AEROSOL CONCENTRATIONS AT TWO HEIGHTS (2550 AND 650 M ASL) IN SE SPAIN

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The simultaneous aerosol sampling at two heights in southern Spain may provide valuable information on the vertical structure of the dust transport from North Africa to the Iberian Peninsula. It also allows the characterization of the ambient air at two sites with distinct anthropogenic impact. This work presents the results obtained from the first field campaign of the FRESA project (Impact of dust-laden African air masses and of stratospheric air masses in the Iberian Peninsula. Role of the Atlas Mountains), performed in the period July-November 2017 at El Albergue Universitario in Sierra Nevada (2550 m a.s.l.) and the city of Granada (650 m a.s.l.). The two sites were instrumented with a low-volume sampler with PM10 inlet for daily sampling and mass and chemical composition characterization, a high-volume sampler for total suspended particles (TSP) for weekly sampling and radionuclide activity determination, and with a GRIMM 365 optical particle counter that provides continuously the aerosol size distribution.

In Sierra Nevada, daily PM10 concentrations range from 0 to 100 μg m^{-3} depending mainly on the origin and features of the air masses that reach this high-elevation site. Levels overpassed 50 μg m^{-3} on 5 days and were lower than 20 μg m^{-3} on 90 days. The impact of dust-laden African airflows is particularly intense as dust is transported in most of the cases within well-defined low mid-tropospheric layers. The associated episodic concentrations largely exceed 40 μg m^{-3}. In turn, clean subsiding airflows associated to the polar jet strongly reduce concentrations.

In Granada, daily PM10 concentrations are moderately high with values generally between 20 and 40 μg m^{-3} before the first snows fall over Sierra Nevada. Levels were over 50 μg m^{-3} on 2 days while they were lower than 20 μg m^{-3} on 32 days. The highest concentrations do not reach the peaks found at Sierra Nevada. The impact of anthropogenic aerosols of local origin, which are accumulated on high-stability conditions, and also of regional origin (both from the Mediterranean and from the SW Iberian Peninsula) is significant. The contribution of African dust outbreaks superimposes to concentrations in the ambient air and in some events the increase is observed one day after African dust impacts Sierra Nevada. After the first snows over Sierra Nevada, PM10 levels drop and only accumulation periods or African dust events increase concentrations to those before the first snows.

Back-trajectories (96-hour, calculated with HYSPLIT using ERA-Interim data of 0.5 degree resolution) show that air flows are quite often decoupled at the two altitudes. Dust-laden African flows reached Sierra Nevada on 33 days; of these, dust was advected poleward over the Atlas near the Algerian-Moroccan border on 19 days and on the remaining 14 it followed a pathway over the Atlantic close to the Moroccan coast. However, only on 3 days air masses of African origin reached Granada. In turn, airflows reaching Granada passed previously over the western Mediterranean Sea on 32 days while only on 3 days Mediterranean flows reached Sierra Nevada. Moreover, the residence time over northern Africa of the air parcels reaching Sierra Nevada while at the same time parcels reaching Granada resided over the Mediterranean is 11,338 hours during the study period. In contrast, the residence time when those reaching Granada resided over Africa is only of 56 hours. This implies that during African dust outbreaks the air masses reaching the study area at the lowest levels do not have African origin but have resided over the Mediterranean. Chemical analysis of the PM10 samples (in progress) while provide the first direct experimental evidence of this fact.

The diurnal pattern of both PM10 and particle number concentrations at Granada presents the two typical peaks. Particle concentrations are smaller in winter than in summer, even though in winter the atmospheric boundary layer is shallower and domestic heating is used. Much higher concentrations of coarse (supermicronic) particles are found in summertime during the course of the day. Finer (submicronic) particles present a stronger morning peak (centered about 10 LT) in winter and also concentrations are slightly higher at about 20-21 LT, being quite similar the rest of the day in winter and summer.

A number of distinct episodes can be identified: strong African dust impact at Sierra Nevada while Granada is heavily polluted by anthropogenic aerosols (1 August 2017); strong African dust impact at Sierra Nevada which is observed the following day in Granada (15-16 August 2017); African dust outbreaks impacting simultaneously both sites (25 November 2017); episode of accumulation of pollutants at Granada whilst very low concentrations are registered at Sierra Nevada (19-24 November 2017); and fair air quality at both sites (16 September 2017).