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Case study of simultaneous observation of PMSE overshoot carried out by China with VHF and UHF radars

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Radar echoes produced at polar latitude at an altitude of 80-90km during summer months called polar mesospheric summer echoes (PMSE) associated with the noctilucent cloud (NLC), both contain electrically charged aerosol particles. These radar backscattering can be modulated by artificial electron heating [1]. In new heater cycling, heater is on for a short time and then off for a long enough time. When the heater is switched off, the PMSE strength can increase by a factor of several times compared to its strength before the heater was switched on, this effect is called PMSE overshoot. During an overshoot heating cycle the time variation of the PMSE strength is called an overshoot characteristic curve (OCC). We can get substantial amount of information on the state of the PMSE dusty plasma by analyzing the shape of the OCC during an overshoot heating cycle as the PMSE varies through a weaken, an overshoot and a subsequent relaxation back to the state before the heating on [2].

We obtain and compare the overshoot characteristic curves of EISCAT VHF radar at 224 MHz and UHF radar at 930 MHz observed simultaneously from 10:56:46 UT to 10:58:56 UT on July 12 2007 at an altitude of 82.9 km. Heater is on for 20s and off for 160s. Here apparent electron density represents PMSE radar echoes intensity. From Fig.1 in subplot 1, it is obvious that both OCCs (VHF and UHF) having close resemblance at the same height, but there still have some clear differences, OCC of VHF radar for this particular time and height shows larger recovery and an overshoot as compare to UHF radar. The differences will be discussed. The backscattering cross section per unit volume or the absolute observed volume reflectivity depends on the radar frequency is the important property of PMSE. Subplot 2 shows that the volume reflectivity shows great increase with decreasing radar frequency (or increasing Bragg scale). The change of volume reflectivity observed at the same time and height will be analyzed and discussed.

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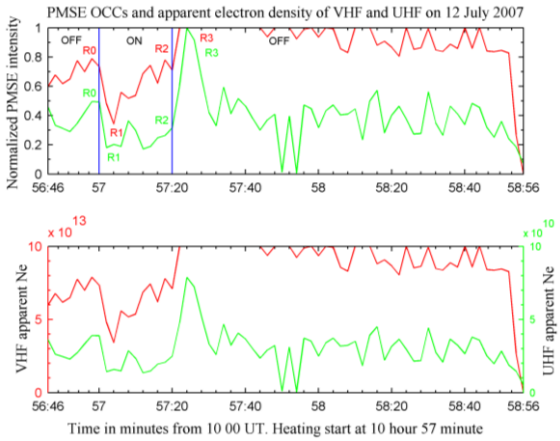

Figure 1. OCCs and apparent electron densities of VHF and UHF radars. R0, R1, R2 and R3 represent reflectivity sampling intervals. Red, green and blue colors show VHF, UHF radars and heating time, respectively.