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CHANGES IN AEROSOL CHARACTERISTIC DUE TO CHANGES IN LAND-SEA BREEZE OBSERVED OVER KALPAKKAM

SANAT K. DAS* AND A. JAYARAMAN
Space and Atmospheric Sciences Division, Physical Research Laboratory,
Ahmedabad -380 009, India
*email: sanat@prl.res.in

Atmospheric aerosol is a major source of uncertainty in climate change studies due to the lack of data on the temporal and regional distribution of aerosol with required accuracy. The changes in regional radiative budget can alter large scale circulation and the hydrological cycle. In this context, the east coast of India shows large seasonal variations in aerosol concentrations. In this paper we present the observed changes in aerosol characteristics due to the reversal of land/sea breeze over Kalpakkam (12.56°N and 80.12°E), a station situated at the south-east coast of India.

Measurements were carried out at the Indira Gandhi Centre for Atomic Research, Kalpakkam a small township 80 km far from Chennai as a of the integrated campaign for Aerosol Budget (ICARB) during 16th March – 1st April 2006. During the campaign period variation in temperature was found very small with a mean surface temperature of 30.7±1.7 °C. Being a costal site, the station experienced large diurnal changes in wind direction and speed. In general, during early morning hours wind was from the main land (land breeze) and rest of the time wind was mainly from the Bay of Bengal (BoB) (sea breeze). In present study wind coming from 30-210° (clockwise from North) is considered as sea breeze and rest of wind as land breeze. During the land breeze regime wind speeds were in general less than that during sea breeze.

Aerosol Optical Depth (AOD) was made using Microtops sunphotometer [Morys et al., 2001]. The AOD measurements were made simultaneously in five different narrow wavelength bands centered at 0.38, 0.44, 0.5, 0.675 and 0.87 µm .Each optical filter has a bandwidth of about 0.01µm and a field of view of 2.5°. With the help of another Microtops AOD at 1.02 µm, the total columnar ozone concentration and water vapor values were measured. Both the instruments were regularly calibrated using the Langley plot technique carried out at the clear atmosphere of Mount Abu (26.6°N, 72.7°E) at a height of 1.7 km from mean sea level. The absolute uncertainty in the AOD value is less than 0.03.

Black Carbon (BC) mass concentration and aerosol absorption coefficients at seven different wavelengths centered at 0.37, 0.47, 0.52, 0.59, 0.66, 0.88 and 0.95 µm were measured using a multichannel Aethalometer (model AE-42 manufactured by Magee Scientific, USA; Hansen et al., 1984). The instrument measures real-time attenuation of light transmitted through quartz-fiber filter on which the particles are deposited with a constant flow rate 3.0 $l.min^{-1}$of ambient air. Data is averaged for of 2 min and stored. The real-time BC mass concentration is considered for 0.88 µm wavelength channel as the spectral response of elemental carbon particles has a peak near this wavelength (Bodhaine, 1995). From the difference in the light transmitted through the particle deposited sample spot and particle free reference spot on the filter by using a suitable calibration constant, aerosol absorption coefficients (σ_{abs}, m^{-1}) at above mentioned wavelengths we calculated using the formula proposed by Bodhaine, 1995 and Weingartner et al., 2003. The inlet of the Aethalometer was kept at 50° C temperature with the help of a temperature controller.

Diurnal variations of black carbon concentration, wind direction, wind speed and temperature are shown in figure (1). The shaded region is the variation in mean values in each plot. The BC concentration has only one peak during the morning hours and the second peak normally found at other places like Ahmedabad, Delhi, Kanpur [Ganguly et al., 2006 , Tripathi et al, 2005] is found missing. Over Kalpakkam during evening hours the wind was mainly coming from the sea which has relatively less BC which are produced due to anthropogenic activities. During the land breeze period BC concentration has found 2-4 times higher than that during sea breeze. Also during land breeze, wind speed is low and temperature is at minimum which favored to the low ventilation and high anthropogenic BC concentration. It is however noticed that on 20-29th March during sea breeze average BC concentration has increased by a factor of 2. These days wind was found coming from the Indo-Gangetic basin which is rich in anthropogenic aerosols. Rest of the days wind was coming from the Northern part of Indian Ocean which has fewer amounts of anthropogenic aerosols.

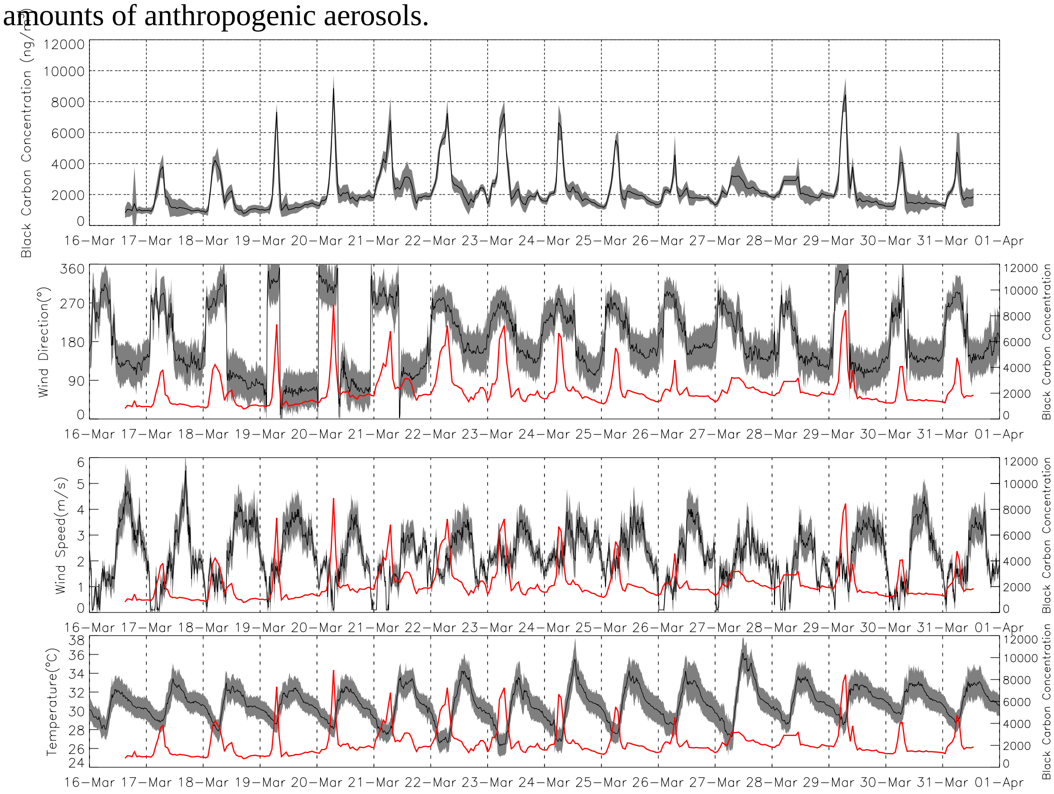

Figure 1 Diurnal variations of black carbon concentration, wind direction, wind speed and temperature are shown and the shaded region is the one-   variation.

Aerosol Optical Depth (AOD) observation at 0.5 µm wavelength on cloud free days shows that during land breeze AOD is about 0.34 and during sea breeze it becomes 0.30 due to the high abundances of sea-salt particles . Radiative forcing calculations are made for the wavelength range 0.28-40   m using SBDART (Santa Barbara DISORT Atmospheric Radiative Transfer), developed by Ricchiazzi et al. [1998]. It is found that the top of the atmosphere aerosol radiative forcing is -0.02 W/m^2 during land breeze and during sea breeze it becomes -3.78 W/m^2. On some days BC concentration was high the aerosol radiative forcing became positive during land breeze.

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