# SPATIAL DISTRIBUTION OF ULTRAFINE PARTICLES IN GIRONA, SPAIN: A LAND USE REGRESSION MODEL

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**Background and aims:** Ultrafine particles (UFP) are studied recently with increasing concern because of their toxic and pathogenic effects. A stronger association of cardiovascular and respiratory outcomes and UFP as compared to $PM_{2.5}$ has been reported. However, the epidemiological evidence is still insufficient and studies on the long term effects of UFP are needed. Given the high spatial variation of UFP, the assignment of exposure levels in epidemiological studies requires a fine spatial scale.

**Methods**: We measured UFP during 15min on the sidewalk of 652 participants' homes in 12 towns of Girona Province (Spain). The measurements were done during non-rush traffic hours 9:15-12:45 and 15:15-16:45 in 32 days during June 15–July 3, 2009. In parallel, we counted the number of vehicles driving in both directions. Potential predictor variables like building density, distance to bus lines and land uses were collected in GIS format. We adjusted for temporal variation using $NO_X$ measurements at a central monitor. The model with highest adjusted $R^2$ was derived by supervised forward linear regression. Performance of other methods (GAM, regression trees, random forests) was tested.

**Results**: Individual models for groups of neighboring towns performed better than a general model for the study area. Adjusted $R^2$ varied from 0.16 to 0.76 across groups of towns. The most frequent determinants were traffic, traffic load (product of traffic and road length in a given radius) and household density. Other regression techniques improved the fit of the linear regression only marginally. Adjusted $R^2$ at a subset of sites in Girona city improved from 0.46 to 0.76 when the average of two repeated measurements was used.

**Conclusions**: Land use regression models of UFP for 12 towns in Girona were successfully developed using short-term data from a high density monitoring network. These are the first LUR models of the spatial variation of UFP in the Mediterranean area.