Fuel losses and assessment of air quality at selected traffic intersections in Delhi

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The rapid growth in the road transport sector has resulted in high consumption of fossil fuels and increased air pollution levels in urban areas, often exceeding the prescribed air quality standards set by various regulatory agencies. The direct effect of vehicle idling is fuel loss, along with related emissions that contribute to heightened air pollution levels. The CAL3QHC model, a Gaussian-based air quality dispersion model approved by the United States Environmental Protection Agency, is specifically developed for predicting air quality at traffic intersections. This model is capable of predicting pollutant concentrations generated from long queues of vehicles waiting at signals (idling condition). The present study focuses on the performance evaluation of the CAL3QHC model in Delhi by utilising local traffic, meteorological, and morphological data. The methodology adopted for estimating signalised intersections, including queue parameters such as signal timing, red signal duration, approach traffic volume, and saturation flow rate, is also discussed. The CAL3QHC model has been employed to predict CO and $PM_{2.5}$ concentrations at three selected signalised traffic intersections. Simultaneously, 48 h traffic volume counts were conducted at these intersections on weekends (Sunday) and weekdays (Monday) during both summer and winter seasons.

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corresponding emissions of vehicles. Therefore, the data requirements for the present study are broadly divided into two categories: (i) traffic characteristics and (ii) air quality parameters. Heterogeneous traffic conditions further complicate predictions due to the situation and the presence of multiple vehicle types with varying dimensions and manoeuvrability. Additionally, space-sharing-based traffic conditions, which differ from lane-based traffic sharing, further complicate the estimation process. Apart from traffic characteristics, parameters necessary for estimating air quality at signalised intersections (commonly referred to as 'hot spots') include the presence of physical structures (e.g., buildings, flyovers, etc.) and normal wind flow (both speed and direction). Although various air dispersion models have been developed and used to estimate vehicular pollution and air quality at signalized intersections, most are line source models that cannot accurately predict vehicular pollution dispersion in complex areas, such as traffic intersections or junctions in semi-urban and central business district (CBD) areas. Further, the line source models fail to estimate dispersion at pedestrian levels, despite the presence of a significant number of pedestrians at most signalised intersections. One widely known model, CAL3QHC, a Gaussian-based air quality dispersion model developed by the United States Environmental Protection Agency (USEPA)[1], predicts pollutant concentrations generated from queues of vehicles idling at intersections. In the absence of a model that accounts for the traffic heterogeneity of Indian traffic, this study focuses on calibrating such a model for Indian conditions.

Literature review