Scanning Lidar: Potential for Dust Layer Characterization

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Most of the aerosol particles – in particular in winter – are confined in the lowest few hundred meters. Therefore, investigating the complete vertical distribution of aerosols and characterizing the optical properties of the dust layer require a scanning lidar system. To demonstrate this, data are taken from 100 noon measurements, maximum one per day, at Munich, 539 m above sea level (a.s.l.), in the EARLINET-period between 1. May 2000 and 31. December 2002.

Properties of the Dust Layer

The annual cycle of the dust layer height \( z_{DL} \) is printed for the period of the EARLINET measurements (green: 2000, red: 2001, blue: 2002). \( z_{DL} \) is defined where the signal at 532 nm decreases for the first time significantly. Not included are additional layers formed for example by saharan dust. For 4 days \( z_{DL} \) is below 200 m, for 22 days below 500 m and for 49 days below 1000 m above ground (a.g.).

For the same period of measurements the optical depth \( \tau_{P,DL} \) for the aerosol particles in the dust layer at 532 nm is plotted. The black line is a sinusoidal fit for all measurements, showing a maximum of \( \tau_{P,DL} \) in May and a minimum in November.

The ratio between the optical depth in a layer close to the ground \( \tau_{P,Layer} \) to the total optical depth \( \tau_{P,tot} \) is shown for the layer below 200 m (black), below 500 m (red) and below 1000 m (green). Extinction profiles are extrapolated to 10 km by OPAC\(^1\) data. On average 52 %, 32 % and 16 % of the total optical depth is concentrated below 1000 m, 500 m and 200 m, respectively. All these values are calculated for 532 nm.

Summary

• The annual cycle of the dust layer height in Munich is more pronounced compared to Hamburg.
• The average value of the optical depth of the dust layer at 532 nm is 0.096.
• About half of the aerosol optical depth is found in the lowermost 1000 m.
• Aerosol observation must include the lowest 500 meters. A scanning lidar can fulfill this requirement.

Literature


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