Toward estimating the plasmaspheric plasma density by using both the field-line resonance and the TEC

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The plasmasphere is the region in space close to the Earth, filled with ionosphere-origin plasma that is essentially corotating with the Earth.　It is important to monitor three-dimensional plasma distribution in and near the plasmasphere; for example, the plasmasphere can affect the progress and decay of magnetic storms via plasmasphere-ring current interactions.

It is possible to estimate the three-dimensional density in and near the plasmasphere by using data from 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 guess 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 guess three-dimensional plasma density in the region threaded by the field lines running through the ground surface.

From a set of a GPS satellite and a ground GPS receiver, one can obtain TEC (total electron contents) along the line segment between the two; from the TEC one can guess the electron density distribution along the line segment.　There are 24 GPS satellites, and the ground coverage by GPS receivers is getting thicker day by day, from which one can guess three-dimensional electron plasma density in the region covered by the line of sights from the GPS satellites to the ground GPS receivers.

In this paper we invent a method to evaluate the ground magnetometer-FLR information and the GPS-TEC information at the same time and to obtain a unified plasma density distribution in and near the plasmasphere.　In short, the method assumes a model of the density distribution, calculates the difference between the model and the actual observation for both FLR and TEC, and, determines the model parameters by minimizing the sum of the differences for the two types of observations. Details will be given at the presentation.　We will first realize this method by using iterative methods such as the quasi-Newton methods, and test it with simulated data and sample data.