Study of relative variation in attenuation of visible solar radiation reaching the earth surface

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ABSTRACT

Aerosol Optical Depth (AOD) are derived from direct solar radiation measurements at selected wavelengths in visible and near infrared region, onboard a Ship Cruise during Oct.- Nov. 2004 period along Indian West Coast and over North Indian Ocean near equator. It is found that AOD was 3-6 times larger along the coast compared to deep-sea area. The Minimum Erythemal Doses (MED/ Hr) derived from global UV-B measurements were found 50% higher on deep sea area compared to coastal area.

INTRODUCTION

Solar radiation, while traversing through the atmosphere, is affected by the presence of atmospheric gases, water vapour and aerosols. The distribution of aerosol is not uniform globally and is dependent on distribution of their sources and the local, regional and global atmospheric dynamics. The dynamical processes carry the pollution generated over the mainland to the ocean side and vice-versa [1]. The aerosol properties over Indian Ocean have shown unique features during the month of February–March [2]. To see the behaviour of the aerosols during October–November period, an observation campaign was undertaken, over the North Indian Ocean surface to study the flow of pollution from Indian Mainland towards the ocean or vice-versa, during the month of Oct-Nov, 2004 and the solar radiation intensities were measured in UV, Visible and Near Infrared region of wavelengths. The unique features of Asian aerosols will provide special input to their climate impacts [3].

INSTRUMENTS USED

During the above campaign, two instruments were used, one was Microtops Sunphotometer which measures radiation intensities, in direct measurement mode, at five wavelengths i.e. 340, 500, 675, 870 and 1020 nm using narrowband interference filters. From the intensity values observed during the above campaign at above mentioned wavelengths, the Aerosol Optical Depths (AOD), which is a aerosol attenuation indicator for solar radiation, after eliminating the non-variable attenuation factors, are derived. The second instrument was Ultraviolet-B Biometer (UV Biometer) which measures solar radiation intensity in 280-340 nm wavelength band using a wide band filter and the radiation intensities, after convolution with Erythema action spectra, are converted to the minimum Erythemal Dose (MED) which are direct indicators of skin damage factors due to UV-B radiation.

CAMPAIGN AREA

The instruments were taken on board the Sagarkanya Ship, which sailed from Karwar (14° 47' N, 74° 03' E) on 11th Oct 2004 and returned to Goa (15° 29' N, 73° 49' E) on 17th Nov 2004. During the onward journey the ship remained along the west coast of India during 11-14 Oct, 2004, (Lat:14° 47′-5°19' N) in the deep ocean around equator during 16th Oct.-10th Nov 2004 (Lat: +-2°N/S) and again during return journey along west coast during 11-17 Nov 2004 (Lat: 2°-15°N).

DATA ANALYSIS AND RESULTS

The data on AOD at 5 wavelengths during the whole cruise are analysed to find out the relative variations at different locations.

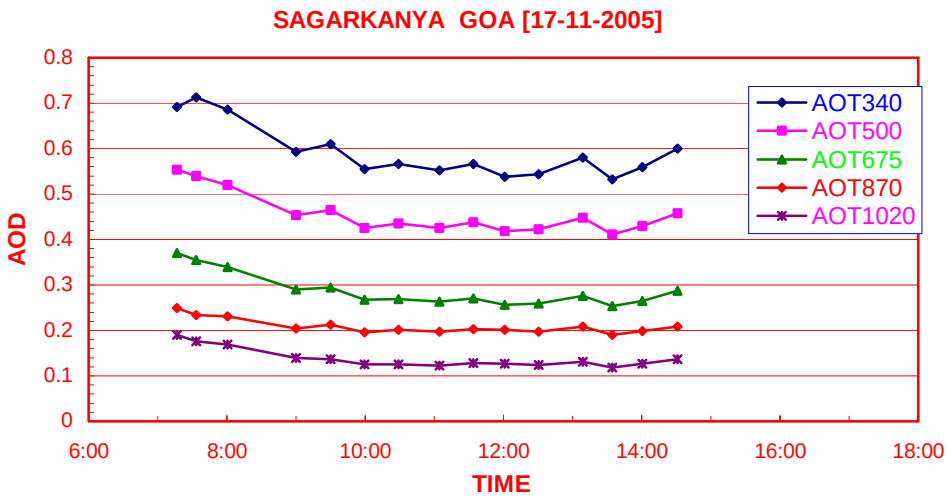

Fig 1. Diurnal variation of AOD at Coastal Ship location at different wavelengths

It is found that along coast the AOD was higher than those over the deep sea around equator. On coastal side the AOD varied between 0.15 to 0.55 for different wavelengths and being larger at shorter wavelengths and lower at larger wavelengths. The AOD values decreased for each wavelength as soon the ship sailed into the deep sea. At the near Southern Indian tip location of ship the AOD values decreased about 50% compared to coastal values and the ship sailed still deeper into the Indian Ocean near the equator the AOD values further decreased. The typical average AOD at 500nm was 0.45 (fig 1),0.25 (fig 2) and 0.08 (fig 3) at coastal, Indian Southern tip and deep ocean near equator locations respectively.

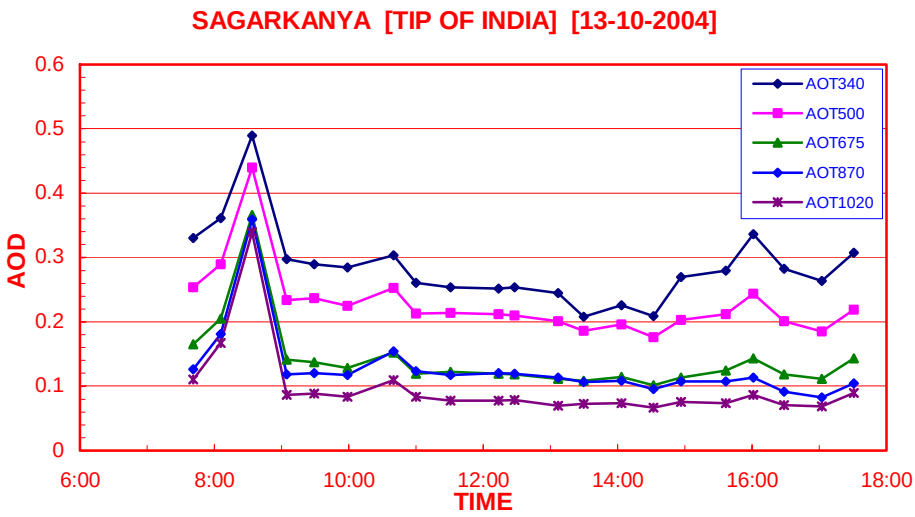

Fig 2. Diurnal variation of AOD at Southern tip of Indian Ship location for different wavelengths

This reduction was not found to be same for all the wavelengths. The 340nm radiation experienced the maximum reduction up to one sixth of its coastal values. The next highest reduction was found to be in 675nm radiation. The AOD values corresponding to the 500nm, 870nm and 1020nm radiations decreased to one fourth, one third and one third respectively.

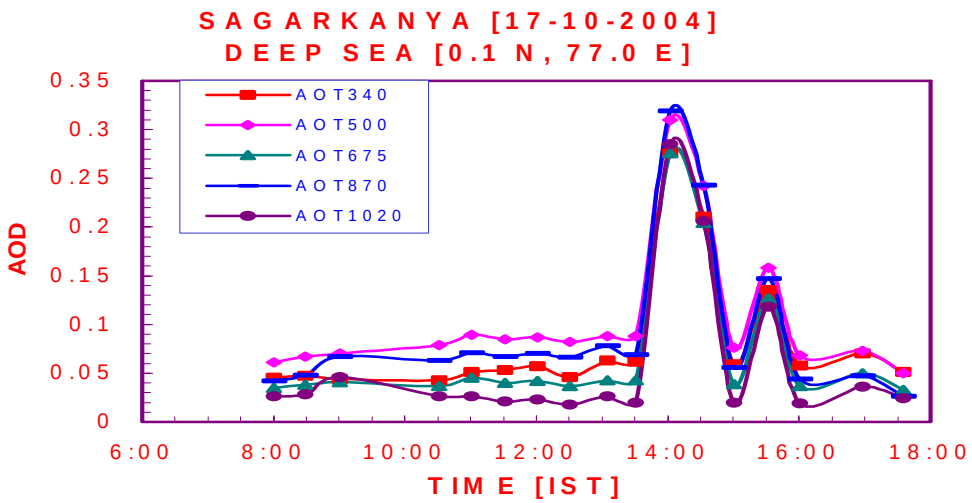

Fig.3 Diurnal Variation of AOD at near equatorial ship location for different wavelengths

The data collected by UV-Biometer on MED was analysed to see the relative variations in attenuation due to total column ozone and the pollution levels. It is found that MED values were 50% higher over deep sea locations compared to the coastal locations (fig. 3) The MEDs shown in fig 4 at local noon time were nearly 2.5 and 3.8 at coastal & deep sea locations respectively.

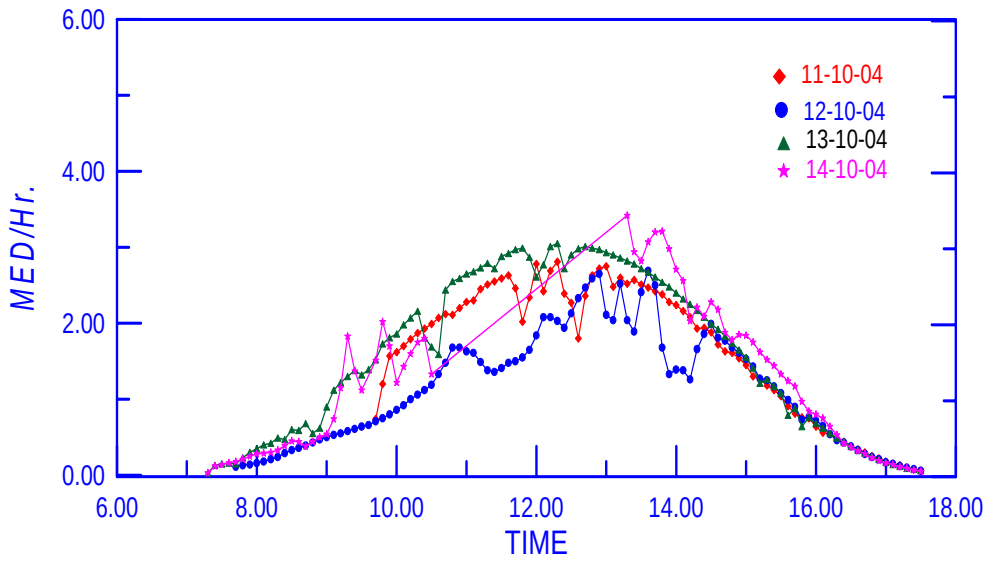

Fig 4 Diurnal variation of MED/ Hr for different days when Ship remained along Indian West Coast

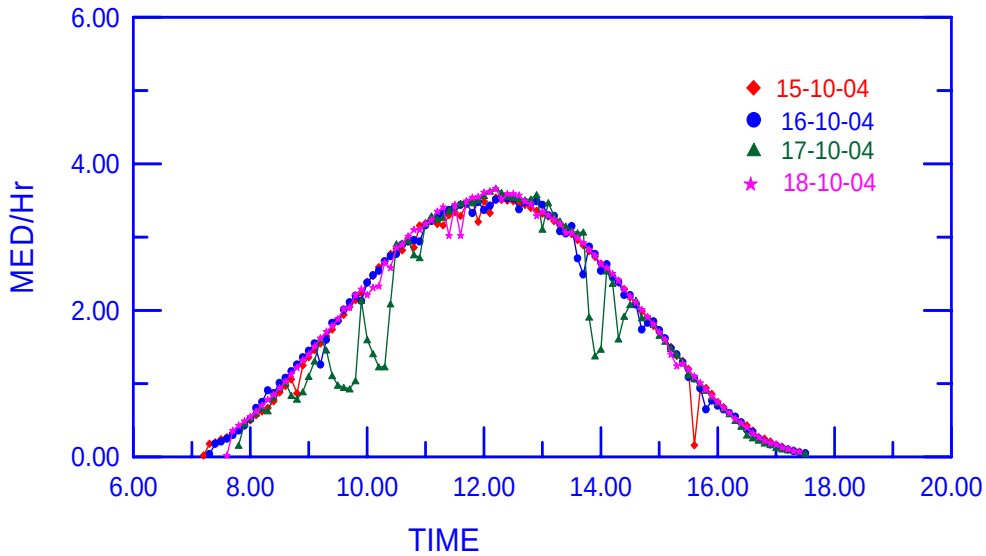

Fig: 5 Diurnal variation of MED/Hr. for different days when Ship remained near equatorial locations

It may be because of the reason that three factors may be contributing toward the increased MEDs over deep sea locations viz. (i) near the equator the column ozone is less than that over coastal locations (ii) the Solar Zenith Angle is higher near the equator than for coastal region during the campaign period.(iii) The pollution level aerosol content is higher at coastal region compared to the deep sea locations.

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