CSIR-NLC Mobile LIDAR for Atmosphere Remote Sensing

V. Sivakumar[1,2], J. Botai[2], D. Moema[1,3], A. Sharma[1], C. Bollig[1] and C.J. deW. Hannes Rautenbach[2]

[1]*National Laser Centre, Council for Scientific and Industrial Research,*
P.O. Box 395, Pretoria 0001, South Africa

[2]*Department of Geography, Geoinformatics and Meteorology, University of Pretoria,*
Lynwood Road, Pretoria 0002, South Africa

[3]*Tshwane University of Technology, Pretoria 0001, South Africa*

Abstract

A mobile LIDAR (LIght Detection And Ranging) system is being developed at the Council for Scientific and Industrial Research (CSIR) National Laser Centre (NLC), Pretoria (25°5° S; 28°2° E), South Africa. Lidar is a state-of-the-art for South Africa and has deployed presently for atmosphere research. The CSIR mobile LIDAR system is the only of its kind in South Africa and can remotely monitor the atmosphere up to an altitude of 40 km. The system is primarily designed for atmospheric remote sensing including pollutant measurements. The LIDAR system comprises a laser transmitter, optical receiver and a data acquisition system. The complete LIDAR system is custom fitted into a van using a shock absorber frame. Hydraulic stabilizer feet have been added to the vehicle suspension to ensure stability during measurements. A Nd:YAG laser is used for transmission which is presently employed at the second harmonic (532 nm) at a repetition rate of 10 Hz. The receiver system employs a Newtonian telescope configuration with a 16 inch primary mirror. The backscattered signal is subjected to fall on the primary mirror of the telescope and is then focused to a plane mirror kept at an angle of 45 degrees. It is detected by the Photo-Multiplier Tube (PMT) and the PMT output is transmitted to the transient digitizer and PC for analysis and archival. The data acquisition is performed by a transient recorder which communicates with a host computer for storage and offline processing of data [1].

The CSIR National Laser Centre and the Department of Geography, Geoinformatics and Meteorology at the University of Pretoria (UP) have embarked on a project involving specialized laser research into atmospheric remote sensing using LIDAR. The initiative forms part of the Southern Education and Research Alliance (SERA), which seeks to create the education, research and technology transfer infrastructure and competence needed to significantly contribute to South Africa's global competitiveness. A 24-hour LIDAR experiment was planned at the University of Pretoria from 15-17 October 2008 for better understanding the atmosphere boundary layer evolution and aerosol (solid particles suspended in the air) concentrations. The experimental data was collected over 23 hours from 16 October, 16h00 to 17 October 15h00. The study further addressed the level of mixing of different chemicals (pollutants) emitted by various sources over Pretoria. In this paper, we present

the results obtained from the above experiment and interpret through archived meteorological satellite pictures of bio-mass burning, dust, air-mass transport and water vapour variations.

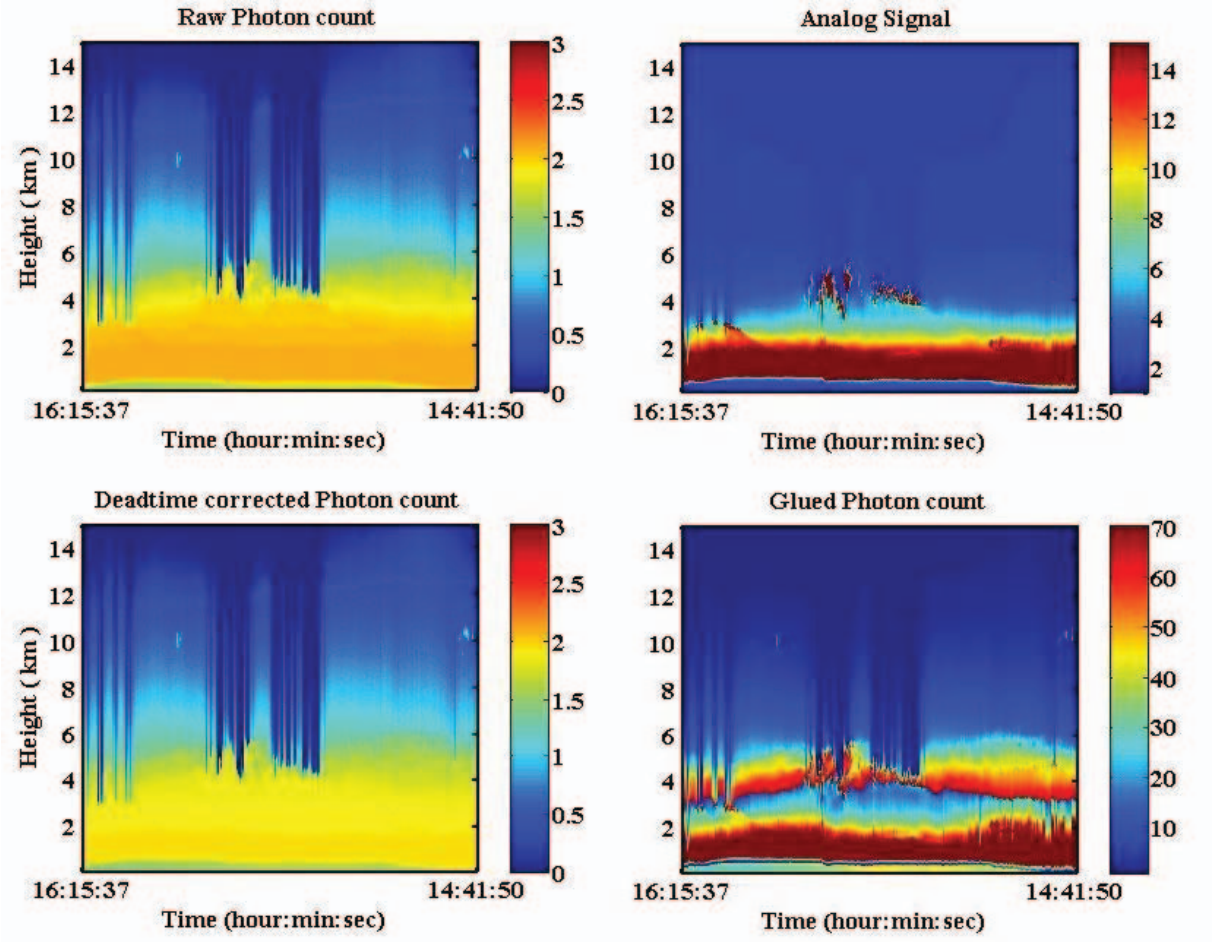

Figure-1: Diurnal evolution of LIDAR backscattered signal obtained for 16-17 October 2008, implying the boundary layer evolution at ~2.5 km.

The LIDAR-retrieved information (after off-line processes) (see.. Figure-1), will be subjected into a one dimensional model and will qualitatively provide various pollutants levels. The water vapour measurements provide a better idea for predicting rain. Fortunately, the experiment was carried out just before the summer rain began two hours later. Future plans intend to make use of LIDAR inputs for predicting rain.

References

[1] Sivakumar, V., A.Sharma, D. Moema, C. Bollig C. van der Westhuizen and H. van Wyk, CSIR-NLC South Africa Mobile LIDAR system description, *Proceedings of 24th international laser radar conference*, 99-102, 2008.