POSSIBLE ROLE OF AEROSOL IN WEAKENING THE VISIBLE (0.5-0.7)μ AND INFRARED RADIATION (10.5-12.5)μ BY WEAK CLOUDY ATMOSPHERE IN THE PRESENCE OF OZONE AND HUMIDITY USING INSAT 1-B SATELLITE

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Introduction: The sensitivity of the general circulation models (GCM) is dependent upon the radiative heating and cooling due to aerosols, ozones. In this context, the optical thickness of atmospheric aerosols and ozone is a property of immediate interest (Chandrasekhar, 1950, Grassl 1972, Ghosh et al 1984). Condensation of water vapour takes place on the aerosol particles when the relative humidity increases whereas water evaporates from the particles with decreasing relative humidity. Thus the optical thickness of aerosols is a function of relative humidity. Moreover ozone has absorption cross-sections in the (0.5-0.7)μ and (10.5-12.5)μ region and hence the contribution of ozone has to be taken into account to deduce aerosol optical depth in the (0.5-0.7)μ and (10.5-12.5)μ radiance measurement from INSAT 1-B satellite.

Evolution of aerosol optical depth: While considering the radiative equilibrium model, the thermal radiation passing through the atmosphere is absorbed and scattered by the neutral particles, aerosols, water vapour and ozone.

The low of absorption (sometimes known as Lambert's law or Bouguet's law) states that the absorption which occurs when a radiation of Intensity I traverses an element slab of atmosphere of thickness dz is proportional to the mass of absorber ρ dz (ρ being the density of absorber) and to the incident of radiation itself. Thus

$$dI = -I k \rho dz \quad (1)$$

where k is the absorption coefficient. Integrating (1) leads to

$$I = I_0 \cdot \exp\left[-\int k.\rho\, dz\right] \quad (2)$$

where $\int k\rho dz$ is the optical depth

Thus $I = I_0 \exp\left[-\left(R + k.x + A\right)\right]$ (3)

where I = Intensity of thermal radiation in (0.5-0.7)μ and (10.5-12.5)μ region received by satellite

I_0 = Intensity of radiation in (0.5-0.7)μ and (10.5-12.5)μ region at the ground

R = Rayleigh optical depth

k = absorption coefficient of ozone

A = aerosol optical depth

x = amount of ozone in the atmosphere

INSAT 1-B satellite measures the terrestrial-atmospheric radiation over India in the (0.5-0.7)μ and (10.5-12.5)μ region. In the present paper, brightness temperatures in the visible and infrared region are taken during December 1987 from INSAT 1-B over Delhi (77.2^{o}N, 28.6^{o}E).

The flux of radiation at a given wavelength is given by $F = \sigma T^4$

where $\sigma = 5.67 \times 10^{-8}$ $Wm^{-2}K^{-4}S^{-1}$ & T is the brightness temperature equivalent to the satellite radiance at the frequency of observation.

The spectral radiance at the ground (I_0) for terrestrial temperatures at various frequencies are available (Selby et al 1978, Forsythe, W.E. 1954). From the available data of ozone over Delhi by Dobson method during December 1987 aerosol optical depth is deduced from eqn.(3), the other parameters being known.

Results and Discussion: The aerosol optical depth is calculated in the visible and infrared region over Delhi (Fig.1&2). It is seen that as the brightness temperature increases, the aerosol optical depth decreases. In the visible region (0.5-0.7)μ, the aerosol optical depth decreased from 0.45 to 0.05 as the equivalent brightness temperature increased from 287^{o}K to 315^{o}K. Similarly in the infrared region (10.5-12.5)μ, the aerosol optical depth decreased from 1.9 to 0.035 as the equivalent brightness temperature increased from 180^{o}K to 290^{o}K. The water vapour content over Delhi is calculated from the water vapour density profile obtained from India Meteorological Department. It is seen that as the water vapour content increased from 2 gm/cm^2 to 4.6 gm/cm^2, the aerosol optical depth decreased from 1.9 to 0.035 (Fig.3). Similarly ozone content values are taken from Dobson measurement and it is seen that as the integrated ozone content increased from 230 DU to 255 DU, the aerosol otical depth decreased from 1.9 to 0.035 (Fig.4) Thus it is seen that aerosol particles play an important role in weakening radiation in the visible and infrared region. Water vapour & ozone plays dominant role in reducing the aerosol optical depth of the atmosphere.

More work is in progress to derive aerosol optical depth all over INdia and ocean and correlation of ozone depletion, dehydration with tropospheric-stratospheric aerosol optical depth. In view of the present concerns about potential ozone depletions and related increase in UV-visible-IR radiation reaching the biosphere, it is suggested that a combination of satellite measurements and appropriate radiative transfer modelling be used to assess the effects of environmental parameters such as clouds, aerosols, ground albedo, ozone on the transmitted visible and IR irradiance and to estimate the amount of visible and IR radiation penetrating into the ocean.

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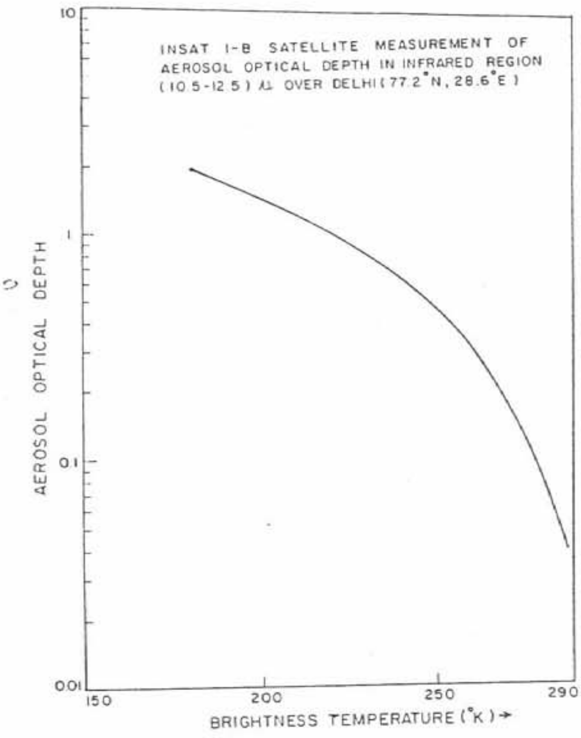

Fig. 2.

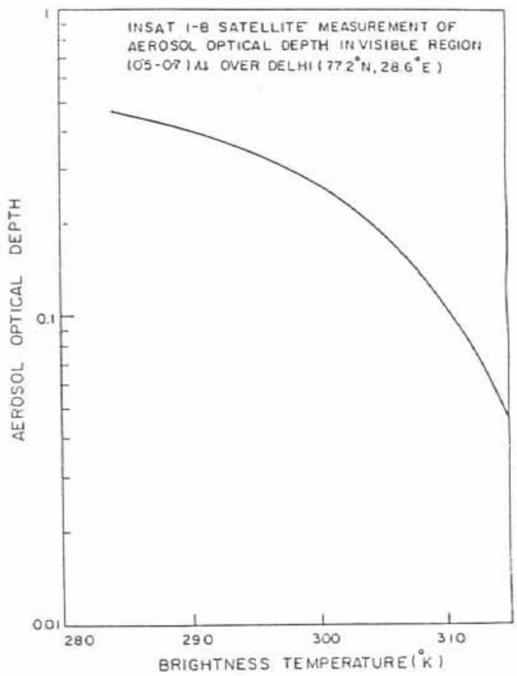

Fig. 1.

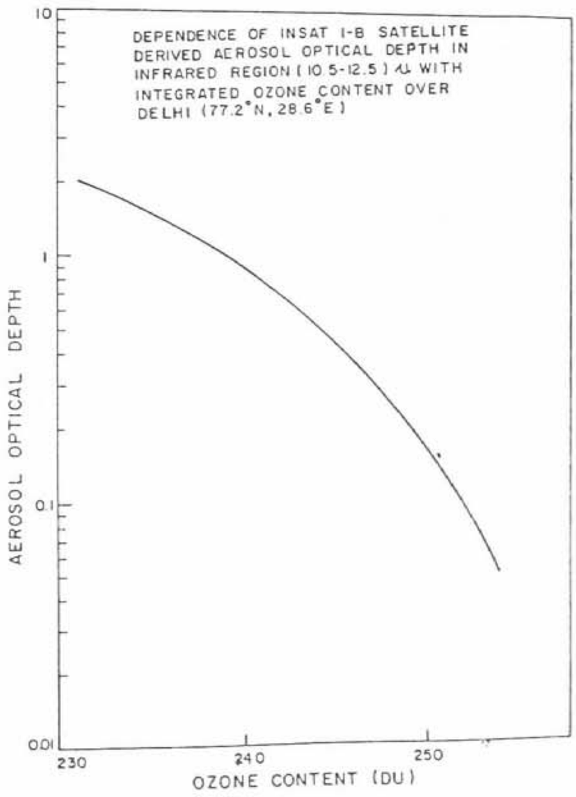

Fig. 4.

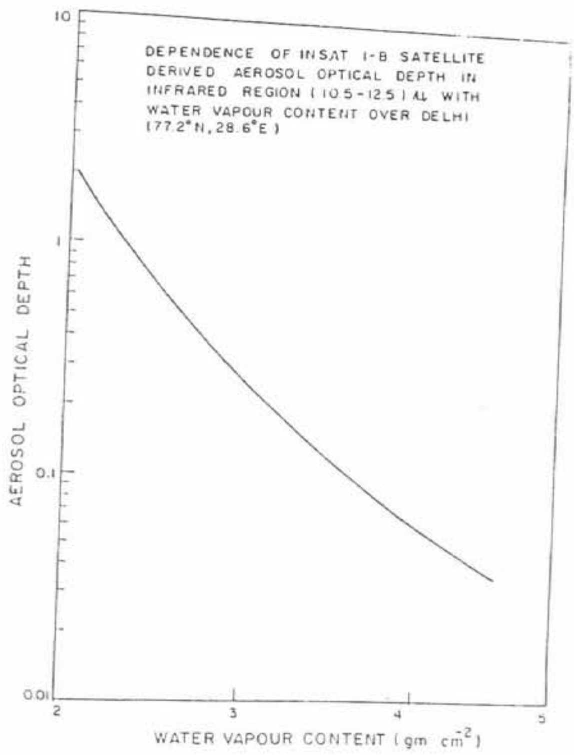

Fig. 3.