Association of surface meteorological parameters with aerosol optical depth measured over Dibrugarh, India

M. M. Gogoi[1], P. K. Bhuyan[1], P. S. Pillai[2] and K. Krishna Moorthy[2]
[1]Department of Physics, Dibrugarh University, Dibrugarh 786 004, India
[2]Space Physics Laboratory, Vikram Sarabhai Space Centre, Thiruvananthapuram 695 012, India

Extensive solar spectral extinction measurements were carried out over Dibrugarh (27.3°N, 94.1°E) during the period October 2001 to September 2004, as part of the Aerosol Climatology and Effects (ACE) network established under the auspices of the Indian Space Research Organization's Geosphere Biosphere program. Spectral extinction measurements are made at ten narrow wavelength bands centered at 380, 400, 450, 500, 600, 650, 750, 850, 935 and 1025 nm with full width at half maximum bandwidth of 6 to 10 nm. The Multiwavelength Solar Radiometer (MWR) used for this study has been designed at SPL, VSSC following the principles of filter wheel radiometers and from the MWR measurements, the total columnar atmospheric optical depths (τ_λ) have been evaluated following the conventional Langley technique for each of the ten wavelengths (Shaw et al., 1973; Tomasi et al., 1983). The details of application of this technique and the retrieval of aerosol optical depth ($\tau_{p\lambda}$) from τ_λ are described by Moorthy et al., (1989, 1991, 1993). The variations of the experimental data in the light of the environmental and meteorological conditions prevailing in the station are presented. A systematic seasonal variation has been observed with the optical depth maximizing in the local summer season (March, April and May) at all the wavelength while decrease in $\tau_{p\lambda}$ is seen in retreating monsoon (October and November) in 2001 and 2002 along with the monsoon minimum in 2003 and 2004. The seasonal variation of aerosol optical depth has been found to be associated with the near-surface wind speed, U (ms^{-1}) and rainfall. A fairly good correlation is observed between $\tau_{p\lambda}$ and U. The surface winds are generally low (< 4ms^{-1}) at Dibrugarh with no significant variation in magnitude from month to month or season to season. However, there is a small increase in the wind speed during the summer and monsoon season. The direction of the surface winds changes from north easterly in winter to easterly in the monsoon season during the period of observation. The south west monsoon wind over Dibrugarh is not significant as its location and topography, encircled on three sides by high mountain ranges and the presence of precipitous plateau (Meghalaya) thwart the course of incoming south west monsoon winds. The distribution of monthly total rainfall experienced at Dibrugarh indicates that the aerosol optical depths at all the wavelengths are negatively associated with rainfall. The effects of changes in the atmospheric water vapor content W (g cm^{-2}) on spectral optical depth are also investigated. It is found that during meteorologically calm periods (i.e., in the absence of any significant air-mass type) the aerosol optical depths increase with increase in water vapor content. The shorter (visible) wavelengths are more sensitive to the changes in W, compared to the near infra-red (longer) wavelength. The features are indicative of changes in the size distribution of aerosols with changes in water vapor content.

References:

1. Shaw, G.E., Reagen, J.A. and Herman, B.M.; *J. Appl. Met., 12, 374-380, 1973.*
2. Tomasi, C., Prodi, F., Sentimenti, M., Cesari, G.; *Appl. Opt., 22, 622-630, 1983.*
3. Moorthy, K.K., Nair, P.R. and Krishna Murthy, B.V.; *Ind. J. Radio and Space Physics, 18, 194-201, 1989.*
4. Moorthy, K.K., Nair, P.R. and Krishna Murthy, B.V.; *J. Appl. Met., 30, 844-852, 1991.*
5. Moorthy, K.K., Nair, P.R. and Krishna Murthy, B.V.; *J. Appl. Met., 32, 1196-1205, 1993.*