MONITORING OF VERTICAL AEROSOL PROFILES USING MICRO PULSE LIDAR

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Tropospheric aerosols play an important role in local regional meteorology eg visibility, air pollution, haze formation, hygroscopic nuclei for fog formation and energy balance of radiation. Specially in huge urban areas like New Delhi, India a large amount of aerosols from anthropogenic origins is continuously produced and released in the atmospheric boundary layer. The effect of aerosols on atmospheric energy balance is a key global change problem. Full knowledge of aerosol vertical distribution is difficult to obtain by passive sensing alone. Aerosol vertical distribution monitoring can be significantly improved using active remote sensing systems such as Lidar. Micro-pulse lidar proved to be an important state of art tool providing a detailed picture of the vertical structure of boundary layer and elevated dust or tiny aerosol. Aerosols are spatially and temporarily varied in short period. So at a long term continuous monitoring with a short repetition time is significant to understand problems related to fog, haze, air pollution and transportation. In night nocturnal inversion isolates the flow above from the surface and the flow near the surface is generally light and vertical transport of pollutants shut down. Studies show that night time processes have a critical role in the distribution of urban pollutants clearing out air over the city and distributing it to long way to rural areas where they became part of background. The movement of the pollutants can be tracked or mapped out as a function of time by the help of Lidar which is very important to understand the dynamics of particulate matters. The in-situ measurements of aerosol at ground will not be a true representation of total aerosol and its vertical distribution in the atmosphere, therefore the monitoring of vertical profiles of aerosol is very important and timely which is not possible by conventional methods. In view of the above a micro pulse lidar (MPL) is being setup at NPL, New Delhi to get vertical profiles of aerosol to study the radiative forcing and characterization of aerosols using depolarization ratio. The MPL will also be used for the study of the transport of aerosol. The Photograph of the Micro pulse lidar setup at NPL, New Delhi is shown in Fig1. Some of the features of the system are given in Table 1.

Table 1. Micro Pulse LIDAR specifications

Transmitter	
Laser type	Diode pumped solid state(DPSS) Nd Yag
Wave Length	532nm
Out put pulse energy	10 micro joule
Pulse repetetion rate	2.5 KHz Variable
Pulse width	10ns
Beam expansion	20x
Polarization ratio	100
Receiver	
Telescope optical design	Schmidt Cassegrain
Clear aperture	200 mm
Focal Ratio	f/10
Field of view	100 micro radian
Detector types	Photon counting type APD/PMT's with Amplifier, Discriminator and power supplies
Multi channel scalar	Two Channel Photon counting, A/D converters
Narrow Band Pass filtering	By Febry Perot Etalon
Height Range	50 cm to 20 km
Range resolution (selectable)	15m, 30 m, 60 m, 90 m,150 m, 300 m

The NPL micro pulse lidar system incorporates state of the art components viz DPSS laser, precision optical components, miniaturized electronics, photon counting detectors, high resolution multi channel scalers and Lap Top control monitoring and data processing computer. All main parts viz transmitter, receiver, optics and relevant hardware is mounted in rugged chassis. Polarization analysis is performed by simultaneously collecting backscatter by two PMT detectors placed at right angles to each other at the receivers end.

The principal components of the lidar system are a transmitter and a receiver. The transmitter is a rugged Diode pumped solid state Nd:Yag laser coupled with a half wave plate and a beam splitter, optics and a telescope as beam expander for beam collimation and minimizing divergence. The receiver fore optics is a 200 mm Schmidt Cassegrain zenith pointing fixed telescope with 3.048 meter focal length and f/10 focal ratio. The backscattered signal in the receiver section is collected on to a beam splitter which separates its horizontal and vertical components and directs them to two un cooled photon counting PMT's by collimating, focusing optics and narrow band pass interference filters. The MPL will be mounted on a van for the study of aerosol loading in different regions of the country covering rural, urban and semi- urban areas.

In the present communication details of the system and some preliminary results obtained will be presented.

Fig.1. Photograph of Micro Pulse LIDAR at National Physical Laboratory , New Delhi, India