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MEASUREMENT AND ANALYSIS OF RADIO REFRACTIVE INDEX OVER PATIALA DURING MONSOON SEASON WITH RESPECT TO ITS DIURNAL AND MONTHLY CHARACTERISTICS

1. Radio wave transmission from a station is received at a distant point through tropospheric mode of propagation. The transmitted radio wave follows the curved path, due to refraction and the degree of curvature is controlled by the refractive index of the atmosphere, which leads to signal de-focussing (Kukushkin and Sinistin 1983). RRI becomes more pronounced during monsoon season. Thus, it is important to map the radio refractive index of Patiala during monsoon season, taking the monthly and diurnal variations separately. Profiles of radio refractive index (RRI) of different stations have

TABLE 1

Diurnal and monthly variations and ranges (Monsoon season)

Month & Level		Average value of RRI		Average diurnal variatios	Variations in RRI	
		0000 (UTC)	1200 (UTC)		0000 (UTC)	1200 (UTC)
Jun	At surface	370.8	357.5	13.3	318.9 to 403.2	312.3 to 396.4
	At 1.5 km	278.4	245.5	32.9	250.0 to 310.2	219.5 to 290.0
	% variation from surface to 1.5 km	Falls by 24.9%	Falls by 31.3%			
Jul	At surface	387.1	381.7	5.4	371.0 to 401.0	366.0 to 395.0
	At 1.5 km	306.2	301.3	4.9	271.0 to 338.0	264.0 to 336.0
	% variation from surface to 1.5 km	Falls by 20.9 %	Falls by 21.1%			
Aug	At surface	388.6	387.6	1.0	361.4 to 407.3	370.7 to 409.0
	At 1.5 km	299.4	293.5	5.9	262.8 to 338.6	258.6 to 325.3
	% variation from surface to 1.5 km	Falls by 22.9%	Falls by 24.3%			
Sep	At surface	387.9	380.2	7.7	369.0 to 398.3	360.3 to 395.2
	At 1.5 km	285.7	291.2	5.5	260.5 to 317.0	253.6 to 318.1
	% variation from surface to 1.5 km	Falls by 26.3%	Falls by 23.4%			

been received earlier (Bayonton 1965; Majumdar *et al.*, 1976; Kulshrestra 1987 and Sukla 2008).

The refractivity of troposphere is a function of atmospheric pressure, temperature and water vapor pressure as derived by Bean and Dutton (1968).

The total refractivity is given as

$$N = N_{dry} + N_{wet} \quad (1)$$

A formula for the dry and wet refractivity is given by :

$$N_{dry} = 77.6 \times PT^{-1} \quad (2)$$

and

$$N_{wet} = 3.73 \times 10^5 \times eT^{-2} \quad (3)$$

Where P is atmospheric pressure in hPa, T is absolute temperature and e is the water vapor pressure in hPa.

$$T = t + 273 \quad (4)$$

t = temperature in degree C and

$$e = 6.1078 \times \exp [5417.1 \times (1/273 - 1/T_d)] \quad (5)$$

Where T_d is dew point temperature in degree Kelvin

Hence, the total refractivity comes out to be

$$N = 77.6\, PT^{-1} + 3.73 \times 10^5 eT^{-2} \quad (6)$$

For refractivity over Patiala, the atmospheric pressure, temperature and dew point temperature are examined at 0000 UTC and 1200 UTC from radiosonde data of eleven years (1997-2007) for monsoon season. The refractivity for twice a day is calculated for two levels namely surface and 1.5 km by using equation (6) above. The surface refractivity is determined at ground level and the elevated refractivity at a little above planetary boundary layer around 1.5 km (above the mean sea level) height are computed. Data for monsoon season (1st June to 30th September) for the years 1997-2007 have been studied and the average values are determined.

2. The average values of RRI and their diurnal and monthly variations during monsoon season at 0000 UTC and 1200 UTC hours are summarized in Table 1. Variation in the values of RRI during the month of June is more pronounced at surface at 0000 UTC and 1200 UTC. They vary from 318.9 to 403.2 at 0000 UTC and from

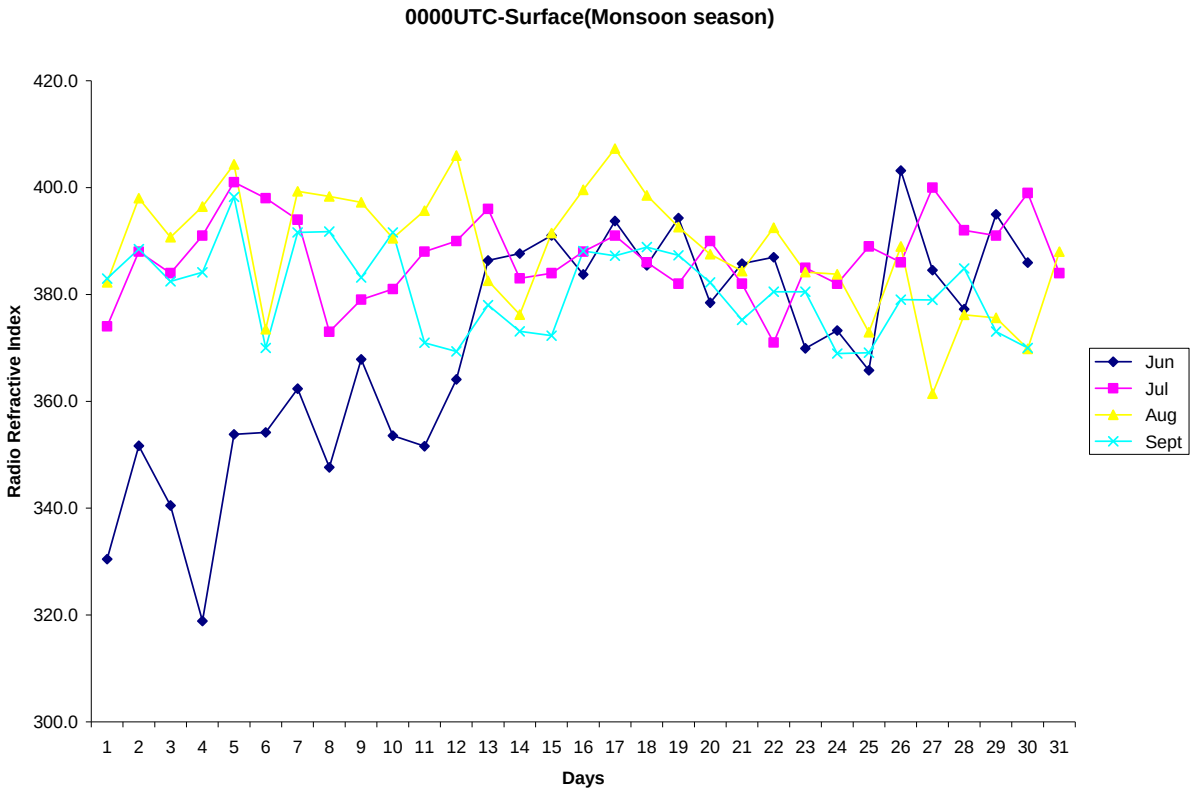

Fig.1. RRI profile of monsoon season (June-September) at surface at 0000 UTC

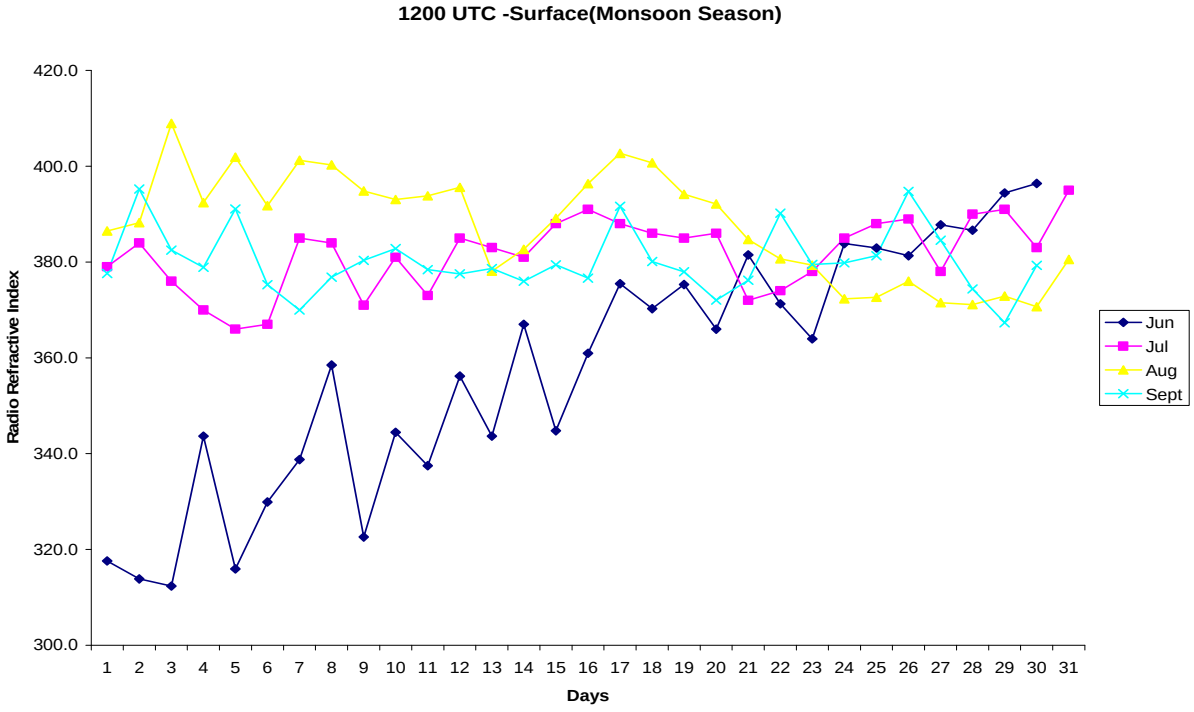

Fig. 2. RRI profile of monsoon season (June-September) at surface at 1200 UTC

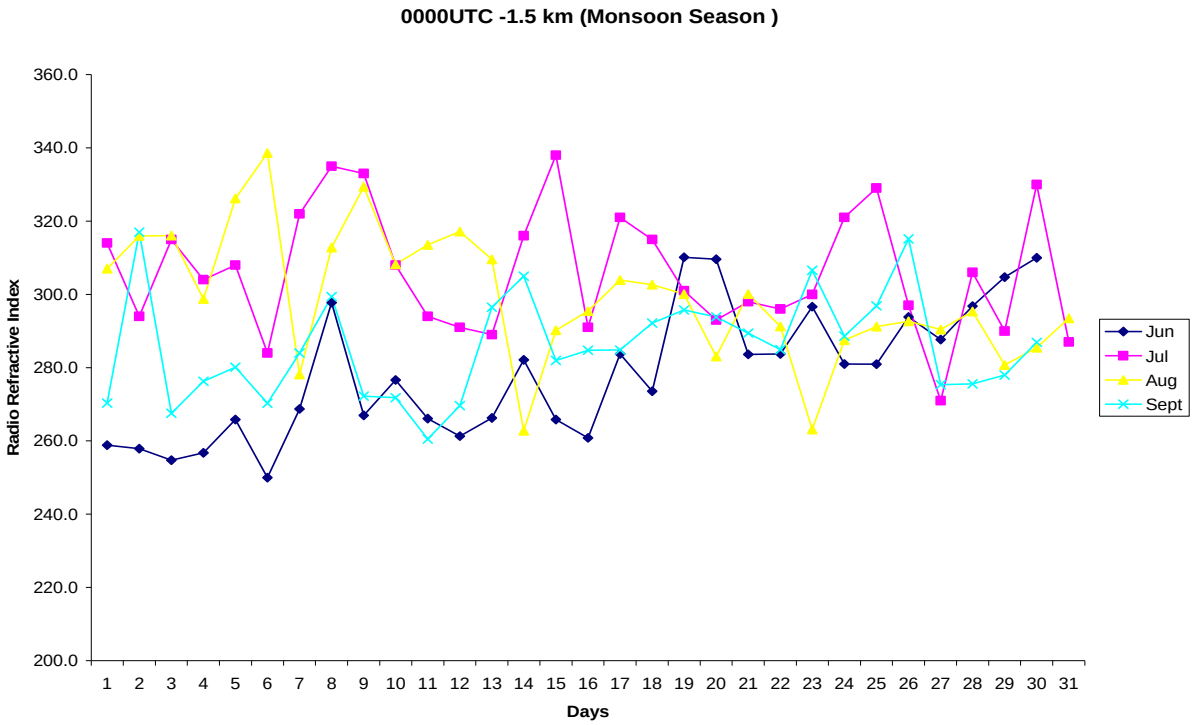

Fig. 3. RRI profile of monsoon season (June-September) at 1.5 km at 0000 UTC

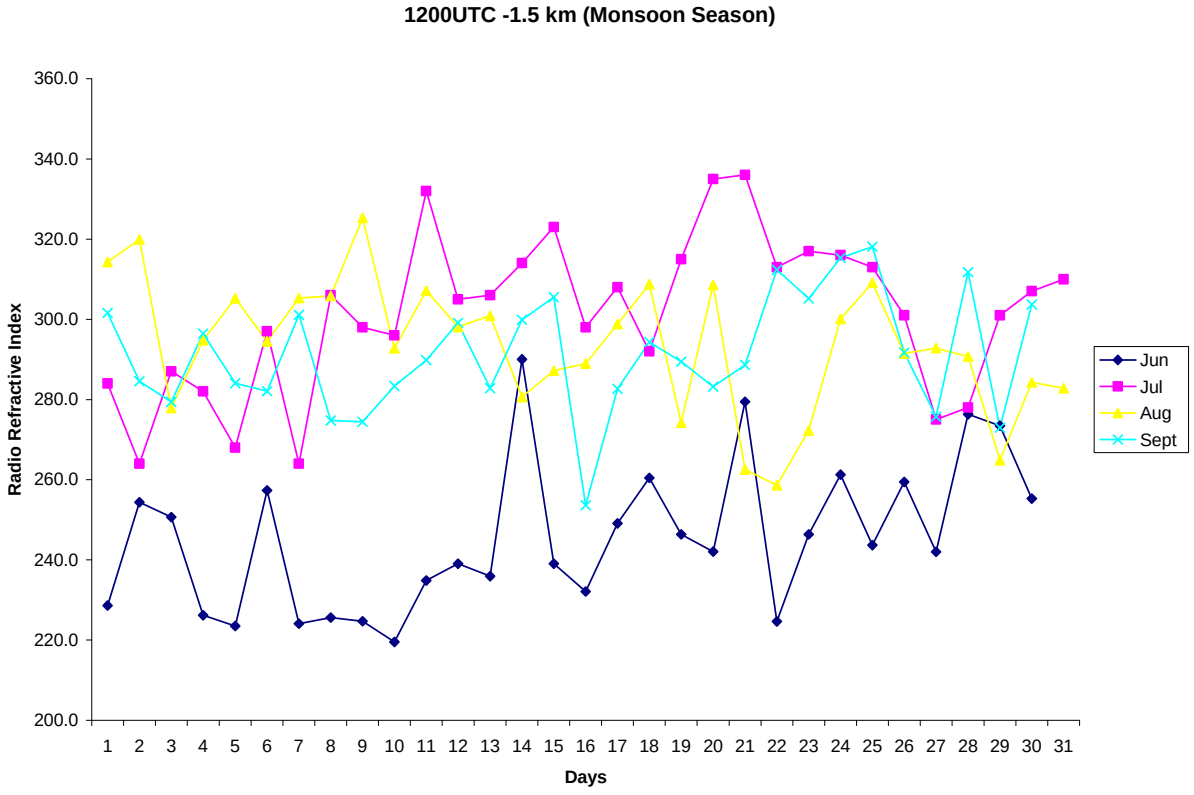

Fig. 4. RRI profile of monsoon season (June-September) at 1.5 km at 1200 UTC

312.3 to 396.4 at 1200 UTC as shown in Table 1 and Figs. 1&2.

During July, August and September, variations in the values of RRI at surface are less at 0000 UTC and 1200 UTC as shown in Table 1 and Figs. 1&2. At 0000 UTC they vary from 371.0 to 401.0, 361.4 to 407.3 and 369.0 to 398.3 during July, August and September respectively. At 1200 UTC they vary from 366.0 to 395.0, 370.7 to 409.0 and 360.3 to 395.2 during July, August and September respectively.

Variations in the values of RRI during July, August and September at 1.5 km are more than those of surface at 0000 UTC and 1200 UTC as shown in Table 1 and Figs. 3&4. At 0000 UTC they vary from 271.0 to 338.0, 262.8 to 338.6 and 260.5 to 317.0 during July, August and September respectively. At 1200 UTC they vary from 264.0 to 336.0, 258.6 to 325.3 and 253.6 to 318.1 during July, August and September respectively. However, during June the trend is different as the values of RRI are less than that of surface. They vary from 250.0 to 310.2 and 219.5 to 290.0 at 0000 UTC and 1200 UTC respectively.

Monthly variations at surface in average values of RRI range from 370.8 to 388.6 and 357.5 to 387.6 at 0000 UTC and 1200 UTC respectively. Similarly monthly variations at 1.5 km in average values of RRI, range from 278.4 to 306.2 and 245.5 to 301.3 at 0000 UTC and 1200 UTC respectively. As we go from surface level to1.5 km level, falls in RRI values range from 20.9% to 26.3% and 21.1% to 31.3% at 0000 UTC and 1200 UTC respectively during monsoon season. It has been observed that values of refractivity at surface are higher in morning and lower in the evening. The probability of presence of atmospheric boundary layer that forms due to vertical diffusion of moisture and heat attributes to the above facts (Schiavone 1982). This atmospheric boundary layer gets distorted itself only after sunset.

Average diurnal variations are 13.3, 5.4, 1.0 and 7.7 at surface level during June, July August and September respectively. They are 32.9, 4.9, 5.9 and 5.5 at 1.5 km level during June, July August and September respectively.

3. Following results have been drawn from the study.

(*i*) At surface, values of RRI are mostly lower in 1st half of June at 0000 UTC and 1200 UTC and their day to day variation is more. After 1st half of June till the end of September, values of RRI increase but their day-to-day variation is less.

(*ii*) At 1.5 km RRI values are lower in June and higher in July, August and September at 0000 UTC and 1200 UTC but day to day variation is large in all the months.

(*iii*) RRI values are mostly higher in the morning and lower in the evening at surface and 1.5 Km levels. Diurnal variation is maximum during June at surface and 1.5 km levels.

(*iv*) As we go from surface level to 1.5 km level, **%** fall in monthly average values of RRI is least in July.

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