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# Measurements of tropospheric aerosol over Rome throughout the period 2006–2009

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The laboratory of the Department of Physics of the University of Rome Sapienza is an interesting site for aerosol studies because it is placed in an urban center where different type of aerosol may be found and where aerosols from anthropogenic activities are produced. Moreover particular synoptic conditions which are not uncommon allow soil dust transported from remote desert areas to contribute to the total aerosol amount.

The seasonal evolution of the tropospheric aerosol vertical distribution and of its optical properties are studied using Lidar and MFRSR (MultiFilter Rotating Shadow-band Radiometer) measurements collected throughout the period 2006–2009 in Rome.

Information on aerosol vertical distribution is primarily derived from Lidar measurements. The Lidar installed at the Department of Physics has been developed to retrieve aerosol and cloud properties in both day and nighttime conditions. Once a single tropospheric Lidar profile is derived, the extinction and backscattering coefficients are calculated assuming that their ratio, the Lidar Ratio, does not depend on altitude. In cloud-free conditions, when the aerosol optical depth derived from MFRSR is available, the Lidar Ratio is directly obtained combining the radiometer measurements with the Lidar profile. Backward trajectories are considered to identify possible aerosol sources in remote regions. The trajectories are estimated using the HYSPLIT4 (Hybrid Single-Particle Lagrangian Integrated Trajectory) Model. HYSPLIT is used to generate five-days back-trajectories for air masses arriving over our site at different altitudes (between 2000 m and 6000 m) for all days of available Lidar measurements. The path of the back-trajectories and other properties, such as rain rate, mixed layer altitude, and surface wind, have been considered to classify the observation days on the basis of different criteria. About 214 days of measurements distributed over more of 3 years, from January 2006 to May 2009 in daylight condition are analyzed. Only cases with aerosol layers neatly separated from clouds are used in this analysis. All measurements carried out in the analyzed period are considered in order to study the seasonal variability of aerosol properties. The annual average occurrence of desert dust is 27% and the maxima have been registered in Spring and in the first part of Summer. The aerosol vertical distribution is influenced by dust events that induce a seasonal behavior on this. Desert dust generally reaches higher altitudes than other aerosol types; the maximum altitude is observed during summer, when the monthly average altitude exceeds 5 km. Non desert aerosols are confined below 3 km altitude throughout the year.

The MFRSR is a seven-band Sun radiometer that measures global and diffuse solar radiation with a broad-band channel for total shortwave radiation and six channels with 10 nm band-pass. For the different channels, the direct irradiances are calculated as the difference between global and diffuse irradiances and are used to derive, by applying the Beer-Lambert law, the total atmospheric optical depth ($\tau$). From the values of the aerosol optical depth is also calculated the Ångström exponent ($\alpha$), that is the negative slope of $\tau$ versus wavelength in logarithmic scale. The distribution of the measurements is characterized by high values of the Ångström exponent, underlying a predominance of fine particle which influence the entire column. Low values of $\alpha$ indicate the presence of large particles, as desert dust, while large values of $\alpha$ are generally linked with the prevalence of small particles, such as urban industrial or biomass burning aerosols.

The monthly average aerosol optical depth at 500 nm and the Ångström exponent processed from MFRSR measurements are also presented. Only measurements collected in clear-sky conditions are included in the data set.