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SPATIAL DISTRIBUTION OF AEROSOLS OVER THE MARINE ENVIRONMENT OF BOB DURING ICARB

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1. Introduction

The interactions of aerosols with solar and terrestrial radiation as well as their consequent climatic impacts are widely discussed topics today. Several field experiments and campaigns are being conducted all over the world to identify the major sources of atmospheric aerosols, and to delineate the role of atmospheric circulation in transporting them to cause global impacts. Though dedicated experimental programmes for aerosol characterisation over south Asian regions are scarce before Indian Ocean Experiment (INDOEX) much attention is being paid in this direction in the recent times. Integrated Campaign for Aerosols gases & radiation Budget (ICARB) has been one such effort under ISRO-Geosphere Biosphere Programme (IGBP) to study the aerosol properties and their radiative effects in the Indian scenario. The ICARB was a multi-platform, multi-instrumented and multi-institutional field programme aiming at the mapping of aerosols and trace gases over the Indian landmass and adjoining oceanic environments. Major focus of these measurements was to delineate the aerosol sources, sinks and transport mechanisms and to quantify their climatic/environmental impacts. During this campaign simultaneous measurements were carried out from land stations, ship and air craft to have an integrated picture. Ship-based measurements of aerosol parameters and trace gases were carried out over Bay of Bengal (BoB), Indian Ocean (IO) and Arabian Sea (AS) during March-May, 2006 on board the Oceanic research vessel Sagar Kanya (Cruise No. SK 223A&B). Preliminary results from the ship-borne measurements of aerosol mass loading, contribution of major chemical species, columnar AOD and water vapour over BoB during the cruise of Sagar Kanya (No. SK 223A) are presented in this manuscript.

2. Cruise Track

Fig.1 shows the track of the cruise track of SK 223 A. The ship started from Chennai on March 18, 2006 sailed towards north following a track almost parallel to the east coast to reach near Calcutta on March 21 and then proceeded towards Myanmar coast. Following this the ship took a zig-zag route along latitude and longitude, as shown in Fig. 1, to map the entire oceanic region at small grid sizes and reached Chennai on April 01.

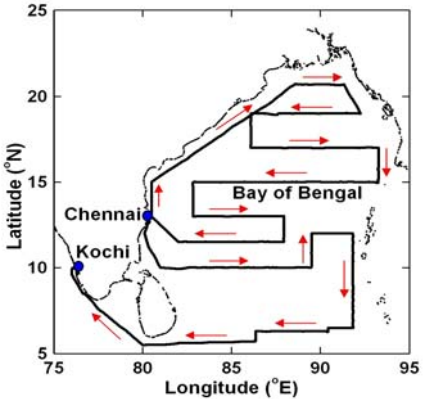

Fig. 1 Cruise track of SK 223A during ICARB

Starting from Chennai on April 02, the ship again sailed towards Andaman and Nicobar islands and moved further towards south to reach 5.5°N, 92°E and then towards west

along a route close to Sri Lanka and reached Cochin on April 13 after completing its 27-day cruise.

3. Instrumentation and data

Regular measurements of aerosol mass loading, columnar aerosol optical depth (AOD) and column water vapour content have been carried out on this cruise. Aerosol samples have been collected using a High Volume Sampler, a single stage instrument operating a flow rate of 20CFM. It uses quartz fibre filter as collection substrate and samples total suspended particulate matter. About 38 samples have been collected from the marine environment of BoB covering latitude sector of 5°N to 20°N covering a longitude span of 80°E to 93°E. The columnar AOD at 1020nm and column water vapour have been measured using Microtops II Sunphotometer/Ozone monitor.

4. Results and discussions

4.1 Spatial variation of aerosol parameters

Over the marine environment of BoB, the total aerosol mass loading varied from 10 μg m^{-3} to 100 μg m^{-3}. Fig. 2 shows the spatial variation in mass loading (normalized to the maximum) over the Bay of Bengal. A prominent high in aerosol mass loading was observed close to the east coast as well as at the head BoB region.

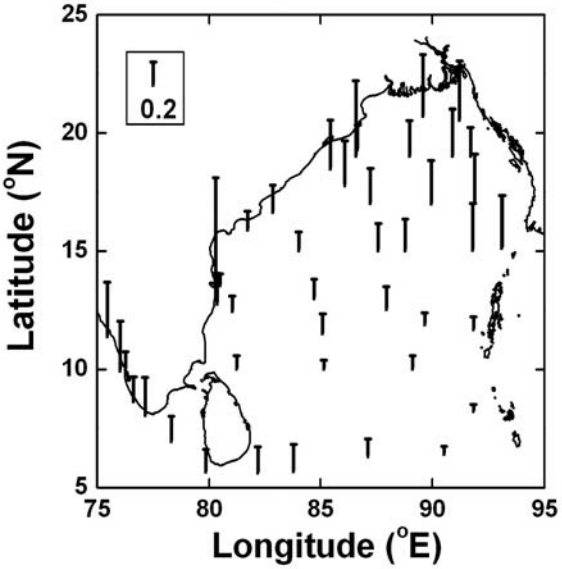

Fig. 2 Spatial variation of aerosol mass loading (normalized to the maximum) over the BoB

The observed aerosol loading was notably low in the southeast BoB. The enhanced aerosol loading is confined to latitudes above 12°N. The columnar loading of aerosols also showed more or less similar spatial feature but the region of high AOD was found to be detached from the east coast towards east. Lower AOD values have been measured in the southern parts of BoB (south of ~12°N). The columnar water vapour content was found to be highest at the mid and southern BoB.

4.2. Latitudinal variation of aerosol chemical species

The aerosol samples collected were also analyzed for various chemical species. Ion Chromatography has been used for the analysis of major anions viz., SO_4^{2-}, NO_3^-, Cl^-, etc. and for the water-soluble fractions of various cations, viz., NH_4^+, Na^+, K^+, Mg^{2+} and Ca^2. Acid soluble components like Fe, Al, Ca, etc. were analyzed using the technique of ICP-

AES (Inductively Coupled Plasma – Atomic Emission Spectroscopy) and Na and K by Atomic Absorption Spectroscopy. Mass loadings of most of the aerosol species were well above the oceanic background values. Species of continental/anthropogenic origin like SO_4^{2-}, NO_3^-, Fe, Ca, Al etc. dominated over the northern parts of BoB as well as near-coastal regions. Major continental species exhibited enhanced mass loading towards north of ~12°N latitude. Significantly lower loading of these species was observed over the southern BoB. The spatial patterns of aerosol parameters were examined in terms of boundary layer meteorological conditions. Flow patterns obtained from NCEP/NCAR Reanalysis and the surface meteorological parameters recorded onboard the ship have been used in this study. The flow patterns indicate low wind conditions with convergence persisting in the northern BoB. This pattern also indicated significant advection of continental aerosols over to the oceanic environments of BoB.