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Modeling the formation of traditional and non-traditional secondary organic aerosols from in-use, on-road gasoline and diesel vehicles exhaust

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ABSTRACT

In this study, we implement a numerical model to predict secondary organic aerosol (SOA) formation from semi- and intermediate-volatility organic compounds emitted from in-use gasoline and diesel vehicles. The model is formulated based on the volatility basis set (VBS) approach, and it accounts for OH oxidation of unspeciated low-volatility organics, which are classified by their volatility. This model incorporates SOA formation data from smog chamber and emission measurements of vehicle exhaust in a Hybrid framework to calculate the contribution of both traditional and non-traditional SOA precursors to total SOA formation observed in photo-oxidation experiments. Emission and SOA formation data were acquired from a series of experiments conducted at the Center for Atmospheric Particle Studies, Carnegie Mellon University on different gasoline and diesel vehicles. Instead of assigning surrogate compounds, the source-specific mass yield for non-traditional SOA precursors are calculated directly from the experiments. The present performance of the model is in good agreement with its previous application to aircraft exhaust. Based on the model predictions, a set of average VBS mass yields for each class of vehicles is presented. The obtained yield matrix is able to reproduce the observed SOA concentrations in the smog chamber within the measurement uncertainty.