

Spatial distribution of air pollution by PM10 in Oporto in 2012

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Abstract

Air pollution can promote the onset of disease, especially respiratory and cardiovascular diseases. This poster presents a geostatistical analysis of air pollution by PM10 in Oporto in 2012. Results indicate the area around Maia municipality and station of Mecco-Perafita (Matosinhos) containing a high value of this pollutant. Attention must be paid to the air quality in these areas.

Keywords: Geostatistics, Air Pollution, PM10.

1 Introduction

Air pollution can promote the onset of disease, especially respiratory and cardiovascular diseases [1]. WHO (World Health Organisation) regards motor vehicles as a common source of air pollution, among others. Carbon monoxide and atmospheric particles are considered as some of the pollutants which have an impact on public health [2].

The Council of the European Union established the Directive 96/62/EC of 27 September 1996 on ambient air quality assessment and management [3]. This directive was transposed to national legislation by the Decree-Law 276/99, of 23 July.

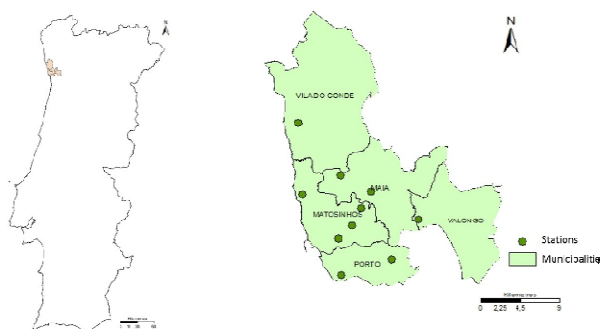
These legal instruments called for the need to reduce air pollution and established a maximum value of pollution allowed by type of pollutant.

This work presents a spatial analysis of PM10 (particulate matters with diameter of 10 micrometres or less) pollution in an area of recognized high motorized traffic, Oporto.

2 Study area and data

The study area includes five municipalities of Oporto district (Vila do Conde, Matosinhos, Maia, Valongo and Porto), located in the North of Portugal (Figure 1).

Figure 1: Study Area.



In this study we used values for PM10 in 2012, from Agência Portuguesa do Ambiente (APA) [4].

We considered both number of exceedance days (as defined in Decree-Law 102/2010, of 23 September) [5] and the annual mean value with daily base.

3 Method

We used a variety of methods in order to explore and analyse data and predict unknown values, such as: exploratory data analysis (statistic and spatial); deterministic methods for spatial interpolation like Voronoi map and Inverse Distance Weighting (IDW) and a geostatistical method, Ordinary Kriging.

4 Results

The exploratory analysis of exceedance days of PM10 showed that the minimum value was 16 (at Custoias-Matosinhos) and the maximum 55 (at Maia – D. Manuel II – Vermoim). The mean value was 32.2 and standard deviation 12.2.

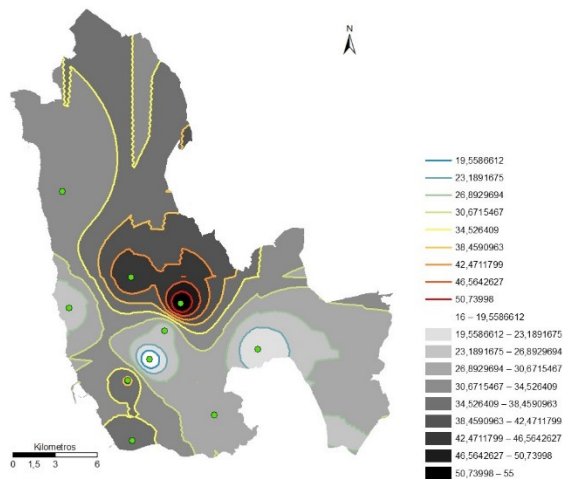
Table 1 shows some of results obtained in the calculation of IDW.

Máx Neighbor	Mín Neighbor	Sector type	Major Range	Mean	RMSE
15	10	1	5650	-0,14	13,96
10	3	8	5650	0,10	14,16
9	3	4	5650	-0,005	14,4

Table 1 – Parameters and results in the calculation of IDW

The IDW interpolation was performed using the parameters presented in the last row of Table 1. The result is portrayed in Figure 2.

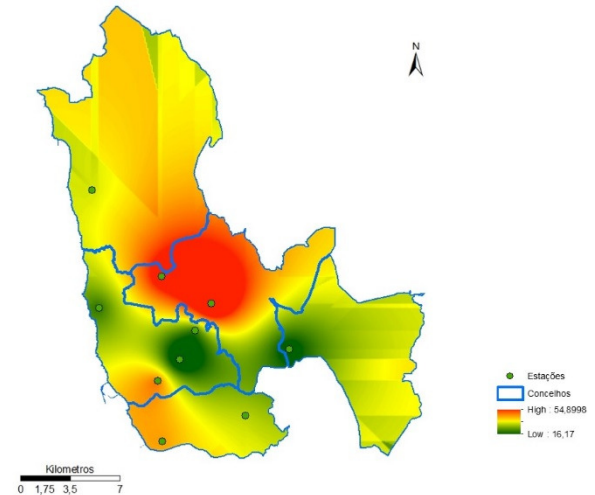
Figure 2: Contour map of exceedance days of PM10 in 2012 in Oporto



The pattern seems to be isotropic around the stations and anisotropic when distance to them increases. Considering the absence of stations, the pattern in the north sector is clearly artificial, resultant of the extent of the map to the study area.

Figure 3 shows the interpolation map created by Ordinary Kriging.

Figure 3: Ordinary Kriging map of exceedance days of PM10 in 2012 in Oporto

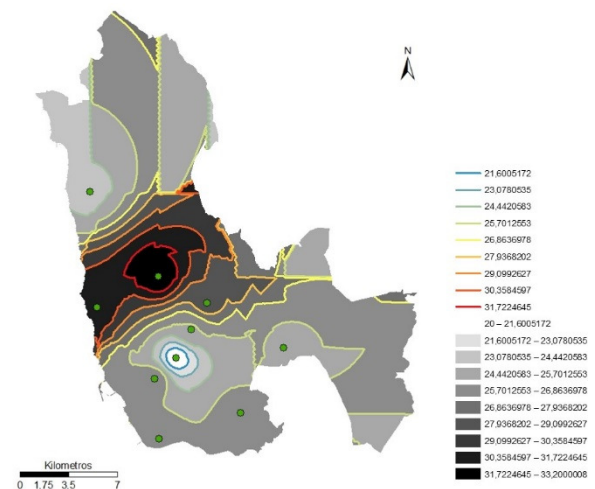


It stands out a range of low values which crosses the Matosinhos municipality and extends towards Valongo, which separates the high values of Maia from others, not so high, located in the southwest sector of Matosinhos and in almost the entire municipality of Oporto.

The exploratory analysis of annual mean value of PM10 showed that the minimum value was 20 (at Custoias-Matosinhos) and the maximum 33.2 (at V. N. Telha, Maia). The mean value was 26.8 and standard deviation 3.7.

In the calculation of IDW, we used the following parameters: number of neighbors - maximum 6, minimum 1; 4 sectors. The result was a mean value 0.01 and RMSE 4.49. Figure 4 presents the resulting contour map.

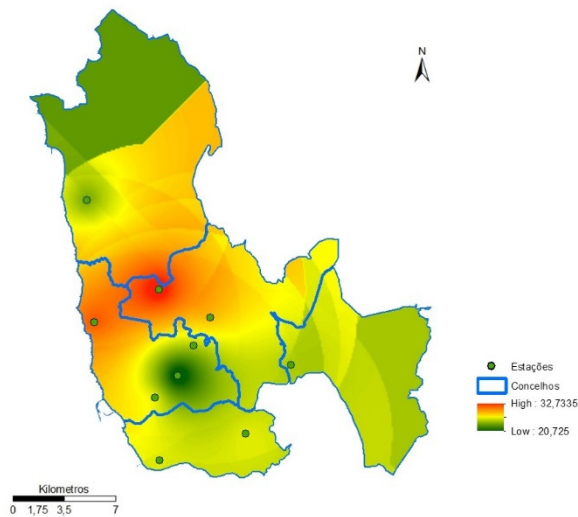
Figure 4: Contour map of annual mean value of PM10 in 2012 in Oporto



The pattern is anisotropic. The North sectors and Northeast show distributions that suggest lack of stations for proper interpolation of the data.

Figure 5 shows the result of processing Ordinary Kriging.

Figure 5: Ordinary Kriging map of annual mean value of PM10 in 2012 in Oporto



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5 Conclusions

The stations' network is insufficient. Due to the need for a larger number of stations, the resulting maps of the IDW and Ordinary Kriging present a diffuse and inconsistent standard in neighboring sectors of the study area, particularly in the North and East sectors.

Some differences are detected when comparing the resulting maps of the analysis of the number of exceedance days and the annual average PM10. The number of exceedance days has highest values around the Maia's stations. The highest annual average values, in turn, are organized in an oblique band around the stations Meco – Perafita, at Matosinhos, and VN de Telha, at Maia.

The monitoring observation of PM10 concentration should be more careful in the combination of the two above-mentioned areas (Maia's stations and Meco-Perafita, Matosinhos).

Finally, it is noted that the analysis of the variograms of exceedance days and annual average value of PM10 seem to indicate that the effect of PM10 could be local. For the validation of this hypothesis we would need a denser stations network.

References

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