EGU21-4752, updated on 18 May 2021
https://doi.org/10.5194/egusphere-egu21-4752
EGU General Assembly 2021


# Model-based closure experiments with optical particle counters for dust-like aerosols

**Josef Gasteiger**, Adrian Walser, Maximilian Dollner, Marilena Teri, and Bernadett Weinzierl
University of Vienna, Aerosol Physics and Environmental Physics, Faculty of Physics, Wien, Austria
(josef.gasteiger@univie.ac.at)

The size distribution of desert dust is a central parameter, e.g., for the dust climate effect and the fertilization of oceans and rain forests. The uncertainties of size distribution measurements, however, are large for which the nonsphericity of dust particles is a major reason. Optical particle counters (OPCs) are frequently used for size distribution measurements and possible reasons for uncertainties include (a) the fact that nonspherical dust particles fly with individual orientations through the sampling volume of the OPC while the scattering signals and derived sizes depend on particle orientation, (b) the variability of particle shape, and (c) uncertainties about which definition of particle size is best suited for nonspherical dust.

To test the consistency between OPC measurements and independent measurements with other instruments types (e.g., a nephelometer or a lidar) closure experiments can be performed. In such experiments, size distributions derived from OPC measurements are used as input for model calculations of specific optical parameters which then are compared to independent measurements of the same optical parameters (e.g. scattering or backscattering coefficient) of the same aerosol. Deviations have been reported in the literature for desert dust. These deviations may be caused by the particle nonsphericity affecting the derivation of size distributions from OPC as indicated above but may also have other causes, e.g., using a wrong refractive index or assuming spherical particles for calculating the specific optical parameters. So far, the OPC nonsphericity effect has not been investigated in detail. A better understanding of this effect would be helpful for our understanding of size distribution uncertainties and of reasons for deviations in closure experiments.

In order to gain insight into the OPC nonsphericity effect, we performed simulations for different combinations of OPCs and instruments measuring specific optical parameters. Irregular dust-like shapes over a wide size range and different refractive indices were considered. Firstly, the deviations of the derived sizes from the original particle sizes were analyzed. Secondly, the derived

sizes were used for Mie simulations of the optical parameters and the deviations from those of the original irregularly-shaped particle were calculated. In this respect, e.g., nephelometer responses and lidar-relevant parameters were simulated to reproduce possible closure experiments. These results will be compared to measurement-based closure experiments performed during field campaigns or in a laboratory in order to investigate how well the OPC nonsphericity effect explains observed discrepancies.

The simulated closure experiments show, for example, an overestimation of the scattering coefficient at λ=532nm by about 5% to 34% (depending on size range) when using size distributions derived from the DMT CAS instrument (λ=658nm, 4°-12° scattering angle) assuming non-absorbing dust particles. Using the TSI OPS model 3330 (λ=660nm, 30°-150° scattering angle) deviations in the range from -16% to +16% are found.