Geophysical Research Abstracts
Vol. 17, EGU2015-13261, 2015
EGU General Assembly 2015

Estimation of desert-dust-related ice nuclei profiles from polarization lidar

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This paper presents a methodology based on the use of active remote sensing techniques for the estimation of ice nuclei concentrations (INC) for desert dust plumes. Although this method can be applied to other aerosol components, in this study we focus on desert dust.
The method makes use of the polarization lidar technique for the separation of dust and non-dust contributions to the particle backscatter and extinction coefficients. The profile of the dust extinction coefficient is converted to APC280 (dust particles with radius larger than 280 nm) and, in a second step, APC280 is converted to INC by means of an APC–INC relationship from the literature. The observed close relationship between dust extinction at 500 nm and APC280 is the key to a successful INC retrieval. The correlation between dust extinction coefficient and APC280 is studied by means of AERONET sun/sky photometer at Morocco, Cape Verde, Barbados, and Cyprus, during situations dominated by desert dust outbreaks. In the present study, polarization lidar observations of the EARLINET (European Aerosol Research Lidar Network) lidar at the Cyprus University of Technology (CUT), Limassol (34.7o N, 33o E), Cyprus were used together with spaceborne lidar observations during CALIPSO satellite overpasses to demonstrate the potential of the new INC retrieval method.
A good agreement between the CALIOP (Cloud Aerosol Lidar with Orthogonal Polarization) and our CUT lidar observations regarding the retrieval of dust extinction coefficient, APC280, and INC profiles were found and corroborate the potential of CALIOP to provide 3-D global desert-dust-related INC data sets. In the next step, efforts should be undertaken towards the establishment of a global, height-resolved INC climatology for desert dust plumes. Realistic global INC distributions are required for an improved estimation of aerosol effects on cloud formation and the better quantification of the indirect aerosol effect on climate.

Acknowledgements. The authors thank the CUT Remote Sensing Laboratory for their support. The research leading to these results has also received scientific support from the European Union Seventh Framework Programme (FP7/2011–2015) under grant agreement no. 262254 (ACTRIS project). We acknowledge funding from the EU FP7-ENV-2013 programme “impact of Biogenic vs. Anthropogenic emissions on Clouds and Climate: towards a Holistic UnderStanding” (BACCHUS), project no. 603445. We are grateful to AERONET for high-quality sun/sky photometer measurements in Cyprus, Morocco, Cape Verde, and Barbados. We thank the NASA Langley Research Center and the CALIPSO science team for the constant effort and improvement of then CALIPSO data.