Monitoring of regional background atmospheric pollutants in Majorca (Spain): surface measurements

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INTRODUCTION

Atmospheric aerosols and gaseous pollutants measured at regional background (RB) sites are the result of a number of atmospheric transformations, transport mechanisms and source origins. In order to asses the climatic and environmental effects of these atmospheric pollutants, scientific investigations at RB locations are needed in order to avoid direct influence of local anthropogenic emissions.

In the context of the ChArMEx (Chemistry-Aerosol Mediterranean Experiment) initiative, an existing RB monitoring site in the Majorca Isle has been implemented with additional instrumentation to fulfil most of the objectives of the project: a complete chemical characterization of the atmospheric aerosols and the identification of their main sources; the assessment of the levels of gaseous pollutants and atmospheric aerosols in different particles sizes; and the quantification and chemical characterization of the deposition fluxes are the main objectives of the ongoing sampling.

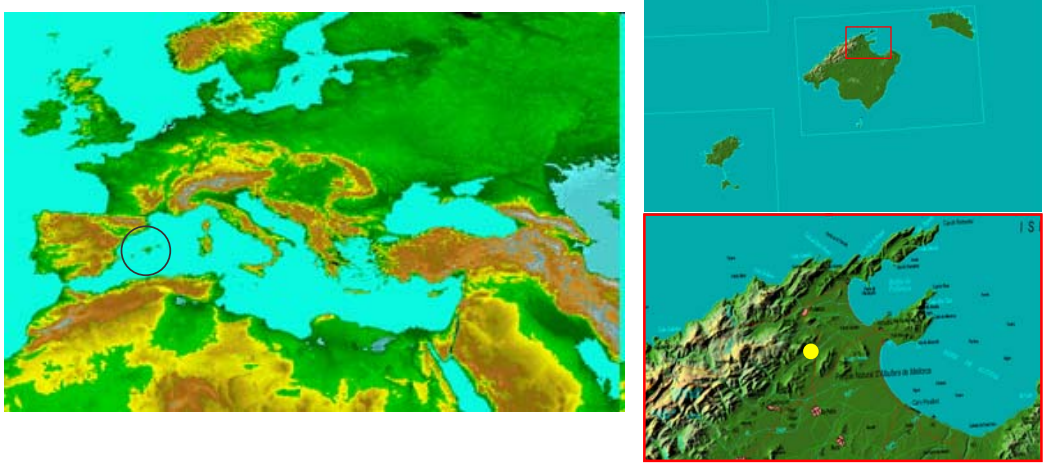
METHODS

1) Inlet for gaseous sampling. SO_2, NO, NO_2, O_3 with conventional instrumentation

2) GRIMM optical particle counter to determine real-time levels of PM_{10}, $PM_{2.5}$ and PM_1

3) Inlet for the new BETA absorption monitor to register real-time PM_{10} concentrations

4) Sequential high-volume sampler MCV for PM_{10} collection on quartz micro-fiber filters (PALLFLEX)



5) Automatic collector of dry and wet deposition of atmospheric particles.

6) 10-meters above-ground meteorological tower for wind direction and velocity. Also with T and Pressure sensors

Monitoring site operative since 1997.
PM_{10}, $PM_{2.5}$, PM_1 levels measured continuously since January 2010.
PM_{10} samples from 18/01/2010. Currently, 27 valid samples (24-hours) have been collected.
Deposition sampling (weekly) planned to start at the end of May-beginning of June.

PRELIMINARY RESULTS

Table 1. Mean monthly concentrations of PM_{10}, $PM_{2.5}$, PM_1 (uncorrected data), SO_2, NO, NO_2, O_3, temperature and accumulated precipitation recorded at Can Llompart in 2010. All units in µg m^{-3}, except for T (ºC) and precipitation (mm).

	PM_{10}	$PM_{2.5}$	PM_1	SO_2	NO	NO_2	O_3	T	Prec
Jan	8	5	3	1.2	1.3	3.9	56	10	181
Feb	9	6	4	1.8	1.5	4.3	69	11	138
Mar	18	11	7	1.3	1.8	3.6	71	12	131
Aprl	10	6	4	1.4	1.5	3.8	79	14	139
May	9	5	3	NA	NA	NA	NA	NA	NA

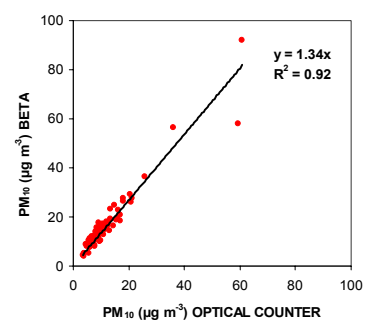


Figure 1. Scatter plot between daily concentrations of PM_{10}, (uncorrected data) registered by BETA and OPTICAL COUNTER monitors at Can Llompart in 2010.

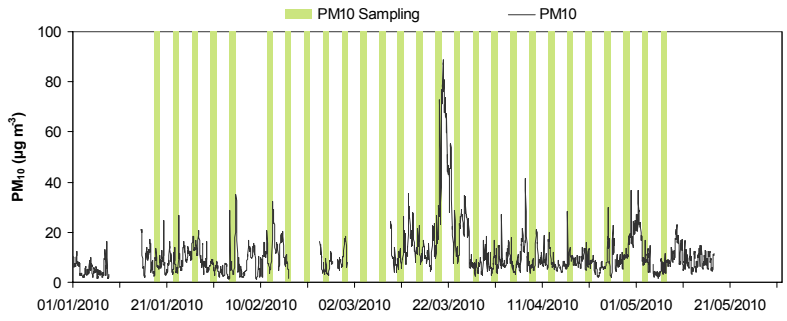


Figure 2. Hourly concentrations of PM_{10}, (uncorrected data) registered by the OPTICAL COUNTER monitor at Can Llompart in 2010. Shadowed green-bars indicate the 24-hour PM_{10} valid sampling.

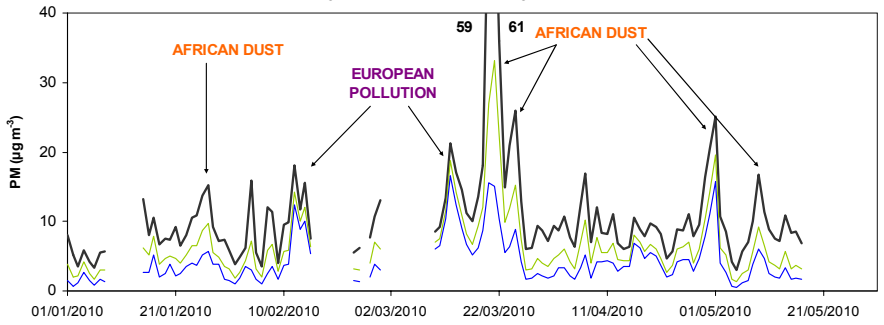


Figure 3. Mean daily concentrations of PM_{10}, $PM_{2.5}$, PM_1 (uncorrected data) recorded at Can Llompart in 2010. African dust outbreaks and European pollution events are indicated with arrows.

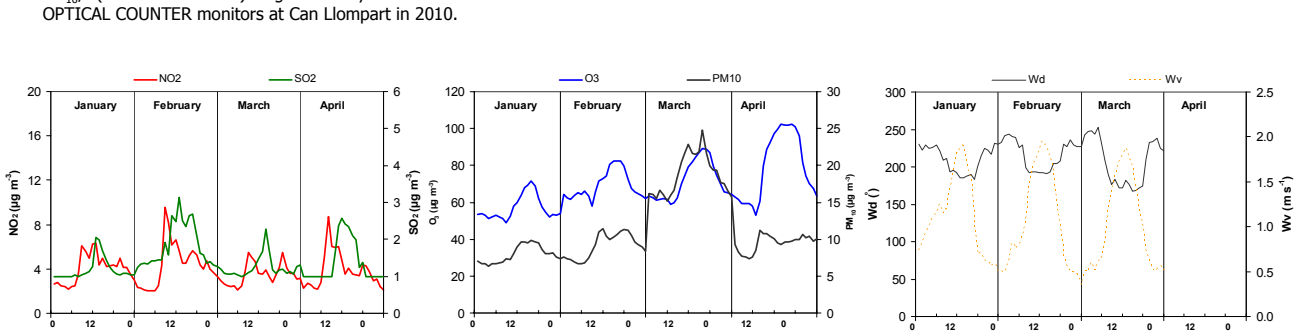


Figure 4. Mean monthly cycles of: NO_2 and SO_2; PM_{10} (uncorrected data) and O_3; wind direction (Wd) and wind velocity (Wv) recorded at Can Llompart in 2010.

I. The preliminary results obtained during the first 4-months of study reveal that the concentrations of the different atmospheric pollutants fall in typical values of regional background sites in the Western Mediterranean (*Querol et al., 2009*).

II. Mean levels of PM_{10}, $PM_{2.5}$ and PM_1 were 14, 9 and 6 µg m^{-3}, respectively. Mean levels of SO_2, NO, NO_2 and O_3 were 1.4, 1.5, 3.9 and 65 µg m^{-3}, respectively.

III. Daily interpretation of the origin of air masses allowed the identification of different PM episodes. African dust outbreaks increased markedly PM_{10} levels; whereas European pollution plumes noticeably increased PM_1 concentrations.

IV. 27 PM_{10} valid samples have been collected, in which gravimetric determinations have been conducted. After that, these samples will be subjected to different analytical procedures (*Pey et al., 2009*) in order to ascertain the concentrations of major and trace elements including particulate Hg; soluble anions and cations; total, organic and elemental carbon.

V. Hourly evolution of gaseous pollutants and particulate matter concentrations is clearly controlled by the wind regime. A southern component is patent during the daylight hours, bringing PM, O_3 and slight concentrations of SO_2. Western winds prevail from late afternoon to early morning.

VI. Fresh emissions of NO_2 (increasing the background levels 2-5 µg m^{-3}) are evident in the morning rush hours (at 08:00 UTC), but they do not affect significantly the PM mass.

VII. As regards for the preliminary results, the monitoring site selected in Majorca seems to represent the regional background of the North-Western Mediterranean.

VIII. Instrumentation for measuring optical properties of the aerosols will be probably installed soon.

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