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Using Artificial Neural Networks to resolve the aerosol type

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The NATALI code relies on the capability of specialized Artificial Neural Networks to resolve overlapping values of intense optical parameters obtained for each recognized layer in multiwavelength Raman lidar profiles [1]. It has been developed in Python and optimized for execution on the EARLINET profiles, which consist of three backscatter coefficients, two extinctions, and one linear particle depolarization ratio.
In this study we have applied NATALI on an extended lidar dataset collected by EARLINET stations between 2015 and 2019. The resulting dataset was analysed separately for the lower region and the upper region of the troposphere, in order to put in evidence local influences and long-range transport. The dataset was divided in seven geographical clusters based on similarities of the air mass transport. NATALI was used for quantifying the layer boundaries, for the calculation of the layer-mean optical properties, and for the identification of the aerosol predominant component. Layer-means of the aerosol intensive optical parameters were calculated for each station, each season, year and cluster.
We analysed the Angstrom exponent, which is a good indicator of the particle size, the lidar ratios at 532 and 355 nm, which describe the extinction versus scattering properties of the particles, and the ratio of the lidar ratios which is a good indicator of the age of smoke particles. The predominant aerosol type was retrieved for each layer, and the frequency of appearance was calculated by normalization to all layers. In the low troposphere, continental aerosol is predominant in all regions except East Europe (where smoke particles contribute significantly) and North Europe. Minor contribution of dust particles is present in the West and East Mediterranean but also in East Europe and North Europe. In the high troposphere, mineral dust and smoke are more frequent in all regions.
We also analysed the variability of the optical properties for dust and smoke, as identified by NATALI. The analysis showed that in case of smoke the ratio of the lidar ratios as well as the Angstrom exponent vary significantly from region to region, while for dust these parameters are almost constant.

Keywords: retrieval algorithm, aerosol type, multiwavelength lidar

References

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