EGU22-9407
https://doi.org/10.5194/egusphere-egu22-9407
EGU General Assembly 2022

Observation of Simultaneous Etna Volcanic aerosol and Desert Dust aerosol over Naples: an experimental test for a new lidar inversion algorithms

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Studies on the spatio-temporal characterization of microphysical and optical properties of atmospheric aerosol are of particular interest for their impacts on life cycle. Unfortunately, large uncertainties govern these studies because of the wide variability of the components which characterize the aerosol, especially when several sources concur in the observations. This is exactly what happens over the Central Mediterranean where particles of different nature and typology, produced by local sources or long-range transport phenomena from natural and anthropogenic sources, coexist frequently in the aerosol layers. Among these contributions, a special mention deserves the volcanic activity, since Mediterranean area hosts numerous active volcanoes, like Mount Etna, in Italy, whose degassing and explosive activities have a strong impact on the atmospheric aerosol composition. In this work we present the results from the Etna paroxysmal event occurred in February 21st - 26th, 2021 and observed in the Naples area in coexistence with Saharan dust transport. The event has been characterized by the ACTRIS (Aerosol, Clouds and Trace Gases Research Infrastructure) observation station of the University of Naples “Federico II” by combining lidar, sunphotometer and satellite data. Back-trajectories and volcanic plume dispersion simulations were also performed in order to better distinguish geometrical, optical and microphysical properties of the atmospheric aerosol. From our analysis, spatio-temporal information of the two main aerosol components in terms of their optical and microphysical proprieties were clearly identified. In particular, starting from lidar data, the particle size distributions were retrieved at desired altitudes using a novel inversion approach based on a new Monte Carlo algorithm. Interestingly, when integrated over the range on the observation column, the experimental findings result in good agreement with the data provided by the sunphotometer.