Letters To The Editor

551·508·822 : 551·553·21 (54)

A NOTE ON THE COMPARATIVE STUDY OF THE RADIOSONDE ASCENTS OVER BOMBAY AND POONA DURING THE MONSOON SEASON OF 1950

It is well known that the southwest monsoon air mass which gives copious precipitation along with West Coast of India does so, largely due to the presence of the Western Ghats. The changes in this air mass during the process of crossing the hill ranges can be studied only by taking soundings on either side of the hill ranges. For the monsoon season of 1950, radiosonde ascents, once daily at 1400 GMT are available at Juhu aerodrome, Bombay (Lat. 19° 06′N, Long. 72° 50′ E, Ht 9 ft above mean sea level) on the sea coast and at Poona (Lat. 18° 32′N, Long. 73° 55′E, Ht 1836 ft above mean sea level) eighty miles to the southeast of Bombay on the other side of the Western Ghats. Results of the study of the average and daily characteristics of temperature and humidity as well as variations of the characteristic elements during different monsoon types are presented in this note.

2. The Western Ghats rise abruptly from the coastal plains to a height of 2000 to 3000 ft, the highest peaks being 4500 to 5500 ft above mean sea level. During the monsoon months the mean air flow along the Bombay coast[1] is mainly westerly up to 6 km. Aloft, the wind changes sharply to east. During active monsoon the winds are stronger (about 20/25 knots) up to about 5 km and weaker aloft than those occurring during weak monsoon. Air mass from the same source region normally affects Bombay as well as Poona at different levels. For studying the characteristics of the air mass during periods of strong, moderate, or weak monsoon, the ascents during these periods are grouped together and their average values worked out to be representative of each type. In view of the close proximity of the stations, while working out the averages, data of same day's ascents at Bombay as well as Poona have been considered. The strength of the monsoon has been classified mainly according to the intensity of the rainfall at Juhu as follows—

Strong monsoon—Rainfall of 3″ or more in 24 hours

Moderate monsoon—Rainfall between 1-3″ in 24 hours

Weak monsoon—Rainfall less than 1″ in 24 hours.

The period from 13 to 27 August 1950 when Bombay and Poona were rainless has been considered to be representative of 'break' monsoon conditions. The intensity of rainfall at the neighbouring coastal stations, *viz.*, Santacruz, Colaba and Harnai at distances of 1 mile, 10 miles and 70 miles respectively to south of Juhu, and Dhanu, 60 miles north of Juhu has also been looked into and the days grouped for working out averages are representative of the different types of monsoon.

3. Table 1* gives the average values of dry bulb temperature, humidity mixing ratio, relative humidity and potential wet bulb temperature at different pressure levels.

It is noticed that the average dry bulb temperature at Bombay is lower than that at Poona by 1 to 2 degrees up to 500 mb and very nearly equal aloft. This feature is also noticeable on days of strong, moderate and weak monsoon periods. Even in the daily curves of dry bulb temperature at different pressure levels, this feature is noticeable and the day to day rises or falls at Bombay are correspondingly reflected at least in 80 per cent cases at Poona up to 600 mb. Though this difference of two degrees can easily be within the limits of accuracy of the instruments[2], it may be considered significant since it is systematically observed in all the months in the monthly mean curves and also on different types of monsoon days.

* Based on monthly data computed by department

TABLE 1

Pressure (mb)	No. of Observations		Dry bulb temperature (°C)	Humidity mixing ratio (gm)	Relative humidity (%)	Potential wet bulb temperature (°A)
900	Bombay	88	20·5	14·8	86	295·0
	Poona	90	21·6	14·8	80	296·0
850	Bombay	88	18·2	13·2	83	295·2
	Poona	89	19·2	13·3	81	295·6
800	Bombay	88	15·3	11·6	83	294·5
	Poona	89	16·5	11·7	78	295·1
700	Bombay	84	10·4	8·0	68	293·9
	Poona	88	11·7	7·7	63	294·2
600	Bombay	89	3·7	5·6	67	293·8
	Poona	80	4·7	5·6	61	294·1
500	Bombay	74	−4·0	Data scanty		
	Poona	64	−3·1			
400	Bombay	68	−13·2			
	Poona	53	−13·1			
300	Bombay	56	−26·9			
	Poona	11	−26·8			

Freezing level— Bombay : 16,500 ft Poona : 17,000 ft

The average values of humidity mixing ratio as well as its day to day variations at different pressure levels do not show any systematic differences as in the case of the dry bulb temperature. The average relative humidity at Poona is, however, lower than that at Bombay upto 600 mb. It is also seen that the average lapse rates of dry bulb temperature at both the places are very nearly equal to the saturated adiabatic lapse rate and that the mean wet bulb potential temperature decreases. The air mass is, therefore, highly humid and convectively unstable and there are no noticeable changes in its stability characteristics as it moves across the Western Ghats. The rise of temperature and the lowering of the relative humidity at Poona is probably due to the orographic descent of the air on the leeward side of the Western Ghats.

4. On examining the average values worked out for the different monsoon types it is seen that there is very little change in dry bulb temperature up to 600 mb but its decrease is noticeable aloft with decreasing activity of the monsoon. The 'break' conditions are characterised by a decreased lapse rate between 800 and 700 mb and a marked fall in temperature above 600 mb. The average wet bulb curves drawn, mark out distinctly the different types—'strong' being associated with high moisture content, and 'break' monsoon conditions with least moisture content. The decrease in temperature noticed aloft and the decreased moisture content associated with decreasing activity of the monsoon is probably due to the advection of dry *Tc* air aloft. An examination of the day to day temperature changes revealed that every fresh strengthening of the monsoon is associated with 1 to 2 degrees fall up to 800 mb, changes at 700 mb being not systematic. This decrease in temperature in lower levels associated with high moisture content is probably due to arrival of fresh surges of the monsoon current across the equator[3]. There were cases when there was fall in dry bulb temperature but without rise in moisture

content. In such cases there was little rain. The variations of humidity mixing ratio at 700 mb and 600 mb seem to give better indication to judge the strength of the monsoon current than changes in the dry bulb temperature.

Table 2 gives the relative humidity values at different pressure levels in the various monsoon types.

TABLE 2

Pressure	S	M	W	B
900	92	88	87	75
850	94	83	82	74
800	96	80	77	72
700	80	74	72	45
600	80	71	64	49

S—Strong monsoon M—Moderate monsoon
W—Weak monsoon B—Break in monsoon

It is seen that if 80 per cent saturation is assumed as the minimum for the moisture layer, the thickness of the moist layer seems to be a *necessary* factor for determining the strength of the monsoon, in Bombay. Throughout the 'break' period, the thickness of the moist layer rarely exceeded 850 mb. Excluding this period in nearly 65 per cent cases, the weakening of the monsoon was associated with a diminishing thickness of the moist layer particularly above 700 mb. It is, however, noticed that the same depth of moist layer is not associated with the same order of rainfall. *i.e.*, a moist layer of 300 mb depth has not always given the same order of rainfall. This means that although the thickness of the moist layer is a *necessary* factor, it is not a *sufficient* criterion for determining the strength of the monsoon. This is probably due to the fact that besides orographic features, other factors due to varying types of circulation patterns prevailing on the days also affected the rainfall.

I wish to express my grateful thanks to Dr. B. N. Desai and Dr. P. Koteswaram for valuable guidance. I am also thankful to Sri Y. P. Rao for helpful suggestions.

D. KRISHNA RAO

Meteorological Office,
Santacruz Airport, Bombay
December 26, 1950.

REFERENCES

1. Venkiteshwaran, S. P. and Yegnanarayanan, S., *Ind. J. Met. Geophys.*, **2**, 3, p. 228 (1951).
2. Kalyanasundaram, V., Performance Characteristics of the Fan-type radiosonde (Unpublished).
3. Field, J. H., *Ind. met. Dep. Mem.*, **20**, Pt. 1 (1906).