Use of the measured volume scattering function for extrapolation to angular ranges inaccessible to measurement.

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Introduction:

The determination of the volume scattering function requires the intense illumination of a volume of aerosol and the measurement of the light which is scattered by the particles ideally at scattering angles between 0° and 180°. This is not possible experimentally since in the backwards direction near 180° the photo detector shields the illumination and in close forward direction near 0° the intense illuminating light would shine into the photo detector causing catastrophic consequences. Usually the range not accessible is between 0° and 5 .. 10° in the forward direction and 170° …..175° and 180° in the backward direction. But for the determination of the phase function, the asymmetry parameter, the backscattered fraction and the scattering coefficient the inaccessible range is needed, thus an estimation of the scattering function in this range is needed

Method:

(a) Forward direction: In the close forward direction the shape of the volume scattering function is characterized by a steep increase at angles below 10° and a leveling at 0°. This shape is independent of refractive index and shape for particle sizes below 5 µm. Model calculations for spherical particles have shown that an unanimous relation exists between the slope of the scattering function between 5 and 8° and the slopes for smaller angles, thus by stepwise extrapolation the volume scattering function can be extrapolated for the non accessible range.

(b) Backward direction: With reasonable accuracy an extrapolation is also possible (although not as accurate as for the forward direction). Again using the slope between 170° and 174° as information for the range from 174° to 180°, an extrapolation is possible.

Results

This method has been tested for model size distributions giving satisfactory results, also for irregular shaped particles. Figure 1 shows the accuracy of the determination of the asymmetry parameter, the backscattered fraction and the scattering coefficient.

Conclusion

The extrapolation method has proven useful and is applicable for atmospheric aerosols with particle sizes less than 5 µm.

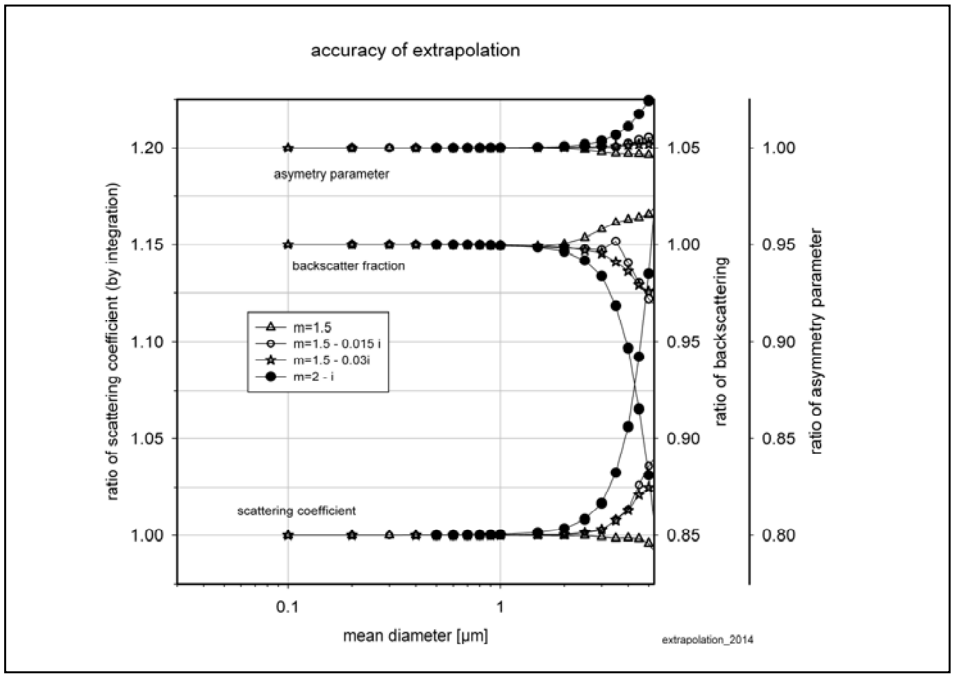

Figure 1: Accuracy of the determination of the scattering coefficient, the backscattered fraction and the asymmetry parameter, using the described method.