

HEALTH EFFECTS OF PARTICULATE MATTER IN LISBON, PORTUGAL

Pedro Serpa*¹, Elsa Casimiro^{1,2}, Pedro Garrett¹, Filipe Duarte Santos¹,

¹ Grupo de Investigação em Alterações Climáticas, Mitigação e Adaptação (SIM/CCIAM), Faculdade de Ciências, Universidade de Lisboa, Portugal

² INFOTOX - Consultores em Risco Ambiental, Lisboa, Portugal

*pserpa@siam.fis.fc.ul.pt



INTRODUCTION

The impact of particulate matter (PM10) on human health remains an environmental public health concern in many developed countries. As urban PM10 concentrations are influenced by local emissions, weather and geography as well as background concentrations, their ambient concentrations can differ significantly within urban areas.

This study investigates the potential health impact of PM10 on various locations within the Lisbon county area, with about 490 000 residents, in 2008. The study area was sub-divided into 15 zones, and the attributable number of cases for each estimated. The health impact of PM10 in these various locations is discussed.

METHODS

The spatial distribution of PM10 ambient air concentrations in Lisbon was estimated based on local traffic and key industrial sources as well as regional weather. Air dispersion modeling was performed with multi-scale deterministic model TAPM. The emission inventory includes data from 26 main point sources, 104 main traffic sources, and area/volume sources from Lisbon airport. The initial conditions in the innermost grid where PM10 concentrations from Chamusca station (regional background). A contribution from re-suspension of 1.83 ug PM10/ug PM10 in exhaust emitted by road traffic sources is assumed (zero in rainy days). This value was found by model calibration.

Figure 1 locates the study area. Lisbon county is encompassed in the innermost 20x20 km model grid at 1 km gridpoint spacing (Figure1, left).

The gridpoint concentrations obtained from the air pollution model were aggregated to fit available population data from parishes (Census 2001, INE). Population data was linearly adjusted using county level population data for 2008. Groups of parishes fitting a 2x2 km area where also aggregated according to the location of the model gridpoints and concentration clusters. The daily spatialized concentrations were then processed to obtain annual statistics and frequency distributions for daily averages for use in health impact assessment.

The WHO AirQ Health Impact Assessment Tool was used to estimate the number of deaths and hospital admissions attributed to acute exposure to these daily PM10 concentrations. The WHO default values for health endpoint incidence and relative risks were used.



Figure 1 – Location of the study area (right: domain of the air pollution model; left: study area with red icons as point pollution sources).

CONCLUSIONS

- Results show that atmospheric particles (PM10) exposure in Lisbon county can represent a significant health risk (central accumulated number of cases per 100 000 inhab of 4.6).
- Modeling results indicate Zones 7, 8 (where a hospital is located) to be health risk hotspots. The respective central accumulated nr cases per 100 000 inhab is 15.2% (5.3 Z7) and 50% (6.9, Z8) higher than the global value for Lisbon county. As the using monitoring data indicate higher PM10 values, the overall health impacts from PM10 exposure are likely to be higher than the ones currently calculated.

RESULTS AND DISCUSSION

The annual PM10 concentrations for Lisbon county in 2008 were (ug/m3) : Min 2.3, P25: 9.1, Mean: 14.6, P75: 17.6, P95: 30.6, P98: 38.9, MAX: 54.4 .

The model represented about 50% - 60% of observed measurements from stations within the study area. Reasons for this include an incomplete inventory (e.g. missing data for city centre traffic in some days), and the effect of dust transport from Sahel desert in Africa not being accounted for in model background. There is also a high uncertainty in the contribution from re-suspension.

The relative risk (RR) for increase in mortality per 10 ug/m3 and the Cumulative nr cases per 100 000 people is shown in Table 1. Overall results for Lisbon indicate the following attributable cases: 22 (95% CI: 18.5-25.6) for total mortality, 11.7 (95% CI: 7.3 -26.1) for cardiovascular mortality, and 2.3 (95% CI: 1.6-7.1) for respiratory mortality

Table 1 – Relative risks (RR) used and corresponding attributable deaths/cases in Lisbon from PM10 modelled exposures for 2008.

Health Endpoint	RR (per increase of 10 ug/m3 PM10)	Accumulative attributable cases per 100 000 inhabitants
Mortality		
- Total	1.0074 (95% CI: 1.0062-1.0086)	4.5 (95% CI: 3.8-5.2)
- Cardiovascular	1.008 (95% CI: 1.005-1.0086)	2.4 (95% CI: 1.5-5.4)
- Respiratory	1.012 (95% CI: 1.008-1.018)	0.5 (95% CI: 0.3-1.5)
Hospital Admissions		
- Respiratory Diseases	1.008 (95% CI: 1.0048-1.0112)	6.1 (95% CI: 3.7-8.5)
- Cardiovascular Diseases	1.009 (95% CI: 1.006-1.013)	2.4 (95% CI: 1.6-3.4)

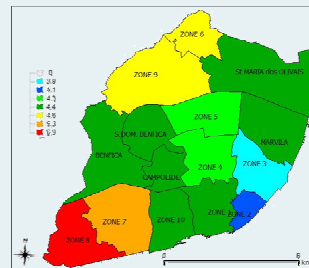


Figure 2 – Accum. nr cases per 100 000 inhabit. attributable to PM10 in Total mortality

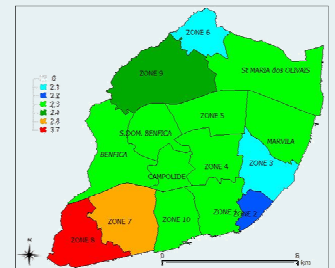


Figure 3 – Accum. nr cases per 100 000 inhabit. attributable to PM10 in cardiovascular disease mortality

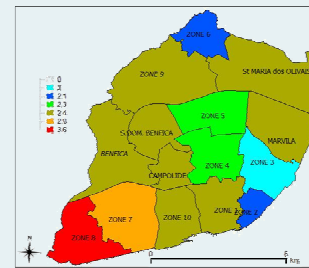


Figure 4 – Accum. nr cases per 100 000 inhabit. attributable to PM10 in Hospital Admissions due to Cardiovascular Diseases

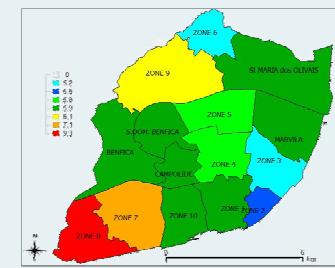


Figure 5 – Accum. nr cases per 100 000 inhabit. attributable to PM10 in Hospital Admissions due to Respiratory Diseases

ACKNOWLEDGMENTS

Local emission data provided by Câmara Municipal de Lisboa, Portuguese Agency of Environment, INE, Estradas de Portugal, SA. This study was funded by project 2FUN, under EU contract n° FP6-2005-GLOBAL-4-036976.