SEASONAL VARIATIONS OF THE ELECTRON DENSITY DISTRIBUTION IN THE POLAR MAGNETOSPHERE DURING GEOMAGNETICALLY QUIET PERIODS

NARITOSHI KITAMURA 1, Atsuki Shinbori 2, Yukitoshi Nishimura 3, Naoki Terada 4, Takayuki Ono 5, Atsushi Kumamoto 6, and Masahide Iizima 7

1. Department of Geophysics, Graduate School of Science, Tohoku University, Sendai, Japan, e-mail: kitamura@stpp.gp.tohoku.ac.jp
2. Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan, e-mail: shinbori@stelab.nagoya-u.ac.jp
3. Solar-Terrestrial Environment Laboratory, Nagoya University, Nagoya, Japan, e-mail: yukitosi@stelab.nagoya-u.ac.jp
4. Department of Geophysics, Graduate School of Science, Tohoku University, Sendai, Japan, e-mail: teradan@stpp.gp.tohoku.ac.jp
5. Department of Geophysics, Graduate School of Science, Tohoku University, Sendai, Japan, e-mail: ono@stpp.gp.tohoku.ac.jp
6. Planetary Plasma and Atmospheric Research Center, Tohoku University, Sendai, Japan, e-mail: kumamoto@pparc.gp.tohoku.ac.jp
7. Shukutoku Gakuen, Tokyo, Japan, e-mail: iizima@stpp.gp.tohoku.ac.jp

Seasonal variations of meridional electron density distributions during geomagnetically quiet periods near solar maximum have been statistically investigated. The electron density data used in the present study were taken from 63 months of plasma wave observations by the Akebono satellite in an altitude range of 500-10,500 km and in a region above 45° AACGM MLAT. Electron density profiles at low altitudes are well fitted by exponential functions, while those at higher altitudes are well described by power law functions. A transition of the density profile from exponential to power law types is identified in an altitude range of 1600-5500 km (>70° AACGM MLAT). The scale height at low altitudes shows a remarkable seasonal variation; the scale height is largest in the summer (~600 km) and smallest in the winter (~200 km) in a region above 70° AACGM MLAT in the nightside. This leads to the seasonal variation of the transition height; the transition height is the highest in the summer (~3700 km) and the lowest in the winter (~1700 km). A large electron density ratio of 19-41 between summer ($0.8\text{-}1.0*10^4$ cm^{-3}) and winter ($2\text{-}6*10^2$ cm^{-3}) is found near 2000 km altitude in 65°-75° AACGM MLAT in the dayside and above 65° AACGM MLAT in the nightside. On the other hand, the seasonal variation of the electron density in the trough and polar regions above 6600 km altitude is relatively small (a factor of <10). Furthermore, the SZA dependence of the electron density profile in the polar cap has been derived. Comparing the electron densities in SZA ranges of 50°-60° ($1.4*10^4$ cm^{-3}) and 120°-130° ($1.4*10^2$ cm^{-3}), the largest SZA dependence is identified at 2100 km altitude, with a factor of 98. The electron density, scale height and transition height decrease drastically with increasing SZA in an SZA range of 90°-130°. The scale height and transition height in an SZA range of 120°-130° (207 and 1700 km) are less than half of that in a SZA range of 90°-100° (568 and 3700 km), respectively. The drastic decrease near SZA of 110° strongly suggests the dominant role played by photo-ionization processes in determining the electron density in the polar cap during geomagnetically quiet period.

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Naritoshi Kitamura, Department of Geophysics, Graduate School of Science, Tohoku University, 6-3 Aramaki, Azaaoba, Aoba-ku, Sendai, Miyagi, Japan, 980-8578, tel: +81-022-795-6518, fax +81-022-795-6517, e-mail: kitamura@stpp.gp.tohoku.ac.jp