B006-03 **会場: A** **時間: 11月5日 9:50-10:05**

A data-driven model of the plasmasphere based on the Akebono observation

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A data-driven model of the plasmasphere has been developed based on the Akebono wave data. The local electron number density in the plasmasphere can be derived from upper limit frequency of upper hybrid resonance (UHR) waves measured by the satellite. However, snapshot of global distribution of plasmasphere, such as provided by extreme ultraviolet (EUV) imager [Nakamura et al., 2000; Yoshikawa et al., 2000; Burch et al., 2001; Sandel et al., 2001], can not be directly obtained by those in-situ wave observations. In order to obtain the global distribution of the plasmasphere based on the in-situ wave data, we calculated time evolution of electron number density distribution in the magnetic equatorial region within L=10 by using in-situ wave data. For simplicity, followings are assumed: (a) Plasma distribution along the magnetic field is determined by diffusive equilibrium with almost constant temperature and composition. (b) Plasma drifts are caused by corotation electric field and Volland-Stern-type convection electric fields [Volland, 1973; Stern 1975; Maynard and Chen, 1975]. (c) Plasma refilling process from the ionosphere within one hour has little effect on global distribution of the plasmasphere. The evolution of the global plasmasphere was calculated as follows: (1) The magnetic equatorial region within 10 Re is divided into 20x24 L-MLT bins. In initialization, N_{eq}, electron number density in each bin, was set to 0. (2) After calculating drift motion of plasma within 1 hour, N_{eq} in each bin was evolved. (3) N_{eq} in the meridian of the Akebono satellite orbit was corrected by N_{eqo}, electron number density derived from the Akebono wave data. Based on statistical analysis of electron number density in the plasmasphere, scale height is 0.4 Re in a geopotential height range of z>0.3 Re. Using the scale height and wave data at the satellite position, electron number density in the magnetic equator, Neqo, was obtained. By repeating the procedures (2) and (3), the model provides global plasmasphere distribution within 10 Re every 1 hour. The global structure of the plasmasphere derived from the model shows good coincidence with EUV images. The structures of "plasma tail" and "shoulder", which have been reported by EUV observations [Burch et al., 2001; Sandel et al., 2001], are also seen in the calculated plasmasphere. In order to evaluate the model, $a=\log(N_{eq}/N_{eqo})$ has been calculated. The value a is almost within a range from -2 to 1. In order to reduce $|a|$to 0, the convection electric field model should be more improved in future works.