Long-term atmospheric aerosol deposition in Southern Portugal: first results on chemical and morphological characterization of particles by VP-SEM+EDS

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INTRODUCTION

Atmospheric aerosol particles play an important role in climate and air quality. In Portugal, long time series on the chemistry and morphology of atmospheric aerosol particles as well as on their seasonal dependency are still relatively scarce and mostly confined to the North of the country.

To assess the relative contribution of several aerosol particle sources, a 1 year quasi continuous aerosol sampling is currently under way, which started on 10 August 2011 at a sampling site in Évora, Southern Portugal.

Évora is a small city with about 50000 inhabitants. It is located inland about 130 km away from the Atlantic No major air polluting industrial sources are present near the city. Measurements were taken at the observational platform on the roof of Évora Geophysics Center (CGE) within the historical city center.

INSTRUMENTATION

Particulate matter was collected using a modified version of the aerosol passive sampler (Fig. 1) Type A “flat plates” by Ott and Peters (2008).

Fig. 1. Sedimentation sampler

Single particle automated analysis was performed using an HITACHI VP-SEM interfaced with a Bruker EDS QUANTAX automatic ESPRIT software. Analytical conditions were as follows: 20 kV accelerating voltage; 10 mm WD; 120 mA emission current; 70 mA probe current. Particles were classified according to their chemical composition and size respectively into 8 and 4 classes (Fig. 2)

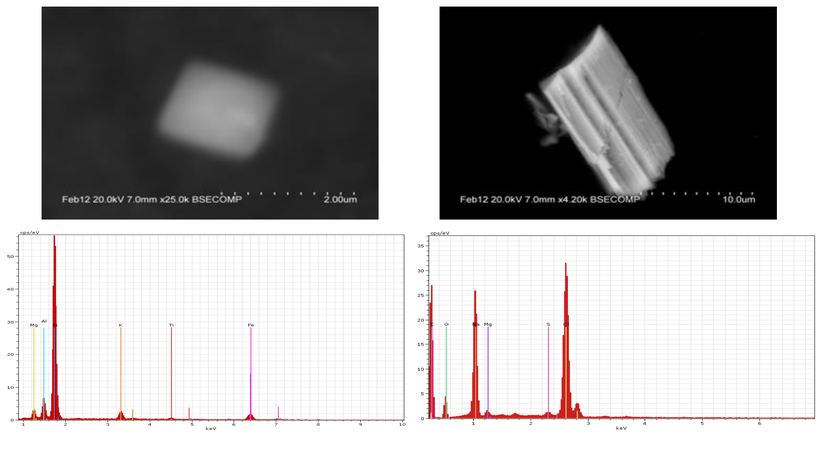

Fig. 2. Aerosol particles and associated EDS spectra.
a,b) Sea-Salt (NaCl); c,d) silicate mineral particle.

RESULTS

Sampling periods and meteo parameters

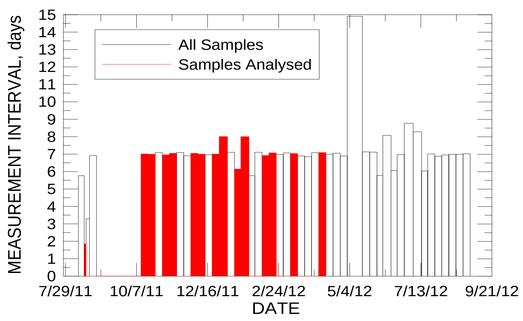

Fig. 3. Overview of the sampling times and duration

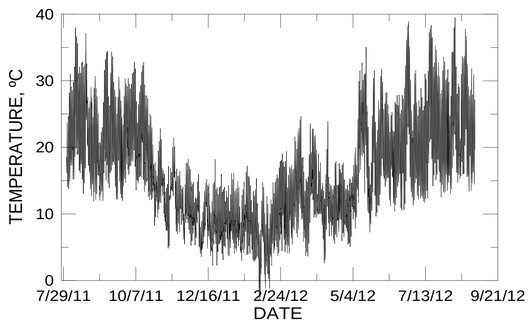

Fig. 4. Air temperatures at sampling site

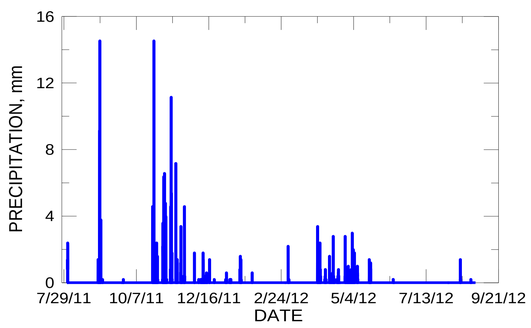

Fig. 5. Precipitation at Sampling site

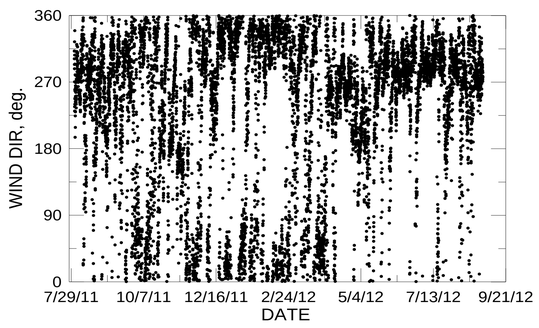

Fig. 6. Wind Direction at CGE

Chemical and Morphological Aerosol classification (full dataset)

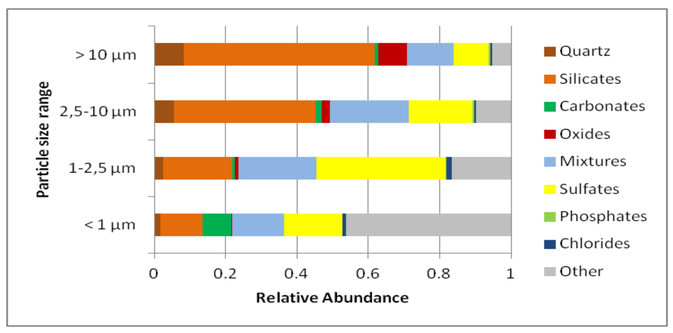

Fig. 7. Size dependent composition of particles for major chemical compounds of all 15 samples

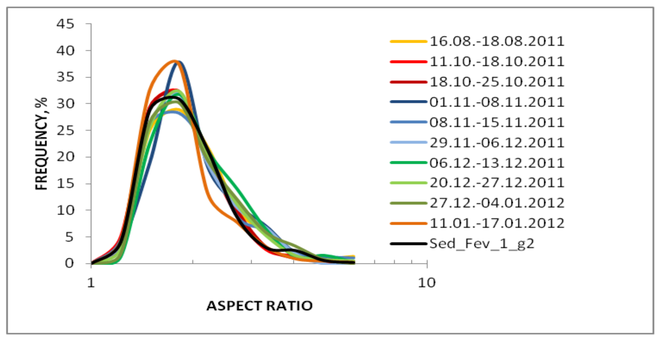

Fig. 8. Aspect Ratio

1000 individual particles were analysed for each sedimentation sample. Fig. 7 shows the average chemical composition for 4 size classes of sample so far analysed. It can be seen clearly that the fraction of quartz and silicates increases with size. This can be attributed to particles originating from soil sources. Sulfates and mixtures of chemical compounds are distributed in all size classes but they slightly increase towards smaller particle diameters.

Fig. 8. Shows the Aspect Ratio parameter weekly variation. Here only particles which covered a minimum pixel area of 10 were taken into account. The distribution for all samples is similar and has a peak at around 1.5.

Chemical Aerosol classification and HYSPLIT/GDAS trajectories (selected weekly samples)

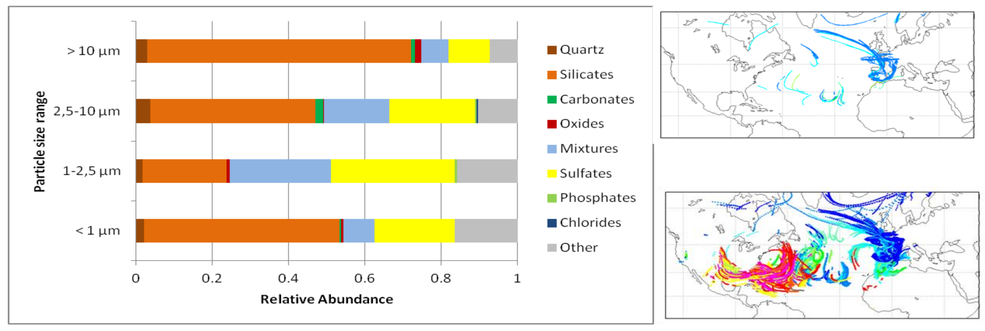

Fig. 9. (left) Aerosol chemical composition for the week 11-18 Oct. 2011; (right top) corresponding aerosol origin for trajectories occurring only within the boundary layer and (right bottom) for the whole troposphere between 500 and 10000m *asl.*

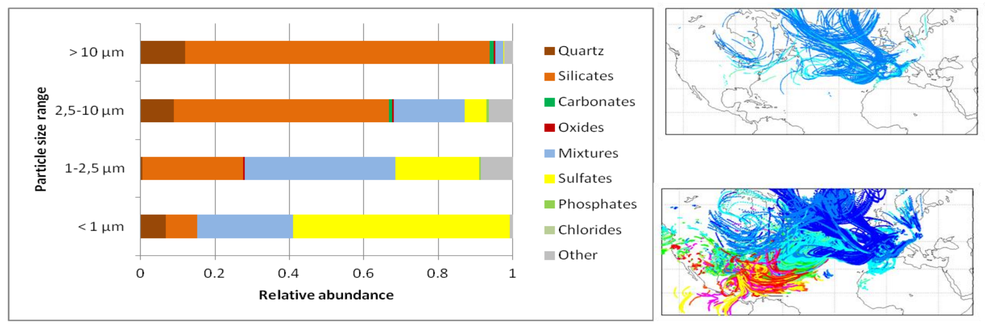

Fig. 10. (left) Chemical Composition for the week 18-25 Oct. 2011; (right, top) corresponding aerosol origin for trajectories occurring within only the boundary layer and (right, bottom) for the whole troposphere between 500 and 10000m *asl.*

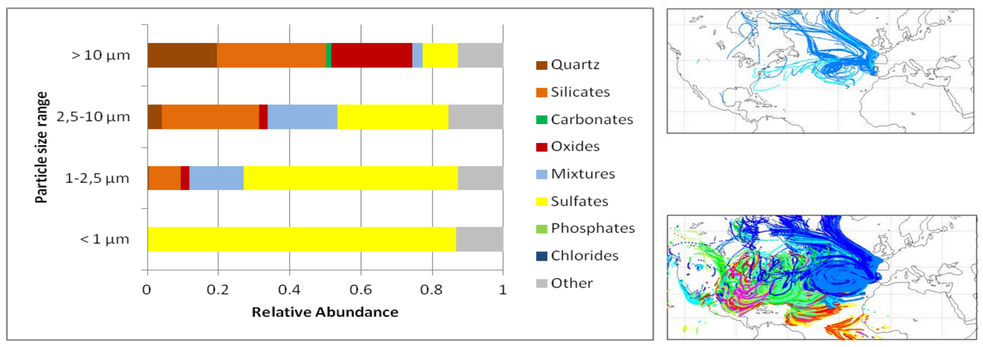

Fig. 11. (left) Chemical Composition for the week 06-13 Dec. 2011; (right, top) corresponding aerosol origin for trajectories occurring only within the boundary layer and (right, bottom) for the whole troposphere between 500 and 10000m *asl*.

Combining aerosol chemical data with trajectories, 3 distinct patterns can be distinguished. Fig. 9 serves as an example where the chemical composition is all size classes varies only slightly. In contrast, Figs 10 and 11 show how the quartz and silicate fraction increases with size whereas the sulfate fraction increases in the smaller size classes. However the sample of Fig. 11 has much more oxides at the expense of silicates and quartz than the sample of Fig. 10.

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