
3 PM_{2.5} and PM₁₀ Concentrations in the North of Portugal

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Particulate matter (PM), a mixture of suspended particles and aerosols, can lead to health effects and even premature mortality. Recent research studies seem to indicate that PM₁₀ (particles with diameters less than 10 micrometers) are associated with respiratory responses and PM_{2.5} (particles with diameters less than 2.5 micrometers) mainly with cardiovascular diseases. Nevertheless, there is no indication if it is the physical or the chemical PM characteristics that are responsible for these effects. On the other hand, natural sources of PM make difficult to reduce ambient concentrations to less harmless levels. In European Union (EU), the future legislative intentions will focus also limit values for PM_{2.5}, emphasizing the necessity for more appropriate information about these fractions. Therefore, the knowledge of PM₁₀, PM_{2.5} and other fractions, their chemical composition in relation to their size, source distribution, etc., are important data to deal with this problem.

The first continuous PM_{2.5} measurements started recently in the north of Portugal in two sites with different characteristics: background and traffic. Thus, the aims of this study are to present the spatial variations of PM_{2.5} and PM₁₀ in the north of Portugal and to analyse both PM concentrations exceedances according the PM₁₀ UE and PM_{2.5} US actual legislation. The available data was also correlated to understand the contribution of the PM_{2.5} in the PM₁₀ fraction.

Background daily averages varied between 3-40 and 5-31 $\mu\text{m}/\text{m}^3$ for PM₁₀ and PM_{2.5}, respectively. The daily profiles of both PM are similar and perfectly correlated ($r=0.898$) with a PM_{2.5}/PM₁₀ ratio of 0.88, showing that the most representative fraction is PM_{2.5}, allowing to conclude that in background places just one of them should be measured. In the traffic site PM₁₀ daily averages varied between 5-136 $\mu\text{m}/\text{m}^3$ (25% of these averages exceeded the EU limits: 50 $\mu\text{m}/\text{m}^3$), and PM_{2.5} varied between 2-129 $\mu\text{m}/\text{m}^3$ (9% of exceedances according US limit: 65 $\mu\text{m}/\text{m}^3$ for 98th percentile). The daily PM_{2.5} profile does not follow the same tendency of PM₁₀, which is clearly related with the road traffic in the area. The correlation between both PM data showed a PM_{2.5}/PM₁₀ ratio around 0.80 ($r=0.809$). For the background site, the PM₁₀ and PM_{2.5} annual averages were 17 and 16 $\mu\text{m}/\text{m}^3$, which exceeded the PM_{2.5} annual US, limit (15 $\mu\text{m}/\text{m}^3$). For the traffic site, the PM₁₀ and PM_{2.5} annual averages were 39 and 29 $\mu\text{m}/\text{m}^3$, exceeding both de PM₁₀ (20 $\mu\text{m}/\text{m}^3$) and PM_{2.5} US limits.

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AIRNET
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Objectives

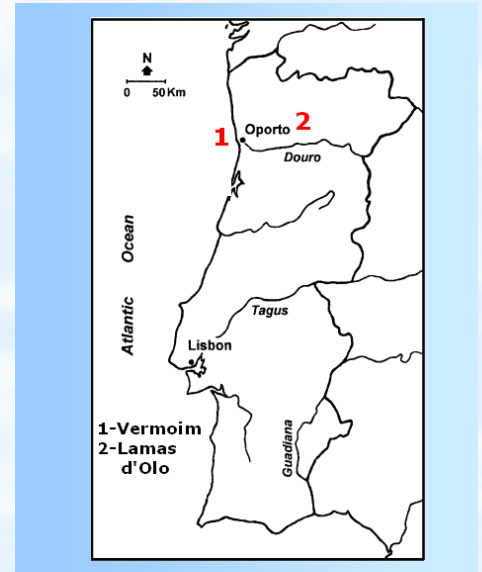
- To evaluate the spatial variations of the **first continuous measurements of PM_{2.5}** and PM₁₀ in the north of Portugal
- To analyze both PM concentration exceedances according to EU and US legislations

Monitoring Sites

The analyzed PM monitoring data was attained in the period of January to July 2004 from two distinct sites in the north of Portugal.

Background site: Lamas d'Olo, with a rural involving, is located in a mountainous region inserted in the forest reserve of Alvão, 1000 m altitude

Traffic site: Vermoim, belongs to the air quality monitoring network of the Oporto Metropolitan Area, it is an urban zone near a traffic road



Results

PM exceedances at the background and the traffic sites, daily and annual limits according to EC and US legislations

	24-hours limits		Background exceedance		Traffic exceedance		Annual limits		Annual average	
	EC ¹	US ²	EC	US	EC	US	EC ³	US	Background	Traffic
PM ₁₀ (µg/m ³)	50	150	N	N	25 %	N	20	50	17	39
PM _{2.5} (µg/m ³)	-	65	N	N	-	9 %	-	15	16	29

N - Not exceeded

¹ Council Directive 1999/30/EC

² US EPA National Ambient Air Quality Standards (NAAQS) ((150)99th and (65)98th percentiles)

³ Limit to be met by 1 January 2010

In the traffic site PM₁₀ daily averages varied between 5-136 µg/m³ and PM_{2.5} daily averages varied between 2-129 µg/m³.

Annual limits of PM_{2.5} exceeded the US limits in both monitoring sites.

The EC PM₁₀ limit was exceeded in the traffic site.

The PM_{2.5}/PM₁₀ ratio was 0.88 for the traffic and for 0.80 the background site.

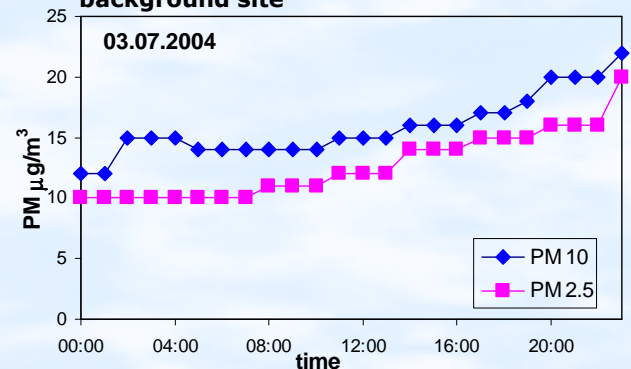
Conclusions

In the background site the daily profiles of both PM were similar and perfectly correlated (r=0.898) with a high PM_{2.5}/PM₁₀ ratio. As the PM_{2.5} was the most representative fraction it might be concluded that in the background site only one PM fraction could be monitored.

Oporto Metropolitan Area is strongly influenced by traffic emission and the exceedances of PM₁₀ limits are alarming and these concentrations could lead to health effects and even premature mortality. Strategies to implement better public transportation system and strict car maintenance should be applied.

As the future EC legislative intentions will also focus on PM_{2.5}, it requires more detailed information about these fractions, their chemical composition and relation to the size. In Portugal this field is nearly "untouched".

Daily PM₁₀ and PM_{2.5} profile in the background site



PM₁₀ and PM_{2.5} correlation in the traffic site

