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Effect of energetic particle precipitation on electron temperature in the E-region of ionosphere

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Energetic charged particles coming from the outer space, collectively known as energetic precipitating particles (EPPs) are continuously bombarding our planet Earth. These particles penetrating into the Earth's atmosphere can affect different atmospheric processes [1]. The electron temperature (*T*e) in the ionosphere is of great significance because it usually controls the rates of many chemical and Physical ionospheric processes. Since nitric oxide (NO) production is sensitive to temperature, so the high-latitude Joule heating plays a significant role in NO production [2].The auroral electron precipitation has also a significant role in NO production, mainly by increasing the number density of excited N(^{2}D) and ground state N(^{4}S) atomic nitrogen atoms in the lower thermosphere. The atomic nitrogen reacts with oxygen molecules and produces NO [3]. Lu *et al.* (2010) postulated that NO radiative cooling acts as a "natural thermostat" to the thermosphere [4].

The aim of this study is to investigate the effect of energetic particle precipitation on electron temperature in the E-region (90–150 km) of ionosphere. The electron density in the E-region of the ionosphere is about 10^{10} to 10^{11} m^{-3}. The electron density $Ne \geq 10^{11}$ m^{-3} at altitude of 137 and 145 km is used as a proxy of energetic particle precipitation.

The electron temperature and electron density is obtained from EISCAT VHF radar located near Tromsø, Norway (69.58° N, 19.23° E). It has an operating frequency of 224 MHz. The radar ran an operating mode 'manda' of the common Program (CP-6) experiment from 23:29 to 23:39 UT on 9 July 2013. The integration time of the experiment mode 'manda' is 4.8 s.

For investigating the effect of energetic particle precipitation on electron temperature, we have compared the variations in electron temperature during and before particle precipitation at two different altitudes of 137 and 145 km in the E-region of the ionosphere. From Fig.1, it is clear that the electron temperature during particle precipitation is stable as compared to that before particle precipitation. Moreover, it is clear from Fig.1 that during particle precipitation the electron temperature is higher when electron density is low and vice versa. This might be because of nitric oxide production due to energetic particle precipitation which makes the electron temperature more stable than before the energetic particle precipitation. In future, we will analyze other cases and carry model work for getting more convincing results.

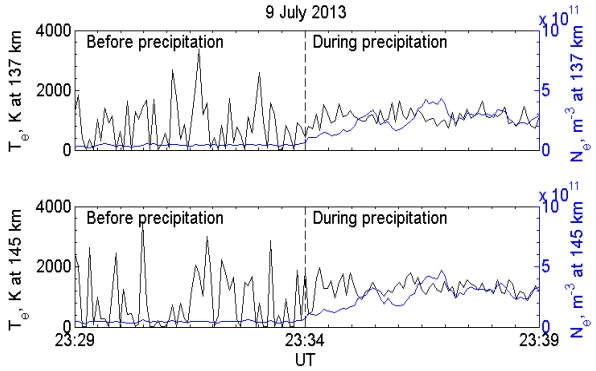

Figure 1. Variations in electron temperature before and during the particle precipitation at two different altitudes. The vertical dotted line is drawn to separate the time before and during particle precipitation.

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