551.524.4 : 551.510.52(547.1)

VERTICAL VARIATION OF RADIO REFRACTIVE INDEX IN LOWER TROPOSPHERE OVER BOMBAY

The radio refractive index (RRI) variation in in the lower troposphere is mainly governed by the variation of water vapour content of the air mass. Other factors, influencing the RRI variation are the lapse rate of the density of dry air under isothermal condition and the lapse rate of temperature (Starr 1953). But the contribution of these other factors to the RRI variation is relatively low and insignificant. Earlier workers Kulshrestha and Chatterjee (1967) have described the vertical structure of radio refractive index over India upto a height of approximately 10,000 ft but their studies were based on 5-year average values of pressure, temperature and relative humidity and the results were discussed for total radio refractive index. In the present analysis, however, the radio refractive index at four levels in the lower troposphere has been computed for individual radiosonde ascents of Bombay for the year 1980 and the results averaged. The contribution to the refractive index by the water vapour content (N_m) has been separated out. For simplicity of calculation RRI at 1000 mb is taken to represent the RRI value at ground level. Symbols N_T and N_d represent the total radio refractive index and the contribution of dry air respectively.

Fig. 1 shows the vertical gradients of radio refractive indices in different seasons over Bombay. The following features are observed for sublayer I (1000 mb to 850 mb) and sublayer II (850 mb to 700 mb).

(*i*) The vertical gradient of total radio refractive index (N_T) in sublayer I is more than in sublayer II. This is contributed mainly by the RRI component due to water vapour.

(*ii*) The vertical gradient N_m and hence N_T in sublayer I is maximum during summer and minimum during winter. In sublayer II, the N_m or N_T gradient is maximum during monsoon and minimum during summer.

(*iii*) There is practically no seasonal variation in N_d or its vertical gradient in both the sublayers.

It may be mentioned here that during summer when the radio refractive index gradient is very steep in the lower atmosphere, VHF-TV transmissions have occasionally been received at Bombay from far-off stations in the Middle East.

Fig. 2 shows the monthly variation of vertical gradient of radio refractive index (N_m). The N_m curves have been marked by serial numbers 1, 2, 3 etc. to represent different months in chronological order. It is observed that except for May and October which are the transition months, the N_m gradient curves fall into two broad groups namely, monsoon (A) and non-monsoon (B) months. Further it is observed that month to month variations in N_m gradients are more during the non-monsoon in the sublayer I.

It is also observed from Fig. 2 that N_m values at 1000 mb level increase systematically from winter to monsoon months. As the temperature near the ground surface (which may be taken as approximate equal to that of 1000 mb) also increases from winter to summer, the increase in N_m value cannot be ascribed to that (since increase in T has the effect of decreasing N_m) but can only be due to the increase of relative humidity.

From this study, we are led to conclude that the vertical gradient of radio refractive index N_m and hence N_T in the atmosphere upto 1.5 km a.s.l. over Bombay is minimum during winter

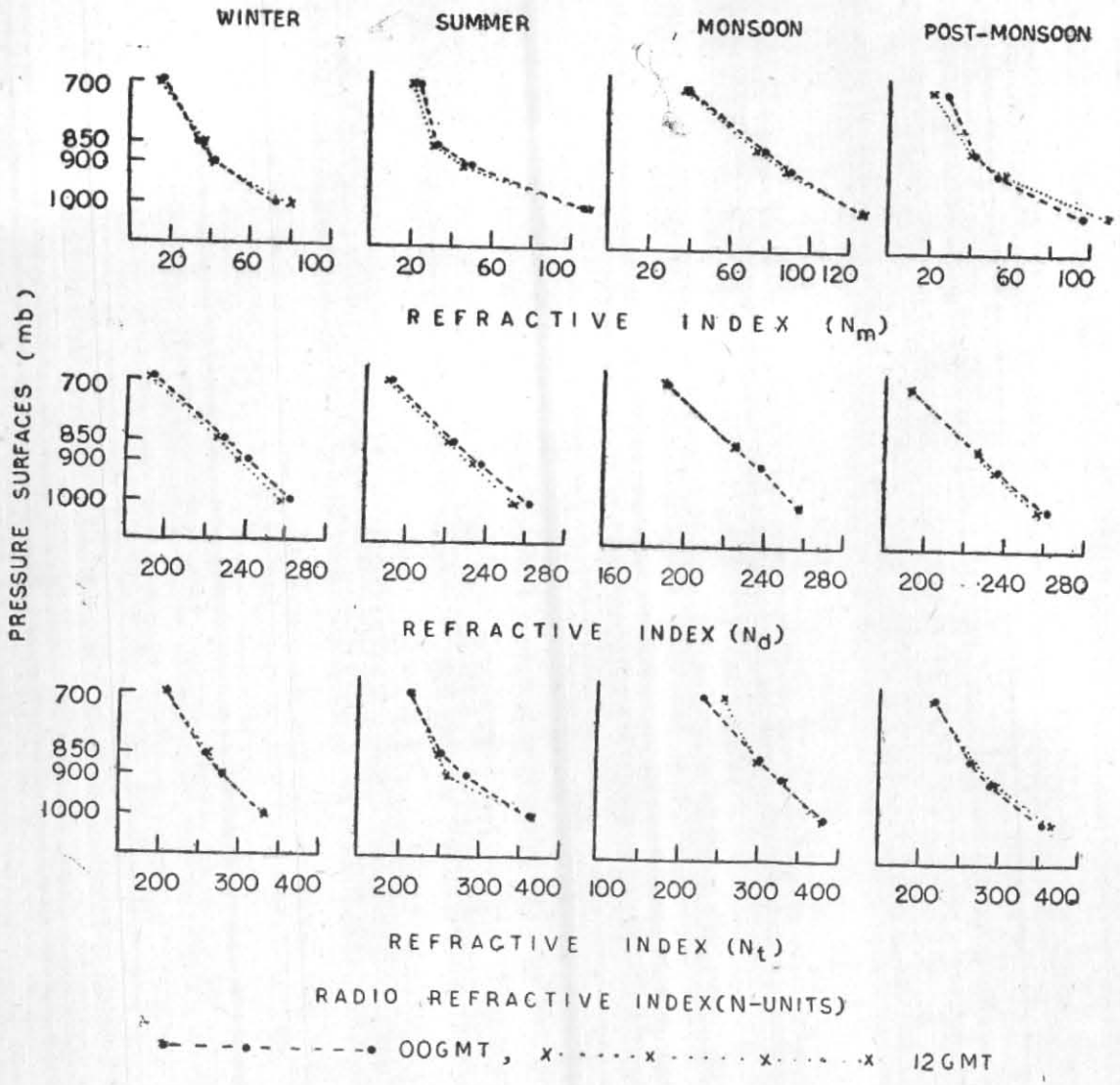

Fig. 1. Seasonal gradients of radio refractive indices N_T, N_d, N_m over Bombay

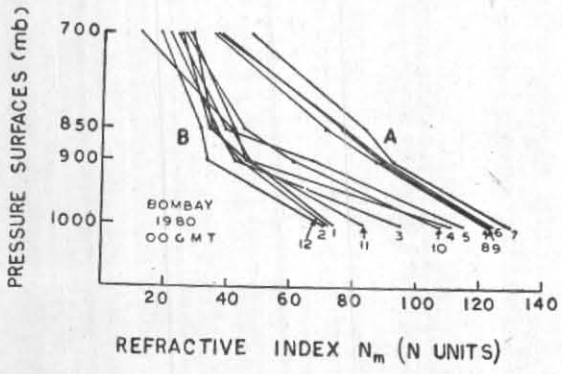

FIG. 2 MONTHLY GRADIENTS OF RADIO REFRACTIVE INDEX DUE TO MOISTURE OVER BOMBAY

and maximum during summer; between 1.5 and 3.1 km, it is minimum during summer and maximum during monsoon. There is no seasonal variation in N_d gradient.

These features of radio refractive index over Bombay may be of interest to radio physicists and radio engineers.

References

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