551.587 : 551.510.62 (545.3)

RADIO CLIMATOLOGY OF PATIALA

1. Variation in refractivity of a place helps for communication engineers and radiophysicists in estimating the better reception of signal during point to point radio communication/microwave links. The tropospheric radio horizon and the signal strength at a given point is not only significantly influenced by terrain features and vegetations but also on existing meteorological conditions especially pressure, moisture and temperature which may cause signal variations and trapping of radiowave. Accordng to CCIR study group V for 30 to 300 mHz tropospheric communication, a change of 0.2 dB in field strength occurs for every unit change of surface radio refractivity index. Thus, knowledge of climatic variation is desirable to have a better microwave link in the area of interest.

Bean *et al.* (1966) have derived world radio climatological data while Kulshrestha and Chatterjee (1966) for India. Local variations at Delhi (Deshpande 1974), Bombay (Dayakishan and Pradhan 1977), over Arabian Sea and Singapore (Sivaramakrishnan 1981, 1982) have been studied. Since Patiala has an airport and microwave link base, it is a better place to study the variation of refractivity for usual radio path.

2. *Climatology of Patiala* — Patiala is located in the northern part of the country at a Lat. 30° 20′ N, Long. 76° 28′ E and at height 252.29 metres a.m.s.l. Its climate is strongly affected during winter with the passage of western disturbances associated with thunderstorms accompanied by squalls and sometimes with hails, low clouds, poor visibility due to heavy showers and fog. Western depressions also affect weather conditions occasionally. Temperature starts falling from November itself and the period of mid-December to mid-February is the coldest and the minimum temperature of about 3°C is normally observed.

Rapid rise of temperature and decrease of pressure starts from beginning of March and the highest is recorded during May and June. Average maximum temperature of more than 45°C is observed. Maximum duststorm activity is during May and June.

Southwest monsoon sets in by first week of July. The average annual rainfall is about 100 cm. Nearly 80-90 per cent of the annual rainfall is received during the southwest monsoon period. Sub-tropical westerly jet stream prevails over the station at an altitude of 200 mb during October to May.

3. *Data used* — The monthly average value of surface pressure, temperature and relative humidity are taken from the available meteorological records from October 1985 to December 1986. The radio refractivity index is computed using the following relation (Smith and Weinturb 1953) :

$$N = (\eta - 1) \times 10^6 = 77.6 \frac{P}{T} + 373000 \frac{e}{T^2}$$

where N is the modified radio refractive index, P is pressure in mb, T is temperature in degrees Kelvin, e is water vapour pressure is mb and η is atmospheric radio-refractive index. The above equation contains two terms — the first one is called dry term while the second is wet term. The variation of first term is small compared to the second term and hence the terms were separately calculated and then added up.

4.1. *Seasonal variation* — Table 1 expresses the monthly mean values of RRI at surface for each synoptic hour for all the months. It may be seen that maximum value is reached around July and August (southwest monsoon) at surface and similar trend exists in upper air levels [Fig. 1 (a)]. The maximum value of N_s is of the order of 391 N which is well within limit for any station in India during the entire year (Kulshrestha and Chatterjee 1966) while minimum value is 294 N, but there is a steady variation from November to March. The annual range of variation within a year at surface is about 18 N units while variation of mean value at higher levels

TABLE 1

Mean monthly values of surface RRI in N-units

Month	Time (GMT)								Mean			
	0000	0300	0600	0900	1200	1500	1800	2100	N_s	Max.	Min.	Range
Jan	318	317	319	311	318	321	320	319	318	321	331	10
Feb	320	316	317	312	318	324	319	322	318	324	312	12
Mar	325	326	315	308	317	326	327	325	321	327	308	19
Apr	322	320	301	294	295	314	323	324	312	324	294	30
May	336	321	323	315	312	326	333	334	325	336	312	24
Jun	355	351	341	335	334	347	353	354	346	355	334	21
Jul	382	382	379	376	383	381	384	383	381	384	376	08
Aug	385	382	379	383	383	391	391	385	385	391	379	12
Sep	365	361	355	349	350	370	365	362	360	370	349	21
Oct	347	350	340	329	341	349	349	349	344	350	329	21
Nov	327	328	318	306	322	327	328	328	323	328	306	22
Dec	324	324	320	314	321	326	325	325	323	326	314	12

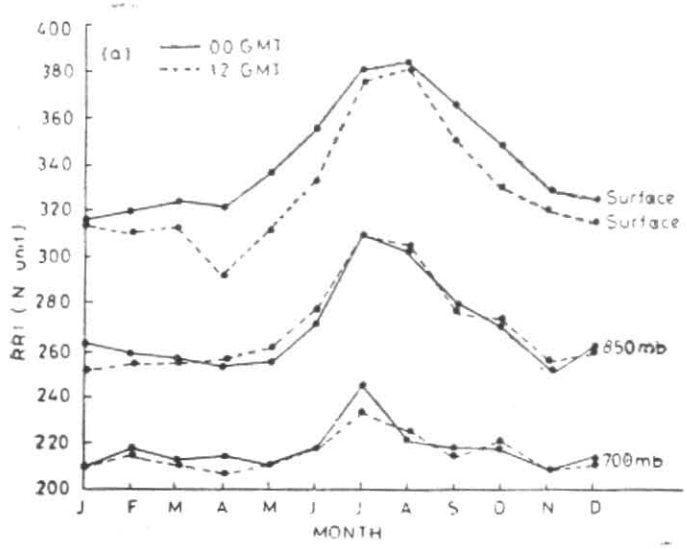

Fig. 1 (a). Monthly mean values of RRI at different levels

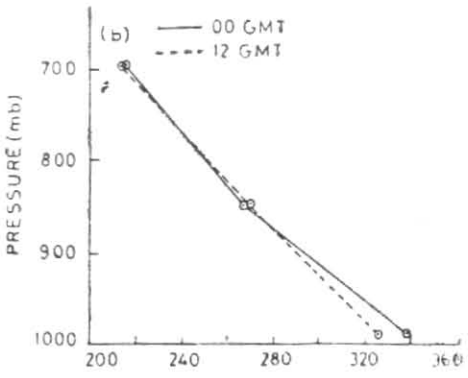

Fig. 1 (b). RRI at upper air levels at 0000 and 1200 GMT

are 267 ± 1 at 850 mb and 215 ± 1 at 700 mb [Fig. 1 (b)]. A considerable difference in surface RRI values is observed at 1200 GMT synoptic observation and upper air sounding. This difference is due to different time of two observations. Humidity variation of the order of 30% has been observed during the time tolerance of 1200 GMT upper air sounding as a result of radiative cooling of the earth in the evening. The main contribution in RRI is due to the wet term.

4.2. *Diurnal variation* — The study of diurnal N_s pattern reveals that there is a considerable variation (More than 10 N) throughout the year except in July. Patiala gets maximum RRI values at surface in July and August (southwest monsoon) and lowest in April. Diurnal variation is maximum (order of 30 N) in April while minimum in July at surface. The annual range of variation in surface RRI is about 18 N while there is a steep decrease up to lower tropospheric level (700 mb) during both times [Fig. 1 (b)].

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References

Bean, B.R., Cahoon, B.A., Samson, G.A. and Thayer, G.D., 1959 *A World Atlas of Atmospheric Radio Refractivity*, ESSA-Monograph 1, United States Govt. Printing Office, Washington.

Deshpande, C.V., 1974, *Indian J. Met. Geophys.*, **25**, p. 301.

Dayakishan and Pradhan, S.K., 1977, *Indian J. Met. Hydrol. Geophys.*, **28**, pp. 400-401.

Kulshrestha, S.M. and Chatterjee, K., 1966, *Indian J. Met. Geophys.* **17**, pp. 367-384.

Sivaramakrishnan, T.R., 1981, *Mausam*, **32**, pp. 27-30.

Sivaramakrishnan, T.R., 1982, *Pageoph*, **120**, pp. 698-701.

Smith (Jr.), E.K. and Weinturb, S., 1953, *Proc. Inst. Rad. Engrs* N.Y., **41**, p. 1035.

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