Time-of-Day Stratification and Its Impact on Traffic Assignment and Vehicle Emission Estimates

Li-Yang Feng, Denver Regional Council of Governments

Abstract

The Clean Air Act Amendment (CAAA) of 1990 has greatly impacted the transportation planning process. One of the requirements of CAAA is to estimate vehicular emissions, a major source of air pollution. The forecasting of vehicular emissions is based on the projections from travel demand forecasting model. Consequently, any changes in the travel demand model would affect air pollution forecasting. In response to the CAAA, the Denver Regional Council of Governments (DRCOG), as a federally mandated Metropolitan Planning Organization, is revising its transportation modeling process, especially in the traffic assignment procedure which is closely related to the time -of-day (TOD) stratification.

The study used the Denver regional travel model as a study case to explore the influence of different TOD stratification techniques to the assignment results and vehicle emission estimates. Experiments were performed on three basic TOD stratification methods, a single period assignment, a three period assignment and a 24 hourly assignment. The HCM85 based volume-delay functions were used in the assignment processes and the resultant speeds were inputs to MOBILE5A, a mobile source emission factor model, to produce emission factors for each of the three test cases.

The study analyzed difference in traffic assignment performance between test cases, and examined their impacts on vehicle emission estimates. The study also discussed the spatial distribution changes of VMT, speed, and three major pollutants: HC, CO, and NOx, between highway facility types.

The study concluded that the three period assignment had the advantage over single period assignment of being able to differentiate the traffic situation between peak and off peak periods. However, the speeds in the three period assignments were produced under the worst traffic congestion conditions. The 24 hourly assignment procedure significantly improved the travel speed estimates, especially for the peak periods by further differentiating the O-D table into shorter periods. As a result, more reasonable vehicle emission estimates for the three major pollutants were produced. The study also verified that the emission estimates are very sensitive to the speed changes among the three different TOD stratification methods while VMT presents a secondary role.

To reduce computing time and operation complexity, an average TD factor method was developed and recommended to reduce number of periods required for the off peak assignment without hurting the accuracy of the results.