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Case study of electron temperature effect on simultaneously observed VHF and UHF PMSE

Safi Ullah, Hailong Li, Abdur Rauf, Lin Meng, Bin Wang, Maoyan Wang
School of Electronic Science and Engineering, University of Electronic Science and Technology of China
safiullah9396@yahoo.com

For more than 30 years during summer condition at middle and polar latitudes strong radar echoes have been observed from the mesopause region called Polar Mesospheric Summer Echoes (PMSE). The combination of neutral air turbulence and ice or aerosol (negatively charged) particles cause the inhomogeneities in electron density distribution. These inhomogeneities comparable to half of the radar wavelength (typically 3 m at 50 MHz) caused the observed PMSE. PMSE is artificially modulated by using the high frequency radio waves. One of the important parameters of dusty plasma is electron temperature, which enhanced in D-region due to HF radio wave. Simultaneous PMSE observations carried out by the EISCAT VHF and UHF radars on 13 July 2004 are used to analyze the PMSE response to HF heating at VHF and UHF radars. In panel 1 of Fig.1 it is obvious that for all cycles at both radars the backscatter intensity weakens ($R_1/R_0<1$) [1]. See panel 2 at UHF the PMSE shows no recovery as at each cycle $R_2/R_0<1$. On the other hand at VHF radar at two cycles (4^{th} and 6^{th}) the PMSE shows recovery ($R_2/R_0>1$) [1]. In panel 3 at cycles 1, 3 and 4 at UHF whereas at cycles 3 and 4 at VHF the ratio (R_3/R_0) is greater than 1 indicates the PMSE overshoot ($R_3/R_0>1$) [1]. Electron temperature is estimated using volume reflectivity instead of power in model given in [2]. Panel 4 shows that electron temperature except at first cycle is almost the same at both radars. From experimental result shown in Fig.1 we can say that the ratio of radar echoes intensities are greatly decreases at higher radar frequency. The electron temperature at VHF and UHF remains the same. The reason of comparatively great difference between electron temperature at VHF and UHF (cycle 1, panel 4) will be discussed.

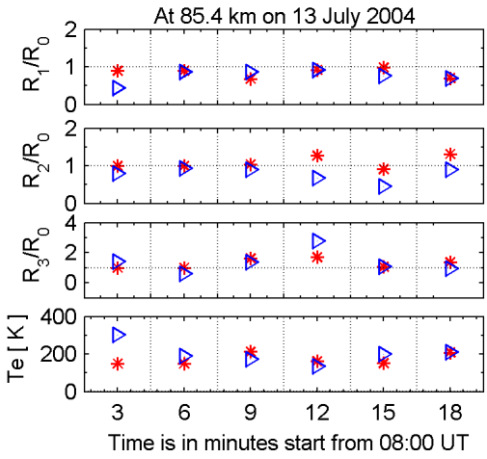

Figure. 1. The measurements at VHF and UHF are represented by asterisks and triangles respectively. UHF PMSE was defined as reflectivity $\geq 1.2\times10^{-18}$ m^{-1}.

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