Variations of PM_{10} and its relationship with ^{7}Be and ^{210}Pb measurements at Malaga (Southeastern coast of Spain)

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Levels of particulate matter fraction PM_{10} were monitored between 2009 and 2011 in Málaga (Spain). PM_{10} concentrations were measured at "Carranque" station by the beta attenuation method. This station is one of the Atmospheric Pollution Monitoring network managed by the Environmental Health Service of the Andalusian Government.

Weekly ^{7}Be and ^{210}Pb concentrations in air were continuously monitored (4º 28' 4" W; 36º 43' 40"N) with a high-volume air sampler (ASS-500C). This sampler uses polypropylene square filters (44 x 44 cm^2) with a collection efficiency 93-99%, at a flow rate of 90,000 L min^{-1}. Measurements by gamma-spectrometry were performed to determine the activities of the samples using an intrinsic REGe detector.

Long-term measurements of cosmogenic radionuclides such as ^{7}Be provide an important data in studying global atmospheric processes and comparing environmental impact of radioactivity from man-made sources to natural ones. On the other hand, ^{210}Pb is produced by radioactive decay from its progenitor, ^{222}Rn, which emanates primarily from land surface. Therefore, ^{210}Pb in the air is an effective tracer of the continental surface air mass. The variation of the data with time was studied by time series analyses and seasonal patterns were identified. The study of air back-trajectories were computed by means of the Hybrid Single-Particle Lagrangian Integrated Trajectories (HYSPLIT) trajectory model (Draxler, 1994) using meteorological data supplied by the US National Climatic Data Centre.

Table 1 provides arithmetic mean (AM) and related statistical information such as geometric mean (GM), standard deviation (SD), variation coefficient (CV), maximum (MAX) and minimum (MIN) values.

Table 1. Statistical parameters of the different measurements.

	AM	GM	SD	CV(%)	MAX	MIN
^{7}Be (mBq/m^3)	5.1	4.8	1.7	34.7	10.2	2.1
^{210}Pb (mBq/m^3)	0.55		0.31		2.04	0.1
PM_{10} ($\mu g/m^3$)	40.3	37.8	14.3	35.5	86.3	17.4

The concentration data of ^{7}Be, ^{210}Pb and PM_{10} with meteorological variables were correlated to understand the weekly variation of these radionuclides in air. This study has shown that ^{7}Be and PM_{10} are associated with different sources in Málaga and they may reach high concentrations simultaneously. The reason for this is the concurrent occurrence of subsidence processes over North Africa (resulting in the downward transport of ^{7}Be from the mid-troposphere) and the suspension of mineral dust over desert region with a subsequent transport to Málaga. Additionally, in order to simplify the analysis, the events have been grouped into: (a) High PM_{10} and ^{210}Pb concentrations with low ^{7}Be concentrations; (b) High PM_{10} and ^{210}Pb concentrations with high ^{7}Be concentrations; (c) Low PM_{10} and ^{210}Pb concentrations with low ^{7}Be concentrations.

Several events of high ^{7}Be concentrations are mainly caused by downward transport of ^{7}Be from the mid-troposphere at mid-latitudes. The meteorological situation was characterised by an Atlantic anticyclone system with a low-pressure area over central European North Atlantic. High ^{7}Be concentrations were also found associated with low aerosol mass concentrations. These values were attributed to downward transport from mid-to-upper troposphere over the North Atlantic. The meteorological situation was characterised by a south Europe anticyclone located in the South Atlantic Ocean that favoured the development of a blocking system with a low-pressure area over north Europe. Under these conditions, a slanting stratospheric air mass can penetrate into the troposphere (Hernández et al., 2008). The distribution of ^{210}Pb in the atmosphere show both spatial and temporal variations depending on the geographical location, atmospheric circulation and scavenging processes. High concentrations for ^{210}Pb are obtained with air masses from the Sahara area.

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