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Near Surface Aerosol Characteristics at NPL New Delhi During ICARB 2006

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INTRODUCTION

The near surface atmospheric aerosols have direct & indirect influence on environment, air quality, visibility, human health and alter the radiation budget through radiative forcing, thereby affecting the global climate (Charlson et al., 1992; Boucher and Anderson, 1995; Moorthy et al., 2001). Aerosol size distribution influences the dynamics of aerosol number density, their production process, the size transformation and lifetime. National Physical Laboratory (NPL) participated, during March to May 2006, in the ISRO-GBP sponsored "Integrated Campaign for Aerosols, Gases & Radiation Budget (ICARB)" program. In this paper we present the near-surface aerosol characteristics during ICARB at NPL, New Delhi that lies in a semiarid zone in northern India. The temporal evolution of aerosol loading, size distribution, number-size distribution data measured using Quartz crystal microbalance (QCM) (model PC-2 of California Measurements Inc.) are presented and discussed.

Methodology

Near real time measurements for mass-size distribution of aerosols are made regularly during ICARB land campaign, from March to May 2007 using the QCM. It samples the ambient air and segregates the aerosols in accordance with the aerodynamic diameter (0.05 to 25 μm) into ten size bins and provides direct information on two parameters of aerosols, namely the total mass concentration (M_t) and the mass concentration (m_{ci}) in each of its size bins (Pillai and Moorthy, 2001). The instrument was operated on the NPL terrace at about 13 m above ground and at ambient relative humidity (RH) below 75%. The monthly mean relative humidity and temperatures data are taken from the meteorological observation facility in NPL. QCM day-data (9:00 to 17:00 hrs) with a sampling duration of 1 minute at every 15-minute interval for about 6 to 8 hours per day was collected during campaign.

Result and discussion

Figure 1 (a, b, and c) represent the daytime monthly average data of total mass concentration (TSP) upto PM_{25} as measured by QCM during the ICARB period. The vertical bars for the given period in the figure represent the standard deviation of the daily monthly mean. Average TSP loading during the months of March, April and May is 74±46, 40±16 and 48±20 □g m^{-3} respectively. The maximum and minimum temperatures variations are between 35 to 45^{0}C and 11 to 21^{0}C respectively, with the ambient RH variation in the range of 30-75% (Fig. 2a & b). The prevailing winds (average speed ~ 6 m/s) are in west-east direction during this period (Fig.2c). High TSP loading during fore noon in March may be due to boundary layer inversion and in other months the period has

mid day TSP increase due to dry surface conditions and high convective activity owing to high sensible heat flux caused by increased surface heating (Kunhikrishnan et al., 1990; Prakash et al., 1992). Abrupt rise in the TSP on 21st and 24th April may be due to dust storm arisen from Thar Desert region on the west, as confirmed by back trajectory analysis. High value in the TSP on 9th may be due to dust storm arisen due to surface heating as evident from meteorological conditions (temperature 43±5 ^{0}C, Humidity 45±8 % and wind speed 8-10 m/s). Aerosol's average number size distributions for the month of March, April and May lies between 10^4 - 10^{13} m^{-3} μm^{-1} (Fig. 3). Fine mode particle sizes ($\leq$ 0.8 m) have maximum number-size density for March, whereas the accumulation & coarse mode particle sizes (0.8 to 1.6 and 1.6 to 3.2 m and more) show distinct dominance in the month of May. This can be due rise in temperature as compared to March with change in meteorology & wind patterns, and also due to onset of summer with inflow of air mass from western Indian region.

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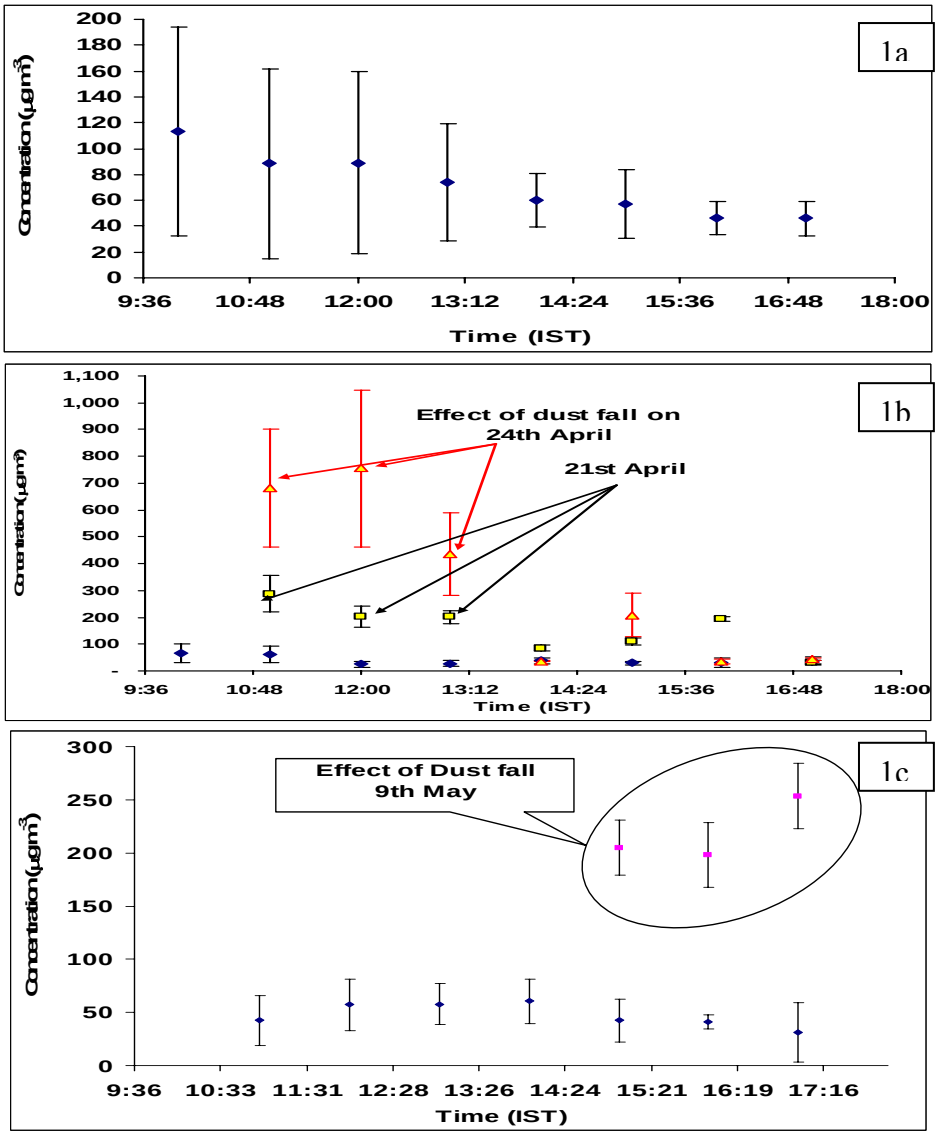

Fig. 1: Day time monthly average TSP variation in (1a) March, (1b) April and 1(c) May 2006

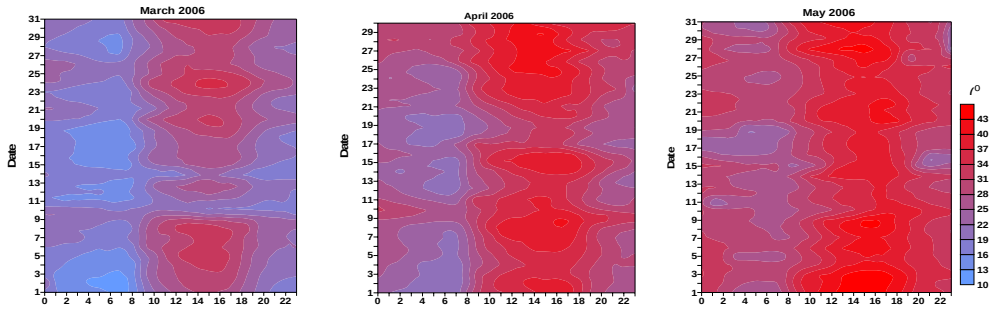

Fig. 2a: Air Temperature during March at NPL, New Delhi, April and May 2006.

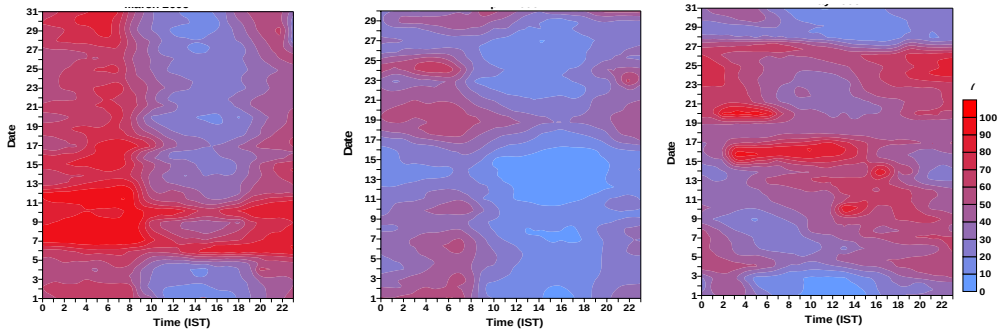

Fig. 2b: Relative Humidity Delhi during March at NPL, New, April and May 2006**.**

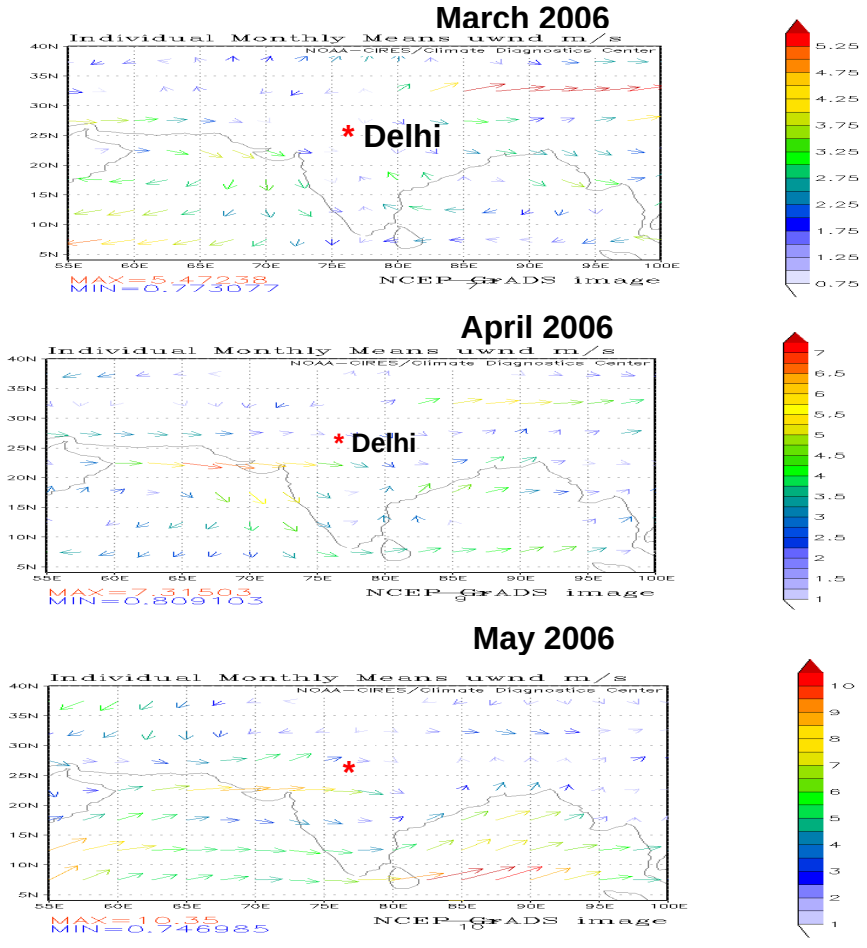

Fig. 2c : Wind pattern during March, April and May 2006 at NPL, New Delhi

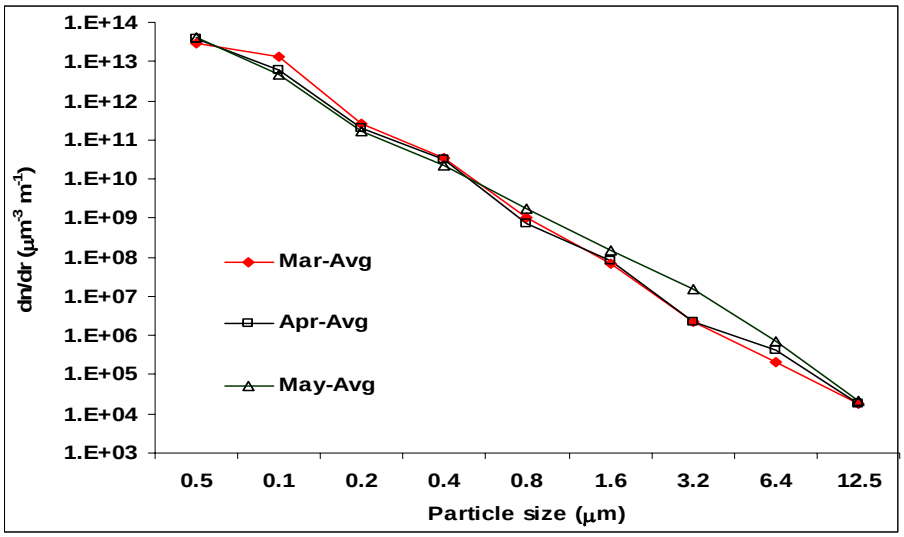

Fig. 3: Number-size distribution measured during the month from March to May 2006