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Characterization of particle hygroscopicity by Raman lidar: selected case studies from the Convective and Orographically-induced Precipitation Study

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Abstract

The characterization of particle hygroscopicity has primary importance for climate monitoring and prediction. Model studies have demonstrated that relative humidity (RH) has a critical influence on aerosol climate forcing. The relationship between aerosol backscattering and relative humidity has been investigated in numerous studies (among others, Pahlow et al., 2006; Wulfmeyer and Feingold, 2000; Veselovskii et al., 2009). Hygroscopic properties of aerosols influence particle size distribution and refractive index and hence their radiative effects.
Aerosol particles tend to grow at large relative humidity values as a result of their hygroscopicity. Raman lidars with aerosol, water vapour and temperature measurement capability are potentially attractive tools for studying aerosol hygroscopicity as in fact they can provide continuous altitude-resolved measurements of particle optical, size and microphysical properties, as well as relative humidity, without perturbing the aerosols or their environment. Specifically, the University of Basilicata Raman lidar system (BASIL) considered for the present study, has the capability to perform all-lidar measurements of relative humidity based on the application of both the rotational and the vibrational Raman lidar techniques in the UV.
BASIL was operational in Achern (Black Forest, Lat: 48.64 ° N, Long: 8.06 ° E, Elev.: 140 m) between 25 May and 30 August 2007 in the framework of the Convective and Orographically-induced Precipitation Study (COPS). During COPS, BASIL collected more than 500 hours of measurements, distributed over 58 measurement days and 34 intensive observation periods (IOPs). The present analysis is focused on selected case studies characterized by the presence of different aerosol types with different hygroscopic behaviour. The observed behaviour, dependent upon aerosol composition, may range from hygrophobic to strongly hygroscopic. Results from the different case studies will be illustrated and discussed at the Conference.

References

Pahlow, M., Feingold, G., Jefferson, A., Andrews, E., Ogren, J.A., Wang, J., Lee, Y.-N., Ferrare, R.A., Turner, D.D., 2006. Comparison between lidar and nephelometer measurements of aerosol hygroscopicity at the southern great plains atmospheric radiation measurement site. Journal of Geophysical Research 111, D05S15. doi:10.1029/2004JD005646.

Veselovskii, I., Dubovik, O., Kolgotin, A., Lapyonok, T., Di Girolamo, P., Summa, D., Whiteman, D.N., Mishchenko, M., Tanré, D., 2010. Application of randomly oriented spheroids for retrieval of dust particle parameters from multiwavelength lidar measurements. Journal of Geophyical Research 115, D21203. doi:10.1029/2010JD014139.

Wulfmeyer, V., Feingold, G., 2000. On the relationship between relative humidity and particle backscattering coefficient in the marine boundary layer determined with differential absorption lidar. Journal of Geophysical Research 105, 4729e4741.