Characterization of mineral dust aerosols: emphasis on columnar microphysical properties and surface mass concentration

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To go further in the characterization of desert dust (DD) aerosols in the Western Mediterranean Basin, their fingerprints on optical and microphysical properties are investigated between 2003 and 2014 in the North-Central Iberian Peninsula. This study is based on a DD inventory which allows a classification of the DD episodes in two different categories (purer, "D" and mixed, "MD") and highlights the relevance of the jointly interpretation of surface and columnar aerosol data (Cachorro *et al.*, 2016). The main columnar properties (obtained from Palencia site of AERONET network) deeply analysed in this study are aerosol optical depth (AOD), Ångström exponent (AE), volume size particle distribution (VSPD), total and fine volume concentration (VC_T and VC_F, respectively), and sphericity. Relationships between some of these quantities are established (see Figures 1a and 1c). Moreover, some of these columnar properties are also faced to surface quantities (obtained from EMEP network in the nearby site of Peñausende) such as particle mass concentrations PM_{10}, $PM_{2.5}$ and their ratio (see Figures 1b and 1d).

In the VC_F/VC_T analysis, three categories can be distinguished. Those coarse-mode-dominated cases with $VC_F/VC_T \leq 0.2$ present maximum concentration of particles around 2 µm, non-sphericity, stronger absorption power at shorter wavelengths, among others. When the fine mode gains weight, the categories with $0.2 < VC_F/VC_T < 0.45$ and $VC_F/VC_T \geq 0.45$ exhibit aerosol mixtures and thus, there is a larger variability in all studied aerosol properties.

The non-spherical shape of mineral dust aerosols is corroborated (shown in Figure 1). Overall, the mean sphericity during DD episodes is 0.25. When sphericity is plotted against AE, the two categories (D and MD) are clearly differentiated (Figure 1a). This delimitation is slightly vaguer in the case of sphericity vs $PM_{2.5}/PM_{10}$ scatterplot (Figure 1b).

Relationships between AOD and PM_{10} with VC_T are displayed in Figures 1c and 1d. Columnar extinction efficiency is obtained from the relationship between AOD and columnar VC_T and presents a range between 1.7 and 3.7 $\mu m^2/\mu m^3$ for our DD database. The relationships between surface and columnar concentrations provide an estimation of the scale height between 8 and 10km depending on the intrusion type. The knowledge of aerosol microphysical properties are of great interest to reduce the uncertainty associated with the transformation between AOD and PM_{10} quantities.

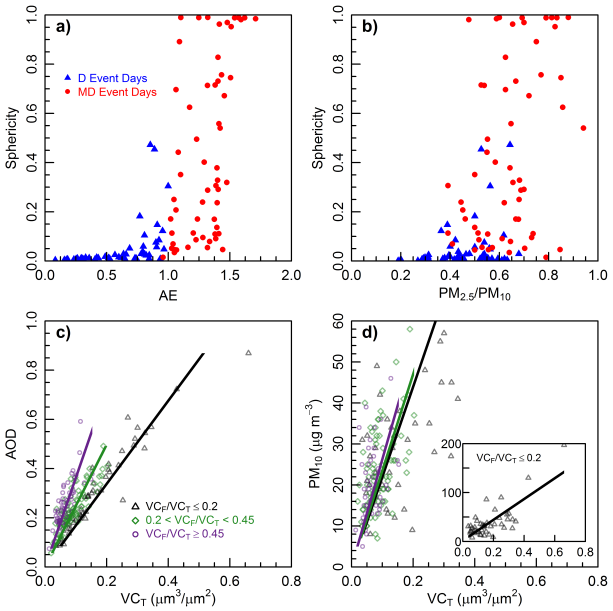

Figure 1. Sphericity vs AE (a) and $PM_{2.5}/PM_{10}$ (b) for two types of DD event days. Linear fits between AOD (c) and PM_{10} (d) vs VC_T for three categories of VC_F/VC_T.

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