Height variations of nighttime D-region ionosphere estimated by tweek atmospherics during the magnetic storms of October 29, 2003

Hiroyo Ohya[1]; Kazuo Shiokawa[2]; Yasuhiro Murayama[3]; Yoshizumi Miyoshi[4]

[1] Electronics and Mechanical Eng.,Chiba Univ; [2] STELAB, Nagoya Univ.; [3] NICT; [4] STEL, Nagoya Univ.

The purpose of this study is to investigate behavior of nighttime D region ionosphere during large magnetic storms on October 29-31, 2003, by analyzing tweek atmospherics. Height and electron density of nighttime D-region ionosphere are estimated by tweek atmospherics (1.5 - 10 kHz). A few hundred of tweeks are usually received in one minute at night. The tweeks are originated from lightings, and propagate long distances in Earth-ionosphere waveguide. The tweeks are reflected at a height where the equivalent electron densities are ˜20 - 30 cm^{-3}. These densities correspond to the bottomside of the D region. By using spectral shape of the tweek emissions, we determined the reflection heights statistically. Path of tweek is usually several thousand kilometers long, so that the obtained reflection height data are averages in the wide area at low- and mid-latitudes.

During large magnetic storms of October 29 - November 2, 2003, the reflection heights were estimated using nighttime tweek data obtained at Moshiri (44.4N, 142.3E) and Kagoshima (31.5N, 130.7E), Japan. The height variations of Moshiri were similar with those of Kagoshima. We found that the reflection height variations were closely associated with the Dst variations: when Dst values abruptly decreased with a time scale of one hour, the reflection heights decreased, and when Dst values increased during the storm recovery phase, the reflection heights increased.

We compared these reflection height variations with other D-region observations. At 04:00-16:00 UT on October 29, 2003, phase advances were seen in the 40-kHz standard LF waves on Fukushima - Kagoshima path, corresponding to the D-region height decrease. From density-height profiles measured with a MF radar at Yamagawa, an increase of electron density was seen in the height range of 86-94 km at 08:00-15:00 UT on October 29 (No data for 15:00-18:00 UT on that day). These LF data and MF-radar data support that D region electron density increased in the wide area at low- and mid-latitudes during the main phase of the storm.

In the presentation, we will discuss these D region behavior associated with the large storms by comparing with precipitation particle data by the NOAA satellites.