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16 December 2013 Etna eruption: first estimates of Extinction to Backscattering ratio near the source by an Elastic/Raman lidar system

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The lidar technique can be a valid support in the studies of volcanic emissions allowing real-time information on geometrical, optical and microphysical characteristics of particles and gas dispersed in the atmosphere with high spatial and temporal resolution.
Until now, the volcanic emissions were quite extensively studied by lidar systems, but all the information derived from measurements are referred to particles that are long range transported in the troposphere; only few works are available from lidar measurements of fresh volcanic ash.
Mount Etna, in the south of Italy, is one of the most active volcanoes in the world and it is being monitored with several ground-based instruments by the Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo (INGV – OE) researchers.
The instrumentation suitable for Etna volcanic ash monitoring includes a lidar system (AMPLE - Aerosol Multi-wavelength Polarization Lidar Experiment) developed in cooperation with the Consorzio Interuniversitario per le Scienze Fisiche della Materia (CNISM), in the frame of the VAMOS SEGURO (Volcanic Ash Monitoring and ForecaSting between Sicilia and Malta arEa and sharingG of the resUlts foR aviatiOn safety) project. AMPLE is a mobile multi-wavelength Elastic/Raman scanning lidar system with depolarization capability and high repetition rate laser source especially designed to carry out 4-D (space and time) imaging of aerosol particles distributions, their optical properties and microphysical characterization also in presence of high dense aerosol layers as it happens during highly explosive eruptions or heavy dust storm events.
In the period between 14 and 17 December 2013, a Strombolian activity of the Mt. Etna (Sicily) associated with emission of fresh volcanic ash took place from the New South East Crater (NSEC).
During this eruption, lidar measurements were out in Catania, toward the volcanic plume that was dispersed in the South East direction. These measurements allow to analyze volcanic ash layers in terms of aerosol backscattering (βA) and extinction (αA) coefficients profiles at 355nm, and for the first time, measured Lidar Ratio (LR) profiles. A characterization of the particle shape has been also performed using calibrated particle linear depolarization values (δA) obtained from the lidar profiles measured in parallel and perpendicular polarized channels at 355nm. Finally βA , LR and δA profiles were used to estimate the ash concentration (γ) profile in the volcanic plume.