ひのとり衛星で観測された電子密度と電子温度の正相関

柿並 義宏 [1]; 渡部 重十 [2]; Liu Jann-Yenq[3]
[1] 北大・地震火山; [2] 北大・理・宇宙; [3] なし

A positive correlation between electron density and temperature measured with the Hinotori satellite

Yoshihiro Kakinami[1]; Shigeto Watanabe[2]; Jann-Yenq Liu[3]
[1] Inst. Seismo. Vol., Hokkaido Univ.; [2] Cosmosciences, Hokkaido Univ.; [3] ISS, NCU

Electron temperature (Te) is governed by the heat balance between the heating by photoelectrons, cooling through Coulomb collisions with ions and heat conduction along the magnetic field line in the ionosphere. Since photoelectron flux, neutral density and plasma density increase with increasing solar flux, it is not clear whether Te increases or decreases with an increase in solar flux. However, theoretical studies done by Lei et al. (2007) suggested a positive correlation between electron density (Ne) and Te during periods of high solar flux supported with the incoherent scatter data at Arecibo and Millstone Hill when solar flux is high. Meanwhile, another study indicates that the positive correlation between Ne and Te was detected when Ne is significantly high irrespective of solar flux [Kakinami et al., 2011].

In this paper, we investigate a correlation between Te and electron density (Ne) at 600 km height using data measured with the Hinotori satellite from February 1981 to June 1982. The results show a negative correlation between daytime Ne and Te when Ne is low. Further, though the positive correlation is most clear around the equator when the daytime Ne is significantly high, the correlation turns positive irrespective of latitude, longitude, season, solar flux and magnetic activity level. Also, Te is found to increase with the increase of MLat in the same Ne range. These results suggest that an additional heat source is involved in the positive correlation between Ne and Te. Since theoretical study suggest heating rate by photoelectron increase with increase of ambient plasma density [Hoegy 1984], heating by photoelectron possibly increases with increase of the integrated Ne. In addition, because the integrated Ne along the magnetic flux lines from the ground to 600 km altitude in one hemisphere also increases with increase of MLat, the results imply that the Te in the topside ionosphere is possibly controlled more with the integrated Ne than with the in-situ Ne.

References

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