Climatology of dust events at Mt. Cimone (2165 m a.s.l.), Italy

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Mediterranean basin is a key area in the climate studies, because of its high vulnerability and temperature rise predictions higher than the global average. Dust aerosol plays an important role in climate system, by affecting the radiation budget of the atmosphere. The optical and microphysical properties of aerosol particles are monitored since 2002 at global GAW station of Mt. Cimone (MTC; 44° 11' N, 10° 42' E). Its location in the Mediterranean region, its physical characteristics (highest peak of the Italian northern Apennines, 2165m a.s.l.), makes it particularly suitable to study the transport of air masses from the north African desert area to Europe.

The monitoring of the aerosol particle number with an optical particle counter (OPC-GRIMM 1108) has shown a mean concentration of 22.9 ± 28.6 # cm^{-3} for fine particles (Dp<1µm) and of 0.19 ± 0.41 # cm^{-3} for coarse particle (1µm<Dp<20µm). Particles number observed with the SMPS (1540 ± 1460 # cm^{-3}) was much higher due to the different size range of two instruments and in the same order that was has been observed at the remote station of puy de Dome (Venzac et al 2008). In addition, the mean scattering coefficient is 21 ± 24 Mm^{-1} and the mean absorption coefficient is 1.5 ± 5.0 Mm^{-1}.

Moreover, the analysis of back-trajectories allows us to make a statistical climatology of the optical and microphysical properties of the aerosol according to the origin of the air masses. We used the Lagrangian model FLEXTRA (Stohl et al 1995) to calculate three-dimensional 6-d back-trajectories (3d-BTJ) arriving at MTC every 6 h (00, 06, 12, 18 UTC).

In order to identify dust transport events (DTE) at MTC, we analysed the variability of number of coarse particles, considered a tracer for mineral dust. The analysis of 3D-BTJ and of transport model (NAAPS) was considered to identify the days characterized by transport of desert dust from North Africa.

We identified 380 DTE, corresponding to 15% of the days at MTC; in these days the coarse particle number is 685% higher than with respect to rest of the time (Fig 1). It can be noted that 65% of DTE occurs in spring and summer.

Regarding the aerosol particle number concentration, the coarse mode showed a spring-summer maximum and a winter minimum. In addition to this, the size distribution of dust particles evolves within the year, with a mean mode diameter higher in winter.

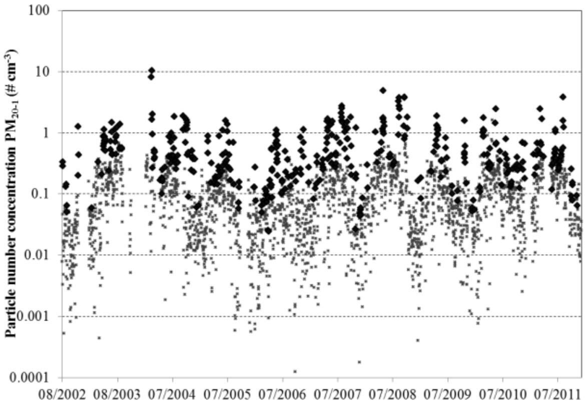

Figure 1. Time series of the coarse aerosol particle number concentrations (# cm^{-3}) at MTC for PM_{20-1}. The black diamond represents the DTE.

The absorption and scattering coefficients in DTE days have been calculated on a seasonal basis, with the aim to study the impact of dust transport on aerosol properties at MTC (Fig.2). It clearly shows an increase of the absorption coefficient in presence of dust, while the scattering coefficient is less affected.

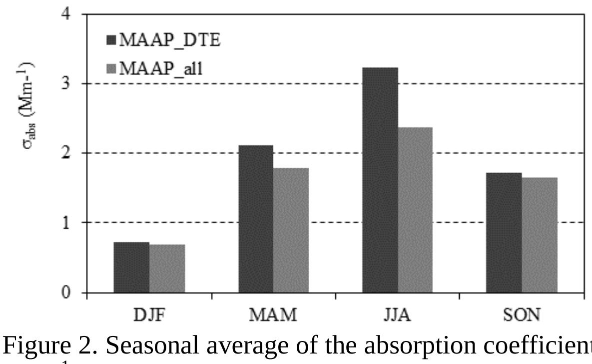

Figure 2. Seasonal average of the absorption coefficient (Mm^{-1}) during the dust events and in the rest of the year 2009 at MTC.

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