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Small-scale volcanic aerosols variability and processes observed at Mount Etna during the EPL-RADIO measurement campaigns

Pasquale Sellitto (1), Giuseppe Salerno (2), Alessandro La Spina (2), Tommaso Caltabiano (2), Simona Scollo (2), Antonella Boselli (3), Giuseppe Leto (4), Ricardo Zanmar Sanchez (4), Pierre-Jean Gauthier (5), Luca Terray (5), Suzanne Crumeyrolle (6), and Pierre Briole (7)

(1) Laboratoire Inter-universitaire des Systèmes Atmosphériques, Université Paris-Est Créteil (LISA-UPEC), France (pasquale.sellitto@u-pec.fr), (2) Istituto Nazionale di Geofisica e Vulcanologia (INGV), Catania, Italy, (3) CNR-IMAA, Tito Scalo (Potenza), Italy, (4) INAF, Catania, Italy, (5) LMV, Clermont-Ferrand, France, (6) LOA, Lille, France, (7) Laboratoire de Géologie, UMR CNRS/ENS-PSL, Paris, France

The EPL-RADIO (Etna Plume Lab - Radioactive Aerosols and other source parameters for better atmospheric Dispersion and Impact estimatiOns) project, funded by the EC Horizon2020 ENVRIplus TNA programme, aims at advancing the understanding of Mount Etna as a persistent source of atmospheric aerosols, and at quantifying its impact on the radiative budget at the proximal spatial scale. This project is focused on the study of emission processes during background passive degassing, from inner degassing mechanisms to the characterisation of near-source aerosol physico-chemical properties. To do so, two measurement campaigns were carried out in the summers 2016 and 2017, to observe the volcanic plume from close distance from the summit active craters to more distal surroundings of the volcano. A variety of observations, gathered through the interactions between atmospheric sciences and volcanology specialists, has been collected. An integrated multi-parameter approach has been developed, by employing fixed and mobile instrumentation, in details: (i) a distal permanent scanning multi-wavelength polarisation LiDAR with Raman capability, (ii) proximal mobile cascade impactors, (iii) a proximal mobile optical particle counter, (iv) proximal and distal combinations of two spectrally-complementary Microtops-II sun-photometers, and (v) complementary gas measurements by UV spectrometers and a Fourier Transform IR spectrometer. The acquired information allowed, for the first time, the investigation of the small-scale variability of Mount Etna volcanic aerosols three-dimensional properties (within a few km from the volcanic source), during passive degassing activity and as a function of the environmental conditions, and their inherent processes. Small-scale variability of volcanic aerosols properties - within a few km from the volcanic source - together with potential inherent triggering and atmospheric evolution processes is discussed here. The ensemble of EPL-RADIO observations shows that small-scale chemical/microphysical processes play a major role in the determination of wider-scale aerosol optical properties, thus influencing their impact on the regional climate in the Mediterranean basin.