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# Diurnal and seasonal variation of vertical velocity pattern in boundary layer over a high altitude site in central Himalayan region

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During the Indo-US collaborative Ganges Valley Aerosol Experiment (GVAX) a Doppler lidar (DL) was operated continuously from June 2011 to March 2012 at a high altitude site on Manora Peak (29.4$^o$ N; 79.2$^o$ E; 1958 m above mean sea level (amsl)) in the the Himalayan foothills. The lidar provided height-resolved measurements of vertical velocity and attenuated backscatter above the site. This study investigates seasonal and diurnal variations of vertical velocity and attenuated backscatter in the local boundary layer height $\sim$1 km above ground level (agl) during the monsoon(June-August) ,post-monsoon (September-November), winter (December-February) and pre-monsoon (March) periods. The upslope flows were observed during the daytime and down slope flows were are observed during the nighttime. The magnitude of the vertical velocity varied between 0.1-0.4 m.s$^{-1}$ in all seasons. The vertical velocity variances ranged from 0.2 to 1.5 m$^{-2}$s$^{-2}$. Variances were higher during the daytime due to convection. At night, the variance decreased due to cooling at the surface. There is good correlation ($R^2$ $\sim$ 0.26, 0.66 and 0.4) between the daily mean attenuated backscatter and relative humidity during post-monsoon, winter and pre-monsoon seasons respectively and an anti-correlation ($R^2$ $\sim$0.03) between the attenuated backscatter and relative humidity in monsoon season. There are very less co-relation ($R^2$ $\sim$0.06, 0.19, 0.002 and 0.12) between daily mean vertical velocity and attenuated backscatter in all the seasons respectively. The mean diurnal vertical velocity component is modulated by the terdiurnal (8-hour) component in all the seasons. We investigate the impact of variable weather conditions on vertical velocity.