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MODELING IONOSPHERE VTEC OVER JAPAN BASED ON GNSS REGRESSION MODELS AND GEONET

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Abstract. *In [1–3], we have preliminary developed a method of estimating the local models of an ionosphere VTEC (Vertical Total Electron Content) based on Global Navigation Satellite System (GNSS) regression models (abbreviated by GR models) and have shown the ionospheric delay (or advance) in the sky over Japan using the Gps Earth Observation NETwork (GEONET) data provided from the Geographical Survey Institute (GSI) of Japan [4]. In this paper, we try to refine the local models based on the orthogonal polynomials for the VTEC at the ionospheric pierce points in the ionospheric single layer model by comparing with the Taylor series expansion. From the aspect of model fitting, we also discuss the best number of orthogonal polynomials for the local model of the VTEC from informational theoretical points of views such as AIC [5] and BIC [6].*
Keywords: GNSS regression models, Ionospheric delay, VTEC, GEONET, Orthogonal polynomials

1. **Introduction.** It is well known that Global Positioning System (GPS) developed by the United States is one of the Global Navigation Satellite System (GNSS). For the precise GPS positioning, we have introduced the very powerful models of the observables of L1 and L2 carrier phase and pseudoranges based on C/A and P(Y) codes in GPS signal, called GR models [7–11]. GR models are formulated as they are easily extended to the other GNSS signals such as GPS modernization and European GNSS satellite (Galileo). Based on GR models, we have developed the precise point positioning (PPP) algorithms [7,8,10] and the very precise point positioning (VPPP) algorithms with multiple antennas [12–14]. These positioning algorithms achieved the positioning accuracy of decimeter level. We have also developed the relative positioning algorithms in [11] and [15] based on GR models.

On the other hand, the accuracy of GNSS positioning strongly depends on effects of ionosphere around the earth. Generally, the ionospheric effects can cause several meters to several tens of meters error in the measurement of distance between a satellite and a receiver [16]. Thus it is important to properly correct the ionospheric delays or advances of signals from satellites in precise positioning. As the global ionosphere information, there exist some ionosphere models and ionosphere information services. For example, by using so-called Klobuchar model, almost 50 % of ionospheric effects can be removed. As more precise ionospheric information, there are Global Ionosphere Maps (GIMs) provided by the International GNSS Service (IGS) [17]. However, these models are developed to be globally utilized, so that they can not accommodate the ionosphere changes in local