Influence of Saharan dust in deposition fluxes of nutrients in Spain

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The mineral dust deposition, originated from the African dust outbreaks episodes, influences largely in deposition fluxes of metal nutrients in Southern Europe (Avila, 1996) and oceanic regions (Arimoto, 2001). The low precipitation in the Mediterranean basin favours the long residence time of dust in the atmosphere with the consequent impact on air quality and in atmospheric deposition. Recently, more studies are coming out about the impact of dust from deserts on health. An association between the increase of hospital admissions (respiratory and cardiovascular causes) and days with Saharan dust episodes (Perez et al., 2008) shows the evidence of the importance of these natural episodes in areas closely to Sahara desert.

Most studies that quantify the Saharan dust deposition have only measured the soluble fraction. In this study we compare the fluxes both in the soluble and insoluble fractions for the wet and dry deposition at two sites located at different distances from North Africa. One sampling site was in a rural area of the North-eastern of the Iberian Peninsula, in the Montseny Mountains (MSY) at 40km NNE from Barcelona. The other site was in the city of Santa Cruz de Tenerife (SCO) in Canary Islands.

The atmospheric deposition fluxes depend of the concentration of suspended particulate matter (SPM) in the atmosphere. In SCO where SPM levels were 3.3 times higher than in MSY, for the same period, the total annual deposition levels registered was up 29 g/m^2 while in MSY was up 20.9 g/m^2 (Table 1).

Table 1. Annual deposition levels (g/m^2) both in soluble and insoluble fractions in wet and dry deposition.

		soluble	insoluble	Total
MSY	DRY	2.9	4.3	7.2
	WET	8.0	5.7	13.7
	TOT			20.9
SCO	DRY	6.7	10.4	17.1
	WET	6.8	5.1	11.9
	TOT			29.0

It´s highly remarkable the dependence of climatology in the deposition fluxes. In MSY with an annual mean precipitation of 800-1000 l/m^2, 65% of SPM deposited was by wet deposition mode. In SCO with an annual mean precipitation of 200 l/m^2 was 41%. However, total wet deposition amounted to 13.7 g/m^2 in MSY and 11.9 g/m^2 in SCO (Table 1). The relatively high fluxes registered in SCO by wet deposition were accounted largely by the high sea spray contribution at this coastal site (being this 62% of the total mass, Na^+ and Cl^-) and the dust transported from Sahara and Sahel deserts (Ca^{2+} was 20% of the total mass). .

By contrast, dry deposition registered major annual levels in SCO than in MSY by a factor of 2.4, with 17.1 g/m^2 in SCO against 7.2 g/m^2 in MSY (Table 1). This is the result of the sea spray contribution (46% of total mass) and the high influence of the African dust outbreaks above the Islands (Ca^{2+} reaches 32%) under the quasi-permanent dry meteorological conditions in the Canary Islands. The vast amount of dust transported from Sahara and Sahel deserts into Atlantic Ocean generate elevated dry deposition fluxes of mineral dust to the surface.

Calcium presents the highest contribution in MSY and SCO. In MSY, with high precipitation and low levels of SPM, Ca^{2+} contribution is similar in wet and dry deposition and more elevated in the soluble fraction. In SCO, with low precipitation, high SPM levels and an elevated influence of African dust outbreaks, Ca^{2+} dominates in dry deposition, and is higher in the insoluble fraction.

Sodium content (originated by sea spray) is the second highest contribution in SCO (high sea spray emission rate in Atlantic Ocean) but not in MSY (low emission rate in Mediterranean Sea). Moreover, due to the high solubility of this species, the major contribution is in the soluble fraction, which is the dominant fraction (both in wet and dry deposition) at SCO.

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