

Differences between inorganic ion concentrations in an urban and a remote background station

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Two different locations were chosen for the present study. The first location is the city centre of Elche (235,000 inhabitants), approximately 12 km from the Spanish Mediterranean coast. The sampling point is situated in a busy canyon street with a lot of traffic. The device was placed 3 m above ground level on the first floor of a City Hall building. The other location is at the top of the Aitana mountain range (38°38'56.50"N, 0°15'55.23"W, ▲1558 amsl.). It is located approximately 60km from the city of Elche and 20 km from the Mediterranean coast in an east westerly direction. Twenty-four hour PM1 samples were collected approximately every three days from February to October 2012 using a low volume sampler (2.3m/h). The set of samples (around 168 samples in each site) collected was analysed for inorganic ions in our facilities at the Miguel Hernandez University with Dionex chromatographs with the method described by Nicolas et al. (2009).

Period mean, seasonal averages and daily maximum and minimum concentration values are presented from both sites during the study period (Table 1 and 2), for the main inorganic ions. From all the ions analyzed, only those with a high percentage of data above the mdl have been chosen for this study.

Table 1. Statistics and seasonal evolution of main inorganic ions in Aitana ($\mu\text{g}/\text{m}^3$)

	NO_3^-	SO_4^{2-}	$\text{C}_2\text{O}_4^{2-}$	NH_4^+
Mean	0.11	0.87	0.07	0.33
%<mdl	26	2	2	8
Std. Dev.	0.16	0.64	0.05	0.26
Max	1.17	3.16	0.35	1.44
Min	0.02	0.02	0.0002	0.01
Summer	0.05	1.20	0.08	0.44
Autumn	0.25	0.66	0.11	0.16
Winter	0.18	0.45	0.04	0.19
Spring	0.09	1.02	0.07	0.39

As can be seen, Aitana ion concentration is very low for all the ions. The highest concentration was found for the sulphate ion, with higher concentrations during spring and summer than in winter due to a higher photochemical activity. In contrast, nitrate levels were very low during the entire study. The levels in summer are negligible, being higher during winter and autumn. This is due to the thermal decomposition of ammonium nitrate at high temperatures. The nitrate concentrations measured in the Aitana station are remarkably low, despite being located close to important cities such as

Benidorm (a coastal city which is highly populated during summer months, is located less than 20km away). Ammonium ion concentrations are also remarkable, showing a high correlation with the sulphate ion concentrations. This highlights the presence of ammonium sulphate. This compound and the organic matter are the main constituents of the PM1 Aitana aerosol.

Table 2. Statistics and seasonal evolution of main inorganic ions in Elche ($\mu\text{g}/\text{m}^3$)

	NO_3^-	SO_4^{2-}	$\text{C}_2\text{O}_4^{2-}$	NH_4^+
Mean	0.48	1.99	0.15	0.77
%<mdl	2	0	5	0
Std. Dev.	0.88	1.47	0.07	0.65
Max	8.66	10.42	0.49	4.51
Min	0.07	0.22	0.04	0.05
Summer	0.18	2.60	0.17	0.88
Autumn	0.47	1.62	0.12	0.59
Winter	0.53	1.83	0.15	0.71
Spring	0.26	2.32	0.16	0.88

In table 2, the same results are present for the urban traffic station ions in Elche. The ions with higher concentrations are sulphate and ammonium. On the contrary the presence of nitrate is not negligible in this station, showing a higher concentration in winter. The correlation between sulphate and ammonium ions is high, especially during the summer months whereas during winter, the presence of ammonium nitrate is observed during high atmospheric stability episodes. Potassium ion is also measured in the urban city but without a clear origin and seasonal evolution.

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