Identification of the ABL height and its temporal evolution over a coastal station in the Northeast Monsoon region using Micro-Pulse Lidar observations

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The Mini Micro Pulse Lidar (MPL) is installed at SRM University, Kattankulathur (12.49^{o}N, 80.02^{o}E) on January, 2016 funded by Ministry of Earth Sciences (MoES), Govt. of India. The MPL is dual polarization elastic backscatter lidar developed at Sigma Space Corporation, USA, which continuously monitors aerosol and clouds from surface to up to about 20 km. The lidar is being operated between 1500 IST to 1100 IST on the next day on all the clear sky days. We have 308 days of lidar observations during January 2016 -January 2017. The lidar data samples at 30 m vertical resolution and 30 sec time intervals are averaged for 5 minutes before the atmospheric boundary layer (ABL) identification. Since lidar backscattering has generally multiple aerosols layers, detection of the top of the ABL is not straight forward. These layers either represent convectively mixed layer (or convective boundary layer (CBL)), elevated aerosol layer or the cloud layer at different levels. During night-time detection of the stable boundary layer (SBL) generally becomes difficult due to presence of the residual layer. Occurrences of the cloud during night-time further complicate the detection of the SBL. There are occasions when the SBL is completely overlain by the residual layer. In this study, we have used gradient method to identify the ABL height in the lidar backscatter profiles and compared with three independent observations viz radiosonde observations about 35 km away from lidar site, GPS RO collected within 1^{o} of the lidar site and CALIPSO available at closest proximity of the lidar site. The ABL height obtained from the lidar backscattering agree very well with radiosonde observations especially at 1730 IST (correlation coefficient 0.91) when compared to 0530 IST (correlation coefficient 0.69). We observed three types of the diurnal pattern of the ABL having: (1) no stable boundary layer (SBL) formation (i.e no diurnal variation), (2) very strong evening transition at about 1800-1900 IST and (3) well defined diurnal variations (formation of the SBL). For the well defined diurnal type, ABL becomes minimum during midnight consistent which either remains constant or increases with progress of night. The ABL height is about 2 km during daytime (CBL) and about 0.5 km during night-time (SBL). The day to day variation of the ABL studied for the late afternoon (1500-1600 IST), evening transition (1800-1900 IST), midnight (0000-0100 IST), and morning transition (0500-0600 IST) and before noon (1000-1100 IST). It is observed that day to day variation in the ABL height is very small at different timings of the day except at evening transition. The ABL remain within 2 km throughout the day except at 1000-1100 IST. The large day to day variation at 1800-1900 IST indicates collapse of the ABL after the sunset during evening transition.