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Some statistical properties of lidar measurements in the Atmospheric Boundary Layer

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We analyzed time series of lidar profiles to investigate the morphology, the evolution and dynamical characteristics of the Planetary Boundary Layer (PBL) using aerosols as tracers of motion. The lidar data provided the temporal evolution of the vertical distribution of aerosols, from the ground up to an altitude of 3 km, with a vertical resolution of 3.75 m and a temporal resolution of 1 s, and were acquired for little more than one hour, during some summer day in a field near Rome. The height of the PBL was computed with the gradient method and the Haar wavelet transform method. We produced profiles of variance, skewness, kurtosis of the fluctuations of the time series of the signal at various altitudes. The fluctuations deviate from a Gaussian distribution within the PBL, while are Gaussian in the free troposphere. The power spectra in the diurnal PBL scales as $f^{-5/3}$ and the autocorrelation is not zero, with an integral time scale between 20 and 40 s. This suggests that part of the inertial subrange can be detected and the turbulent fluctuations can be resolved. The study of the structure functions at various altitudes showed a pattern consistent with the presence of turbulence.