Validation of a field-deployed detection system for angular light scattering measurements under natural weather conditions

A. Peckhaus (1), T. Hall (1), U. Bierbrauer (1), C. Pargmann (2), F. Duschek (1)

(1) Technical Physics, German Aerospace Center, Germany
(2) Faculty of Mechanics and Electronics, Heilbronn University of Applied Sciences, Germany.

Motivation

- Free-space propagation of high-power lasers raises the question of laser safety due to exposure of scattered laser radiation
- Off-axis scattered radiation due to atmospheric particles can be a potential threat to the human eye of operators and thirty parties in close vicinity to the laser source

Experimental setup

- To determine the absolute scattered radiation relative to the laser beam direction, an optical detection system has been developed

Times series of scattered radiation

- Scattered radiation is collected via off-axis parabolic (OAP) mirrors and detected with photoreceivers at scattering angles of 30°, 60°, 90°, 120°, and 150°
- Each of the detection units is radiometrically calibrated to obtain absolute powers
- The detection system is housed in a weatherproof box at the DLR test range

Correlation of scattered radiation with aerosol particle concentration

- For clear weather conditions, the measured scattered powers are linearly related to the total number concentration of aerosol particles in the range from 0.18 µm to 18 µm
- Calculated scattered powers based on measured number size distributions and Mie theory are in reasonable agreement with experimental scattered powers for clear conditions
- Deviations come from an inaccurate knowledge of the chemical composition of the particles and different detection methods (single vs. ensemble)

Deviations come from an inaccurate knowledge of the chemical composition of the particles and different detection methods (single vs. ensemble).