

Solar zenith angle and solar activity dependences of electron number density distribution in the nightside auroral region

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Solar zenith angle and solar activity dependences of electron number density distribution in the nightside auroral region from the topside ionosphere to the magnetosphere within a geocentric radial distance of $2.6 R_E$ were statistically investigated based on 7-years plasma wave data obtained by the Akebono (EXOS-D) satellite. Electron number density N_e is derived from the upper limit frequency of whistler-mode auroral hiss, which is almost equal to plasma frequency f_{pe} in the polar region. In order to focus on the nightside auroral region, the datasets obtained in a sector from 2100 to 0300 MLT were selected for the analyses in this study. In order to investigate seasonal and solar activity dependence of electron number density, the selected datasets were divided into 12 sub-datasets depending on solar zenith angle (SZA) and phase of the solar cycle. In this study, the periods from April, 1989 to March, 1992, and from July, 1993 to June, 1997 are defined as "solar maximum", "solar minimum", respectively. For each sub-dataset, the average electron number density in each spatial bin with 500 km square in the meridian plane. The results are summarized as follows: (1) Electron number density N_e changes depending on SZA and solar activity: N_e in sunlight is about 3 times larger than that in darkness, and N_e during solar maximum is about 10 times larger than that during solar minimum. (2) The polar low density region with an N_e range below 100/cc during solar maximum is wider than that during solar minimum. The plasmopause is at $L = 3.5$ during solar maximum while it becomes at $L = 4.5$ during solar minimum. (3) Vertical N_e profile varies depending on SZA and solar activity. The low density region with an N_e range below 100/cc is distributed in an altitude range above 8500 km in a SZA range from 60° to 70° during solar maximum while it becomes distributed in an altitude range above 2500 km in a SZA range from 110° to 120° during solar minimum. The vertical N_e profile during solar minimum is quite similar to the empirical model proposed by Kletzing et al. [1998]. The coincidence is probably because the model is based on the S3-3 datasets obtained mainly in 1976, or during solar minimum. The N_e distribution in the meridian plane, shown in this study, will be useful for studies such as ray tracing of radio waves in the polar region and simulations of field line resonance along the auroral field lines, which highly depend on the background plasma density models. In those studies, the SZA and solar activity dependence of N_e shown in this study should be taken into consideration in future.