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New remote-sensing-based methodologies for aerosol-cloud studies: Application on space-borne and ground based observations

Rodanthi-Elisavet Mamouri (1), Albert Ansmann (2), Argyro Nisantzi (1), Johannes Buehl (2), and Diofantos G. Hadjimitsis (1)

(1) ERATOSTHENES Research Centre, Faculty of Engineering and Technology, Cyprus University of Technology, Limassol, Cyprus (rodanthi.mamouri@cut.ac.cy), (2) Leibniz Institute for Tropospheric Research, Leipzig, Germany (albert@tropos.de)

Field studies of aerosol–cloud-dynamics interaction are presently in the focus of atmospheric research. Large uncertainties in weather and future-climate predictions arise from gaps in our knowledge of the detailed impact of aerosols on the evolution of liquid-water, mixed-phase and cirrus clouds. This unsatisfactory situation motivates the strong efforts presently undertaken to investigate formation and evolution of cloud layers and associated aerosol–cloud interactions. In this respect, several field campaigns took place in Cyprus region in the framework of BACCHUS project since 2015. Aerosol particles influence cloud evolution, lifetime, and cloud microphysical properties in two ways. Ground-based active remote sensing (Raman depolarization and Doppler lidar and radar observations) can be used to continuously monitor the evolution of clouds in their natural (aerosol) environment, at given meteorological conditions with high vertical and temporal resolution.
New methods were developed to retrieve height profiles of aerosol particle backscatter, extinction, and mass concentration as well as of the number concentration of cloud condensation nuclei and ice-nucleating particles (INPC). Furthermore, Doppler radar and lidar observations allow us to estimate the ice crystal number concentration (ICNC) in mixed-phase and ice clouds. Measurement examples and INPC vs ICNC closure studies will present. The case studies corroborate the usefulness of the new methods and their application to space-borne datasets.

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