

Toward estimating the plasmaspheric density using data of ground magnetometers and GPS TEC

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The plasmasphere is the region in space, close to the Earth. It is a part of the magnetosphere (region filled with the Earth-origin magnetic field). The plasmasphere is filled with ionosphere-origin plasma, and the shape of the plasmasphere changes in response to the activity of the magnetosphere. It is important to monitor three-dimensional plasma distribution in and near the plasmasphere; for example, the plasmasphere can affect the progress of magnetic storms via plasmasphere-ring current interactions (the ring current is another region in which strong electric currents, carried by plasma there, flow in the shape of a ring surrounding the Earth).

Measures to monitor the three-dimensional density distribution in and near the plasmasphere include ground magnetometers and GPS satellites, as follows. From ground magnetometer data one can identify the eigenfrequency of the field line running through the magnetometer. From thus identified frequency (so-called FLR frequency, where FLR stands for "field line resonance"), one can obtain information on the plasma mass density distribution along the field line. Ground coverage by magnetometers is getting thicker day by day toward two-dimensional ground coverage, from which one can obtain information on three-dimensional plasma density distribution in the region threaded by the field lines running through the ground magnetometers.

Each GPS satellite provides TEC (total electron contents) along the line of sight from the satellite to a GPS receiver; from the TEC one can obtain information on the electron density distribution along the line of sight. There are 24 GPS satellites, and the coverage by GPS receivers (located on the ground and in space) is getting thicker day by day, from which one can obtain information on three-dimensional electron density distribution in the region threaded by the line of sights from the GPS satellites to the GPS receivers.

In this paper we present a method to evaluate the ground-magnetometer information and the GPS-TEC information at the same time and obtain a unified plasmaspheric plasma density distribution. In essence, the method calculates the differences between the observations and the corresponding quantities calculated from the estimated plasma distribution, and minimizes the sum of the differences for the two types of observations. Details will be given at the presentation. We first realize this method in an iterative manner by using the quasi-Newton method. Tests with simulated data are ongoing, and we will show the results at the meeting. Some sample observational data will also be shown.