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The investigation of extreme air quality conditions based on traffic and meteorological factors by using Bayesian Networks

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Many studies indicate that traffic emissions have been one of the major sources of air pollution in urban areas. Understanding the impact of traffic factors on air quality is a very important part of the process of air quality management. Therefore, in this study, we take the ambient air quality concentration including NO_x, CO, and PM2.5 of Taipei city, Taiwan as target, and integrate the heterogeneous factors including traffic flow, speed, and meteorological factors. The Bayesian network probability model is built as a big data analysis framework to understand the causality relationship and condition probabilities of traffic factors, meteorological factors and air pollutant concentrations. The Bayesian network model is a good predictive model and assists decision support in providing government effective transport and environmental management.

The results show that there is a high probability of low traffic flow and faster speed resulting in extremely low levels of air pollutants, especially NO_x and CO, which are about 66% and 62% respectively; However, under the conditions of extremely high concentrations of air pollutants, the posterior probability distribution shows that the traffic factor does not have a significantly higher probability. It is slightly affected by lower car speed and higher traffic flow, but mainly due to extremely high meteorological factors or other factors causing worst air quality incident occurred. For the meteorological factors, there is a relatively high probability of a lowest wind speed (39%), lowest temperature (39%) and highest relative humidity (76%) causing the highest NO_x and CO concentrations, and vice versa. In addition, for PM2.5 extreme conditions, traffic factors have no significantly effect on the occurrence of extreme high concentrations of PM2.5 events. However, the changes of the PM2.5 posterior probability distribution were highly correlated with NO_x and CO, and higher temperature and lower relative humidity have higher probability causing PM2.5 concentration become lower.