Comparison of particle concentrations obtained at urban and regional background environments

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The study focuses on characterizing the particle number concentration registered at a regional background station (RS) and comparing it with the one obtained at an urban background site (US).

The stations are inside the province of Alicante in southeastern Spain. This region belongs to the Western Mediterranean Basin. RS (38°39´N; 0°16´W; 1558 m a.s.l) is located on top of a mountain range, in a military area (EVA nº 5) of the Ministry of Defence, 25 km from the Mediterranean coast. The station is located specifically at the named "Aitana peak". US (38°16´N; 0°41´W; 95 m a.s.l), is located in the city of Elche, 12 km from the coast. Specifically, the measurement site is placed on the roof of a building at the Miguel Hernández University, approximately 15 m a.g.l. The study period comprised from October 2011 to September 2012. The instruments used to measure particle concentrations were two optical counters. The instruments permit the determination of a fraction of fine mode (from 0.25 to 1 μm) and the coarse mode particles (size >1 μm).

Table 1 shows monthly and global average values of the coarse and fine particles at RS and US. Regarding the fine particle concentration at US (N_{FUS}), the winter and summer months were when the highest levels were registered. N_{FUS} obtained an absolute peak during August. The coarse particle concentration at US (N_{CUS}) showed a clear discontinuity between the colder months (November-March), with values below 0.15 cm^{-3}, and the warmer ones, in which the concentration became three times higher with a maximum in June (0.57 cm^{-3}).

Table 1. Monthly average values (cm^{-3}) of fine and coarse particles at RS and US.

Month	N_{FUS}	N_{FRS}	N_{CUS}	N_{CRS}
Oct-11	136.92	61.47	0.34	0.23
Nov-11	99.49	n.d	0.15	n.d
Dec-11	92.11	18.72	0.11	0.14
Jan-12	125.89	24.90	0.14	0.06
Feb-12	101.92	59.80	0.13	0.12
Mar-12	133.94	83.68	0.15	0.24
Apr-12	73.36	31.93	0.37	0.16
May-12	86.79	45.83	0.43	0.30
Jun-12	104.81	57.51	0.57	0.72
Jul-12	115.05	96.41	0.31	0.63
Ago-12	139.71	69.41	0.44	0.86
Sep-12	137.38	75.43	0.30	0.30
Annual	112.28	54.95	0.29	0.33

At RS, the fine particles showed a similar monthly tendency as the one seen at US. Fine particle concentration at RS (N_{FRS}) obtained maximum levels during the warmer period (from July to September). Although slightly lower than in summer, N_{FRS} showed high values during February and March as well. N_{FRS} made up between 20 and 85% of N_{FUS}. This percentage varies according to the season, with minimum values in January and February and maximum values in spring and summer. The annual average was: $N_{FRS}=0.5 \cdot N_{FUS}$. The coarse particle concentration at RS (N_{CRS}) was quite higher during summer than the rest of year. Standing out in a significant way as $N_{CRS}>N_{CUS}$ during summer-time. It is likely to due to between June and August the 55% of days were affected by Saharan dust outbreaks and these air mass entrances affected more at RS than at US. For this reason, N_{CRS} annual average value was slightly higher than N_{CUS} one.

In Fig. 1 we can compare the particle size distributions obtained at RS and US. The distributions are calculated for the colder (December-January and February) and warmer (June-July and August) months.

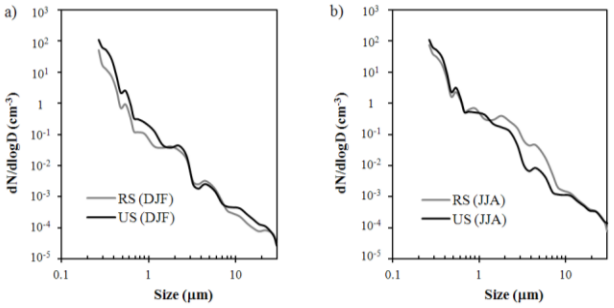

Figure 1. Average number size distributions obtained at RS and US during: a) cold months; b) warm months.

In general, the size distributions at both stations during the cold period (Fig. 1a) were quite similar, although the particle number concentration up to 2 μm registered at US was higher. In the warm months (Fig. 1b), we observe two differences with respect the distributions obtained in winter. First, the particle concentration difference in the accumulation mode particles between RS and US decreased, although the concentration at US remained slightly higher. On the other hand, the particle concentration in coarse mode up to 10 μm was higher at RS, establishing the major difference in the range 3-5 μm as a result of the significant impact of Saharan dust outbreaks at RS.

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