

Meteorological conditions on days of radon measurements in air over the eastern Arabian Sea off Bombay

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ABSTRACT

Meteorological conditions prevailing over and west of Bombay on the four days on which Bhat *et al.* (1974) made measurements of radon concentration at different altitudes from the surface to 3.7 km and distances of 0-50 and 350-400 km west of Bombay, do not appear to support their conclusions about airmasses.

INTRODUCTION

IN a recent paper in this journal, Bhat, Krishnaswami and Rama (1974) have discussed radon measurements over the eastern Arabian Sea at a distance of 0-50 and 350-400 km west of Bombay at different levels from surface to 3.7 km on 26 August 1969, 27 June and 10 July 1970, and 29 July 1971. According to them, their radon observations showed the presence of easterly continental airmasses over the area on 26 August 1969 and of monsoon airmasses of recent continental origin on the other three days. Although they have explained radon results on the basis of airmasses present over the area on the days in question, they have given inadequate or no information about actual meteorological conditions. For example, on 26 August 1969, they have given remarks—"easterly wind"; on 27 June 1970, "cloudy with a little rain" at 0-50 km west of Bombay, and "clear weather" at 350-400 km west of Bombay; on 10 July 1970, "cloudy" both at 0-50 km and 350-400 km west of Bombay, and on 29 July 1971, no information is given for either at 0-50 or 350-400 km west of Bombay. In order to enable the readers to appreciate how far their explanations about airmasses on the basis of radon results are tenable, we are giving in this note available relevant meteorological information for the Bombay area for the days in question.

DISCUSSION

26 August 1969

Although no upper air data are available for the Bombay area for 00 GMT of the day, the 06 GMT observations showed 110 to 158 degrees 4-13

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kt winds up to 3.6 km at least. There was a depression in the east Arabian Sea in the morning of the day with centre near 13° N, 71° E west of Goa. At 00 GMT the upper winds over Vengurla were 130 to 170 degrees 5–10 kt from 0.3 to 2.1 km and 090 degrees 10 kt at 3.1 km, over Goa 140 to 160 degrees 5–15 kt between 0.3 and 1.5 km, and over Mangalore 120 to 160 degrees 15–25 kt from 0.3 to 0.9 km, no winds being available for higher levels for all the three stations. Thus, winds over the Konkan, Goa and Karnataka coasts were under the grip of a depression. The depression moved northwestwards.

Temperature (T), dew-point (T_d) and wind direction (D) in degrees and speed (V) in knots up to 600 mb level for 12 GMT of the day for Santacruz are given in table 1, no sounding and wind data being available for 00 GMT.

It will appear that the dew-point was about 3–6° lower than the temperature and the lapse rate was near moist adiabatic. With the north-westward movement of the depression, the winds over Bombay up to about 1 km (900 mb) were getting out of its grip. It can be taken that similar conditions prevailed at least up to 50 km west of Bombay. The data would show that there was maritime air up to about 3.7 km. Santacruz had 4.9 and 1.2 mm and Colaba 9.0 and 35.0 mm rain in 24 hours ending at 03 GMT of 26 and 27 August respectively. The depression off the coast would not form without incursion of maritime air over the area. Therefore, the statement of Rama and co-workers that there was “easterly continental air” over Bombay on 26 August 1969 would not appear correct.

27 June and 10 July 1970, and 29 July 1971

Rama and co-workers have considered that there was monsoon airmass over and off Bombay on the three days. In table 2 are given

Table 1. Meteorological conditions at Santacruz on 26 August 1969

Level	Temperature	Dew-point	Wind	
	T (K)	T_d (K)	D	V
Surface	301	296	000	0
950 mb	298	293	256	13
900 mb	295	291	234	11
850 mb	291	288	104	8
700 mb	283	277	093	34
600 mb	276	271	174	34

Table 2. Rainfall recorded at Santacruz and Colaba

Station	Rainfall in mm recorded in 24 hrs ending at 03 GMT					
	27 June 1970	28 June	10 July 1970	11 July	29 July 1971	30 July
Santacruz	1.6	4.0	40.1	26.2	0.8	7.4
Colaba	0.0	0.2	7.2	35.6	3.5	1.5

Table 3. Upper winds over Santacruz

Level	27 June 1970		10 July 1970		29 July 1971	
	<i>D</i>	<i>V</i>	<i>D</i>	<i>V</i>	<i>D</i>	<i>V</i>
Surface	000	0	270	11	270	9
950 mb	169	9	225	13	249	25
900 mb	273	9	243	13	245	28
850 mb	258	11	225	29	226	21
700 mb	140	6	227	9	279	13
600 mb	358	2	241	13	246	17

rainfall amounts in mm recorded at Santacruz and Colaba in 24 hrs ending at 03 GMT of the day and also of the next day.

It will be seen that except on 10–11 July 1970, the monsoon over Bombay area was weak in terms of rainfall.

Upper winds over Santacruz up to 600 mb at 00 GMT on the three days in question are given in table 3.

It will appear from the table 3 that winds were stronger on 10 July 1970 and 29 July 1971 than on 27 June 1970.

The sounding at Santacruz at 00 GMT showed that on 27 June 1970, the dew-point was lower than the temperature by 1 to 3° except at 700 mb where it was lower by 7°; on 10 July 1970 it was 1 to 4° lower, and on 29 July 1971, 1 to 3° lower except at 600 mb where it was 7° lower. The air had nearly saturation adiabatic lapse in all the cases, it having been forced to ascend due to the Western Ghats; such conditions might have also existed up to about 400 km west of Bombay (Desai 1970). The "cloudy weather with a little rain" was due to the effect of the Ghats near Bombay; at 350–400 km west of the station, the skies were clear because the monsoon was

weak as seen from rainfall and the Ghats' influence could not extend to 350-400 km west of Bombay.

On 10 July 1970, the sky was cloudy both near and west of Bombay due to the influence of the Ghats as the monsoon was strong over Bombay in terms of rainfall as stated above. On 29 July 1971, no weather remarks have been given by Rama and co-workers; the monsoon was weak over Bombay in terms of rainfall, as stated before.

It may be stated that there was a depression over the north Madhya Pradesh on 29 July 1971, and to its west and southwest, continental air was being brought, which also extended to the Bombay area. The 12 GMT sounding over Bombay of that date showed, when compared with 00 GMT, that the dew-point depression had considerably increased from 3° to 7° at 700 mb, from 7° to 18° at 500 mb and from 6° to 11° at 400 mb, although it decreased at 600 mb from 7° to 4° ; on other days the dew-point depression in the same levels generally decreased at 12 GMT when compared with 00 GMT due to the effect of solar heating. These results of dew-point depressions will show that on 29 July 1971 there was generally drier air over Bombay at 12 GMT than at 00 GMT above 850 mb. These discussions would not appear to justify their interpretation of radon data on the basis of airmasses without considering details of meteorological conditions.

Regarding their statement that the monsoon air was of recent continental origin, it might be stated that, as shown by the IIOE data (Desai 1970), the continental air is hot and as it moves over the cool sea surface, an inversion develops right from the surface and no significant amount of moisture can be transported upward across the inversion. In case where there is a cold maritime airmass in the surface layers, the continental airmass flows over it and an inversion develops at the boundary, the height of inversion base depending upon the thickness of the moist airmass. As the air moves eastward towards the west coast of the peninsula, the base of inversion rises, the cloudiness increases and rain begins to occur as a result of the moist air being forced to rise due to the presence of the Ghats up to a distance of about 500 mb from them (Desai 1970); over the coast, the inversion disappears and there is moist air with high humidity and nearly saturation adiabatic lapse up to about 500 mb.

As shown by Rao and Desai (1973), the monsoon originates in the southern hemisphere and moves into the Arabian Sea across the equator between about longitudes 37° and 60° E.

CONCLUSION

The interpretation of airmass characteristics on the basis of radon results would not appear so easy as considered by Rama and co-workers.

The assumptions of Rama and co-workers about the airmass over the Bombay area on the days in question with inadequate or no information about meteorological conditions would not appear tenable and it would be difficult for meteorologists to accept their conclusions. We believe that the radon results should be judged with reference to the prevailing meteorological conditions, as explained by Rao and Desai (1970, 1971 and 1974).

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