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UNUSUAL BEHAVIOUR OF ANGSTROM'S TURBIDITY PARAMETERS

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INTRODUCTION

Atmospheric turbidity is a measure of total vertically integrated particulate load in the atmosphere. Also, it is used as an index of atmospheric pollution, particularly in the studies of long term secular changes in the composition of the atmosphere and the resultant global climatic changes. During the last century, some indices of turbidity were proposed and several methods were developed to determine the value such as, Linke 1922, Angstrom 1929, Unsworth & Monteith 1972. Atmospheric turbidity depends on both the number and size of aerosols. Angstrom relates these two parameters with the aerosol optical thickness τ_λ (AOT here after), which has a spectral dependence and is a measure of extinction of solar radiation by the aerosols at wavelength λ as

$$\tau_\lambda = \beta\lambda^{-\alpha} \qquad (1)$$

In this equation β is called the turbidity coefficient and α the wavelength exponent. These are dependent respectively on the number and the size of aerosols. Further, the wavelength λ is in micrometer (Iqbal 1983). Throughout an individual day, both α and β exhibit variations because of changing meteorological conditions in the atmosphere. These changes can cause decrease or increase in α and β values. Mahesh Kumar et al (2000) have observed an anti correlation between α and β. But there appears to be no studies which gives us the information about the correlation between α and β. In this paper we are presenting the cases in which α and β exhibits positive correlation (unusual behaviour) and the possible causes for this type of positive correlation.

LOCATION

Mysore, situated at an altitude of 767m above sea level on the Deccan plateau of peninsular India is a low latitude (12^0 $19^{'}$N and 76^0 $39^{'}$E) station. On the East, West and South, about 300-500 km away is the water spread of Bay of Bengal, Arabian Sea and Indian Ocean respectively. To the North lies the landmass of Asiatic continent. Geographic climate is moderate. In any year the period, June-November, receives monsoon rains, which account for 73% of the average annual rainfall of 760mm. Following the rainy season, the winter prevails through December-February. During this season the temperature is low and the rainfall is about 3%. The hot months March-May constitute the summer and account for 24% rainfall. An overall range of temperature of the year lies between 291K to 309K.

EXPERIMENTAL

A Microtops II Sunphotometer developed by Solar Light Company, USA was employed to obtain AOT. The instrument has five customer specified spectral filters transmitting wavelength centered at 440, 500, 675, 936 and 1020nm. The direct beam of Sunlight traversing through the optical channels gets automatically processed by a built in algorithm and the AOT along with precipitable water vapour are displayed. To carryout the observations, the Microtops II was mounted on a tripod to ensure stability. The passage of direct beam of Sunlight was ascertained by the sun targeting device provided in the instrument. The measurements were carried out at 20min interval during 09 00 – 16 30hrs IST.

Retrieval of Angstrom's parameters

The Angstrom equation (1) delineates into linear form on logarithmic scale

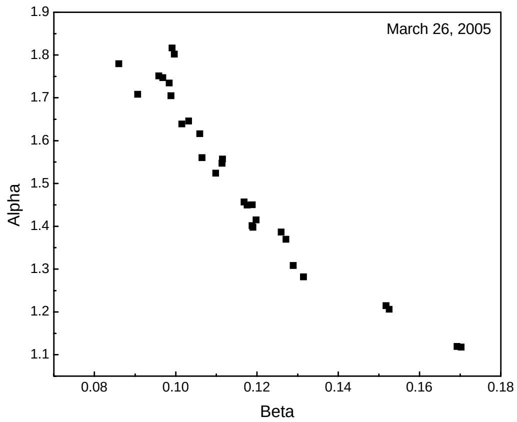
$$\ln \tau_\lambda = \ln\beta - \alpha\ln\lambda \qquad (2)$$

By a logarithmic regression analysis and least squares fit of each of the scans one set of values for α and β is obtained. Cachorro et al (1987) report that this method is the most appropriate one for determining the Angstrom parameters.

RESULTS

In the present study, we have analyzed about 3100 data points collected during the period December 2003 to June 2006. For each scan Angstrom's turbidity parameters are determined graphically according to eqn. (2). From the analysis of data sets, it has been observed that on majority of days α and β shows anti correlation. We know that α is a measure of the ratio of small to large particles and β is a measure of large particles. Higher the value of β implies that more is the number of large particles and lesser will be the value of α and vice versa. Possibly, we can say that small particles thus entered into the atmosphere coalesce under the influence of atmospheric water vapour and temperature to form large particles. Hence as a result of this phenomenon β value increases. This type of behaviour of Angstrom's turbidity parameters was observed by other workers (Mahesh Kumar et al, 2000, Sundar and Xiangao). On some other days of observation a trend exactly opposite to the above said trend is noticed. A typical graph showing anti correlation and correlation between α and β is shown in Fig.1 and Fig.2 respectively. This type of deviation from the regular trend in the graph of α versus β is called as *unusual behaviour* of Angstrom's parameters. The cause for such unusual behaviour may be listed as below

- ☞ Increasing trend in the graph of α versus β gives us the positive slope, which implies that both α and β have increased over the time.
- ☞ High value of β is an indication of more number of large size particles which is because of cohesion of small size particles. As a result of cohesion of small particles, α value should decrease. But in this special case α is also increasing.
- ☞ Increase in the value of α is mainly due to the continuous inflow of small size particles to the study area by various anthropogenic activities.
- ☞ Thus, the rate of increase in both small and large size particles on some special days is the cause for the observed positive correlation between α and β.



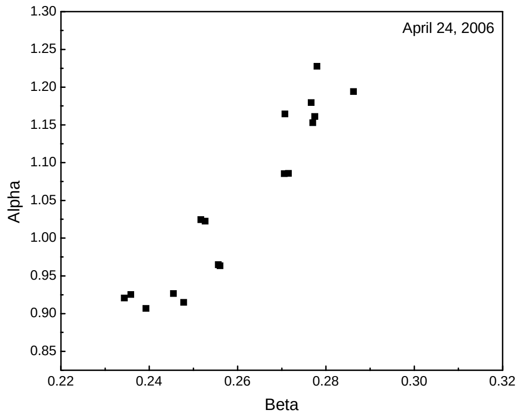


Figure 1 Figure 2

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