

**MEDIUM CLOUD DISTRIBUTION OVER NORTH INDIAN  
OCEAN IN MONSOON FIELD AS REVEALED  
BY AIRCRAFT REPORTS \***

M. V. DEKATE

*Meteorological Office, Santa Cruz, Bombay*

**ABSTRACT**

This study was undertaken because most of the surface observations (synoptic as well as metars) report the medium clouds at a height of about 3 km. However, available radar observations show convective activity in SW monsoon season extending to about 6 km over peninsular India. From physical consideration a doubt has arisen whether stratified clouds of AS-type can exist within the convective layer. Data from turbo-prop aircraft which fly near the level of the middle clouds were studied with special reference to the occurrence and height of the clouds. The results indicate that whenever convective clouds in the lower levels and the middle clouds above occurred at the same place, the base of the latter was well above the top of the former and in many cases it was just at the top of the cumulus cloud. However, in many of the areas where vigorous convective activity was present and cloud tops reached great heights, AS was totally absent.

**INTRODUCTION**

Mostly in the surface observations (synoptic as well as metars) medium clouds are reported at a height of about 3 km whereas radar observations shows that convective activity in the south-west monsoon season extends to about 6 km over peninsular India. From the physical consideration, a doubt has arisen whether stratified clouds of AS-type can exist within the convective layer.

Therefore the data from turbo-prop aircraft which fly near the level of the medium clouds were studied with special reference to the occurrence and height of the clouds. The results of this study are presented in this paper.

I wish to thank Mr. V. C. Bedekar and Dr. N. S. Bhaskara Rao for going through the manuscript and offering some suggestions on the subject.

**DATA AND MODE OF ANALYSIS**

The post-flight reports received by Santa Cruz M.M.O. during the years 1960 and 1961 were utilised in this study. During these years, a large number of turbo-prop aircrafts were flying. These aircrafts were gradually replaced by jet aircrafts. The turbo-prop aircrafts fly at about the level of medium clouds and hence their estimate of medium cloud heights and amounts are more reliable than the observations from ground or high flying jet aircraft.

---

\* Presented at the 'Symposium on Indian Ocean and Adjacent Seas—Their Origin, Science and Resources' held by the Marine Biological Association of India at Cochin from January 12 to 18, 1971.

The routes covered by the post-flight reports are:

- |                   |                     |
|-------------------|---------------------|
| 1. Bangkok—Bombay | 4. Aden—Bombay      |
| 2. Colombo—Bombay | 5. Singapore—Bombay |
| 3. Karachi—Bombay | 6. Daharan—Bombay   |

The total number of reports available for study were about 400. The routes were divided into 10 Deg. Long sectors, and the occurrence of different types of clouds in each of such sectors were taken as a count.

### RESULTS

The main purpose of this study being to ascertain the base of medium AS clouds in areas where activity of Cumulus convection is taking place, comparative study of the tops of Cu clouds and base of medium clouds was made.

The heights of tops of Cu clouds as well as of the base of medium AS clouds vary considerably during the monsoon period (Table 1). This result is in conformity with earlier studies by Krishna Rao and Ganesan (1955) and Venkateswara Rao (1955).

TABLE 1. *Percentage Frequency of Cloud Heights*

Height in 1000 of ft.	<8-8	9-10	11-12	13-14	15-16	17-18	19-20	>20
Cu Tops	3.0	8.1	21.3	13.5	13.0	24.0	8.0	9.1
Medium Cloud Base	4.0	14.3	17.7	12.0	15.4	24.0	7.0	5.6

The average heights for Cu tops works out to be about 18,700 ft (5.70 km) and for medium clouds base to be 17,900 ft (5.45 km).

As can be seen (Fig. 1) in almost all the cases the AS layer is above the Cu tops. The average height of AS is 17,900 ft (5.45 km) and also that AS hardly exists below 10,000 ft (3 km).

Thus it is noticed from the aircraft observations that the heights of base of the medium clouds are generally 5,000 ft (1.52 km) higher than are generally believed and that in the areas where Cumulus clouds are present the AS base is invariably above the Cu tops.

During the course of this study it was noticed, that reporting of heights of base of medium clouds is biased to some extent by the flight level of the reporting aircraft.

The above tendency is indicated in Fig. 1b, which shows the scatter diagram of reported heights of medium clouds (mostly AS) plotted against cruising level of the aircraft. In this figure, data from all types of aircrafts were utilised. A scrutiny of the data also revealed that on a large number of occasions in many of the areas

where vigorous convective activity was present and cloud tops reached great heights AS was totally absent.

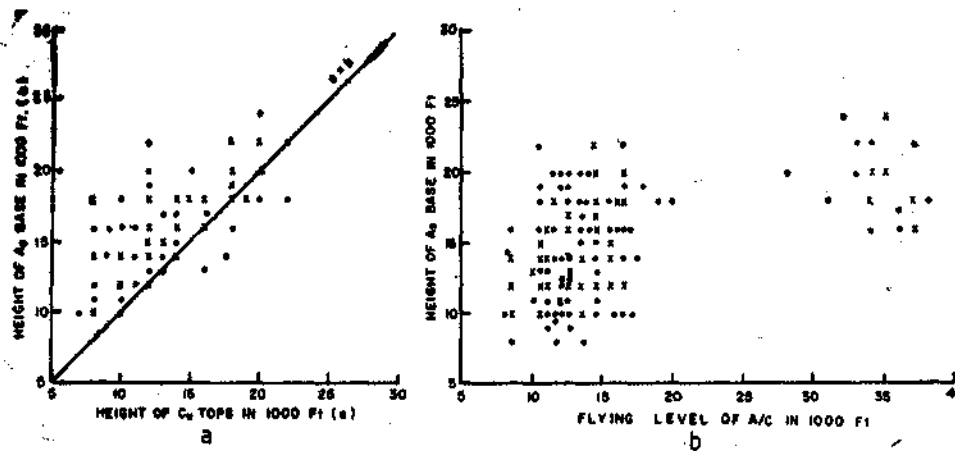


Fig. 1. Scatter observations in which both Cu and AS clouds were reported at the same place.

In the non-monsoon field, there was not a single case in the data scrutinised where both these clouds exist.

#### CONCLUSIONS

This study reveals that :

1. The average height of base of medium cloud (AS) is 17,900 ft (5.45 km) and its height varies from 8,000 (2.44 km) upto 20,000 ft (6.10 km).
2. When Cu and AS coexist, AS is always above the top of Cu clouds.
3. The average height of Cu tops are 18,700 ft (5.70 km) in monsoon.
4. Where vigorous convective activity was present and cloud tops reached great heights, AS was totally absent.

#### REFERENCES

- KRISHNA, RAO, P. R. and GANESAN, V. 1955. On the formation and Physical properties of clouds over Madras. *Symp. 'Artificial Rain', C.S.I.R., New Delhi.*
- VENKATESWARA RAO, D. 1958. Cloud heights and turbulence in monsoon season in South Asia. *Symp. 'Monsoons of the World', & Ind. Met. Dept.*