Remote Sensing

Dual-field-of-view lidar

The dual-field-of-view (dual-FOV) Raman lidar technique allows the investigation of cloud microphysical properties. Profiles of the cloud extinction coefficient as well as cloud droplet effective radius are derived in the lowest 150 to 250 m of water clouds up to optical depths of 2 to 3. From these quantities profiles of the liquid water content (LWC) and cloud droplet number concentration (CDNC) are calculated. All four of these quantities are very important cloud properties, e.g. for the evaluation of the clouds' radiative effects. Thus, the capability to obtain these cloud properties in combination with the conventional lidar methods for the retrieval of numerous aerosol properties makes the dual-FOV Raman lidar technique an ideal approach for the investigation of aerosol-cloud interactions.

The technique relies on the measurement of multiply scattered light. At lidar probings of water clouds, a large fraction of the light which is scattered at cloud droplets is scattered in forward direction. The result are multiple scattering processes, which describe a scattering process where one or more forward scattering events occur before and/ or after a backscattering event. As the angle at the forward scattering depends bijectively on cloud droplet size, the angular distribution of the backscattered light contains information about the droplet size.

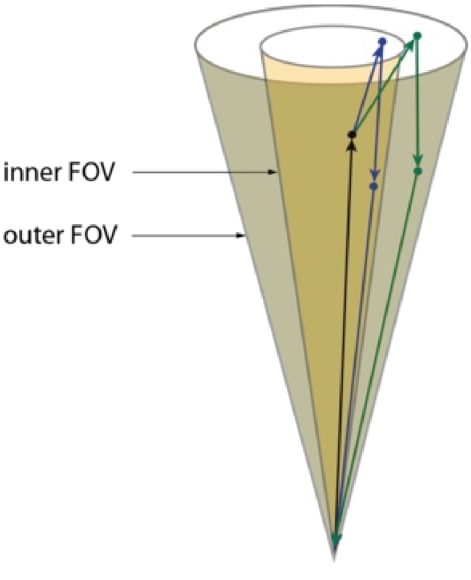

Fig. 1: Detection of multiple scattering with two fields of view.

This information is exploited at dual-FOV Raman lidar measurements. At probings of clouds, the lidar return is detected with two coaxial FOVs, as displayed in Fig. 1. A forward iterative algorithm, developed at the National Academy of Sciences in Belarus within a collaboration, utilizes these signals to derive the mentioned profiles of cloud properties.

An important feature of this measurement technique is the detection of Raman scattered light in both FOVs. The exclusive detection of light which was once Raman scattered by a nitrogen molecule guarantees that the backscattering event occurs at a nitrogen molecule with an isotropic phase function, which facilitates the data analysis.

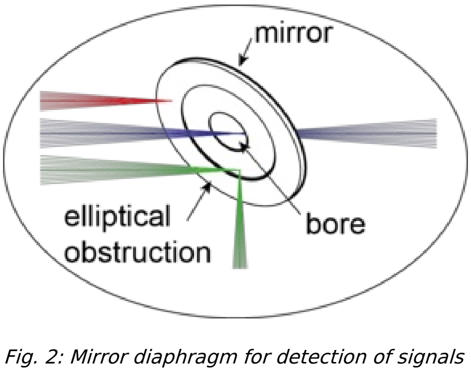

Fig. 2: Mirror diaphragm for detection of signals from two fields of view.

The simultaneous measurement with two FOVs is rendered possible through the usage of a mirror diaphragm (see Figure 2) despite of a conventional field stop. It consists of a mirror which is placed under 45° degree in the optical path. An elliptical bore serves as field stop and defines the inner FOV. Light from without this FOV is reflected towards the detection channels for the outer FOV. An elliptical obstruction of the mirror defines the size of the outer FOV.

Contacts

Dr. Ulla Wandinger
Scientific staff

+49 341 2717-7082
ulla.wandinger[at]tropos.de
Dr. Albert Ansmann
Group leader

+49 341 2717-7064
albert.ansmann[at]tropos.de

Leibniz-Institut für Troposphärenforschung e.V. (TROPOS)
Permoserstraße 15
04318 Leipzig

Phone: ++49 (341) 2717 7060
Fax: ++49 (341) 2717 99 7060
Follow us on Twitter:
@TROPOS_de

The Leibniz Institute for Tropospheric Research is a member of the Leibniz Association.