Seasonal Variation in Mass and Electron Densities of the Plasmasphere in the New Zealand Meridian

*Yuki Obana[1], Akiko Fujimoto[2], Satoko Saita[3], János Lichtenberger[4,5], Tanja Petersen[6]

1. Department of Engineering Science, Faculty of Engineering, Osaka Electro-Communication University, 2. Graduate School of Computer Science and Systems Engineering, Kyushu Institute of Technology, 3. National Institute of Technology, Kitakyushu College, 4. Eötvös Loránd University, 5. Research Center for Astronomy and Earth Sciences, 6. GNS Science

The equatorial mass and electron densities of the plasmasphere are respectively obtained from field line resonance (FLR) frequency and dispersion of whistler wave frequency. They have been effective tools for monitoring the plasmasphere from ground-based measurements.

At the two geomagnetic stations Middlemarch (L=2.8, belonging to CRUX magnetometer array http://www1.osakac.ac.jp/crux/) and Eyrewell (EYR, L=2.5, belonging to INTERMAGNET http://www.intermagnet.org/) in New Zealand, 1 sec observation of geomagnetic field started in 2011, and data have been accumulated for over 9 years. These observation points are approximately 300 km (dL=0.3) apart in the north-south direction, and this is an ideal location to detect field line resonances from cross-phase and power ratio.

In order to detect FLR frequencies, we applied an automatic algorithm, well-known 't-statistic method' introduced by Berube et al., 2003, to this data set and derive equatorial plasma mass densities. As a result, the plasma density in quiet time (maximum of Kp index in the previous 4 days < 4) showed the seasonal variation with minima in December, and its amplitude is larger in the solar maximum. According to the previous studies (e.g., Park et al., 1978), the electron density in the West American meridian showed opposite seasonal variation with minima in June) and similar dependence of solar activity (amplitude of the seasonal variation is larger in the solar maximum).

The Automated Whistler Detectorand Analyser (AWDA) system automatically detects whistler traces from VLF signals recorded at Dunedin (L=2.8) in New Zealand and provides equatorial electron densities.

By combining the electron and plasma mass densities, the corresponding average ion mass can be estimated by the reasonable assumptions that the plasma is quasi-neutral and the electron mass is negligible compared to the ion mass.

In the presentation, we will introduce the first results of comparison of these densities obtained from New Zealand stations during 2011-2019 which includes both solar maximum and minimum.

Keywords: plasmasphere, inner magnetosphere, ionosphere, Magnetosphere-Ionosphere coupling

