Aerosol climatology – from aerosol remote sensing measurements, models and deep learning

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In this paper a new synergistic methodology used to develop a complex aerosol climatology is presented. This methodology uses data collected from lidar, photometer and ceilometer, operated at Magurele Centre for Atmosphere and Radiation Studies (MARS), combined with CAMS products [1], NATALI aerosol-typing model [2] and FLEXPART atmospheric transport model [3]. The aerosol layers are obtained from the lidar and ceilometer data using unsupervised deep learning W-NET models [4]. For each layer identified, a detailed investigation of aerosol sources is performed with FLEXPART.

For the aerosol analysis, we consider the combination of lidar and CAMS aerosol products correlated with photometer and ceilometer measurements. The optical properties retrieved from the photometer are re-scaled to the lidar wavelengths using an Angstrom exponent equal to 1 for the comparison with optical properties obtained from lidar measurements. The values of CAMS model and lidar wavelengths are very close, no re-scaling is needed.

The lidar and CAMS extinction coefficient profiles, integrated over the air column provide the AOD values, that are further cross-checked with the AOD values obtained from the photometer.

If a good correlation is obtained between AODs from lidar, CAMS and photometer, then the lidar measurements are used to calculate the optical properties of aerosols within each layer, the ceilometer measurements are used for the time evolution of aerosol layers, CAMS data are used to calculate the aerosol mixing ratios and NATALI is used for aerosol typing.

Keywords: deep learning, aerosol climatology, FLEXPART, CAMS, remote sensing.

References

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