Size distribution of PM at Cape Verde - Santiago Island

J. Cardoso [1,2], C. Pio [1], T. Nunes [1], A. Caseiro [1], M. Cerqueira [1], D. Custodio [1], M. C. Freitas [3], and S. M. Almeida [3]

(1) CESAM & Department of Environment, University of Aveiro, 3810-193 Aveiro, Portugal, (2) University of Cape Verde, 279 CPraia, Santiago, Cabo Verde, (3) ITN/MCTES - 2686-953 Sacavém, Portugal

Introduction

Understanding the contribution of desert areas such as the North Africa Sahara to the presence of dust particles in the atmosphere is very important for assessing air quality at regional and global levels and their impact on global climate system or on human health. For this purpose detailed data on the size distribution and the size-resolved chemical and mineralogical composition of dust providing from this region were characterized in Cape Verde.

The size distribution of PM at Cape Verde Santiago Island obtained with a Grimm dust monitor is discussed here. The chemical composition of PM10 is presented in poster (XY73) also presented in this session.

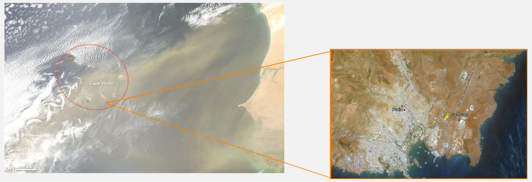

Fig.1: Localization map of CV-Dust sampling point.

Located to the west of the African coast and inside the main area of dust transport over tropical Atlantic, the Cape Verde archipelago is a good location to set up studies for characterizing and quantifying the dust transported from Africa to the Atlantic. In the scope of the CVDust project a surface field station was implemented in the surroundings of Praia City, Santiago Island, where atmospheric aerosol sampling was performed during one year using different PM samplers and monitors .

Experimental Procedure

Measurement of the PM size was based on optical particle counter (OPC) method and was carried out using an environmental dust monitor (GRIMM, model EDM164). The equipment allowed the counting of particles in real time (every 5 minutes) with sizing from 0.25 up to 32 µm, using 31 size channels. Measures were run almost continuously from January 2011 to December 2011.

Fig.2: Equipments mounted on the site.

The performance of Grimm PM quantification was evaluated throughout the sampling period by comparing with gravimetric data obtained by using high and low volume samplers. Meteorological data and backtrajectories of the air mass, created with NOAA Hysplit model, were used to assess the effects of aerosol origin and transport on aerosol loading and size distribution on the various seasons of the year.

Results

Figures 3a to 3c show the correlations between mass concentration measured by PM samplers and the averaged PM10 and PM2.5 mass concentration estimated with Grimm for each period of sampling. Grimm fitting was optimized by considering a dust density of 3g/cm^3.

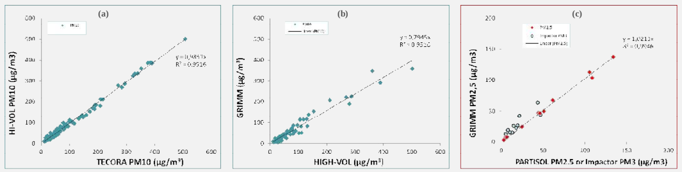

Fig.3 (a-c): Linear regression and R-square of comparison mass data between Grimm and PM samplers.

Time evolution of PM mass concentration estimated by Grimm during CV-Dust campaign is presented in the figure 4.

Higher number and mass of PM observed in January and February are related to Sahara dust events, this phenomena commonly know in Cape Verde as "bruma seca" (dry haze). During these months, PM10 average was ~80 µg/m^3, accounting PM1 and PM2.5 to less than 11% and 47% of PM10, respectively. During Saharan dust events, hourly PM2.5 and PM10 reached values as high as 200 and 600 µg/m^3, respectively.

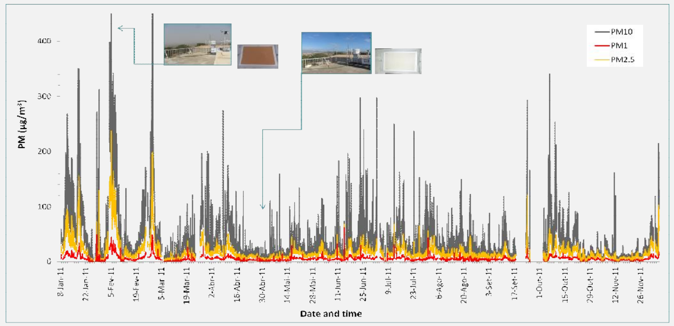

Fig.4: Time evolution of mass concentration for PM1, PM2.5 and PM10 .Photos on the graph show the changes on atmospheric visibility and sampling filters appearance for two specific period.

Figures below display the size distributions of PM (0.25 to 30 µm) for two selected periods corresponding to high concentration (Saharan dust event) and to low concentration (without Saharan dust event). For the same periods, the trajectories of air mass arrived at the site are simulated using Hysplit model.

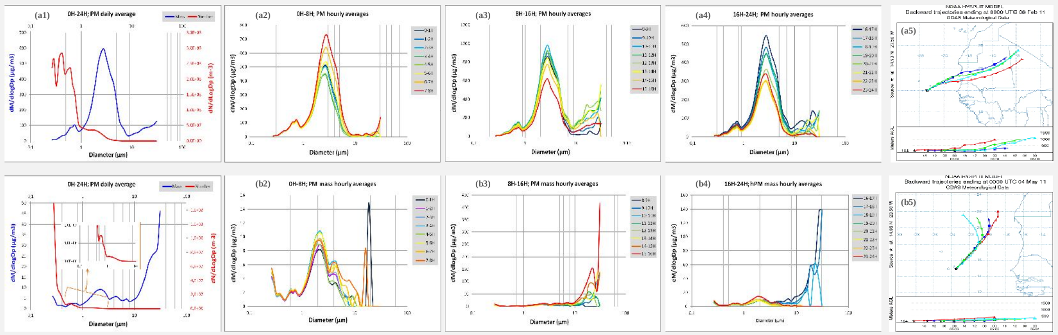

Fig.5: Graphs (a1) and (b1) represent the daily average number and mass size distribution of PM corresponding to the Saharan dust event (in February 5th) and marine air mass influence (in May 3rd), respectively. Graphs (a2-4) and (b2-4) represent the hourly average mass size distribution plotted for time intervals of 8H. Figures (a5) and (b5) illustrate the trajectories of air mass arriving at the site, created by NOAA Hysplit model.

Summary and conclusion

PM10 and PM2.5 mass estimated from the Grimm show a good correlation with PM mass measured gravimetrically by samplers. This reveals a good performance of the monitor.

Number and mass size distribution of PM exhibit a multimodal profile, the particles sizing between 2.0 to 4.0 µm presenting the major contribution to PM mass during the Saharan dust events. From the daily cycle particles larger than 10 µm appear to have preferentially a local origin.

Saharan dust transport to the Atlantic varies temporally (in a hourly, daily and monthly scales), and influences strongly the number and mass size distribution of PM and the atmospheric properties on the Cape Verde archipelago.

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