



Investigation of Air Refractive Index Profile over Silchar Region to Predict the Propagation of Radio Wave

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Abstract

To investigate the atmospheric dynamism over Silchar is of great significance. Though it is practically important to understand and reveal the atmospheric variation of this region, yet no such study has been reported over this region till now. This study is of technical interest as the high frequency (radio wave) communications are greatly influenced due to the variation of refractive index profile. In the present investigation, we have considered “air refractive index” through-out the year, as refractive index profile plays the central role in controlling dynamism of tropospheric atmosphere. Lastly, this work highlights the radio wave propagation behaviour with variation in air refractive index.

Keyword: Refractive Index, Atmosphere, Troposphere, Stratosphere, Radio wave

Introduction

The information about the variation of atmospheric (air) refractive index profile is of great importance in predicting the stability/behaviour of various radio technical systems operating in the surface layer of atmosphere. For example, the microwave communication, depend on the refractive index to a great extent (Ajayi, G. O et. al. 1996). Reliable prediction of variation of air refractive index is possible by adopting some standard mathematical models if the necessary parameters like time, temperature, pressure etc. are known (Emiliani, L. D et al. 2004). Dynamical change of refractive index with seasons have been reported in the other part of world (Gomboev . N. Ts et. al.2009) but no such work has been carried out over Silchar region, though this kind of studies are significantly important for many practical purposes. Silchar is situated between longitude 92°15' and 93°15' east and latitude 24°8' and 25°8' North. This region shares its border with North-Cachar Hills district of Assam, the state of Meghalaya in the north; the state of Manipur in the east; the state of Mizoram in the south, the state of Tripura and Sylhet district of Bangladesh in the west. The region has an undulating topography characterized

by hills, hillocks, wide plane and low-lying waterlogged areas. In fact over this region variation of air refractive index with the seasonal change are very interesting. Hence, here in the present work, it is attempted to estimate (Dorvlo AS et.al, 2002) the variation of air refractive index (ζ) with changes in seasons over Silchar at very low tropospheric level (within the height of 200 ft).

Methodology of the analysis: It has been reported (Gage et al., 1991) that in troposphere and stratosphere, refractive index (ζ) can be expressed as:

$$\eta - 1 = \frac{7.76 \times 10^{-5} p}{T} + \frac{3.75 \times 10^{-1} e}{T^2} \text{ ----- (1)}$$

where η is the refraction index, e is the vapour pressure (mB), T is the temperature (K) and p the atmospheric pressure (mB). From the above expression the air refractive index can easily be assessed as:

$$\eta = \frac{7.76 \times 10^{-5} p}{T} + \frac{3.75 \times 10^{-1} e}{T^2} + 1 \text{ ----- (2)}$$

The first term of Equations 1 and 2 is function of atmospheric pressure p and temperature T while the second term is contributed from water vapour pressure e and atmospheric temperature T . Hence, during winter the first term plays significant role where as during rainy season, the second term becomes comparatively important. In the other part of a year, both the terms become equally significant. Furthermore; the radio wave propagation is greatly influenced due to changes in air refractive indices throughout the year (<http://www.windpower.org/tour/wres/weibull.htm>). It has also been tried to predict the behaviour of radio wave propagation by relating the propagation velocity with refractive index (Gomboev . N. Ts. Et al. 2008)

Result and discussion: The present atmospheric data are collected from the weather reports of Silchar, Cachar, Assam from May 2009 to May,

2010 and also from literature survey (Gupta R, et. al, 2010). Fig 1 shows the average relative variation of air refractive index (ζ), while fig 2 shows the similar kind of variation of ' ζ ' from May to Sept. The changes in ζ have also been estimated from October to December in fig 3 and finally the average variation of air refractive index has been assessed throughout the whole year (12 months) and plotted in fig 4. Also fig 5 indicates the RF wave propagation behaviour with variation in refractive indices. The velocity of propagation in air attains maximum value in the month of June and almost constant during July to September but a slight decrease of its value. There is a sudden drop of this velocity at the end of September. The variation of refractive index as given in figure 4 mimics the variation of velocity of RF wave as given in figure 5, since refractive index is inversely proportional to velocity.

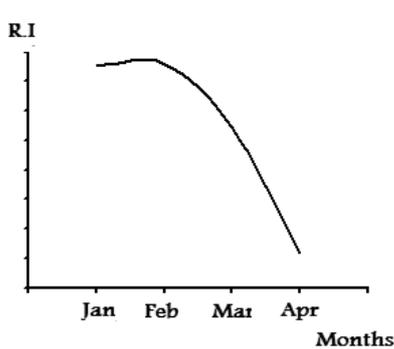


Fig. 1: Relative variation of R.I (ζ) with time (from January – April)

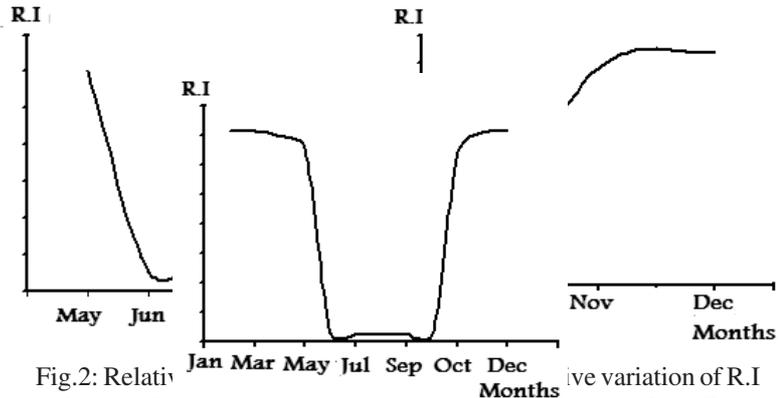


Fig. 2: Relative variation of R.I (ζ) with time (from May – September)

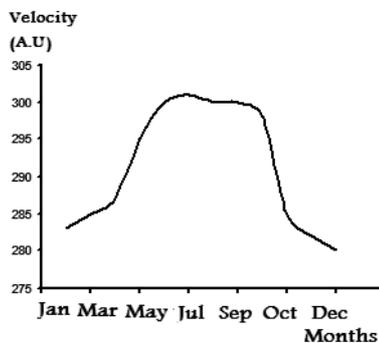


Fig. 4: Relative variation of R.I (ζ) with time (from January – December)

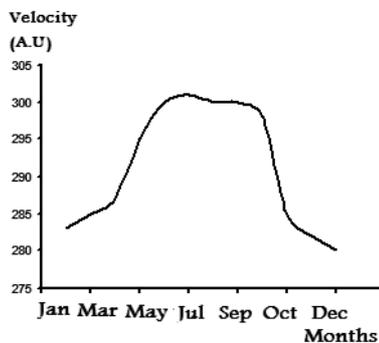


Fig. 5: Relative variation in radio wave (Kl band) propagation velocity through air

Conclusion

Present study indicates that air refractive indices in Silchar shows drastic decrease from February

to June while no such significant variation is observed in the period from June to September. Further, remarkable change in air refractive index

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is noticed from October to November. Due to this, radio wave communication also suffers a variation in its propagation behaviour throughout the whole year.

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