-flows, the aspect ratio of the canyon (*H/W*), background concentrations and tidal traffic flows. There is strong evidence for high concentrations of [PNC] were observed when the prevailing wind were blew perpendicular to the station. [PNC] was found to be highly correlated with NO_x concentrations.

An advanced methodology for analysing [PNC], the Boosted Regression Trees (BRT) method, was used to explore the relationship between variables to [PNC] concentrations. It was found that the most important variable at all sites was the prevailing wind direction, followed by traffic flow, prevailing wind speed and vehicle speed. The performance of the [PNC] boosting algorithm was validated using a separate three months of experimental data. In this particular [PNC] air pollution study, moving from conventional analytical models to ones which include multi-level methods that can account for variable intersections, a clearer understanding of urban air quality emission sources and dispersion mechanisms can be developed.