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Observation of aerosol layers using co-located multiwavelength Raman lidar and microwave radar at CIAO during Eyjafjallajökull 2010 eruption

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Ultragiant aerosol particles have been observed at the CNR-IMAA Atmospheric Observatory (CIAO) using a multiwavelength Raman lidar and a Ka-band radar. During spring 2010, volcanic aerosol layers coming from Eyjafjallajökull volcano were observed over most of the European countries, using lidar technique. From 19 April to 19 May 2010, they have been also observed at CIAO with the multi-wavelength Raman lidar systems of the Potenza EARLINET station (40.60N, 15.72E, 760 m a.s.l), Southern Italy. During the same period, the co-located Ka-band MIRA-36 Doppler microwave radar operating at 8.45 mm (35.5 GHz) observed in four separate days (19 April, 7, 10, 13 May) signatures consistent with the observations of ultragiant aerosol particles. The radar signatures of aerosol layers are characterized by a similar scenario in all four cases. In particular, the linear depolarization ratio shows values higher than -4 dB, probably related to the effect of aerosol bulk density.
The observation of volcanic layers over Potenza by multi-wavelength Raman lidar measurements suggests a volcanic origin of the ultragiant aerosol particles observed by the radar, revealing that these particles might have travelled for more than 4000 km after their injection in the atmosphere. This result is also supported by the 7-days backward trajectory analysis provided by different models. The backtrajectory analysis shows air masses coming from the volcano area and only in one case the trajectories do not come directly from Iceland, but from Central Europe where many lidar observations confirm the presence of volcanic aerosol in the previous days.
Recent studies already report that microwave radars, typically used for cloud monitoring, are able to detect volcanic aerosol layers in proximity of the source. We report for the first time observations of ultragiant particles of volcanic origin using a microwave radar at very large distances from the volcanic source.
Radar monitoring of giant aerosol particles could fill an important observational gap in the study of the impact of giant aerosol both on the weather and on the climate system as well as in the characterization of the dynamic evolution of the volcanic aerosol. An example obtained using simultaneous observations of volcanic aerosol from co-located radar and lidar will be also presented. In particular, a preliminary analysis for the optimization of the combination of lidar and radar measurements for characterization of aerosol geometrical and microphysical properties will be reported. Moreover, the analysis of the impact of differences in the representativeness of radar and lidar observations will be discussed.