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Measurement of Ionospheric TEC Variation Over Low Latitude Region Using Single Frequency GNSS Receiver

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Plasma in the ionosphere makes GNSS (Global Navigation Satellite System) signals delay. The delay is directly proportional to the total electron content (TEC) of plasma along the signal path from the satellite to the receiver, and the delay is known to be the largest error factor in satellite positioning. Such ionospheric plasma has been investigated by top and bottom side sounding experiments for a long time. Recently, continuous monitoring of the TEC using networks of GNSS observation stations, which are basically built for land survey, has been conducted in several countries. In these stations, multi-frequency receivers are installed to estimate the effect of plasma delay from its frequency dependence. However, the cost of multi-frequency GNSS receivers are much higher than that of consumer single frequency receivers. It is not easy for researchers to construct the GNSS observation network only for TEC observation. A TEC estimation method from single frequency GNSS measurements was developed in order to solve this problem [1]. In the method, the ionospheric TEC distribution is represented by polynomial functions for latitude and longitude, and parameters of the functions are determined by least-squares fitting on pseudorange data obtained at a known location under an assumption of thin layer ionosphere. The validity of the method was evaluated by measurements obtained by the Japanese GNSS observation network, GEONET.

In the present study, we applied the method to one-day data obtained in low latitude region; we set up an observation site for single frequency GPS signal in the campus of Mandalay Technological University in Myanmar. In the low latitude regions, several interesting phenomena, such as equatorial plasma bubble, are expected to be observed. A consumer receiver manufactured by ublox was used to obtain raw (pseudorange) data every second. The satellite orbits were obtained by precise ephemeris and satellite (transmitter) hardware biases were calculated from dual-frequency measurements obtained by the GEONET in advance. Because the ublox observation data include random fluctuations which are considered to be caused by perturbation of internal clock of the receiver, we reduce it by Kalman filter. As for the one-day observation, a typical day-night TEC variation was estimated as a result. For continuous observations, we still have problems. The electric power supply is interrupted at night at the observation site. We try to solve the problem by battery (UPS) and plan to obtain continuous data in future.

1. Win Zaw Hein, Y. Goto, Y. Kasahara, "Development of a New Method to Estimate Ionospheric TEC Distribution by Single Frequency Measurements of GPS Signals," *International Journal of Advanced Computer Science and Applications (IJACSA)*, 7(12), 2016, pp. 1-6.