Modeling of CO emissions from traffic vehicles using artificial neural networks

ABSTRACT

Traffic emissions are considered one of the leading causes of environmental impact in megacities and their dangerous effects on human health. This paper presents a hybrid model based on data mining and GIS models designed to predict vehicular Carbon Monoxide (CO) emitted from traffic on the New Klang Valley Expressway, Malaysia. The hybrid model was developed based on the integration of GIS and the optimized Artificial Neural Network algorithm that combined with the Correlation based Feature Selection (CFS) algorithm to predict the daily vehicular CO emissions and generate prediction maps at a microscale level in a small urban area by using a field survey and open source data, which are the main contributions to this paper. The other contribution is related to the case study, which represents the spatial and quantitative variations in the vehicular CO emissions between toll plaza areas and road networks. The proposed hybrid model consists of three steps: the first step is the implementation of the correlation-based Feature Selection model to select the best model's predictors; the second step is the prediction of vehicular CO by using a multilayer perceptron neural network model; and the third step is the creation of micro scale prediction maps. The model was developed using six traffic CO predictors: number of vehicles, number of heavy vehicles, number of motorbikes, temperature, wind speed and a digital surface model. The network architecture and its hyperparameters were optimized through a grid search approach. The traffic CO concentrations were observed at 15-min intervals on weekends and weekdays, four times per day. The results showed that the developed model had achieved validation accuracy of 80.6 %. Overall, the developed models are found to be promising tools for vehicular CO simulations in highly congested areas.

Keyword: Traffic CO; Traffic CO prediction; Neural networks; GIS; Land use/land cover (LULC)