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AEROSOL CHARACTERISTICS OVER INDIA DURING THE ICARB

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Introduction

An exhaustive, multi-instrumented, multi-institutional, multi-platform, field campaign, ICARB (Integrated Campaign for Aerosols gases and Radiation Budget), was conducted during March-May 2006, under the ISRO Geosphere Biosphere Programme (Moorthy et al. 2006). The land segment of ICARB was aimed at campaign mode observations of spectral aerosols optical depth (AOD) and mass concentrations (M_B) of aerosol BC from several fixed laboratories spread over the Indian mainland and the two islands Minicoy (MCY, in the Arabian Sea) and Port Blair (PBR, in the Bay of Bengal). The spatial distribution of these stations is given in Fig. 1. This provided a unique time series of the parameters concerned over the mainland and adjoining stations.

Observational details

Columnar AODs have been estimated during the period of ICARB at ten wavelengths (380, 400, 450, 500, 600, 650, 750, 850, 935, 1025) using a Multi-Wavelength solar Radiometer (MWR) at Kullu (31.9°N, 77.1°E, 1155 m, KLU), Dehra Dun (30.34°N, 78.04°E, 680 m, DDN), Nainital (29.2°N, 79.3°E, 950 m, NTL), Dibrugarh (27.3°N, 94.6°E, 104 m, DBR), Port Blair (11.63°N, 92.7°N, 73 m, PBR), Visakhapatnam (17.7°N, 83.3°E, 66 m, VSK), Hyderabad (17.48°N, 78.4°E, 545 m, HYD), Anantapur (14.7°N, 77.6°E, 335 m, ATP), Minicoy (8.2°N, 73.0°E, 1m, MCY), and Trivandrum (8.55°N, 76.9°E, 3m, TVM). Besides, AOD measurements were also made regularly using Microtops sun-photometers, at 340, 500, 670, 936, and 1020 nm, from Delhi, (28.58°N, 77.2°E, 216 m, DEL). In addition, under AErosol Robotic NETwork program (AERONET), spectral AODs (level 1.5 data) are available from the Indian Institute of Technology (IIT) Kanpur, (26.4°N, 80.3°E, 142m, KNP) and Gandhi College campus (25.8°N, 84.1°E, GC) using CIMEL radiometer within the spectral range of 340-1020 nm.

Instrumental details are available in Moorthy et al., (1997; 1999) (for MWR) and Holben et al., (1998; 2001) for AERONET. Continuous and near-real-time measurements of M_B were carried out using Aethalometers from TVM, MCY, PBR, DEL, Kharagpur (22.5°N, 87.5°E, 40m, KGP), and Pune (18.53°N, 73.85°E, 560 m, PUN).

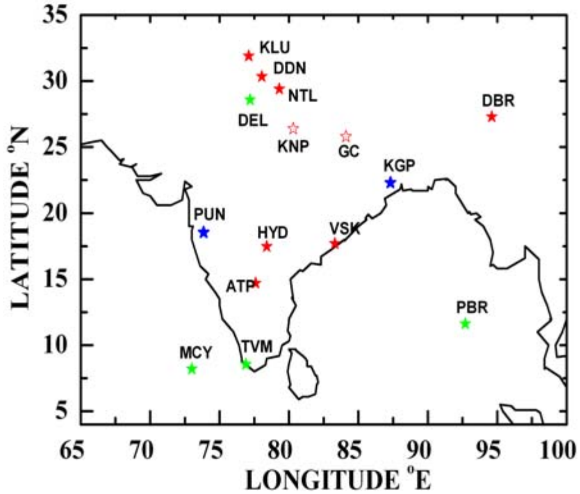

Fig-1: The network stations operated during ICARB. Filled stars denote the I-GBP network stations with the red colour representing stations having only spectral AOD measurements, and green representing stations having both M_B and spectral AOD measurements, blue represents stations having only M_B and the unfilled stars represent the AERONET stations having observations at ICARB period.

Results

Aerosol Optical depth

Spectral variations of monthly mean AODs depth for the above stations are shown in Fig. 2 with the panel from left to right for months of March, April and May respectively. For March, highest AODs are observed at ATP in the central peninsula, followed by HYD, DBR, TVM, and DDN; the least AOD values are observed for the high altitude stations NTL, and KLU. The spectra are comparatively steeper at TVM, VSK, and HYD. During April the AOD spectra become steeper (than March) for PBR, HYD and ATP, while at other stations (TVM, KLU, NTL, KNP, DDN, and DHI) they tend to flatten. AOD increases substantially over TVM, HYD, KNP and DDN, while at NTL it was only marginal. By May AODs become highest at DEL (0.98), followed by KNP and GC. In the south, ATP and HYD show an increase in AOD from March to May, whereas it start decreasing at TVM and MCY. Among the high altitude stations, KLU and NTL show a small increase from March to May, whereas for DDN, the increase in AOD from March to April is exceptionally high. In east, DBR shows a gradual decrease in AOD from March to May. All these show the prevalence of a large Spatio-temporal heterogeneity.

Angstrom Coefficients

The wavelength exponent α, indicating the size distribution, and the turbidity parameter, β, (a measure of aerosol loading) are calculated for each stations using the Angstrom power law, $\tau = \beta\lambda^{-\alpha}$, where τ the optical depth and λ the wave length. Angstrom wavelength exponent shows higher values in March at VSK, HYD, and TVM with highest in VSK, and shows a decrease to April. The IGP stations shows lower values of α in March and it continues to decrease towards May, showing increasing a bundeance of coarse mode particles, associated with the raising of dust

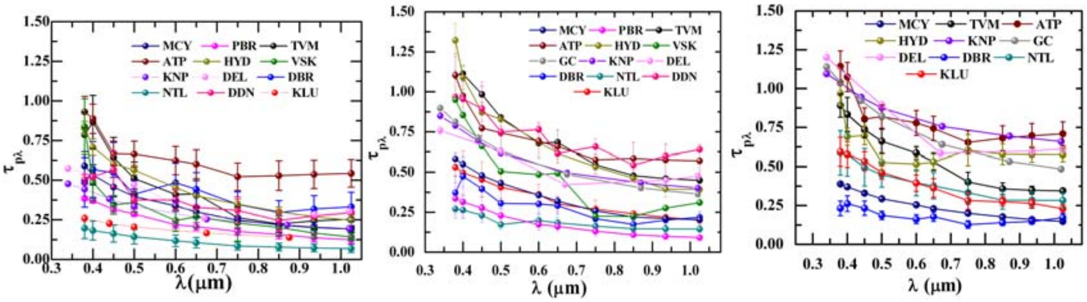

Fig-2: Monthly mean Spectral variations of AOD for different stations during March, April, and May respectively in panels left, middle and right.

BC Mass Concentration

We have aerosol Black Carbon measurements over five stations during the period of ICARB, TVM, PBR, KGP, PUN and DEL. For all the above stations the diurnal pattern are quite similar with a nocturnal peak and midday minimum. The temporal variations of daily mean BC concentration at these stations are shown in Fig. 3 (left panel), and that of the monthly mean values of M_{BC} are shown in Fig. 3(right panel). While the monthly mean values of M_{BC} decrease from January to May at TVM, PBR, KGP and PUN, DEL shows a peak in April. Amongst these stations, DEL shows the highest BC concentration and MCY shows the least.

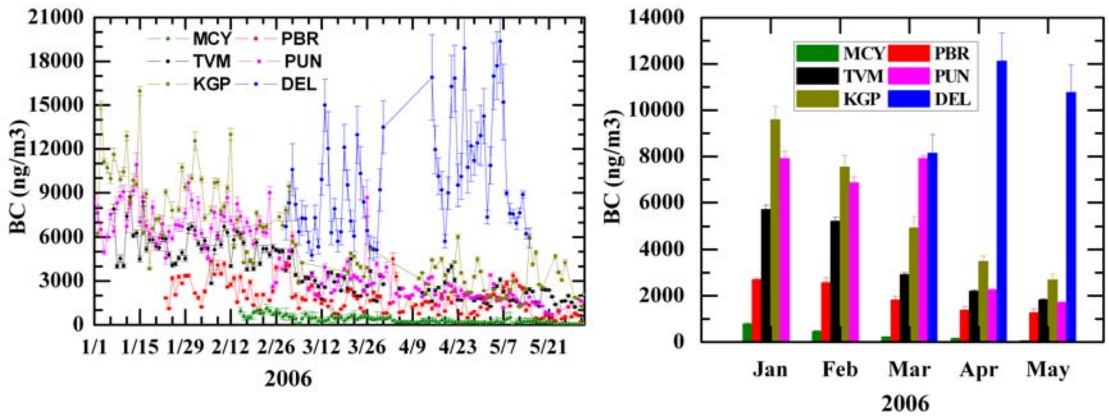

Fig-3: Monthly mean values of BC mass concentration for different stations of TVM, PBR, PUN, KGP and DHI during ICARB.

References

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