Occurrence characteristics and causative mechanisms of daytime L-band scintillations over Dibrugarh, a station at the northern edge of EIA during 2010 – 2014

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Dibrugarh (27.5° N, 95° E, 43° dip), a location at the northern edge of EIA behaves as low as well as mid latitude location during nighttime. The nighttime L-band scintillations during ascending half of the solar cycle 24 (from January, 2010 to December, 2014) over Dibrugarh are found to be attributed to both equatorial irregularities and sporadic-E (Dutta et al., 2018a). The occurrence characteristics and possible mechanisms of daytime scintillations are investigated and presented in this paper at the same frequency for the same phase of solar cycle. The daytime amplitude scintillations are found to be associated with insignificant phase scintillations, TEC depletions, ROT and ROTI (Figure 1). This implies that no plasma bubbles are formed during daytime scintillations over the location. The association of insignificant TEC depletions/ ROT fluctuations during daytime scintillations were observed earlier at Guilin (25.3° N, 110.3° E) a station near the northern crest of EIA (Zou and Wang, 2009; Zou, 2011) and at equatorial station University Kebangsaan Malaysia (UKM), Malaysiya (2.6° N, 101.5° E) (Seif et al., 2012). They reported that daytime scintillations were caused by small scale irregularities in E-region.

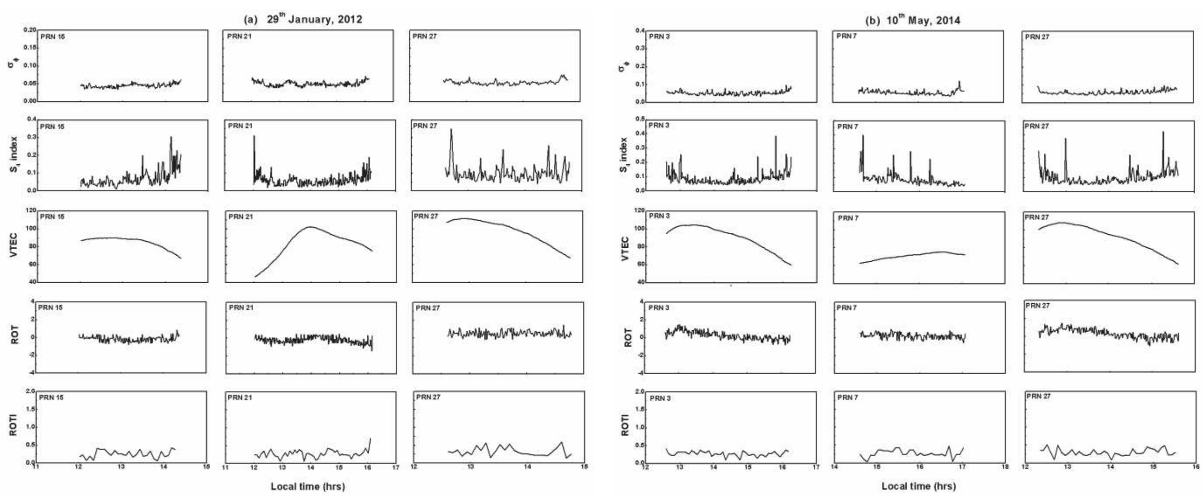

Figure 1. Plots of phase scintillations (σ_φ), amplitude scintillations (S_4), vertical TEC (in TEC unit, 1 TECU=10^{19} electrons/m^2), ROT (in TECU/min) and ROTI (in TECU/min) with local time for (a) PRNs 15, 21 and 27 on 29th January, 2012 and (b) PRNs 3, 7 and 27 on 10th May, 2014.

In the diurnal variation, evening peak of occurrence of scintillations in all seasons (winter, equinox and summer) is noticed while morning peak is seen in equinox and summer (Figure 2). Seasonally, summer maximum is noticed in the years 2013 and 2014 while for the years 2010, 2011 and 2012 the occurrence is maximum in March equinox, winter and September equinox respectively (Figure 3). The summer daytime scintillations are seen to be the consequences of sporadic-E (Es) over the location whereas the scintillations in equinox and winter are the combined effect of Es, equatorial scintillations and mid-latitude scintillations. The peak occurrence of summer daytime scintillations is correlated with the maximum value of critical frequency of Es. The zonal drift velocity of summer daytime irregularities is calculated from power spectral analysis which is found to be in the range of 86 m/s to 178 m/s. The power spectral analysis also provides the spectral index of irregularities varies in between -1 and -4 which implies the variation of density of Es clouds over Dibrugarh. The decorrelation time is computed from autocorrelation function (Table 1). The horizontal spread of E-layer irregularities is estimated from drift velocity and decorrelation time. The maximum horizontal spread is obtained in the range 2–6 km for drift velocity 86 m/s while it is in the range 4–12 km for drift velocity 178 m/s (Figure 4). The latitudinal extent of scintillations as estimated by Hajkowicz and Minakoshi (2003) was 100–200 km during daytime. However, most of the previous studies estimate the Fresnel scale size of irregularities or calculate the irregularities drift velocity (Chatterjee et al., 2013) by using power spectral analysis. Banerjee et al. (1992) over Sikandarabad (28.48° N, 77.71° E) and Patel et al. (2009) over Varanasi (25.25° N, 82.98° E) estimated the horizontal spread of irregularities for various periods through power spectral analysis and autocorrelation function of C-band, L-band and VHF-band signals. The present calculated value of horizontal extent of E-layer irregularities lies in the range of the value estimated earlier.

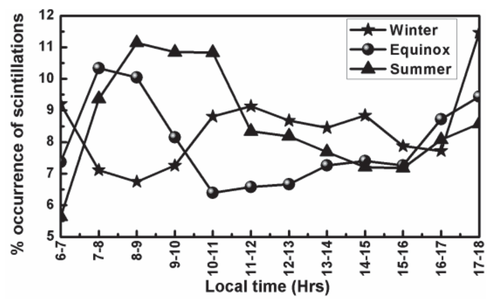

Figure 2**.** The diurnal variation of percentage occurrence of scintillations with local time for different seasons.

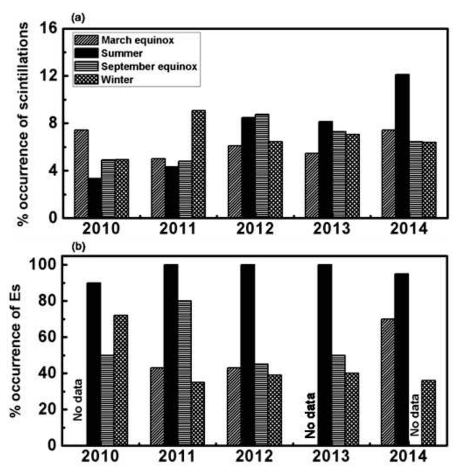

Figure 3**.** Seasonal variation of percentage occurrence of (a) daytime scintillation and (b) Sporadic-E for the years 2010 - 2014.

Date	Time	Slope	F_{min}	Drift velocity (m/s)	Half de-correlation time (s)	Horizontal spread (km)
PRN7, 4th June, 2014	13:57 - 16:58 LT	-1.25	0.7	137	41	5.2
PRN8, 4th June, 2014	13:57 - 17:57 LT	-1.04	0.5	98	47	4.6
PRN30, 10thJune, 2014	13:38 - 16:41 LT	-2	0.9	176	35	6.2
PRN17, 11thJune, 2014	15:06 - 17:59 LT	-1.05	0.72	140	61	8.5
PRN19, 19thAugust, 2014	7:11 - 9:17 LT	-1.37	0.55	107	25	2.7
PRN4, 26thAugust, 2014	10:05 - 12:47 LT	-2.23	0.82	160	57	9.1
PRN7, 26thAugust, 2014	7:08 - 10:02 LT	-2.11	0.48	94	57	5.4
PRN7, 27thAugust, 2014	7:08 - 9:17 LT	-3.31	0.46	90	42	3.8
PRN8, 27thAugust, 2014	7:20 - 9:17 LT	-3.62	0.69	135	29	3.9
PRN28, 27thAugust, 2014	9:17 - 10:23 LT	-2.23	0.44	86	37	3.2

Table. 1 The parameters obtained from the analysis of power spectrum and autocorrelation function for 10 typical examples of summer 2014.

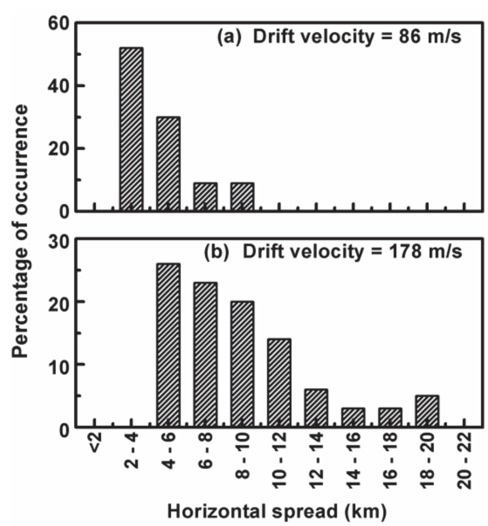

Fig. 9. Bar diagram showing percentage occurrence of horizontal spread against various ranges in kilometer.

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