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A near-road modeling system for community-scale assessments of traffic-related air pollution in the United States

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ABSTRACT

The Community Line Source (C-LINE) modeling system estimates emissions and dispersion of toxic air pollutants for roadways within the continental United States. It accesses publicly available traffic and meteorological datasets, and is optimized for use on community-sized areas (100–1000 km^2). The user is not required to provide input data, but can provide their own if desired. C-LINE is a modeling and visualization system that access inputs, performs calculations, visualizes results, provides options to manipulate input variables, and performs basic data analysis. C-LINE was applied to an area in Detroit, Michigan to demonstrate its use in an urban environment. It was developed in ArcGIS, but a prototype web version is in development for wide-scale use. C-LINE is not intended for regulatory applications. Its local-scale focus and ability to quickly (run time < 5 min) compare different roadway pollution scenarios supports community-based applications and help to identify areas for further research.

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1. Introduction

Living, working, and going to school near roadways has been associated with a number of adverse health effects, including asthma exacerbation, cardiovascular impairment, and respiratory symptoms (see HEI, 2007 for a comprehensive review). In the United States, 30%–45% of urban populations live or work in the near-road environment, with a greater percentage of blacks, Hispanics, and low-income residents than whites living in areas of highly-trafficked roadways (Tian et al., 2012). Near-road studies typically use surrogates of exposure to evaluate potential causality of health effects (Lipfert and Wyzga, 2008). Surrogates include proximity, traffic counts, or total length of roads within a given radius around the impacted location (HEI, 2010; Ryan et al., 2007).

In the United States, modeling efforts related to a state or federal policy initiative (EPA, 2008) require detailed analyses using specific datasets and highly-structured models to produce the most accurate estimates possible of actual pollutant concentrations. Typical modeling efforts for these applications require the use of separate emissions and dispersion models, with subsequent visualization being performed separately as needed. Applications are often related to specific projects and regions, such as highway expansions or traffic re-routing for an urban area. Therefore, users might require modeling expertise to run the models and collect the local input datasets necessary for their performance, and then to subsequently interpret results (Cook et al., 2006).

Community groups are becoming increasingly active in local initiatives that seek to mitigate potentially harmful environmental conditions. Community-based participatory research is an example where community residents work directly with the scientific community to identify these situations. Studies are typically independent, locally-based, and solution-oriented. As such, they are not required to follow regulatory procedures to collect information and make decisions, but instead utilize information sources relevant to their defined objectives. While these sources may not be adequate to meet regulatory requirements, they can meet the goal of informing local decision making. For example, an integrated modeling system that includes an activity-based

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