Connected Emission Control Technologies for Freight Vehicles Dataset

Dataset available at: https://doi.org/10.6086/D1PT0J

(This dataset supports report **Connected Emission Control Technologies for Freight Vehicles**)

This U.S. Department of Transportation-funded dataset is preserved by the University of California in the digital repository Dryad (https://datadryad.org/), and is available at https://doi.org/10.6086/D1PT0J

The related final report **Connected Emission Control Technologies for Freight Vehicles**, is available from the National Transportation Library's Digital Repository at https://rosap.ntl.bts.gov/view/dot/54430.

Metadata from the Dryad Repository record:

Abstract:
This project explores how connected vehicle technology can be used to reduce the impacts of air pollutant emissions from freight vehicles. Specifically, the objective of this project is to develop new vehicle routing algorithms for determining travel routes for heavy-duty diesel trucks that would reduce the exposure of local residents to air pollutant emissions from these trucks. The core of the methodology is to first estimate the total amount of human exposure to pollutant emissions generated by a truck when that truck travels on a particular road segment. Once this is performed for all road segments, the estimated exposure value can be used in a least cost path algorithm to find a travel route that would minimize the total exposure value for the trip. To evaluate the potential benefits of this air pollution mitigation strategy, simulation-based experiments were carried out using the Reseda-Northridge area of Southern California as a case study. Overall, it was found that as compared to the fastest route, the low exposure route could result in more than 30% reduction in total air pollutant exposure for about 40% of the 400 simulated trips while keeping the increase in trip travel time to no more than 10%.

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Methods:
The traffic emission exposure modeling includes three steps and four components: 1) an emissions model is first used to quantify pollutant emissions from traffic activity; 2) next, a dispersion model is applied to compute the pollutant concentrations in the study area; and 3) a pollutant exposure model is then utilized to account for how much pollutant is actually inhaled by a target population group--in this research, inhaled mass (IM) is used as the metric for pollutant exposure. The final exposure estimates can be generated on a roadway link-by-link basis in a roadway network and used as input to a routing engine as part of the routing cost.

1) A digital roadway map is at the heart of any routing or navigation application. The map represents geographic features (e.g., location, length, shape), and stores attributes (e.g., road type, lane number, speed limit) of the roadway network. Then, traffic activities on roadways are estimated based on traffic demand and network attributes. In this study, we use street map of

North America provided by ESRI due to the highly-detailed street information [12]. Posted speed limit values are assigned as average traffic speed in this project. For this particular implementation, EMFAC2011 is applied for mesoscale emission factor calculation. Emission factors for specific vehicle categories are downloaded from EMFAC2011 online database (https://www.arb.ca.gov/emfac/2011/). Then, link-by-link emission factors are determined based on the overall traffic speed on the links and saved as a new attribute of the roadway network.

2) An atmospheric dispersion model is utilized to estimate the concentration of air pollutants emitted from traffic sources at specific receptor locations. R-LINE (https://www.cmascenter.org/r-line/) is used in this study, where micrometeorology data inputs for R-LINE such as temperature, wind speed, wind direction, surface friction velocity, and Monin-Obukhov length are obtained from the South Coast Air Quality Management District.

3) In this study, inhaled mass (IM) is used as the metric and calculated as IM=C·Pop·t·BR. where C is the pollutant concentration (µg/m3) in a given microenvironment as calculated by R-LINE. Pop is the number of subjects in the microenvironment. t is the duration of each trip (hour), and BR denotes the breathing rate (m3/hour/capita) of the subjects exposed to the pollutant. We apply the new routing algorithm to high-emitting vehicles (e.g., trucks) in order to minimize the target population's exposure to certain pollutants for the purpose of protecting their health.

Then, we use a weighting method that transforms the multi-cost routing into a single-cost routing problem. An alternative route can be potentially found with less IM within a reasonable duration.

Usage Notes:
street_attributes.xlsx: the attribute table of the street links corresponding to the R-LINE source input. The fields are described in the header.

sensitive_facilities.xlsx: the table of sensitive facilities. The fields are described in the header.

2010sfc.txt, 2010pfl.txt: surface and profile meteorological parameters for R-LINE. Please refer to AERMOD/AERMET mannual for field description (https://www3.epa.gov/scram001/7thconf/aermod/aermetugb.pdf).

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Dataset description:
This dataset contains 1 .zip file collection described below.

doi_10.6086_D1PT0J_v2.zip:
This collection contains 2 .xlsx files and 2 .txt files listed below:

- street_atrributes.xlsx

- sensitive_facilities.xlsx
- 2010sfc.txt
- 2010pfl.txt

The .xlsx file is a Microsoft Excel file, which can be opened with Excel, and other free available software, such as OpenRefine. The .txt file type is a common text file, which can be opened with a basic text editor. The most common software used to open .txt files are Microsoft Windows Notepad, Sublime Text, Atom, and TextEdit (for more information on .txt files and software, please visit https://www.file-extensions.org/txt-file-extension).

National Transportation Library (NTL) Curation Note:
As this dataset is preserved in a repository outside U.S. DOT control, as allowed by the U.S. DOT's Public Access Plan (https://doi.org/10.21949/1503647) Section 7.4.2 Data, the NTL staff has performed ***NO*** additional curation actions on this dataset.

NTL staff last accessed this dataset at https://doi.org/10.6086/D1PT0J on 2021-02-01.

If, in the future, you have trouble accessing this dataset at the host repository, please email NTLDataCurator@dot.gov describing your problem. NTL staff will do its best to assist you at that time.