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Observations of California forest fire aerosol in Potenza (Italy) by the multi-wavelength Raman lidar MUSA

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Smoke aerosols play an important role in the atmospheric chemistry in terms of direct and indirect radiative forcing. Despite this, their properties in free troposphere and stratosphere are still insufficiently studied. When the smoke reaches these altitudes can be transported over transcontinental distances. During the transport of particles important transforming processes, such as coagulation, condensation, and gas-to-particle conversion occur, thus affecting environment and climate. The optical properties of smoke plumes have been usually analyzed by ground-based radiometers and satellite. However, these techniques cannot characterize accurately the high variability of the vertical structure of smoke aerosol. Raman lidar systems are characterized by high temporal and vertical resolutions and have demonstrated a strong capability to study long-range transport, optical properties and vertical structure of forest fire smoke.

In the 2020 California's fire season was exceptionally catastrophic. 23rd October, the immense Sonoma fire, in few days scorched 31000 hectares. The deep convection lifted the smoke from these fires to great heights. After reaching the free troposphere and stratosphere, the forest fire smoke was transported over great distances and reached the south of Italy, as evinced by the map of biomass burning aerosol optical depth at 550 nm, provided by the Copernicus Atmosphere Monitoring Service (CAMS).

This work reports measurements carried out in the frame of the project CAMS21b by the Raman lidar system MUSA deployed at CNR-IMAA Atmospheric Observatory (CIAO) in Potenza. CAMS21b aims to design, test and set up the provisioning to CAMS of ACTRIS/EARLINET products in real time and near real time.

In the case study of 26 October 2020, from to 10:13 to 13:45 UTC, measurements of particle backscattering coefficient at 355, 532 nm and 1064 and of the particle extinction coefficient at 355 nm and 532nm, show the presence of two distinct aerosol layers. A lower one extending from 6 km to 8 km and an upper one extending from 10 km to 12 km. The back-trajectory analysis reveals that the air masses originated over California, overpassed the Atlantic sea before reaching the measurement site.

The values of the particle depolarization ratio are similar to those found in literature for smoke aerosols. In the first layer, values lower than 0.05 are indicative for small and spherical smoke

particles. The moderately increased depolarization ratios in the second layer indicate the possible presence of partly coated smoke particles.

More results from this measurement effort will be reported and discussed at the Conference.