IRS2012-441
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012

Developing novel Lidar systems with a sophisticated retrieval simulator

R. Buras and J. Gasteiger
Ludwig-Maximilians-Universitaet, Lehrstuhl fuer Experimentelle Meteorologie, Munich, Germany (robert.buras@lmu.de)

A state-of-the-art lidar system such as the MUlti wavelength LIdar System (MULIS) of LMU Munich measures the backscatter signal at several wavelengths, depolarization ratios and even Raman scattering off molecules. In case of aerosol remote sensing, these measurements can be used to retrieve optical properties of the aerosols, and thus hint to the aerosol type and concentration being detected.

With help of the Raman channels it is possible to derive the extinction coefficient and the lidar ratio. To derive the mass concentration from the extinction coefficient, information about the size of the aerosol particles is needed. In fact, the lidar ratio is inverse proportional to the scattering phase function in backward direction, which is a function of the effective radius of the aerosol. However, the dependency is by no means monotonic, such that a retrieval of the effective radius is not possible.

An alternative way to obtain information of the effective radius can be achieved by equipping the lidar system with an additional detector with wide field of view (WFOV). This detector would measure not only the backward (single) scattered light, but also light having been scattered twice (or even more often). Most of this light will have scattered backward once, and forward once, hence the signal will be sensible to the forward scattering peak, which is strongly - and monotonously - dependent on the effective radius.

In order to develop a retrieval algorithm for a WFOV lidar, a forward simulator is needed which is capable of precisely calculating the multiple scattering contribution of the lidar signal, a task which includes complex geometric effects. We have therefor equipped the Monte-Carlo model MYSTIC (part of libRadtran) with a lidar simulator, which is used as the forward model in our Monte-Carlo-based Exact Lidar Retrieval Algorithm (ARLEM), a retrieval based on the Bayesian approach.

We have used ARLEM to test various kinds of lidar configurations on their capabilities to retrieve aerosol properties. We discuss which upgrades to the existing lidar MULIS can lead to a significant improvement in aerosol retrieval.