CHAPTER – 8

EFFECT OF CLOUDS ON THE VERTICAL PROFILES OF AEROSOLS

8.1. INTRODUCTION

The twilight sounding method (TSM) yields a reasonable qualitative picture of the vertical distribution of aerosols from about 6 km to a maximum of 350 km. This is being a passive technique; clear sky conditions are preferable for obtaining the vertical profile of aerosols. However, in this study an attempt has also made to conduct an experiment during cloudy sky conditions. Suppose if there exist an isolated cloud in the field of view of the twilight photometer, the color of the cloud changes from yellow to orange (or deep red in humid or polluted atmosphere) as the sun sinks. It then fades to gray as the earth’s shadow falls on it [1]. The rate of change of red light due to cloud would show a large maximum at this time. The same considerations can apply to a dust layer on which the sun sets, but the maximum in the rate of change of intensity is not usually as intense as that observed due to cloud.

8.2. RELATION BETWEEN VERTICAL PROFILES OBTAINED DURING VERY CLEAR SKY DAYS AND CLOUDY DAYS

Following Figure-8.1 shows few typical profiles of (1/I) (dI/dh) against shadow, heights (h) obtained during very clear sky days. Figure-8.2 shows the small peaks observed on the vertical profiles of aerosols obtained during change in aerosol number density. Figure-8.3 shows some vertical profiles of aerosols obtained during existence of an isolated cloud in the field of view of the twilight photometer.
Figure-8.1: Few typical profiles of $(1/l) (dl/dh)$ against shadow, heights $(h)$ obtained during very clear sky days.

Figure-8.2: The small peaks observed on the vertical profiles of aerosols obtained during change in aerosol number density.

Figure-8.3: Some vertical profiles of aerosols obtained during existence of an isolated cloud in the field of view of the twilight photometer.
The solar ray grazing the surface of earth traverses through the long air path. Therefore, the incident light will suffer attenuation in passing through the atmosphere owing to molecular scattering. The attenuation will depend on the wavelength. Moreover, the particles of dust and of condensed water, which exist in varying quantities in the troposphere, will add to further attenuation. Therefore, some portion of the earth’s atmosphere will be almost opaque to the grazing rays. This called as screening height. It is wavelength dependent, decreasing with increasing wavelength. The calculations made by Shah (1970) [2], shows that the maximum scattered light for red color, come from a height of about 6 Km above the surface of the earth. He assumed the screening height for red light has to be 6Km. Thus considering this fact we can study only high-level clouds, using twilight photometer.

8.3. MEASUREMENT OF THE THICKNESS OF THE CLOUD

Also considering the above fact the height and the thickness of the cloud can measure. Figure-8.2 shows the typical profile of \((1/l) (dl/dh)\) against shadow heights \((h)\) obtained at cloudy day.

This figure shows two layers of cirrus clouds. First layer of cirrus clouds is from 10.9Km to 11.6 Km, peaking at 11.26Km. Second layer of cirrus clouds is from 12.69Km to 14.07Km, peaking at 13.26Km. Thus, thickness of first layer is about 0.7Kms and that of second layer is about 1.38Kms.
8.4. EXISTENCE OF INVISIBLE CIRRUS CLOUDS

Tropical cirrus clouds play an important role in the radiation budget of the tropics. Despite their impact on the climate of the earth, relatively little is known about their processes. Tropical cirrus appears in a variety of forms, ranging from optically thick anvil cirrus closely associated with deep convection to optically thin cirrus layers frequently observed just below the tropopause. The thin cirrus layers extend several hundred to more than a thousand kilometers horizontally [3] and persist for period of several hours to several days before dissipating. Though they play a less significant role in the earth’s radiation budget than thick cirrus, their impact on the upper tropospheric thermal structure and vertical velocity, on the lower stratospheric water vapor mixing ratio, and on remote sensing applications are not negligible [4]. These clouds are invisible for normal eyes; but one can observe a typical peak at the height of their existence.
Figure 8.3: The typical profiles of \( \frac{1}{I} \frac{dI}{dh} \) against shadow heights \( h \) obtained at invisible cloudy days.

Figure 8.3 shows the typical profiles of \( \frac{1}{I} \frac{dI}{dh} \) against shadow, heights \( h \) obtained at invisible cloudy days. This figure shows one layer of invisible cirrus clouds, at 14 Km, having thickness of about 0.34Kms and second layer at 23 Km, having thickness of about 0.41Kms.

8.5. SUMMARY AND CONCLUSIONS

1. Using twilight technique the height and thickness of an isolated cloud exist in the field of view of the twilight photometer can be calculated.

2. Using twilight technique existence of thin invisible cirrus cloud in the field of view of the twilight photometer can be discovered.
REFERENCES

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