On the relationship between equatorial plasma wave activities and diffuse auroral electron precipitations

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It has been thought that the origin of diffuse auroral emissions is scattered plasma sheet electrons into the loss cone by some wave-particle interactions. Both ECH waves and whistler-mode chorus have been thought to be the contributors to the production of diffuse auroral electrons since they can resonate with plasma sheet electrons. A question which wave mode dominantly contributes to the production of diffuse auroral electrons has been discussed for more than four decades. However there is still controversy on the magnetospheric physics. A recent study made by Thorne et al. [2010] reveals that whistler-mode chorus is dominantly responsible for the production of diffuse auroral electrons. While, there are some observational suggestions that ECH waves cause diffuse auroral electron precipitations. [e.g., Nishimura et al., 2010; Liang et al., 2010]. Furthermore, the distributions of diffuse auroral electron precipitations derived by Newell et al. [2009] showed that diffuse auroras can be observed where no intense chorus emissions occurred as shown by the THEMIS statistical survey [Li et al., 2009].

The scope of this study is to investigate distributions of average amplitudes of ECH waves and whistler-mode chorus near the equatorial magnetosphere at the L-values between 5 and 10 to consider the respective roles of ECH waves and whistler-mode chorus in production of diffuse auroral electrons. The THEMIS Filter Bank (FBK) data were used to investigate the ECH wave distributions and the data obtained from June 1 2007 to November 30 2010 were used for the analyses. The magnetic equator is determined from the T89 magnetic field model and the magnetic latitude is also estimated from the ratio of the local magnetic field intensity to the equatorial magnetic field intensity based on the model.

The derived magnetic local time distributions showed that ECH waves were observed at higher L-shells (above L = 7) on the night side and the mean amplitudes enhance as geomagnetic activity level increases. Furthermore, as geomagnetic activity level increases, ECH emissions tend to be frequently observed on the dusk side magnetosphere. The regions mentioned above correspond to the region where there are no intense chorus waves [Li et al., 2009] while diffuse auroral electrons are observed by the low-altitude satellite measurements [Newell et al., 2009]. This indicates that ECH waves contribute to the production of the diffuse auroral precipitations to some degree. Thus, it is suggested that ECH waves actually contribute to the global morphology of the diffuse aurora besides whistler-mode chorus.

Considering that resonant energies for these waves are different (ECH waves: 0.1 - 10 keV, whistlers: 0.1 - 100 keV), properties of diffuse auroral electrons such as characteristic energy and/or energy spectrum should be an important clue using the low-altitude satellite observations to examine the suggestion. We have investigated the properties using the low-altitude satellite observations. The results will also be discussed by comparing them with the wave distributions derived by THEMIS.