ACTIVE PERTURBATION OF PLASMA IRREGULARITIES ASSOCIATED WITH CHARGED AEROSOLS IN THE MESOSPHERE

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Recently, experimental observations have shown that Polar Mesospheric Summer Echoes PMSE may be modulated by radio wave heating the irregularity source region with a ground-based ionospheric heating facility. In the first experiments, the strength of the PMSE was observed to be reduced upon turning on the radio wave heating and there was ultimate recovery of the PMSE upon turning the radio wave heating off. Subsequently, it was predicted and verified that an overshoot effect may occur during the recovery period. During this period after the radio wave turn-off, the PMSE strength may be enhanced over the undisturbed level. It is clear from past investigations that the temporal behavior of PMSE during ionospheric heating shows promise as a diagnostic for the associated dust layer. For investigating this temporal behavior, this work describes a new model that incorporates both finite diffusion time effects as well as dust charging. The model utilizes fluid ions described by continuity and momentum equations, electrons whose behavior is determined from quasi-neutrality, and charged dust described by the standard Particle-In-Cell PIC method. The model has been used to investigate temporal behavior of electron irregularities during electron temperature enhancement associated with radio wave heating. The model predicts that the temporal behavior of the irregularities depends on the ratio of the electron-ion ambipolar diffusion time to the dust particle charging time $\tau_{\rm dif}/\tau_{\rm chg}$. The results indicate that typically for $\tau_{\rm dif}/\tau_{\rm chg} << 1$, an overshoot occurs during turn-off of the radio wave heating. This is the regime of previous models which incorporated Boltzmann electrons. The work also predicts that for $\tau_{\rm dif}/\tau_{\rm chg} >> 1$, a turn-on overshoot should be observed in which there is an increase in PMSE amplitude for a short period of time before ultimate suppression of the PMSE during continued heating. Also, for sufficiently large $\tau_{\rm dif}/\tau_{\rm chg}$, the PMSE amplitude may be enhanced during the entire heating period. Due to the dependence of $\tau_{\rm dif}$ on irregularity scale-size, these results have important implications for observations of PMSE modification at different radar frequencies. Therefore new possibilities may exist for diagnosing the dust layer with radio wave heating which are discussed.

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2. H - Waves in Plasma

3. (a) S-G/H1

4. C - Contributed Paper

5. No special instructions