GBASにおける電離圏脅威となりうる電離圏勾配を含むプラズマバブルの継続時間について

Durations of ionospheric gradients and plasma bubbles as ionospheric threats to GBAS

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Ground-Based Augmentation System (GBAS) of global navigation satellite systems (GNSS) is now being widely deployed in the world. Ionospheric disturbances are one of the threats to GBAS operation because it is based on the differential GNSS (DGNSS) technique with L1 single frequency signals.In 2017, The International Civil Aviation Organization (ICAO) Asia-Pacific (APAC) region has defined the ionospheric threat model that can be used in the low magnetic latitude part of the region [1]. The threat model is being optimized for the transition region from low to mid-latitude regions over Japan by collecting more data using Japanese dense GNSS network (the GNSS Earth Observation NETwork: GEONET) [2,3,4].

Steep ionospheric delay gradients of which widths are several tens kilometers or less are one of the ionospheric threats in GBAS, because steep ionospheric gradients with small spatial scales may not be detected neither by GBAS ground stations nor by an airborne receiver when the gradient stands between the GBAS ground station and airplanes. From the viewpoint of GBAS operations, it is important to know how long such gradient events would last to predict the duration of GBAS operation outage. Therefore, clarifying durations of steep but small ionospheric gradients is important for GBAS operations. Though the duration of the ionospheric delay depletions associated with plasma bubbles have been studied extensively, the duration of the steep gradients have not been studied well.

In this paper, we extracted the steep ionospheric gradients caused by plasma bubbles from the ionospheric delay differences between some pairs of stations using the single-frequency-carrier-phase based and code-aided (SF-CBCA) technique [5] and GEONET data. Once the plasma bubbles candidates and the satellites which is affected by the ionospheric disturbances are selected, ionospheric delay variations of each receiver derived by dual-frequency measurements for estimation of the durations for each ionospheric gradient. The analyses of durations of steep ionospheric gradients which could be the threat for GBAS operations will be reported.

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キーワード：電離圏、電離圏脅威モデル、プラズマバブル、電離圏勾配、衛星測位、地上型衛星航法補強システム
Keywords: ionosphere, ionospheric threat model, plasma bubble, ionospheric gradient, GNSS, GBAS

