Geophysical Research Abstracts
Vol. 21, EGU2019-15376, 2019
EGU General Assembly 2019

Usage of polarization lidar systems in the study of aerosol–cloud interactions

Camelia Talianu (1,2) and Simona Andrei (1)

(1) National Institute of R&D for Optoelectronics, Magurele, Romania, (2) University of Natural Resources and Life Sciences, Institute of Meteorology (BOKU-Met), Department of Water - Atmosphere - Environment, Vienna, Austria (camelia.talianu@gmail.com)

In this paper the capability of polarization lidar systems to provide vertical profiles of aerosol optical and microphysical properties is used to improve the determination of cloud droplet number, a key element of aerosol–cloud interactions.

The aerosol activation is parameterized in atmospheric models as an empirical function of cloud condensation nuclei concentrations (CCNC) and supersaturation (S). The present study uses the parametrization defined in the COSMO model and the sulfate aerosol as cloud condensation nuclei (CCN). The work was carried out using measurements of polarization lidar systems from ACTRIS, aerosol and cloud cover products from CAMS reanalysis data and the NATALI aerosol model.

The presence of the aerosol and the clouds was determined from the lidar measurements. If present, the aerosol layers and optical properties were retrieved from these measurements. The cloud bottom height was also retrieved from the same measurements. The components of the aerosol were extracted from the CAMS data for the aerosol layers identified from the lidar measurements. For the identified aerosol, the microphysical properties were computed using the NATALI aerosol model. If sulfate was one of the components of the aerosol, its concentration was computed from the depolarization and backscatter profiles obtained from the lidar measurements. The supersaturation was computed from the microphysical properties using Köhler theory. The cloud droplet number concentration was then computed using the aerosol activation parametrization.

Several cases were analyzed, involving different types of aerosols with sulfate components. The nucleation of the cloud droplet rate was calculated from the time derivative of the activation relation using constant profiles of CCNC and profiles of CCNC computed from lidar. We found that the cloud droplet number concentration computed with constant profiles is significantly larger that the values determined with the methodology described above.

In conclusion, the assimilation of data from polarization lidar systems in the atmospheric models can provides the observation of aerosol layering, which can be further used to compute the concentrations profiles of CCN yield to improve the understanding of aerosol–cloud interactions.