SFDPH Program on Health, Equity, and Sustainability
Urban Health and Place Team
Air Quality Measurement and Modeling – June 2010

Air Quality Measurement and Modeling

Introduction

The San Francisco Department of Public Health utilizes several existing tools to characterize air pollutant concentrations and hot spots within the City. *Nitrogen dioxide passive dosimetry and particulate matter monitoring* can characterize the relative concentrations of these pollutants using both short and long term samples; portable devices permit measurement within and among residences and at different points along a single street. *Physical dispersion models* use computer algorithms to predict the ambient concentrations of pollutants from roadway traffic and industrial sources taking into account meteorological conditions, pollutant type, traffic counts and types, and other parameters. *Land use regression models* characterize the spatial distribution of exposure in a city or region based on zoning, topology, traffic volume, prevailing meteorology, and other land use characteristics.

Background and Development

Within an area or place, exposure to air pollution typically varies with higher levels of exposure proximate to sources of pollution. For example, motor vehicle air pollution emissions result in higher exposure for those living near freeways and busy roadways. Significant sources of intra-urban variation in air pollution also include truck routes, bus yards and distribution centers, commercial and industrial exhaust, topology, and the aspect ratio of urban canyons. Regional monitoring data conducted for national and state air quality standards does not assess the spatial variation in air pollution within cities nor does it identify air pollution "hot spots".

SFDPH developed facility with air quality measurement and modeling tools to respond to the growing need to identify air quality hot spots within cities. For example, in 2005, the California Air Resources Board issued advisory guidance on preventing roadway related air quality conflicts; however, without air quality models and measurement tools appropriate for planning, it is difficult to implement this guidance. Our tools were developed to support guidance and regulations to prevent health impacts associated with air pollution hot spots.

As a routine method to assess air pollutant impact from roadways in the context of land use planning, SFDPH uses the California Air Resources Board's, EMFAC 2007 vehicle emissions model and the USEPA approved CAL3QHCR Line Source Dispersion Model to model PM 2.5 exposures. CAL3QHCR is a Gaussian dispersion model which estimates air pollution concentrations based on physical characteristics of emissions, meteorology, topography, and receptor horizontal and vertical location. In addition, SFDPH is exploring the use of urban canyon models to identify "hot spots" where traffic and building height combine to create increased exposure and higher population intake of roadway pollutants. SFDPH is also developing a spatial regression model to predict concentrations of nitrogen oxides based on land use patterns and traffic volumes. This model will be validated based on field measurements at over 100 locations in San Francisco.

Collaborations/Constituencies Involved

Multiple collaborations have developed around our air quality work. For example, PHES has developed a key collaboration with Edmund Seto, a researcher with the Center for Occupational and Environmental Health at UC Berkeley, to support the development of assessment tools, particularly with regards to the assessment of traffic volumes and truck counts and the validation of regression models. PODER, an environmental justice organization based in the Mission District, has used PHES tools to assess air quality impacts from I-280 within the Excelsior area. In addition, the Chinese Progressive Association is working with PHES to understand freeway channeling traffic effects associated with moving traffic and goods from the Southeast to Northwest neighborhoods in San Francisco including: noise, air quality, and pedestrian injury impacts. To date, the Lyell/Still, Silver Avenue, and Paul Avenue freeway channels have been evaluated.

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The Bay Area Air Quality Management District has helped to support SFDPH regulatory guidance for the assessment and mitigation of roadway related land use-air quality conflicts. In December of 2008 the San Francisco Board of Supervisors passed Article 38 of the San Francisco Health Code that required air quality modeling of new residential construction sites exposed to high roadway traffic volumes. Locations found to exceed the action level are required to provide mitigations that could include air filtration (See Figure 1).

Relevance to Health and Health Equity

Exposure to air pollution has well documented effects on health, including effects on children's lung development, chronic diseases like asthma and chronic obstructive pulmonary disease (COPD), and cancer. Populations sensitive to the health effects of air pollutants include the elderly and the young, those with higher rates of respiratory disease such as asthma and COPD, and those with other environmental or occupational health exposures that impact cardiovascular or respiratory diseases.

Disproportionate burdens of exposure to air pollution are a well recognized environmental justice issue. For example, health research has consistently demonstrated that children living within 100-200 meters of freeways or busy roadways have poorer lung function and more asthma and respiratory symptoms than those living further away. In California, poor children and children of color are much more likely to live in high-traffic areas.

Applications and Policy Targets

Environmental review of land use decisions has been the primary target for application of our air quality assessment tools. SFDPH has created air quality evaluation and mitigation guidance for evaluating health impacts associated with new residential development proposed near freeways or busy arterial roadways. The involvement of SFDPH and the application of air quality assessment tools are becoming standard practice in the environmental review process of the San Francisco Planning Department.

Air quality assessment tools are also being used in the assessment of air quality conditions in established neighborhoods. For example, assessments conducted in Chinatown single room occupancy hotels suggest that investments in restaurant cooking exhaust systems might reduce particulate exposures to nearby residents. Such findings might translate into new regulatory standards, including: discharge location, mounting design, and discharge height of restaurant ventilation systems.

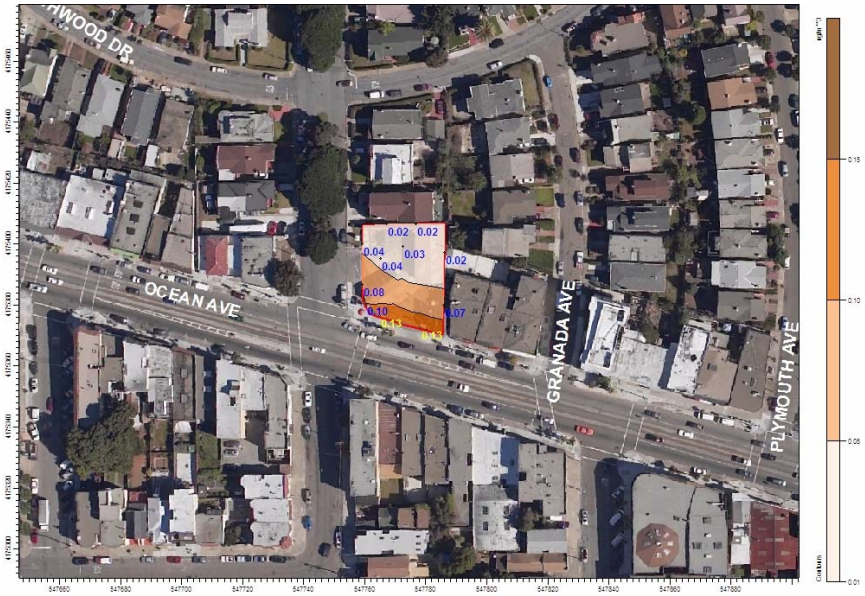

Figure 1: Annual average PM 2.5 concentrations at a proposed residential development project site on Ocean Avenue. The modeled roadway attributable concentrations of PM 2.5 range up to 0.13 ug/m3. The project is under the action level and will not require mitigation.

For more information, please visit:
www.sfphes.org