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RADIO REFRACTIVE INDEX STRUCTURE OVER DIBRUGARH

Dibrugarh is situated in the extreme northeast corner of India. This is the main linking point for Arunachal pradesh and adjoining areas. Because of the typical topography and furious *Brahmaputra* wireless communication is the only efficient mode of communication used by different agencies in this place. Even for the expansion of T.V. and AIR network so as to benefit the NE India Dibrugarh is one of the main centres chosen. Hence, the factors affecting the radio communication is of vital importance to not only the communication engineers but also the user agencies.

Radio Refractive Index (RRI) is a parameter which can describe to a great extent the radio refractive field. This refraction can cause fading also. Pressure,

TABLE 1

Mean surface RRI over Dibrugarh at different hours (IST)

	0530	0830	1130	1430	1730	2030	2330	0230	Diurnal variation
Jan	325	330	313	314	332	330	330	332	19
Feb	335	333	320	318	338	332	335	333	17
Mar	342	340	328	325	340	342	345	345	17
Apr	353	350	345	345	350	352	352	350	8
May	370	370	370	368	368	370	370	372	4
Jun	383	380	380	375	378	380	382	382	3
Jul	390	393	390	390	393	390	390	390	3
Aug	390	395	390	385	390	390	390	395	5
Sep	390	380	380	382	385	390	390	390	10
Oct	378	368	372	360	380	375	378	373	20
Nov	345	350	340	340	353	350	352	348	13
Dec	330	335	325	323	340	335	333	333	17

temperature and humidity are the three factors which influence the radio horizon which should be reflected in this parameter. Hence this parameter, if evaluated for Dibrugarh area for different situations will be of help in effecting better communication systems.

Radioclimatology for India (1966) includes the surface RRI for Dibrugarh based on 5 years' data and the seasonal variation is also mentioned. But it is the experience of radio engineers at Dibrugarh that a lot of signal fluctuation is observed even within a day and hence, a study on the diurnal nature of RRI will be of practical importance to this place. Yet another point is that there was no upper air observatory at or around Dibrugarh to measure the structure of atmosphere (and hence the vertical structure of RRI) till late seventies. However, as a result of Monex-79 expedition, a radiosonde station has started functioning at Dibrugarh Airport, Mohanbari since 1979 and upper air temp. data valid for 0530 a.m. and 0530 p.m. are available. A full study on the radio refractive index structure using the available meteorological data was made and the results are presented here.

2. *Methodology* — Current weather registers are maintained at Mohanbari and the temperature, dew point and pressure recorded at eight synoptic hours of the day were noted and monthly averages were worked out. From the monthly averages of the years in the recent decade mean values for dry bulb and dew point temperatures and surface pressure valid for 00, 03, 06, 09, 12, 15, 18 and 21 GMT were derived. Radio refractive index was computed using the formula :

$$N = (N - 1) \times 10^6 = \frac{77.6}{T}\left(P + 4810\frac{e}{T}\right)$$

where, N — Modified radio refractive index.

P — Pressure in millibars.

T — Temperature in degrees Kelvin.

e — Partial vapour pressure.

From the available upper air data since 1979, monthly average temperature and dew points for 850, 700 and 500 mb level (1.5, 3.1 and 5.8 km a.g.l.) were also derived. RRI was computed for these levels also using the same formula.

3. *Result* — The mean RRI at surface at 3 hourly intervals within a day valid for each month is presented in Table 1. The variation within a day is also given in the last column. It can be seen that there is not much difference between 00 and 12 GMT values. Same was found to be true at 1.5, 3.1 and 5.8 km level also. Table 2 presents the mean RRI values for surface, 1.5, 3.1 and 5.8 km levels.

4. *Discussion* — It is seen that the diurnal change can be as high as 20 N units in October to practically nil in June/July. Hence post monsoon month's of October/November can have a considerable signal strength variation even within a day as revealed by the values. During October to March RRI values are higher at night than the day. There is a sharp fall of RRI between 03 and 06 GMT and a sharp rise between 09 and 12 GMT. Obviously this may be the temperature effect. May to August is the period of practically steady radio refraction during the day time coinciding with the monsoon season. April and September are the switch-over months. This suggests that as far as diurnal variation in RRI is concerned, there are two types in Dibrugarh area: (*i*) winter type where there is a diurnal trend present and (*ii*) monsoon type where absolutely no such trend is present. Table 2 gives the picture of RRI at different levels of the lower troposphere. Even at 850 and 700 mb levels, RRI values are typically high in monsoon months while winter values are less. But there is no significant variation of RRI at 500 mb level (5.8 km a.s.l.). This indicates that the presence of seasonal variation is confined to the tropospheric region below 5.8 km only. This is similar to the RRI behaviour over equatorial seas (Sivaramakrishnan 1981).

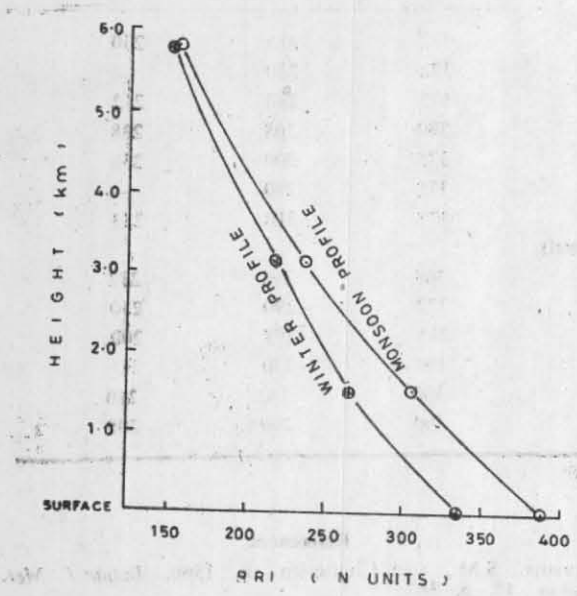

Fig. 1. Vertical RRI profile

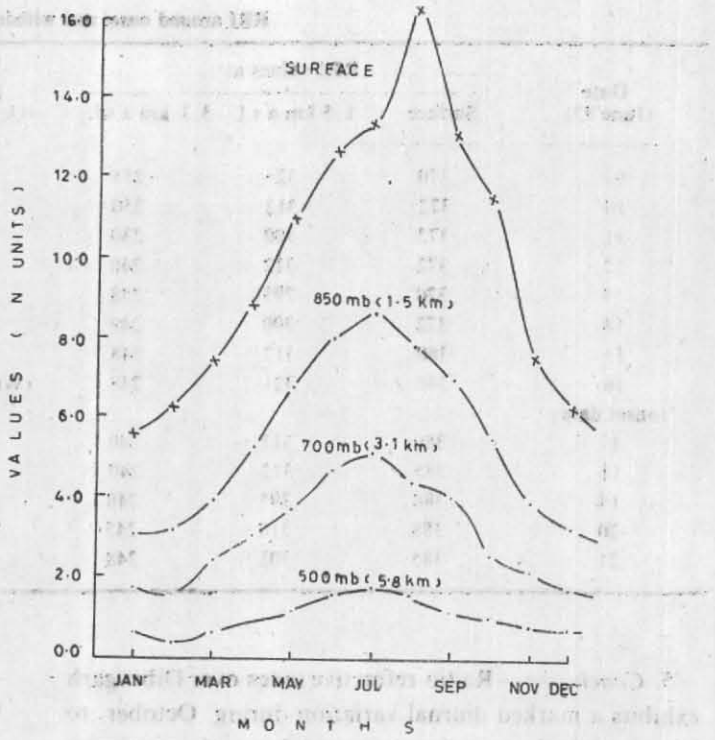

Fig. 2. Wet term variation

TABLE 2

Mean RRI in lower tropospheric levels
(N units)

	Surface	1.5 km	3.1 km	5.8 km
Jan	325	264	217	155
Feb	335	267	218	155
Mar	342	270	222	155
Apr	353	282	225	156
May	370	295	230	158
Jun	383	305	237	159
Jul	387	312	243	161
Aug	390	303	235	159
Sep	390	296	233	155
Oct	378	282	220	155
Nov	345	269	218	155
Dec	330	265	218	157

4.2. The typical mean vertical profiles for monsoon and winter season are shown in Fig. 1. These are derived from the monthly means of the two seasons in the table.

4.3. At Dibrugarh rainy season starts even in April and early May due to nor'wester activity. So the actual onset of monsoon cannot be easily distinguishable from the surface weather. Hence, an attempt was made to identify onset and withdrawal of monsoon in RRI pattern. Actual onset dates were picked up from *Indian Daily Weather Reports* for the years 1981, '82, '83 and '84. Daily values of RRI were evaluated one week before onwards upto one week afterwards for surface, 850 and 700 mb levels. It was found that the surface RRI which is around 370 in the preceding week to the onset date of monsoon jumps to a value around 380 and then maintained to a value above 380. A typical example of the year 1982 is shown in Table 3. Thus, the arrival of monsoon can be identified from the trend in this parameter. However, the arrival of monsoon is not clearly reflected in 850 and 700 mb. Similarly after the withdrawal of monsoon, there is a significant fall in RRI values.

4.4. RRI is made up of two terms as seen in the formula. The first one is called 'dry term' as the temperature decides this value. The second term is the wet term. Because of vast water vapour potential due to the *Brahmaputra* river and its tributaries, humidity is always high around Dibrugarh (75% or more). The dry term varied between 257 and 273 N units in a year. However, the wet term value is around 60 N units in winter months and it goes to around 160 N units in September. The trend of large variation is present in higher levels also as brought out in Fig. 2. Dry term values during monsoon months are smaller compared to winter month values.

TABLE 3

RRI around onset and withdrawal periods of monsoon

Date (June'82)	RRI values at			Date (Oct'82)	RRI values at		
	Surface	1.5 km a.s.l.	3.1 km a.s.l.		Surface	1.5 km a.s.l.	3.1 km a.s.l.
9	370	325	255	1	372	315	230
10	372	312	250	2	372	280	—
11	372	300	230	3	375	280	212
12	372	312	240	4	380	308	238
13	370	295	238	5	375	300	238
14	372	300	248	6	375	290	—
15	380	317	248	7	375	310	233
16	380	321	248	(Withdrawal)			
(onset date)				8	368	298	232
17	380	312	240	9	372	290	230
18	385	312	240	10	365	278	200
19	388	295	248	11	360	270	215
20	388	310	245	12	360	270	210
21	385	305	248	13	360	260	208

5. *Conclusion*—Radio refractive index over Dibrugarh exhibits a marked diurnal variation during October to March while the same is not present during the southwest monsoon season. Two typical vertical profiles (*i*) monsoon profile and (*ii*) winter profile can be identified here and both have been derived upto 5.8. km level.

References

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

Sivaramakrishnan, T.R., 1981, *Mausam*, **32**, 1, pp. 27-30.

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