3D analysis of discrete arcs based on auroral computed tomography

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We have studied the magnetosphere-ionosphere (MI) coupling process in the auroral region by using data obtained from ground-based network observation. In this study we present three-dimensional (3D) distribution of discrete arcs observed in Northern Europe on March 14, 2015 and interpret it in terms of the MI coupling process. We focus on multiple vortex structure in the discrete arcs, which was observed by the multi-point monochromatic imagers (wavelength = 427.8 nm) during 22:15-22:20 UT.

We applied the auroral computed tomography method to the multiple monochromatic images. As a result, 3D distribution of the optical emission and horizontal distribution of precipitating electron's energy were obtained every 10 second during 22:15-22:20 UT. It was newly found that the averaged energy of precipitating electrons was higher around the center of auroral vortices where the total energy flux was also greater. This result can be explained by the Ohm's law along the field lines, i.e., the relation that the field-aligned current is proportional to the field-aligned potential difference. In addition, the altitude profile of the 427.8 nm emission was similar to the electron density profile simultaneously observed by the EISCAT UHF radar. Thus, we could estimate the height-integrated conductivity in the area of 150km x 300km from the optical emission with the MSIS atmosphere model. By combining the ionospheric conductivity with the geomagnetic field observed by the IMAGE magnetometer network, we will further investigate the distribution of the ionospheric current and field-aligned current, i.e., 3D current system for the discrete arcs.