

Three-dimensional ionosphere tomography with GPS-TEC from GEONET in Japan

Mamoru Yamamoto^{1}, Gopi Seemala², Chia-Hung Chen³ and Akinori Saito⁴*

¹Research Institute for Sustainable Humanosphere (RISH), Kyoto University, Uji, Kyoto, Japan
yamamoto@rish.kyoto-u.ac.jp

²Indian Institute of Geomagnetism (IIG), Mumbai, Maharashtra, India

³Department of Earth Science, National Cheng Kung University, Tainan, Taiwan

⁴Department of Geophysics, Kyoto University, Sakyo-ku, Kyoto, Japan

Abstract

Measurement of ionospheric total electron content (TEC) by using the ground-based GPS receivers is now widely used. We can refer to it as GPS-TEC. As there are always several GPS satellites available for the measurement, it is a very good tool for constant monitoring of the ionosphere. One of the most dense and wide network of the GPS network is GEONET operated by Geospatial Information Authority of Japan (GSI). This is the network of more than 1000 points over the whole Japan with averaged spatial resolution of 25km. The GPS-TEC from the GEONET of every 30s is used for studies of ionospheric disturbances (e.g., [1] [2]). This paper reports three dimensional ionospheric tomography based on this database. We developed a way to solve the tomography equation by using the constrained least-squares fitting method. This technique is different from most other tomography solvers in the sense that it does not require the initial guess of plasma density at the beginning of calculations. Three dimensional plasma density distribution over Japan is determined to minimize the cost function that is defined as summation of “sum of squared error between model and observation” which is normal in the least-squares method, and the weight. The weight term is selected as summation of density differences with 6 neighboring cells around each grid point. We also need to modify “restrained parameter” to balance importance of these two terms. After development of several years we have reached a good level. In the presentation, we will show the tomography technique and results of calculation with the model and the real GPS-TEC data, and discuss possibility of 3D monitoring of the ionosphere by using this technique.

References

- [1] Saito, A., S. Fukao, and S. Miyazaki, High resolution mapping of TEC perturbations with the GSI GPS network over Japan, *Geophys. Res. Let.*, vol. 25, 3079-3082, 1998.
- [2] Saito, A., M. Nishimura, M. Yamamoto, Kubota, K. Shiokawa, Y. Otsuka, T. Tsugawa, S. Fukao, T. Ogawa, M. Ishii, T. Sakanoi, and S. Miyazaki, Traveling ionospheric disturbances detected in the FRONT campaign, *Geophys. Res. Let.* 28, 689-692, 2001.