

Low latitude ionospheric effects on SBAS systems

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Satellite Based Augmentation Systems (SBAS) provides augmentation to GNSS users in three main areas (1) broadcasting accurate corrections to the broadcast GNSS satellite ephemeris, (2) providing a real-time empirical model of the ionospheric delays in the region covered by the system and (3) providing integrity information in the form of reliable estimates of the confidence of the ephemeris corrections and ionospheric delays.

Ionospheric effects on SBAS system are twofold, on one hand the input data used by the SBAS systems to generate their augmentation information will be affected by ionospheric effects, and on the other hand the more perturbed is the ionosphere the more difficult will be to provide accurate and reliable ionospheric information to the users.

It is well known that the ionosphere at low latitudes presents larger variability and more intense phenomena than at mid latitudes. Therefore, SBAS systems containing low latitude regions in their service area will be more affected than those at mid or high latitude.

From the different low latitude ionospheric effects, this paper will focus on those having the largest impact on a SBAS system, which are the Total Electron Content (TEC) temporal and spatial gradients, the ionospheric scintillations and the equatorial depletions. The validity at low latitude of assumptions made inside the SBAS systems on ionospheric conditions (e.g. thin shell mapping function) will be also analysed, as well as, the impact on final SBAS performances in case those assumptions are no longer valid.

Ionospheric impact will be different for Single-Frequency SBAS systems (as those currently deployed) than for Dual-Frequency SBAS systems (future generation of SBAS systems). The analysis performed and presented in this paper will consider only Single-Frequency SBAS systems.

This paper will presented the impact of low latitude ionospheric effects on EGNOS, the European SBAS system. Although EGNOS can be considered a mid-latitude SBAS system, it has to provide coverage up to rather low latitudes (e.g. Canary Islands), and so, sometimes low latitude ionospheric effects are observed in the EGNOS data.

It will be shown EGNOS performances obtained in case of nominal conditions and how those performances are degraded when low latitude ionospheric phenomena are present. EGNOS real data affected by low latitude ionospheric phenomena will be used as far as possible.