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SPATIAL HETEROGENEITIES IN THE MASS CONCENTRATION OF NEAR-SURFACE AEROSOLS OVER THE ARABIAN SEA DURING ICARB

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Introduction

Extensive characterization of aerosol properties over the oceanic regions surrounding Indian peninsula were limited to the (i) Indian Ocean Experiment (INDOEX, Ramanathan *et al.,* 2001) focusing on the northern Indian Ocean during winter season; (ii) Arabian Sea monsoon Experiment (ARMEX, Moorthy *et al.,* 2005), which addressed to the small warm pool region in the south east Arabian Sea during inter monsoon season and summer monsoon season and (iii) few short cruises along the Indian coastal waters. Despite the significant importance of the Arabian Sea to the weather and climate of Asia and Africa, and the varying impacts of the vast and diverse continental land mass near to these vast oceanic region, an investigation of the entire Arabian Sea between India and Africa has been attempted for the first time only during the ICARB (Moorthy et al., 2006). During the second phase of ICARB extensive and collocated measurements of aerosol properties were made over the Arabian Sea.

Cruise details and measurements

During the second phase of the Ocean segment of ICARB from April 18 to May 11 was focus was on the Arabian Sea and measurements were made onboard the cruise SK223B of the ORV Sagar Kanya over the vast regions of Arabian Sea covering regions from west coastal India to far as far as east cast of Somalia and Oman, from 9°N to 21°N, within a span of 26 days. Cruise commenced from the port of Kochi (9.9°N, 76.2°E) on 18 April 2006 and after the expedition culminated at Goa (15.4°N, 73.7°E) on 11 May 2006. The cruise track is shown in Fig.1 by the solid line and daily position of the ship at 05:30 UTC is shown by the solid points and major ports on the west coast of India and Arabia are shown in the figure.

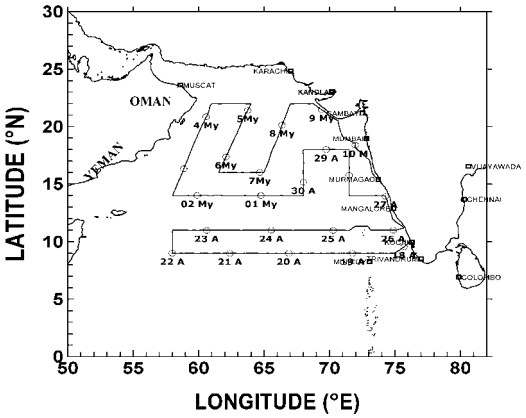

Fig. 1: Cruise track of ICARB second phase over the Arabian Sea (SK223B) in solid line and solid circles on the lines show the position of the ship at 5:30 UTC. Cities along the east and west of Arabian Sea are marked.

Size segregated measurements of aerosol mass concentrations were carried out

using a 10-stage quartz crystal microbalance (QCM) cascade impactor (PC2, California measurements inc., USA), having lower cut off (50%) at particle diameters >25, 12.5, 6.4, 3.2, 1.6, 0.8, 0.4, 0.2, 0.1, and 0.05μm respectively for stages 1 to 10. Details of instrument, sampling procedure, data analysis and error budgeting are available in Pillai and Moorthy, (2001).

Results and discussion

Total aerosol mass concentration (M_T) varied from 5 to 45 μg m^{-3} over the Arabian Sea during the cruise period. The spatial distribution of M_T is shown in Fig. 2. About 60% of the M_T values were between 10 to 18 μg m^{-3} with a mean value of 16.7±7 μg m^{-3}. It is interesting to note that the concentrations obtained from current measurements were 2-fold lower than the values reported from earlier measurements over the Arabian Sea during Indian Ocean Experiment (INDOEX) cruise (Parameswaran *et al* 1999; Ramachandran 2004). Significant deviations from the mean pattern were observed mainly on three regions (1) central AS, (2) northern AS, and (3) along the west coast of peninsular India and these regions are marked (as 1, 2, and 3) in Fig. 2 and their details are examined. Extremely low mass loading was observed over the south and central AS; the region bounded between 65 to 70°E in longitude and 10 to 15°N in latitude, with mean values always <15 μg m^{-3}. Northern Arabian Sea showed very high values of M_T (~30 μg m^{-3}) and it is mainly attributed to the mineral dust transport based on the earlier measurements and model results. Mean value of 20 μg m^{-3} was persisted along the west coast of India with high values very near to the port. Anthropogenic activities on the highly industrialized urban areas and ports in west coast of peninsular India, Kochi, Mangalore, Goa and Mumbai, were also influence the M_T over the coastal region as shown in Fig. 2. Over the entire AS, average percentage contribution of accumulation mode to the total is 42% and more than 62% of the M_A/M_T values were lies between 0.35 and 0.55. M_A/M_T values were greater than 0.75 is nearly 4% of the total measurements. This shows the dominance of super micron/coarse mode sea salt and mineral dust aerosols over the entire AS in contrast to the earlier observations of very high sub micrometer aerosol loading. More details regarding the spatial heterogeneity of total mass concentration over the Arabian Sea will be presented.

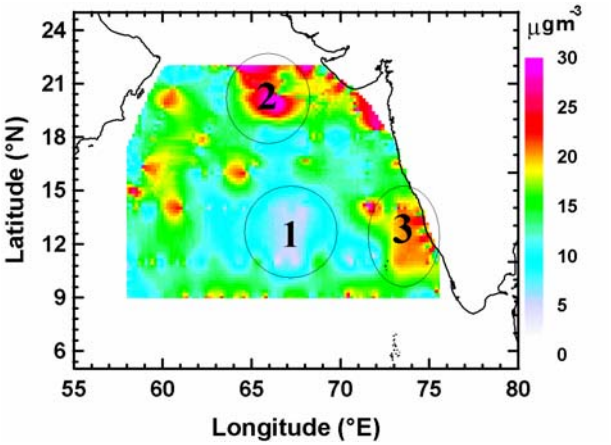

Fig. 2: Spatial variation of total mass concentration over the Arabian Sea. Regions having distinct aerosol properties are marked as 1, 2 and 3.

Reference

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