Environmental inequalities in France – A spatio-temporal analysis conducted at a small geographical level in four French metropolitan areas.

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Introduction*:* Several studies suggested that more deprived population tend to live in areas characterized by higher levels of environmental pollution. Yet, time and geographical patterns of this disproportionate distribution of environmental burden remain poorly assessed.

Methodology: We investigated the spatial and temporal relation between ambient air NO2 levels and socioeconomic and demographic data in the metropolitan areas of Lille (North of France), Lyon (center), Marseille (south) and Paris between two periods. We conducted an ecological study using the French census block as the geographical unit. The response variable was the NO2 yearly average per census block and the explanatory variables were a neighborhood deprivation index and socioeconomic and demographic data estimated from the 1999 and 2006 census. Generalized additive models allowed to take into account spatial autocorrelation and generate maps using smoothing on longitude and latitude while adjusting for covariates.

Results*:* We found that the strength and direction of the association between deprivation and NO2 estimates varied between cities. In Paris, residents in the higher social categories was more likely to be exposed to higher levels of air pollution; in Lyon, the middle categories experienced greater exposure; which was the case of the lower social categories in Lille and Marseille. Socioeconomic determinants as predictors of pollution exposure change according to the metropolitan areas and the time period. We found that proportions of executives, of no owners of their house and of high income residents were significant predictors of exposure over the two periods whereas other social determinants changed their association with exposure according to the period.

Conclusion*:* There is clear evidence of a variety of spatial and temporal environmental inequalities in French metropolitan areas, entailed to their historical social make-up. General statements about environmental inequalities are inappropriate. This result illustrates the relevance of spatial statistical techniques in modeling exposure.

Keywords : air pollution, environmental inequalities, generalized additive models, social determinants