551.510.62 : 621.391.812.6 (547.1)

THE INFLUENCE OF SEA BREEZE CIRCULATION ON SURFACE RADIO REFRACTIVITY AND TROPOSPHERIC SIGNAL STRENGTH AT BOMBAY

1. Knowledge of seasonal and diurnal variations of surface radio refractivity is useful for design and communication engineers. Recently, Deshpande (1974) studied diurnal and local variations of surface radio refractivity over Delhi which is an inland station. In the present study, diurnal and seasonal variations of surface refractivity over Bombay have been worked out. Since Bombay is a coastal station, the influence of sea breeze circulation on such variations has been discussed.

2. Mean monthly values of surface pressure, temperature and water vapour pressure for Santacruz for various synpotic hours were obtained for the six year period 1968 to 1973. Mean values for each of these variables were calculated for synoptic hours for all the months. Surface refractivity, N_s, was then computed according to Eqn. (1) given below :

$$N_s = (n-1) \times 10^6 = \frac{77 \cdot 6}{T} \left(P + \frac{4810\, e}{T} \right)$$

$$= 77 \cdot 6 \frac{P}{T} + 3 \cdot 73 \times 10^5 \frac{e}{T^2} \qquad (1)$$

where symbols P, T and e have usual meaning.

3. Variation of surface radio refractivity, Ns, for various synoptic hours for Santacruz during different months is presented in Table 1. The maximum and minimum values of N_s with their timings of occurrence are also shown in the table. The diurnal range and the monthly mean values of N_s during different months over Santacruz are presented in Fig. 1. It may be seen that during monsoon months (June-September) the mean monthly N_s is highest and its diurnal range least. During winter months (November-February) mean monthly N_s is lowest and its diurnal range highest. N_s values show a sharp rise from winter to summer months and steady rise from summer to monsoon months.

4. Surface refractivity N_s was calculated for Colaba also for the synoptic hours 03, 06 and 12 GMT. Differences of N_s between Colaba and Santacruz for these synoptic hours are presented in Table 2. It is seen that values of N_s are higher at Colaba as compared to that of Santacruz in all the months. The differences are well marked in the winter months and least in monsoon months.

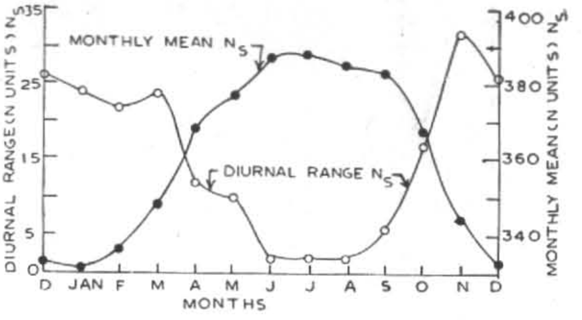

Fig. 1. The diurnal range and monthly mean of Ns during different months over Santacruz

5(a). At Bombay, which is a coastal station, the seasonal and diurnal variations in surface refractivity are greatly controlled by the sea breeze circulation. Onset of sea breeze inhibits further rise of surface temperature and causes increase in moisture and fall in temperature. Dekate (1968) has shown that sea breeze sets in earlier and more vigorously in summer than in winter. Therefore, surface temperatures at Bombay during hot weather period do not reach high, while the moisture content is rather large due to early and vigorous setting in of sea breeze. Hence surface refractivity is much higher in summer months than in winter (unlike the case of interior station).

5(b). At Bombay sea breeze sets in between 05 and 08 GMT and maximum temperature around 0730 GMT. After setting in of sea breeze the values of N_s continue to rise till late evening. Once the land breeze sets in, N_s values start decreasing. Minimum values of N_s at Bombay, except for monsoon months, occur around 06 GMT and maximum values occur around 15/18 GMT as shown in Table 1.

5 (c). At Delhi which is an inland station, Deshpande (1974) has shown that differences in N_s values between Palam and Safdarjung are not significant. At Bombay, sea breeze circulation causes large differences in N_s values between Colaba and Santacruz, except for monsoon months (Table 2). The values are higher at Colaba (on the sea coast) as compared to that of Santacruz which is 3 km away from the coast.

TABLE 1

Variation of N_s for various synoptic hours for Santacruz during different months (1968-73)

	Time (GMT)								Mean	Maximum Ns (GMT hr)	Minimum Ns (GMT hr)
	00	03	06	09	12	15	18	21			
Jan	335	330	316	322	330	340	338	338	331	340 (15)	316 (06)
Feb	340	335	321	330	333	341	343	342	336	343 (18)	321 (06)
Mar	357	346	334	341	341	352	358	356	348	358 (18)	334 (06)
Apr	375	371	364	365	364	371	376	..	369	376 (18)	364 (06)
May	381	376	372	373	375	380	382	381	377	382 (18)	372 (06)
Jun	388	387	386	386	386	388	388	388	387	388 (18)	386 (06)
Jul	388	389	389	389	387	387	389	389	388	389 (18)	387 (06)
Aug	385	385	385	386	384	385	386	386	385	386 (18)	384 (12)
Sep	385	385	380	382	381	383	385	386	383	386 (18)	380 (12)
Oct	372	369	357	359	365	374	372	373	368	374 (15)	357 (06)
Nov	344	336	323	331	345	355	352	349	244	355 (15)	323 (06)
Dec	335	330	318	321	335	344	342	333	333	344 (15)	318 (06)

TABLE 2

Differences of Ns between Colaba and Santacruz (1968-73)

	Time (GMT)		
	03	06	12
Jan	+13	+19	+15
Feb	+14	+18	+16
Mar	+14	+20	+17
Apr	+8	+12	+10
May	+6	+9	+7
Jun	+1	+3	+2
Jul	+1	+2	+1
Aug	+2	+3	+1
Sep	+2	+4	+2
Oct	+9	+12	+10
Nov	+21	+19	+14
Dec	+19	+21	+19

6. Studies of Bean and Dutton (1966) and various other workers have shown the influence of climate on mean signal strength. In fact there exists a close relationship between the variations in N_s and signal strength because both undergo similar variations due to changes in weather. Actually C.C.I.R. has accepted a variation of 0·2 db in field strength per unit change in N_s for tropospheric propagation. Therefore design and communication engineers at Bombay can utilize the diurnal and seasonal changes occurring in N_s as discussed above, to study the respective variations in tropospheric signal strength.

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