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Localized Variabilities in Traffic-related Air Pollutant Concentrations Revealed Using Compact Sensor Networks

Authors : Eric A. Morris, Xia Liu, Yee Ka Wong, Greg J. Evans, Jeff R. Brook

Abstract : Air quality monitoring stations tend to be widely distributed and are often located far from major roadways, thus, determining where, when, and which traffic-related air pollutants (TRAPs) have the greatest impact on public health becomes a matter of extrapolation. Compact, multipollutant sensor systems are an effective solution as they enable several TRAPs to be monitored in a geospatially dense network, thus filling in the gaps between conventional monitoring stations. This work describes two applications of one such system named AirSENCE for gathering actionable air quality data relevant to smart city infrastructures. In the first application, four AirSENCE devices were co-located with traffic monitors around the perimeter of a city block in Oshawa, Ontario. This study, which coincided with the COVID-19 outbreak of 2020 and subsequent lockdown measures, demonstrated a direct relationship between decreased traffic volumes and TRAP concentrations. Conversely, road construction was observed to cause elevated TRAP levels while reducing traffic volumes, illustrating that conventional smart city sensors such as traffic counters provide inadequate data for inferring air quality conditions. The second application used two AirSENCE sensors on opposite sides of a major 2-way commuter road in Toronto. Clear correlations of TRAP concentrations with wind direction were observed, which shows that impacted areas are not necessarily static and may exhibit high day-to-day variability in air quality conditions despite consistent traffic volumes. Both of these applications provide compelling evidence favouring the inclusion of air quality sensors in current and future smart city infrastructure planning. Such sensors provide direct measurements that are useful for public health alerting as well as decision-making for projects involving traffic mitigation, heavy construction, and urban renewal efforts.

Keywords : distributed sensor network, continuous ambient air quality monitoring, Smart city sensors, Internet of Things, traffic-related air pollutants
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