

## Positive correlation between electron density and temperature in high density region of the topside ionosphere

KAKINAMI, Yoshihiro<sup>1\*</sup>, WATANABE, Shiget<sup>2</sup>, LIU, Jann-Yenq<sup>3</sup>, BALAN, Nanan<sup>3</sup>, LIU, Huixin<sup>4</sup>

<sup>1</sup>Institute of Seismology and Volcanology, Hokkaido University, <sup>2</sup>Department of Cosmospice, Hokkaido University, <sup>3</sup>Institute of Space Science, National Central University, <sup>4</sup>Department of Earth and Planetary Science, Kyushu University

Electron temperature ( $T_e$ ) in the ionosphere is determined by the heat balance between the heating by photoelectrons, cooling through Coulomb collisions with ions and heat conduction along the magnetic field lines. Many studies have shown a negative correlation between the electron density ( $N_e$ ) and  $T_e$  during daytime because cooling through Coulomb collision increases with increase of  $N_e$ . In this study, the correlation between  $T_e$  and  $N_e$  observed by the Hinotori satellite and other satellites. Although the results show the well-known negative correlation between daytime  $N_e$  and  $T_e$  when  $N_e$  is low, when the daytime  $N_e$  is significantly high ( $>10^6 \text{ cm}^{-3}$ ), the correlation turns positive irrespective of latitude, longitude, season, solar flux levels and magnetic activity levels. The results suggest that an additional heat source(s) is involved for the positive correlation between  $N_e$  and  $T_e$ . Since  $T_e$  also increases with increasing magnetic dip latitude in the same  $N_e$  range,  $T_e$  does not correlate with in-situ  $N_e$ , which suggests the integrated  $N_e$  along the magnetic field lines from the ground to 600 km altitude in one hemisphere are important for  $T_e$  in the topside ionosphere. Therefore, the additional heat source seems to be related the integrated  $N_e$ . Although the mechanism for the positive correlation is not well understood, the results imply that the  $T_e$  in the topside ionosphere is controlled more by the integrated  $N_e$  than by in-situ  $N_e$  or F2-peak  $N_e$ .

Keywords: mid-low latitude ionosphere, electron temperature, electron density, topside ionosphere, heat budget of ionospheric plasma