ALGORITHM AND SOFTWARE FOR THE RETRIEVAL OF VERTICAL AEROSOL PROPERTIES USING COMBINED LIDAR/RADIOMETER DATA: DISSEMINATION IN EARLINET

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ABSTRACT

Ten combined lidar and sun-radiometer stations in the European Aerosol Research Lidar Network (EARLINET) have been testing technique and software for retrieving aerosol microstructure parameters from coordinated lidar and sun-radiometer data with the aim of creating new type of routing cooperative observations. The paper presents description of a program package and preliminary results of testing measurements at some stations.

1. INTRODUCTION

Nowadays lidars and sun/sky-scanning radiometers are among the base equipment in complex experiments aimed at studying aerosol transformation and transport.

Aerosol properties retrieved from Sun radiometer and lidar data are complimentary pieces of information that characterize aerosol particles. The synergetic interactive processing of co-located radiometric and lidar observation data results in further enhancement of aerosol characterization and can provide superior characterization of aerosol as compared with the outcome of detached processing lidar and radiometer observations.

In such approach we deal with an optimal measurement procedure and calculate parameters of a heterogeneous aerosol layer that are in accordance with all measurement data.

The idea of combining lidar and Sun-radiometer measurements in the frame of EARLINET and AERONET and the method for retrieving vertical distributions of aerosol microstructure characteristics were posed in [1], developed in [2-4] and implemented in studying long range aerosol transport at the combined EARLINET and AERONET stations in Minsk (Belarus) and Belsk (Poland) [5].

Integration of lidar and radiometer observations in EARLINET and AERONET is in the order of the day and being realized by ten combined lidar and radiometer stations (Fig. 1) in the frame of ACTRIS, EC 7th Framework Programme project.

This paper presents a retrieving algorithm and uniform program package for processing data of combined lidar/radiometer measurements, as well as preliminary results of their application at the EARLINET stations.

2. ALGORITHM FOR PROCESSING LIDAR&PHOTOMETER DATA

The method of combined lidar and radiometer measurements envisages lidar atmosphere sounding over an altitude range contributing to integral aerosol parameters. Actually the majority of EARLINET stations provide measurements of backscatter signal at

3. PROGRAM PACKAGE FOR PROCESSING DATA OF COMBINED LIDAR&PHOTOMETER SOUNDING

The uniform software SLP-2 (Soft Lidar Photometer_v2) has been designed for processing data that are measured at combined EARLINET & AERONET lidar and Sun-photometer stations (Fig. 1).

Program package structure is shown in the Fig. 2. Program package SLP-2 consists of 3 sub-packages.

Package 1 – LIOPT for preprocessing of Sun-photometer data. Program LIOPT creates the databank DB-Ph of column aerosol optical parameters at the lidar wavelengths by recalculation of AERONET datafiles.

Package 2 – SignalSuite for preprocessing lidar data. As the first step the package SignalSuite creates the databank of raw lidar signals DB-Lidar_raw from a set of lidar signals measured at the EARLINET stations by means of converter nc2mdb. Some stations use the special executable code ULIS that creates databank in measuring procedure. Program Synthesizer provides fusion of some lidar data measured to the effective lidar signal over the whole aerosol layer. Program Tropoexport is meant for preprocessing of lidar signals and calculation of errors of signals measured.

Package 3 – ProfileRetriever for calculation of aerosol mode concentration profiles. Depending on the list of input parameters concentrations of two or three aerosol modes are retrieved. Program Output Viewer provides viewing of the profiles of aerosol mode concentrations.

4. PRELIMINARY RESULTS OF APPLICATION OF COMBINED LIDAR&PHOTOMETER SOUNDING METHODS AT EARLINET STATIONS

Developed technique and program package are tested at ten combined lidar & radiometer stations (Fig. 1) with the aim to arrange specific routine coordinated lidar and photometer observations in the frame of EARLINET/AERONET.

Results of calculation of the vertical profiles of aerosol modes volume concentrations from two types of processing are shown in Fig.3. Measurements were performed in Granada, 15-05-2011. The profiles of coarse non-spherical aerosol particles confidently define a dust layer at the altitude of about 2 km. Figure 4 shows close fit of measured and calculated lidar signals.

Test processing of combined lidar and photometer data was carried out for different kinds of aerosol events dust particles, fire smoke, volcano ash, background conditions. Some examples of retrieved aerosol mode profiles are presented in Fig. 5 and Fig. 6. In any case calculated concentrations profiles were stable relative to change of input data.

Figure 2. Structure of program package SLP-2.

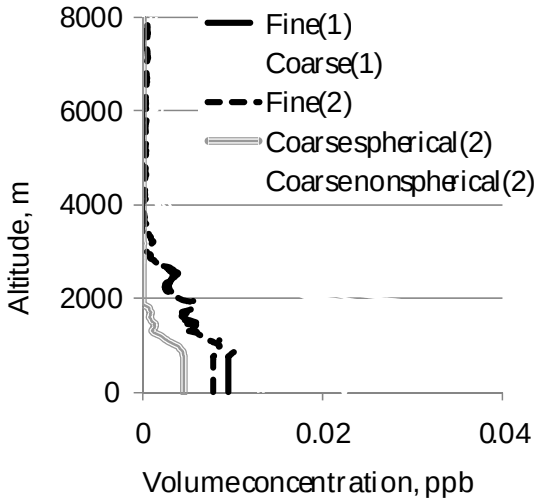

Figure 3. Vertical profiles of aerosol volume concentrations of aerosol modes from two types of processing of combined lidar and photometer input data: (1) – backscatter lidar signals for three wavelengths; (2) – additional couple of cross/parallel polarization measurements; Granada, 15-05-2011.

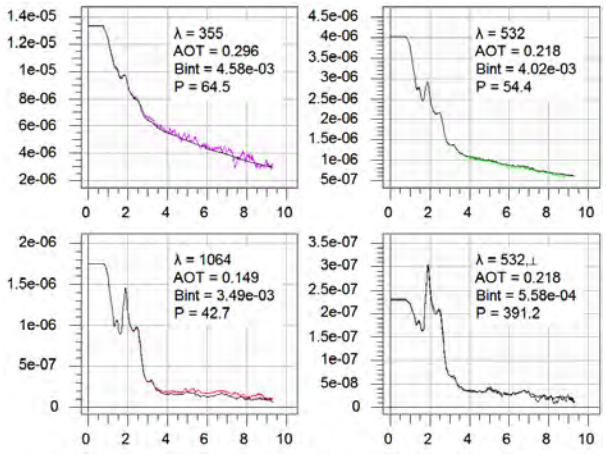

Figure 4. Corrected lidar signals measured (black lines) and calculated (colour lines) from the retrieved parameters of aerosol layer, Granada, 02-09-2011.

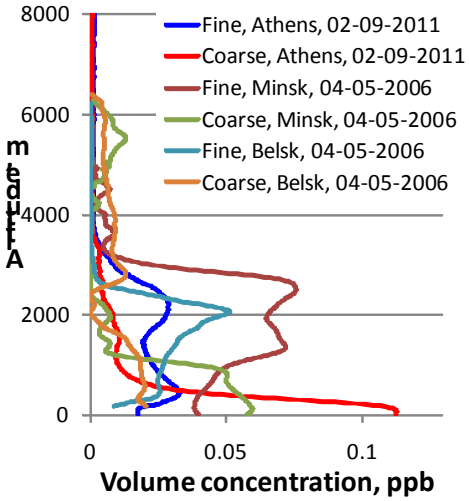

Figure 5. Vertical profiles of aerosol volume concentrations of fine and coarse aerosol modes, fire smoke events in Athens, Minsk and Belsk.

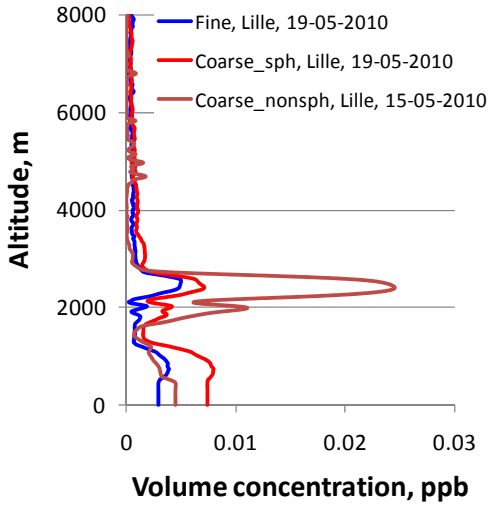

Figure 6. Vertical profiles of aerosol volume concentrations of fine, coarse-spherical and coarse-non spherical aerosol modes, Eyjafjallajökull volcanic ash event in Lille, 19-05-2010.

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