

GPS-TEC ionospheric 3D tomography; Massive data analysis with supercomputer

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Measurement of ionospheric total electron content (TEC) by using ground-based GPS receivers is now widely used, which we refer to as GPS-TEC. In Japan, there is one of the densest network of GPS receivers that is named as GEONET (GNSS Earth observation network system) operated by Geospatial Information Authority of Japan (GSI). We have developed three-dimensional (3D) tomography analysis based on the constrained least-squares fitting method, and applied it to the GPS-TEC data from GEONET. We started the real-time analysis with 15 minutes interval and about five minutes latency since March 2016. In this paper we report that we analyzed most of GEONET data since 1996 by using the supercomputer of Kyoto University. We assign one core of the supercomputer to one-day analysis (15-minute interval from 200 GPS receivers). By utilizing about 2000 core of the supercomputer system, we achieved that processing time for one-year data was about 30 hours only. The results are statistically validated through comparisons with ionosondes and COSMIC occultation measurements. The maximum density from the 3D tomography showed good agreement with the foF2 parameter from ionosondes. We also found that the F2-peak of the 3D tomography density profile is lower in density, and higher in altitude compared with corresponding parameters from the COSMIC occultation measurements.

Keywords: GPS-TEC, Ionospheric tomography, Parallel processing