Aerosol characteristics over a decade at Gulbarga, Karnataka using satellite data

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***Abstract*—Aerosol optical depth data retrieved for the years 2000 to 2015 using Moderate Resolution Imaging Spectro-radiometer (MODIS) for a continental location Gulbarga, Karnataka. Analysis of the data shows seasonal variation in aerosol optical depth (AOD). AOD values are higher during summer. The winter AOD show a lower values as compared to summer. The probable causes for this type of variation in AOD characteristics have been presented in this paper.**

***IndexTerms*—Aerosol remote sensing, MODIS, Aerosol optical depth**

I. Introduction

Aerosol monitoring through satellites over the land has entered into a new era with the launching of the MODIS instrument onboard Terra and Aqua [1]. Using the ten-year (2000–2009) Data-Assimilation (DA) quality Terra MODIS and MISR aerosol products, as well as 7 years of Aqua MODIS, both regional and global aerosol trends over oceans were studied [2]. The evaluation of the satellite-derived estimate with ground-based in situ measurements indicates significant spatial agreement with North American measurements [3]

It is proposed to study the aerosol characteristics over Karnataka. Gulbarga is the district in the northern part Karnataka. Study of aerosol characteristics over Bidar the northern most part of Karnataka is carried out [1]. The second district to be taken in the order is Gulbarga. Hence aerosol characteristics at Gulbarga is studied using the Moderate Resolution Imaging Spectroradiometer (MODIS) Terra satellite data available on atmospheric aerosols. The monthly & inter annual variations in the aerosol optical depth are studied in this paper.

II. AOD Data : MODIS Terra Satellite using GES DISC

MODIS is a space sensor aboard NASA's (National Aeronautics and Space Administration) Terra Earth Observing System (EOS) satellite launched in December 1999. Operating at an altitude of approximately 700 km, this polar-orbiting satellite is able to provide aerosol data. Using Goddard Earth Sciences Data & Information Services Centre (GES DISC), monthly aerosol optical depth data at 550nm is retrieved for Gulbarga (17.32 N, 76.9 E), with a spatial resolution of 1^o x 1^o for the years 2000 to 2015.

III. Geographical Features of Gulbarga, Karnataka

Gulbarga is on the Deccan Plateau, and the elevation ranges from 300 to 750 m above MSL. Two main rivers, the Krishna and Bhima, flow through the district. Gulbarga is an industrially backward district but is showing signs of growth in the cement, textile, leather and chemical industries. The climate is generally dry, with temperatures ranging from 8 °C to 45 °C and an annual rainfall of about 750 mm.

IV. Monthly, Inter-Annual Variation of AOD over Gulbarga

Aerosol optical depth values for the years 2000 to 2015 for the months January to December are considered. Variation of AOD for winter month (December), summer month (March), North East monsoon month (November), southwest monsoon (June) are shown in the figures 1 to 4.

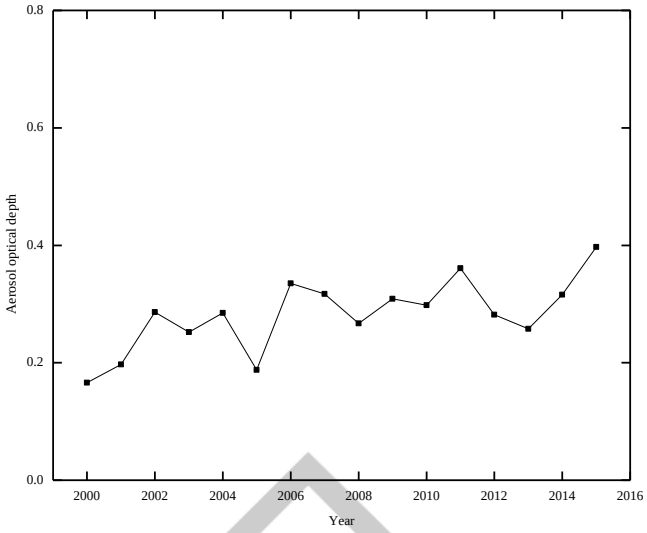

Fig. 1 : Monthly aerosol optical depth over the years for Decemberr

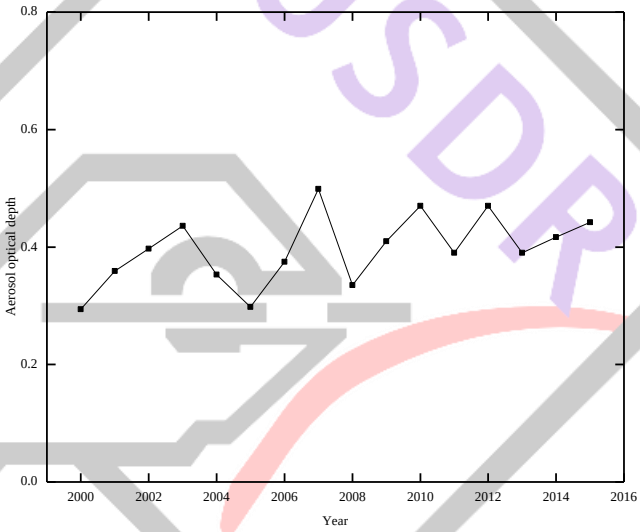

Fig. 2 : Monthly aerosol optical depth over the years for March

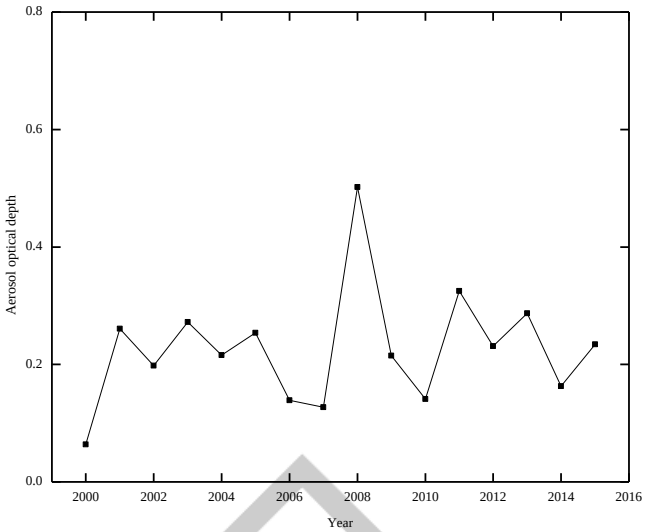

Fig. 3 : Monthly aerosol optical depth over the years for June

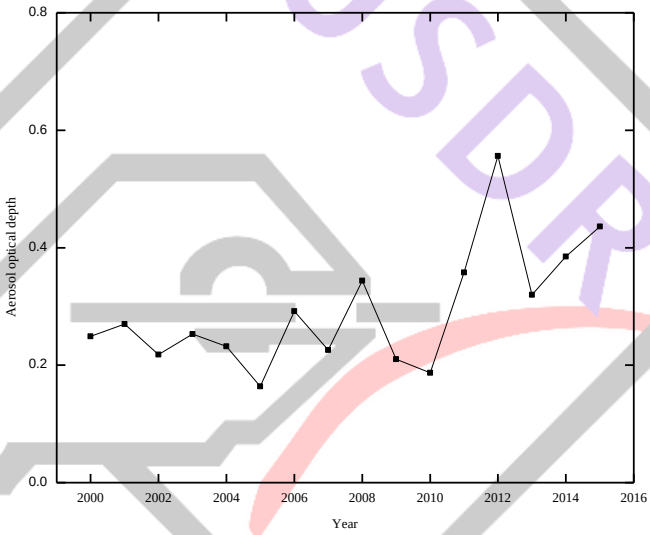

Fig. 4 : Montly aerosol optical depth over the years for November

The monthly AOD is increasing over the years from 2000 to 2015 which is evident from the above figures.

The peak values attained in summer months are due to

- Increased humidity in summer.
- Raising dust due to surface winds associated with the dry surface conditions.
- Increased photo-chemical activities in summer months.
- Weak wet removal mechanisms.

Reduced optical depths during the monsoon months arise due to

- Weak production processes.
- Reduction in the lower tropospheric aerosols due to monsoon activity

An increase in the value of aerosol optical depth during monsoon may be due to increase in the water vapour content in spite of strong removal and weak production mechanisms.

The minimum in aerosol optical depths occurs in winter months and it is due to

- Lower water content& dry air condition.
- The soil generated dust component is lower in the air.

- Secondary production mechanisms such as gas to particle conversion is generally very weak in winter months.

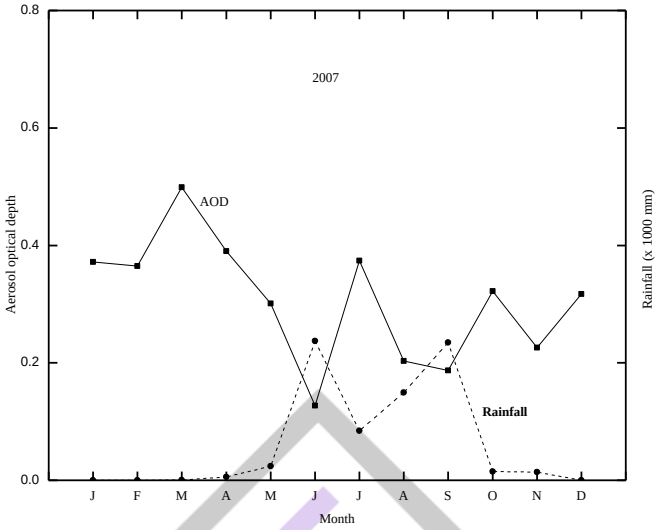

Fig. 5 : Monthly aerosol optical depth & rainfall for the year 2007

Figure 5 represents the variation of monthly aerosol optical depth along with the monthly rainfall for the year 2007. It clearly shows an anti correlation of aerosol optical depth with rainfall depicting the rain out process.

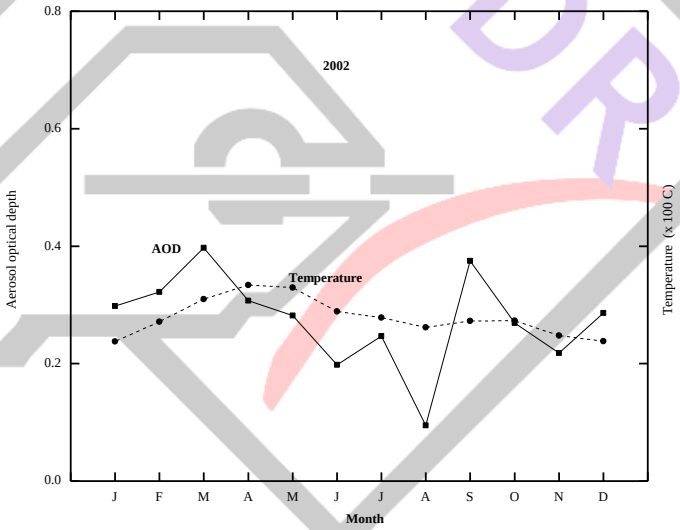

Fig. 6 : Monthly aerosol optical deptn & average temperature for the year 2002

The variation of monthly aerosol optical depth and monthly average temperature for the year 2002 is represented in Figure 6. It is clear from the figure that there is a good correlation between the two which show that production of aerosols increase with the increase in the temperature.

Figure 7 represents inter annual variation of monthly aerosol optical depth over years from January 2000 (Month number 1) to December 2015 (Month number 192). It is clear that there is an increase in the aerosol optical depth over the years which means an increase in the aerosol loading over the years due to natural & anthropogenic activities.

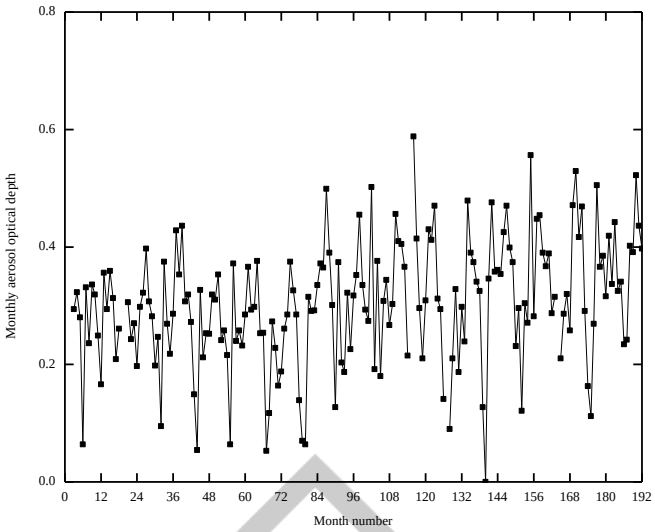

Fig. 7: Inter annual varriation of aerosol optical depth over the years

V. Results & Discussion

A steady increase of monthly AOD at shorter wavelengths from 1994 onward, while it is not so significant at longer wavelengths is reported for Visakhapatnam [4]. It is reported at Mysore that the turbidity parameter β which is an index of the amount of aerosols present in the vertical direction is high for summer compared to winter values [5]. AOD values reported for Trivandrum showed low values for winter months increasing gradually into March-April [6].

The aerosol optical depth is high during summer& low in winter months. One of the reason is the high & low temperature during summer & winter months respectively which is clearly seen from Figure 6. Rain out is one of the major aerosol removal mechanism. This is clearly depicted in Figure 5, where the aerosol optical depth decrease with the increase in rain. The weak secondary production processes result in lower value for the aerosol optical depth during winter. The peak values attained in summer months are due dry surface conditions, increased photochemical activities in summer months, weak wet removal mechanisms. Reduced optical depths during the monsoon months arise because of significant depletion of lower tropospheric aerosols due to weak production mechanisms during monsoon.

VI. Acknowledgment

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