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Occurrence of Exceptionally Large Temperature Gradients in the Lower Atmospheric Boundary Layer in Urban Environment — New Results

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Frequent occurrence of intense fog and haze events have been quite common in northen Indian region during winter months. Increasing urban pollution also seems to intensify such events. In order to have a better understanding of the phenomenon involved, simultaneous measurements of atmospheric radiation, aerosols, GHG, s and meteorological parameters have been made in the lower atmospheric boundary layer in the campus of National Physical Laboratory, New Delhi during last three years. The atmospheric temperature measurements are made using matched bead thermisters tower mounted at 9 levels (i.e. at 1 cms, 0.5m, 1m, 2m, 5m, 13m, 18m, 30m& 35m levels) above the ground surface. In addition, underground temperatures are also monitored at 5 levels below the earth surface at -1cms, -10cms, - 0.5m, -1m& -3m levels. Data are recorded round the clock at 1 minute interval on a PC based system. Occasionally, measurement are also made between 35 to 150m heights using tethered balloon. Simultaneous measurements of relative humidity and atmospheric pressure are also made. Vertical temperature profiles derived from these measurements depict the presence of a very strong inversion layer having exceptionally large temperature gradients (more than 250 degree Celcius per Km) during postsunset and nighttime hours almost on a daily basis. The temperature rise of 4 to 7 degree Celcius are seen from close to ground to 30m altitude. The temperature inversion starts building up around suset by rapidly cooling of the atmosphere layers close to the ground and relatively much slower cooling of the higher level layers (13m and above) due to green house effect. Within an hour of sunset, a strong inversion layer thus sets in having temperature minima any where close to ground surface (at 1cm level) to within 2m above ground, and elevated temperatures at higher atmospheric layers (above 18m). The important observation to be noted during such periods is that the earth surface temperature (i.e. at - 1cm level)including the underground temperatures, remain much higher than the temperature of the atmosphere close to ground. The atmospheric temperature at + 1 cm level has been found to be 4 to 6 deg celcius Lower than the earth surface skin temperature at (- 1 cm level). During rest of the night, the temperaure of the lower atmosphere continues decreasing gradually and also pulling the earth surface temperature to lower values at almost the same rate. This phenomenon appears to

be contrary to the present understanding of formation of post sunset inversion, wherein faster cooling of earth surface after sunset is supposed to be responsible for cooling of the atmosphere in its close proximity. Present observations, on the contrary, show that cooling of the atmosphere forces the earth surface to cool at a faster rate. Simultaneous measurements of aerosol indicate that the processes responsible for self cooling of the lower atmosphere, sandwitched between the hotter ground and the higher level atmospheric layers, is possibly linked to the anthropogenic aerosols also. Results are likely to give a new direction in understanding of the lower atmosphere micrometerology responsible for fog/haze in urban and rural environments.