Geophysical Research Abstracts
Vol. 18, EGU2016-10686, 2016
EGU General Assembly 2016

Emissions of CO_2 and criteria air pollutants from mobile sources: Insights from integrating real-time traffic data into local air quality models

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In 2013, on-road mobile sources were responsible for over 26% of U.S. fossil fuel carbon dioxide ($ffCO_2$) emissions, and over 34% of both CO and NO_x emissions. However, accurate representations of these emissions at the scale of urban areas remains a difficult challenge. Quantifying emissions at the scale of local streets and highways is critical to provide policymakers with the information needed to develop appropriate mitigation strategies and to guide research into the underlying process that drive mobile emissions.

Quantification of vehicle $ffCO_2$ emissions at high spatial and temporal resolutions requires a detailed synthesis of data on traffic activity, roadway attributes, fleet characteristics and vehicle speeds. To accurately characterize criteria air pollutant emissions, information on local meteorology is also critical, as the temperature and relative humidity can affect emissions rates of these pollutants by as much as 400%. As the health impacts of air pollutants are more severe for residents living in close proximity (<500m) to road sources, it is critical that inventories of these emissions rely on highly resolved source data to locate potential hot-spots of exposure.

In this study we utilize real-time GPS estimates of vehicle speeds to estimate $ffCO_2$ and criteria air pollutant emissions at multiple spatial and temporal scales across a large metropolitan area. We observe large variations in emissions associated with diurnal activity patterns, congestion, sporting and civic events, and weather anomalies. We discuss the advantages and challenges of using highly-resolved source data to quantify emissions at a roadway scale, and the potential of this methodology for forecasting the air quality impacts of changes in infrastructure, urban planning policies, and regional climate.