

Spatial gradients in the ionospheric delays (TECs) and scintillations associated with plasma bubbles

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Spatial gradients in the ionospheric delays (equivalently ionospheric total electron contents: TECs) are the threat to the differential GNSS systems such as the ground-based GNSS augmentation system (GBAS), because they decorrelates the ionosphere induced errors between the reference and user stations. Another important issues is the scintillations associated with small-scale (a few hundred meters for GPS L1 signals at 1.57542 GHz) plasma irregularities. While the spatial gradient in the ionospheric delay may result in differential correction errors, the scintillation may result in increased noise of pseudo-range measurements, and in the worst case, cycle-slips and signal lock-off. Although both are associated plasma bubbles, they may not always occur simultaneously, partly because they are associated with plasma irregularities with different scale sizes.

In this study, correlation between the ionospheric spatial variation measured by a set of GNSS stations locate at the New Ishigaki Airport (24.3N, 124.2E) and the amplitude scintillation index (S4) observed near the airport are analyzed. The GNSS stations at the airport are separated by 0.1 - 2.3 km. The ionospheric delay differences are estimated based on the carrier-phase double differences with sophisticated methods originally developed for integrity monitors for GBAS. S4 index is estimated by a dedicated GNSS scintillation receiver. It was shown that the ionospheric delay gradients are not always enhanced when scintillation index is enhanced, though they are positively correlated. Further analysis of their correlations with different scale sizes by different combinations of GNSS receivers for ionospheric delay gradient estimation will be conducted, and the results will also be reported at the meeting.

Keywords: plasma bubble, spatial gradients in TEC, scintillations