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Statistical analysis of the atmospheric aerosol size distributions and complex refractive index from the AERONET data-set.

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The important role played by the aerosol in the Earth radiative balance and their interaction with the human life, frequently harming human health, requires the need of an ever greater and accurate knowledge on their characteristics and of the processes in which they are involved. These processes depend on optical and microphysical proprieties of the particles and on their spatial distribution.
Currently, the best way to investigate the space-time distributions of atmospheric particles optical properties is linked to the use of range resolved lidar technology, however the retrieval of the aerosol microphysical properties from their optical properties is still a challenge depending on the application of inverse methods and on the choice of additional information.
This work proposes a statistical study of the aerosol particle size distributions and of their complex refractive index as available from the international network of sun-photometers AERONET project dataset, in order to identify microphysical and optical properties of different typologies of particles . A non-secondary objective of this study concerns the possible use of the statistical analysis in the development and validation of methods of inversion of lidar signals. Several AERONET stations located in different part of the Earth have been selected; a consistent number of them have been chosen in a random way. On the contrary, another huge part of data was chosen to underline the contribution of three different kinds of particles source (Desert Dust, Marine and Volcanic Ash). For each station, eight data set has been taken referred to two days for each season.
A three-modal lognormal distribution has been chosen to parameterize the particles size distributions from AERONET and the lognormal standard parameters (Area, Mode and Geometrical Standard Deviation) for each mode of the distributions have been found. The real and the imaginary parts of the complex refractive index are retrieved as daily averaged values at the wavelengths corresponding to the sky radiance measures.
The statistical distribution of each of the three modal-lognormal distribution parameters as well as of the complex refractive index has been retrieved and the statistical correlations between them have been determined. As a consequence several relationships between parameters of the modal distributions, refractive index and optical parameters of the atmospheric particulate matter have been determined. These relations constitute valuable elements for the knowledge of the atmospheric aerosol properties and can help the development of effective inversion methods starting from the optical lidar data.