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FEATURES OF ATMOSPHERIC AEROSOLS AT PUNE

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Introduction

In recent years, there is increasing awareness that man is perturbing the atmosphere and encroaching on the environment on a global scale. Studies have revealed that atmospheric aerosols play a vital role in many process in the Geosphere-Biosphere system, which affects our life either directly (health) or indirectly (climate). Atmospheric aerosols play important role in radiative forcing, atmospheric chemistry, and cloud microphysics Optical properties of atmospheric aerosols can vary greatly depending on environmental conditions as well as local sources. In a given location, aerosols are characterized by their concentration, their size distribution, their shape, their chemical composition and their vertical profile. In the urban surroundings the sources of aerosol particles are more complex. Vehicular and other traffic, anthropogenic combustion products, industrial emissions, dust, and fine particles are the important sources of air pollution in urban environment.

Physical properties of aerosols are strong functions of their sources, which are widely distributed and highly variable from one region to the other. Accordingly, the aerosol impact on earth's climate system has a strong regional component.

Pune ($18^0 32'$ N, $73^0 51'$ E, 559 m AMSL) is a fairly big and growing inland tropical city situated on the lee-side of the Western Ghats. Pune city is surrounded by distant low hills (100-500 m high) on southern and western sides. To the north-west of the Pune University lies the industrial twin-township of Pimpri-Chinchwad that has some automobile manufacturing, chemical, and other industries. Pune city has a population of about 50 Lakhs and has a very high density of registered motor vehicles and two-wheelers. The possible aerosol type present over the experimental station is a mixture of water-soluble, dust like and soot type aerosols.

Methodology

Ground based intensity measurement of direct solar radiation under clear-sky conditions as a function of solar zenith angle has been an "on going" activity at Pune University for the study of atmospheric aerosols. The instrument consist of a 10-channel sun-tracking MWR having UDT 555 UV/LN Silicon photodetector, enabling measurements from UV to near IR(400-1020 nm) region of the solar spectrum. Intensity measurements of direct solar radiation are carried out on clear – sky days, which occur in Pune during December to May only. Atmospheric conditions thus become a controlling factor in the total period available for measurements.

Total optical depth of the local atmosphere is obtained from the measured intensity of direct solar radiation using Beer-Lambert-Bouguer law. Aerosol optical depth (AOD) is then calculated from the total optical depth by subtracting the contribution of molecular (Rayleigh) scattering and an estimated contribution from ozone absorption (Shaw et.al .,1973; Kocifaj et. al., 2005).

Results

Study of the Langley plots has shown the occurrence of 2-segment Langley plot at Pune. These occur all through the observing season with higher frequency in winter. Two linear segments, one for forenoon (FN) and other for afternoon (AN) defining respective AODs viz., $\tau_{p\lambda}$(FN) and $\tau_{p\lambda}$(AN). Usually it is found that $\tau_{p\lambda}$(FN) › $\tau_{p\lambda}$(AN). This variation of $\tau_{p\lambda}$ is regarded as diurnal variation of AOD (Wang et al., 2004). The change in AOD from FN to AN is expressed as a normalized fraction of $\tau_{p\lambda}$(FN) using the expression,

$$\delta_\lambda = \{\tau_{p\lambda}(FN) - \tau_{p\lambda}(AN)\} / \tau_{p\lambda}(FN)$$

Results expressed in δ_λ percent are given in Table 1. Results show that δ_λ has higher values at 400-546 nm wavelengths and smaller values at higher wavelengths. The sign of δ_λ remains positive showing that in the forenoon (FN) AOD magnitude is higher than its value during the afternoon (AN). Hence AOD magnitude decreases from FN to AN

Table 1 : **Range of δ_λ values at different wavelengths**

Wavelength λ in nm	400	500	600	750	850	1020
δ_λ % ranges between	29 to 57	19 to 48	17 to 31	10 to 34	10 to 54	14 to 25

The spectral variation of AOD shows significant small changes from forenoon to afternoon, indicating a change in the aerosol size distribution accompanying the change in AOD mentioned above. This is also shown by the values of the Angstrom coefficients (α, β) during forenoon and afternoon. Indications are strong that the diurnal variation of AOD is related to the diurnal cycle of variation of relative humidity (RH) and temperature at the ground in clear- sky condition.

From the tabulation of daily AOD values for different days of observation, it is noticed that the daily AOD magnitude has significant day-to-day variation, which appears to be related to the day-to-day variation in the magnitude of local weather parameters. This is investigated by studying correlation between the two.

In the seasonal variation of AOD peaks occur in February and April months. From the analysis of the data, it is found that upper air circulation at the top of the atmospheric boundary layer(ABL) plays an important role in the occurrence of these peaks in the seasonal variation curve by bringing in influx of marine aerosols in February and by confining local aerosols in April.

Spectral variation of AOD is primarily determined by the aerosol size distribution, which is governed by the sources present in the local atmosphere. It is found that the

spectral variation of AOD and the corresponding size distribution obtained by the inversion method (King et al., 1978) during different years of observation show the influence of the prevailing meteorological processes.

Conclusions

The study shows that (i) The traffic (coarse & fine particles) and the other anthropogenic combustion sources make important contribution to ambient aerosol background. (ii) It is found that during drought conditions anthropogenic aerosols predominate, resulting in a different pattern of behaviour of aerosols having more complex relationship with local weather parameters. (iii) The observed diurnal variation of AOD appears to be a special feature at Pune.(iv) Study shows presence of interesting regional features in the aerosol characteristics at Pune.

References

1. Shaw et al., *J. Appl. Meteor.,* **12,** 374 - 380,1973.
2. Kocifaj et al., *Atmospheric Enviriment,* **40**, 1922 - 1934, 2005.
3. Wang et al., *Geophys. Res. Lett.,***31**(L08107), doi:10.1029/2004GL019580, 2004.
4. King et al., *J. Atmos. Sci.,* **35**, 2153 – 2167, 1978.