INVESTIGATING the GEOMETRICAL and OPTICAL PROPERTIES of the PERSISTENT STRATOSPHERIC AEROSOL LAYER OBSERVED OVER THESSALONIKI, GREECE, DURING 2019

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A persistent stratospheric layer first appeared during July 2019 above Thessaloniki, Greece (40.5°N, 22.9°E), initially at 12km and later on even up to 20km. The event was monitored till the end of October 2019 with a multi-wavelength Depolarization Raman lidar, which is part of the European Aerosol Research Lidar NETwork (EARLINET). Thessaloniki's lidar system (THELISYS) consists of three elastic channels at 355, 532, and 1064nm, two night-time only Raman channels at 387nm and 607nm, and two depolarization channels at 532nm, one cross polarized and the other parallel polarized to the linearly polarized laser beam.

The layers first appeared on 11/07/2019. On 01/08/2019 all layers were monitored in similar altitudes but with increased thickness and reduced attenuated backscatter levels. During September, the backscatter levels decreased even further while the layer thickness started growing. During October, the layer extended from 13 to 20km. Possible sources can be either the Raikoke volcanic eruption on 2/06/2019 or large scale and intensity biomass burning events (i.e., from Canada, Siberia) that were both identified by the air mass backward trajectories. Both types of events can create updrafts strong enough to penetrate the tropopause and it is possible that both sources have contributed to the long-lasting observed aerosol plume over Thessaloniki.

In this study, we analyze the geometrical and optical properties (spectral aerosol optical depth, depolarization ratio at 532nm, spectral lidar ratio) of this stratospheric layer, using the night-time depolarization Raman measurements from THELISYS. Potential changes in the aerosol properties during the period that signify changes in the composition are identified and discussed. The temporal evolution of the plume is further monitored by the lidar satellite retrievals from the AEOLUS and CALIPSO overpasses over Thessaloniki (e.g., CALIPSO aerosol subtype). The microphysical properties are then obtained using T-matrix simulations with refractive indexes and aspect ratios typical for biomass burning and volcanic (sulfate and/or ash) aerosols found in literature. The mixtures that best describe the optical properties are used as an indicator of whether the stratospheric layer is pure volcanic ash, pure aged smoke, or both.