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Application of Generalized Auroral Computed Tomography to the EISCAT_3D project

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Aurora Computed Tomography (ACT) is a method for retrieving three-dimensional (3-D) distribution of auroral luminosity from auroral images obtained simultaneously by the multi-point observation. As a next step of the ACT, we have developed Generalized - Aurora Computed Tomography (G-ACT) that reconstructs the energy and spatial distributions of precipitating electrons from multi-instrument data, such as ionospheric electron density from the EISCAT radar, cosmic noise absorption (CNA) from imaging riometer, as well as the auroral images. This method is compatible with 3-D ionospheric data observed by the EISCAT_3D radar, because the tomography method essentially assumes that the observational data are the projection of the 3-D data.

In this study, we examine how the G-ACT method can contribute to the EISCAT_3D project by numerical simulation. We first obtained auroral images observed by ALIS (Aurora Large Imaging System) and the electron density distribution observed with the EISCAT_3D radar by assuming spatial and energy distribution of incident electrons and then applied the G-ACT to these data. The results showed a possibility that the G-ACT can interpolate the electron density distribution observed with the EISCAT_3D radar at a higher spatial resolution. On the other hand, the 3-D aurora distribution reconstructed from only optical images was improved by a use of the EISCAT 3-D data. Furthermore, we suggest where new imagers should be installed for simultaneous observation with the EISCAT_3D radar.

Keywords: aurora tomography, EISCAT_3D, inverse problem, 3 dimensional structure, aurora imager, ionospheric electron density