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STUDY OF TURBIDITY PARAMETERS AT TROPICAL STATION PUNE

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Introduction

Scattering of solar radiation by matter other than dry air molecules is called turbidity of the atmosphere in the optical sense [Iqbal, 1983]. Hence, scattering of direct solar radiation by atmospheric aerosols is referred to as atmospheric turbidity. It is a function of both the number and size of the aerosols.

In meteorology, the term called atmospheric visibility is also determined by the number, mass and size distribution of aerosols in the air. It is thus closely related to atmospheric turbidity and can be determined from Angstrom's turbidity coefficients, α and β. Atmospheric visibility is an important air quality parameter that is closely related to the aerosol extinction coefficient, $\tau_{p\lambda}$, which is an integral function of the particle size distribution. Angstrom turbidity equation, $\tau_{p\lambda} = \beta\lambda^{-\alpha}$ relates turbidity coefficients, α, β with aerosol extinction coefficient.

Methodology

In the present study, the authors operated a sun-tracking multiple wavelength radiometer (MWR), at a number of wavelengths in visible to near IR spectral region from Pune University campus (18^0 32' N; 73^0 51' E, 559m AMSL) during 1998-2001, in a ground based experiment. Data is analyzed to determine aerosol optical depth (AOD), $\tau_{p\lambda}$ by using Langley technique. Derived $\tau_{p\lambda}$ values a re used for calculating Angstrom atmospheric turbidity parameters (α, β) by linearsing Angstrom equation [Cachorro et al., 1987].

Results

Analysis of the data shows that the monthly mean values of Angstrom turbidity parameters α and β vary more or less in opposite manner. It is also seen that the pattern of variation is different during different observing seasons viz., 1998 – 1999; 1999 – 2000 and 2000 – 2001. β–values range between 0.51 to 0.81 and the corresponding α- values are between -0.09 to -0.375 during 1998-1999. Thus α – values are negative or near zero for this period. It is seen that the higher β – values are associated with smaller α values suggesting abundance larger size aerosol particles.

For observing season1999-2000. β–values are relatively smaller (in the range: 0.37 – 0.65) as compared to those in 1998-1999. Also, α – values are small but positive (Range: 0.15 – 0.55) showing predominance of accumulation mode particles thus showing a change in aerosol size spectrum during 1999-2000 as compared to that during 1998-1999. Similarly for the period 2000 -2001, β –values are on the higher side as compared to those during both

1998-1999 and 1999- 2000. α – values, however, show a mixture of positive and negative values ranging between -0.1 to 0.47.

The present data of α and β values, thus, in general, show small positive as well as negative α – values indicating dominance of coarse mode particles in the years 1998-1999 and 2000-2001; while accumulation mode aerosol particles more in number during 1999-2000. This is also confirmed by size spectrum analysis. Abundance of coarse mode aerosol particles is possible due to passage of marine air mass, originating from the Arabian Sea, which passes over Pune during period of observation.

Meteorological range of visibility, termed as atmospheric visibility (Vis, in km) determined from observed values of Angstrom's turbidity parameters (α, β). using equation (Iqbal, 1983) :

$$\beta = 0.55^{\alpha} [(3.912 / Vis) - 0.01162] [0.02472 (Vis-5) + 1.132]$$

There is a strong inverse relationship between visibility and turbidity parameters. It is found that higher the visibility, smaller is the turbidity and consequently higher the atmospheric transparency. Meteorological conditions strongly influence the dispersal of atmospheric pollutants and thus have a major effect on visibility. Fig.1 shows the relation between the AOD at 546 nm and the visibility.

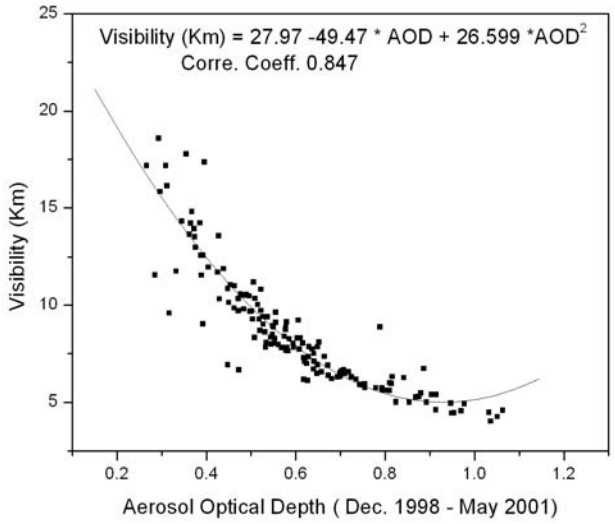

Fig.1: Co-relation between Visibility and AOD at 546 nm

Polynomial of degree 3 fits well to the data points with correlation coefficient 0.85. This shows that visibility is strongly related to AOD. With increase in AOD in summer season turbidity coefficient also increases and visibility decreases .

References

1. Iqbal, M.. (1983) *An Introduction to Solar Rradiation,* Academic Press Toronto.
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