Title: Freight Shipments, Greenhouse Gases and Polluting Emissions: Implications for California and the U.S.

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Project Objective

Can we obtain useful estimates of greenhouse gases and polluting emissions from models that simulate freight traffic on trucks? In this research we simulate air pollution emissions on California road networks associated with truck operations.

Problem Statement

Estimating greenhouse gases (GHGs) and other emissions (especially diesel particulates) is an increasingly important basis for regional policy analysis. According to the EPA (2010b), the transportation sector contributed 27.2 percent of total GHG emissions in 2008, and 50 percent of these were from truck operations. This research focuses on estimating GHGs and other emissions (e.g. PM) from freight movements on roads in California (a prototypical example because of its leadership in air quality policy making) as well as the concurrent effects of various regulation scenarios. In this way, we address questions of sustainability and environmental policy as well as efficiency in freight transportation.

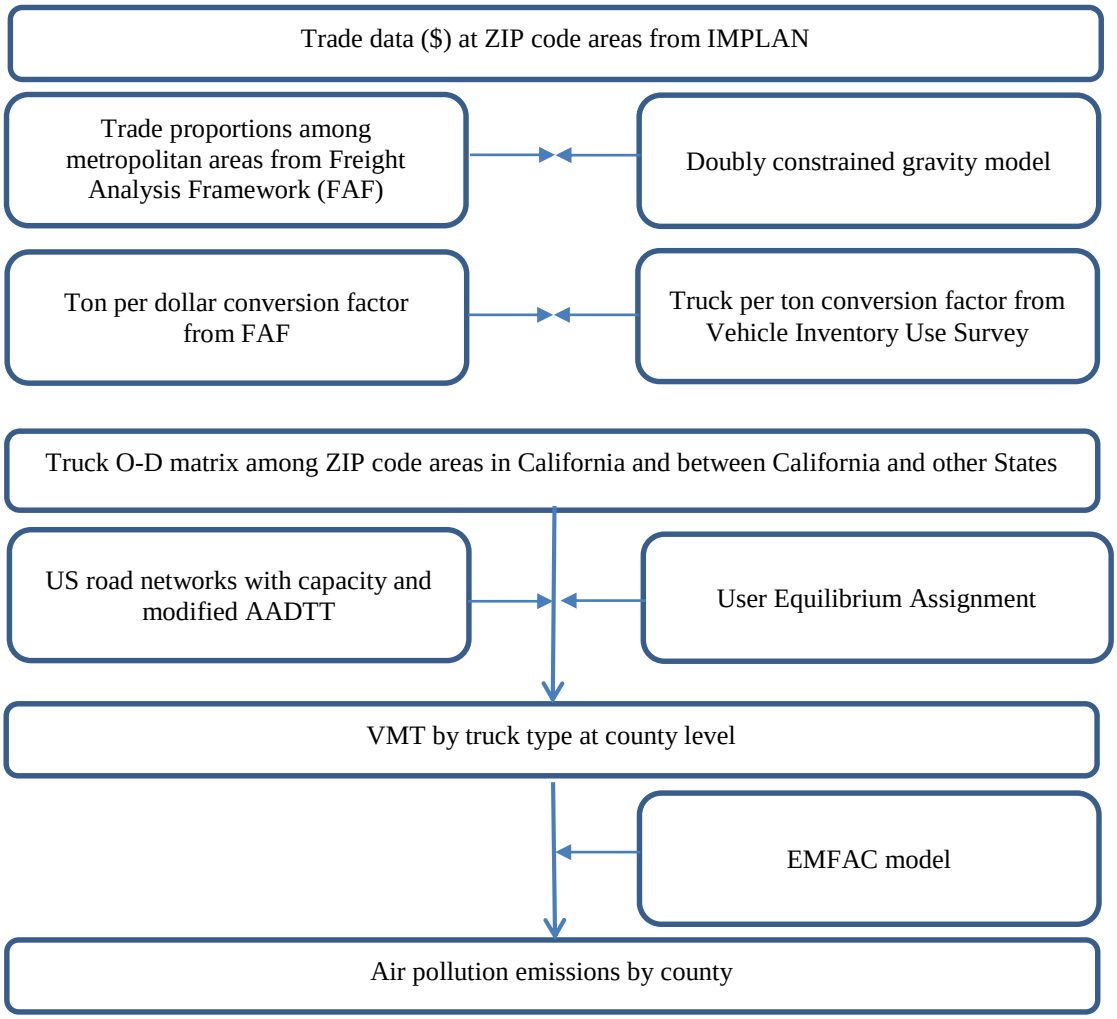
Research Methodology

This research presents a method to estimate truck O-D flows among ZIP code areas, using key sources such as, ZIP code-level IMPLAN input-output data and the Freight Analysis Framework (FAF) which provides information on interregional freight movements throughout the U.S. for 2002-2035. We use these data to estimate interregional trade flows between ZIP code areas by applying a gravity model. We translate the estimated interregional trade flows into vehicle miles traveled (VMT) by applying a User Equilibrium model. The estimated VMT in turn are used as inputs to the emissions model to estimate GHGs and other emissions. The Figure shows the processes of the model.

The model developed for this research includes a truck origin-destination (O-D) matrix at ZIP code areas for domestic and foreign trade by commodity sector. To account for the effects of interregional and international trade, the locations of a region's international gateways for trucking, such as airports, seaports, and border regions, are identified. The model includes road and highway networks that trucks utilize when traveling between O-D pairs. The model is, therefore, appropriate for identifying and analyzing changes in commodity flow patterns or changes of road network utilization and the corresponding consequences resulting in various emissions. The developed model is implemented for three emissions control policy scenarios : 1) To what extent are emissions such as PM and NOx are reduced by replacing old trucks with newer models in Los Angeles County and how great are the impacts throughout the Los Angeles MSA due to a truck upgrade in Los Angeles County. 2) To what extent are emissions are reduced by introducing zero emission lanes on I-710 in Los Angeles County. 3). The what extent are emissions are reduced by developing an inland port at the Mira Loma area for Los Angeles County as well as throughout the Los Angeles MSA. Scenario results are compared to projected baseline trends.

We demonstrate that interregional freight flow data can be an important data source for emission models. The results are useful not only for estimating GHGs and other emissions based on estimated freight flows, but also for evaluating area specific environmental impacts of policy alternatives.

Estimating Air Pollution Emissions: Modeling Steps



Results

The results show that a truck replacement strategy can be effective for reducing emissions in both LA County and the surrounding area. Introducing zero emission lanes on a major truck highway can deliver small impacts, although it may have a significant impact on emissions in specific local areas. Developing an inland port, however, can increase emissions in the MSA, although it can reduce them around the port.

By analyzing and comparing the results of three scenarios, various lessons are learned. First, when a policy alternative is considered to reduce emissions, it is important to make the objectives clear. There can be a strategy that reduces emissions in a specific area but increases emissions in the surrounding county or MSA. Similarly there can be a strategy that reduces emissions in the county or MSA, although the reduction in a specific area is not likely. If the objective is to reduce overall emissions in large areas, the vehicle replacement strategy seems to be promising. If the objective is to reduce emissions in a specific area such as near highway segments, developing zero emission truck lanes could be a good option. Second, moving transport activities from one site to another could have both positive and negative impacts. Total air pollution emissions may not be changed, although emissions in a local area could be reduced. There are also possibilities to increase overall emissions if proper developments of infrastructure are not implemented. More studies are needed to more thoroughly evaluate land use change.