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Mass concentration of volcanic ashes combining automatic remote sensors ceilometers and sunphotmeters during La Palma volcano eruption

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In this study, the aerosol optical and microphysical properties measured at three different locations in La Palma, Spain, during the 2021 eruption of the Cumbre Vieja volcano (from 19 September to 13 December 2021) are presented. The different phases of the volcanic eruption are described through the spatiotemporal evolution of attenuated backscattering profiles and the mass concentration in four different atmospheric layers. The impact of the plume's pathway that reached the South of France is also characterized. Here, passive and active remote sensors were used, namely CL51 and CL61 ceilometers, and AERONET sunphotometers. The attenuated backscattering ranged from 0.8 to 9.1 $Mm^{-1}sr^{-1}$, and the volume depolarization ratio reached values as high as 0.3. The ash plume remained within the first 4 km agl, with intense episodes that reached mean aerosol optical depth values of up to 0.4. Thirteen study cases were selected where the coarse mode was dominant over the fine mode. For the data selection, the fine- and coarse-mode lidar ratios found were, respectively, 3.9 ± 0.8 and 21.0 ± 3.8 sr in the north and 6.9 ± 1.8 and 30.1 ± 10.3 sr in the south. The estimated ash mass concentration reached moderate levels with maximum values of up to 314 μgm^{-3} below 1 km a.g.l.

Keywords: volcano; remote sensing; ash particles; lidar; ceilometer, AERONET