

# Aerosol Optical Depth and Black Carbon Concentration along the Coast of Bay of Bengal

Vinod Kumar A., Jagatheeswari A., S. Muneeswaran S., Palanivelraja S., Chockalingam, M.P.

**Abstract:** Climate can be affected by Atmospheric Aerosols through the Earth's incoming solar radiation. Monitoring of aerosol concentrations is essential for understanding the atmospheric effect on the earth's surface. Therefore, the Aerosol and their radiative effects are important in climate forcing studies. This study is undertaken to investigate the aerosol optical depth and black carbon concentration by satellite based measurements over Bay of Bengal.

**Keywords:** Aerosol Optical Depth, Black Carbon Concentration, Bay of Bengal.

## I. INTRODUCTION

### A. General

The major ecological issue concerning our planet is climate change, it is generally agreed that the Earth climate will modify in response to radiative forcing induced by variations in atmospheric aerosols but its behavior is complex.

Aerosols scatter solar radiation back to space by changing the effective albedo of Earth (Dickerson et al., 1997). Therefore, the aerosols and their radiative effects are important in climate forcing studies. The concentrations of Aerosol vary from few minutes to years.

As aerosol accounts for much of the lower atmosphere of Earth, the studies on seasonal changes of aerosol optical depth and its role on radiation budget is much significant. Aerosols generally originated either from primary industrial sources or marine sources. The amount of aerosol in the atmosphere is sometimes specified in terms of the number of particles per cubic centimetre. The number density decreases exponentially with altitude, up to about 5 Km, and remains constant at 10-15 Km altitude. To measure aerosol absorption, single scattering albedo ( $\omega_A$ ) is used. The single scattering albedo is the ratio between the scattering coefficient and the total extinction coefficient (scattering and absorption) and its value for standard maritime aerosols vary between 0.98 and 0.99 (Kay and Michael 2000).

It is clearly understand that the atmospheric aerosols significantly impact the climate due to their role on modifying the incoming and outgoing infrared radiation. The uncertainty in predicting the future climate is either aerosol cooling or warming (Hansen et al., 1998).

Aerosols decrease surface short wave (SW) and may increase SW diffuse radiation thus by alter photosynthetically active radiation (PAR)(400-700 nm). As a potential agent to compensate for the greenhouse effect, aerosols are receiving increasing attention. Despite this, the knowledge about the impact of aerosols on radiation and climate is quite poor and falls behind the greenhouse effect.

As climate change and population development in the 21st century is expected to cause an increase in atmospheric aerosols which need to improve knowledge about the interaction between changes in atmospheric aerosols and Earth system with a view to strengthening confidence in our understanding of why and how climate and environment change and to improve the predictive capacity for integrated assessment of climate change in the future. The objective of this study is to investigate the Black Carbon Concentration over the Bay of Bengal.

## II. METHODOLOGY

### A Satellite data for measurement of Aerosols by MODIS Aqua

MODIS (or Moderate Resolution Imaging Spectroradiometer) is a key instrument view the entire Earth's surface every 2 days, acquiring data in 36 spectral bands (see MODIS Technical Specifications).. The flow chart of this study is shown in Fig.1

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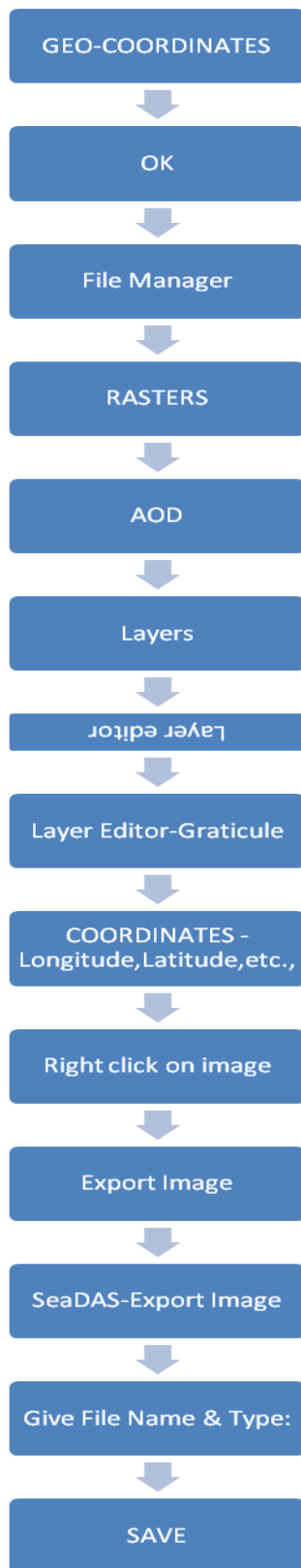


Fig .1: Methodology of the Study

## III. RESULT AND DISCUSSION

### A Monthly variation of AOD

A Monthly variation of AOD Spatio-temporal distribution of aerosol optical depth (AOD) is of importance for many studies starting from radiative forcing to climate change. MODIS derived daily aerosol data from January , February, March 2019 has been analysed to accomplish the above

objective. Figures 2(a), 2(b) and 2(c) show. AOD values are high at shorter wavelengths of 380 nm than decreases towards the longer wavelength of 1020 nm. The presence of the fine and Course particles which are enhancing the irradiance scattering and therefore the AOD values are high at the shorter wavelength.

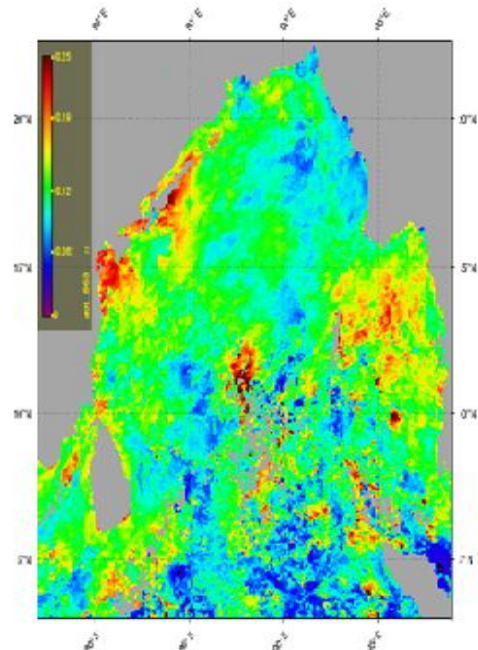


Fig. 2(a):Monthly Variation of AOD Over Bay Of Bengal in January 2019

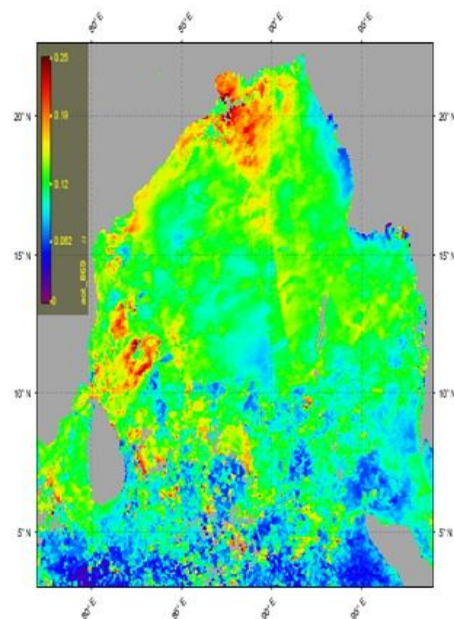


Fig. 2 (b):Monthly Variation of AOD Over Bay Of Bengal in February 2019

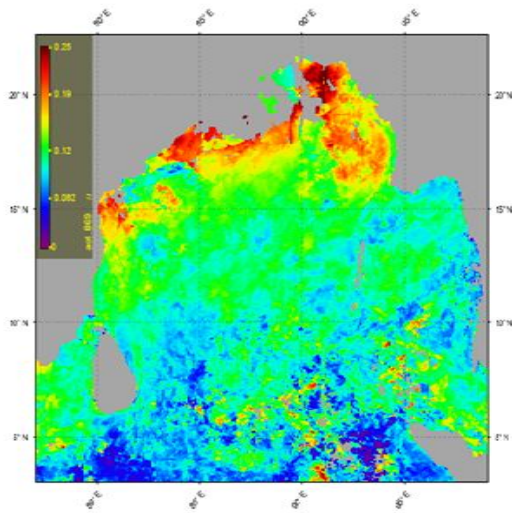


Fig. 2 (c): Monthly variation Of AOD Over Bay Of Bengal in March 2019

Analysis of Black Carbon concentration  
 The concentration of Black Carbon (BC) over the coastal zone of Cuddalore was estimated from the linear equation derived from the study of Study Sumanth.E (2004) is given below ,

$$\tau_p = 0.36 * BC + 0.15 \dots \dots \dots (1)$$

where  $\tau_p$  = Aerosol Optical Depths

The Black Carbon concentration over the bay area of Cuddalore District for all the three the months were estimated by using the equation (1) and is shown in Table 1 and from the Figures 3 to 8. Table 1: Maximum and Minimum of AOD and BC over the Bay area of Cuddalore district.

Table 1 : Maximum and Minimum of AOD and BC over the Bay area of Cuddalore district.

January		February		March	
AOD( nm)	BC( $\mu\text{g}/\text{m}^3$ )	AOD( nm)	BC( $\mu\text{g}/\text{m}^3$ )	AOD( nm)	BC( $\mu\text{g}/\text{m}^3$ )
0.185	0.097	0.181	0.086	0.110	-0.111
0.145	-0.014	0.100	-0.134	0.106	-0.122

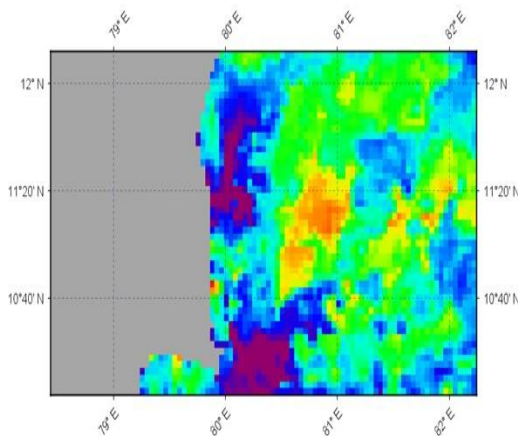


Fig. 3. Monthly Variation of AOD Over Cuddalore coastal in January 2019

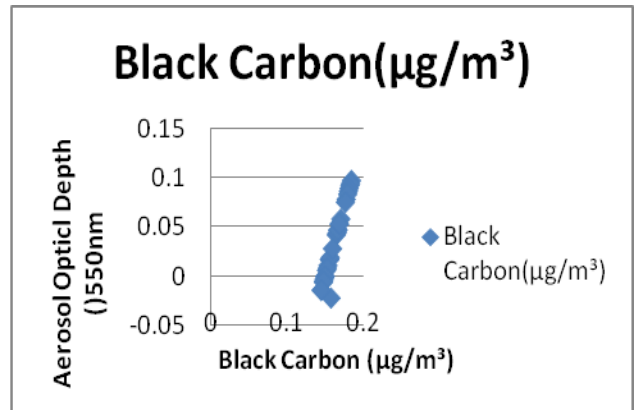


Fig. 4. Variation in the BC in the month of JANUARY 2019 over cuddalore coastal.

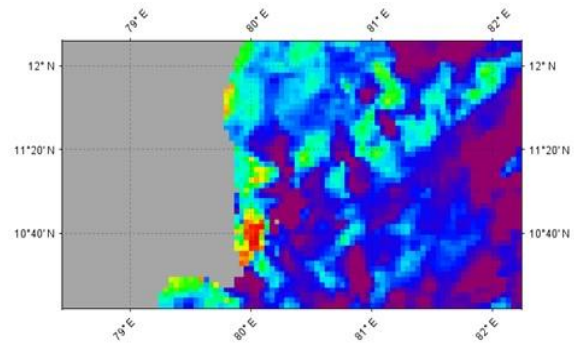


Fig. 5. Monthly Variation of AOD Over Cuddalore coastal in February 2019

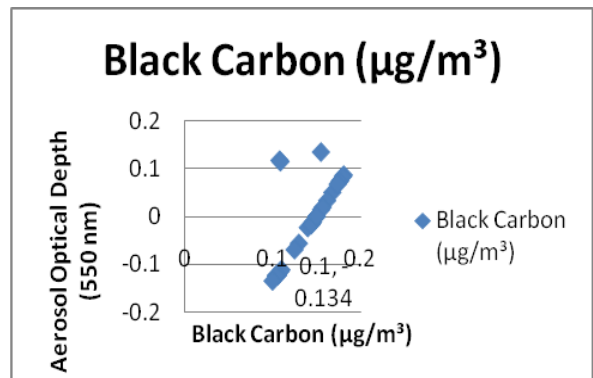


Fig. 6. Variation in the BC in the month of FEBRUARY 2019 over cuddalore coastal

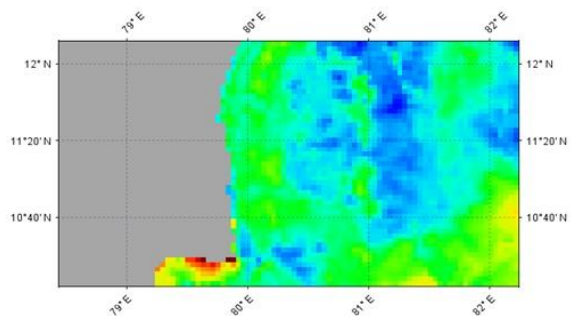
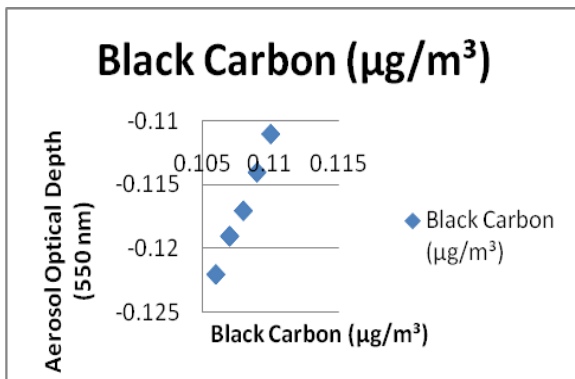


Fig. 7. Monthly Variation of AOD Over Cuddalore coastal in March 2019



**Fig. 8. Variation in the BC in the month of MARCH 2019 over Cuddalore coastal.**

## IV. CONCLUSION

The climate system is highly influenced by the aerosol particles because with the growing population, industrialization and urbanization increases the aerosol loading.

Satellite data help in detection, tracking and understanding of aerosols distributions by providing continuous observations over vast areas, which cannot be provided by traditional monitoring stations.

In the present study, the MODIS product is used for investigating AOD and BC over Bay of Bengal. AOD values over Cuddalore in the month of January are found to be high as compared to the month of February and March in all wavelengths.

Minimum concentration of Black Carbon (BC) is observed in early morning (before 06:00 AM) and in evening (before 06:00PM). Maximum concentrations of Black Carbon (BC) are found in morning (08:00 to 14:00) and Night time (beyond 20:00) when anthropogenic activities are high.

The Black Carbon concentration (BC) is lesser in the month of March as compared to the month of January, February. The relationship between Aerosol Optical Depth (AOD) & Black Carbon (BC) for the month of January, February, March are inversely proportional because when Aerosol Optical Depth (AOD) was increasing Black Carbon (BC) concentration was decreasing because Black Carbon (BC) is organic fine mode particles.

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