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Spatial Analysis of Soil Lead Concentrations in Los Angeles, California, USA

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Background:

Lead (Pb) poisoning causes permanent neurologic and developmental disorders. Despite dramatic reductions in environmental lead sources, lead exposure is still an important environmental health problem for U.S. children. This study aims to examine the spatial distributions and sources of soil lead concentrations in the urban areas in south central Los Angeles County, California.

Methods:

A total of 600 soil samples were collected in 2004. Concentrations of total and bio-available lead were analyzed. We examined soil lead concentrations by land-use patterns (commercial, industrial, residential, parks and open areas) and sample type (near freeways and highways, near major arterials, and in stratified random grids). A matrix of traffic index variables were created at different buffer distances (10 to 5000 m), including total roadway length, distance to the nearest roadway, and distance-weighted traffic counts based on 2005 traffic activity data from California Department of Transportation. Dispersion of traffic emissions was also modeled using a line source dispersion model. Tax parcel data with house age information were used to examine the impact of historical lead paint on soil lead concentrations. Other variables we examined included population density, elevation, and lead emissions from EPA's TRI facilities back to 1988.

Results:

We found mean total and bio-available lead concentrations were 180 and 130 μg g^{-1}, respectively. Bioavailable lead was highly correlated with total lead after removing an outlier (bio_Pb = - 1.2 + 0.74 × total_Pb; N = 488, R^2 = 0.93). Lead concentrations near freeways and major arterials were significantly higher than those collected at random grids. Both traffic and building-age related variables were important in predicting soil lead concentrations, but the predicting power varied by different land use patterns and sample types. Age of the nearest parcel explained 23% of the variance in soil lead concentrations in residential areas (N = 152). Age of the nearest parcel and length of small streets within 3000 m explained 54% and 40% of the variance, respectively, in soil lead concentrations in random grid samples at residential areas (N = 44). Road length of freeways within 750 m explained 29% of soil lead concentrations in parks and open areas (N = 26). Distance weighted traffic counts and modeled pollution dispersion were found to be not as predicative as road length variables likely because we used current traffic count data instead of historical traffic counts.

Conclusion:

This study implies that both historical lead-based paint and historical traffic contribute to the current soil lead contaminations.