BACKGROUND LEVELS OF ATMOSPHERIC PARTICULATE MATTER OVER THE NORTHEAST ATLANTIC OCEAN

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1. Introduction

Understanding the physical and chemical properties of marine aerosol particles is crucial because of the role these particles play in a number of atmospheric processes. Marine aerosols affect climate directly through scattering and absorption of radiation and indirectly as they can act as cloud condensation nuclei and thus influence the albedo of clouds. In addition, marine aerosol particles play an important role in the cycling of various elements through the atmosphere.
Many aspects about the origin of marine aerosols and their impact on atmospheric processes are still poorly known at present and this lack of understanding stems in part from the relatively few measurements which have been performed in the most pristine areas of the earth.
In order to improve our knowledge about the marine aerosol and its formation we established a land-based aerosol sampling station on the western coast of Terceira island (Azores). Here we present the first measurements of a project of sampling atmospheric particulate matter which started in Spring of 1999 and will be extended for one year.

2. Experimental Description

The measurements were conducted at a coastal site (latitude: 38°41'26''N; longitude: 27°21'15''; altitude: 50 **m**), about 15 **Km** of Angra do Heroísmo, the main city of Terceira island, with 20000 inhabitants. The site is isolated from roads and the nearest houses, in small number, lie approximately 1 km to the Northeast. Thus, the impact of

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local sources of pollution is minimal, with the site ideally located to characterise westerly maritime air masses.
A high-volume sampler equipped with a size selective inlet and a quartz fibre filter was used to collect particulate matter less than or equal to 10 **μm** in diameter, PM_{10} (Figure 1) [1].

(a)

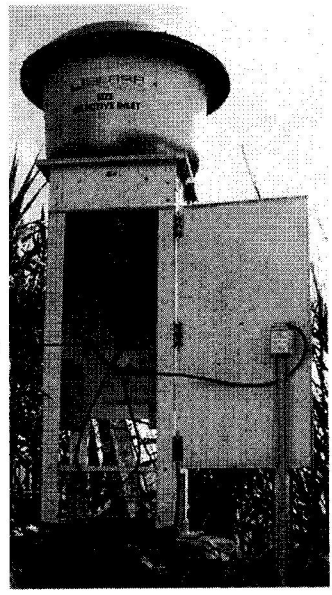

Figure 1. High-volume sampling setup installed at Terceira (a-orifice).

The instrument working model is given by Equation 1,

$$PM_{10}\left(\mu g/m^3\right)=\frac{m\times b\times 10^6}{\Delta t\left(\sqrt{\frac{T\times \Delta H}{p}}-a\right)} \tag{1}$$

where T is the average sampling temperature, in **K**, p the average sampling pressure, in **mmHg**, Δt the sampling period, in **min**, m the mass of the sample, in **g**, a and b are the constants of the calibrated head fitting, respectively, the intercept and slope (a = -0.07759 and b = 1.0131) [2]. ΔH, is given by Equation 2, in **in**,

$$\Delta H = c + d\,\Delta h \tag{2}$$

where Δh is the pressure displacement measured in the orifice of the high-volume with a water manometer, in **in**, c and d are the calibrated constants obtained in the calibration of the apparatus (Figure 2).

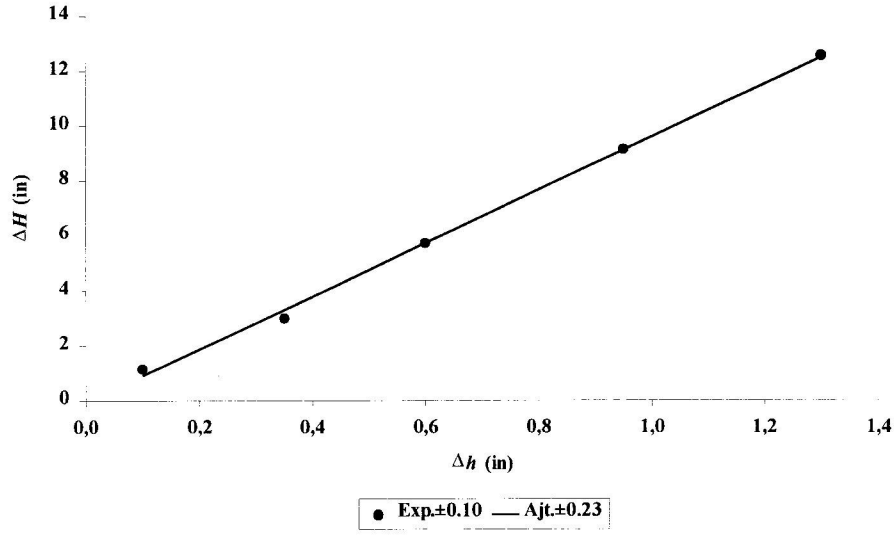

Figure 2. Calibration curve for the high-volume sampler (c=-0.06±0.19**in**; d=9.62±0.24).

The filters were weigthed before and after sampling with an automated analytical balance in a controlled environment. In general, the precision of the measurement of the mass was 0.0001 **g** and the average reproducibility 0.003 **g**.

3. Results and Discussion

The results of the first set of measurements performed at Terceira during April and May of 1999 are shown in Table 1.

TABLE 1. Atmospheric levels of PM_{10} measured at Terceira during April and May of 1999.

Julian Day	$T \pm 1$ (°C)	$p \pm 1$ (mmHg)	$V \pm 170$ (m^3)	$\Delta t \pm 2$ (min)	$m \pm 0.003$ (g)	$PM_{10} \pm 2.5$ ($\mu g/m^3$)
111 a 113	20	760	3176	2830	0.177	55.6
113 a 115	21	761	3188	2838	0.226	70.9
115 a 117	21	763	3308	2950	0.131	39.5
117 a 119	18	757	3298	2844	0.089	26.9
119 a 121	14	746	3394	2926	0.117	34.3
121 a 123	13	747	3275	2926	0.101	30.9
123 a 125	15	743	3230	2870	0.195	60.4
125 a 127	17	745	3084	2734	0.153	49.6

The average accuracy of the data was 4.9% for volume, 2.5% for mass and 5.6% for the particulate matter levels. Future improvements in our technique of measurement of Δh will permit a decrease in the uncertainty of PM_{10} levels to about 4%. Further decreases in the final error are limited by the quality of mass measurements. For example, a decrease of 0.001 g in the uncertainty of mass measurements will reduce the PM10 final error to a value as low as 0.5%. Thus, we are now focusing efforts in the improvement of our weighting procedure, particularly in what concerns ambient conditions for the operation of the analytical balance.

The mean PM_{10} concentration for the first set of measurements was 46.1 ± 15.6 $\mu g/m^3$. This value is somewhat lower than the average concentration observed by Pio *et al.*[3] at the portuguese west coast, which is about 65 $\mu g/m^3$, suggesting a lower impact of pollution sources in the atmosphere of the Azores.

Chemical characterisation of aerosol particles is presently being performed and includes the analysis of the following species: SO_4^{2-}, NO_3^-, Cl^-, H^+, NH_4^+, Na^+, K^+, Ca^{2+} and Mg^{2+}.
The measurements will be extended for one year and we hope they will enhance the global data set of the chemical composition of the marine aerosol which is crucial for a complete understanding of his climatic relevance.

4. Acknowledges

To the Foundation for Science and Technology and the Azores Regional Government for the financial support to the project, to the Azores Electricity company for the installation of the power supply, and to Mister Francisco Carrondo for allowing the installation of the sampling instrument in his lands.

5. References

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3. Pio, C. A., Castro, L. M., Cerqueira, M. A., Santos, I. M., Belchior, F. and Salgueiro, M. L. (1996) Source assessment of particulate air pollutants measured at the southwest european coast. *Atmospheric Environment* **30**, 3309-3320.