

# Particulate Matter Measurements at the Akrotiri Research Station

M. Lazaridis<sup>1</sup>, A. Voulgarakis<sup>1</sup>, T. Glytsos<sup>1</sup>, I. Kopanakis<sup>1</sup>, M. Latos<sup>1</sup>, E. Katsivela<sup>2</sup>,  
Ø. Hov<sup>3</sup>, P. Grennfelt<sup>4</sup>, M. Kulmala<sup>5</sup> and K. Tørseth<sup>6</sup>

## Introduction

- ◆ Many studies suggest association between exposure to particulate matter and the resulting health effects.
- ◆ Mediterranean Sea constitutes an area where atmospheric particles originating from continental natural and anthropogenic sources (for example forest fires), marine sources and gas-to-particle conversion simultaneously exist.
- ◆ Transport of Sahara dust occurs mostly during the spring and summer and causes non-continuous crustal aerosol pulses to the Mediterranean area.
- ◆ The meteorological conditions in the Mediterranean area are also quite influential for the Central and Southern European weather.
- ◆ Most of the studies on the chemical composition on Mediterranean particulate aerosol have been conducted in the western and north-west region. However relatively few studies have been undertaken in the southern part of eastern Mediterranean and Greece.
- ◆ On this basis continuous aerosol measurements are started during 2003 at the Akrotiri research monitoring station on the island of Crete (Greece).

## Objective

In this work we study the  $PM_{10}$  and  $PM_{2.5}$  ambient levels and the influence of African dust outbreaks on the particulate matter concentration.

## Methodology

### Location:

- ◆ The place of the measurements (Akrotiri station) of particulate matter ( $PM_{10}$  and  $PM_{2.5}$ ) is at a rural station on the island of Crete, Greece, mid-distance between Athens and the northern African coast (Figure 1).
- ◆ The Akrotiri station (35° 31' N, 24° 03' E) is a coastal site eastward of Chania at an elevation of 180 m.
- ◆ The region of interest includes parts of the southern Greece which is consistent mainly from marine environments and islands. The main urban and industrial areas are located along the coastal of the Greek mainland. The region is characterized from a complicated topography combined with strong winds, long sunny and humid periods.



Figure 1: Geographical location of the Akrotiri research station on the island of Crete.

### Measured parameters and Measurement periods

Measured parameters	$PM_{10}$	$PM_{2.5}$
Measurement periods	15/04/2003 – 10/03/2004	10/03/2004 – 31/05/2005

### Instrumentation:

Automatic beta radiation attenuation monitor (FH 62 I-R)

## Results

- ◆ Daily average  $PM_{10}$  concentrations.
- ◆ The average value for the whole period is  $35.1 \mu\text{g}/\text{m}^3$ .
- ◆ There is a large variability of the  $PM_{10}$  values mainly during the summer period with concentrations up to  $80\text{--}90 \mu\text{g}/\text{m}^3$ .
- ◆ During the winter period the  $PM_{10}$  concentrations are in general lower and the variability smaller (Figure 2).

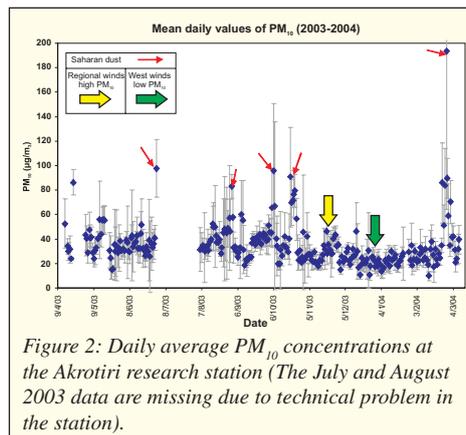


Figure 2: Daily average  $PM_{10}$  concentrations at the Akrotiri research station (The July and August 2003 data are missing due to technical problem in the station).

### Some considerable days

- ◆ Although during the winter period the  $PM_{10}$  concentrations are in general lower, on the 27/02/2004 a major Sahara dust events leads to an average  $PM_{10}$  level of  $193.2 \mu\text{g}/\text{m}^3$ .
- ◆ The lowest observed  $PM_{10}$  value during the measurement period was on 13/02/2004 ( $10 \mu\text{g}/\text{m}^3$ ) during a storm event.
- ◆ High  $PM_{10}$  concentrations were also associated with elevated  $O_3$  levels at the station during regional transport from Central Europe (for example the period from 15/11/2003 until 05/12/2003).

### Mean monthly values of $PM_{10}$

- ◆ High aerosol concentrations were observed during the whole measurement period with an average concentration for October 2003 equal to  $45.8 \mu\text{g}/\text{m}^3$  (Figure 3).
- ◆ The reason for the elevated concentrations during some months as for example October 2003 is the outbreak of a number of Sahara dust episodes in the area of the station.

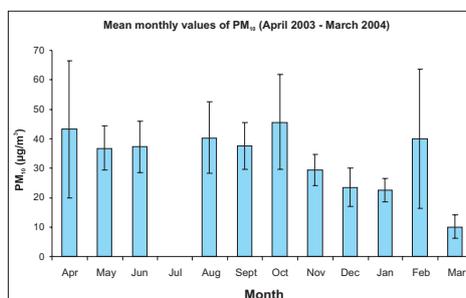


Figure 3: Mean monthly  $PM_{10}$  concentrations during April 2003 – March 2004 at the Akrotiri research station.

### Daily average $PM_{2.5}$ concentrations

- ◆ The average  $PM_{2.5}$  concentration during the measurement period is  $27.23 \mu\text{g}/\text{m}^3$ .
- ◆ There are some days where the  $PM_{2.5}$  concentration reached high values which correspond to Sahara dust episodes in the area (Figure 4).

1. **Technical University of Crete**, Department of Environmental Engineering, Polytechnioupolis, Chania 73100, Greece
2. **Technological Educational Institute of Chania**, 73100 Chania, Greece
3. **Norwegian Meteorological Institute (met.no)**, P.O. Box 43 Blindern NO-0313 Oslo, Norway
4. **The Swedish Environmental Research Institute (IVL)**, Gothenburg, Sweden
5. **University of Helsinki, Dept. Physics**, FIN-00014 Helsinki, Finland
6. **Norwegian Institute for Air Research (NILU)**, P.O. Box 100, 2027 Kjeller, Norway

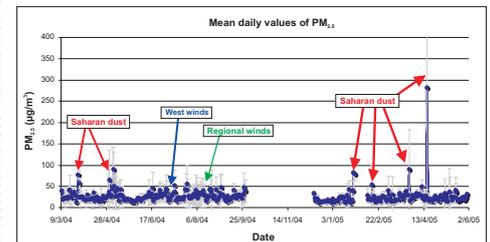


Figure 4: Daily average  $PM_{2.5}$  concentrations between 10/03/2004 – 31/5/2005.

- ◆ The last Sahara dust episode was very intense with a considerable reduction in the visibility. At 17:45 h on 17/4/2005 the  $PM_{2.5}$  concentration reached the  $780 \mu\text{g}/\text{m}^3$ .
- ◆ In general,  $PM_{2.5}$  concentrations are lower during the winter period (Figure 5).

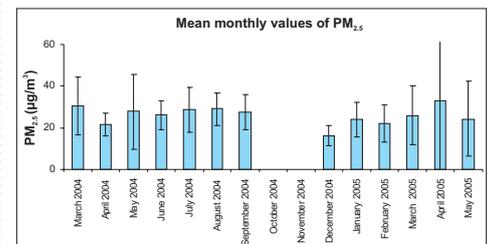


Figure 5: Mean monthly  $PM_{2.5}$  concentrations during March 2004 – May 2005 at the Akrotiri research station (Crete).

## Conclusions

- ◆ The ambient  $PM_{10}$  and  $PM_{2.5}$  concentrations at the Akrotiri research station on Crete (Greece) show a large variability.
- ◆ It is observed elevated concentrations during Sahara dust episodes whereas low  $PM_{10}$  and  $PM_{2.5}$  concentrations events occur during in winter storm episodes and transport originating from the west Mediterranean sea and the Atlantic region.
- ◆ Sahara dust episodes are observed during all the year.